Evidian

SafeKit User's Guide

High Availability Software for Critical Applications

Overview

Subject	This document covers all the phases of the SafeKit implementation: architecture, installation, tests, administration & troubleshooting, support, and command line interface.	
Intended Readers	***Architectures***	"High availability architectures" page 15 "SafeKit cluster in the cloud" page 291
	Installation	"Installation" page 25
	Console	"The SafeKit web console" page 37 "Securing the SafeKit web service" page 173
	Advanced configuration	"Cluster.xml for the SafeKit cluster configuration" page 201 "Userconfig.xml for a module configuration" page 207 "Scripts for a module configuration" page 265 "Examples of userconfig.xml and module scripts" page 271
	Administration	"Mirror module administration" page 93 "Farm module administration" page 105 "Command line interface" page 139 "Advanced administration" page 153
	Support	"Tests" page 67 "Troubleshooting" page 109 "Access to Evidian support" page 131 "Log Messages Index" page 307
	Other	"Table of Contents" page 5 "Third-Party Software" page 303
Release	SafeKit 8.2	
Supported OS	Windows and Linux; for a detailed list of supported OS, see here	
Web Site	Evidian marketing site: http://www.evidian.com/safekit Evidian support site: https://support.evidian.com/safekit	

Ref	39 A2 38MC 02

If you have any comments or questions related to this documentation, please mail us at **institute@evidian.com**

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1.High availability architectures

1.1 SafeKit cluster definition

A SafeKit cluster is a set of servers where SafeKit is installed and running.

All servers belonging to a given SafeKit cluster share the same cluster configuration (list of servers and networks used) and communicate with each other's to have a global view of SafeKit modules configurations. The same server can not belong to many SafeKit clusters.

Setting the cluster configuration is a prerequisite to SafeKit modules installation and configuration since the 7.2 release of SafeKit and of the web console. The cluster configuration is set through the web console as described in section 3.2 page 39. The web console provides the ability to administer one or more SafeKit clusters.

1.2 SafeKit module definition - application integration

A SafeKit module is associated with an application. A module is customizable by the user, and it defines the behavior of the high availability solution for the application. Different modules can be defined for different applications.

In practice, an application module is an easy-to-setup file that contains:

⇨ a main configuration file `userconfig.xml`, which lists networks used for communication between servers, files to replicate in real time (for a mirror module), virtual IP configuration, network load balancing criteria (for a farm module) and more...

⇨ application stop and start scripts

SafeKit offers two types of modules detailed in this chapter:

⇨ the mirror module

⇨ the farm module

Combining multiple application modules allows the implementation of advanced architectures:

⇨ active/active: 2 mirror modules backuping each other

⇨ N-1: N mirror modules with a single backup

⇨ mixed farm and mirror: mixing network load balancing, file replication and failover

1.3 Mirror module: synchronous real time file replication and failover

1.3.1 File replication and failover

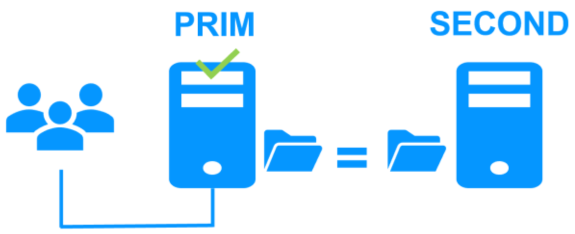
The mirror architecture is a primary-backup high-availability solution that is suitable for all applications. The application runs on a primary server and is restarted automatically on a secondary server if the primary server fails.

The mirror architecture can be configured with or without file replication. With its file-replication function, this architecture is particularly suitable for providing high availability for back-end applications with critical data to protect against failure. Indeed, the secondary server data are highly synchronized with the primary server and the failover is done on the secondary server from the most up-to-date data. If the application availability is more critical than the application data synchronization, the default policy can be relaxed by allowing a failover on the secondary server when the time elapsed since the last synchronization is below a configurable delay.

Microsoft SQL Server.Safe, MySQL.Safe, and Oracle.Safe are examples of "mirror" type application modules. You can write your own mirror module for your application, based on the generic module Mirror.Safe.

The failover mechanism works as follows.

1.3.2 Step 1. Normal operation



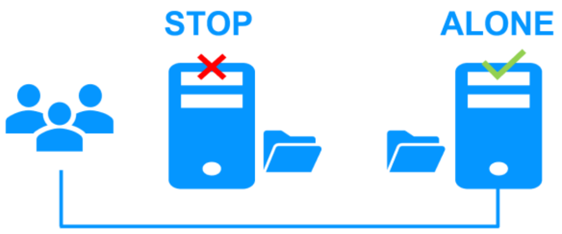
For replication, only the names of file directories are configured in SafeKit. There are no pre-requisites on the disk organization for the two servers. Directories to replicate can be located in the system disk.

Server 1 (`PRIM`) runs the application.

SafeKit replicates files opened by the application. Only the changes made by the application in the files are replicated in real time across the network, thus limiting traffic.

Thanks to the synchronous replication of file write operations on the disks of both servers, no data is lost in case of failure.

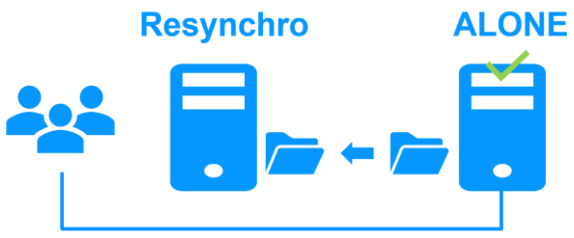
1.3.3 Step 2. Failover



When Server 1 fails, Server 2 takes over. SafeKit switches the cluster’s virtual IP address and restarts the application automatically on Server 2. The application finds the files replicated by SafeKit in the identical state they were when Server 1 failed, thanks to the synchronous replication. The application continues to run on Server 2, locally modifying its files, which are no longer replicated to Server 1.

The switch-over time is equal to the fault-detection time (set to 30 seconds by default) plus the application start-up time. Unlike disk replication solutions, there is no delay for remounting file systems and running recovery procedures.

1.3.4 Step 3. Failback and reintegration



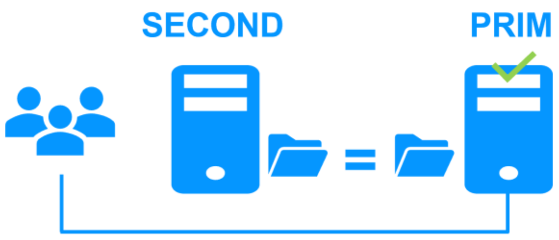
Failback involves restarting Server 1 after fixing the problem that caused it to fail. SafeKit automatically resynchronizes the files, updating only the files that were modified on Server 2 while Server 1 was stopped.

This reintegration takes place without disturbing the applications, which can continue to run on Server 2. This is a major feature that differentiates SafeKit from other solutions, which require you to stop the applications on Server 2 to resynchronize Server 1.

To optimize file reintegration, different cases are considered:

1. The module must have completed the reintegration (on the first start of the module, it runs a full reintegration) before enabling the tracking of modification into bitmaps
2. If the module was cleanly stopped on the server, then at restart of the secondary, only the modified zones of modified files are reintegrated, according to a set of modification tracking bitmaps.
3. If the secondary crashed (power off) or was incorrectly stopped (exception in nfsbox replication process), the modification bitmaps are not reliable, and are therefore discarded. All the files bearing a modification timestamp more recent than the last known synchronization point minus a graceful delay (typically one hour) are reintegrated.
4. A call to the special command `second fullsync` triggers a full reintegration of all replicated directories on the secondary when it is restarted.
5. If files have been modified on the primary or secondary server while SafeKit was stopped, the replicated directories are fully reintegrated on the secondary

1.3.5 Step 4. Return to normal operation



After reintegration, the files are once again in mirror mode, as in step 1. The system is back in high-availability mode, with the application running on Server 2 and SafeKit replicating file updates to the backup Server 1.

If the administrator wants to run the application on Server 1, he/she can execute a `swap` command either manually at an appropriate time, or automatically through configuration.

1.3.6 Synchronous, fault-tolerant replication that loses no data when a server fails

There is a significant difference between synchronous replication, as offered by the SafeKit mirror solution, and asynchronous replication traditionally offered by other file replication solutions.

With synchronous replication, when a disk IO is performed by the application or by the file cache system on the primary server onto a replicated file, SafeKit waits for the IO acknowledgement from the local disk and from the secondary server, before sending the IO acknowledgement to the application or to the file system cache.

The synchronous, in real time, replication of files updated by an application eliminates the loss of data in case of server failure. Synchronous replication ensures that any data committed on a disk by a transactional application is also present on the secondary server.

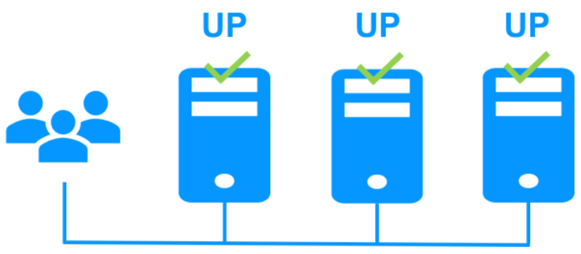
The bandwidth required to implement synchronous data replication is in the order of magnitude of a typical modern LAN, or extended LAN between two computer rooms located a few kilometers apart.

With asynchronous replication implemented by other solutions, the IOs are placed in a queue on the primary server but the primary server does not wait for the IO acknowledgments of the secondary server. So, the data that did not have time to be copied across the network on the second server is lost if the first server fails. In particular, a transactional application loses committed data in case of failure. Asynchronous replication can be used for data replication through a low-speed WAN, to back up data remotely over more than 100 kilometers.

SafeKit provides an asynchronous solution with no data loss, ensuring the asynchrony not on the primary machine but on the secondary one. In this solution, SafeKit always waits for the acknowledgement of the two machines before sending the acknowledgement to the application or the system cache. But on the secondary, there are 2 options asynchronous or synchronous. In the asynchronous case (option <rfs async="second">), the secondary sends the acknowledgement to the primary upon receipt of the IO and writes to disk after. In the synchronous case (<rfs async="none">), the secondary writes the IO to disk and then sends the acknowledgement to the primary. The async="none" mode is required if we consider a simultaneous double power outage of two servers, with inability to restart the former primary server and requirement to re-start on the secondary.

1.4 Farm module: network load balancing and failover

1.4.1 Network load balancing and failover



The farm architecture provides both network load balancing, through transparent distribution of network traffic, and software and hardware failover. This architecture provides a simple solution for increasing system load. The same application runs on each server, and the load is balanced by the distribution of network activity between the different servers of the farm.

Farm architecture accommodates/implements well with front-end applications like web services. Apache_farm.Safe and Microsoft IIS_farm.safe are examples of farm application modules. You can make your own farm module, modified to suit your application, from the generic module Farm.safe.

1.4.2 Principle of a virtual IP address with network load balancing

The virtual IP address is configured locally on each server of the farm. The input traffic for this address is split among them at low level by a filter inside each server's kernel.

The load balancing algorithm inside the filter is based on the identity of the client packets (client IP address, client TCP port). Depending on the identity of the client packet input, a single filter instance in a server farm transmits the packet to the upper network layers; the other filter instances in other servers drop it. Once a packet is accepted by the filter on a server, only the CPU and memory of this server are used by the application that responds to the request of the client. The output messages are sent directly from the application server to the client.

If a server fails, the SafeKit membership protocol reconfigures the filters in the farm to re-balance the traffic on the remaining available servers.

1.4.3 Load balancing for stateful or stateless web services

With a stateful server, there is session affinity. The same client must be connected to the same server on multiple HTTP/TCP sessions to retrieve its context from the server. In this case, the SafeKit load balancing rule is configured on the client IP address. Thus, the same client is always connected to the same server on multiple TCP sessions. And different clients are distributed across different servers in the farm. This configuration is used when there is a need for session affinity.

With a stateless server, there is no session affinity. The same client can be connected to different servers in the farm on multiple HTTP/TCP sessions; because there is no context stored locally on a server from one session to another. In this case, the SafeKit load balancing rule criteria is the TCP client session identity. This configuration is the best solution to distribute sessions between servers, but it can only load balance a TCP service without session affinity.

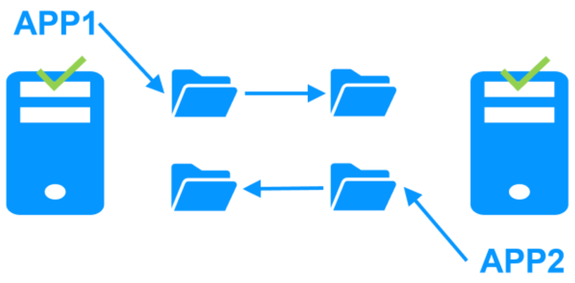
Other load balancing algorithms are available for UDP services.

1.5 Combining mirror and farm modules

1.5.1 Active/Active: 2 mirror modules backuping each other

Two active servers mirroring each other

In an active / active architecture, there are two servers and two mirror application modules in mutual takeover (Appli1.Safe and Appli2.Safe). Each application server is a backup of the other server.



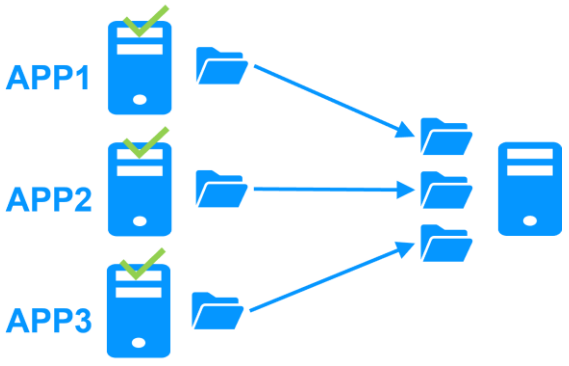
If one application server fails, both applications will be active on the same physical server. After restart of the failed server, its application will run again on its default primary server.

A mutual takeover cluster is a more economical solution than two separate mirror clusters, because there is no need to invest in back-up servers that will spend most of their time sitting idle waiting for the primary server to fail. Note that during a failure, the remaining server must be able to handle the combined workload of both applications.

1.5.2 N-to-1: N mirror modules with a single backup

Shared backup for multiple active servers

In N-to-1 architecture, there are N mirror application modules installed on N primary servers and one backup server.



If one of the N active servers fails, the single backup server restarts the module of the failed server. Once the problem is fixed and the failed server is restarted, the application switches back to its original server.

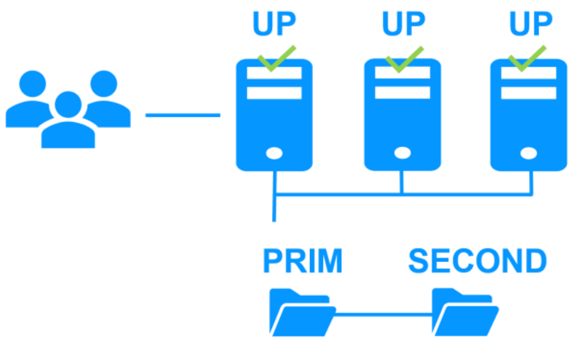
In case of failure, unlike the active/active architecture, the backup server doesn't have to handle a double workload when a primary server fails. Assuming that there is only one failure at a time - the solution can support multiple primary server failures at the same time, but in this case the single back-up server will have to handle the combined workload of all the failed servers.

Mixed farm/mirror: network load balancing, file replication, failover

Network load balancing, file replication and failover

You can mix farm and mirror application modules on the same cluster of servers.

This option allows you to implement a multi-tier application architecture, such as Apache_farm.Safe (farm architecture with load balancing and failover) and MySQL.safe (mirror architecture with file replication and failover) on the same application servers.



As a result, load balancing, file replication and failover are managed coherently on the same servers. Specific to SafeKit, this mixed architecture is unique on the market!

1.6 The simplest high availability cluster in the cloud

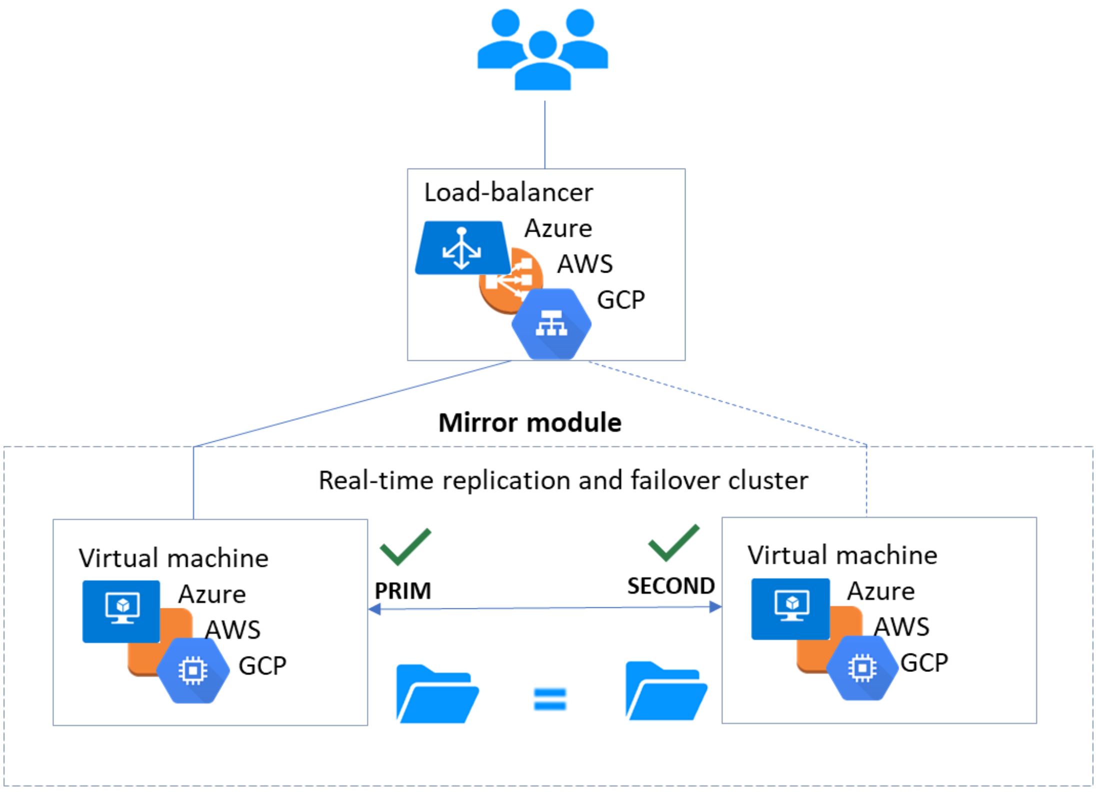
SafeKit brings in the Microsoft Azure, Amazon AWS and Google clouds the simplest solution for a high availability cluster. It can be implemented on existing virtual machines or on a new virtual infrastructure, that you create by simply clicking on a button that deploys and configures everything for you in Azure or AWS clouds.

For a full description, see section 16 page 291.

1.6.1 Mirror cluster in Microsoft Azure, Amazon AWS and Google GCP

SafeKit brings in the Azure, Aws and GCP clouds the simplest solution for a high availability cluster with real-time replication and failover (mirror module).

For a quick start, refer to mirror cluster in Azure, mirror cluster in AWS or mirror cluster in GCP.



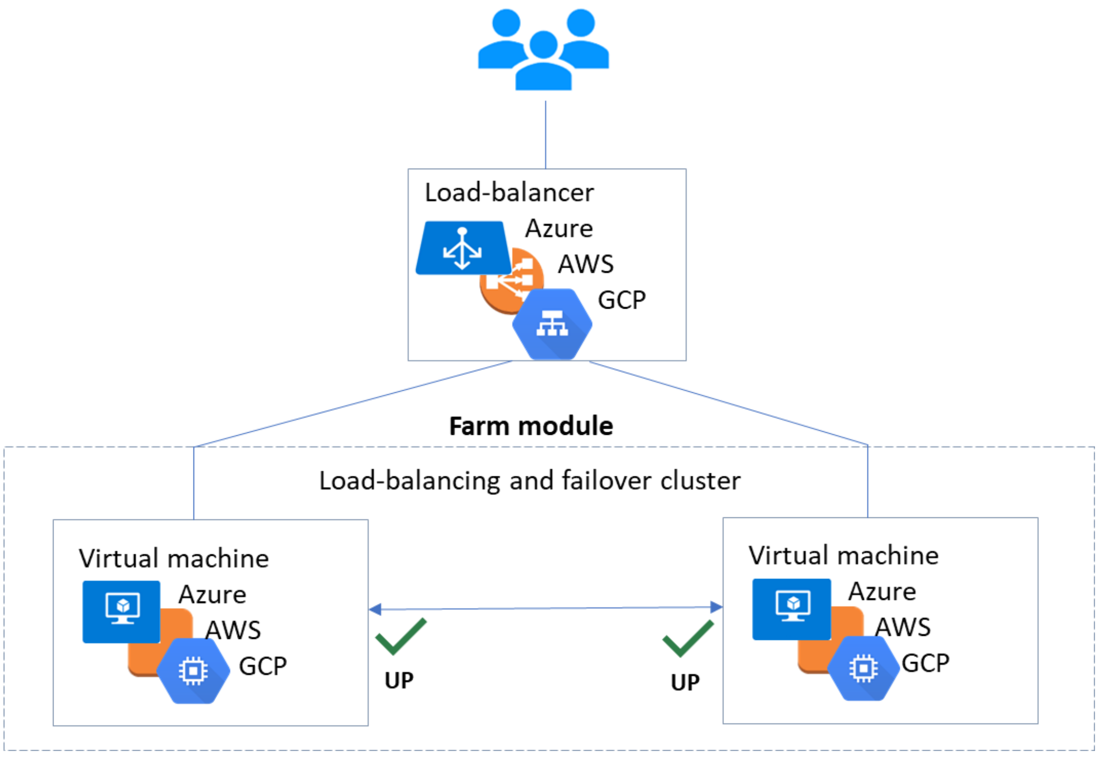
- the critical application is running on the `PRIM` server
- users are connected to a primary/secondary virtual IP address which is configured in the cloud load balancer
- SafeKit brings a generic checker for the load balancer. On the `PRIM` server, the checker returns OK to the load balancer and NOK on the `SECOND` server
- in each server, SafeKit monitors the critical application with process checkers and custom checkers
- SafeKit automatically restarts the critical application when there is a software failure or a hardware failure thanks to restart scripts
- SafeKit makes synchronous real-time replication of files containing critical data

- a connector for the SafeKit web console is installed in each server. Thus, the high availability cluster can be managed in a quite effortless way to avoid human errors

1.6.2 Farm cluster in Microsoft Azure, Amazon AWS and Google GCP

SafeKit brings in the Azure, AWS and Google clouds the simplest solution for a high availability cluster with load balancing and failover (farm module).

For a quick start, refer to farm cluster in Azure, farm cluster in AWS or farm cluster in GCP.



- the critical application is running in all servers of the farm
- users are connected to a virtual IP address which is configured in the cloud load balancer
- SafeKit brings a generic checker for the load balancer. When the farm module is stopped in a server, the checker returns NOK to the load balancer which stops the load balancing of requests to the server. The same behavior happens when there is a hardware failure
- in each server, SafeKit monitors the critical application with process checkers and custom checkers
- SafeKit automatically restarts the critical application in a server when there is a software failure thanks to restart scripts
- a connector for the SafeKit web console is installed in each server. Thus, the load balancing cluster can be managed in a quite effortless way to avoid human errors.

2. Installation

2.1 SafeKit install

2.1.1 Download the package

1. Connect to https://support.evidian.com/safekit
2. Go to `<Version 8.2>/Platforms/<Your platform>/Current versions`
3. Download the package
   In Windows, two packages are available:
   - ✓ A Windows Installer package (`safekit_windows_x86_64_8_2_x_y.msi`). It depends on the VS2022 C runtime which must be previously installed
   - ✓ A standalone executable bundle (`safekit_windows_x86_64_8_2_x_y.exe`), which includes the SafeKit installation and the VS2022 C runtime

   Choose one or the other package depending on whether the VS2022 C runtime is installed or not.

2.1.2 Installation directories and disk space provisioning

SafeKit is installed in:

`SAFE`	⇨ in Windows
	`SAFE=C:\safekit`
	if `%SYSTEMDRIVE%`=C:
	⇨ in Linux
	`SAFE=/opt/safekit`
		Minimum free disk space: 97MB

`SAFEVAR`	⇨ in Windows
	`SAFEVAR= C:\safekit\var`
	if `%SYSTEMDRIVE%`=C:
	⇨ in Linux
	`SAFEVAR=/var/safekit`
		Minimum free disk space: 20MB + at least 20MB (up to 3 GB) per module for dumps

2.1.3 Install procedure

2.1.3.1 On Windows as administrator

2.1.3.1.1 SafeKit package install

1. Log-in as administrator
2. Locate the downloaded file `safekit_windows_x86_64_8_2_x_y.msi` (or `safekit_windows_x86_64_8_2_x_y.exe`)
3. Install in interactive mode by double-clicking it and go through the installer wizard

It is also possible to install the .msi in non-interactive mode by running in a PowerShell terminal: `msiexec /qn /i safekitwindows_8_2_x_y.msi`

2.1.3.1.2 Firewall setup

This step is mandatory to enable communications between SafeKit cluster nodes and with the web console.

1. Open a PowerShell console as administrator
2. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:)

   ```
   cd c:\safekit
   ```
3. Run `.\private\bin\firewallcfg.cmd add`

This configures the Microsoft firewall for SafeKit. For details or other firewalls, see section 10.3 page 156

2.1.3.1.3 Web service initialization

This step is mandatory to initialize the default configuration of the web service, which is accessed by the web console and the global safekit command. By default, authentication is required to access the service. The following script makes it easy to implement by initializing it with the `admin` user and the given password `pwd`, for example.

1. Open a PowerShell console as administrator
2. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:)

   ```
   cd c:\safekit
   ```
3. Run`.\private\bin\webservercfg -passwd pwd`

This then allows to access to all the web console's features, by logging in with `admin/pwd`, and to run distributed commands. For details, see 11.2.1 page 175.

Important The password must be identical on all nodes that belong to the same SafeKit cluster. Otherwise, web console and distributed commands will fail with authentication errors.

Note: On upgrade, this step can be skipped if it has already been done during the previous install of SafeKit 8.2. If it is reapplied, it will reset the password with the new value.

2.1.3.2 On Linux as root

2.1.3.2.1 SafeKit package install

1. Open a Shell console as root
1. Go to the directory that contains the downloaded file `safekitlinux_x86_64_8_2_x_y.bin`

   auto extractible zip file
3. Run `chmod +x safekitlinux_x86_64_8_2_x_y.bin`
4. Run `./safekitlinux_8_2_x86_64_x_y.bin`

   it extracts the package and the `safekitinstall` script
5. Install in interactive mode by executing ./`safekitinstall`

   During the installation:

   ✓ reply to "`Do you accept that SafeKit automatically configure the local firewall to open these ports (yes|no)?`"

   If you answer `yes`, it configures `firewalld` or `iptable` Linux firewall for SafeKit. For details or other firewalls, see section 10.3 page 156.

   ✓ reply to "`Please enter a password or "no" if you want to set it later`"

   This step is mandatory to initialize the default configuration of the web service. The web service requires authentication to access the service.

   It initializes it with the `admin` user and the given password `pwd`, for instance. It then allows to access to all the web console's features, by logging in with `admin/pwd`, and run distributed commands. For details, see 11.2.1 page 175.

   Important: The password must be identical on all nodes that belong to the same SafeKit cluster. Otherwise, web console and distributed commands will fail with authentication errors.

or

5. Install in non-interactive mode, by executing:

   ```
   ./safekitinstall -q
   ```

   Use the option `-nofirewall` for disabling the firewall automatic setup

   Use the option `-passwd pwd` for initializing the web service authentication (where `pwd` is the password set for the `admin` user)

2.1.3.2.2 Firewall setup

No action required when firewall automatic configuration has been performed during install. Otherwise see section 10.3 page 156.

2.1.3.2.3 *Web service initialization*

This step is mandatory to initialize the default configuration of the web service, which is accessed by the web console and the global safekit command. The web service requires authentication to access the service. No action required when the web service initialization has been performed during install. Otherwise, see section 11.2.1 page 175.

2.1.4 Use the SafeKit console or command line interface

Once installed, the SafeKit cluster must be defined. Then modules can be installed, configured, and administered. All these actions can be done with the SafeKit console or the command line interface.

2.1.4.1 The SafeKit console

1. Start a web browser (Microsoft Edge, Firefox, or Chrome)
2. Connect it to the URL `http://host:9010` (where `host` is the name or IP address of one of the SafeKit nodes)
3. In the login page, enter `admin` as user’s name and the password you gave on initialization (e.g., `pwd`)
4. Once the console is loaded, the `admin` user can access to Monitoring and Configuration in the navigation sidebar, as he has the default `Admin` role

For details see section 3 page 37.

2.1.4.2 The SafeKit command line interface

It is based on the single `safekit` command located at the root of the SafeKit installation directory. Almost all `safekit` commands can be applied locally or on a list of nodes in the SafeKit cluster. This is called global or distributed command.

To use the `safekit` command:

In Windows	1. Open a PowerShell console as administrator 2. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:) `cd c:\safekit` 3. Run `.\safekit.exe <arguments>`
In Linux	1. Open a Shell console as root 2. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=/opt/safekit`) `cd /opt/safekit` 3. Run `./safekit <arguments>`

For details, see section 9 page 139.

2.1.5 SafeKit license keys

- If you do not install any license keys, the product will stop every 3 days
- You can download a one-month trial key (which is accepted on any hostname/any OS) from the following address: http://www.evidian.com/safekit/requestevalkey.php
- To obtain permanent keys see section 8.2 page 132
- Save the key into the `SAFE/conf/license.txt` file (or any other file in SAFE/conf) on each server
- If files in SAFE/conf contain more than one license keys the most favorable key will be chosen
- Check the key conformance with the command `safekit level`

2.1.6 System specific procedures and characteristics

2.1.6.1 Windows

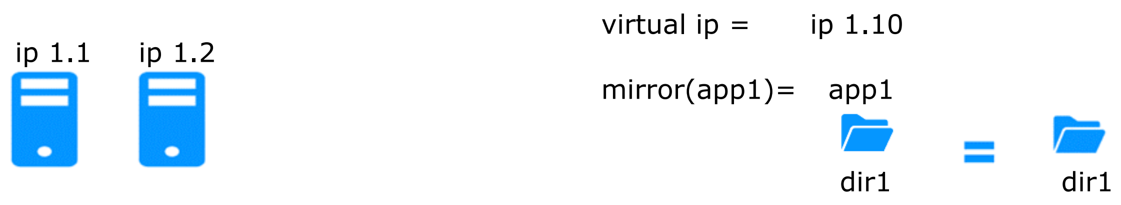
- Apply a special procedure to properly stop SafeKit modules at machine shutdown and to start `safeadmin` service at boot: see section 10.4 page 161.
- For network interfaces with teaming and with SafeKit load balancing, it is necessary to uncheck "Vip" on physical network interfaces of teaming and keep it checked only on teaming virtual interface.

2.1.6.2 Linux

- In Linux, the SafeKit package depends on other system packages. Most of them are installed automatically, except those specific to the implementation of load-balancing in a farm and file replication in a mirror.

  For an updated list of required packages, see the *SafeKit Release Notes.*
- The user `safekit` and a group `safekit` are created: all users belonging to the `safekit` group, and the user `root` can execute SafeKit commands
- In a farm module with load balancing on a virtual IP address, the vip kernel module is compiled when the module is configured. To compile successfully, Linux packages must be installed, as well as the `devel` package corresponding to the kernel version installed (`kernel-devel`).
- For a farm with SafeKit load balancing on a bonding interface, no ARP should be set in the bonding configuration. Otherwise the association <virtual IP address, invisible virtual MAC address> is broken in client ARP caches with physical MAC address of the bonding interface: see section 4.3.4 page 78
- For a mirror, if using file replication, install `nfs-util` package and remove the `logwatch` package `(rpm -e logwatch)`; otherwise NFS service and SafeKit are stopped every night

2.2 Mirror installation recommendation



2.2.1 Hardware prerequisites

- 2 servers with the same Operating System
- Supported OS: https://support.evidian.com/supported_versions/#safekit
- Disk drive with write-back cache recommended for the performance of the IOs

2.2.2 Network prerequisites

- 1 physical IP address per server (ip 1.1 and ip 1.2)
- If you need to set a virtual IP address (ip 1.10), both servers must be in the same IP network with the standard SafeKit configuration (LAN or extended LAN between two remote computer rooms). For setting a virtual IP address with servers in different IP networks, see section 13.5.3 page 215.

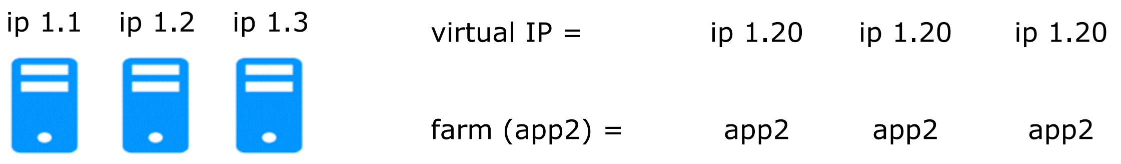
2.2.3 Application prerequisites

- The application is installed and starts on both servers
- Application can be started and stopped using command lines
- On Linux, command lines like `service "service" start|stop` or `su -user "appli-cmd"`
- On Windows, command lines like `net start|stop "service"`
- If necessary, application with a procedure to recover after crash
- Remove automatic application start at boot and configure the boot start of the module instead

2.2.4 File replication prerequisites

- File directories that will be replicated are created on both servers
- They are located at the same place on both servers in the file tree
- It is better to synchronize clocks of both server for file replication (NTP protocol)
- On Linux, align uids/gids on both servers for owners of replicated directories/files
- See also system specific procedures and characteristics in section 2.1.6 page 29

2.3 Farm installation recommendation



2.3.1 Hardware prerequisites

- At least 2 servers with the same Operating System
- Supported OS: https://support.evidian.com/supported_versions/#safekit
- Linux: kernel compilation tools installed for vip kernel module

2.3.2 Network prerequisites

- 1 physical IP address per server (ip 1.1, ip 1.2, ip 1.3)
- If you need to set a virtual IP address (ip 1.20), servers must be in the same IP network with the standard SafeKit configuration (same LAN or extended LAN between remote computer rooms). For setting a virtual IP address with servers in different IP networks, see section 13.5.3 page 215.
- See also system specific procedures and characteristics in section 2.1.6 page 29

2.3.3 Application prerequisites

The same prerequisites as for a mirror module described in section 2.2.3 page 30

2.4 SafeKit upgrade

2.4.1 When proceed to an upgrade?

If you encounter a problem with SafeKit, see the *Software Release Bulletin* containing the list of fixes on the product.

If you want to take advantage of some new features, see the *SafeKit Release Notes*. This document also tells you if you are in the case of a major upgrade (ex. 7.5 to 8.2) which requires a different procedure from the one presented here.

The upgrade procedure consists in uninstalling the old package and then installing the new package. All nodes in the same cluster must be upgraded.

2.4.2 Prepare the upgrade

1. Note the state "on" or "off" of SafeKit services and modules started automatically at boot `safekit boot webstatus; safekit boot status -m AM` (where AM is the name of the module) and in Windows: `safekit boot snmpstatus;`

Important

The start at boot of the module can be defined in its configuration file. If so, the use of the `safekit boot` command becomes unnecessary.

2. for a mirror module

note the server in the `ALONE` or `PRIM` status to know which server holds the up-to-date replicated files

3. optionally, take snapshots of modules

   Uninstalling/reinstalling will reset logs and dumps of each module. If you want to keep this information (logs and last 3 dumps and configurations), run the command `safekit snapshot -m AM /path/snapshot_xx.zip` (replace AM by the module name)

2.4.3 Uninstall procedure

On Windows as administrator and on Linux as root:

1. stop all modules using the command `safekit shutdown`

   For a mirror in the `PRIM-SECOND` status, stop first the `SECOND` server to avoid an unnecessary failover
2. close all editors, file explorers, shells, or terminal under `SAFE` and `SAFEVAR` (to avoid package uninstallation error)
3. uninstall SafeKit package

In Windows	Use the Control Panel-Add/Remove Programs applet
In Linux	Use the command `safekit uninstall`

4. undo all configurations that you have done manually for the firewall setup (see section 10.3 page 156)

Uninstalling SafeKit includes creating a backup of the installed modules in `SAFE/Application_Modules/backup`, then unconfiguring them.

2.4.4 Reinstall and postinstall procedure

1. install the new package as described in section 2.1 page 25
2. check with the command `safekit level` the installed SafeKit version and the validity of the license (which has not been uninstalled)

   If you have a problem with the new package and the old key, take a temporary license: see section 2.1.5 page 29
3. if you use the web console, clear the browser cache and refresh pages in the web browser
4. reconfigure each installed module either with:

   ✓ the web console by navigating to Configuration/Modules configuration/ Configure the module/

   ✓ the web console by directly entering the URL http://host:9010/console/en/configuration/modules/AM/config/

   ✓ the command `safekit config -m AM`

   where AM is the module name
5. if necessary, reconfigure the automatic start of modules at boot

The start at boot of the module can be defined in its configuration file. If so, skip this step. Otherwise, run the command `safekit boot -m AM on` (replace AM by the module name)

6. restart the modules

Mirror module	The module must be started as primary on the node with the updated replicated files (former `PRIM` or `ALONE`) either with: ✓ the web console by navigating to 👁 Monitoring/••• of the node/Force start/As primary ✓ the command `safekit prim -m AM` (replace `AM` by the module name) Check that the application is working properly once the module is in `ALONE` state, before starting the other node. On the other node (former `SECOND`), the module must be started in secondary mode either with: ✓ the web console by navigating to 👁 Monitoring/••• of the node/Force start/As secondary ✓ the command `safekit second -m AM` (replace `AM` by the module name) Once this initial start has been performed by selecting the primary and secondary nodes, subsequent starts can be performed with: ✓ the web console by navigating to 👁 Monitoring/••• of the node/▷ Start/ ✓ the command `safekit start -m AM` (replace `AM` by the module name)
Farm module	Start the module either with: ✓ the web console by navigating to 👁 Monitoring/••• of the module/▷ Start/ ✓ the command `safekit start -m AM` (replace `AM` by the module name)

Furthermore, in exceptional cases where you have modified the default setup of the SafeKit web service or SNMP monitoring :

⇨ the SafeKit web service `safewebserver`

- ✓ If its automatic start at boot had been disabled, disable it again with the command `safekit boot weboff`
- ✓ If you had modified configuration files and these have evolved in the new version, your modifications are saved into `SAFE/web/conf` before being overwritten by the new version. Carrying over your old configuration to the new version may require some adaptations. For details on the default setup and all predefined setups, see section 11 page 173.

For HTTPS and login/password configurations, certificates, and `user.conf / group.conf` generated for the previous release should be compatible.

- The SafeKit SNMP monitoring
  - ✓ In Windows, if its automatic start at boot had been enabled, enable it again with the command `safekit boot snmpon`
  - ✓ If you had modified configuration files and these have evolved in the new version, your modifications are saved into `SAFE/snmp/conf` before being overwritten by the new version. Carrying over your old configuration to the new version may require some adaptations. For details, see section 10.8 page 168.

2.5 SafeKit full uninstall

For completely removing the SafeKit package, follow the procedure described below.

2.5.1 On Windows as administrator

1. stop all modules using the command `safekit shutdown`
2. close all editors, file explorers, shells, or cmd under `SAFE` and `SAFEVAR` (to avoid package uninstallation error)

   (`SAFE=C:\safekit` if `%SYSTEMDRIVE%=C: ; SAFEVAR=C:\safekit\var` if `%SYSTEMDRIVE%=C:`)
3. uninstall SafeKit using the Control Panel-Add/Remove Programs applet
4. reboot the server
5. delete the folder `SAFE` that is the installation directory of the previous install of SafeKit
6. undo all configurations that you have done for SafeKit boot/shutdown (see section 10.4 page 161)
7. undo all configurations that you have done for firewalls rules setting (see section 10.3 page 156)

2.5.2 On Linux as root

1. stop all modules using the command `safekit shutdown`
2. close all editors, file explorers, shells, or terminal under `SAFE` and `SAFEVAR` (`SAFE=/opt/safekit ; SAFEVAR=/var/safekit`)
3. uninstall SafeKit using the `safekit uninstall -all` command and answer `yes` when prompted to delete all SafeKit folders
4. reboot the server
5. undo all configurations that you have done for firewalls rules setting

   See section 10.3 page 156
6. delete the user/group created by the previous install (default is `safekit`/`safekit`) with the commands:

   ```
   userdel safekit
   groupdel safekit
   ```

2.6 SafeKit documentation

SafeKit Solution	The SafeKit solution is fully described.
SafeKit Training	Refer to this online training for a quick start in using SafeKit.
SafeKit Release Notes	It presents: ✓ latest install instructions ✓ major changes ✓ restrictions and known problems ✓ migration instructions
Software Release Bulletin	Bulletin listing SafeKit 8.2 packages, with descriptions of changes and fixed issues.
SafeKit Knowledge Base	List of known SafeKit issues and restrictions. Other KBs are available on the Evidian support site, but are only accessible to registered users. For more details on the support site, see section 8 page 131.
SafeKit user's guide	This is the guide. Please refer to the guide corresponding to your SafeKit version number. It is delivered with the SafeKit package and can be accessed via the web console under ⋮/? User's guide. The link opposite takes you to the latest version of this guide.

3. The SafeKit web console

The SafeKit 8 web console and API have evolved from previous versions. As a result, the console delivered with SafeKit 8 can only administer SafeKit 8 servers, which cannot be administered with an older console.

Note

See the Release Notes, at https://support.evidian.com/safekit, for restrictions and known problems with the SafeKit web console.

3.1 Start the web console

The web console permits to administer one SafeKit cluster. A SafeKit cluster is a set of servers where SafeKit is installed and running. All servers belonging to a given SafeKit cluster share the same cluster configuration (list of servers and networks used) and communicate with each other's to have a global view of SafeKit modules configurations. The same server can not belong to many SafeKit clusters.

3.1.1 Start a web browser

- The web browser runs on any allowed SafeKit nodes or workstation that can reach the SafeKit servers over the network.
- Network, firewall and proxy configuration must allow access to all the servers that are administered with the web console
- JavaScript must be available and enabled in the web browser
- Tested browsers are Microsoft Edge, Firefox, and Google Chrome
- To avoid security popups in Microsoft Edge, you may add the SafeKit servers addresses into the Intranet or Trusted zone
- The messages in the web console are displayed in French or English languages, according to the selected language into the console
- After SafeKit upgrade, you must clear the browser's cache to get the new web console pages. A quick way to do this is a keyboard shortcut:
    1. Open the browser to any web page and hold `CTRL` and `SHIFT` while tapping the `DELETE` key
    2. A dialog box will open to clear the browser. Set it to clear everything and click Clear Now or Delete at the bottom

3. Close the browser, stop all background processes that may be still running and re-open it fresh to reload the web console

3.1.2 Connect to a SafeKit server

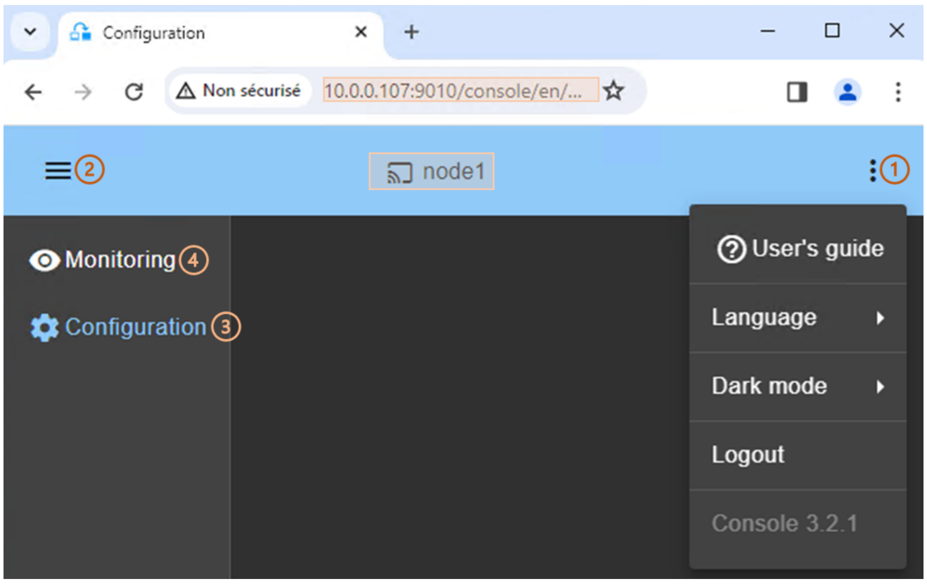
By default, access to the web console requires the user to authenticate himself with a name and password. On SafeKit install, you had to initialize it with the user `admin` and assign a password. This `admin` name and password are sufficient to access all the console's features. For more details on this configuration, see 11.2.1 page 175.

1. Start a web browser (Microsoft Edge, Firefox, or Chrome)
2. Connect it to the URL http://host:9010 (where `host` is the name or IP address of one of the SafeKit servers). If HTTPS is configured, there is an automatic redirection to https://host:9453.

   The SafeKit server to which the console is connected (`host` in the URL) is called the **connection node**. This node acts as a proxy to communicate on behalf of the console with all other SafeKit servers.

Note: You can connect to any node of the cluster since the console offer global view and actions. On connection error with one node, connect to another node.

3. In the login page, enter `admin` as user's name and the password you gave on initialization (e.g., `pwd`).
4. The SafeKit web console is loaded



- When the console is connected to a SafeKit server on which the cluster is configured, the name of the node corresponding to the server (as defined in the cluster configuration) is displayed in the header. This is the **connection node** (`node1` in the example).

  If the cluster is not yet configured, no name is displayed.
- (1) Click on ⋮ to open the menu to read the SafeKit User's Guide, select the language, enable/disable the dark mode and logout.
- (2) Click on ≡ to collapse or expand the navigation sidebar.

- (3) Click on ⚙ Configuration to configure the cluster and the modules. Configuration is only authorized to users that have Admin role. By default, the `admin` user has the Admin role.
- (4) Click on 👁 Monitoring to monitor and control the configured modules. Monitoring is authorized to users that have Admin, Control and Monitor roles. With Monitor role, actions on modules (start, stop…) are prohibited.

Note

The web console offers contextual help by clicking on the ⓘ icon.

3.2 Configure the Cluster

The SafeKit cluster must be defined before installing, configuring, or starting a SafeKit module. A Safekit cluster is defined by a set of networks and the addresses, on these networks, of a group of SafeKit servers, named nodes. These nodes implement one or more modules. Each server is not necessarily connected to all the networks, but at least one.

The cluster configuration is saved on the servers' side into the `cluster.xml` file (see section 12 page 201). For a correct behavior, it is required to apply the same cluster configuration on all the nodes.

Important

You must fully define the cluster configuration before installing and configuring modules since the modification of the cluster can affect the configuration or the execution of installed modules.

The cluster configuration home page is available :

✓ Directly via the URL http://host:9010/console/en/configuration/cluster

Or

✓ By navigating the console via ⚙Configuration/Cluster configuration

If the cluster is not yet configured, the cluster configuration wizard is automatically opened.

3.2.1 Cluster configuration wizard

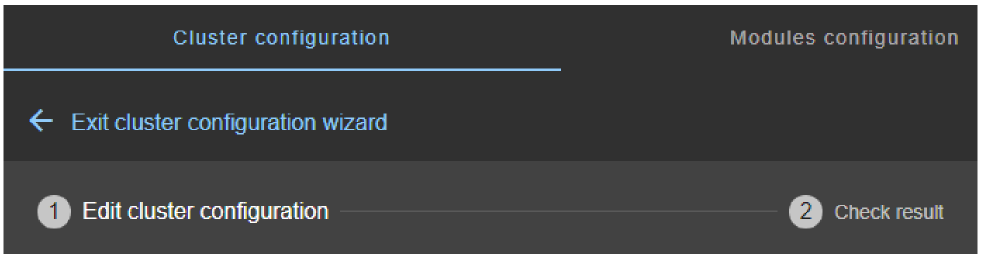
Open the configuration wizard:

✓ Directly via the URL http://host:9010/console/en/configuration/cluster/config

Or

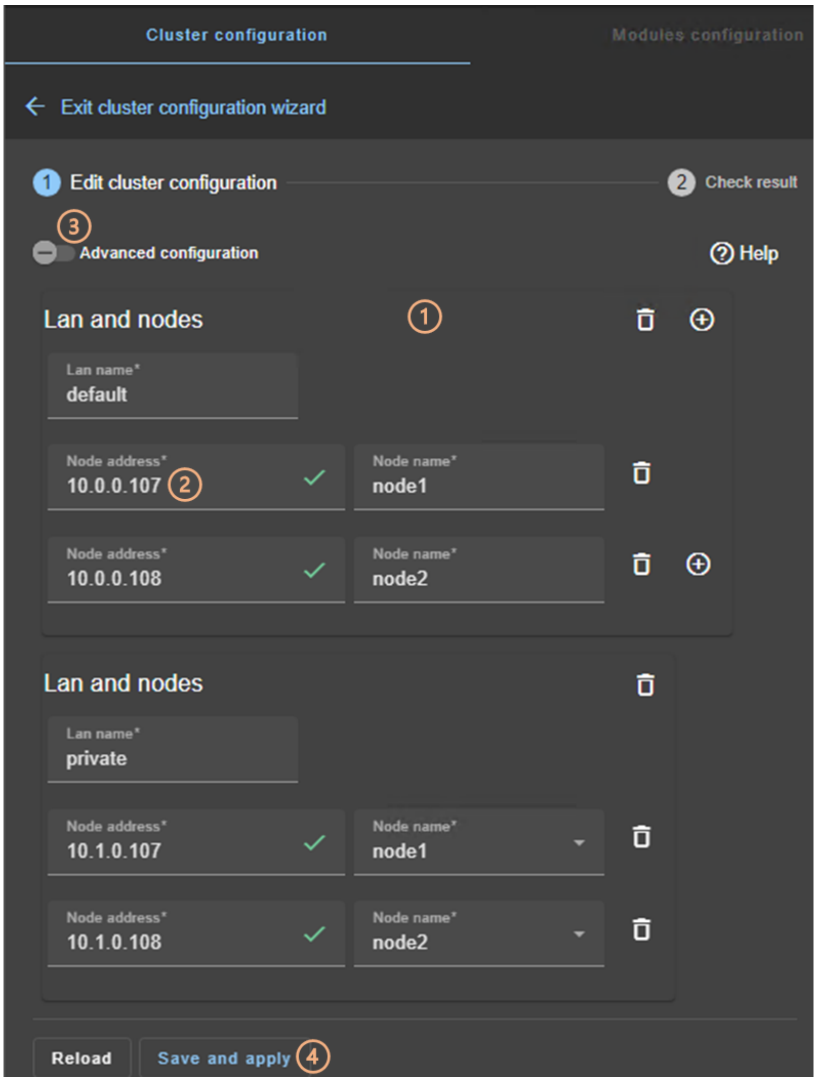
✓ Navigate in the console via ⚙Configuration/Cluster configuration/ ⚙Configure the cluster/

The cluster configuration wizard is a step-by-step form:


Cluster configuration
Modules configuration
Exit cluster configuration wizard
1 Edit cluster configuration
2 Check result

1. Edit cluster configuration described page 40
2. Check result described page 42
3. ← to Exit cluster configuration wizard

3.2.1.1 Edit cluster configuration



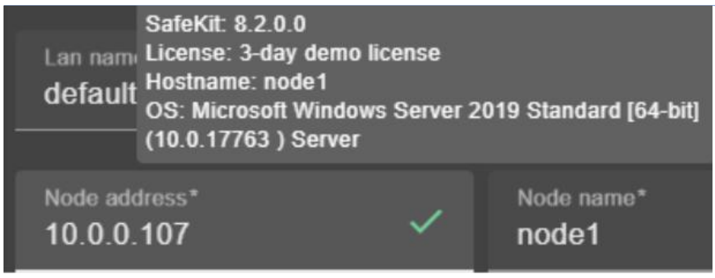
- (1) Fill in the form to first assign a user-friendly name for the lan. This name is used for configuring heartbeat networks used by a module.

  Click on ⊕ to add another node/lan or on 🗑 to remove the node/lan from the cluster.

Important — When a node/lan is removed from the cluster, all modules using it in its configuration may become unusable.

- (2) Fill in the IP address of the node and then press the Tab key to check the server connectivity and automatically insert the server hostname

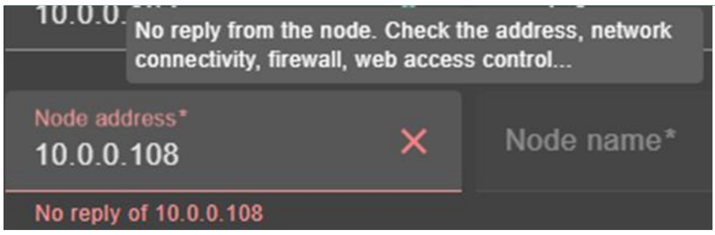
  The icon next to the address reflects the reachability of the node.



SafeKit: 8.2.0.0
License: 3-day demo license
Hostname: node1
OS: Microsoft Windows Server 2019 Standard [64-bit] (10.0.17763) Server

Lan name: default
Node address*: 10.0.0.107 ✓
Node name*: node1

✓ means that the SafeKit server is available. The tooltip gives information on the server.



No reply from the node. Check the address, network connectivity, firewall, web access control...

Node address*: 10.0.0.108 ✕
Node name*

No reply of 10.0.0.108

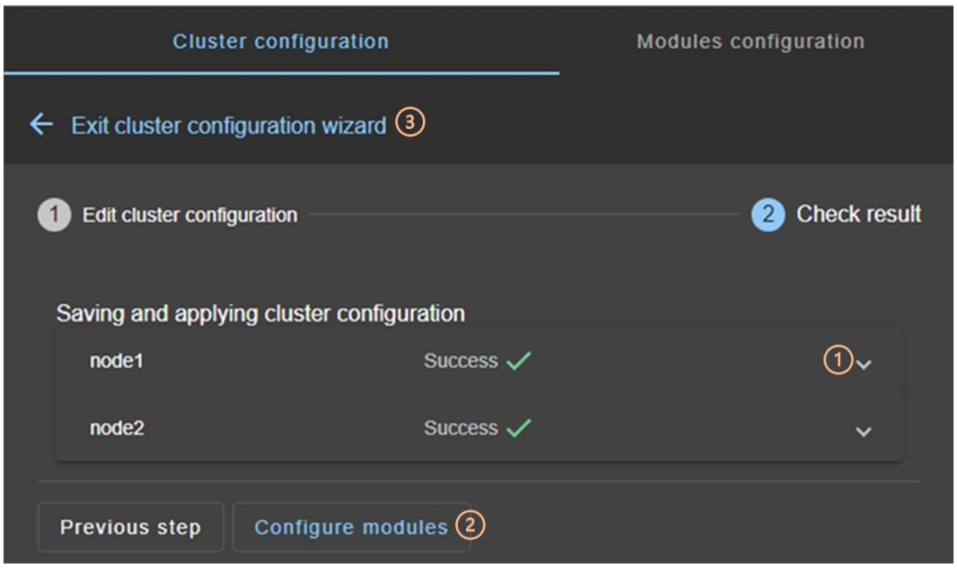
✕ means that there was no reply from the server within the timeout delay. Fix the problem to be able to administer this node. It may be a bad address, a network or host failure, a bad configuration of the web browser or the firewall, the stop of the SafeKit web service on the node. For solving the problem, refer to the section 7.1 page 109.

- Change the node name if necessary. This name is the one that will be used by the SafeKit administration service for uniquely identifying a SafeKit node. It is also the one displayed into the SafeKit web console.
- (3) If you prefer, click on Advanced configuration to switch to XML cluster editing.

  Click on ⓘ to open the SafeKit User's Guide on the configuration description in the `cluster.xml` file.
- Click on Reload to discard your current modifications and reload the original configuration.
- (4) Once the edition is completed, click on Save and Apply to save and apply the edited configuration to all nodes in the cluster.

Important — If required, you can reapply the configuration to all nodes without modifying it.

3.2.1.2 Check result



- (1) Read the result of the operation on each node:
  - ✓ Success✓ means the configuration was successful.
  - ✓ Failure✗ means the configuration has failed. Click to read the output of commands executed on the node and search for the error. You may need to modify the parameters entered or connect to the node to correct the problem. Once the error has been corrected, Save and apply again.
- (2) Click on Configure modules to exit the cluster configuration wizard and navigate to modules configuration.

Or

- (3) Click on ← to exit the cluster configuration wizard and navigate to the cluster configuration home page.

3.2.2 Cluster configuration home page

When the cluster is configured, the cluster configuration home page is available.

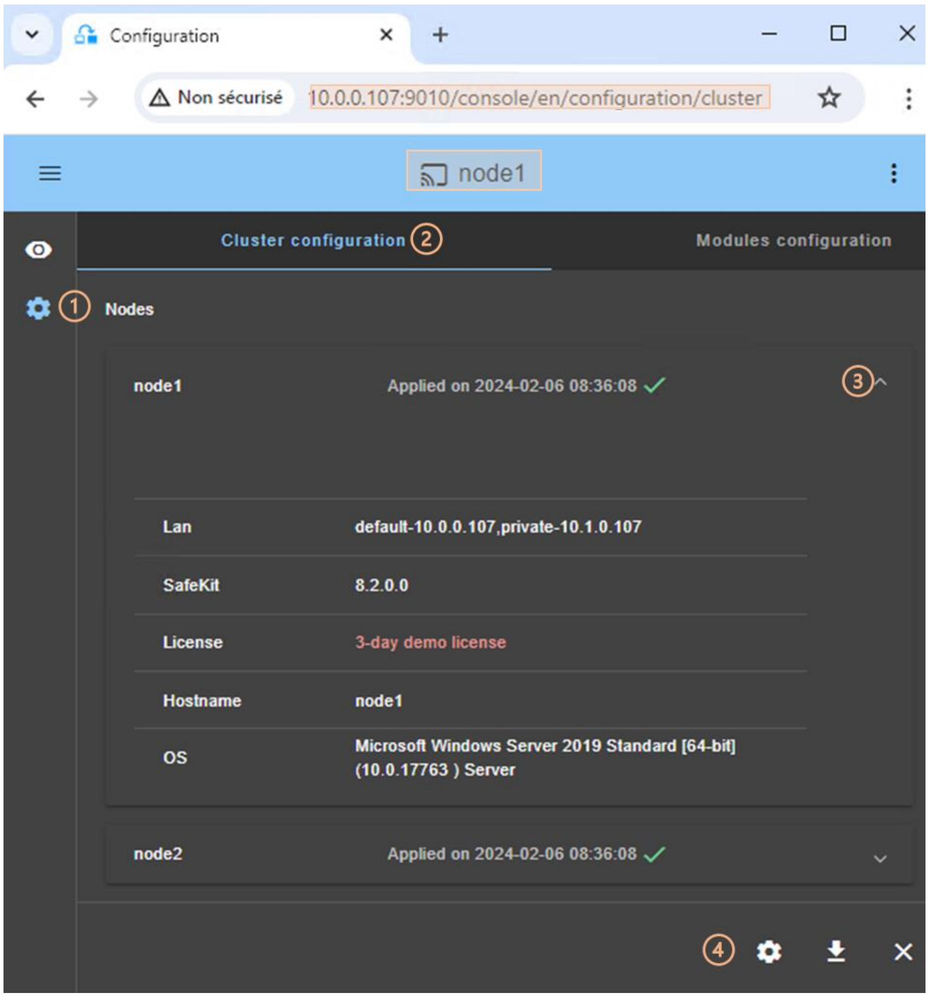
Open it:

✓ Directly via the URL http://host:9010/console/en/configuration/cluster

Or

✓ By navigating the console via ⚙Configuration/Cluster configuration

In this example, the console is loaded from `10.0.0.107`, which corresponds to `node1` in the existing cluster. This is the connection node.



node1	Applied on 2024-02-06 08:36:08 ✓
Lan	default-10.0.0.107,private-10.1.0.107
SafeKit	8.2.0.0
License	3-day demo license
Hostname	node1
OS	Microsoft Windows Server 2019 Standard [64-bit] (10.0.17763) Server
node2	Applied on 2024-02-06 08:36:08 ✓

- (1) Click on ⚙Configuration in the navigation sidebar
- (2) Click on Cluster configuration tab
- Nodes configured in the cluster are listed with their configuration date.
- (3) Click on ⌄ to display details about the node (names of lans and addresses defined in the cluster configuration…).
- (4) Click on one of the buttons:
  - ✓ ⚙to modify the cluster configuration and/or re-apply it. This opens the cluster configuration wizard and loads the cluster configuration from the connection node.
  - ✓ ⤓ to download the cluster configuration in XML format from the connection node.
  - ✓ ✕ to unconfigure the cluster on one or more nodes.

3.3 Configure a module

Once the cluster has been set up, you can configure a new module on the cluster. The module configuration home page is accessible :

✓ Directly via the URL http://host:9010/console/en/configuration/modules

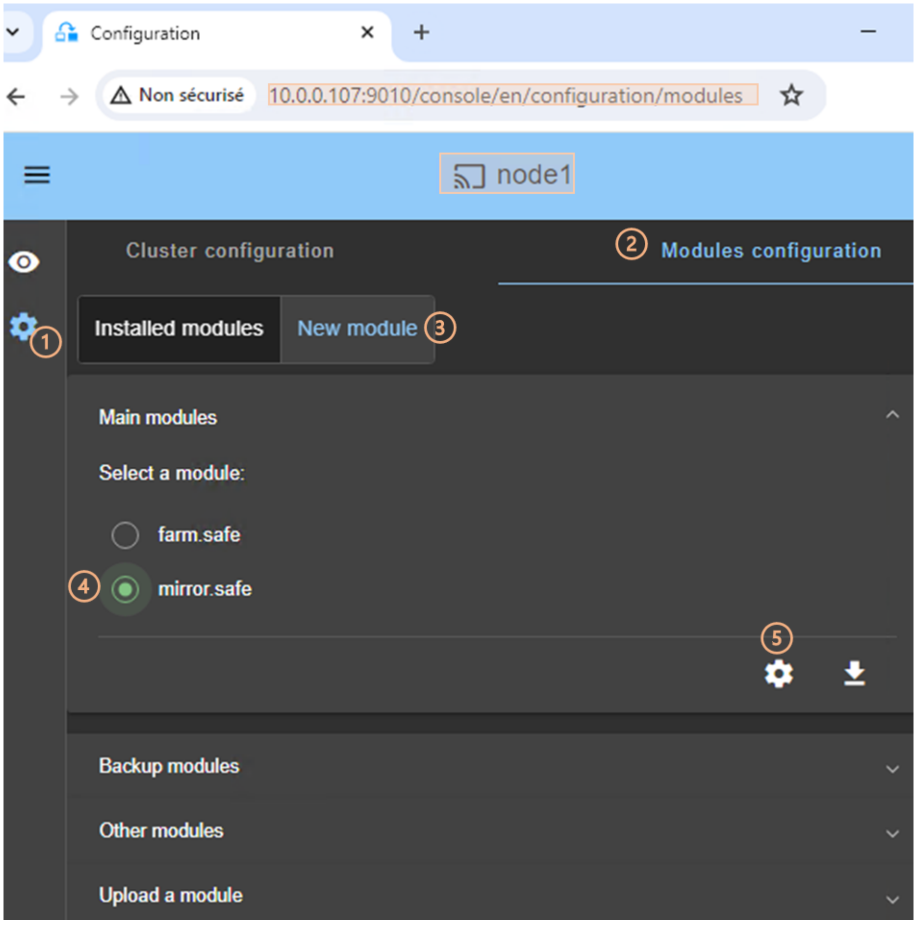
Or

✓ By navigating the console via ⚙Configuration/Modules configuration

If no module has been configured, the console automatically presents the page for configuring a New module.

3.3.1 Select the new module to configure

In this example, the console is loaded from `10.0.0.107`, which corresponds to `node1` in the existing cluster. This is the connection node.



- (1) Click on ⚙Configuration in the navigation sidebar
- (2) Click on Modules configuration tab
- (3) Click on New Module
- The page proposes to select a new module among several proposals visible by clicking on ⌄:

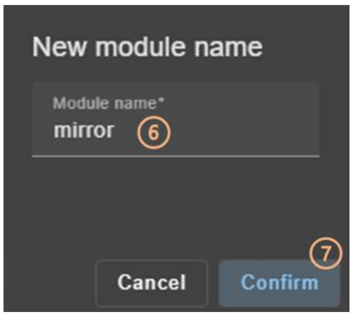
- ✓ The Main modules, including the generic `mirror.safe` and `farm.safe` modules for integrating a new application into a mirror or farm architecture.

  Here are the modules stored on the connection node, `node1`, under `SAFE/Application_Modules/generic`, `SAFE/Application_Modules/demo` and `SAFE/Application_Modules/published`.
- ✓ Backup modules archived on the connection node, which are saved when a module is uninstalled on this node.

  They are loaded from `node1` under `SAFE/Application_Modules/backup`.
- ✓ Other modules which are examples of SafeKit features used in modules supplied for testing purposes only.

  They are loaded from `node1` under S`AFE/Application_Modules/other`.
- ✓ A locally stored module accessible from Upload module.

- (4) Select a module to configure from those listed above. In the example, `mirror.safe`.
- (5) Click on the button ⚙Configure the new module.
- A dialog opens to give the new module name

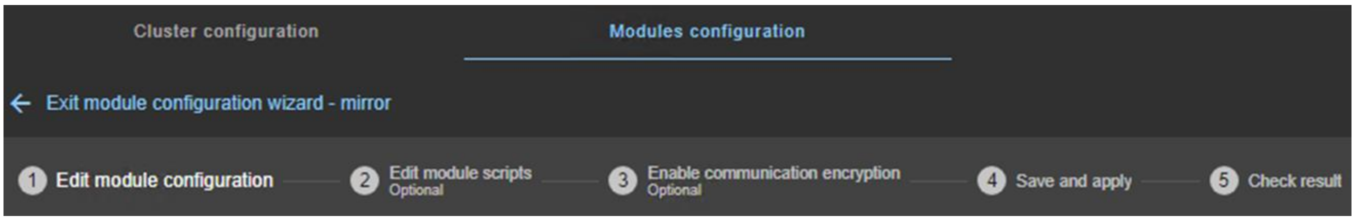

New module name

Module name*
mirror

- (6) Enter the name of the new module.
- (7) Click on Confirm
- The module configuration wizard is opened. This is described below.

3.3.2 Module configuration wizard

The module configuration wizard is a step-by-step form:


Cluster configuration
Modules configuration
Exit module configuration wizard - mirror
1 Edit module configuration
2 Edit module scripts Optional
3 Enable communication encryption Optional
4 Save and apply
5 Check result

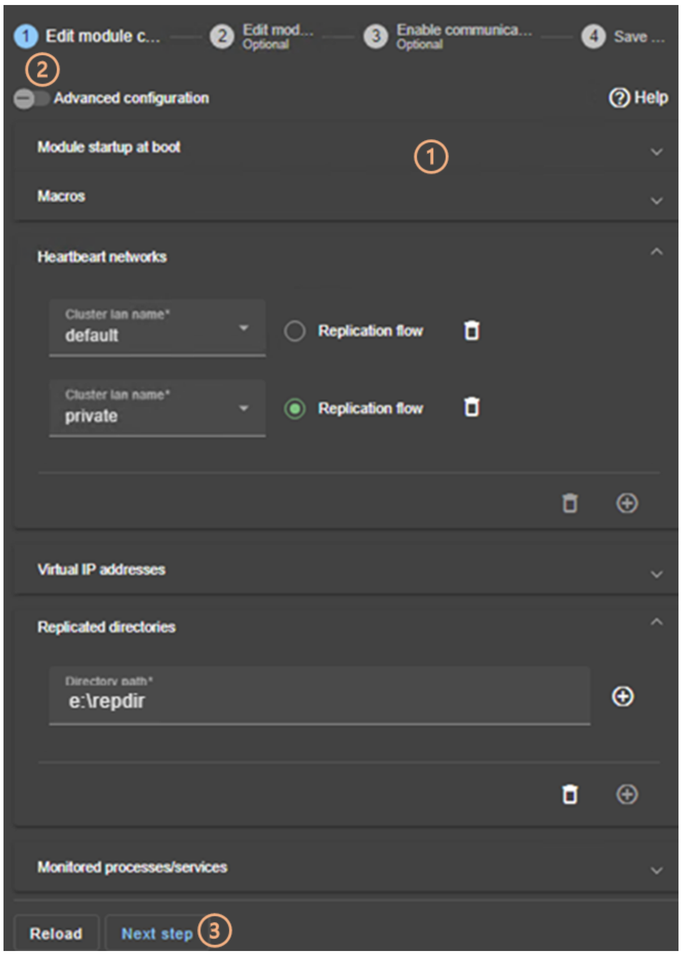
1. Edit module configuration described page 46
2. Edit module scripts (Optional) described page 47
3. Enable communication encryption (Optional) described page 48
4. Save and apply described page 48
5. Check result described page 50

6. ← to Exit module configuration wizard

Note that module reconfiguration can only be applied to nodes on which the module in question is not started. Therefore, stop the module before starting the configuration wizard.

3.3.2.1 Edit module configuration

Below is an example of editing the `mirror.safe` module configuration.



- (1) Fill in the form to assign values to the various components, add or remove them. Click on ⌄ to open the detailed panel for each component.

  This form is used to enter only the main module configuration parameters.

Note

The names of the Heartbeat networks proposed are the names of the lans entered during cluster configuration.

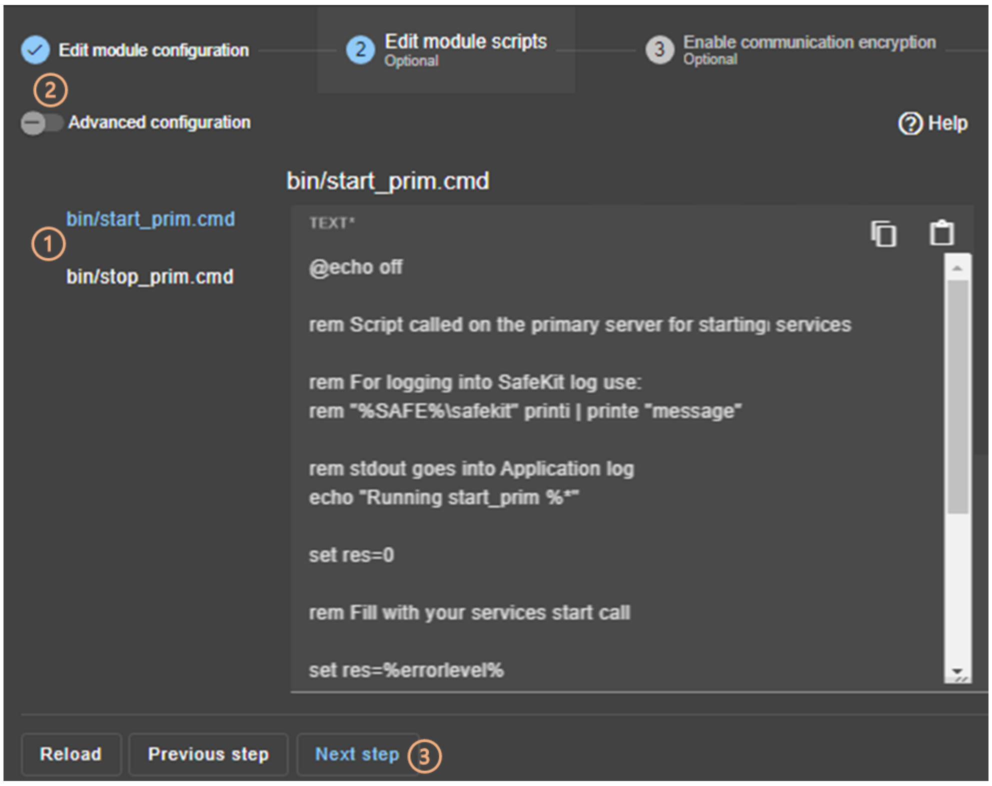
- (2) For advanced module configuration, exhaustive compared to the form, click on Advanced configuration. This switches to editing the module configuration file in XML format, `userconfig.xml`.

Click on ⓘ to open the SafeKit User's Guide describing the configuration of the various components in the `userconfig.xml` file.

- If necessary, click on Reload to discard your modifications and reload the complete original configuration (including scripts if these were modified in the next step).
- (3) Once you have finished editing the module configuration, click on Next step.

3.3.2.2 Edit module scripts

Below is an example of editing the `mirror.safe` module scripts.



bin/start_prim.cmd

```
TEXT*
@echo off

rem Script called on the primary server for starting services

rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"

rem stdout goes into Application log
echo "Running start_prim %*"

set res=0

rem Fill with your services start call

set res=%errorlevel%
```

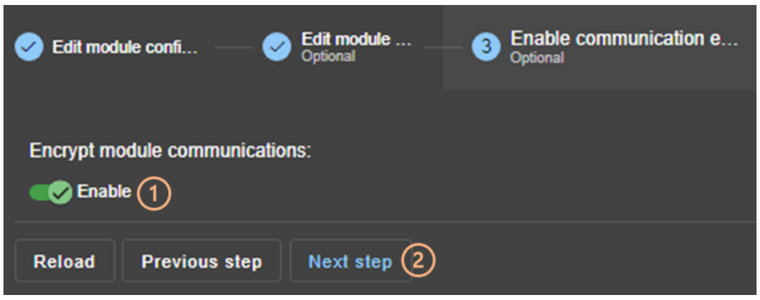
- (1) Click on `start_prim` or `stop_prim` to edit it and insert your application start/stop.

  Click on ⧉ to copy the content and edit it with your favorite syntax editor. Once done, paste the modified content into the input field with 📋.
- (2) If necessary, click on Advanced configuration to list the other module's scripts and edit them (`prestart`, `poststop`, scripts for checkers…).

  Click on ⓘ to open the SafeKit User's Guide describing the module scripts.
- If necessary, click on Reload to discard your modifications and reload the complete original configuration (including the module configuration if it was modified in the previous step).
- (3) Once you have finished editing the module scripts, click on Next step.

3.3.2.3 Enable communication encryption

Encryption of internal module communications between cluster nodes is enabled by default. For details, see section 10.5 page 162.



- (1) Click Enable to enable or disable encryption of module communications.

  Important When the module's encryption key is not identical on all nodes, internal communication is impossible. The configuration must be reapplied to all nodes to propagate the same key.

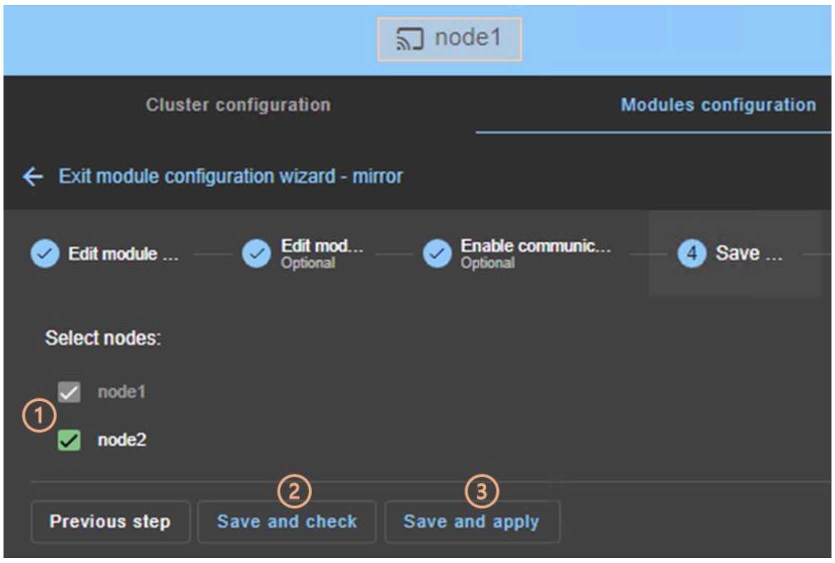
  To generate new encryption keys, you need to:

  1. disable encryption, then Save and apply configuration to all nodes
  2. enable encryption, then Save and apply configuration to all nodes

- If necessary, click on Reload to discard your modifications and reload the complete original configuration (including the module configuration and scripts if these were modified in the previous steps).
- (2) Once this step is complete, click on Next step.

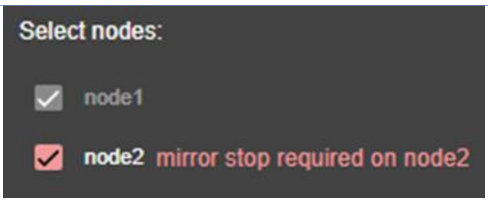
3.3.2.4 Save and apply

Step to select the nodes affected by the configuration.



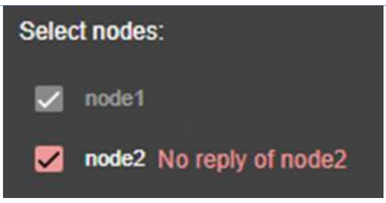
- (1) Check/uncheck to select/unselect nodes. Please note that the connection node (`node1` in the example) is mandatory.

  There are 2 cases where Save and Apply is disabled:



mirror stop required on node2

The module on the selected node is started and, in a state, other than ✗ `STOP (NotReady)`.



No reply of node2

There was no reply from the node within the timeout delay. It may be a bad address, a network or host failure, a bad configuration of the web browser or the firewall, the stop of the SafeKit web service on the node. For solving the problem, refer to the section 7.1 page 109..

In both cases, uncheck the node or click on Save and check to apply it later, after stopping the module or solving the communication problem.

- (2) Click on Save and check to save the edited configuration on the connection node and check its consistency. It then proceeds to the next step to display the result of this operation.

  Once this operation has been completed, any changes are saved on the connection node. The configuration wizard can be exited and relaunched later to apply the saved configuration. Until the saved configuration is applied, the last applied configuration of the module remains active.

- (3) Click on Save and apply to save and apply the edited configuration on selected nodes. It then proceeds to the next step to display the result of this operation.

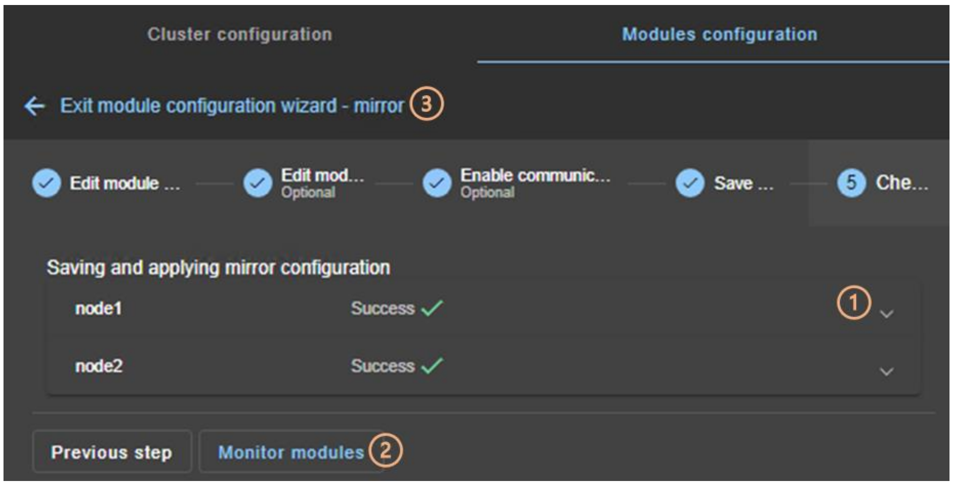
  If this operation is successful, the applied configuration becomes the active one for the module.

Important

On the server side, the module configuration is saved under `SAFE/modules/AM`(where `AM` is the module name). When reconfiguring a module, this directory is deleted and overwritten with the changes made in the console. Thus, on the servers' side, you must close all editors, file explorers, shells or cmd under `SAFE/modules/AM` before applying the configuration (otherwise there is a risk that the apply fails).

3.3.2.5 Check result

The example below shows the result of the Save and Apply operation. The layout for Save and Verify is similar



Saving and applying mirror configuration

node1 Success ✓

node2 Success ✓

- (1) Read the result of the operation on each node:
  - ✓ Success✓ means the operation was successful.
  - ✓ Failure✗ means the operation has failed. Click to read the output of commands executed on the node and search for the error. You may need to modify the parameters entered or connect to the node to correct the problem. Once the error has been corrected, repeat the operation from the previous step.
- (2) Click on Monitor modules to exit the module configuration wizard and navigate to modules monitoring.

Or

- (3) Click on ← to exit the module configuration wizard and navigate to the modules configuration home page.

3.3.3 Modules configuration home page

Once the first module has been configured, the module configuration home page is available. It allows you to view the modules installed on the cluster and to access the configuration of a new module.

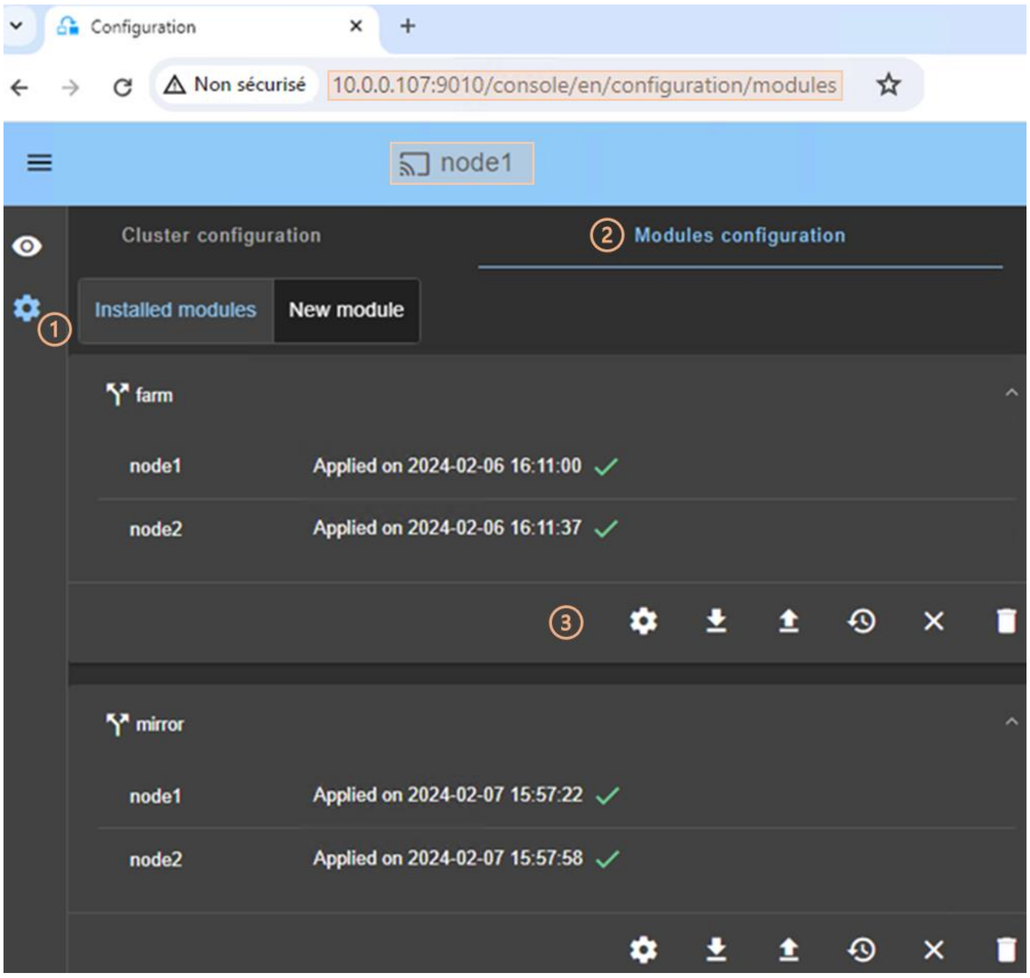
Open it:

✓ Directly via the URL http://host:9010/console/en/configuration/modules

Or

✓ By navigating the console via ⚙Configuration/Modules configuration

In this example, the console is loaded from `10.0.0.107`, which corresponds to `node1` in the existing cluster. This is the connection node.



farm

node1	Applied on 2024-02-06 16:11:00 ✓
node2	Applied on 2024-02-06 16:11:37 ✓

mirror

node1	Applied on 2024-02-07 15:57:22 ✓
node2	Applied on 2024-02-07 15:57:58 ✓

- (1) Click on ⚙Configuration in the navigation sidebar.
- (2) Click on Modules configuration tab.
- Modules installed on the cluster are listed with the date the configuration was applied and, if applicable, the date the configuration was saved but not yet applied.
- (3) Click on one of the buttons associated with the module:
  - ✓ ⚙ to modify its configuration or reapply its current configuration. This opens the module configuration wizard and loads its current configuration from the connection node.
  - ✓ ⤓ to download the `.safe`, consisting of all module files (`userconfig.xml`, scripts) from the connection node.
  - ✓ ⤒ to reconfigure the module from the contents of a locally stored `.safe`.
  - ✓ ⟲ to restore a previous module configuration.

    SafeKit keeps a copy of the last three successful configurations (stored under `SAFE/modules/lastconfig` on the server side). All module configuration files are packaged in a `.safe` file, whose name is of the type of `AM_<date>_<time>` (where `AM` is the module name).

- ✓ ✕ to remove internal files for the module on one or more nodes, without uninstalling it. The user configuration files are kept for later re-application.
- ✓ 🗑 to completely uninstall the module on one or more nodes.

  All module configuration files are packaged in a `.safe` file, which is archived on the server side under `SAFE/Application_Modules/backup`.

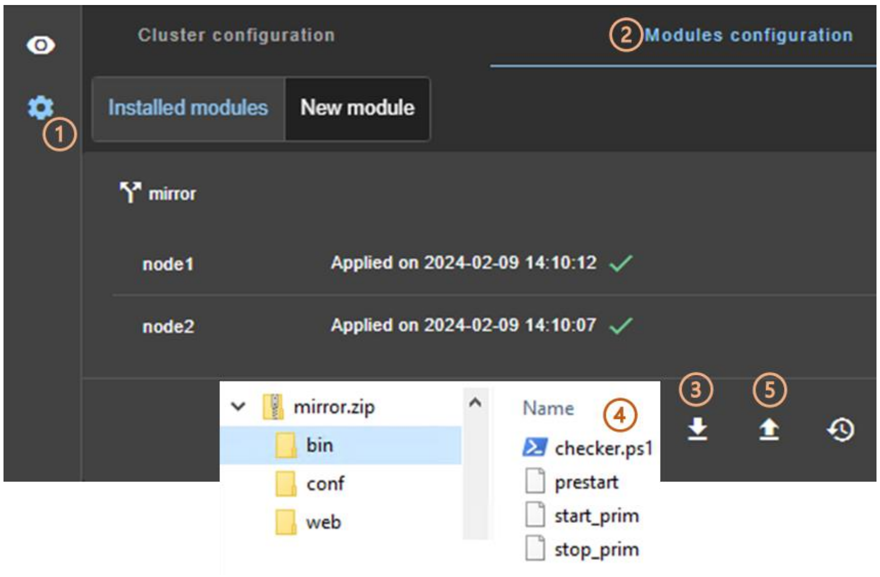
Important: Before each reconfiguration, deconfiguration and uninstallation, on each node, close all editors, file explorer, shells or cmd under `SAFE/modules/AM` (or risk the operation failing).

- To configure a new module, click on New module.

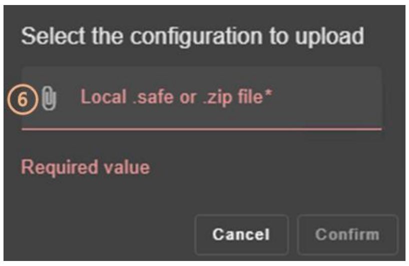
3.3.4 Add module scripts

You may need to add module scripts, such as custom checkers, to your current configuration of the module.

In this example, a script is added to `mirror` module.



- (1) Click on ⚙ Configuration in the navigation sidebar.
- (2) Click on Modules configuration tab.
- (3) Click on ⬇ to download the `mirror.safe` on your workstation.
- (4) Edit the `mirror.safe` that is a zip file to add your module script files into `bin` directory (`checker.ps1` in the example).
- (5) Upload the modified `mirror.safe` (.zip extension is also accepted).



- (6) Click on 📎 to select the file to be uploaded then Confirm.
- The module configuration wizard is launched with the contents of this file. The new scripts are visible with the Advanced configuration in step 2. Got to step 4 to Save and apply this new configuration.

3.4 Monitor a module

Once a module is configured, you can monitor its state and run actions on it (start, stop…).

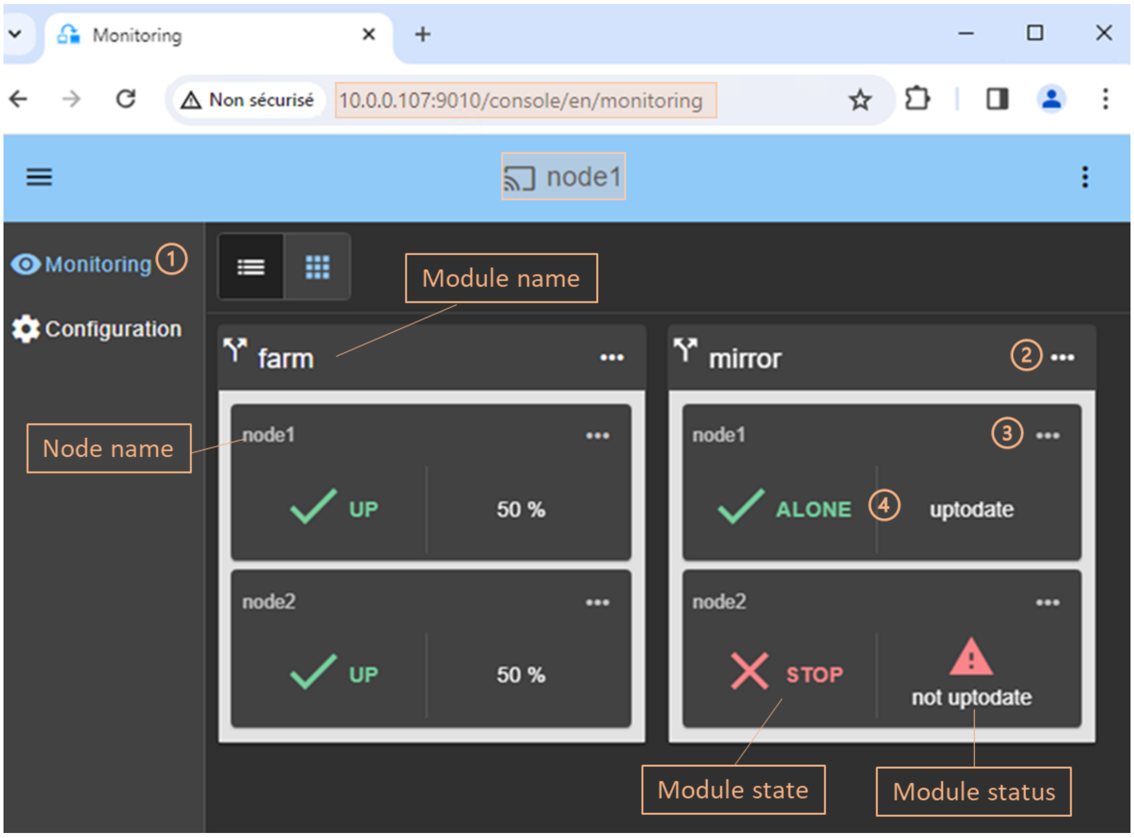
The modules monitoring home page is accessible :

✓ Directly via http://host:9010/console/en/monitoring

Or

✓ By navigating the console via 👁 Monitoring

In this example, the console is loaded from `10.0.0.107`, which corresponds to `node1` in the existing cluster. This is the connection node. Two modules are configured: `farm` and `mirror`.



- (1) Click on Monitoring in the navigation sidebar
- For each installed module, it displays:
  - ✓ the module name and nodes name on which it is installed
  - ✓ the module state and status on the node

  For a description, see 3.4.1 page 54.
- (2) Click on ••• to open the menu of global actions (start, stop…) on the module that apply on all nodes (`node1`, `node2` in the example).

  (3) Click on ••• to open menu of actions (start, stop…) on the module that applies only to the node (`node1` in the example).

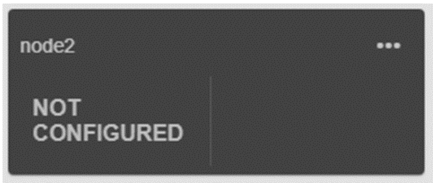
  For a description, see 3.4.2 page 56.
- (4) Click on the node panel (`mirror>node1` in the example) to open details for the module on this node (logs, resources…).

  For a description, see 3.4.3 page 57.

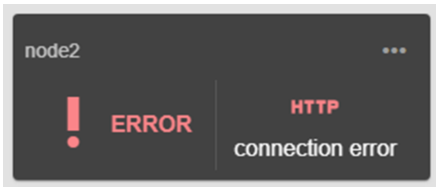
3.4.1 Module state and status

⇨ The module state on one node is one of the following.

The module is installed but not configured:



The node is not responding:



Fix the problem to be able to administer the module on this node. It may be a bad address, a network or host failure, a bad configuration of the web browser or the firewall, the stop of the SafeKit web service on the node. For solving the problem, refer to the section 7.1 page 109.

This may also be due to the temporary unavailability of the connection node. In this case, reload the console from another SafeKit node.

The module is configured, and the node is responding:

`STOP`	stopped (ready for starting)
`WAIT`	waiting for one resource
`ALONE`	primary without secondary (mirror module)
`PRIM`	primary with secondary (mirror module)
`SECOND`	secondary with primary (mirror module)

`UP`	active (farm module)

With the associated icon/color that means:

✗ or ○ `NotReady`	blocked state
⟳ `Transient`	transiting state
✓ `Ready`	stable state

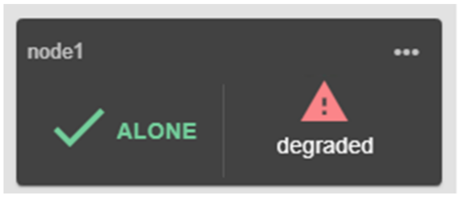
For details on state changes of a mirror module, see section 5.2 page 95.

For details on state changes of a farm module, see section 6.2 page 106.

⇨ The module status is one of the following.

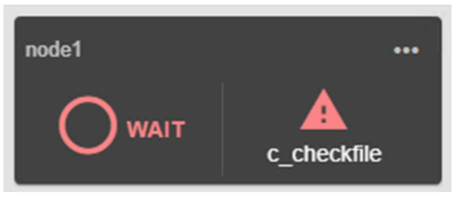
For a mirror module, it displays the status of replicated directories: `uptodate` or `not uptodate`.

In the special degraded case (see 7.6 page 115), it displays:



For a farm module, it displays the current network load share on the virtual IP: `0%`, `50%` or `100%` (for 2 nodes).

When the module (farm or mirror) is in state ○`WAIT (NotReady)`, the reason is displayed, usually the name of the failover rule that blocks the module until the associated resource comes back from `down` to `up`. For details, see 7.9 page 117.



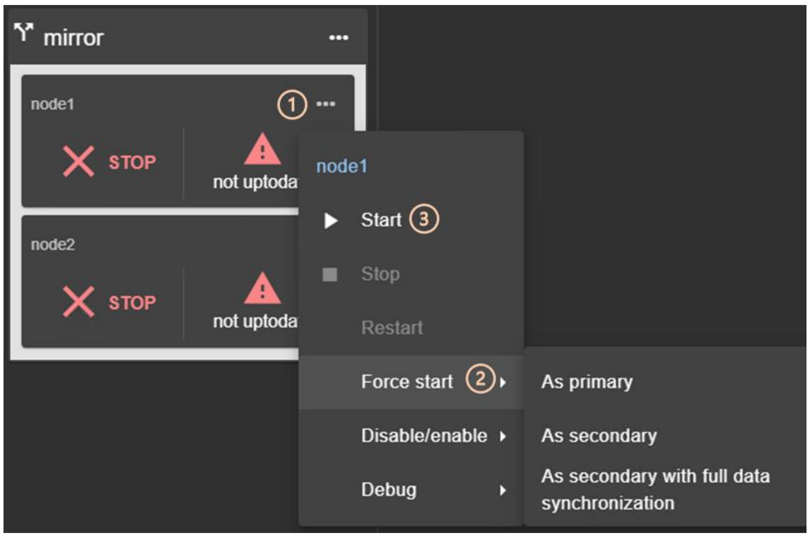
In the example above, the module is blocked by the failover rule named `c_checkfile`. To analyze the problem, read the logs and resources states as described later.

When the node is not responding, the status is connection error.

3.4.2 Module control menus

⇨ Control a mirror module

In the example, the module `mirror` is configured on `node1` and `node2`.



- Click on ••• to open the menu of actions on `node1`.
- Use Force start when you need to decide which node should start primary or secondary.
- For instance, on the 1st start of a mirror module, you must Force start/As primary the node which has the up-to-date replicated folders.
- For subsequent starts, click on ▷ Start, as SafeKit retains the most up-to-date node.
- Click on Debug to download module logs or snapshots from a single node, or from all nodes.

Refer to sections listed below:

✓ For the first start-up of a mirror module, see section 5.3 page 96

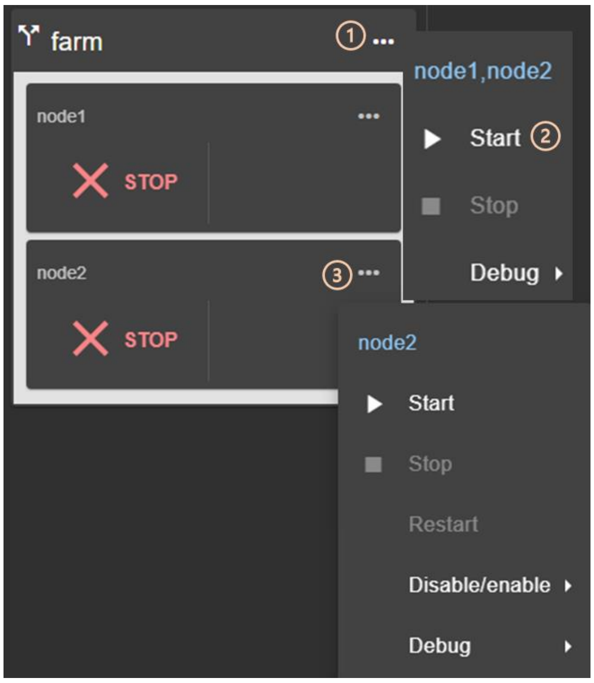
✓ For the start-up of a mirror module with the up-to-date data, see section 5.5 page 98

✓ To continue the tests, see 4 Tests page 67

✓ To understand and check the correct behavior of a mirror module, see section 5 page 93

➾ Control a farm module

In the example, the module `farm` is configured on `node1` and `node2`.



- (1) Click on ••• to open the global menu of actions, applied .
- (2) Click on ▷ Start to start the module `node1` and `node2`.
- (3) Click on ••• to open the menu and run actions only on `node2`.
- Click on Debug to download module logs or snapshots from a single node, or from all nodes.

Refer to sections listed below:

✓ To continue the tests, see 4 Tests page 67

✓ To understand and check the correct behavior of a farm module, see section 6 page 105

3.4.3 Module details

You can display details for a module on one node:

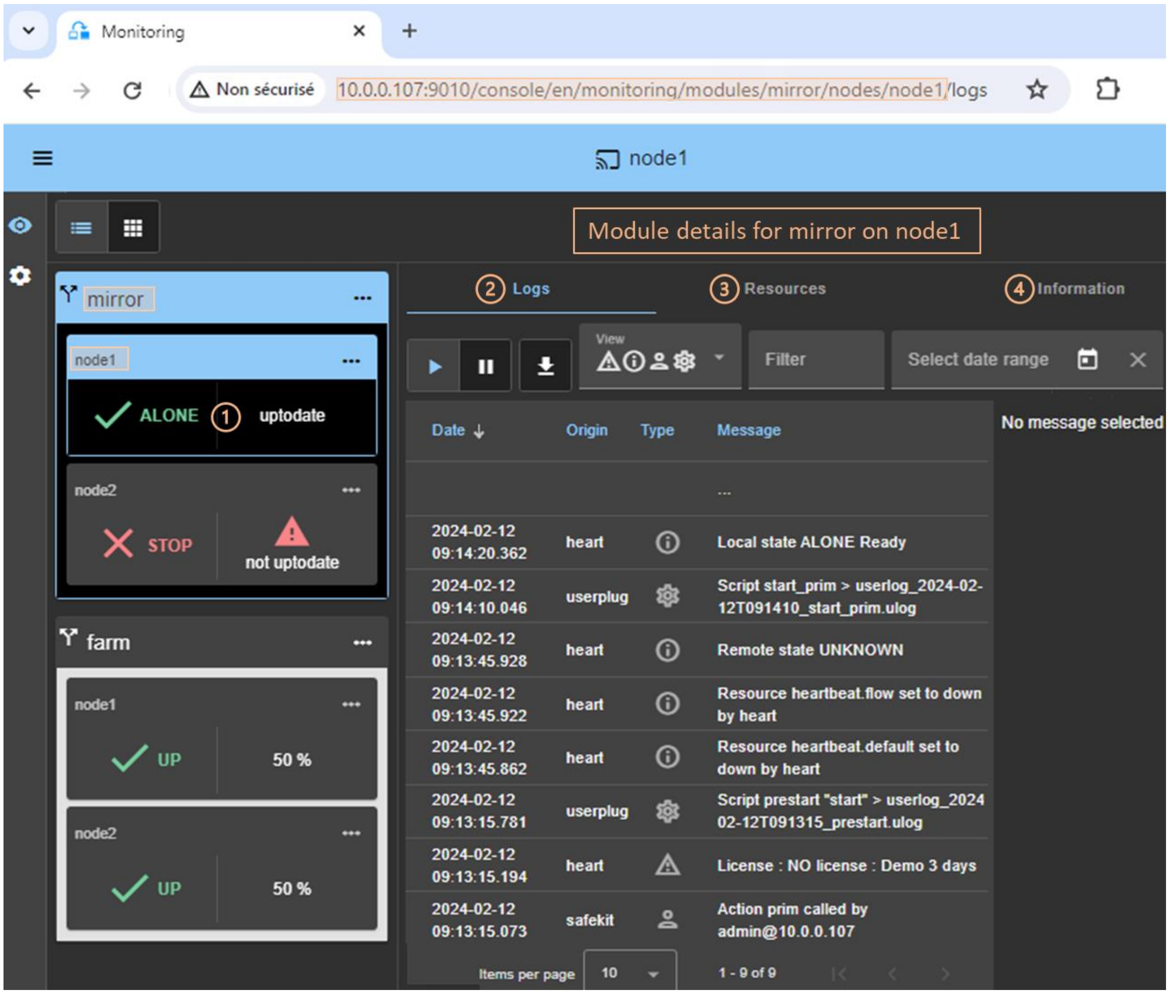
✓ Directly via the URL http://host:9010/console/en/monitoring/modules/AM/nodes/node (replace `node` by the node name and `AM` by the module name)

Or

✓ By navigating the console via Monitoring/Click on the module>node

The selected module>node is highlighted with a blue color.

In the example, the detail for the module `mirror` on `node1` is displayed.



Date	Origin	Type	Message
			...
2024-02-12 09:14:20.362	heart	ⓘ	Local state ALONE Ready
2024-02-12 09:14:10.046	userplug	⚙	Script start_prim > userlog_2024-02-12T091410_start_prim.ulog
2024-02-12 09:13:45.928	heart	ⓘ	Remote state UNKNOWN
2024-02-12 09:13:45.922	heart	ⓘ	Resource heartbeat.flow set to down by heart
2024-02-12 09:13:45.862	heart	ⓘ	Resource heartbeat.default set to down by heart
2024-02-12 09:13:15.781	userplug	⚙	Script prestart "start" > userlog_2024 02-12T091315_prestart.ulog
2024-02-12 09:13:15.194	heart	⚠	License : NO license : Demo 3 days
2024-02-12 09:13:15.073	safekit	👤	Action prim called by admin@10.0.0.107

- (1) Click on the node panel (`mirror>node1` in the example) to open details for the module on this node (logs, resources…).
- (2) Click on Logs tab to visualize the module logs.
- (3) Click on Resources tab to visualize the module resources.
- (4) Click on Information tab to visualize information on the node (SafeKit version and license…).

3.4.3.1 Module log and scripts log

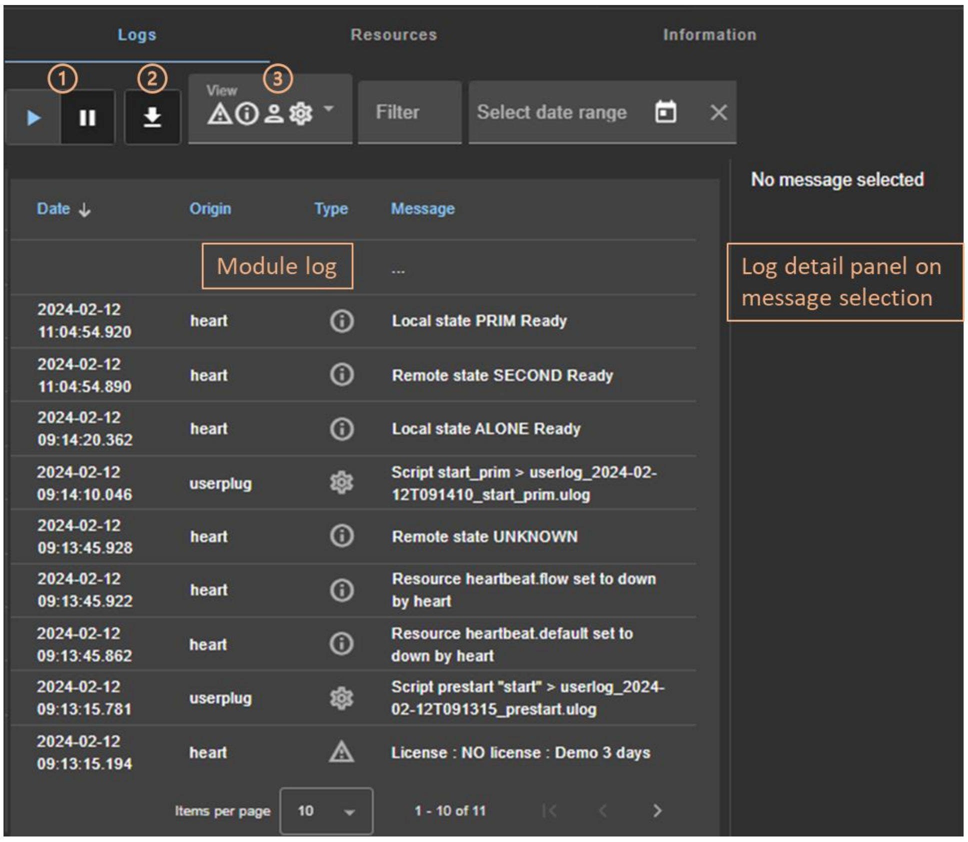
You can display logs of a module on one node:

✓ Directly via the URL http://host:9010/console/en/monitoring/modules/AM/nodes/node/logs (replace `node` by the node name and `AM` by the module name)

Or

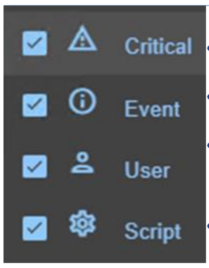
✓ By navigating the console via 👁 Monitoring/Click on the module>node/Logs tab

The left panel displays the non verbose module log for the selected module>node.



Date	Origin	Type	Message
			...
2024-02-12 11:04:54.920	heart	ⓘ	Local state PRIM Ready
2024-02-12 11:04:54.890	heart	ⓘ	Remote state SECOND Ready
2024-02-12 09:14:20.362	heart	ⓘ	Local state ALONE Ready
2024-02-12 09:14:10.046	userplug	⚙	Script start_prim > userlog_2024-02-12T091410_start_prim.ulog
2024-02-12 09:13:45.928	heart	ⓘ	Remote state UNKNOWN
2024-02-12 09:13:45.922	heart	ⓘ	Resource heartbeat.flow set to down by heart
2024-02-12 09:13:45.862	heart	ⓘ	Resource heartbeat.default set to down by heart
2024-02-12 09:13:15.781	userplug	⚙	Script prestart "start" > userlog_2024-02-12T091315_prestart.ulog
2024-02-12 09:13:15.194	heart	⚠	License : NO license : Demo 3 days

- (1) Click on ▶❚❚ to resume/suspend the view in real time of the module log.
- (2) Click on ⤓ to download the module log (verbose or not verbose).
- (3) Select the message type to view:



⇨ C(ritical) messages such as error detection

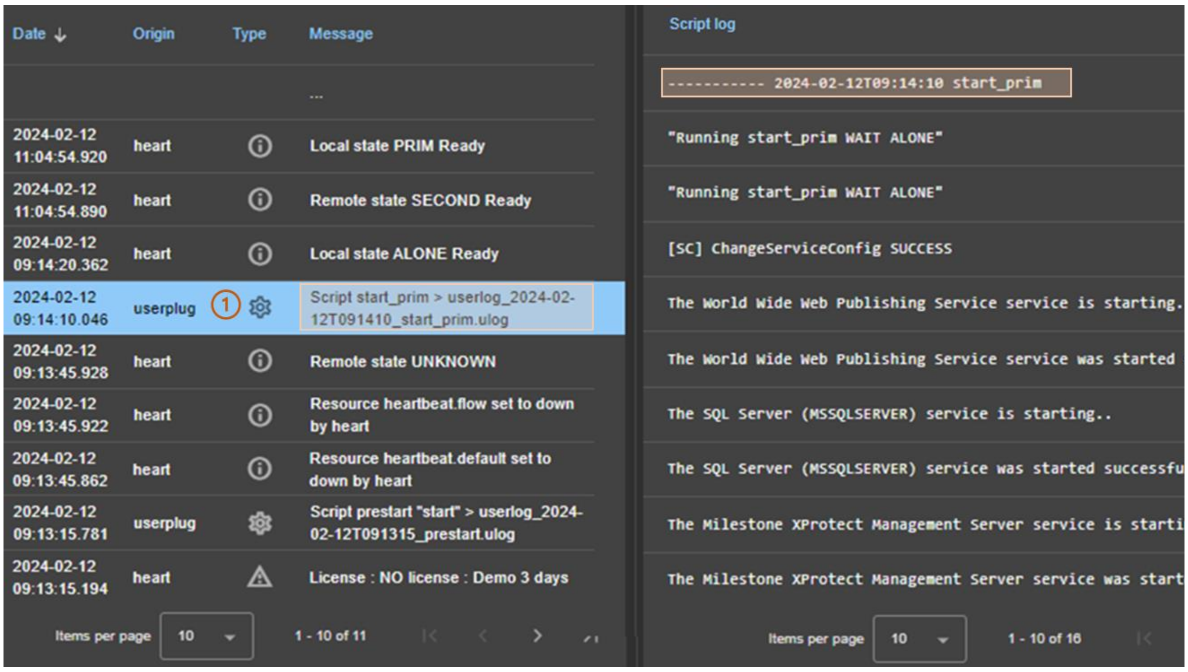
⇨ E(vent) messages such as local and remote states

⇨ U(ser) messages when the user run action on the module

⇨ S(cript) messages when module scripts are executed

- Click on a message to display the verbose module log or the script log (output of scripts) into the log detail into the right panel.

To display the script log, click on the ⚙S(cript) message whose output you want to view.



Date ↓	Origin	Type	Message
			...
2024-02-12 11:04:54.920	heart	ⓘ	Local state PRIM Ready
2024-02-12 11:04:54.890	heart	ⓘ	Remote state SECOND Ready
2024-02-12 09:14:20.362	heart	ⓘ	Local state ALONE Ready
2024-02-12 09:14:10.046	userplug	(1) ⚙	Script start_prim > userlog_2024-02-12T091410_start_prim.ulog
2024-02-12 09:13:45.928	heart	ⓘ	Remote state UNKNOWN
2024-02-12 09:13:45.922	heart	ⓘ	Resource heartbeat.flow set to down by heart
2024-02-12 09:13:45.862	heart	ⓘ	Resource heartbeat.default set to down by heart
2024-02-12 09:13:15.781	userplug	⚙	Script prestart "start" > userlog_2024-02-12T091315_prestart.ulog
2024-02-12 09:13:15.194	heart	⚠	License : NO license : Demo 3 days

Items per page 10 1 - 10 of 11

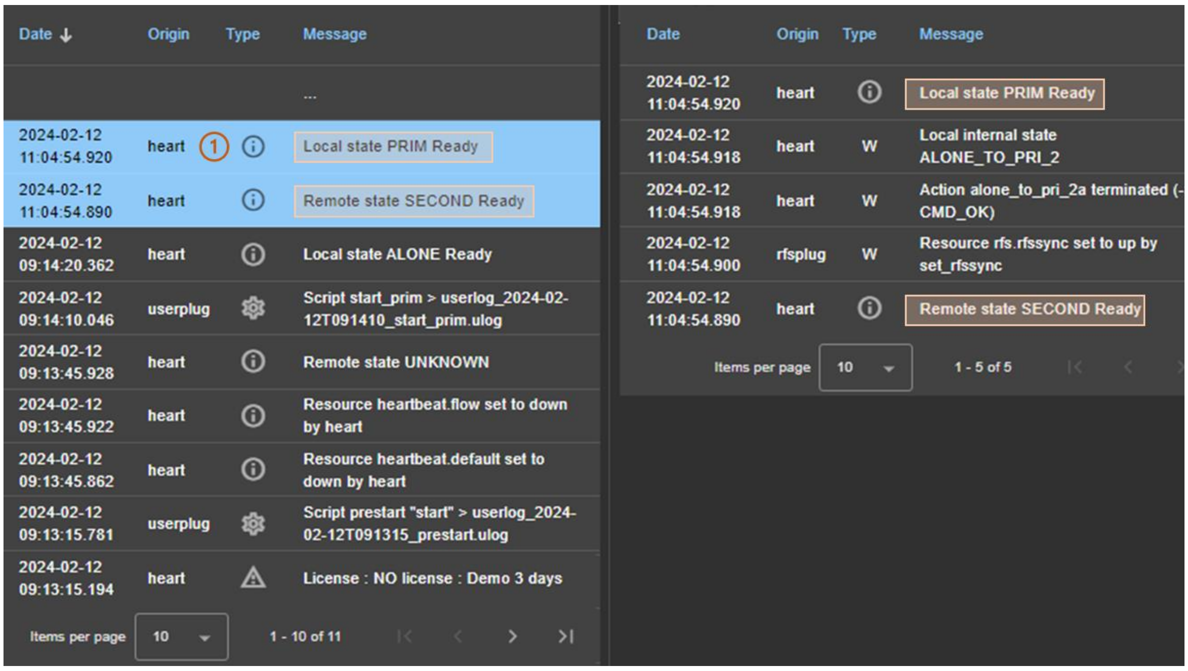
Script log

```
----------- 2024-02-12T09:14:10 start_prim
"Running start_prim WAIT ALONE"
"Running start_prim WAIT ALONE"
[SC] ChangeServiceConfig SUCCESS
The World Wide Web Publishing Service service is starting.
The World Wide Web Publishing Service service was started
The SQL Server (MSSQLSERVER) service is starting..
The SQL Server (MSSQLSERVER) service was started successfu
The Milestone XProtect Management Server service is starti
The Milestone XProtect Management Server service was start
```

Items per page 10 1 - 10 of 16

- (1) Click the ⚙S(cript) message consisting of:
  - ✓ the date and time of the execution of the script
  - ✓ the name of the script executed
  - ✓ the name of the name of the corresponding `userlog` file
- The `userlog` file content is displayed into the right panel. In the example, it is the content of the file `SAFEVAR/modules/AM/userlog_2024-02-12T091410_start_prim.ulog` (where `AM` is the module name)

To display the verbose module log, click on a message other than ⚙S(cript).



Date ↓	Origin	Type	Message
			...
2024-02-12 11:04:54.920	heart	(1) ⓘ	Local state PRIM Ready
2024-02-12 11:04:54.890	heart	ⓘ	Remote state SECOND Ready
2024-02-12 09:14:20.362	heart	ⓘ	Local state ALONE Ready
2024-02-12 09:14:10.046	userplug	⚙	Script start_prim > userlog_2024-02-12T091410_start_prim.ulog
2024-02-12 09:13:45.928	heart	ⓘ	Remote state UNKNOWN
2024-02-12 09:13:45.922	heart	ⓘ	Resource heartbeat.flow set to down by heart
2024-02-12 09:13:45.862	heart	ⓘ	Resource heartbeat.default set to down by heart
2024-02-12 09:13:15.781	userplug	⚙	Script prestart "start" > userlog_2024-02-12T091315_prestart.ulog
2024-02-12 09:13:15.194	heart	⚠	License : NO license : Demo 3 days

Items per page 10 1 - 10 of 11

Date	Origin	Type	Message
2024-02-12 11:04:54.920	heart	ⓘ	Local state PRIM Ready
2024-02-12 11:04:54.918	heart	W	Local internal state ALONE_TO_PRI_2
2024-02-12 11:04:54.918	heart	W	Action alone_to_pri_2a terminated (-CMD_OK)
2024-02-12 11:04:54.900	rfsplug	W	Resource rfs.rfssync set to up by set_rfssync
2024-02-12 11:04:54.890	heart	ⓘ	Remote state SECOND Ready

Items per page 10 1 - 5 of 5

- (1) Click the message consisting of:
  - ✓ the date and time of the event
  - ✓ the module message
- All verbose messages between the selected message and the previous one in the table are displayed in the right-hand panel.

Refer to section 7 page 109 for messages examples.

3.4.3.2 Module resources

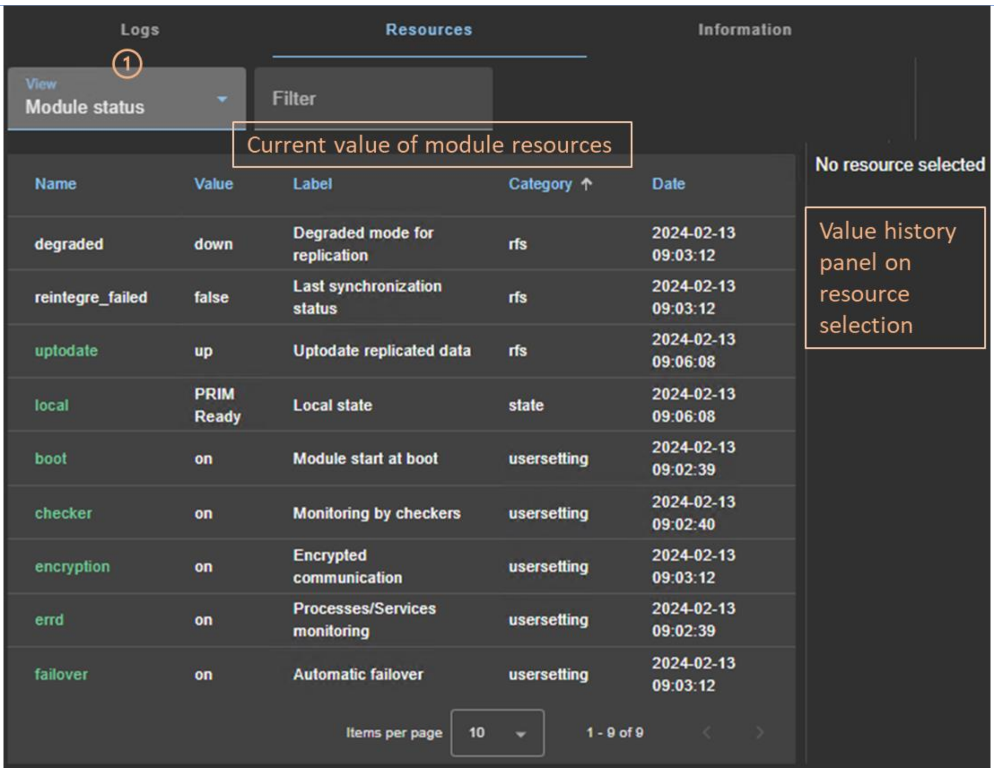
You can display resources of a module on one node:

✓ Directly via the URL http://host:9010/console/en/monitoring/modules/AM/nodes/node/resources (replace `node` by the node name and `AM` by the module name)

Or

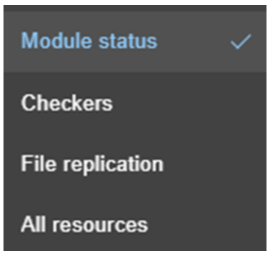
✓ By navigating the console via Monitoring/Click on the module>node/Resources tab

The left panel displays the current state of the resources for the selected module>node.



Name	Value	Label	Category	Date
degraded	down	Degraded mode for replication	rfs	2024-02-13 09:03:12
reintegre_failed	false	Last synchronization status	rfs	2024-02-13 09:03:12
uptodate	up	Uptodate replicated data	rfs	2024-02-13 09:06:08
local	PRIM Ready	Local state	state	2024-02-13 09:06:08
boot	on	Module start at boot	usersetting	2024-02-13 09:02:39
checker	on	Monitoring by checkers	usersetting	2024-02-13 09:02:40
encryption	on	Encrypted communication	usersetting	2024-02-13 09:03:12
errd	on	Processes/Services monitoring	usersetting	2024-02-13 09:02:39
failover	on	Automatic failover	usersetting	2024-02-13 09:03:12

- (1) Select the group of resources to view:



➾ Module status

Main resources, especially the ones of files replication for a mirror module

➾ Checkers

Ressources set by checkers

➾ File replication

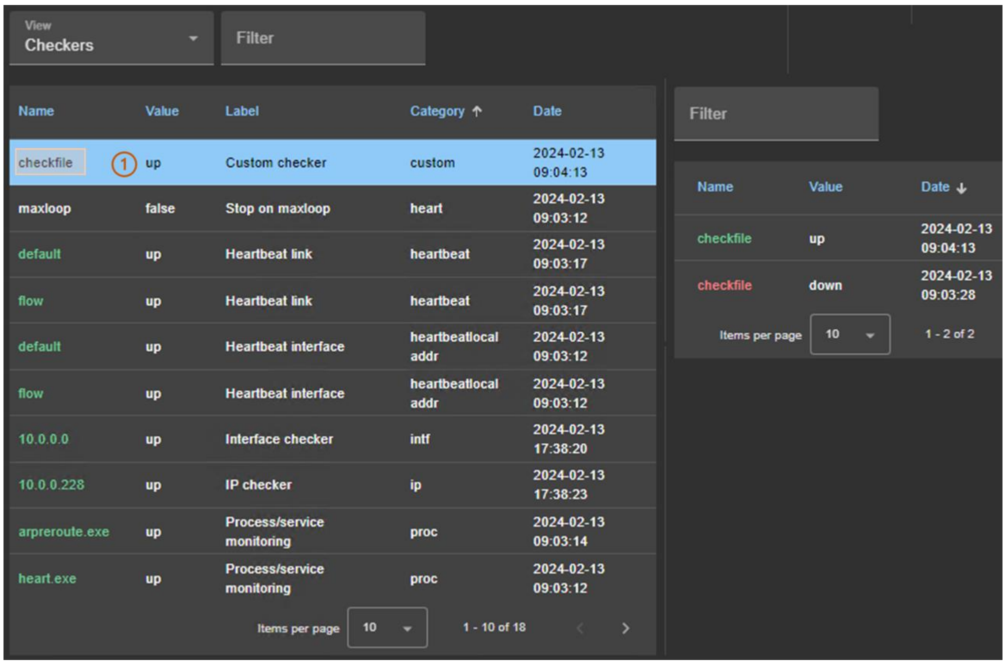
File replication-specific resources that demonstrate synchronization progress

➾ All resources

- Click on a resource to display its value over time in the right panel. This history may be empty for some resources (unassigned or cleaned).

Resource’s state is controlled by the failover machine to trigger a failover on failures (see section 13.18 page 261).

To display a resource's value history, click on the resource you're interested in.



Name	Value	Label	Category ↑	Date
checkfile	up	Custom checker	custom	2024-02-13 09:04:13
maxloop	false	Stop on maxloop	heart	2024-02-13 09:03:12
default	up	Heartbeat link	heartbeat	2024-02-13 09:03:17
flow	up	Heartbeat link	heartbeat	2024-02-13 09:03:17
default	up	Heartbeat interface	heartbeatlocaladdr	2024-02-13 09:03:12
flow	up	Heartbeat interface	heartbeatlocaladdr	2024-02-13 09:03:12
10.0.0.0	up	Interface checker	intf	2024-02-13 17:38:20
10.0.0.228	up	IP checker	ip	2024-02-13 17:38:23
arpreroute.exe	up	Process/service monitoring	proc	2024-02-13 09:03:14
heart.exe	up	Process/service monitoring	proc	2024-02-13 09:03:12

Items per page 10 1 - 10 of 18

Name	Value	Date ↓
checkfile	up	2024-02-13 09:04:13
checkfile	down	2024-02-13 09:03:28

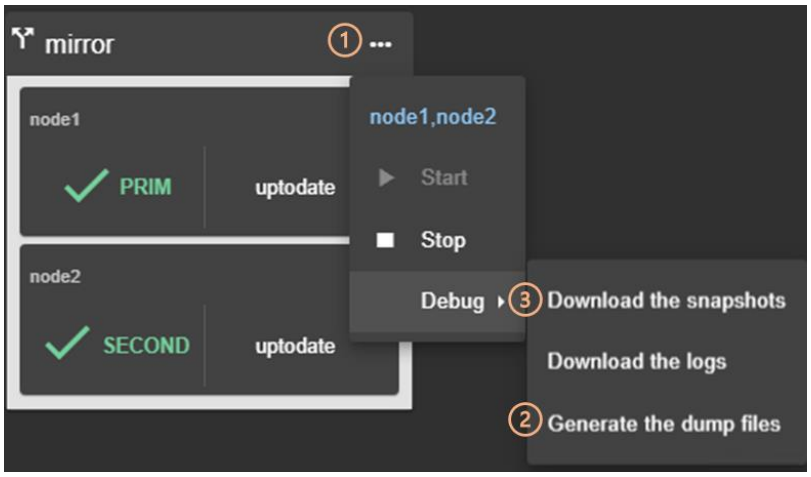
Items per page 10 1 - 2 of 2

- (1) Click on the line consisting of:
  - ✓ the last date the resource was assigned
  - ✓ the name and category of the resource. The full resource name is like `<category>.<name>` (`custom.checkfile` in the example).
- The history of resource values is displayed in the right panel. In the example, this is the `custom.checkfile` resource corresponding to a resource assigned by a custom checker.

3.5 Snapshots of module for support

When the problem is not easily identifiable, it is recommended to take a snapshot of the module on all nodes as described below. Snapshots allows an offline and in-depth analysis of the module and node status as described in section 7.16 page 123. If this analysis fails, send snapshots to support as described in section 8 page 131.

In the following example, the module `AM` is configured on `node1` and `node2`. Note that a snapshot can be downloaded in any state of the module.



- (1) Click on ••• to open the menu of global actions.
- (2) In case of file replication issues, it may be necessary to Generate the dump files at the time the problem occurs.

  The dump contains the module logs and information on the system and SafeKit state at the time of the dump. It is generated on the server side into `SAFEVAR/snapshot/modules/AM/dump_AAAA_MM_DD_hh_mm_ss`.
- (3) Click on Download the snapshots to create and download the snapshot of the module for each node.

  The web console relies on the web browser's download settings to save the snapshot on the workstation. Some browsers may ask confirmation to download many files and zip files.

  The snapshot generation command generates a new dump and creates a .zip file containing the last 3 dumps and the last 3 module configurations.

In this example, it downloads 2 snapshots : `snapshot_node1_AM.zip` and `snapshot_node2_AM.zip`.

3.6 Secure access to the web console

SafeKit offers different security policies for the web console that are implemented by modifying the SafeKit web service configuration. These configurations also offer role management:

Admin role ⚙👁	This role grants all administrative rights by allowing access to ⚙ Configuration and 👁 Monitoring in the navigation sidebar
Control role 👁	This role grants monitoring and control rights by allowing access only to 👁 Monitoring in the navigation sidebar
Monitor role 👁	This role grants only monitoring rights, prohibiting actions on modules (start, stop…) in 👁 Monitoring in the navigation sidebar.

SafeKit provides different setups for the web service to enhance the security of the SafeKit web console. The predefined setups are listed below from least secure to most secure:

- HTTP. Same role for all users without authentication

  This solution can only be implemented only in HTTP and is not compatible with user authentication methods. It is intended to be used for troubleshooting only.

- HTTP/HTTPS with user authentication based on Apache files and optional role management

  It relies on Apache files to store username/password for authenticating users and, optionally, to store the associated role for restricting their access. To connect to the console, the user must enter the username and password as configured with the Apache mechanisms.

  This is the default active configuration, applied for HTTP and initialized with a single `admin` user with the Admin role. The default setup can be extended to add users or to switch to HTTPS.

- HTTP/HTTPS with user authentication based on LDAP/AD authentication. Optional role management

  It relies on LDAP/AD authentication server to authenticate users and, optionally, restricts their access based on roles. To connect to the console, the user must enter the username and password as configured into the LDAP/AD server. It supports HTTP or HTTPS.

- HTTP/HTTPS with user authentication based on OpenId Connect authentication. Optional role management

  It relies on OpenID Identity Provider server to authenticate users and, optionally, restricts their access based on roles. To connect to the console, the user must enter the username and password as configured into the Identity Provider server. It supports HTTP or HTTPS.

To implement them, refer to the section 11 page 173.

4. Tests

Subsequently, analysis of test results may require consulting the module log, the scripts log (which contains the output of module scripts) and the state of module resources. To read these logs and resources, see section 7.3 page 114.

4.1 Installation and tests after boot

4.1.1 Test package installation

Package installation:

Replace below `node1` by the node name and `AM` by the module name.

- `safekit -p` executed on the nodes returns among other values, the value of `SAFE`, the SafeKit root installation path, and `SAFEVAR`, the SafeKit working directory:
  - ✓ in Windows

    `SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:
    `SAFEVAR=C:\safekit\var`
  - ✓ in Linux
    `SAFE=/opt/safekit`"

    `SAFEVAR=/var/safekit`

  For details, see section 10.1 page 153.
- Editing **`userconfig.xml`** of a mirror(/farm) module and its scripts **`start_prim/start_both`**, **`stop_prim/stop_both`** is made with:
  - ✓ the web console at /console/en/configuration/modules/AM/config
  - ✓ under the directory `SAFE/modules/AM` on the node1
- Module log and scripts log (that contains module scripts output) for the module on one node may be analyzed with :
  - ✓ the web console at /console/en/monitoring/nodes/node1/modules/AM/logs
  - ✓ the command executed on `node1`
    `safekit logview -m AM` for the module log
  - ✓ on `node1`, into `files SAFEVAR/modules/AM/userlog_<year>_<month>_<day>T<time>_<script name>.ulog` for the scripts logs (output messages of the scripts)

4.1.2 Test license and version

- `safekit level` returns

  ```
  Host : <hostname>
  OS : <OS version>
  SafeKit : <SafeKit version>
  License : Demo (No license)| Invalid Product | Invalid Host | … Expiration… | <license id> for
  <hostname>…
  or License : Expired license
  ```

- "Demo (No license)" means no `SAFE/conf/license.txt` file: the product stops every 3 days
- "Invalid Product" means an expired license in `SAFE/conf/license.txt`
- "Invalid Host" means no valid hostname in `SAFE/conf/license.txt`
- " …Expiration…" means a temporary key
- "<license id> for <hostname>" means a permanent license
- http://www.evidian.com/safekit/requestevalkey.php to get a temporary key of one month for any OS or any hostname
- https://support.evidian.com to get a permanent key based on the hostname and OS

4.1.3 Test SafeKit services and processes running after boot

See also section 9.2 page 141.

Test `safeadmin` service:

- ➪ The `safeadmin` process must appear in the list of running processes
- ➪ Without this process, no `safekit` command works and they all return:

  "Waiting for `safeadmin` ...."
  "Error: `safeadmin` administrator daemon not running"

- ➪ On Windows, `safeadmin` is a service and can be started in the Services interface of Windows
- ➪ on LINUX, `safeadmin` is started by *service `safeadmin` start* on Linux

Test `safewebserver` service:

- ➪ `safekit boot webstatus` displays start-up or not of `safewebserver` service at boot ("on" or "off", "on" by default)
- ➪ httpd processes must be in the list of running processes if boot "on"
- ➪ without these processes, the web console is not able to connect to servers as well <module> checkers (`userconfig.xml`) and distributed command line interface
- ➪ to start/stop the `safewebserver` service, run: `safekit webserver start|stop`

Test `safeagent` service (Windows only):

- ➪ `safekit boot snmpstatus` displays start-up or not of `safeagent` service at boot ("on" or "off", "off" by default)
- ➪ `safeagent` process must be in the list of running processes if boot "on"
- ➪ to start/stop the `safeagent` service, run: `safekit safeagent start|stop`

Test modules:

- ➪ `safekit boot status` displays start-up ("on") or not ("off") of modules at boot
- ➪ `safekit state` displays state of all configured modules: `STOP` (mirror or farm), `WAIT` (mirror or farm), `ALONE` (mirror), `PRIM` (mirror), `SECOND` (mirror), `UP` (farm)
- ➪ check processes of a module: see section 10.2 page 155
- ➪ `safekit module listid` displays name of installed modules with their ids: id of a module must be the same on all servers
- ➪ go to `SAFE/modules/AM/conf` (replace AM by the module name); `userconfig.xml` file gives the module type, mirror, or farm: <service mode="mirror"> or <service mode="farm">

4.1.4 Test start of SafeKit web console

- connect a web browser to http://<server IP>:9010
- the web console home page is displayed

4.2 Tests of a mirror module

4.2.1 Test start of a mirror module on 2 servers ✗ `STOP (NotReady)`

- message in the logs of both servers (to read logs, see section 7.3 page 114)

  "Action start called by web@<IP>/SYSTEM/root"

- the module goes to the stable state ✓ `PRIM (Ready)` and ✓ `SECOND (Ready)` on both servers with in the first log

  "Remote state `SECOND` Ready"
  "Local state `PRIM` Ready "

- and in the other log

  "Local state `SECOND` Ready "
  "Remote state `PRIM` Ready "

- application is started in the `start_prim` script of the module on the `PRIM` server with message in the log

  "Script `start_prim`"

4.2.2 Test stop of a mirror module on the server ✓ `PRIM (Ready)`

- message in the log of the stopped node (to read logs, see section 7.3 page 114)

  "Action stop called by web@<IP>/SYSTEM/root"

- the stopped node runs the stop_prim script of the module which stops the application on the server with message in the log:

  "Script stop_prim"

- the module becomes ✗ `STOP (NotReady)` with messages in the log:

  "End of stop"

  "Local state `STOP` NotReady"

- the module becomes ✓ `ALONE (Ready)` on the other node with the message in the log:

  "Reason of failover: remote stop"

- the application is started with the `start_prim` script on the `ALONE` node with the message in the log:

  "Script `start_prim`"

4.2.3 Test start of a mirror module on the server ✗`STOP (NotReady)`

- ➩ message in the log of the started module (to read logs, see section 7.3 page 114)

  "Action start called by web@<IP>/SYSTEM/root"
- ➩ the ✗`STOP (NotReady)` module becomes ✓`SECOND (Ready)`
- ➩ the module ✓`ALONE (Ready)` on the other server becomes ✓`PRIM (Ready)` and continues to execute the application

4.2.4 Test restart of a mirror module on the server ✓`PRIM (Ready)`

- ➩ message in the log of the server where the restart command is passed (to read logs, see section 7.3 page 114)

  "Action restart called by web@<IP>/SYSTEM/root"
- ➩ the `PRIM` module becomes ⟲`PRIM (Transient)` and then becomes ✓`PRIM (Ready)`
- ➩ the scripts of the module `stop_prim/start_prim` are executed on the `PRIM` module and restarts locally the application on the server with messages in the log:

  "Script `stop_prim`"
  "Script `start_prim`"
- ➩ the other module on the other server stays ✓`SECOND (Ready)`

4.2.5 Test swap of a mirror module from one server to the other

- ➩ message in the log of the server where the `swap` command is passed (to read logs, see section 7.3 page 114)

  "Action swap called by web@<IP>/SYSTEM/root"

  "Transition SWAP from SYSTEM"

  "Begin of Swap"
- ➩ And in the log of the other server, only:

  "Begin of Swap"
- ➩ reversing the roles of `PRIM` and `SECOND` between both servers
- ➩ the stop_prim script is first executed on the former `PRIM` within its log:

  "Script stop_prim"
- ➩ then the `start_prim` script is executed on the new `PRIM` server within its log:

  "Script `start_prim`"
- ➩ at the end of `swap`, module ✓`PRIM (Ready)` and module ✓`SECOND (Ready)` are reversed on both servers and the application is on the new `PRIM` server

4.2.6 Test virtual IP address of a mirror module

Mirror module in the state ✓`PRIM (Ready)` on server node1 and ✓`SECOND (Ready)` on server node2.

`userconfig.xml`:

```
<vip>
 <interface_list>
 <interface arpreroute="on">
 <real_interface>
   <virtual_addr addr="ipvirt"
              where="one_side_alias"/>
  </real_interface>
  </interface>
 </interface_list>
</vip>
```

1. On an external workstation (or server) in the same LAN, ping both physical IP addresses + virtual IP address:

   ```
   ping node1_ip_address
   ping node2_ip_address
   ping ipvirt
   arp –a
   ```

2. `safekit swap –v AM` on the primary server (where AM is the module name)

3. On the external workstation (or server),

   ```
   ping node1_ip_address
   ping node2_ip_address
   ping ipvirt
   arp –a
   ```

   Note: redo the ping to virtip before looking at the ARP table because the entry may be marked obsolete and refreshes only after ping

1. On server node1, `ipconfig` or `ifconfig` (or `ip addr show`) returns ipvirt as an alias on the network interface.

   On the external workstation (or server), the 3 pings respond

   On the external workstation (or server) in the same LAN, virtip is mapped to the same MAC address as node1_ip_address

   ```
   arp –a
   node1_ip_address       00-0c-29-0a-5c-fc
   node2_ip_address       00-0c-29-26-44-93
   ipvirt      00-0c-29-0a-5c-fc
   ```

2. After the `swap`, ✓`SECOND (Ready)` on node1 server and ✓`PRIM (Ready)` on node2 server

   In the log of new primary, message:

   "Virtual IP <ipvirt of mirror> set"

3. On node2, `ipconfig` or `ifconfig` (or `ip addr show`) returns ipvirt as an alias on the network interface

   On the external workstation (or server), the 3 pings respond

   On the external workstation (or server), virtip is mapped to the same MAC address as node2_ip_address

   ```
   arp –a
   node1_ip_address       00-0c-29-0a-5c-fc
   node2_ip_address       00-0c-29-26-44-93
   ipvirt      00-0c-29-26-44-93
   ```

4.2.7 Test file replication of a mirror module

Mirror module in the state ✓`PRIM (Ready)` on node1 server and ✓`SECOND (Ready)` on node2 server.
`userconfig.xml:`
`<rfs>`
`<replicated dir="C:\replicated" mode="read_only" />`
`(or "/replicated" on Linux)`
`</rfs>`
1. On the server ✓`PRIM (Ready)`, go to /replicated and create a file file1.txt
2. On the server ✓`SECOND (Ready)`, go to /replicated and try to delete file1.txt
3. Stop the server ✓`PRIM (Ready)` and wait for ✗`STOP (NotReady)`. Then go to the other server which is ✓`ALONE (Ready)` and create a new file file2.txt
4. Restart the server ✗`STOP (NotReady)` and wait for ✓`SECOND (Ready)`.
	1. file1.txt has been replicated on ✓`SECOND (Ready)` under /replicated
	2. Failure because the /replicated directory is read-only on the server ✓`SECOND (Ready)`
	3. file2.txt is not replicated in /replicated of the server ✗`STOP (NotReady)`
	4. file2.txt is reintegrated on the restarted server. During the phase of reintegration, the server is ↻`SECOND (Transient)`
	
	In the log of reintegrated server, message
	"Updating directory tree from /replicated"
	And at the end of /replicated reintegration, if at least 1 file with modified data has been reintegrated from primary server to secondary server, message
	"Copied <reintegration statistics>"
	"Reintegration ended (synchronize)"
	This message gives statistics for the reintegrated directory: reintegrated size, number of files, time, and throughput on the network in KB/sec.
	
	Note: reintegrate a file larger than 100 MB to have reliable statistics
	
	At the end of reintegration, the server is ✓`SECOND (Ready)`

4.2.8 Test mirror module shutdown on the server ✓`PRIM (Ready)`

- on Windows, check that the special procedure to stop modules at shutdown has been applied.
- make a shutdown of ✓`PRIM (Ready)` server
- check in the log of server ✓`SECOND (Ready)`, message

  "Reason of failover: remote stop"
- the server ✓`SECOND (Ready)` becomes ✓`ALONE (Ready)`; application in the `start_prim` script of the module is restarted on the `ALONE` server with the message in the log

  "Script `start_prim`"
- on timeout in the SafeKit console, the old server ✓`PRIM (Ready)` becomes grey
- after reboot of the stopped server, check that the OS shutdown has really called a shutdown of the module

  "Action shutdown called by SYSTEM"
- Check that the application `stop_prim` script has been executed with the message

  "Script stop_prim"
- And check that the module has been completely stopped before shutting down the server with the last message

  "End of stop"
- after reboot of stopped server, if the module is started automatically at boot (`safekit boot status`), message in the log

  "Action start called at boot time"
- after a start of the module on the stopped server, the module becomes ✓`SECOND (Ready)` on this server and ✓`PRIM (Ready)` on the other server

4.2.9 Test mirror module power-off on the server ✓`PRIM (Ready)`

`userconfig.xml`:

```
<heart>
 <heartbeat name="default" />
 <heartbeat ident="flow" />
</heart>
```

Note: If you want to make a test with double simultaneous electrical fault on both servers, check that `<rfs async="none">` is set in `userconfig.xml`. For more information, see section 1.3.6 page 18

- in the log of the server ✓`SECOND (Ready)`, message for all heartbeats configured in `userconfig.xml`

  "Resource heartbeat.default set to down by heart"
  "Resource heartbeat.flow set to down by heart"
  "Remote state UNKNOWN grey"
  "Reason of failover: no heartbeat"

- messages appear within 30 seconds after the power-off (if no specified timeout configured for <heart> in `userconfig.xml`)
- the server ✓`SECOND (Ready)` becomes ✓`ALONE (Ready)`; the application in the `start_prim` script of the module is restarted on the `ALONE` server with the message in its log

  "Script `start_prim`"

- on timeout in the SafeKit console, the former server ✓`PRIM (Ready)` becomes grey
- after reboot of stopped server, if the module is started automatically at boot (`safekit boot status`), message in the log

  "Action start called at boot time"

- after reboot, message in the log:

  "Previous halt unexpected"

- after restart of the module on the stopped server, the module becomes ✓`SECOND (Ready)` on this server and ✓`PRIM (Ready)` on the other server

4.2.10 Test split brain with a mirror module

Split brain occurs in situation of network isolation between two SafeKit servers. Each server becomes primary `ALONE` and runs the application. At return of split brain, a sacrifice must be made by shutting down the application on one of the two servers.

Mirror module in the state ✓ `PRIM (Ready)` and ✓ `SECOND (Ready)`

`userconfig.xml`:

```
<heart>
 <heartbeat name="default" />
 <heartbeat name="repli" ident="flow"
/>
</heart>
```

+

on Windows to manage the IP conflict on the virtual IP address virtip

```
<vip>
 <interface_list>
  <interface check="on"
arpreroute="on">
   <real_interface>
    <virtual_addr addr="192.168.1.10"
       where="one_side_alias"/>
   </real_interface>
  </interface>
 </interface_list>
</vip>
```

To obtain the split brain, check that there are no checkers in `userconfig.xml` that can detect the network isolation: no `<interface check="on">`, no <ping> checker

1. disconnect all heartbeat networks at the same time (network default and repli)
2. reconnect networks

- after network isolation of both servers, all heartbeats are lost. In the logs of both servers,

  "Resource heartbeat.default set to down by heart"
  "Resource heartbeat.flow set to down by heart"
  "Remote state UNKNOWN grey"
  "Local state `ALONE` Ready "

- split brain case: both servers are ✓ `ALONE (Ready)` and run the application started in `start_prim`
- when reconnecting heartbeat networks, sacrifice of one `ALONE` server: the former `SECOND` server
- log of the former `PRIM` not sacrificed:

  "Remote state `ALONE` Ready"
  "Split brain recovery: staying alone"

- log of the former `SECOND` sacrificed:

  "Remote state `ALONE` Ready"
  "Split brain recovery: exiting alone"
  "Script stop_prim"

  The server performs a stopstart: stop of the application with stop_prim then reintegration of replicated files from the other server

- come back to the stable state ✓ `PRIM (Ready)` and ✓ `SECOND (Ready)` on both servers as it was before split brain

Note: situation of split brain in a mirror module with file replication is not good. Indeed, the sacrifice of the former secondary server causes file reintegration of this server from the primary one and the loss of data stored on the secondary during the split-brain situation.

For this reason, 2 heartbeats on two physically separate networks are recommended. Typically, a cable between the two servers will allow (1) to avoid split brain with an additional heartbeat network and (2) set the replication flow on a separate network

4.2.11 Continue your mirror module tests with checkers

Go to section 4.4 page 84 for tests of checkers.

4.3 Tests of a farm module

4.3.1 Test start of a farm module on all servers ✗`STOP (NotReady)`

- ⇨ message in the logs of all servers (to read logs, see section 7.3 page 114)

  "Action start called by web@<IP>/SYSTEM/root"
- ⇨ the module goes to ✓`UP (Ready)` on all servers
- ⇨ the application is started in the `start_both` script of the module on all servers with the message in the log

  "Script `start_both`"

4.3.2 Test stop of a farm module on one server ✓`UP (Ready)`

- ⇨ message in the log of the stopped server (to read logs, see section 7.3 page 114)

  "Action stop called by web@<IP>/SYSTEM/root"
- ⇨ the stopped module runs the `stop_both` script which stops the application on the server and with message in the log

  "Script `stop_both`"
- ⇨ the stopped module becomes ✗`STOP (NotReady)` with messages in the log:

  "End of stop"

  "Local state `STOP NotReady`"
- ⇨ the other servers stay ✓`UP (Ready)` and continue to run the application
- ⇨ restart the module ✗`STOP (NotReady)` with the start command

4.3.3 Test restart of a farm module on one server ✓`UP (Ready)`

- ⇨ message in the log of the module where the restart command is passed (to read logs, see section 7.3 page 114)

  "Action restart called by web@<IP>/SYSTEM/root"
- ⇨ the restarted module becomes ↻`UP (Transient)` then becomes ✓`UP (Ready)`
- ⇨ the module scripts `stop_both`/`start_both` are executed on the server and restart locally the application with messages in the log

  "Script `stop_both`"
  "Script `start_both`"

4.3.4 Test virtual IP address of a farm module

4.3.4.1 Configuration with vmac_invisible

Farm module in the ✓ `UP (Ready)` state on 2 servers node1 and node2

`userconfig.xml` with load balancing on the `safewebserver` service (TCP port 9010):

```
<farm>
<lan name="default" />
</farm>

<vip>
 <interface_list>
  <interface>
  <virtual_interface
type="vmac_invisible" >
    <virtual_addr
addr="virtip" where="alias"/>
  </virtual_interface>
  </interface>
 </interface_list>

<loadbalancing_list>
<group name="FarmProto">
  <rule port="9010"
proto="tcp" filter="on_port"/>
</group>
</loadbalancing_list>
</vip>
```

On a remote workstation (or server) in the same LAN, ping of the 2 physical IP addresses + virtual IP + arp –a

➾ In the log of all servers:

"Vitual IP <virtip of farm> set"

➾ On the 2 servers, `ipconfig` or `ifconfig` (or `ip addr show`) returns virtip as an alias on the network interface

➾ On a remote workstation (or server), the pings respond. And virtip is mapped with the invisible virtual MAC address:

```
ping node1_ip_address; ping node2_ip_address ; ping
virtip; arp –a
node1_ip_address        00-0c-29-0a-5c-fc
node2_ip_address        00-0c-29-26-44-93
virtip        5a-fe-c0-a8-38-14
```

➾ Note: by default, the virtual MAC address is a unicast Ethernet address built with 5A:FE (SAFE) and the virtual IP address in hexadecimal

4.3.4.2 Configuration with vmac_directed

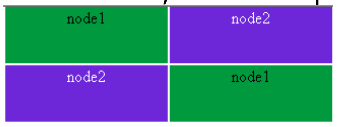
Farm module in the ✓`UP (Ready)` state on 2 servers node1 and node2
 	
`userconfig.xml` with load balancing on the `safewebserver` service (TCP port 9010):
```
<farm>
<lan name=”default” />
</farm>

<vip>
 <interface_list>
  <interface arpreroute=”on”>
  <virtual_interface
type="vmac_directed" >
    <virtual_addr
addr="virtip" where="alias"/>
  </virtual_interface>
  </interface>
 </interface_list>

<loadbalancing_list>
<group name="FarmProto">
  <rule port="9010"
proto="tcp" filter="on_port"/>
</group>
</loadbalancing_list>
</vip>
```
On a remote workstation (or server) in the same LAN, ping of the 2 physical IP addresses + virtual IP + arp –a
	⇨ In the log of all servers:
	"Vitual IP <virtip of farm> set"
	
	⇨ On the 2 servers, `ipconfig` or `ifconfig` (or `ip addr show`) returns virtip as an alias on the network interface
	
	⇨ On a remote workstation (or server), the pings respond, and ip1.20 is mapped with the MAC address of one of the 2 servers:
	```
	ping node1_ip_address; ping node2_ip_address; ping
	virtip; arp –a
	node1_ip_address        00-0c-29-0a-5c-fc
	node2_ip_address        00-0c-29-26-44-93
	virtip      00-0c-29-26-44-93
	```

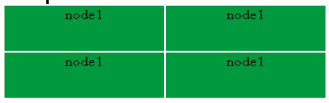
4.3.5 Test TCP load balancing on a virtual IP address

Farm module in the state ✓`UP (Ready)` on the 2 servers node1, node2.

Same load balancing configuration in `userconfig.xml` as the previous test.

On a remote workstation:

1. Connect a browser to http://virtip:9010/safekit/mosaic.html, then click on Mosaic Test. node1, node2 respond


2. `safekit stop -m AM` on node2 (where AM is the module name). Reload the URL: node1 responds


Special command to check the load balancing bitmap for port 9010 on each node ✓`UP (Ready)`:

⇨ `safekit -r vip_if_ctrl -l`

An entry in the bitmap of 256 bits must be 1 on a single server.

Furthermore, the 256 bits are fairly distributed in the bitmaps of all servers ✓`UP (Ready)` (if no definition of power inside `userconfig.xml`)

⇨ ✓`UP (Ready)` on the 2 servers: load balancing of TCP sessions between node1, node2 when loading the URL

In the resources of the module, for node1 and node2: FarmProto 50%

Example of logs with node1 and node2:

In the logs of node1 and node2:

"farm membership: **node1 node2** (group FarmProto)"
"farm load: **128/256** (group FarmProto)"

128/256: 128 bits on 256 are managed by each server

`safekit -r vip_if_ctrl -l` on node1 and node2:

```
Bitmap 1:00000000:00000000:00000000:00000000:
ffffffff:ffffffff:ffffffff:ffffffff
Bitmap 2:ffffffff:ffffffff:ffffffff:ffffffff:
00000000:00000000:00000000:0000000
```

Bits are fairly distributed between both servers

⇨ ✗`STOP (NotReady)` on node2: TCP sessions served only by node1 when loading the URL

In the log of node1:

"farm membership: **node1** (group FarmProto)"
"farm load: **256/256** (group FarmProto)"

256/256: all the bits are managed by node1

`safekit -r vip_if_ctrl -l` on node1:

```
Bitmap 1:ffffffff:ffffffff:ffffffff:ffffffff:
ffffffff:ffffffff:ffffffff:ffffffff
```

All the bits are managed by node 1

4.3.6 Test split brain with a farm module

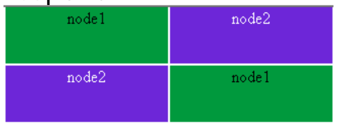
Split brain occurs in case of network isolation between SafeKit servers.

Farm module is ✓`UP (Ready)` on the servers node1 and node2.

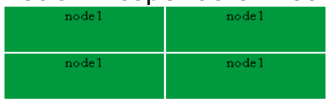
Same configuration of load balancing in `userconfig.xml` as the previous test. To get the split brain, check in `userconfig.xml` that there are no checkers that can detect isolation: no `<interface check="on">` or `<ping>` checker

On the external workstation:

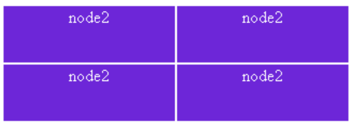
1. Connect a browser to http://virtip:9010/safekit/mosaic.html, then click on Mosaic Test. node1 and node2 respond



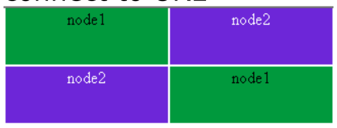
2. disconnect the network between node1 and node2. Depending on the location where the external console is, node 1 responds or node 2



or



3. reconnect the network and connect to URL



Same special command as in the previous test to check the load balancing bitmap for port 9010 on each node ✓`UP (Ready)`

➾ before split brain, state ✓`UP (Ready)` on node1 and node2:

In the resources of the module, for node1 and node2: FarmProto 50%.

In the logs of node1 and node2:

"farm membership: **node1 node2** (group FarmProto)"
"farm load: **128/256** (group FarmProto)"

128/256: 128 bits on 256 are managed by each server

`safekit -r vip_if_ctrl -l` on node1 and node2:

```
Bitmap 1:00000000:00000000:00000000:00000000:
ffffffff:ffffffff:ffffffff:ffffffff
Bitmap 2:ffffffff:ffffffff:ffffffff:ffffffff:
00000000:00000000:00000000:0000000
```

Bits are fairly distributed between both servers

➾ after isolation of servers, split brain:

In the resources of the module, for node1 and node2: FarmProto 100%.

In the log of node1:

"farm membership: **node1** (group FarmProto)"
"farm load: **256/256** (group FarmProto)"

256/256: all the bits are managed by node 1

`safekit -r vip_if_ctrl -l` on node1:

```
Bitmap 1:ffffffff:ffffffff:ffffffff:ffffffff:
ffffffff:ffffffff:ffffffff:ffffffff
```

in the log of node 2:

"farm membership: **node2** (group FarmProto)"
"farm load: **256/256** (group FarmProto)"

256/256: all the bits are managed by node 2

```
Bitmap 2:ffffffff:ffffffff:ffffffff:ffffffff:
         ffffffff:ffffffff:ffffffff:ffffffff
```

➾ after split brain when network is reconnected between ip1.1 and ip1.2, the same messages can be found in the log and the same bitmaps as those before split brain

Note: the default behavior of farm in situation of split brain is good. The recommendation is to put in `userconfig.xml` a monitoring network <lan></lan> where the virtual IP address is.

Note: In vmac_directed mode, the log messages and vip_if_ctrl output are different.

4.3.7 Test compatibility of the network with invisible MAC address (vmac_invisible)

4.3.7.1 Network prerequisite

A unicast MAC Ethernet address 5a-fe-xx-xx-xx-xx is associated with the virtual IP address of a farm module. It is never presented by SafeKit servers as source Ethernet address (invisible MAC). Switches cannot locate this address. When they follow a packet to the destination MAC address 5a-fe-xx-xx-xx-xx, they must broadcast the packet on all ports of the LAN or VLAN where the virtual IP address is (flooding). All servers in the farm therefore receive packets destined to the virtual MAC address 5a-fe-xx-xx-xx-xx.

Note that this prerequisite does not exist for a mirror module: see section 4.2.6 page 72

4.3.7.2 Server prerequisite

The packets are captured by Ethernet cards set in promiscuous mode by SafeKit. And the packets are filtered by the module kernel <vip> according to the load balancing bitmap. To make a test, you need network monitor tool.

Network monitoring on Windows 2003 (CD2):

- install "Network Monitor Tools" in "Management and Monitoring Tools" (capture only packets in source or destination of the server)
- Start / Network Monitor then Capture Filter / Address Pairs / virtip then Capture / Start then "Stop and View" at the end of capture

Network monitoring on Linux:

- tcpdump host virtip: capture all network packets
- all servers are ✓`UP (Ready)`
- the network monitoring is started on each server with a filter on virtip
- an external workstation sends a single ping to the virtual IP address with ping –n (or –c) 1 virtip
- result: 1 packet "ICMP: Echo: From ipconsole To virtip" sent and received by all servers
- result: there must be as many packets "ICMP: Echo Reply: To ipconsole From virtip" as there are servers ✓`UP (Ready)`
- if it is not the case, check if options restrict the "port flooding" in switches and prevent the broadcast of "ICMP: Echo" to all servers
- be careful: the "port flooding" restriction in switches can occur after a certain number of flooding (time, number of KB flooded): the ping test must be repeated during several hours by creating flooding to the virtual IP address
- Note: to avoid network monitoring tools, an external Linux console can be used. The Linux ping prints duplicate packets coming from the 2 servers ✓`UP (Ready)`:

```
ping virtip
64 bytes from ip1.20 icmp_seq=1
64 bytes from ip1.20 icmp_seq=1 (DUP!)
64 bytes from ip1.20 icmp_seq=2
64 bytes from ip1.20 icmp_seq=2 (DUP!)...
```

This test may be carried out for several hours by storing the output of the ping in a file and then ensuring that there was (DUP!) all the time: `date > /tmp/ping.txt ; ping virtip >> /tmp/ping.txt`

4.3.8 Test farm module shutdown of a server ✓`UP (Ready)`

- ➪ on Windows, check that the special procedure to stop modules at shutdown has been performed
- ➪ make a shutdown of a ✓`UP (Ready)` server
- ➪ the other servers stay ✓`UP (Ready)` and continue to run the application
- ➪ on timeout in the SafeKit console, the former server ✓`UP (Ready)` becomes grey
- ➪ after reboot, check that shutdown of the OS has called a shutdown of the module

  "Action shutdown called by SYSTEM"
- ➪ Check that the `stop_both` script which stops the application has been executed with the message

  "Script `stop_both`"
- ➪ And check that the module has been completely stopped before stopping the server with the last message

  "End of stop"
- ➪ after reboot of the stopped server, if the module is started automatically at boot (`safekit boot status`), message in the log

  "Action start called at boot time"
- ➪ after start-up of the module on the stopped server, the module becomes ✓`UP (Ready)` and it executes the `start_both` script which restarts the application on this server with the message in the log

  "Script `start_both`"

4.3.9 Test farm module power-off of a server ✓`UP (Ready)`

- ➪ the other servers stay ✓`UP (Ready)` and continue to run the application
- ➪ on timeout in the SafeKit console, the former server ✓`UP (Ready)` becomes grey
- ➪ after reboot of the stopped server, if the module is started automatically at boot (`safekit boot status`), message in the log

  "Action start called at boot time"
- ➪ after reboot, message in the log

  "Previous halt unexpected"
- ➪ after start-up of the module on the stopped server, the module becomes ✓`UP (Ready)` and it executes the `start_both` script which restarts the application on this server with the message in the log

  "Script `start_both`"

4.3.10 Continue your farm module tests with checkers

Go to section 4.4 page 84 for tests of checkers.

4.4 Tests of checkers common to mirror and farm

4.4.1 Test <errd>: checker of process with action restart or stopstart

In `userconfig.xml`:

```
<errd>
<proc name="appli.exe" atleast="1"

action="restart "

class="prim "/>
</errd>
```

- `name="appli.exe" atleast="1"`: at least one process "appli.exe" must run
- `class="prim"` (mirror module case): checker started on the server in state ✓ `PRIM` or `ALONE (Ready)`, after `start_prim` script (stopped before `stop_prim`)
- `class="both"` (farm module case): checker started on all servers ✓ `UP (Ready)` after `start_both` script (stopped before `stop_both`)
- `action="restart"`: if `appli.exe` is not running, action `restart` which applies only scripts `stop_xx; start_xx`
- `action="stopstart"`: if `appli.exe` is not running, action `stopstart` which stops completely the module and then restarts it

Kill of process `appli.exe` on the server in ✓ `(Ready)` state. That is in states `PRIM` or `ALONE` for a mirror module, `UP` for a farm module:

- messages in the log:

  "Process appli.exe not running"
  "Action restart|stopstart called by errd"
- the module becomes ↻ `(Transient)`, respectively in state `PRIM`, `ALONE` or `UP`
- in the restart case, the module becomes ✓ `(Ready)`, respectively in state `PRIM`, `ALONE` or `UP`
- in the stopstart case, the module becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE` or `UP`

  message in the log:

  "Action start called automatically"

  Note: a stopstart on ✓ `PRIM (Ready)` causes a failover

Repeat the test on the same server if it still runs the application (i.e., ✓ `(Ready)` in state `ALONE` or `UP`):

- with the default values of `maxloop="3"` and `loop_interval="24"` (`userconfig.xml` <service>)
- after 4 kills on the same server, the module becomes ✗ `STOP (NotReady)`
- in the log, message before stopping:

  "Stopping loop"

4.4.2 Test <tcp> checker of the local application with action restart or stopstart

In `userconfig.xml`:

```
<tcp ident="id" when="prim ">
  <to addr="virtip" port="idport"
interval="10"

timeout="5" />
</tcp>
<failover>
<![CDATA[
tcpid_failure: if (tcp.id == down)
then stopstart();
]]>
</failover>
```

⇨ the checker checks that the TCP application started on port idport responds to connection requests

⇨ `addr="virtip" port="idport"` : TCP connections tested on IP address virtip and on TCP port idport

⇨ `interval="10" timeout="5"` by default: test made every 10 seconds and with a timeout of 5 seconds

⇨ `when="prim"` (mirror module case): checker is started on the server in state ✓ `(Ready)` (i.e., `PRIM` or `ALONE`), after the `start_prim` script (stopped before `stop_prim`)

⇨ when="both" (farm module case): checker is started on all servers in state ✓ `(Ready) UP`, after the `start_both` script (stopped before `stop_both`)

⇨ action `restart()`: Default failover rule; if the local TCP connection fails, action `restart` which runs only scripts `stop_xx` ; `start_xx`

⇨ action `stopstart()`: if the local TCP connection fails, action `stopstart` which stops completely the module and then restarts it

Stop the application listening on port idport on the server in state ✓ `(Ready)`. That is in states `PRIM` or `ALONE` for a mirror module, `UP` for a farm module:

⇨ messages in the log:

"Resource tcp.id set to down by tcpcheck"
"Action restart|stopstart from failover rule tcpid_failure "

⇨ the module becomes ↻ `(Transient)`, respectively in state `PRIM`, `ALONE` or `UP`

⇨ in the `restart` case, the module becomes ✓ `(Ready)`, respectively in state `PRIM`, `ALONE` or `UP`

⇨ in the `stopstart` case, the module becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE` or `UP`.

message in the log:

"Action start called automatically"

Note: a `stopstart` on ✓ `PRIM (Ready)` causes a failover.

Repeat the test on the same server if it still runs the application (i.e., ✓ `(Ready)` in state `ALONE` or `UP`):

⇨ with the default values of `maxloop="3" loop_interval="24"` (`userconfig.xml` <service>)

⇨ after 4 stops of the application on the same server, the module becomes ✗ `STOP (NotReady)`

⇨ in the log, message before stopping:

"Stopping loop"

4.4.3 Test <tcp> checker of an external service with action wait

In `userconfig.xml`:

```
<tcp ident="id" when="pre">
  <to addr="ip.external" port="idport"
interval="10"

timeout="5" />
</tcp>
<failover>
<![CDATA[
tcpid_failure: if (tcp.id== down) then
wait();
]]>
</failover>
```

- the checker checks that the external TCP service (`ip.external`, `idport`) responds to connection requests
- `interval="10" timeout="5"` by default: test made every 10 seconds and with a timeout of 5 seconds
- `when="pre"`: started at the beginning of module start-up after prestart script (and stopped before poststop)
- if the TCP connection fails, the checker sets the resource `tcp.id` to `down`. The failover rule on the TCP checker runs the `stopwait` action which stops the application and puts the module in the state `WAIT`, waiting for `tcp.id` reset to `up` by the checker

Stop the external TCP service (`ip.external`, `idport`), on the server in ✓ `(Ready)` state. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- messages in the log:

  "Resource tcp.id set to down by tcpcheck"
  "Action wait from failover rule tcpid_failure"

  Note: a wait on ✓ `PRIM (Ready)` causes a failover
- in all cases, the server becomes ○ `WAIT (NotReady)` on the server

Restart the external TCP process and services:

- messages in the log

  "Resource tcp.id set to up by tcpcheck"
  "Transition WAKEUP from failover rule Implicit_WAKEUP"
- the module restarts on the server and becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE`, `SECOND` or `UP`

Repeat the test on the same server:

- with the default values of `maxloop="3"` `loop_interval="24"` (`userconfig.xml` <service>)
- after 4 restarts of on the same server, the module becomes ✗ `STOP (NotReady)`
- in the log, message before stopping:

  "Stopping loop"

Note: This test allows testing of connectivity to an external service. But if the external service is down or is unreachable on all servers, all servers are in state ○ `WAIT (NotReady)` and the application is unavailable

4.4.4 Test <interface check="on"> on a local network interface and with action wait

In `userconfig.xml`:

```
<vip>
 <interface_list>
  <interface check="on">
      <!--
         definition of a virtual IP
address
         on the network default
       -->
  </interface>
 </interface_list>
</vip>
```

Default failover rule = wait

- ➪ A checker checks that the Ethernet cable is connected in the interface of the `ip.0` network where the virtual IP address is set
- ➪ If the cable is disconnected, the checker updates the resource `intf.ip.0` to down. The failover rule on interface checkers runs the stopwait action which stops the application and puts the module in the `WAIT` state waiting for intf.ip.0 reset to up by the checker.

Note: do not use `check="on"` on bonding or teaming interface because these interfaces bring their own failover mechanisms from interface to interface

Unplug the Ethernet cable from ip.0 network on the server in ✓ `(Ready)` state. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- ➪ messages in the log:

  "Resource intf.ip.default set to down by intfcheck"

  "Action wait from failover rule interface_failure"

  "Transition `WAIT`_TR from failover rule interface_failure"

  Note: a wait on ✓ `PRIM (Ready)` causes a failover
- ➪ in all cases, the module becomes ○ `WAIT (NotReady)` on the server

Plug the cable again:

- ➪ messages in the log

  "Resource intf.ip.0 set to up by intfcheck"
  "Transition WAKEUP from failover rule Implicit_WAKEUP"
- ➪ the module restarts on the server and becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE`, `SECOND` or `UP`

Repeat the test on the same server:

- ➪ with the default values of `maxloop="3"` `loop_interval="24"` (`userconfig.xml` <service>)
- ➪ after 4 restarts on the same server, the module becomes ✗ `STOP (NotReady)`
- ➪ in the log, message before stopping:

  "Stopping loop"

  Note: disabling the interface (instead of unplugging the ethernet cable) leads to ✗ `STOP (NotReady)`. The reason is that the module cannot start (or restart) without local IP address.

4.4.5 Test <ping> checker with action wait

In `userconfig.xml`:

```
<ping ident="id" when="pre">
  <to addr="ip.device" interval="10"

timeout="5"/>
</ping>
Default failover rule = wait
```

- the checker checks that the external device (ex.: a router) with address `ip.device` responds to ping
- `interval="10" timeout="5"` by default: test made every 10 seconds and with a timeout of 5 seconds
- `when="pre"`: started at the beginning of module start-up after prestart script (and stopped before poststop)
- if the ping does not respond, the checker sets the resource `ping.id` to `down`. The failover rule on ping checker runs the stopwait action which stops the application and puts the module in the `WAIT` state, waiting for `ping.id` reset to `up` by the checker.

Break the link between the pinged external device and the server the server in ✓`(Ready)` state. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- messages in the log:

  "Resource ping.id set to down by pingcheck"
  "Action wait from failover rule ping_failure"

  Note: a wait on ✓`PRIM (Ready)` causes a failover
- in all cases, the module becomes ○`WAIT (NotReady)` on the server

Restore the network connection:

- messages in the log

  "Resource ping.id set to up by pingcheck"
  "Transition WAKEUP from failover rule Implicit_WAKEUP"
- the module restarts on the server and becomes ✓`(Ready)`, respectively in state `SECOND`, `ALONE`, `SECOND` or `UP`

Repeat the test on the same server:

- with the default values of `maxloop="3" loop_interval="24"` (`userconfig.xml` <service>)
- after 4 restarts on the same server, the module becomes ✗`STOP (NotReady)`
- in the log, message before stopping:

  "Stopping loop"

Note: this test allows testing of connectivity from the server to the network. But if the external device is down and if the ping fails on all servers, all servers are in ○`WAIT (NotReady)` and the application is unavailable.

4.4.6 Test <module> checker with action wait

In `userconfig.xml` of module X, test of another module `othermodule`:

```
userconfig.xml of module X:

<module name="othermodule">
  <to addr="ip" interval="10"
timeout="5"/>
</module>
```

- ➩ the checker checks the module `othermodule` on its virtual IP address ip
- ➩ `interval="10" timeout="5"` by default: test made every 10 seconds and with a timeout of 5 seconds

If the module `othermodule` is not started, the module X stay in the `WAIT` state waiting for its restart

The module X makes a stopstart when the module `othermodule` is restarted

Note: if the module X is a mirror module using file replication and because of rule `notuptodate_server`, you may experience a wrong behavior with module X blocked in a `WAIT` state, if the stopstart action happens when X in the transition `SECOND` to `ALONE`

Stop the module `othermodule`. And start the module X on all servers:

- ➩ messages in the log of module X

  "Resource module.othermodule_ip set to down by modulecheck
  "Action wait from failover rule module_failure"
- ➩ the module X becomes ○ `WAIT (NotReady)` on all servers

Start the module `othermodule`:

- ➩ messages in the log of module X

  "Resource module.othermodule_ip set to up by modulecheck"
  "Transition WAKEUP from failover rule Implicit_WAKEUP"
- ➩ the module X starts on all servers in ✓ `(Ready)`

Make `safekit restart -m othermodule`

- ➩ messages in the log of module X:

  "Action stopstart called by modulecheck"
- ➩ the module X stops and then restarts

Repeat the test on the same server:

- ➩ with the default values of `maxloop="3" loop_interval="24"` (`userconfig.xml` <service>)
- ➩ after 4 restarts on the same server, the module becomes ✗ `STOP (NotReady)`
- ➩ in the log, message before stopping:

  "Stopping loop"

4.4.7 Test <custom> checker with action wait

In `userconfig.xml`:

```
<custom ident="id" when="pre"

exec="customscript" >
</custom>
```

- script `SAFE/module/<name>/bin/customscript` is a custom checker: a loop with a test on a resource
- `when="pre"`: custom checker started on all servers ✓ `PRIM`, `ALONE`, `SECOND` or `UP (Ready)` after prestart script (stopped before poststop)

Manage the resource custom.id to perform the action:

- in the script customscript:
  on error: `SAFE/`safekit set -r custom.id–v down –i customscript

  on success: `SAFE/`safekit set -r custom.id–v up –i customscript
- in `userconfig.xml`:
  <failover>
  <![CDATA[
  customid_failure: if (custom.id == down) then
  wait();
  ]]>
  </failover>
- if the custom checker sets the resource to down, action wait which stops completely the module and restarts it in the state ○ `WAIT (NotReady)`, waiting for the resource reset to up by the custom checker

Cause the error evaluated by custom checker on the server in state ✓ `(Ready)`. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- messages in the log:

  "Resource custom.id set to down by customscript"
  "Action wait from failover rule customid_failure"
  "Transition `WAIT`_TR from failover rule customid_failure"

  Note: a wait on ✓ `PRIM (Ready)` causes a failover
- in all cases, the module becomes ○ `WAIT (NotReady)` on the server

Fix error tested by custom checker:

- messages in the log

  "Resource custom.id set to up by customscript"
  "Transition WAKEUP from failover rule Implicit_WAKEUP"
- the module restarts on the server and becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE`, `SECOND` or `UP`

Repeat the test on the same server:

- with the default values of `maxloop="3" loop_interval="24"` (`userconfig.xml` <service>)
- after 4 restarts on the same server, the module becomes ✗ `STOP (NotReady)`
- in the log, message before stopping:

  "Stopping loop"

4.4.8 Test <custom> checker with action restart or stopstart

4.4.8.1 Action through a failover rule

In `userconfig.xml`:

```
<custom ident="id" when="prim "
exec="customscript" >
</custom>
```

- script customscript `SAFE/module/<name>/bin/customscript` is a custom checker: loop with a test on the application integrated in the scripts
- `when="prim"` (mirror module case): custom checker started on the server ✓ `PRIM`/`ALONE (Ready)` after `start_prim` script (stopped before stop_prim)
- `when="both"` (farm module case): custom checker started on all servers ✓ `UP (Ready)` after `start_both` script (stopped before `stop_both`)

Manage the resource custom.id to perform the action:

- in the script customscript:
  on error: safekit set -r custom.id–v down –i customscript

  on success: safekit set -r custom.id–v up –i customscript

```
in userconfig.xml:

<failover>
<![CDATA[
customid_failure: if (custom.id ==
down) then restart ();
]]>
</failover>
or
<failover>
<![CDATA[
customid_failure: if (custom.id ==
down) then stopstart ();
]]>
</failover>
```

Cause the error evaluated by custom checker on the server in state ✓ `(Ready)`. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- messages in the log

  "Resource custom.id set to down by customscript"

  "Action restart from failover rule customid_failure"

  "Transition RESTART from failover rule customid_failure"
- the module becomes ↻ `(Transient)`, respectively in state `PRIM`, `ALONE` or `UP`
- in the restart case, the module becomes ✓ `(Ready)`, respectively state `PRIM`, `ALONE` or `UP`
- in the stopstart case, the module becomes ✓ `(Ready)`, respectively in state `SECOND`, `ALONE` or `UP`

  message in the log

  "Action start called automatically"

  Note: a stopstart on ✓ `PRIM (Ready)` causes a failover

Repeat the test on the same server if it still runs the application (i.e., ✓ `(Ready)` in state `ALONE` or `UP`):

- with the default values of `maxloop="3"` `loop_interval="24"` (`userconfig.xml` <service>)
- after 4 restarts on the same server, the module becomes ✗ `STOP (NotReady)`
- in the log, message before stopping: "Stopping loop"

4.4.8.2 Action through a command in the custom checker

In `userconfig.xml`:

```
<custom ident="id" when="prim "
          exec="customscript" >
</custom>
```

- script `SAFE/module/<name>/bin/customscript` is a custom checker: loop with a test on the application integrated in the scripts
- `when="prim"` (mirror module case): custom checker started on the server ✓`PRIM` or `ALONE (Ready)` after `start_prim` script (stopped before stop_prim)
- `when="both"` (farm module case): custom checker started on all servers ✓`UP (Ready)` after `start_both` script (stopped before `stop_both`)

On error, run command `restart|stopstart`:

- in the script customscript:
  on error: safekit restart -i customscript

  or

  safekit stopstart -i customscript
- action restart: run only scripts `stop_xx ; start_xx`
- action stopstart: stop completely the module and then restart it

Cause the error evaluated by custom checker on the server in state ✓`(Ready)`. That is in state `PRIM`, `ALONE` or `SECOND` for a mirror module, `UP` for a farm module:

- messages in the log

  "Action restart called by customscript"

  Or

  "Action stoptart called by customscript"
- the module becomes ↻ `(Transient)`, respectively in state `PRIM`, `ALONE` or `UP`
- in the restart case, the module becomes ✓`(Ready)`, respectively in state `PRIM`, `ALONE` or `UP`
- in the stopstart case, the module becomes ✓`(Ready)`, respectively in state `SECOND`, `ALONE` or `UP`

  message in the log

  "Action start called automatically"

  Note: a stopstart on ✓`PRIM (Ready)` causes a failover

Repeat the test on the same server if it still runs the application (i.e., ✓`(Ready)` in state `ALONE` or `UP`):

- with the default values of `maxloop="3" loop_interval="24"` (`userconfig.xml` <service>)
- after 4 restarts on the same server, the module becomes ✗`STOP (NotReady)`
- in the log, message before stopping: "Stopping loop"

Note: on a direct action in the custom checker, the loop counter is incremented if `-i identity` is passed to the command restart or stopstart. Without identity, SafeKit considers the command is as an administrative operation. The counter is reset and there is no stop after 4 restarts.

5. Mirror module administration

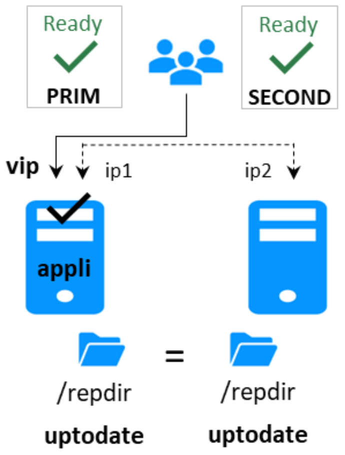
To test a mirror module, see section 4.2 page 70

To analyze a problem, see section 7 page 109.

5.1 Operating mode of a mirror module

1. Normal operation

Stable state: primary with secondary.



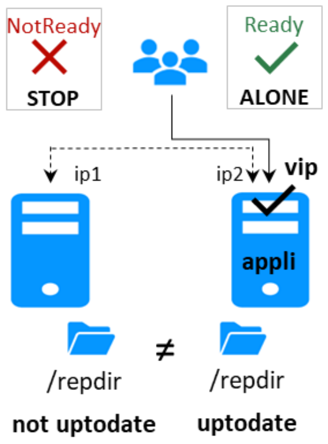
On the primary:

- ✓ Virtual IP is set
- ✓ Application is running
- ✓ Real-time file replication

The secondary is ready to run a failover and become primary.

2. Automatic failover

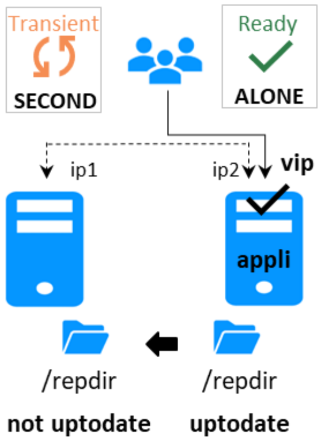
Stable state: primary without secondary.



On primary stop, automatic failover of the virtual IP and application.

3. Failback and reintegration

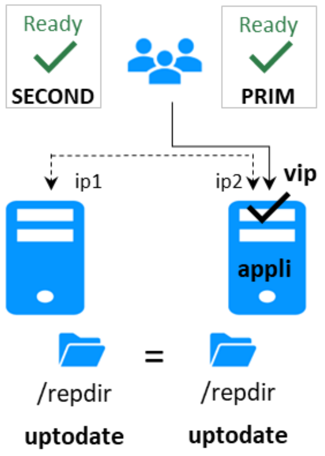
Transient state: secondary reintegrating.



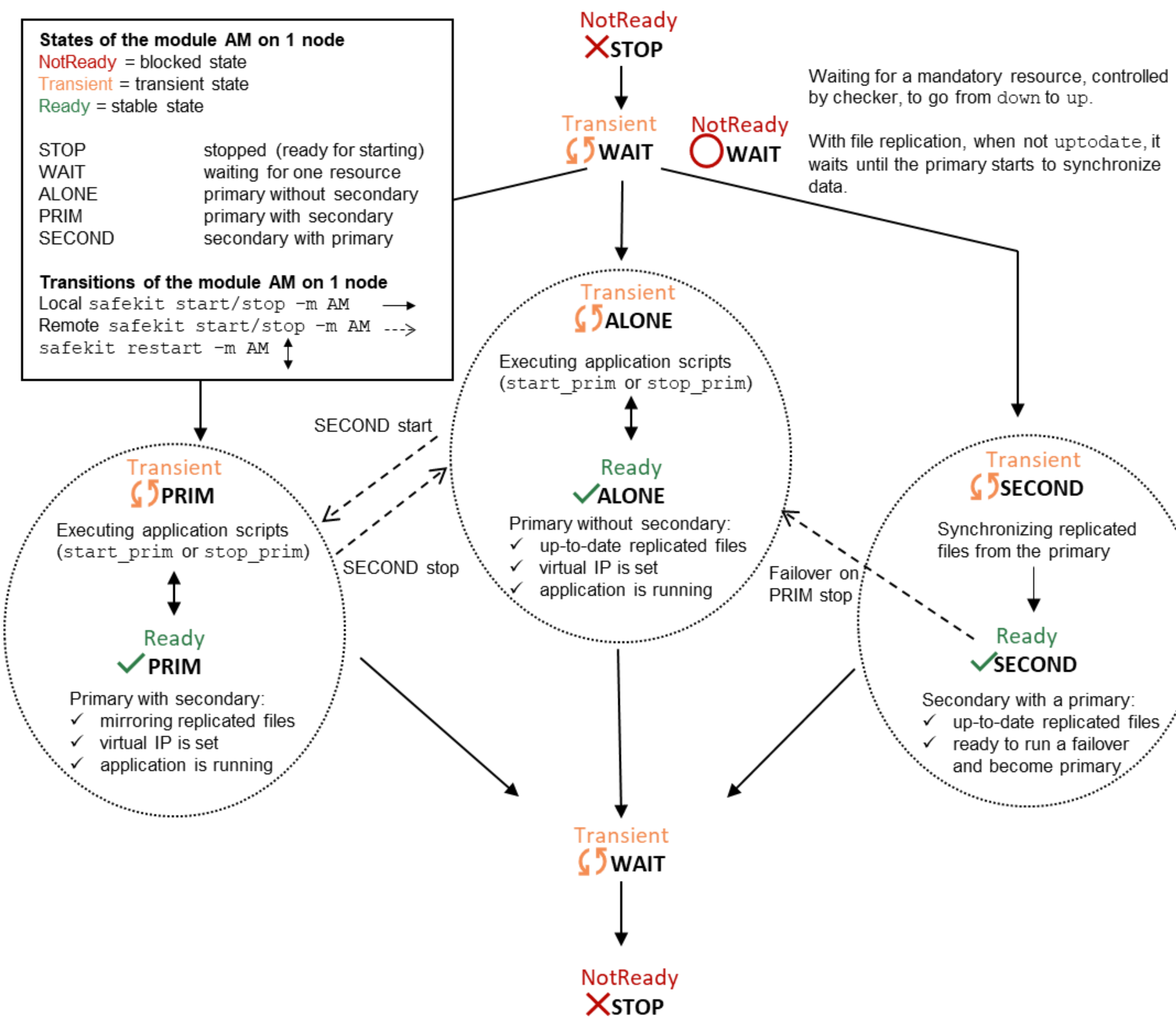
Automatic file synchronization without application shutdown and updating only the files that were modified on the primary while the other node was stopped.

4. Back to normal operation

Stable state: primary with secondary.



5.2 State automaton of a mirror module (`STOP`, `WAIT`, `ALONE`, `PRIM`, `SECOND` - `NotReady`, `Transient`, `Ready`)

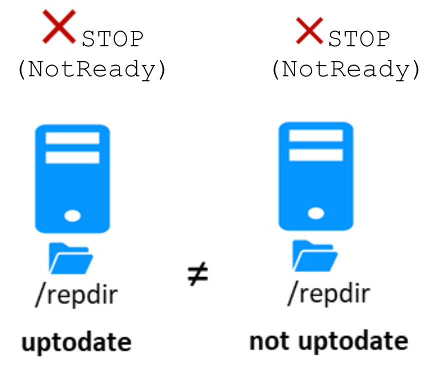

States of the module AM on 1 node
NotReady = blocked state
Transient = transient state
Ready = stable state
STOP stopped (ready for starting)
WAIT waiting for one resource
ALONE primary without secondary
PRIM primary with secondary
SECOND secondary with primary
Transitions of the module AM on 1 node
Local safekit start/stop -m AM
Remote safekit start/stop -m AM
safekit restart -m AM
NotReady STOP
Transient WAIT
NotReady WAIT
Waiting for a mandatory resource, controlled by checker, to go from down to up.
With file replication, when not uptodate, it waits until the primary starts to synchronize data.
Transient ALONE
Executing application scripts (start_prim or stop_prim)
Ready ALONE
Primary without secondary:
✓ up-to-date replicated files
✓ virtual IP is set
✓ application is running
SECOND start
SECOND stop
Transient PRIM
Executing application scripts (start_prim or stop_prim)
Ready PRIM
Primary with secondary:
✓ mirroring replicated files
✓ virtual IP is set
✓ application is running
Failover on PRIM stop
Transient SECOND
Synchronizing replicated files from the primary
Ready SECOND
Secondary with a primary:
✓ up-to-date replicated files
✓ ready to run a failover and become primary
Transient WAIT
NotReady STOP

5.3 First start-up of a mirror module (`safekit prim` command)

At first start-up of a mirror module, if both servers are started with the start command, both go into ○ `WAIT (NotReady)` state with the message "Data may be not uptodate for replicated directories (wait for the start of the remote server)" in the log.
At first start-up of a mirror module, use the special prim command on the server with the up-to-date directory, and the second command on the other one. Data is synchronized from the primary server to the secondary one.
For next start-up, use the start command on both servers.

1. initial state

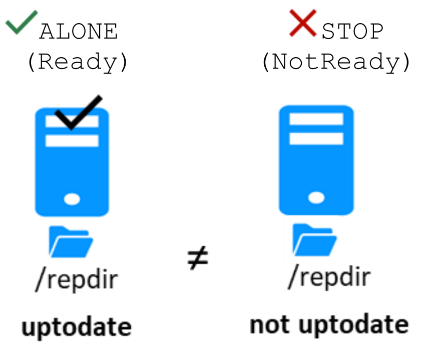
- the mirror module has just been configured with a new directory to replicate between node1 and node2
- node1 has the up-to-date directory
- node2 has an empty directory



2. command `prim` on node1

- use the special `prim` command to force node1 to become primary
- for following start-ups, always prefer start: see section 5.5 page 98
- message in the log:

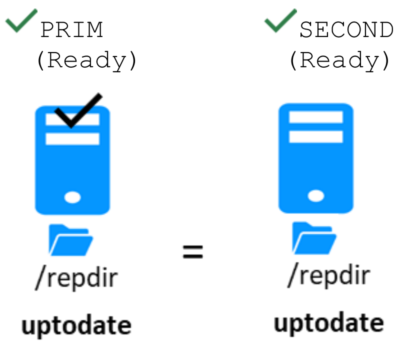
  "Action prim called by web@<IP>/SYSTEM/root"



3. command `second` on node2

- start the other server as secondary
- the secondary reintegrates replicated directory from primary
- message in the log:

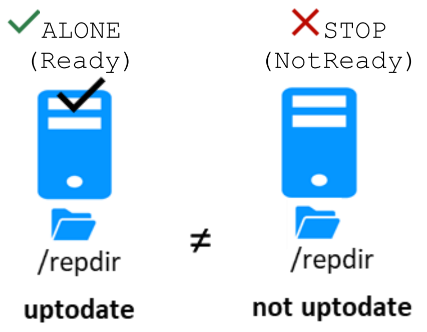
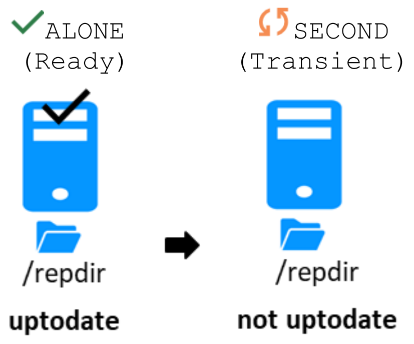
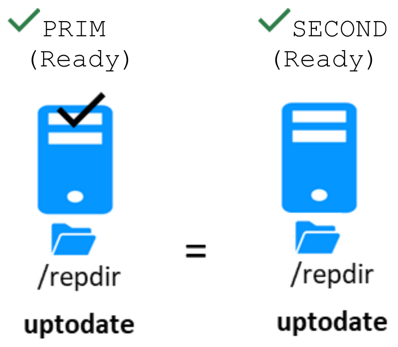
  "Action second called by web@<IP>/SYSTEM/root"



5.4 Different reintegration cases (use of bitmaps)

To optimize file reintegration, different cases are considered:

1. The module must have completed the reintegration (on the first start of the module, it runs a full reintegration) before enabling the tracking of modification into bitmaps
2. If the module was cleanly stopped on the server, then at restart of the secondary, only the modified zones of modified files are reintegrated, according to a set of modification tracking bitmaps.
3. If the server crashed (power off) or was incorrectly stopped (exception in nfsbox replication process), or if files have been modified while SafeKit was stopped, the modification bitmaps are not reliable, and are therefore discarded. All the files bearing a modification timestamp more recent than the last known synchronization point minus a grace delay (typically one hour) are reintegrated.
4. A call to the special `second fullsync` command triggers a full reintegration of all replicated directories on the secondary when it is restarted.

1. secondary server2 has been stopped ⇨ data is desynchronized	 ALONE (Ready) STOP (NotReady) /repdir ≠ /repdir uptodate not uptodate
2. `start` command on node2 ⇨ data is reintegrated with bitmap optimization (see above)	 ALONE (Ready) SECOND (Transient) /repdir /repdir uptodate not uptodate
3. end of reintegration ⇨ data is the same on both servers ⇨ only modifications inside files are replicated with a real-time synchronous replication	 PRIM (Ready) SECOND (Ready) /repdir = /repdir uptodate uptodate

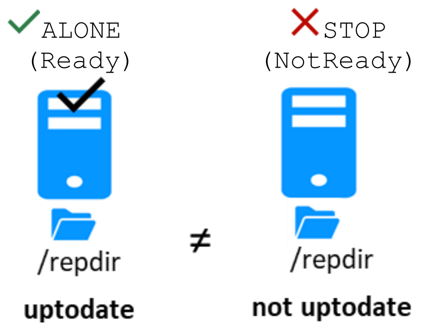
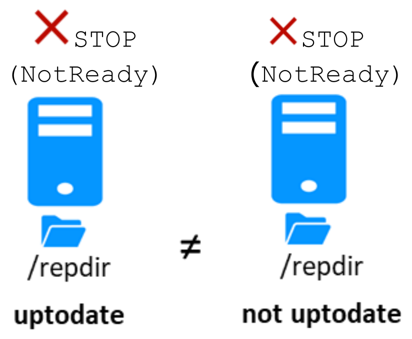
The replication system also keeps track of the last date on which data was synchronized on each node. This synchronization date, named `synctimestamp`, is assigned at the end of the reintegration and changes in the ✓`PRIM (Ready)` and ✓`SECOND (Ready)` states. When the module is stopped on the secondary node and then restarted, the `synctimestamp` is one of the reintegration criteria: all files modified around this date are potentially out of date on the secondary and must be reintegrated. Since SafeKit 7.4.0.50, the synchronization date is also used to implement an additional security. When the difference between the synchronization date stored on the primary and on the secondary is greater than 90 seconds, the replicated data is considered unsynchronized in its entirety. The reintegration is interrupted with the following message in the module log:

```
| 2021-08-06 08:40:20.909224 | reintegre | E | Automatic synchronization
cannot be applied due to an abnormal delta between the dates of the last
synchronization
```

If the administrator considers that the server is valid, he can force the start in secondary with full synchronization of the data, by executing the command: `safekit second fullsync -m AM`.

5.5 Start-up of a mirror module with the up-to-date data ✗`STOP (NotReady)` - ○`WAIT (NotReady)`

SafeKit determines which server must start as primary or not. SafeKit retains the information on the server with the up-to-date replicated directories. To take advantage of this feature, use the command start and NOT the command prim

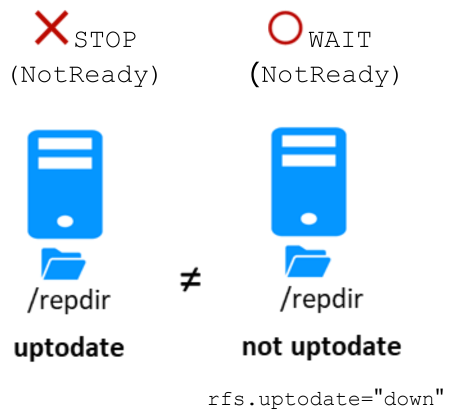
1. initial state ➩ server1 is primary `ALONE` ➩ directories are up-to-date on this server ➩ the module is stopped on node2 ➩ node2 has desynchronized replicated directories	 ALONE (Ready) STOP (NotReady) /repdir ≠ /repdir uptodate not uptodate
2. command `stop` on node1 ➩ stop of the server with the up-to-date directories	 STOP (NotReady) STOP (NotReady) /repdir ≠ /repdir uptodate not uptodate

3. command `start` on node2

- ➾ the module is put in the `WAIT` state waiting for the start of the other server and within its log of messages:

  "Data may be not uptodate for replicated directories (wait for the start of the remote server)"
  "Action wait from failover rule notuptodate_server"
  "If you are sure that this server has valid data, run safekit prim to force start as primary"

- ➾ in this case, you must start server1 to resynchronize data of server2
- ➾ if you really want to sacrifice the up-to-date data and start node2 as primary with the data not up-to-date: issue a stop command then a prim command on node2



See also 5.9 "Prim command fails: why? (`safekit primforce` command)" page 104

5.6 Degraded replication mode (✓`ALONE (Ready)` degraded)

If the replication process nfsbox fails on the primary server (for instance because of an unrecoverable replication problem), the application is not swapped on the secondary server

The primary server goes to the `ALONE` state in a degraded replication mode.

Degraded is displayed in the web console. A "`Resource rfs.degraded set to up by nfsadmin`" message is emitted in the log. `safekit state -v -m AM` returns resource `rfs.degraded` up (replace AM by the module name)

The primary server continues in `ALONE` state with a nfsbox process which does not replicate anymore.

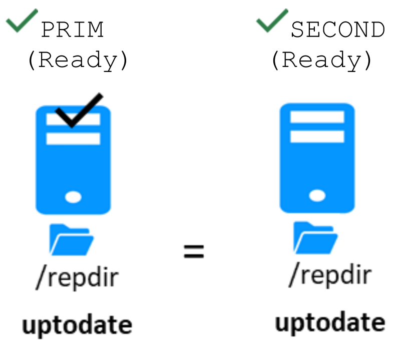
You must stop and start the `ALONE` server to come back to a `PRIM` – `SECOND` state with replication

1. initial state

the mirror is in a stable state:

node1 ✓`PRIM (Ready)`

node2 ✓`SECOND (Ready)`



2. failure of replication process nfsbox on node1

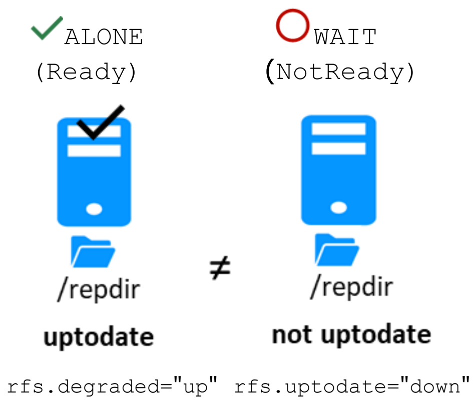
- node1 becomes ✓`ALONE (Ready)` degraded with the message in its log

  "Resource rfs.degraded set to up by nfsadmin".

  `safekit state -v AM` returns resource rfs.degraded=up (where AM is the module name)
- node1 `ALONE` continues to execute the application without replication
- node2 is in ○`WAIT (NotReady)` waiting for the replication process with the message in its log

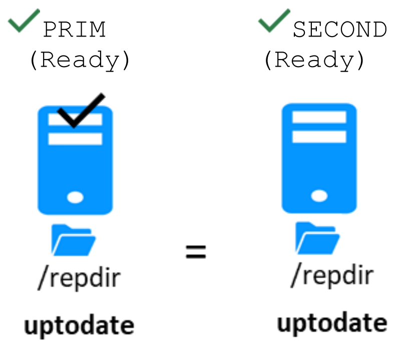
  "Action wait from failover rule degraded_server"

  and with `rfs.uptodate="down"`



3. ome back to replication

- administrator makes stop command and start command on node1 `ALONE`
- the nfsbox replication process is restarted on node1
- node2 reintegrates replicated directories before becoming ✓`SECOND (Ready)`
- node1 becomes ✓`PRIM (Ready)`

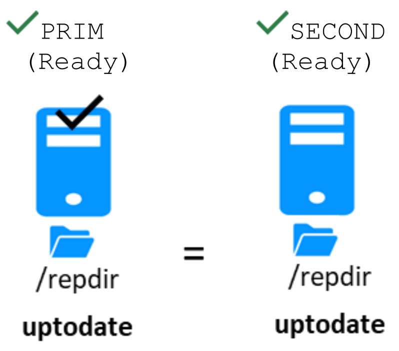
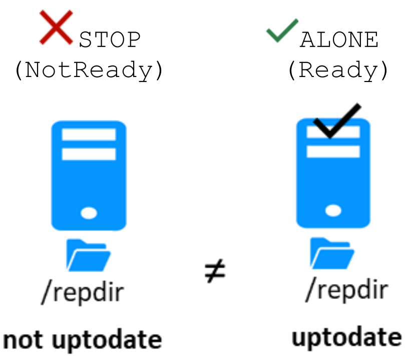


5.7 Automatic or manual failover

Automatic or manual failover on the secondary server is defined in `userconfig.xml` by `<service mode="mirror" failover="on"|"off">`. By default, if the parameter is not defined, `failover="on"`

The `failover="off"` mode is useful when the failover must be controlled by an administrator. This mode ensures that an application runs always on the same primary server whatever operations are made on the server (reboot, temporary stop of the module for maintenance...). Only an explicit administrative action (`prim` command) may promote the other server as primary.

Note: Failover mode could be set dynamically on a running cluster with the `safekit failover on|off -v AM` (replace `AM` by the module name).

1. initial state the mirror is in a stable state: node1 ✓`PRIM (Ready)` node2 ✓`SECOND (Ready)`	 PRIM (Ready) SECOND (Ready) /repdir = /repdir uptodate uptodate
2. restart with `failover="on"` ⇨ if node1 former `PRIM` fails and stops, node2 becomes automatically ✓`ALONE (Ready)` (default mode)	 STOP (NotReady) ALONE (Ready) /repdir ≠ /repdir not uptodate uptodate

3. behavior with `failover="off"`

- if node1 former `PRIM` fails and stops, node2 goes to ○ `WAIT (NotReady)` state with message in its log

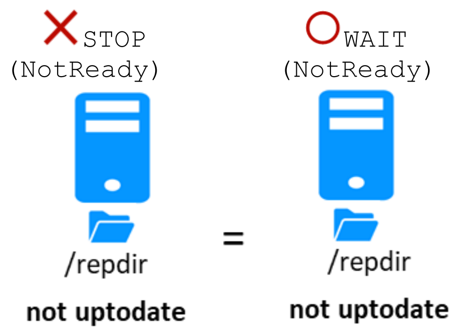
  "Failover-off configured"
  "Action stopstart called by failover-off"
  "Transition STOPSTART from failover-off"
  "Local state `WAIT NotReady` "

- the administrator in this situation can restart node1: the mirror restarts in its former stable state

  node1 ✓ `PRIM (Ready)`

  node2 ✓ `SECOND (Ready)`

- the administrator can decide to force node2 to become primary with the command: `stop` then `prim` on node2



See also section 5.9 page 101

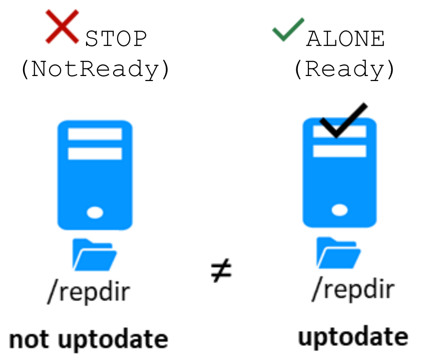
5.8 Default primary server (automatic swap after reintegration)

After reintegration at failback, a server becomes by default secondary. The administrator may choose to swap the application back to the reintegrated server at an appropriate time with the `swap` command. This is the default behavior when `userconfig.xml` <service> is defined without the `defaultprim` variable

If the application must automatically swap back to a preferred server after reintegration, specify a defaultprim server in `userconfig.xml`: `<service mode="mirror" defaultprim="hostname node1">`

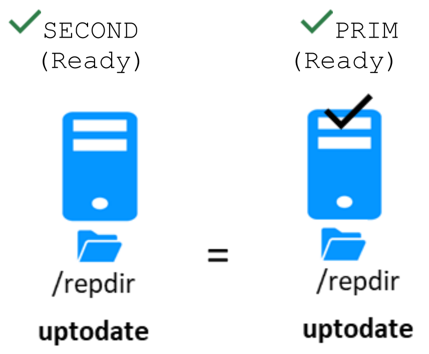
1. initial state

- node1 (former `PRIM`) fails and stops
- node2 secondary becomes automatically `ALONE`



2. failback without `defaultprim`

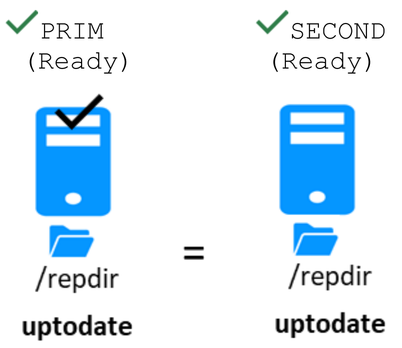
- node1 is restarted with command start
- it reintegrates replicated directories and then becomes secondary
- an administrator can swap the primary to node1 with the command `swap` in a timely manner
- swap stops the application on node2 and restarts it on node1



3. failback with `defaultprim="hostname node1"`

- node1 in ✗ `STOP (NotReady)` at step 1 (initial state) is restarted by command start
- it reintegrates replicated directories
- just after reintegration, an automatic swap is made on node1 with the message in its log:

  "Transition SWAP from defaultprim"
  "Begin of Swap"
- the application is then automatically stopped on node2 and restarted on node1
- at the end, node1 is `PRIM`

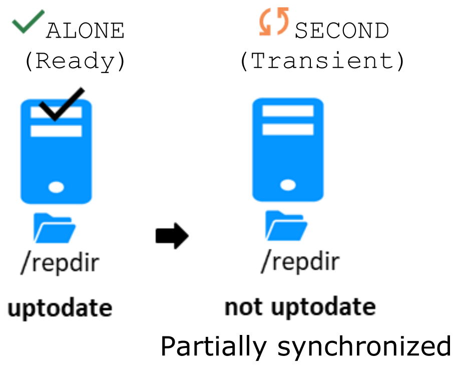


5.9 Prim command fails: why? (`safekit primforce` command)

A prim command may fail to start a server as primary: after trying a start-up, the server goes back to ✗`STOP (NotReady)`.

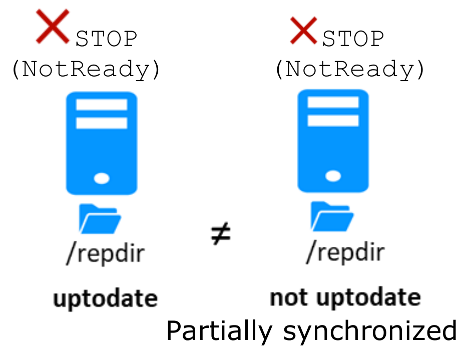
1. initial state

- node1 `ALONE` has the up-to-date directory
- node2 is in the process of reintegrating files from node1



2. command `stop` on node2 then on node1

- stop of node2 during its reintegration: stop of node2 can be made while a file that is half copied (corrupted file)
- node1 is also stopped



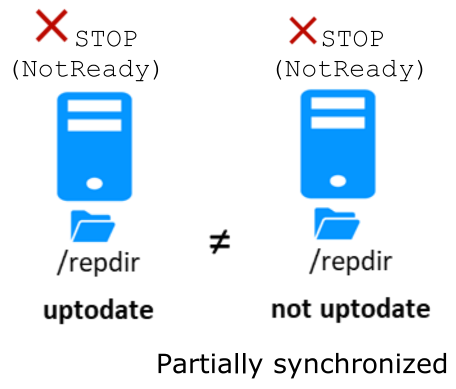
3. command prim on node2

- fails with messages in the log described above

"Data may be inconsistent for replicated directories (stopped during reintegration)"
"If you are sure that this server has valid data, run safekit primforce to force start as primary"

- in this case, you must start node1 with start command or prim command. And to restart node2 with start command to finish reintegration of files. While node2 is not in the state ✓`SECOND (Ready)`, its data may be corrupted
- if you absolutely want to start as primary on node2 partially reintegrated and with data potentially corrupted, use the command `safekit primforce -m AM` on node2 (command line only, where AM is the module name). Message in the log:

  "Action primforce called by SYSTEM/root"



The command prim fails since the data may be corrupted

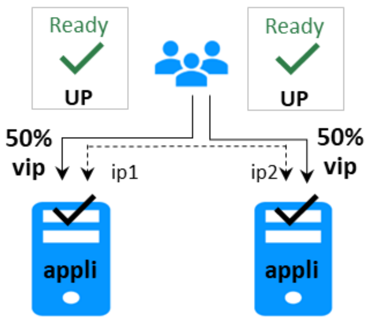
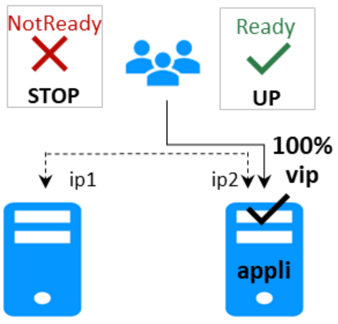
Note: The `safekit primforce -m AM` command forces a full reintegration of replicated directories on the secondary when it is restarted.

6. Farm module administration

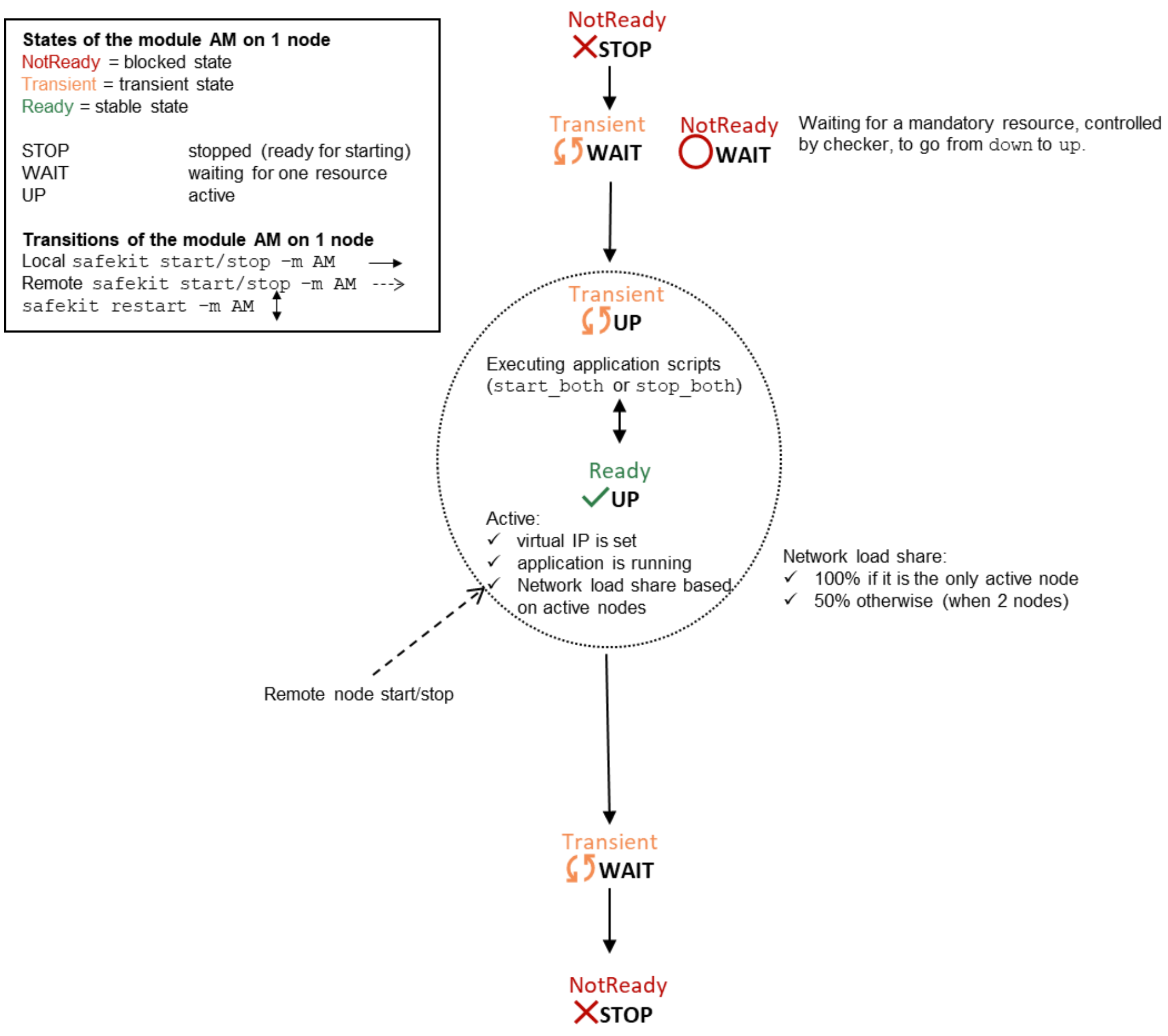
To test a farm module, see section 4.3 page 77.

To analyze a problem, see section 7 page 109.

6.1 Operating mode of a farm module

1. Normal operation	**2. Automatic failover**
Stable state: 2 active nodes.  Ready UP Ready UP 50% vip ip1 ip2 50% vip appli appli On all nodes: ✓ Virtual IP is set ✓ Application is running ✓ Network load sharing is distributed among all nodes Each node is ready to run a failover and take 100% of the load.	Stable state: 1 active node.  NotReady STOP Ready UP 100% vip ip1 ip2 appli On remote node stop, automatic failover of the network load sharing.
3. Back to normal operation Stable state: 2 active nodes.	

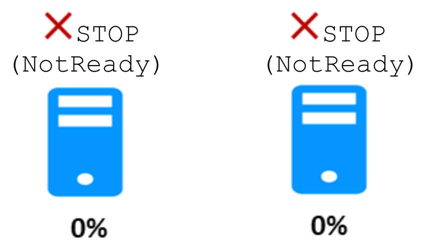
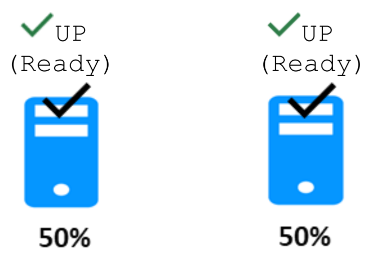
6.2 State automaton of a farm module (`STOP, WAIT, UP - NotReady, Transient, Ready`)


States of the module AM on 1 node
NotReady = blocked state
Transient = transient state
Ready = stable state
STOP stopped (ready for starting)
WAIT waiting for one resource
UP active
Transitions of the module AM on 1 node
Local safekit start/stop -m AM
Remote safekit start/stop -m AM
safekit restart -m AM
NotReady STOP
Transient WAIT
NotReady WAIT
Waiting for a mandatory resource, controlled by checker, to go from down to up.
Transient UP
Executing application scripts (start_both or stop_both)
Ready UP
Active:
✓ virtual IP is set
✓ application is running
✓ Network load share based on active nodes
Network load share:
✓ 100% if it is the only active node
✓ 50% otherwise (when 2 nodes)
Remote node start/stop
Transient WAIT
NotReady STOP

Note: This is also the state automation of a light module. A light module is identified by `<service mode="light">` in `userconfig.xml` file under `SAFE/modules/AM/conf` (where AM is the module name). The light type corresponds to a module that runs on one node without synchronizing with other nodes (as can-do mirror or farm modules). A light module includes the start and stop of an application as well as the SafeKit checkers that can detect errors.

6.3 Start-up of a farm module

Use the start command on each node running the module. An example with a farm of 2 servers is presented below.

1. initial state ➾ the farm module has just been configured on node1 and node2	
2. command `start` on node1 and node2 ➾ message in the log of both servers: "farm membership: **node1 node2** (group FarmProto)" "farm load: **128/256** (group FarmProto)" "Local state `UP` Ready" ➾ resource of the module instance on both nodes: `FarmProto 50%`	

7. Troubleshooting

7.1 Connection issues with the web console

If you encounter problems for connecting to the SafeKit web console to SafeKit node, such as no reply or connection error, run the following checks and procedures:

Then, it may be necessary to reload the console into the browser.

7.1.1 Browser check

For the web browser, check:

- ✓ that it is a supported browser and its level
- ✓ change the proxy settings for direct or indirect connection to the server
- ✓ with Microsoft Edge, change the security settings (add the URL into the trusted zones)
- ✓ clear the browser's state on upgrade as described below
- ✓ that the web console and the server are at the same level (backward compatibility may not be fully preserved)

7.1.2 Browser state clear

- ✓ Clear the browser cache

  A quick way to do this is a keyboard shortcut that works on IE, Firefox, and Chrome. Open the browser to any web page and hold CTRL and SHIFT while tapping the DELETE key. (This is NOT CTRL, ALT, DEL). The dialog box will open to clear the browser. Set it to clear everything and click Clear Now or Delete at the bottom

- ✓ Clear the browser SSL cache if HTTPS is used

  Look at advanced settings for the browser and search for SSL cache.

Finally close all windows for the browser, stop the browser process still running in the background if necessary, and re-open it fresh to test what wasn't working for you previously.

7.1.3 Server check

On each SafeKit cluster node check:

- ✓ the firewall

  If this has not yet been done, run the `SAFE/safekit firewallcfg add` command which configures the operating system firewall. For other firewalls, add an exception to allow connections between the web browser and the server. For details, see section 10.3 page 156.

- ✓ the web server configuration

  HTTP access to the web console requires authentication. If it has not yet been done, run the `SAFE/bin/webservercfg -passwd pwd` to initialize (or reinitialize) this configuration with the password of the user `admin`. For details, see 11.2.1 page 175.

- ✓ the network and the server availability
- ✓ the `safeadmin` and `safewebserver` services

  They must be started.

- ✓ the SafeKit cluster configuration

  Run the command `safekit cluster confinfo` (see section 9.3 page 142). This command must return on all nodes, the same list of nodes and the same value for the configuration signature. If not, reapply the cluster configuration on all nodes (see section 12.2 page 203).

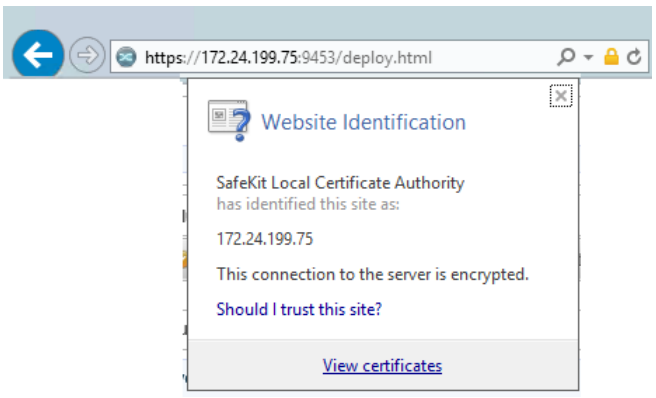
7.2 Connection issues with the HTTPS web console

If you encounter problems for connecting the secure SafeKit web console to SafeKit nodes, you can run the following checks and procedures:

7.2.1 Check server certificates

The SafeKit web console connects to a SafeKit node that is identified by a certificate. To get the SafeKit node certificate content with Internet Explorer or Chrome, run the following:

1. Click on the lock next to the URL to open the security report
2. Click on the View certificates link. It opens a window that displays the certificate content


https://172.24.199.75:9453/deploy.html

Website Identification

SafeKit Local Certificate Authority
has identified this site as:

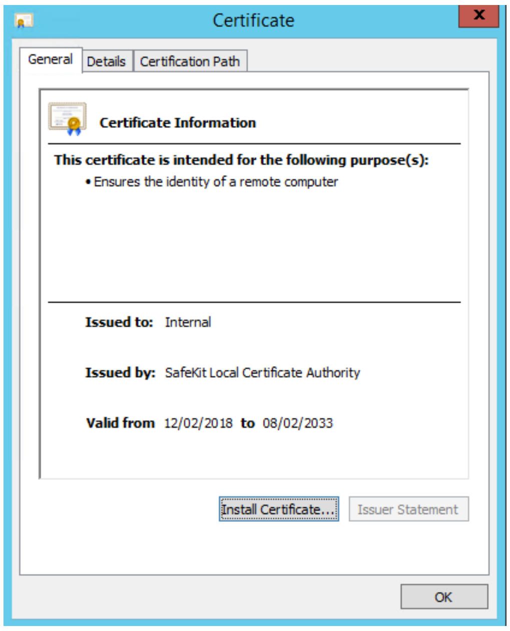
172.24.199.75

This connection to the server is encrypted.

Should I trust this site?

View certificates

3. Check the issuer that must be the appropriate certification authority
4. Check the validity date and the workstation date. If necessary, change the workstation date
5. Check the validity date. If the certificate is expired, you must renew. For certificate generated with the SafeKit PKI, see section 11.3.1.9.1 page 184



Certificate Information

This certificate is intended for the following purpose(s):
• Ensures the identity of a remote computer

Issued to: Internal

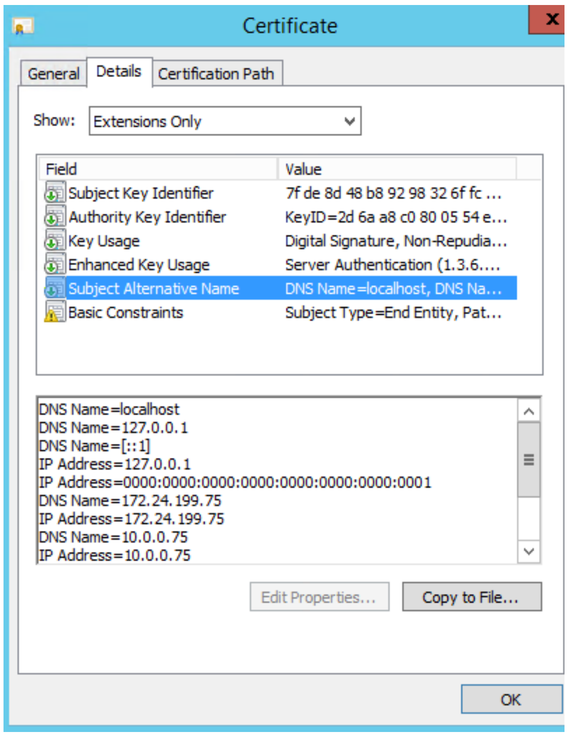
Issued by: SafeKit Local Certificate Authority

Valid from 12/02/2018 to 08/02/2033

6. Click on Details tab
7. Select Subject Alternate Name field. Its content is displayed into the bottom panel. The location set into the URL for connecting the SafeKit web console must be included into this list. Change the URL if necessary
8. The address value for the node, set into the SafeKit cluster configuration, must be one of the values listed. If it is not, change the cluster configuration as described in 12.2 page 203.

   When using DNS name, you must use lower case.

   With SafeKit <= 7.5.2.9, the server's name must be included.



Show: Extensions Only

Field	Value
Subject Key Identifier	7f de 8d 48 b8 92 98 32 6f fc ...
Authority Key Identifier	KeyID=2d 6a a8 c0 80 05 54 e...
Key Usage	Digital Signature, Non-Repudia...
Enhanced Key Usage	Server Authentication (1.3.6....
Subject Alternative Name	DNS Name=localhost, DNS Na...
Basic Constraints	Subject Type=End Entity, Pat...

```
DNS Name=localhost
DNS Name=127.0.0.1
DNS Name=[::1]
IP Address=127.0.0.1
IP Address=0000:0000:0000:0000:0000:0000:0000:0001
DNS Name=172.24.199.75
IP Address=172.24.199.75
DNS Name=10.0.0.75
IP Address=10.0.0.75
```

7.2.2 Check certificates installed in SafeKit

You can use the `checkcert` command for checking all the certificates.

On each SafeKit nodes:

1. Log as administrator/root and open a command shell window
2. Change directory to `SAFE/web/bin`
3. Run `checkcert -t all`

   It checks all installed certificates and returns a failure if an error is detected
4. You can check that the server certificate contains some DNS name or IP address with:

   ```
   checkcert -h ”DNS name value”
   ```

   ```
   checkcert -i ”Numeric IP address value”
   ```

⚠ The server certificate must contain all DNS names and/or IP addresses used for HTTPS connection. These ones must also be included into the SafeKit cluster configuration file.

7.2.3 Revert to HTTP configuration

If the problem cannot be solved, you can revert to the HTTP configuration (where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

On S1 and S2:

➩ remove the file `SAFE/web/conf/ssl/httpd.webconsolessl.conf`

On S1 and S2:

➩ run `safekit webserver restart`

You must then clear the browser cache as described in 7.1.2 page 110.

7.3 How to read logs and resources of the module?

Module log and **Scripts log** for the module on one node may be analyzed with (replace below `node1` by the node name and `AM` by the module name): ✓ the web console at URI /console/en/monitoring/modules/AM/nodes/node1/logs ✓ the command executed on `node1` `safekit logview -m AM` for the module log ✓ on `node1`, into files `SAFEVAR/modules/AM/userlog_<year>_<month>_<day>T<time>_<script name>.ulog` for the scripts log With the module log, you can understand why the module is no longer in its stable state ✓ `(Ready)`. With the scripts log, you can see the output messages of module scripts (`start_xxx` and `stop_xxx`). Note that a module can leave its stable ✓ `(Ready)` because of an administrator command: `safekit stop | restart | swap | stopstart | forcestop… -m AM`	➾ You will find a list of SafeKit log messages in Log Messages Index page 307. ➾ Messages in the log after an administrator command are: "Action start called by web@<IP>/SYSTEM/root" "Action stop called by web@<IP>/SYSTEM/root" "Action restart called by web@<IP>/SYSTEM/root" "Action swap called by web@<IP>/SYSTEM/root" "Action stopstart called by web@<IP>/SYSTEM/root" "Action forcestop called by web@<IP>/SYSTEM/root" web@<ip>: via the SafeKit console SYSTEM: command on Windows root: command on Linux ➾ If "Stopping loop" appears in the module log, see section 7.11 page 119

Resources state of the module on one node may be analyzed with (replace below `node1` by the node name and `AM` by the module name):
✓ the web console at URI /console/en/monitoring/modules/AM/nodes/node1/resources
✓ the command executed on `node1` `safekit state -m AM -v`
	➾ Module status
	`state.local, state.remote`
	`usersetting.errd, usersetting.checker, usersetting.encryption`
	➾ Checkers
	`proc.xxx, intf.xxx, custom.xxx`
	➾ File replication
	`rfs.uptodate, rfs.degraded, rfs.reintegre_failed`

7.4 How to read the commands log of the server?

There is a log of the `safekit` commands ran on the server.

Commands log may be displayed using:

✓ the command `safekit cmdlog`

See section 10.9 page 169 for more details.

7.5 Stable module ✓ `(Ready)` and ✓ `(Ready)`

A stable mirror module on 2 servers is in the state ✓`PRIM (Ready)` - ✓`SECOND (Ready)`: the application is running on the `PRIM` server; on failure, the `SECOND` server is ready to resume the application.

A stable farm module is in the state ✓`UP (Ready)` on all servers of the farm: the application is running on all servers.

7.6 Degraded module ✓ `(Ready)` and ✗/○ `(NotReady)`

A degraded mirror module is in the state ✓`ALONE (Ready)` - ✗`STOP`/○`WAIT (NotReady)`. There is no recovery server, but the application is running on the `ALONE` server.

A degraded farm module is in the state ✓`UP (Ready)` on at least one server of the farm, the other servers being in the state ✗`STOP`/○`WAIT (NotReady)`. The application is running on the `UP` server.

In the degraded case, there is no emergency procedure to implement. Analysis of the state ✗`STOP`/○`WAIT (NotReady)` can be done later. However, you can attempt to restart the module in a stable state:

see 7.8 "Module ✗ `STOP (NotReady)`: restart the module" page 116

see 7.9 "Module ○`WAIT (NotReady)`: repair the `resource="down"`" page 117

7.7 Out of service module ✗/○ `(NotReady)` and ✗/○ `(NotReady)`

An out of service mirror or farm module is in the state ✗`STOP`/○`WAIT (NotReady)` on all servers. In this case, the application is not operational on any server anymore. You must restore the situation and restart the module in ✓ `(Ready)` on at least one server:

see 7.8 "Module ✗ `STOP (NotReady)`: restart the module" page 116

see 7.9 "Module ○`WAIT (NotReady)`: repair the `resource="down"`" page 117

7.8 Module ✗ `STOP (NotReady)`: restart the module

Restart the stopped module (replace below `AM` by the module name) with:

- ✓ the web console via 👁 Monitoring/••• on the node/▷ Start/
- ✓ the command `safekit start -m AM` executed on the node

Check that the module becomes ✓ `(Ready)`.

Analyze results of start in the module and scripts logs (replace below `node1` by the node name and `AM` by the module name) with:

- ✓ the web console at URI /console/en/monitoring/modules/AM/nodes/node1/logs
- ✓ the command `safekit logview -m AM` on `node1`, for the module log
- ✓ the files `SAFEVAR/modules/AM/userlog_<year>_<month>_<day>T<time>_<script name>.ulog` on `node1`, for the scripts log

7.9 Module ○`WAIT (NotReady)`: repair the `resource="down"`

If the module is in the state ○`WAIT (NotReady)`, it waits for the state of a resource to become `up`.

You must identify and fix the problem that caused the resource state to go `down`.

To determine the resource involved, analyze the module log and resources (see 7.3 page 114).

Notes:

A wait checker is started after the `prestart` script and stopped before `poststop`.

The checker is active on all servers ✓`ALONE/PRIM/SECOND/UP (Ready)`.

The action of the checker upon detecting an error is to set a resource to `down`.

A failover rule referencing the resource performs the `stopwait` action.

The module is locally in state ○`WAIT (NotReady)` while the resource stays `down`.

The module exits the ○`WAIT(NotReady)` state as soon as the checker sets the resource back to `up`.

Messages from wait checkers:

⇨ files not up-to-date locally: see section 5 page 93

"Data may be not uptodate for replicated directories (wait for the start of the remote server)"
"Action wait from failover rule notuptodate_server"
"If you are sure that this server has valid data, run safekit prim to force start as primary"

⇨ `<interface check="on">` checker of a local network interface

"Resource intf.ip.0 set to down by intfcheck"
"Action wait from failover rule interface_failure"

⇨ `<ping>` checker of an external IP

"Resource ping.id set to down by pingcheck"
"Action wait from failover rule ping_failure"

⇨ `<module>` checker of another module

"Resource module.othermodule_ip set to down by modulecheck"
"Action wait from failover rule module_failure"

⇨ `<tcp ident="id" when="pre">` checker of an external TCP service

"Resource tcp.id set to down by tcpcheck"
"Action wait from failover rule tcpid_failure"

⇨ `<custom ident="id" when="pre">` customized checker

"Resource custom.id set to down by customscript"
"Action wait from failover rule customid_failure"

⇨ `<splitbrain>` checker

"Resource splitbrain.uptodate set to down by splitbraincheck"

…

"Action wait from failover rule splitbrain_failure"

Files not up-to-date locally due to split-brain: see section 13.17 page 260

7.10 Module oscillating from ✓ `(Ready)` to ⟳ `(Transient)`

If a module oscillates from state `(Ready)` to state ⟳ `(Transient)`, it is probably a victim of a `restart` or `stopstart` checker which detects a constant error.

By default, after the 4th unsuccessful restart on a server, the module stops, and the server stabilizes in ✗ `STOP (NotReady)`.

Use the module log to determine which checker is the source of the logs (to read logs, see section 7.3 page 114).

Notes:

A `restart` or `stopstart` checker is defined in `userconfig.xml` by:

- ✓ `when="prim"` for a mirror module

  The checker is started on the node ✓ `PRIM/ALONE (Ready)` after script `start_prim` (stopped before `stop_prim`). It checks the application started in `start_prim`.

- ✓ `when="both"` for a farm module

  The checker is started on all nodes ✓ `UP (Ready)` after script `start_both` (stopped before `stop_both`). It checks the application started in `start_both`.

The action of a checker on an error is to restart or stopstart the module. stopstart on ✓ `PRIM (Ready)` leads to a failover of the primary on the other node.

The module is in the state ⟳ `PRIM/UP (Transient)` during the application restart.

After several oscillations, the module stops with "Stopping loop" in the module log: see section 7.11 page 119

Messages from `restart` or `stopstart` checkers:

⇨ `<errd>` in `userconfig.xml`

checker of processes

"Process appli.exe not running"
"Action restart|stopstart called by errd"

⇨ `<tcp ident="id" when="prim"|"both">` in `userconfig.xml`

TCP checker of the application

"Resource tcp.id set to down by tcpcheck"
"Action restart|stopstart from failover rule tcp_failure"

⇨ `<custom ident="id" when="prim"|"both">` in `userconfig.xml`

custom checker

"Resource custom.id set to down by customscript"
"Action restart|stopstart from failover rule customid_failure"

or

"Action restart|stopstart called by customscript"

7.11 Message on stop after maxloop

If an error detected by a checker repeats itself several times and successively, the module is stopped on the server in ✗`STOP(NotReady)`: because the error is permanent, and the action of the checker cannot correct it If in `userconfig.xml`, there is no parameter `maxloop` / `loop_interval` in `<service>`, by default, `maxloop="3" loop_interval="24"` if the checkers generate more than 3 unsuccessful restarts (restart, stopstart, stopwait) in less than 24H, then stop of module: ✗`STOP(NotReady)`. The counter is reset to 0 if an administrator executes an action on the module such as `safekit start -m AM` (replace AM by the module name) or `safekit stop -m AM` (without the option `-i <identity>`)	Message on stop after maxloop "Stopping loop"

7.12 Module ✓ (Ready) but non-operational application

If a server has a status of ✓`PRIM (Ready)` or ✓`ALONE (Ready)` or ✓`UP (Ready)`, the application can be non-operational because of undetected errors on start-up. In the following, replace `node1` by the node name and `AM` by the module name.

⇨ Check the output messages of application scripts coming from `start_prim`/`start_both` and `stop_prim/stop_both`. They are visible in (replace below node1 by the node name and AM by the module name) with:

- ✓ the web console at URI /console/en/monitoring/modules/AM/nodes/node1/logs
- ✓ the files `SAFEVAR/modules/AM/userlog_<year>_<month>_<day>T<time>_<script name>.ulog`, on node1, for the scripts log

Check if there are errors during start or stop of the application. Be careful, sometimes the userlog is disabled because it is too large with `<user logging="none">` in `userconfig.xml` of the module.

⇨ Check application scripts `start_prim(/both)` and `stop_prim(/both)` of a mirror(/farm) and `userconfig.xml` with:

- ✓ the web console at URI /console/en/configuration/modules/AM/config
- ✓ under the directory `SAFE/modules/AM` on the node1

⇨ Execute a restart of the ✓`PRIM/ALONE/UP (Ready)` node to stop and restart locally the application (without failover) with:

- ✓ the web console via Monitoring/••• on the node/Restart/
- ✓ the command `safekit restart -m AM` executed on the node (replace `AM` by the module name)

⇨ If the application is still non-operational, apply a stop ✓`PRIM/ ALONE / UP (Ready)` node to stop and the application (stopstart makes a failover if the other node is `Ready`) with:

- ✓ the web console via Monitoring/••• on the node/ ☐ Stop/
- ✓ the command `safekit stop -m AM` executed on the node

7.13 Mirror module ✓`ALONE (Ready)` - ○`WAIT`/✗`STOP (NotReady)`

If a mirror module stays in state ✓`ALONE (Ready)` - ○`WAIT (NotReady)`, check the resource `state.remote` on each node (to read resources, see section 7.3 page 114). If this state is `UNKNOWN` on the two nodes, there is probably a communication problem between the nodes. This problem may also lead to ✓`ALONE (Ready)` - ✗`STOP (NotReady)`.

Possible root causes are:

- Real network problem

  Check your network configurations on the two nodes.

- Firewall rules on one or the two nodes

  For details, see section 10.3 page 156

- Not the same SafeKit cluster configuration or cluster cryptographic keys

  To communicate, cluster nodes must belong to the same cluster and have the same configuration (see section 12 page 201):

  - ✓ The web console warns if nodes in the cluster nodes list have not an identical configuration
  - ✓ The command: `safekit cluster confinfo` on any nodes of the cluster must report an identical configuration signature for all nodes of the cluster (see 9.3 page 142)

  If the cluster configuration is not identical, re-apply the cluster configuration on all cluster nodes as described in 3.2.2 page 42.

- Not the same module cryptographic keys

  When cryptographic has been enabled for the module, the resource `usersetting.encryption` is "`on`" (to read resources, see section 7.3 page 114). If the nodes do not have the same keys for the module, the nodes will not be able to communicate for the internal module communications.

  To distribute the same module cryptographic keys, re-apply the module configuration on all nodes.

  See section 10.5 page 162 for details.

- Expired cryptographic keys

  In SafeKit <= 7.4.0.31, the key for encrypting the module communication has a validity period of 1 year. When it expires in a mirror module with file replication, the secondary fails to reintegrate and the module stops with an error message into the log:

  ```
  reintegre | D | XXX clnttcp_create: socket=7 TLS handshake failed
  ```

  In SafeKit > 7.4.0.31, the message is:

  ```
  reintegre | D | XXX clnttcp_create: socket=7 TLS handshake failed.
  Check server time and module certificate (expiration date, hash)
  ```

  To solve this problem, see 10.5.3.1 page 163

7.14 Farm module ✓`UP (Ready)` but problem of load balancing in a farm

Even though all servers in the farm are ✓`UP (Ready)`, load balancing is not working.

7.14.1 Reported network load share are not coherent

In a farm module, the sum of the network load share of all ✓`UP (Ready)`, module nodes must be equal to 100%.

If it's not the case, there is probably a communication problem between module nodes. Possible root causes are the same as for a mirror module. See section 7.13 page 121 for possible solutions.

See also section 4.3.6 page 81

7.14.2 virtual IP address does not respond properly

If the virtual IP does not respond properly to all requests for connections:

- ➩ choose a node in the farm that receives and processes connections on the virtual IP address (established TCP connections):
  - ✓ in Windows, use the command `netstat -an | findstr <virtual IP address>`
  - ✓ in Linux, use the command `netstat -an | grep <virtual IP address>`
- ➩ stop the farm module on all nodes except the one that receives connections and that remains ✓`UP (Ready)` with:
  - ✓ the web console via Monitoring/••• on the node/ ☐ Stop/
  - ✓ the command `safekit stop -m AM` (replace `AM` by the module name)
- ➩ check that all connections to the virtual IP address are handled by the single server ✓`UP (Ready)`

For a more detailed analysis on this topic, see:

4.3.4 "Test virtual IP address of a farm module" page 78

4.3.5 "Test TCP load balancing on a virtual IP address" page 80

4.3.7 "Test compatibility of the network with invisible MAC address" page 82

7.15 Problem after Boot

If you encounter a problem after boot, see section 4.1 page 67.

Note that by default, modules are not automatically started at boot. For this, you must setup the boot start into the module's configuration with:

- ✓ the web console at /console/en/configuration/modules/AM/config
- ✓ in file `SAFE/modules/AM/conf/userconfig.xml` on the node1, with the `boot` attribute of the `service` tag (see section 13.2.3 page 209)

Then apply the new configuration on all nodes.

7.16 Analysis from snapshots of the module

When the problem is not easily identifiable, it is recommended to take a snapshot of the module on all nodes as described in section 3.5 page 63. A snapshot is a zip file that collects, for one module, the configuration files, dumps, ... Its content allows an offline and in-depth analysis of the module and node status.

Note

The structure and content of the snapshot varies depending on the version of SafeKit.

Since SafeKit 8.1, the structure of the snapshot is as follows:

snapshot_centos7-test3_mirror	⇨ `snapshot_nodename_AM` Snapshot for the module `AM` get from the node named `nodename`
mirror	⇨ `AM` Application module name
config_2021_05_05_14_15_42 config_2021_07_08_16_34_05 config_2021_08_05_16_35_08	⇨ `config_year_month_day_hour_mn_sec` Last 3 configurations for the module, including the current one
dump_2021_05_06_09_10_40 dump_2021_07_16_19_18_03 dump_2021_08_06_09_18_46	⇨ `dump_year_month_day_hour_mn_sec` Last 3 dumps for the module, including the last one
tmp	⇨ for the level 3 support

7.16.1 Module configuration files

The module configuration files are saved as follows:

config_2021_08_05_16_35_08 module bin conf web private	`module` directory contains the user configuration files ⇨ `bin` directory scripts `start_xx`, `stop_xx`, ... ⇨ `conf` directory XML configuration `userconfig.xml`

⇨ Check the user configuration file and scripts for troubleshooting with the application integration into SafeKit

7.16.2 Module dump files

The dump contains the state of the module and the SafeKit node as it was at the time of the dump.

csv licenses userlog var web	➾ `csv` directory logs and status in csv format ➾ `licences` directory SafeKit licenses get from `SAFE/conf` directory ➾ `userlog` directory: module scripts logs ➾ `var` directory Extract of the `SAFEVAR` directory ➾ `web` directory web server configuration gets from `SAFE/web/conf` directory
log.txt logverbose.txt	➾ Module logs (not verbose and verbose)
heartplug	➾ Information file Various information about the node (list and status of installed modules, OS version, disk, and network configuration, ...)
last.txt systemevt.txt Or systemevt.txt applicationevt.txt	➾ System logs `last.txt` and `systemevt.txt` in Linux Or `applicationevt.txt` and `systemevt.txt` in Windows
commandlog.txt	➾ Commands log for the node
heart heart.trc nfsbox nfsbox.trc	➾ Trace files for level 3 support

➾ Check the license file(s) into `licenses` directory for troubleshooting with the SafeKit license check

- Check the Apache configuration files into `web` directory for troubleshooting with the SafeKit web service
- Check the module logs, in `log.txt` and `logverbose.txt`, for troubleshooting with the module behavior
- Check the module scripts logs `userlog/userlog_<year>_<month>_<day>T<time>_<script name>.ulog` for troubleshooting with application start/stop
- If necessary, look at `heartplug` file for some information on the node and search the system logs for events that occurred at the same time as the problem being analyzed
- Check the commands log `commandlog.txt` for troubleshooting with cluster management or distributed commands

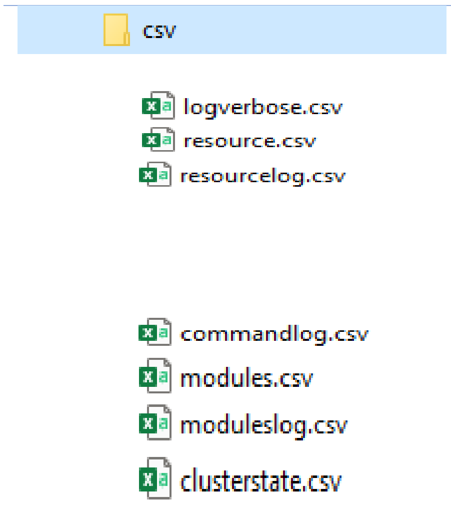
7.16.2.1 `var` directory

The `var` directory is mainly for the level 3 support. It is a copy of some part of the `SAFEVAR` directory. In the `var/cluster` directory:

- look at the `cluster.xml` file for checking the cluster configuration
- look at the `cluster_ip.xml` file for checking the DNS name resolution of names into the cluster configuration

7.16.2.2 `csv` directory

The logs and reports are also exported into csv format in the `csv` directory:

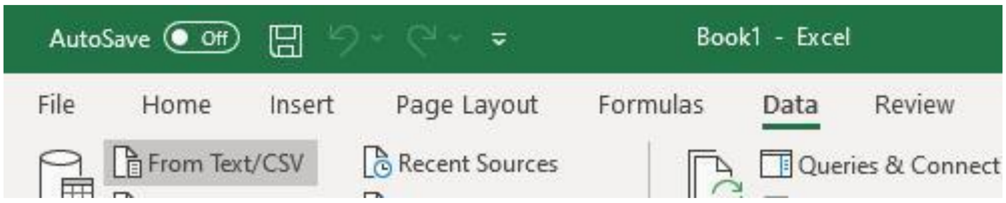


csv	
	Logs and status of the module
logverbose.csv	Verbose log
resource.csv	Resources status
resourcelog.csv	Resources status history
	Logs and status of the node
commandlog.csv	Commands log
modules.csv	List of installed modules
moduleslog.csv	For the level 3 support
clusterstate.csv	For the level 3 support

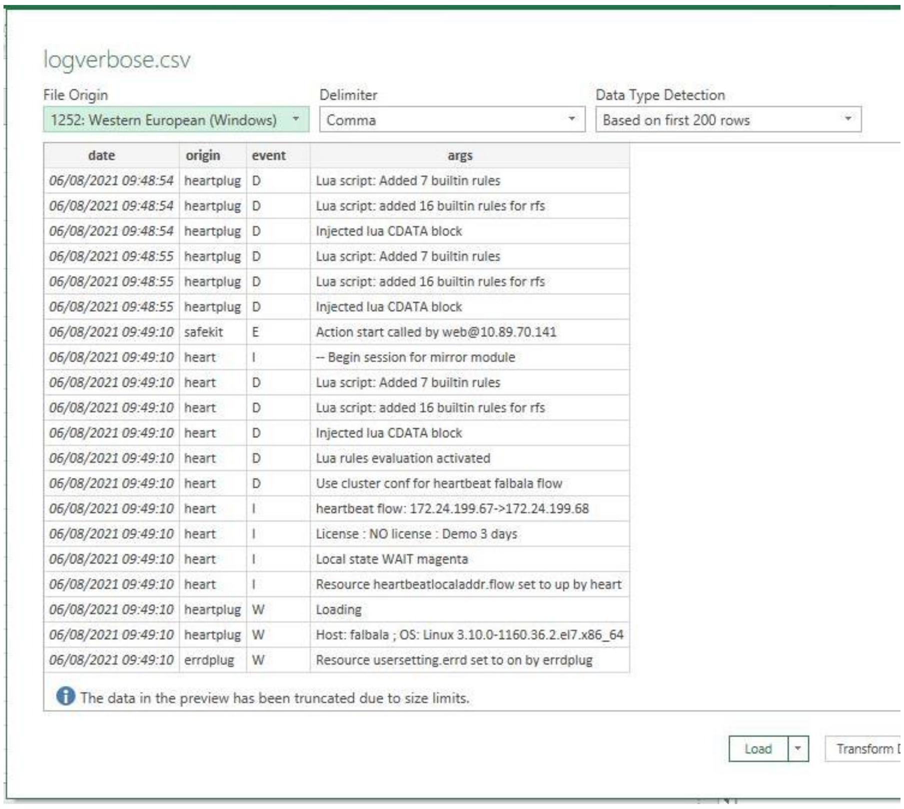
- Import the csv files into an Excel sheet to facilitate their analysis

  To import a file:

  1. Create a new sheet
  2. From the Data tab, import From Text/CSV



3. In the dialog box, locate and double-click the csv file to import, then click Import
4. Then click on Load



logverbose.csv

File Origin: 1252: Western European (Windows)
Delimiter: Comma
Data Type Detection: Based on first 200 rows

date	origin	event	args
06/08/2021 09:48:54	heartplug	D	Lua script: Added 7 builtin rules
06/08/2021 09:48:54	heartplug	D	Lua script: added 16 builtin rules for rfs
06/08/2021 09:48:54	heartplug	D	Injected lua CDATA block
06/08/2021 09:48:55	heartplug	D	Lua script: Added 7 builtin rules
06/08/2021 09:48:55	heartplug	D	Lua script: added 16 builtin rules for rfs
06/08/2021 09:48:55	heartplug	D	Injected lua CDATA block
06/08/2021 09:49:10	safekit	E	Action start called by web@10.89.70.141
06/08/2021 09:49:10	heart	I	-- Begin session for mirror module
06/08/2021 09:49:10	heart	D	Lua script: Added 7 builtin rules
06/08/2021 09:49:10	heart	D	Lua script: added 16 builtin rules for rfs
06/08/2021 09:49:10	heart	D	Injected lua CDATA block
06/08/2021 09:49:10	heart	D	Lua rules evaluation activated
06/08/2021 09:49:10	heart	D	Use cluster conf for heartbeat falbala flow
06/08/2021 09:49:10	heart	I	heartbeat flow: 172.24.199.67->172.24.199.68
06/08/2021 09:49:10	heart	I	License : NO license : Demo 3 days
06/08/2021 09:49:10	heart	I	Local state WAIT magenta
06/08/2021 09:49:10	heart	I	Resource heartbeatlocaladdr.flow set to up by heart
06/08/2021 09:49:10	heartplug	W	Loading
06/08/2021 09:49:10	heartplug	W	Host: falbala ; OS: Linux 3.10.0-1160.36.2.el7.x86_64
06/08/2021 09:49:10	errdplug	W	Resource usersetting.errd set to on by errdplug

The data in the preview has been truncated due to size limits.

You can use the Excel features to filter rows according to the level of the messages, ... and load in different sheets the csv of each node.

Note

For the exact date, format cells with N`umber/Custom jj/mm/aaaa hh:mm:ss,000`

7.17 Problem with the size of SafeKit databases

SafeKit uses SQLite3 storage to save:

⇨ The log and the status of the node

- ✓ `SAFEVAR/log.db` contains the commands log
- ✓ `SAFEVAR/resource.db` contains the list of installed modules and its history

These are referred to as node databases.

- The log and the resources of the module
  - ✓ `SAFEUSERVAR/log.db` contains the module log
  - ✓ `SAFEUSERVAR/resource.db` contains the state of the module resources and its history

  These are referred to as module databases.

The size of the logs and histories increases as events occur on the SafeKit node and modules. Therefore, they should be purged regularly by deleting the oldest entries. This is automatically done thanks to a periodic job (task scheduler in Windows; crontab in Linux) that is controlled by the `safeadmin` service. The clean of the node databases is always active. The clean of the module databases is active only when the module is running. To check that the jobs are ready:

- Job for cleaning node databases
  - ✓ In Windows, run `schtasks /QUERY /TN safelog_clean`
  - ✓ In Linux, run `crontab -u safekit -l`

    The output of this command must contain the `safelog_clean` entry
- Job for cleaning `AM` module databases (where `AM` is the module name)
  - ✓ In Windows, run `schtasks /QUERY /TN safelog_AM`
  - ✓ In Linux, run `crontab -u safekit -l`

    The output of this command must contain the `safelog_clean_AM` entry

The clean-up is implemented by a script located into `SAFEBIN` (in Linux, `SAFEBIN=/opt/safekit/private/bin`; in Windows, `SAFE=C:\safekit\private\bin` - if `%SYSTEMDRIVE%`=C:):

`dbclean.ps1` in Windows and `dbclean.sh` in Linux	Clean the log and history in the node databases
`dbclean.ps1 AM` in Windows and `dbclean.sh AM` in Linux	Clean the log and history in the databases of the module named `AM`

If necessary, you can run this script outside the scheduled period to force the databases clean-up.

7.18 Problem for retrieving the certification authority certificate from an external PKI

When using an external PKI, you must provide the certificate of the certification authority `CA` used to issue server certificates (`cacert.crt` file containing the chain of certificates for the root and intermediates Certification Authorities)

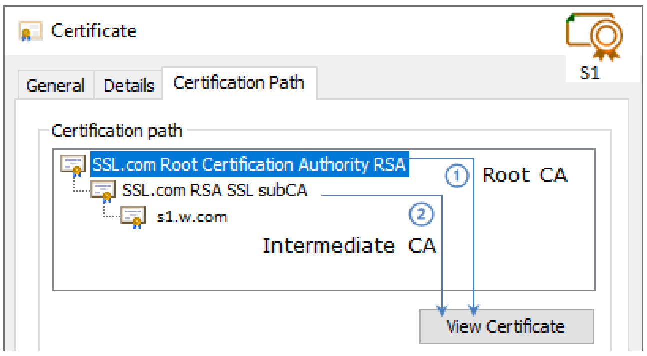
If you have trouble retrieving these files from an external PKI, you can build them using the procedure described below.

7.18.1 Export CA certificate(s) from public certificates

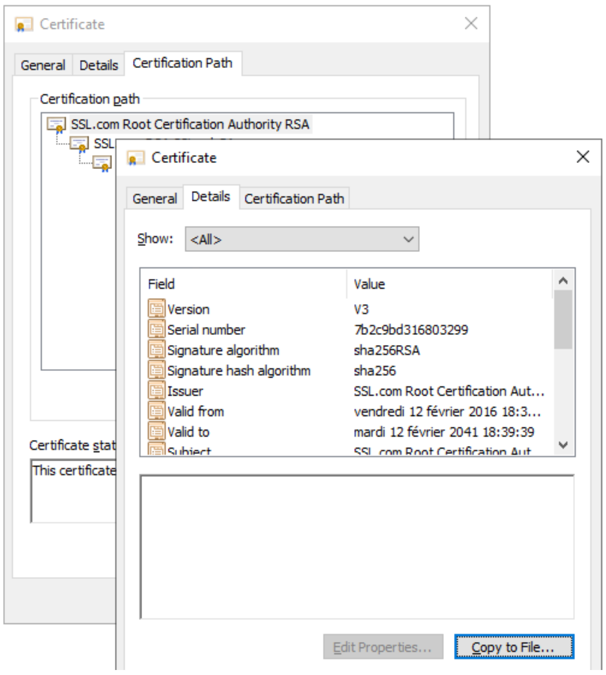
The following procedure explains how to build from a public certificate, the chain of certificates for the root and intermediates Certification Authorities, into the file `combined.cer`.

When you have the public certificate (.crt or .cer file in Base-64 encoded X.509 format) generated by the PKI:

1. Copy the .crt (or .cer) file on a Windows workstation
2. Double click on this file to open it with "Crypto Shell Extensions"
3. Select the "Certification Path" tab to view the tree of certification authorities
4. Select an entry (from top to down except the leaf)

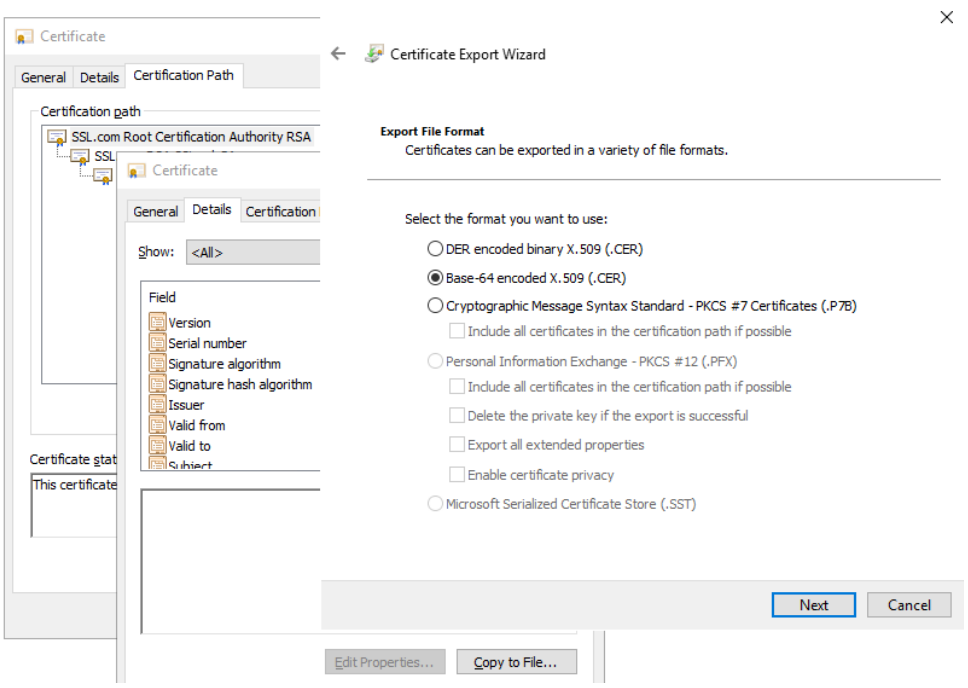


5. Click on "View Certificate". A new window is opened with details for the selected certificate
6. In this new window, select the "Details" tab and click "Copy to File"



Field	Value
Version	V3
Serial number	7b2c9bd316803299
Signature algorithm	sha256RSA
Signature hash algorithm	sha256
Issuer	SSL.com Root Certification Aut...
Valid from	vendredi 12 février 2016 18:3...
Valid to	mardi 12 février 2041 18:39:39
Subject	SSL.com Root Certification Aut

7. It opens the Certificate Export Wizard:
   a. Click on "Next" to continue
   b. On the "Export File Format" page, select "Base-64 encoded X.509 (.CER).", and then click "Next"



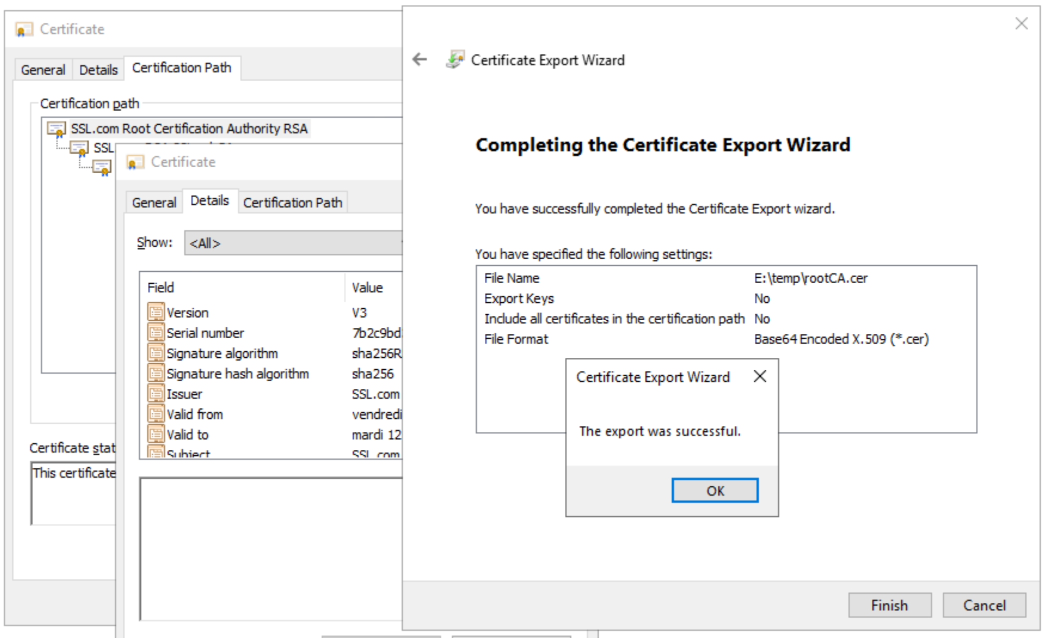
Export File Format
Certificates can be exported in a variety of file formats.

Select the format you want to use:
- DER encoded binary X.509 (.CER)
- [✓ Base-64 encoded X.509 (.CER)]
- Cryptographic Message Syntax Standard - PKCS #7 Certificates (.P7B)
  - Include all certificates in the certification path if possible
- Personal Information Exchange - PKCS #12 (.PFX)
  - Include all certificates in the certification path if possible
  - Delete the private key if the export is successful
  - Export all extended properties
  - Enable certificate privacy
- Microsoft Serialized Certificate Store (.SST)

c. For “File to Export”, “Browse” to the location to which you want to export the certificate. Fill “File name” with the name of the certificate file. Then, click “Next”

d. Click “Finish” to export the certificate

e. Your certificate is successfully exported



Completing the Certificate Export Wizard

You have successfully completed the Certificate Export wizard.

You have specified the following settings:

File Name	E:\temp\rootCA.cer
Export Keys	No
Include all certificates in the certification path	No
File Format	Base64 Encoded X.509 (*.cer)

The export was successful.

8. Now repeat steps 4-7 for all entries (except the last one) to export all intermediate CA certificates in the Base-64 encoded X.509(.CER) format. For the example, you would repeat steps 4-7 on SSSL.com RSA subCA intermediate CA to extract it as its own certificate.

9. Concatenate all your CA certificates into one file `combined.cer`

Run the following command with all the CA certificates you extracted earlier:

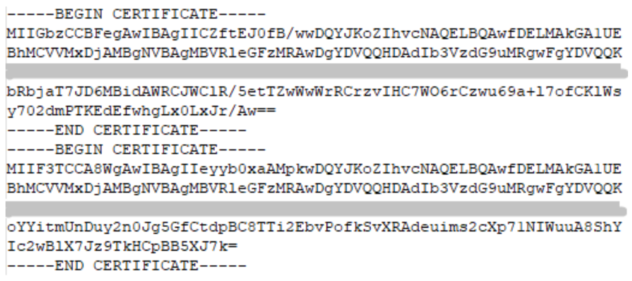
- ✓ In Windows:

  ```
  type intermediateCA.cer rootCA.cer > combined.cer
  ```

- ✓ In Linux:

  ```
  cat intermediateCA.cer rootCA.cer >> combined.cer
  ```

The resulting combined certificate should look something like the following:



```
-----BEGIN CERTIFICATE-----
MIIGbzCCBFegAwIBAgIICZftEJ0fB/wwDQYJKoZIhvcNAQELBQAwfDELMAkGA1UE
BhMCVVMxDjAMBgNVBAgMBVRleGFzMRAwDgYDVQQHDAdIb3VzdG9uMRgwFgYDVQQK
bRbjaT7JD6MBidAWRCJWClR/5etTZwWwWrRCrzvIHC7WO6rCzwu69a+l7ofCKlWs
y702dmPTKEdEfwhgLx0LxJr/Aw==
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
MIIF3TCCA8WgAwIBAgIIeyyb0xaAMpkwDQYJKoZIhvcNAQELBQAwfDELMAkGA1UE
BhMCVVMxDjAMBgNVBAgMBVRleGFzMRAwDgYDVQQHDAdIb3VzdG9uMRgwFgYDVQQK
oYYitmUnDuy2n0Jg5GfCtdpBC8TTi2EbvPofkSvXRAdeuims2cXp7lNIWuuA8ShY
Ic2wBlX7Jz9TkHCpBB5XJ7k=
-----END CERTIFICATE-----
```

This file can be used as the `SAFE/web/conf/cacert.crt`

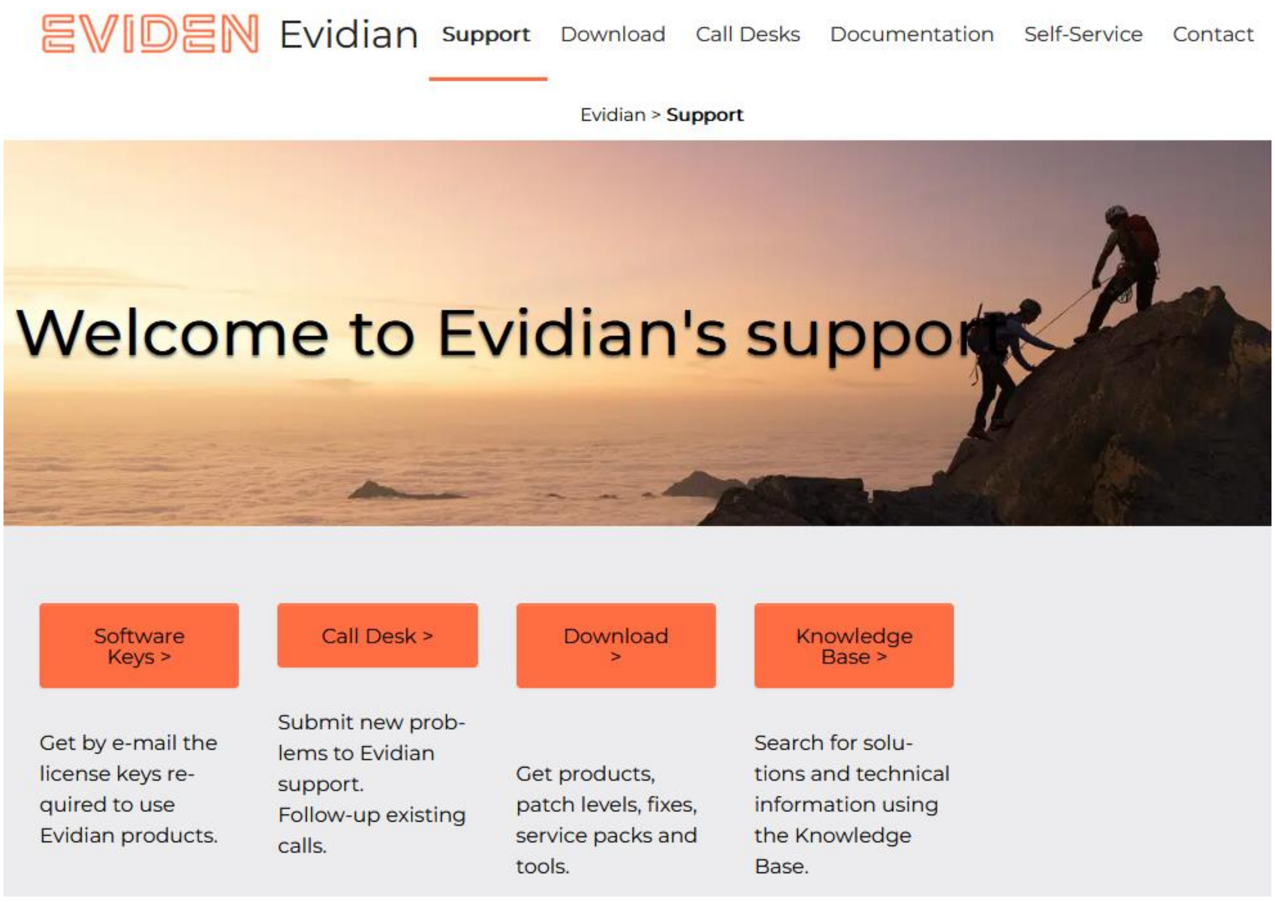
7.19 Still in Trouble

See Messages Index page 307

See section 8.5 page 134 for opening a ticket at the call desk

8. Access to Evidian support

8.1 Home page of support site



Get by e-mail the license keys required to use Evidian products.

Submit new problems to Evidian support. Follow-up existing calls.

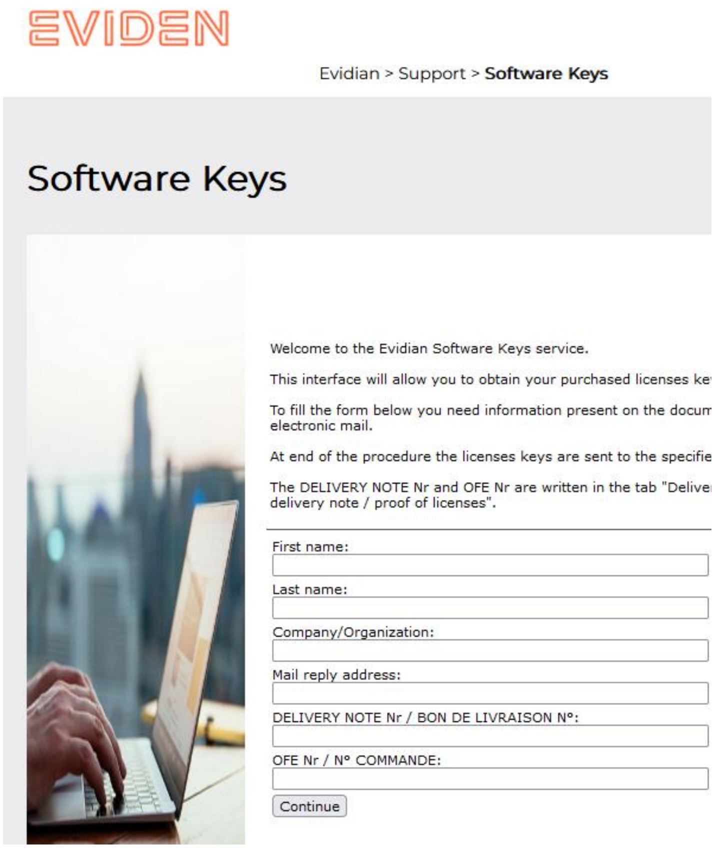
Get products, patch levels, fixes, service packs and tools.

Search for solutions and technical information using the Knowledge Base.

- https://www.evidian.com/support
- Software Keys: get permanent keys
- Subscription Request: create an account
- Download: download product or upload snapshots
- Call desk: tool for opening a call on problem
- Knowledge Base: base of KB

8.2 Permanent license keys

- ➪ https://www.evidian.com/support/software-keys/
- ➪ Software Keys: get permanent keys
- ➪ Fill-in the form with the delivery note sent after a purchase order
- ➪ Take "hostname" and OS of your servers
- ➪ To obtain a temporary key for any hostname and any OS, for details see section 2.1.5 page 29



EVIDEN

Evidian > Support > **Software Keys**

Software Keys

Welcome to the Evidian Software Keys service.

This interface will allow you to obtain your purchased licenses ke

To fill the form below you need information present on the docum electronic mail.

At end of the procedure the licenses keys are sent to the specifie

The DELIVERY NOTE Nr and OFE Nr are written in the tab "Delive delivery note / proof of licenses".

First name:

Last name:

Company/Organization:

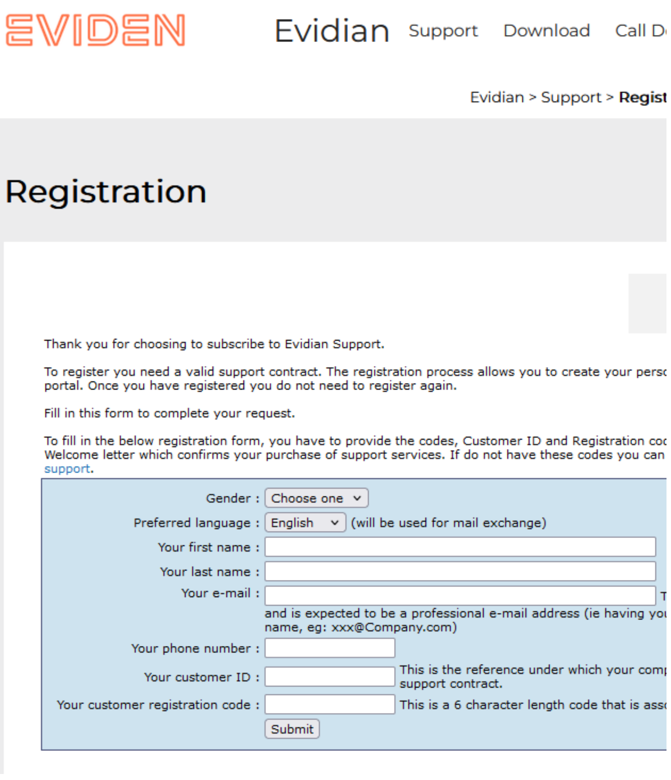
Mail reply address:

DELIVERY NOTE Nr / BON DE LIVRAISON N°:

OFE Nr / N° COMMANDE:

8.3 Create an account

- https://www.evidian.com/support/registration/
- Subscription Request: create an account
- The procedure must be executed once with:
  - Your client identity
  - Your confidential identity
  - A unique e-mail address
- Note: your identities are sent by mail if you take an Evidian support contract
- What you will obtain: a user account and a private password on the site



Registration

Thank you for choosing to subscribe to Evidian Support.

To register you need a valid support contract. The registration process allows you to create your persc portal. Once you have registered you do not need to register again.

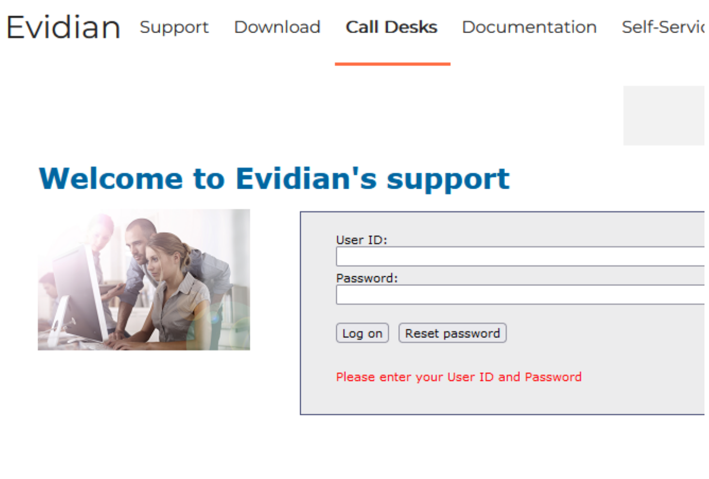
Fill in this form to complete your request.

To fill in the below registration form, you have to provide the codes, Customer ID and Registration coc Welcome letter which confirms your purchase of support services. If do not have these codes you can support.

Gender :	Choose one
Preferred language :	English (will be used for mail exchange)
Your first name :	
Your last name :	
Your e-mail :	T and is expected to be a professional e-mail address (ie having yo name, eg: xxx@Company.com)
Your phone number :	
Your customer ID :	This is the reference under which your comp support contract.
Your customer registration code :	This is a 6 character length code that is ass

8.4 Access to your account

- https://www.evidian.com/support/call-desk/
- Login on top at right with your identity and password
- Then you have access to all services of support site



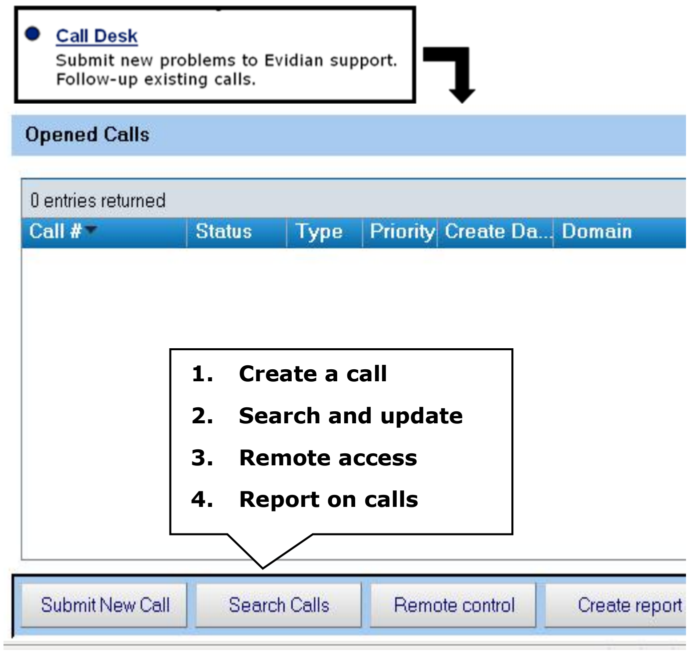
Evidian Support Download Call Desks Documentation Self-Servi
Welcome to Evidian's support
User ID:
Password:
Log on
Reset password

Please enter your User ID and Password

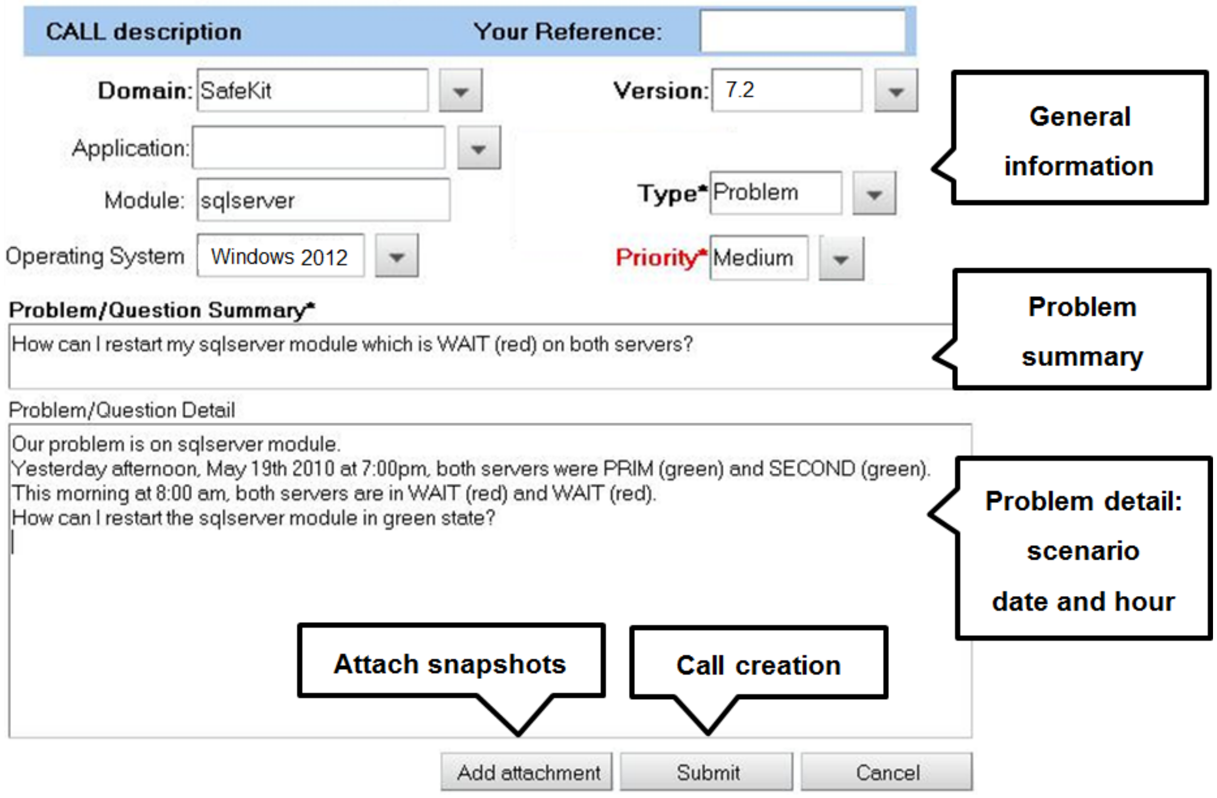
8.5 Call desk to open a trouble ticket

8.5.1 Call desk operations

- https://www.evidian.com/support/call-desk/
- Call desk: tool to open a trouble ticket on problem with 2 main operations
- Create a call
- Search for a Call and exchange with support on a Call



8.5.2 Create a call



CALL description Your Reference:

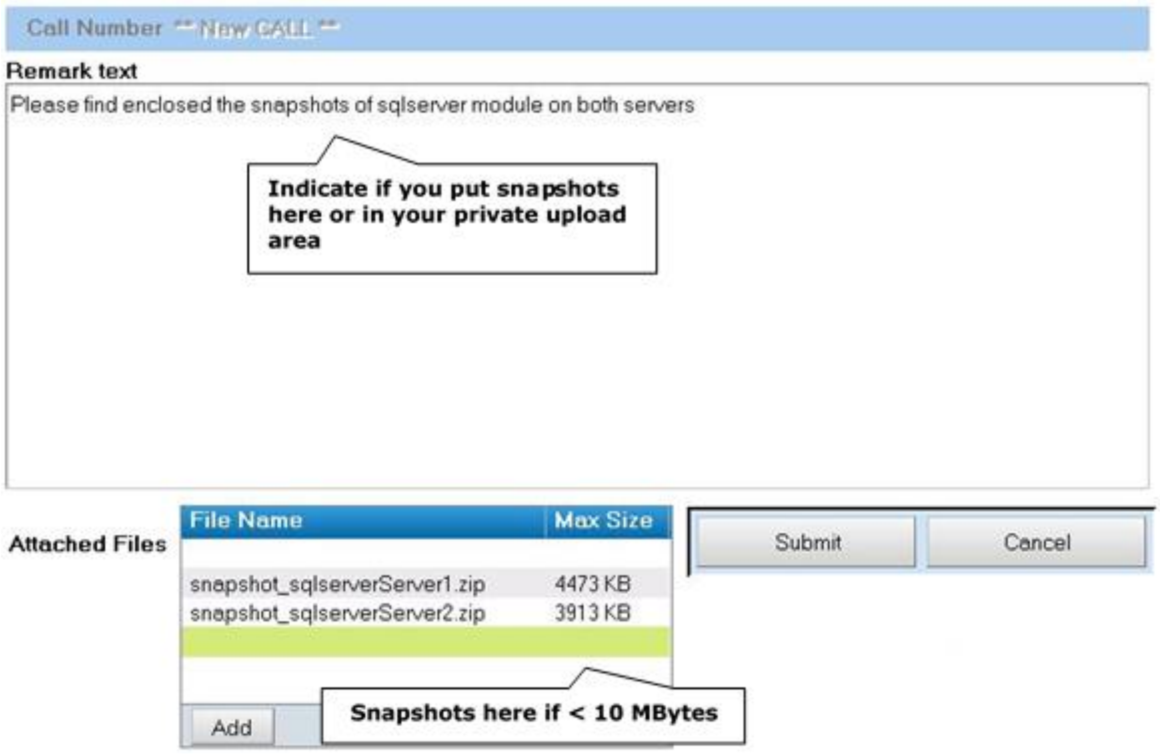
Domain:	SafeKit	Version:	7.2
Application:			
Module:	sqlserver	Type*	Problem
Operating System	Windows 2012	Priority*	Medium

Problem/Question Summary*
How can I restart my sqlserver module which is WAIT (red) on both servers?

Problem/Question Detail
Our problem is on sqlserver module.
Yesterday afternoon, May 19th 2010 at 7:00pm, both servers were PRIM (green) and SECOND (green).
This morning at 8:00 am, both servers are in WAIT (red) and WAIT (red).
How can I restart the sqlserver module in green state?

- In the header, specify the SafeKit version, problem type and priority as well as the module name and the OS
- Summarize the problem and then describe with more details the scenario and the date and time of the problem
- Snapshots of the SafeKit module causing problem are necessary for the analysis. See next section for attaching snapshots
- Create the call by pressing "Submit"

8.5.3 Attach the snapshots


Call Number ** New CALL **

Remark text

Please find enclosed the snapshots of sqlserver module on both servers

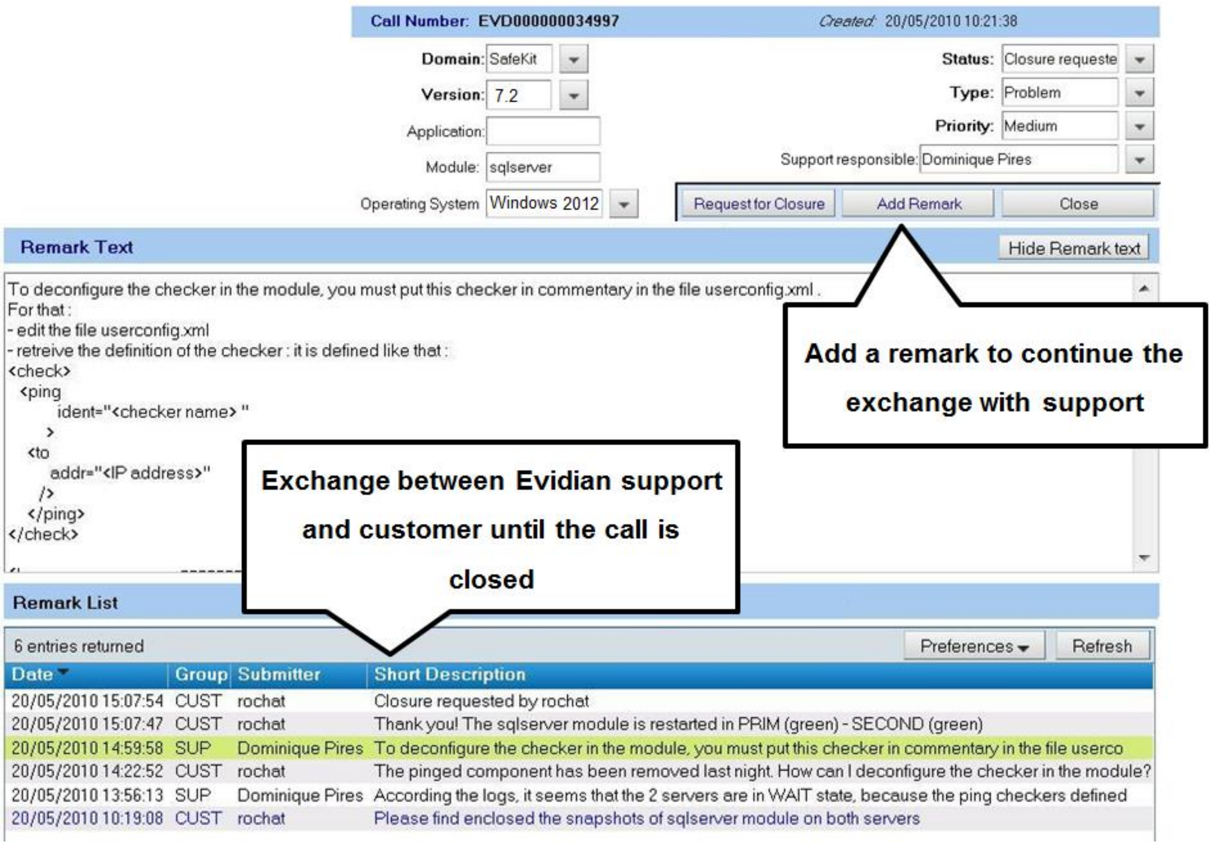
Attached Files

File Name	Max Size
snapshot_sqlserverServer1.zip	4473 KB
snapshot_sqlserverServer2.zip	3913 KB

Indicate if you put snapshots here or in your private upload area
Submit
Cancel
Add
Snapshots here if < 10 MBytes

- When there is a problem on a SafeKit module, snapshots of the module on all servers are necessary for analysis
- To get snapshots, see section 3.5 page 63
- If the snapshots size is smaller than 10 MBytes, you can attach them with the opening of the call by clicking on "Add"
- Otherwise, downloading snapshots on the support site may take several minutes. In this case indicate in "Remark text" that you download them into your private upload area: see section 8.6.3 page 138

8.5.4 Answers to a call and exchange with support


Call Number: EVD000000034997
Created: 20/05/2010 10:21:38
Domain: SafeKit
Version: 7.2
Application:
Module: sqlserver
Operating System Windows 2012
Status: Closure requeste
Type: Problem
Priority: Medium
Support responsible: Dominique Pires
Request for Closure
Add Remark
Close
Remark Text
Hide Remark text
Add a remark to continue the exchange with support
Exchange between Evidian support and customer until the call is closed
Remark List
6 entries returned
Preferences
Refresh

To deconfigure the checker in the module, you must put this checker in commentary in the file userconfig.xml .
For that :
- edit the file userconfig.xml
- retreive the definition of the checker : it is defined like that :

```
<check>
  <ping
      ident="<checker name> "
     >
   <to
      addr="<IP address>"
     />
   </ping>
</check>
```

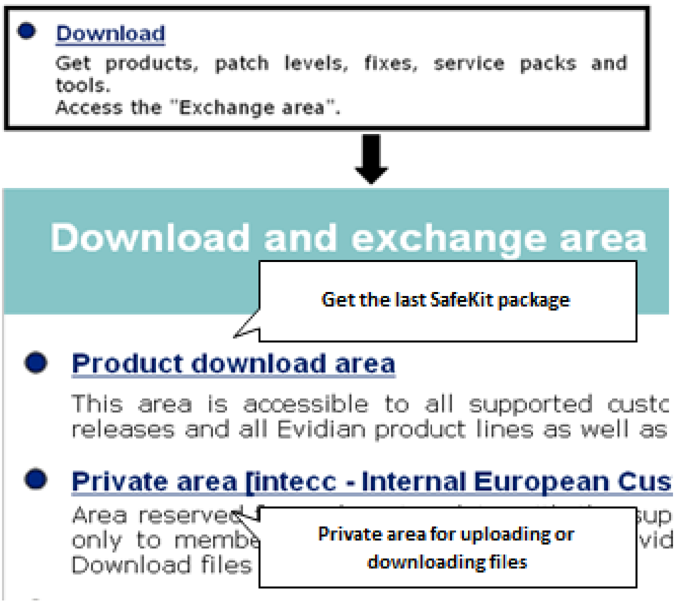
Date	Group	Submitter	Short Description
20/05/2010 15:07:54	CUST	rochat	Closure requested by rochat
20/05/2010 15:07:47	CUST	rochat	Thank you! The sqlserver module is restarted in PRIM (green) - SECOND (green)
20/05/2010 14:59:58	SUP	Dominique Pires	To deconfigure the checker in the module, you must put this checker in commentary in the file userco
20/05/2010 14:22:52	CUST	rochat	The pinged component has been removed last night. How can I deconfigure the checker in the module?
20/05/2010 13:56:13	SUP	Dominique Pires	According the logs, it seems that the 2 servers are in WAIT state, because the ping checkers defined
20/05/2010 10:19:08	CUST	rochat	Please find enclosed the snapshots of sqlserver module on both servers

- All exchanges between the support and the customer are made with "Remarks"
- When support adds a remark on a call, the customer is notified by mail. This is the case for first response of the support after the opening of the call
- After consultation of the last remark of support, the customer can add a new remark in turn
- The exchange takes place until the closure of the call by agreement between the customer and Evidian support

8.6 Download and upload area

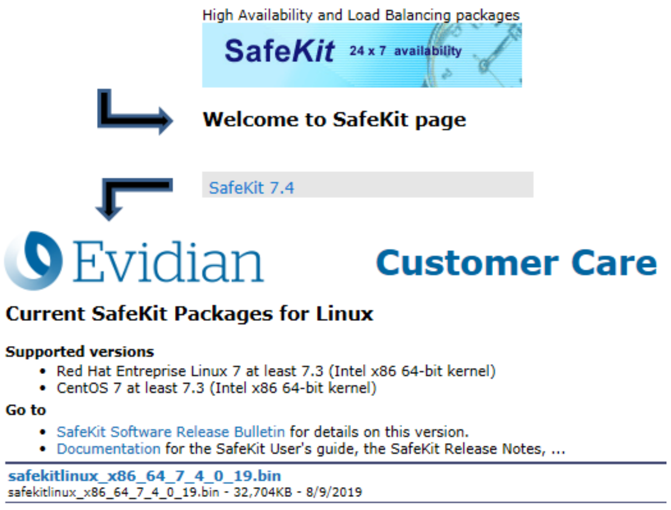
8.6.1 Two areas of download and upload

- https://www.evidian.com/support/download/
- Product download area: area for downloading SafeKit packages
- Private area [client identity]: private area to upload files


Download
Get products, patch levels, fixes, service packs and tools.
Access the "Exchange area".
Download and exchange area
Get the last SafeKit package
Product download area
This area is accessible to all supported custc
releases and all Evidian product lines as well as
Private area [intecc - Internal European Cus
Area reserved
only to membe
Download files
Private area for uploading or downloading files

8.6.2 Product download area

- Go to <Version 8.2>/Platforms/<Your platform>/Current versions
- Download the SafeKit package
- For more information on installation, documentation, upgrade, see section 2 page 25


High Availability and Load Balancing packages
SafeKit 24 x 7 availability
Welcome to SafeKit page
SafeKit 7.4
Evidian
Customer Care

Current SafeKit Packages for Linux

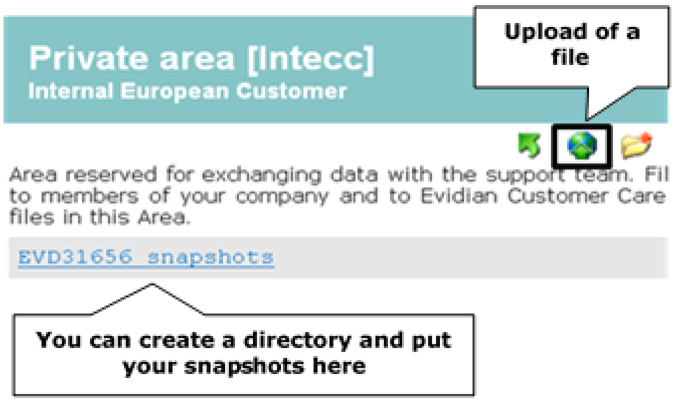
Supported versions
- Red Hat Entreprise Linux 7 at least 7.3 (Intel x86 64-bit kernel)
- CentOS 7 at least 7.3 (Intel x86 64-bit kernel)

Go to
- SafeKit Software Release Bulletin for details on this version.
- Documentation for the SafeKit User's guide, the SafeKit Release Notes, ...

safekitlinux_x86_64_7_4_0_19.bin
safekitlinux_x86_64_7_4_0_19.bin - 32,704KB - 8/9/2019

8.6.3 Private upload area

- Create a directory for a problem
- Upload snapshots in this directory with
- For building snapshots, see section 3.5 page 63
- For attaching snapshots, see section 8.5.3 page 135

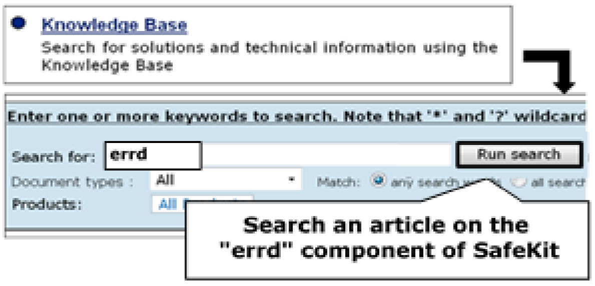

Private area [Intecc]
Internal European Customer

Area reserved for exchanging data with the support team. Fil
to members of your company and to Evidian Customer Care
files in this Area.

EVD31656 snapshots

8.7 Knowledge base

- https://support.evidian.com/knowledge_base/
- Knowledge Base: base of KB
- Search for example all articles on the errd component of SafeKit


Knowledge Base
Search for solutions and technical information using the Knowledge Base

Enter one or more keywords to search. Note that '*' and '?' wildcard

Search for: errd

Document types : All

Match: any search ... all searc

Products: All

9. Command line interface

The SafeKit command-line interface is provided by the `safekit` command. To use:

⇨ In Windows

1. Open a PowerShell console as administrator
2. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:)

   ```
   cd c:\safekit
   ```
3. Run `.\safekit.exe <arguments>`

⇨ In Linux

4. Open a Shell console as root
5. Go to the root of the SafeKit installation directory `SAFE` (by default `SAFE=/opt/safekit`)

   ```
   cd /opt/safekit
   ```
6. Run `./safekit <arguments>`

9.1 Distributed commands

Almost all `safekit` commands can be applied on a list of cluster nodes.
Exceptions are `safekit logview`, `safekit -p` and `safekit -r` commands which can be used only locally.
The distributed command line interface requires the execution of the SafeKit web service on each node of the list (see section 10.6 page 164).

`safekit -H <url>[,<url,...] <action> <arg>`	Execute action on servers specified by the URL list. URLs must be separated by commas.
	Instead of URLs, it is possible to use a comma separated list of server names as they appear in the cluster.xml file. Associated URLs are automatically built as `https:9453` or `http:9010` (depending on `SAFE/web/conf/ssl/` content)
	The special syntax –H "*" stands for all the nodes declared in the cluster.xml admin lan.
	To override protocol and port, use the [<protocol>:<port>] syntax. The ':<port>' part is optional. Protocol may be 'http' or 'https'. Default port for http protocol is 9010.
	Example: `safekit -H http://192.168.0.2:9010,http://192.168.0.3:9010 module list`
	`safekit –H "*" module list`
	`safekit –H "[http],*" module list`
	`safekit –H "[https:9500],server1,server2" module list`

`safekit [-H <url>[,...]] -E <module>`	Deploy the locally installed <module> on the servers specified -H parameter. This command performs the following actions: creates <module>.safe from local `SAFE/modules/<module>` transfers and installs <module>.safe on the list of servers if the module was configured locally, configures it on remote servers Example: `safekit -E farm` will export the local farm module to the list of servers specified in `SAFEVAR/default_cluster.txt` (see example above for syntax of `default_cluster.txt`)
`safekit [-H <url>[,…] -G`	Deploy the local cluster configuration files on all the servers specified with –H. This command performs the following actions: Collect the content of the `SAFEVAR/cluster` directory Transfer and copy the collected files into the target servers' `SAFEVAR/cluster` directory Trigger `safeadmin` configuration reload

9.2 Command lines for boot and for shutdown

Use the following commands for starting/stopping SafeKit services, configuring services and modules automatic start/stop on boot/shutdown, stopping all running modules.

In Windows, you may have to apply the procedure described in 10.4 page 161.

`safeadmin` (Windows)	SafeKit main service mandatory and started automatically at boot. `safeadmin` can be controlled using the Windows Services Control Panel applet
`service safeadmin start` (Linux)	SafeKit main service mandatory and started automatically at boot
`safekit webserver [start | stop | restart]`	Controls start/stop/restart of the `safewebserver` service. This service is used by the web console, module checkers and distributed command line interface. The command starts the httpd processes and waits for their start-up
`safekit safeagent [start | stop | restart | check]`	In Windows : Controls start/stop of the `safeagent` service that implements the SafeKit SNMP agent
`safekit boot [webon | weboff | webstatus]`	Controls the automatic start at boot of the `safewebserver` service ("on" or "off"; by default, "on")
`safekit boot [snmpon | snmpoff | snmpstatus]`	In Windows: Controls the automatic start at boot of the `safeagent` service ("on" or "off"; by default, "off")
`safekit boot [-m AM] [on | off | status]`	Controls whether the `AM` module starts automatically at boot or not ("on" or "off"; by default, "off") Without the option `-m AM`, lists the boot status of all modules. Important: The boot start of a module can be defined in the module configuration with the `boot` attribute of the `service` tag in `userconfig.xml`. This configuration option makes the `safekit boot -m AM on | off` deprecated. However, this is still supported and replaces the module configuration, provided that the `boot` attribute is not present or set with the value `ignore`.
`safekit shutdown`	Stops all running modules

9.3 Command lines to configure and monitor safekit cluster

`safekit cluster config [filepath .xml or .zip] [lock | unlock]`	Apply the new SafeKit cluster configuration with the content of the file passed as argument, cluster.xml or cluster.zip: ⇨ cluster.xml configure with new cluster.xml and generate new cryptographic keys ⇨ cluster.zip configure with the new cluster.xml and cryptographic keys stored into the zip file When called with no argument, this command keeps the current configuration but generates new cryptographic keys. Ex: `safekit cluster config /tmp/newcluster.xml` Note: Use with great care: the new cluster configuration and cryptographic key must then be copied to all cluster nodes to have the same cluster configuration on all nodes. If the command is called with the parameter `lock`, future `safekit cluster config` commands will not be granted until they are called with the `unlock` parameter.
`safekit cluster confcheck filepath`	Check the cluster configuration, with the content of the xml file passed as argument, without applying it

`safekit cluster confinfo`	Return, for each active cluster node:
	• the date of last cluster configuration,
	• the digital signature of last cluster configuration
	• the state: locked (1) or unlocked (0) status for the cluster configuration
	
	This command allows checking if all node of a cluster have the same configuration.
	Ex:
	`safekit cluster conf info`
	`Node        Signature              Date                 Lock`
	`rh6server7  6f1032b11a7b2 … 33e67c 2016-05-20T17:06:45  0`
	`rh7server7  6f1032b11a4e0 … 33e67c 2016-05-20T17:06:45  0`
	
	Note The SafeKit cluster configuration must be the same on all nodes of a cluster. Asymmetric cluster configurations are not supported.

`safekit cluster deconfig`	Remove the cluster configuration and the cryptographic key.
`safekit cluster state`	Return the global SafeKit modules configuration state For each installed module on each cluster node, this commands list: • the node name, • module name, • module mode (farm or mirror) • internal module id number, • date of last module configuration, • digital signature of last configuration This command list which modules are installed on which nodes of the cluster. Signature and date of last configuration on each node allow checking that a module has the same configuration on all nodes, and if not, which node has the most recent configuration.
`safekit cluster genkey`	Create cryptographic key for global SafeKit communication (implemented in the `safeadmin` process). The cluster configuration must be deployed again (with `safekit -G`) for this command to take effect.
`safekit cluster delkey`	Suppress cryptographic keys for global SafeKit communication. The cluster configuration must be applied again (with `safekit -G`) for this command to take effect.

`safekit -H "[http],*" -G`	Redo a name resolution for all names specified in cluster.xml and `userconfig.xml` of modules, without stopping modules (when possible).
`safekit -H <url>[,<url>] -G`	Distributes the local cluster configuration and associated cryptographic key if it exists, to the target nodes specified in the URL list. Ex: `safekit -H http://192.168.1.1:9010,http://192.168.1.2:9010 -G`

9.4 Command lines to control modules

The commands apply to the module named `AM`, passed as an argument with the `-m` option.

`safekit start -m AM`	Starts the module
`safekit waitstart -m AM`	Waits for the end of the module start
`safekit stop -m AM`	Stops the module
`safekit waitstop -m AM`	Waits for the end of the module stop
`safekit waitstate -m AM STOP | ALONE | UP | PRIM | SECOND`	Wait for the required stable state (`NotReady` or `Ready`).
`safekit restart -m AM`	Executes only application stop and start scripts Note For mirror modules, there is no failover on the other server if the module is `PRIM`
`safekit swap [nosync] -m AM`	Mirror modules only Swaps the roles of primary and secondary nodes. Use `nosync` to swap without synchronizing the replicated directories.
`safekit stopstart -m AM`	Unlike the `safekit restart -m AM` command, the `safekit stopstart -m AM` command causes a complete stop of the module followed by a start. If the module was `PRIM`, there is a failover of the `PRIM` module on the other server Note Equivalent to `safekit stop -m AM; safekit start -m AM`

`safekit prim -m AM`	Mirror modules only Forces the module to start as primary. It fails if the other server is already primary. The main use case of this command is described in section 5.3 page 96
`safekit second [fullsync] -m AM`	Mirror modules only Forces the module to start as secondary. It fails if the other server is not primary. Use `fullsync` to force the full synchronization of the replicated directories.
`safekit forcestop -m AM`	Forces the module stop even if some resources are frozen

`safekit errd suspend -m AM`
`safekit errd resume -m AM`
	Suspends/resumes the error detection of module processes defined in <errd> section of `userconfig.xml`
	Useful if you want to stop the application without changing the module state.
	The resource variable *usersetting.errd* reflects the current setting.

`safekit checker off -m AM`
`safekit checker on -m AM`
	Used to stop or start all checkers (interface, TCP, IP, custom, etc.)
	
	Useful for maintenance operation, when man knows that some checker will detect a problem because some parts of the IT infrastructure will be stopped, and don't want that Safekit start a failover.
	
	Notes:
	✓ could be used only on a live module in a stable state (`ALONE`, `UP`, `PRIM`, `SECOND`, `WAIT`)
	✓ the resource variable *usersetting.checker* reflects the current setting
	✓ a side effect of this command is the execution of the update command.

`safekit failover off -m AM`
`safekit failover on -m AM`
	Used to dynamically set the failover attribute to on or off (see section 13.2.3 page 209).
	Notes:
	✓ could be used only on a mirror live module in a stable state (`ALONE`, `PRIM`, `SECOND`,`WAIT`).
	✓ this command must be issued on all machines belonging to the same cluster to not have unexpected results.
	✓ the resource variable *usersetting.failover* reflects the current setting.
	✓ a side effect of this command is the execution of the update command.

9.5 Command lines to monitor modules

The commands apply to the module named `AM`, passed as an argument with the `-m` option.

`safekit level [-m AM]`	Indicates the version of SafeKit and the license With the `AM` parameter, the "level" script of the module is called, and its results displayed
`safekit state`	Displays the status of all modules
`safekit state -m AM [-v | -lq]`	Displays the status of the AM module With the verbose option `-v`, status of all the module resources are listed: see the usefulness of resources in section 7.9 page 117 With the option `-lq`, the command returns status (and exit code): `STOP (0), WAIT (1), ALONE (2), UP (2), PRIM (3), SECOND (4)`
`safekit log -m AM [-s nb] [ -A ] [-l en|fr]`	Displays the last `nb` main messages of the AM module log. Use `-A` for displaying all messages (including debug ones). Use `-l` option for choosing the language, `en`(glish) or `fr`(ench). Default: `-s 300`

`safekit logview -m AM [-A] [-l en|fr]`	View in real time the last main messages of the AM module log. Use `-A` for displaying all messages (including debug ones). Use `-l` option for choosing the language, `en`(glish) or `fr`(ench).
`safekit logview -m AM -s 300 [-A ] [-l en|fr]`	View in real time the AM module log messages starting from the last 300 messages
`safekit logsave -m AM [-l en|fr] [-A] /tmp/f.txt`	Save main messages of the AM module log in /tmp/f.txt (absolute path mandatory). Use `-A` for saving all messages (including debug ones). Use `-l` option for choosing the language, `en`(glish) or `fr`(ench).
`safekit printi|printe -m AM "message"`	Application start/stop scripts can write messages in the module log with I or E level.

9.6 Command lines to configure modules

`safekit config -m AM`	Apply changes made in `SAFE/modules/AM`: `userconfig.xml`, `start_prim/both` or `stop_prim/both` (mirror/farm) Makes each plug-in defined in `userconfig.xml` <errd>, <vip>, <rfs>, <user>... considered in the new module configuration This command could be run on a server in the stable states `STOP`, `ALONE` or `WAIT (NotReady)`. In `STOP` state all the configuration parameters could be modified. Some configuration parameters can be changed while the module is running in `ALONE` or `WAIT (NotReady)` states. This feature is called *dynamic configuration*. Parameters that could be dynamically changed are reported into section 13 page 207 that describes all configuration parameters.
`safekit module genkey -m AM`	Generates cryptographic keys for the module instances network exchanges encryption. Considered after the next configuration of the module.
`safekit module delkey -m AM`	Erase cryptographic keys associated with the module. After the next configuration, module instances network exchanges will be performed without encryption.

`safekit -H <url>[,<url>] -E AM`	Distributes the local configuration for the module `AM` and associated cryptographic key if it exists, to the target nodes specified in the URL list. Ex: `safekit -H http://192.168.1.1:9010,http://192.168.1.2:9010 -E mirror`
`safekit confinfo -m AM`	Display information on the active and current configuration of the module `AM`. ⇨ the active configuration is the last configuration successfully applied. It is in `SAFE/private/modules/AM` ⇨ the current configuration is the one located in `SAFE/modules/AM`. It may be different from the active one when it has been modified and not yet been applied This command is useful for checking the configuration of the module. It displays: ⇨ the signature value and a last modification date (Unix timestamp) for the active configuration ⇨ the signature value and last modification date (Unix timestamp) for the current configuration When the signature values are different, it means that the configurations are not identical and that you may have to apply the current configuration. You can run this command on all the cluster nodes that implement the module to check that the configuration of the module is identical on all nodes.
`safekit confcheck -m AM`	Check the module configuration under `SAFE/modules/AM` without applying
`safekit module install -m AM [-M id] [-r] [AM.safe]`	Installs the AM.safe module file under the `AM` name `[-r]` force reinstallation of the module `[-M id]` forces the installation of the module with the `id` specified as module id ⇨ AM.safe default location is SAFE/Application_Modules/ and its subdirectories ⇨ An absolute path could be used too ⇨ If no AM.safe is given, the command search for file modulename.safe in /Application_Modules/ and its subdirectories
`safekit module package -m AM /…/newAM.safe`	Packages the `AM` module in `/…/newAM.safe` (absolute path mandatory) Used by the console to create a backup in `SAFE/Application_Modules/backup/`

`safekit module uninstall -m AM`	Uninstalls the `AM` module. Deletes the module configuration directory `SAFE/modules/AM`
`safekit module list`	Lists the names of the installed modules
`safekit module listid`	Lists the names and ids of the installed modules
`safekit module getports -m AM (or -i id)`	Lists the communication ports used by the module to communicate between servers

9.7 Command lines for support

`safekit snapshot -m AM /tmp/snapshot_xx.zip`	Saves the snapshot of the `AM` module in /tmp/snapshot_xx.zip (absolute path mandatory) A snapshot creates a dump and gathers under `SAFEVAR/snapshot/modules/AM` the last 3 dumps and last 3 configurations to collect them in a .zip file To analyze snapshots, see 7.16 page 123 To send snapshots to Evidian support, see 8 page 131
`safekit dump -m AM`	To solve a problem in real time on a server, make a dump of the `AM` module A dump creates a directory `dump dump_year_month_day_hour_mn_sec` on the server side under `SAFEVAR/snapshot/modules/AM`. The `dump` directory contains the module log and status, as well as information on the system state and SafeKit processes at the time of the dump
`safekit -r "specialcommand"`	Calls the special command in `SAFEBIN` with SafeKit environment variables set.

`safekit clean [all | log | process | resource] [-m AM]`	Clean the logs, the resource file, and the main processes of the module `AM`.
	
	Important This command must be used with caution since it deletes working files and kills processes.
	
	`safekit clean log -m AM`
	
	Clean the logs (verbose and not verbose logs) of the module. To be used when these logs are corrupted (e.g.: errors in log view).
	
	`safekit clean resource -m AM`
	
	Reinitialize the resource file of the module. To be used when this file is corrupted (e.g.: errors in resources display)
	
	`safekit clean process -m AM`
	
	Kill the main processes (`heart`) of the module. To be used when the `stop` and `forcestop` of the module did not achieve to kill these processes.
	
	`safekit clean all -m AM`
	
	Default value. Clean log, resource, and process.

9.8 Examples

9.8.1 Cluster configuration with command line

See 12.2.2 page 204.

9.8.2 New module configuration with command line

In the following, replace `AM` by your module name; replace `node1` and `node2` by the name of your cluster nodes set during the SafeKit cluster configuration.

1. Log as administrator/root and open a command shell window on one node

   For instance, log-in `node1`

2. Run `safekit module install -m AM SAFE/Application_Modules/generic/mirror.safe`

   to install a new module named `AM`, from `mirror.safe` template

3. Edit the module configuration and scripts in `SAFE/modules/AM/conf` and `SAFE/modules/AM/bin`

4. Run `safekit module genkey -m AM` or `safekit module delkey -m AM`

   to create or delete cryptographic key for the module

5. Run `safekit -H "node1,node2" -E AM`

to (re)install the module AM and apply its configuration, which is get from the node running the command (`node1` in this example). It applies it on all listed nodes (`node1` and `node2`).

9.8.3 Module snapshot with command line

The command line the module snapshot is described below. Replace `AM` by your module name.

1. Log as administrator/root and open a command shell window on one node

   For instance, log-in `node1`

2. Run `safekit snapshot -m AM /tmp/snapshot_node1_AM.zip`

   To save the snapshot of the `AM` module in `/tmp/snapshot_node1_AM.zip` (absolute path mandatory) locally (that is on `node1`).

Repeat all these commands on the other nodes in the cluster.

10.Advanced administration

10.1 SafeKit environment variables and directories

10.1.1 Global

Variable	Description
`SAFE` (given by `safekit -p`)	SafeKit installation directory: **`SAFE=/opt/safekit`** on Linux and **`SAFE=C:\safekit`** on Windows if SystemDrive=C: The license is under **`SAFE/conf/license.txt`**
`SAFEVAR` (given by `safekit -p`)	SafeKit working files directory: **`SAFEVAR=C:\safekit\var`** on Windows and **`SAFEVAR=/var/safekit`** on Linux
`SAFEBIN` (given by `safekit -p`)	SafeKit binary installation directory: **`C:\safekit\private\bin`** on Windows and **`/opt/safekit/private/bin`** on Linux. Useful to access SafeKit special commands (see 14.4 page 268)
`SAFE/Application_Modules`	Installable .safe modules directory. Once a module has been installed, the module is located under **`SAFE/modules`**

10.1.2 Module

Variable	Description
`SAFEMODULE`	The name of the module. The `safekit` command no longer needs the module name parameter (`-m AM = -m SAFEMODULE`)
`SAFE/modules/AM and SAFEUSERBIN`	Editing a module, named AM, and its scripts is made inside directory **`SAFE/modules/AM`**. There are **`userconfig.xml`** file and application start and stop scripts **`start_prim`**, **`stop_prim`** for a mirror, **`start_both`**, **`stop_both`** for a farm (online edition or through the SafeKit console) After a module configuration, scripts are copied to the runtime directory **`SAFE/private/modules/AM/bin`**: this is the value of `SAFEUSERBIN` (do not modify scripts at this place)
`SAFEVAR/modules/AM and SAFEUSERVAR`	Module, named A, working files directory (`SAFEUSERVAR=`**`SAFEVAR/modules/AM`**) Output messages of application scripts are in `SAFEVAR/modules/AM/userlog_`*`year-month-date_striptname`*`.ulog`**.** To check if there are errors during start or stop of the application. Note: the userlog could disabled with <user logging="none"> in `userconfig.xml` Since SafeKit 8, the file name is `userlog_<year>_<month>_<day>T<time>_<script name>.ulog`.
`SAFEVAR/snapshot/modules/AM`	Directory of dumps and configurations put in a snapshot of the module named AM. See section 9.7 page 149 that describes command lines for support.

The module tree (packaged into a .safe or installed into `SAFE/modules/AM`) is the following:

`AM`	Application module name
`conf`	
`userconfig.xml`	User XML configuration file
`userconfig.xml.template`	Internal use only
`modulekey.p12`	Optional. Internal use only (encryption of the module internal communications)
`modulekey.dat`	Optional. Internal use only (encryption of the module internal communications)
`bin`	
`prestart`	Module script executed on module start
`start_prim or start_both`	Module script to start the application in mirror or farm module
`stop_prim or stop_both`	Module script to stop the application in mirror or farm module
`poststop`	Module script executed on module stop
`web`	
`index.html`	Obsolete (for the web console < SafeKit 8)
`manifest.xml`	Internal use only

Since SafeKit 8, you cannot anymore customize the module quick configuration display (since index.html is obsolete).

10.2 SafeKit processes and services

SafeKit Services	Processes per module	
safeadmin (`safeadmin` process): main and mandatory service	`heart`: manages the recovery procedures	`vipd`: synchronizes a farm of servers
safewebserver (`httpd` process): service for the console, for <module> checkers and the distributed commands	`errd`: manages detection of process death	`nfsbox`, `nfsadmin`, `reintegre`: file replication and reintegration

SafeKit Services	Processes per module	
safeagent (safeagent process): SafeKit SNMP agent (optional, windows only)	checkers (ipcheck, intfcheck, …)	

See 10.3.3.1 page 157 and 10.3.3.2 page 159 for full details on SafeKit processes name and ports used.

10.3 Firewall settings

If a firewall is active on the SafeKit server, you must add rules to allow network traffic:

- between servers for internal communication (global runtime and module specific)
- between servers and workstations running the SafeKit console

10.3.1 Firewall settings in Linux

If you opted-in for automatic local firewall configuration during SafeKit installation, you do not have to apply the following procedures.

If you opted-out for automatic local firewall configuration, you must configure the firewall manually or you may use the `safekit firewallcfg` command. It inserts (or remove) the firewall rules required by the SafeKit core processes (`safeadmin` and `safewebserver` services) and modules processes to communicate with their peers in the cluster.

Administrators should review conflicts with local policy before applying it.

`safekit firewallcfg add`
`safekit firewallcfg del`
	Add (or delete) the firewalld or iptable firewall rules for the SafeKit `safeadmin` and `safewebserver` services.
	
	- `SAFE/safekit firewallcfg add`
	add firewall rules for `safeadmin` and `safewebserver`
	
	- `SAFE/safekit firewallcfg del`
	delete firewall rules for `safeadmin` and `safewebserver`

`safekit firewallcfg add AM`
`safekit firewallcfg del AM`
	Add (or delete) the firewalld or iptable firewall rules for the SafeKit modules.
	
	⇨ `SAFE/safekit /firewallcfg add AM`
	add firewall rules for the module named `AM`
	Important: This command must be applied after the first configuration of the module, and on next configurations if used ports have changed (check it with the command `safekit module getports -m AM`).
	
	⇨ `SAFE/safekit firewallcfg del AM`
	delete firewall rules for the module named `AM`

10.3.2 Firewall settings in Windows

When using the operating system firewall (Microsoft firewall), you may use the `safekit firewallcfg` command. It inserts (or remove) the firewall rules required by the processes of SafeKit services (`safeadmin`, `safewebserver`, `safeacaserv`, `safeagent`) and modules processes to communicate with their peers in the cluster.

Administrators should review conflicts with local policy before applying it.

`safekit firewallcfg add`
`safekit firewallcfg del`
	Add (or delete) the Microsoft firewall rules.
	
	⇨ `safekit firewallcfg add`
	add firewall rules for SafeKit core and modules processes.
	
	⇨ `safekit firewallcfg del`
	delete firewall rules for SafeKit core and modules processes.

10.3.3 Other firewalls

If you use another firewall or want to check rules against local policy, the following lists processes and ports used by SafeKit services and modules that may be useful to configure the firewall.

10.3.3.1 List of processes

10.3.3.1.1 Processes performing local-only network exchanges

⇨ Processes for a mirror module

- ✓ `errd`: manages detection of process death

- ✓ `nfsadmin`, `nfscheck`: manage the file replication

⇨ Processes for a farm module

- ✓ `errd`: manages detection of process death
- ✓ `heart`: manages the recovery procedures

10.3.3.1.2 Processes performing external network exchanges

⇨ Processes common to all the SafeKit servers, one process by server, started at boot:

- ✓ `safeadmin` service (`safeadmin` process)

  main and mandatory administration service
- ✓ `safewebserver` service (`httpd` process)

  web service for the console, for <module> checkers and the distributed commands
- ✓ `safecaserv` (`httpd` process)

  web service for securing the web console with the SafeKit PKI (optional)
- ✓ `In Windows : safeagent` service (`safeagent` process)

  SafeKit SNMP v2 agent (optional)

⇨ Processes for a mirror module (depending on its configuration):

- ✓ `heart`: manages the recovery procedures
- ✓ `arpreroute`: manages arp requests (sends ARP packet)
- ✓ `nfsbox`, `reintegre`: manage the file replication and reintegration
- ✓ `splitbraincheck`: manage the splitbrain detection (sends ICMP ping packets)

⇨ Processes for a farm module (depending on its configuration):

- ✓ `vipd`: synchronizes a farm of servers
- ✓ `arpreroute`: manages arp requests (sends ARP packet)

⇨ Processes for a mirror or a farm module depending on checkers configuration:

- ✓ `intfcheck`: for checking interface (interface checker configuration automatically generated when <interface check=on>)
- ✓ `pingcheck`: for pinging an address (<ping> configuration)
- ✓ `ipcheck`: for checking a locally defined ip address (virtual ip checker automatically generated when `<virtual_addr check=on>`)
- ✓ `modulecheck`: for checking a SafeKit module `(<module>` configuration)

- ✓ `tcpcheck`: for checking a TCP connection `(<tcp>` configuration)

10.3.3.2 List of ports

The following list ports used by SafeKit services and modules.

10.3.3.2.1 Ports used by services

➩ `safeadmin`

By default, remote access on UDP port 4800 (to communicate with `safeadmin` instances on other SafeKit servers)

For changing this value , see section 12.1.3 page 202.

➩ `safewebserver`

Local and remote TCP access, by default, on port 9010 for HTTP or port 9453 for HTTPS. For the ports value definition, see section 10.6 page 164.

This service is accessed locally and from remote SafeKit servers and remote workstation running the SafeKit console.

➩ `safecaserv` (optional)

Local and remote access on TCP port 9001 by default. For the port value definition, see section 11.3.1.9.4 page 187.

This service is accessed locally, and from remote SafeKit servers and remote workstation running the HTTPS configuration wizard with the SafeKit PKI.

➩ `safeagent` (Windows only, optional)

Local and remote access on UDP port 3600 by default. For the port value definition, see section 10.8 page 168.

10.3.3.2.2 Ports used by modules

When a module is configured on a SafeKit server, you can run the command `safekit module getports -m AM` to list the external ports used by the module `AM`. For firewall configuration, you must configure all SafeKit servers to enable communications targeted at these ports.

The ports values for one module are automatically computed depending on its module id. Run the command `safekit module listid` to list all the installed modules with their name and id.

You can run the command `safekit module getports -i ID` to list the ports that could be used by a module that got the id value ID (this command can be run even if the module is not yet installed, but it will return a superset of the really used port by the module).

The following gives rules for computing ports values depending on the module id. When checkers are configured for the module, you may also need to change the firewall configuration according to the checkers configuration. You must enable all communications on localhost between SafeKit processes.

- For a mirror module:

  - ✓ Port used by heart
    UDP port used for sending heartbeats between SafeKit servers
    port=8888 +(id-1)

  - ✓ Ports used by rfs (file replication)
    TCP port used for replications requests between SafeKit servers
    safenfs_port=5600 +(id-1)x4

Example for a mirror module with id 1

```
safekit module getports -m mirror


List of the ports used by SafeKit

Process         Ports
safeadmin
        port    UDP 4800

webconsole
        port    TCP 9010
heart
        port    UDP 8888
rfs
        safenfs_port    TCP 5600
```

- For a farm module
  - ✓ Port used by farm
    UDP port used for communications between all SafeKit nodes
    port   4803 + (id-1)x3

Example for a farm module with id 2

```
safekit module getports -m farm

List of the ports used by SafeKit

Process         Ports
safeadmin
        port    UDP 4800
webconsole
        port    TCP 9010
farm
        port    UDP 4806
```

- For configured checkers

  - ✓ Ping checker for mirror or farm module
    Change ICMP settings to allow ping at destination to the address defined into the configuration.

- ✓ TCP checker for mirror or farm module
  Allow TCP connections at destination to the address defined into the <tcp> configuration if this address is not local.
- ✓ Module checker
  Allow TCP connections at destination to 9010 port of the node running the module that is checked.
- ✓ Splitbrain checker
  Change ICMP settings to allow ping at destination to the witness defined into the <splitbrain> configuration.

10.4 Boot and shutdown setup in Windows

`safeadmin` service is configured for automatically starting on boot and stopping on shutdown. In turn, this service starts modules configured for starting at boot and shutdown all modules.

On some Windows platforms, the `safeadmin` boot start fails because the network configuration is not ready, and the modules shutdown does not have time to complete since the timeout for services shutdown is too short. If you encounter such problems, apply one of the following procedures.

Important

When using the SNMP agent, adapt the following procedures to set the manual start of the `safeagent` service and include its start/stop into SafeKit start-up (`safekitbootstart.cmd`) and shutdown (`safekitshutdown.cmd`) scripts.

10.4.1 Automatic procedure

You can run the script as follow:

1. open a PowerShell window as administrator
2. `cd SAFE\private\bin`
3. run `addStartupShutdown.cmd`

This script sets the manual start for `safeadmin` service and adds default SafeKit start-up (`safekitbootstart.cmd`) and shutdown (`safekitshutdown.cmd`) scripts as part of the computer group policy start-up/shutdown scripts. If the script fails, apply the manual procedure below.

10.4.2 Manual procedure

You must apply the following procedure that uses the Group Policy Object Editor.

1. set manual start for `safeadmin` service
2. start the MMC console with the `mmc` command line
3. File - Add/Remove Snap-in Add - "Group Policy Object Editor" – OK
4. under "Console Root"/"Local Computer Policy"/"Computer Configuration"/"Windows Settings"/"Scripts (Start-up/Shutdown)", double click on "Start-up". Click on Add then set for "Script Name:" `c:\safekit\private\bin\safekitbootstart.cmd`. This script launches the `safeadmin` service.

5. under "Console Root"/"Local Computer Policy"/"Computer Configuration"/"Windows Settings"/"Scripts (Start-up/Shutdown)", double click on "Shutdown". Click on Add then set for "Script Name:" `c:\safekit\private\bin\safekitshutdown.cmd`. This script shutdowns all running modules.

10.5 Securing module internal communications

You can secure communications for the module between cluster nodes by creating cryptographic keys associated with the module. By default, these keys are generated by SafeKit with a "private" certification authority (SafeKit PKI). In SafeKit <= 7.4.0.31, the generated key has a validity period of 1 year. See section 10.5.3.1 page 163 for solutions when the key expires.

Since SafeKit 7.4.0.16, you can also provide your own certificates generated with your trusted certification authority (enterprise PKI or commercial PKI). See section 10.5.3.2 page 164 for details.

Since SafeKit 7.4.0.32, the module can be reconfigured with new keys while it is in ALONE state (dynamic update).

Important

When encryption is not properly configured (e.g.: not the same key on all cluster nodes of the module), the module internal communications between nodes are rejected. In this case, the module configuration is not identical on all nodes. You must apply again the configuration on all nodes.

You can check the configuration by running on each node the command `safekit confinfo -m AM` where AM is the module name (see section 9.6 page 147).

The **`encryption`** resource reflects the current communication mode of the module: "on"/"off" when encryption is active/not active. To read resources, see section 7.3 page 114. The resource name is `usersetting.encryption`.

10.5.1 Configuration with the SafeKit Web console

When configuring the module with the SafeKit web console, communication encryption is enabled in the step 3 of the module configuration wizard (see section 3.3.2 page 45).

10.5.2 Configuration with the Command Line Interface

The commands line equivalent for configuring a module, named AM, with cryptographic key are:

1. Stop the AM module on all nodes
2. On one node, log as administrator/root and open a command shell window
3. Run `safekit module genkey -m AM`
4. Run `safekit -H "server1,server2" -E AM`

   where server1 and server2 are the nodes that implement the module

The commands line equivalent for re-configuring a module without cryptographic key are:

1. Stop the AM module on all nodes
2. On one node, log as administrator/root and open a command shell window
3. Run `safekit module delkey -m AM`
4. Run `safekit -H "server1,server2" -E AM`

   where server1 and server2 are the nodes that implement the module

For more details on commands, refer to section 9.6 page 147.

10.5.3 Advanced configuration

10.5.3.1 Advanced configuration with the SafeKit PKI

In SafeKit <= 7.4.0.31, the key for encrypting the module communication has a validity period of 1 year. When it expires in a mirror module with file replication, the secondary fails to reintegrate. You must re-configure the module with a new key, as explained in SK-0084, for reverting to normal behavior. In SafeKit > 7.4.0.31, the validity period has been set to 20 years.

If you cannot upgrade SafeKit, you can generate new keys with a longer validity period. For this apply the following procedure:

1. Stop the AM module on all nodes
2. On one node, log as administrator/root and open a command shell window
3. Run `safekit module genkey -m AM`
4. Delete the file `SAFE/modules/AM/conf/modulekey.p12`
5. Change to the directory `SAFE/web/bin`
6. Run `./openssl req -config ../conf/ssl.conf -subj "/O=SafeKiModule/CN=mirror" -new -x509 -sha256 -nodes -days 3650 -newkey rsa:2048 -keyout pkey.key -out cert.crt`

   Set the `-days` value to the validity period you want
7. Run `./openssl pkcs12 -export -inkey ./pkey.key -in ./cert.crt -name "Module certificate" -out modulekey.p12`

   This command requires to fill a password. Contact Evidian support to get the correct value for the password
8. Delete the files `pkey.key` and `cert.crt`
9. Move the file `modulekey.p12` into `SAFE/modules/AM/conf`
10. Run `safekit -H "server1,server2" -E AM`

    where server1 and server2 are the nodes that implement the module

The module is configured, on the 2 nodes, with the new key and ready to start.

10.5.3.2 Advanced configuration with an external PKI

Since SafeKit 7.4.0.16, you can provide your own key generated with your trusted certification authority (enterprise PKI or commercial PKI). For this apply the following procedure:

1. Stop the AM module on all nodes
2. On one node, log as administrator/root and open a command shell window
3. Run `safekit module genkey -m AM`
4. Delete the file `SAFE/modules/AM/conf/modulekey.p12`
5. Append the X509 certificate in PEM format, for your certification authority (certificate of the CA or certificate bundle of all the certificate authorities) to the file `SAFE/web/conf/cacert.crt`
6. Change to the directory `SAFE/web/bin`
7. Generate your certificate with the PKI with the subject set to `"/O=SafeKiModule/CN=mirror"`
8. Copy the generated files `pkey.key` and `cert.crt` into the directory `SAFE/web/bin`
9. Run `./openssl pkcs12 -export -inkey ./pkey.key -in ./cert.crt -name "Module certificate" -out modulekey.p12`

   This command requires to fill a password. Contact Evidian support to get the correct value for the password
10. Delete the files `pkey.key` and `cert.crt`
11. Move the file `modulekey.p12` into `SAFE/modules/AM/conf`
12. Run `safekit -H "server1,server2" -E AM`

    where server1 and server2 are the nodes that implement the module

The module is configured, on the 2 nodes, with the new key and ready to start.

10.6 SafeKit web service configuration

SafeKit comes with a web service, `safewebserver`, which runs on each SafeKit server. It is a standard Apache web service that is **mandatory** for running:

- the web console (see section 3 page 37)
- the distributed command line interface (see 9.1 page 139)
- the <module> checkers (see 13.16 page 258)

`safewebserver` starts automatically at the end of SafeKit package install and on server reboot. If you do not need the SafeKit web service and want to remove the automatic boot start, refer to section 9.2 page 141.

The default configuration is HTTP with file-based authentication, initialized with a single `admin` user that got the Admin role. This could be changed via configuration files.

10.6.1 Configuration files

The configuration of an instance of `safewebserver` on a SafeKit server is contained in the `SAFE/web/conf` directory. It consists in standard Apache configuration files (see http://httpd.apache.org). The configuration is split into many files, but for most common configurations, only the main configuration file `httpd.conf` need to be modified.

Important

- ➩ After changes, you have to restart the service with the command: `safekit webserver restart` (see section 9.2 page 141).
- ➩ Do not edit `.default` files since they are backups of delivered configuration files.

The `httpd.conf` file consists essentially in a set of `Define` statements. Comment character # disables the definition.

The mains `Define` are:

Connection port definition:

```
Define httpport 9010
Define httpsport 9453
```

- ➩ Set the listening port in http and https mode. (See section 10.6.2 page 166 for usage).

User authentication definition:

```
Define usefile
# Define useldap
# Define useopenid
…
```

- ➩ Select which user authentication to use. At most one must be defined. `usefile` is the default. (See section 11.4 page 191 for details.)

Apache logging definition:

```
#Define Loglevel info
#Define accesslog
```

- ➩ Uncomment these lines to enable the logging for debug purposes. Logging files `httpd.log` and `access.log` are in `SAFEVAR`.

Other `Define` are self-documented in the `httpd.conf file`.

The other configuration files are listed below. Modifying one of them may cause problems when upgrading SafeKit :

Global configuration	**`httpd_main.conf`**
File based authentication and role mapping	**`httpd.webconsolefileauth.conf`**
Form authentication configuration	**`httpd.webconsoleformauth.conf`**
LDAP/AD authentication configuration	**`httpd.webconsoleldap.conf`** using a LDAP/AD server
OpenID Connect authentication configuration	**`httpd.webconsoleopenidauth.conf`** using an OpenID connect identity provider
HTTPS configuration	**`httpd.webconsolessl.conf`** in `SAFE/web/conf/ssl`

User authentication configurations may optionally use `group.conf` (for HTTP) or `sslgroup.conf` (for HTTPS) files in `SAFE/web/conf` for user to role mapping.

10.6.2 Connection ports configuration

By default, connect the web console with the URL `http://host:9010`. The SafeKit web server will redirect to the appropriate page according to your security settings.

If you need to change the default value:

1. Edit `SAFE/web/conf/httpd.conf` and change the value of `httpport` or `httpsport` variables.
2. Restart the service using the command `safekit webserver restart`.

The HTTP and HTTPS configurations cannot be active simultaneously. See 11.3 page 178 for how to configure HTTPS.

The port value `9010(HTTP)/9453(HTTPS)` is also used by the module checker. Therefore, if the configuration of a module defines a `<module>` checker:

1. Edit the module configuration file `userconfig.xml`
2. Edit the `port` attribute and assign it to the new port value

```
<check>
    <module name="mirror">
     <to addr="192.168.1.31" port="9010"/>
    </module>
  </check>
```

3. Apply the new configuration of the module

10.6.3 HTTP/HTTPS and user authentication configuration

- ➩ The default configuration is for HTTP.

  The default configuration is also set with file-based authentication, initialized with a single `admin` user that got the Admin role.

- ➩ The HTTPS configuration requires the installation of certificates and the definition of user authentication.

For a detailed description, see section 11 page 173.

To re-enable the HTTP configuration if it has been changed to HTTPS see 11.2.1.1 page 175.

10.6.4 SafeKit API

Use Swagger UI to visualize and interact with the SafeKit API provided by the SafeKit web service. For this, connect a browser at the URL http://host:9010/swagger-ui/index.html. It may be useful to debug issues with the SafeKit web console and/or API.

10.7 Mail notification

You may need to send a notification, such as an e-mail, when the module is started, stopped, or run a failover. This is implemented thanks to the scripts of the module.

For mail notification, you have first to choose a command line program to send mail. In Windows, you can use the `Send-MailMessage` from the Microsoft Powershell Utility. For Linux, you can use the `mail` command.

- ➩ Notification on the start and the stop of the module

  The module scripts `prestart`/`poststop` can be used for sending a notification on the start/stop of the module.

- ➩ Notification on the failover of the module

  The module script `transition` can be used to send a notification on main local state transitions of the module running on the local server. For instance, it may be useful to know when the mirror module is going `ALONE` (on failover for instance).

For details on module scripts, see 14 page 265.

For a full example with the demonstration module `notification.safe`, see section 15.14 page 287. Since SafeKit 8, this .safe is delivered with the SafeKit package.

10.8 SNMP monitoring

SafeKit could be monitored by snmp. Since version 8, snmp monitoring implementation differs in Windows and Linux : In Windows, SafeKit use its own snmp agent service, when in Linux, the operating system's snmp agent is used.

10.8.1 SNMP monitoring in Windows

For using the SafeKit SNMP agent `safeagent`, you must:

1. configure it to start on boot, with the command

`safekit boot [snmpon | snmpoff | snmpstatus]`	Controls the automatic start at boot of the `safeagent` service ("on" or "off"; by default, "off")

2. add the corresponding firewall rule

   When using the operating system firewall, the firewall has already been configured for `safeagent` if you have applied the command:

   ```
   SAFE/safekit firewallcfg add
   ```

3. start it with the command

`safekit safeagent [start | stop | restart | check]`	Controls start/stop of the `safeagent` service that implements the SafeKit SNMP agent.

The configuration of the `safeagent` is defined in the self-documented **`SAFE/snmp/conf/snmpd.conf`** file. It is a standard net-snmp configuration file as described in http://net-snmp.sourceforge.net. By default, the service is listening on UDP **`agentaddress`** port `3600` and accepts read request from the public community and write requests from the private community. Read requests are used to get module status and write requests to run actions on the module.

You can change the default configuration according to your needs. When you modify `snmpd.conf`, you must manually change the firewall rule and restart the service to load the new configuration with: `safekit safeagent restart`

10.8.2 SNMP monitoring in Linux

Since version 8.0, Safekit did not come with its own snmp agent anymore, so the following safekit commands are obsoleted in Linux**: *safeagent install, safeagent start, safeagent stop, boot snmpon, boot snmpoff, boot snmpstatus*.**

Instead, it is possible to configure the standard snmpd Linux agent to access safekit mib:

1. Install net-snmp
   dnf install net-snmp net-snmp-utils
2. If selinux is in enforced mode, you have to set snmpd in permissive mode for snmp by :
   semanage permissive -a snmpd_t

3. If firewall is active, you have to open the snmp ports with:
   firewall-cmd --permanent --add-service snmp

   firewall-cmd --reload
4. Edit /etc/snmp/snmpd.conf
   Add the following lines :
   pass .1.3.6.1.4.1.107.175.10 /opt/safekit/snmp/bin/snmpsafekit
   view systemview included .1.3.6.1.4.1.107.175.10

   Note : the "view systemview" line set the access rights. You could have to adapt it to your general snmpd configuration.
5. Enable and Start the snmp agent
   systemctl enable snmpd
   systemctl start snmpd

10.8.3 The SafeKit MIB

The SafeKit MIB is common to Windows and Linux implementation. It is delivered in **`SAFE/snmp/mibs/safekit.mib`** .

The SafeKit MIB is accessed with the following identifier (OID, prefix of SafeKit SNMP variables): **= `enterprises.bull.safe.safekit (1.3.6.1.4.1.107.175.10).`**

The SafeKit MIB defines:

➪ The module table: **`skModuleTable`**

The index on the module table is the ID of the application module as returned by the command `safekit module listid`.

Through the MIB, you can read and display the status of an application module on a server (`STOP, WAIT, ALONE, UP, PRIM, SECOND`) or you can take an action on the module (`start`, `stop`, `restart`, `swap`, `stopstart`, `prim`, `second`).

For example, the status of the module with ID 1 is read by an SNMP get to the variable:
`enterprises.bull.safe.safekit.skModuleTable.skModuleEntry.skModuleCurrentState.1 = stop (0)`

Use the `snmpwalk` command to check all MIB entries.

➪ The resource table: **`skResourceTable`**

Each element defines a resource as for instance the one corresponding to the network interface checker `"intf.192.168.0.0"` and its status (`unknown`, `init`, `up`, `down`).

Example: SNMP get request to
`enterprises.bull.safe.safekit.skResourceTable.skResourceEntry.skResourceName.1.2` means name of resource 2 in application module 1.

10.9 Commands log of the SafeKit server

There is a log of the `safekit` commands ran on the server. It allows auditing the actions performed on the server to help support for instance. The log records all the `safekit` commands that are run and that modify the system such as a module install and configuration, a module start/stop, the `safekit webserver start/stop`, …

The command log is stored in the `SAFEVAR/log.db` file in SQLite3 format. For viewing its content:

- ➾ run the command `safekit cmdlog`

or

- ➾ click on the commands log tab into the web console

Below is the raw extract of this log:

```
| 2021-07-27 14:37:33.205122 |   safekit |   mirror |  6883 | START | config -m
mirror
| 2021-07-27 14:37:33.400513 |   cluster |   mirror |     0 |     I | update
cluster state
| 2021-07-27 14:37:33.405597 |   cluster |   mirror |     0 |     I | module
state change on node centos7-test3
| 2021-07-27 14:37:34.193280 |           |          |  6883 |   END | 0
| 2021-07-27 14:37:34.718292 |   cluster |   mirror |     0 |     I | update
cluster state
| 2021-07-27 14:37:34.722080 |   cluster |   mirror |     0 |     I | module
state change on node centos7-test4
| 2021-07-27 14:37:37.510971 |           |          |  6871 |   END | 0
| 2021-07-27 14:38:05.092924 |   safekit |   mirror |  7017 | START | prim -m
mirror -u web@10.0.0.103
| 2021-07-27 14:38:05.109368 |           |          |  7017 |   END | 0
```

Each field has the following meaning:

- ✓ The 1st field in the log entry is the date and time of the message
- ✓ The next one is the type of the action
- ✓ The next one is the module name when the action is not global
- ✓ The next one is the pid of the process that runs the command. It is used as the identifier of the log entry
- ✓ The next ones are `START` when the command starts and the command's arguments; or `END` when the command has finished with the return value.

10.10 SafeKit log messages in system journal

Since SafeKit 8, SafeKit modules log messages are sent to system log too. To view them:

- ➾ In Windows, open a PowerShell window and run

  `Get-EventLog -Logname Application -Source Evidian.SafeKit` that returns:

```
   47086 Nov 23 11:27  Information Evidian.SafeKit       1073873154 mirror |
heart | Remote state UNKNOWN Unknown...
   47085 Nov 23 11:27  Information Evidian.SafeKit       1073873154 mirror |
heart | Resource heartbeat.flow set to down by heart...
   47084 Nov 23 11:26  Information Evidian.SafeKit       1073873154 mirror |
heart | Local state ALONE Ready...
   47082 Nov 23 11:26  Warning     Evidian.SafeKit       2147614977 mirror |
heartplug | Action alone called by heart : remote stop...
```

```
   47081 Nov 23 11:25  Information Evidian.SafeKit        1073873154 mirror |
heart | Remote state PRIM Ready...
   47080 Nov 23 11:25  Information Evidian.SafeKit        1073873154 mirror |
heart | Local state SECOND Ready...
   47079 Nov 23 11:25  Information Evidian.SafeKit        1073873154 mirror |
rfsplug | Reintegration ended (default)...
```

⇨ In Linux, open a shell window and run

`journalctl -r -t safekit` that returns:

```
Nov 23 15:22:43 localhost.localdomain safekit[3689940]: mirror | heart | Local
state ALONE Ready
Nov 23 15:22:43 localhost.localdomain safekit[3689940]: mirror | heart | Local
state PRIM Ready
Nov 23 15:16:48 localhost.localdomain safekit[3689940]: mirror | heart | Local
state ALONE Ready
Nov 23 15:16:48 localhost.localdomain safekit[3690096]: mirror | userplug |
Script start_prim > userlog_2023-11-23T151648_start_prim.ulog
Nov 23 15:16:48 localhost.localdomain safekit[3690066]: mirror | rfsplug |
Uptodate replicated file system
Nov 23 15:16:24 localhost.localdomain safekit[3689940]: mirror | heart | Remote
state UNKNOWN Unknown
```

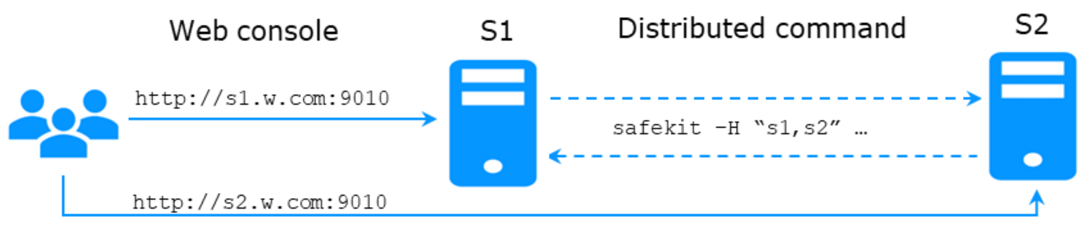
11.Securing the SafeKit web service

11.1 Overview

The SafeKit web service is mainly used by:

- the web console (see section 3 page 37)
- the distributed command line interface (see 9.1 page 139)

SafeKit provides different setups for this web service to enhance the security of the SafeKit web console and distributed commands.



Protocol	Authentication	Role management
✓ HTTP	✓ None (http only)	✓ Admin
✓ HTTPS	✓ File based	✓ Control
	✓ LDAP/AD	✓ Monitor
	✓ OpenID Connect	

The most secure setups are based on HTTPS and user authentication. SafeKit provides a “private” certification authority (the SafeKit PKI). This allows SafeKit to be quickly secured without the need for an external PKI (enterprise PKI or commercial PKI) that provides trusted certification authority.

SafeKit offers also optional role management based on 3 roles:

Admin role	This role grants all administrative rights by allowing access to Configuration and Monitoring in the navigation sidebar
Control role	This role grants monitoring and control rights by allowing access only to Monitoring in the navigation sidebar
Monitor role	This role grants only monitoring rights, prohibiting actions on modules (start, stop…) in Monitoring in the navigation sidebar.

11.1.1 Default setup

The default setup is the following:

Setup	Protocol	Authentication Role management
Default	✓ HTTP	✓ File-based authentication (username/password stored in an Apache file) ✓ Initialization with a single user named `admin` with the Admin role To configure, see 11.2.1 page 175

11.1.2 Predefined setups

The predefined setups are as follows:

Setup	Protocol	Authentication Role management
Unsecure	✓ HTTP	✓ No authentication ✓ Same role for all users For troubleshooting purpose only. To configure, see 11.2.2 page 177
File-based	✓ HTTP ✓ HTTPS To configure HTTPS with: ⇨ the SafeKit PKI, see 11.3.1 page 179 ⇨ an external PKI, see 11.3.2 page 187	✓ username/password stored in a local Apache file ✓ Optional role management stored in a local Apache file To configure, see 11.4.1 page 192
LDAP/AD	✓ HTTP ✓ HTTPS To configure HTTPS with: ⇨ the SafeKit PKI, see 11.3.1 page 179 ⇨ an external PKI, see 11.3.2 page 187	✓ LDAP/AD authentication ✓ Optional role management To configure, see 11.4.2 page 194

OpenID Connect	✓ HTTP ✓ HTTPS To configure HTTPS with: ➾ the SafeKit PKI, see 11.3.1 page 179 ➾ an external PKI, see 11.3.2 page 187	✓ OpenID Connect authentication ✓ Optional role management ➾ To configure, see 11.4.3 page 197

Important

On Linux, for all files added under `SAFE/web/conf`, change their rights with:

```
chown safekit:safekit SAFE/web/conf/<filename>
chmod 0440 SAFE/web/conf/<filename>
```

11.2 HTTP setup

By default, after the SafeKit install, the web service is configured for HTTP with file-based authentication that must be initialized.

This default configuration can be extended as described in 11.2.1 page 175.

It can also be replaced by the unsecure setup described in 11.2.2 page 177 or anyone of the predefined setups.

11.2.1 Default setup

The default setup relies on HTTP with file-based authentication. It requires some initialization described below. It is a mandatory step.

This default configuration can be extended:

- ✓ to add users and assign them a role as described in 11.4.1.1 page 192
- ✓ to switch to HTTPS with:
  - ➾ the SafeKit PKI described in 11.3.1 page 179
  - ➾ an external PKI described in 11.3.2 page 187

After the installation of SafeKit, the configuration and restart of the web service is not necessary since this is the default configuration and the web service has been started with it.

11.2.1.1 Reset to default HTTP Setup

If you have changed the default user authentication configuration and want to revert to it, see 11.4.1 page 192.

If you want to revert to HTTP from HTTPS, on all SafeKit servers:

- Remove `SAFE/web/conf/ssl/httpd.webconsolessl.conf`
- Run `safekit webserver restart`

(where `SAFE=C:\safekit` in Windows if System Drive=C: and `SAFE=/opt/safekit` in Linux)

11.2.1.2 Initialization for the web console and distributed command

SafeKit provides a script to get the web console and distributed commands up and running quickly.

In Linux, this script can be automatically called during the install of SafeKit; in Windows, it must be manually executed. In both cases, you will have to give the password value, `<pwd>` for the `admin` user.

`webservercfg -passwd <pwd>`	On S1 and S2:
	➾ On Windows, open a PowerShell window as administrator and run (`SAFE=C:\safekit` if `%SYSTEMDRIVE%`=C:)
	`SAFE/private/bin/webservercfg.ps1 -passwd <pwd>`
	➾ On Linux, open a shell window as root and run (`SAFE=/opt/safekit`)
	`SAFE/private/bin/webservercfg -passwd <pwd>`
	You must set the same password on all nodes.

Important

The password must be identical on all the nodes of the cluster. Otherwise, web console and distributed commands will fail with authentication errors.

Once this initialization is done on all the cluster nodes:

- you can authenticate in the web console with the name `admin` and the password you provided. The role is Admin by default (unless you change the default behavior by providing the `group.conf` file as described in in 11.4.1.1 page 192)

  On authentication failure in the web console, you may need to reinitialize the `admin` password. For this, run again `webservercfg -passwd <pwd>` on all nodes.
- you can run distributed commands. It is based on a dedicated user `rcmdadmin` with the Admin role. It is managed in a different, private user file that you do not have to change.

On authentication failure for distributed commands, you may need to reset `rcmdadmin` password. To reset only this one, without changing the `admin` password, run `webservercfg -rcmdpasswd <pwd>` on all nodes.

11.2.1.3 Test the web console and distributed command

The setup is complete; you can now test that it is operational.

⇨ Test the web console

1. Start a browser on the user's workstation
2. Connect it to the default URL `http://host:9010` (where `host` is the name or Ip address of one of the SafeKit nodes)
3. In the login page, enter `admin` as user's name and the password you gave on initialization (the value for `<pwd>`)
4. The loaded page authorizes accesses that corresponds to the Admin role by default

⇨ Test the distributed command

1. Connect on S1 or S2 as administrator/root
2. Open a system console (PowerShell, shell, …)
3. Change directory to `SAFE`
4. Run `safekit -H "*" level`

   that should return the level for all nodes

11.2.2 Unsecure setup based on identical role for all

It is based on the configuration of a single role that is applied to all users without requiring authentication. This solution can only be implemented in HTTP and is incompatible with user authentication methods. It is intended to be used for troubleshooting only.

11.2.2.1 Configure and restart the web service

To configure where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

httpd.conf

On S1 and S2:

⇨ edit `SAFE/web/conf/httpd.conf` file

⇨ comment all authentication variants (`usefile`, `useldap`, `useopenid`)

```
#Define usefile
…
#Define useldap
…
#Define useopenid
```

	➩ select the desired role by uncommenting the associated line; if both lines are commented, the default role is **Monitor.**
	`Define httpadmin`
	`#Define httpcontrol`
	✓ `httpadmin` for Admin role
	✓ `httpcontrol` for Control role

	On S1 and S2, disable HTTPS if you had configured it: ➩ remove the file `SAFE/web/conf/ssl/httpd.webconsolessl.conf`
	On S1 and S2: ➩ run `safekit webserver restart`

11.2.2.2 Test the web console and distributed command

The setup is complete; you can now test that it is operational.

➩ Test the web console

1. Start a browser on the user’s workstation
2. Connect it to the default URL `http://host:9010` (where `host` is the name or Ip address of one of the SafeKit nodes)
3. The loaded page authorizes only the actions corresponding to the selected role

➩ Test the distributed command

1. Connect on S1 or S2 as administrator/root
2. Open a system console (PowerShell, shell, …)
3. Change directory to `SAFE`
4. Run `safekit -H "*" level`

   that should return the level for all nodes

11.3 HTTPS setup

The HTTPS web service relies on the existence of a set of certificates listed below:

CA	The certificate of the Certification Authority CA used to issue the server certificate for S1 and S2

S1 S2	The server certificate of S1 and S2 used to assert the nodes' identity

Apply one of the following 2 procedures to configure HTTPS and associated certificates:

- 11.3.1 "HTTPS setup using the SafeKit PKI" page 179

  Go to this section to quickly setup HTTPS with the SafeKit "private" certification authority.

- 11.3.2 "HTTPS setup using an external PKI" page 187

  Go to this section to setup HTTPS with an external PKI (enterprise PKI or commercial PKI) that provides trusted certification authority.

At the end of HTTPS setup, you must implement one of the authentication methods described in 11.4 page 191.

11.3.1 HTTPS setup using the SafeKit PKI

Important

Verify that the system clock is set to the current date and time on all SafeKit nodes and workstations that will run the HTTPS SafeKit web console. Certificates are timestamped, and a time difference between systems may have an impact on certificate validity.

11.3.1.1 Choose the Certificate Authority server

First, choose one SafeKit node to act as the Certificate Authority server. The selected node will be hereafter called the `CA server`. The other cluster nodes are called `non-CA server`. Then go through all the next subsections to activate the HTTPS configuration with the SafeKit PKI.

11.3.1.2 Start the CA web service on the CA server

On the CA server:

1. Log as administrator/root and open a command shell window
2. Change to the directory `SAFE/web/bin`
3. Run the command `./startcaserv`

   When prompted, enter a password to protect the access to this service for the `CA_admin` user (for instance, `PasW0rD)`. This command starts the `safecaserv` service.

Note

Remember this password since it will be required to connect to this service in next steps.

The CA web service running on the first server is also accessed by the additional non-CA servers.

Important

Since the service listens to TCP port 9001, make sure TCP port 9001 is not used, and is allowed in the firewall configuration. On Linux, the TCP 9001 port is automatically opened in local firewall by the `startcaserv` command. In Windows, the `safekit firewallcfg` command opens `safecaserv` service communications.

11.3.1.3 Generate Certificates on the CA server

During this step, the environment for generating certificates is set up: certificate authority, local server and client certificates are created; and server-side certificates are installed in their expected location.

On the CA server:

1. Log as administrator/root and open a command shell window
2. Change to the directory `SAFE/web/bin`
3. List server DNS names and IP addresses

   By default, the server certificate includes all the locally defined IP addresses and DNS names. They are listed into the files: `SAFE/web/conf/ipv4.json` and `SAFE/web/conf/ipv6.json` and `SAFE/web/conf/ipnames.json`.

   For building these files, run the command:

   - In Linux

     ```
     ./getipandnames
     ```

     This command relies on the `host` command delivered with the bind-utils package. Install it if necessary or manually fill the DNS names into the file `SAFE/web/conf/ipnames.json`.

   - In Windows

     ```
     ./getipandnames.ps1
     ```

Important

If the service will be accessed using another DNS name or IP address, edit the corresponding file to insert the new value before executing the `initssl` command. This is required for instance in the clouds using NAT, where the server has a public address mapped on a private address.

4. Run the command:

   ```
   ./initssl sca
   ```

   This command :

- ✓ Create a CA certificate `conf/ca/certs/cacert.crt` and its associated key `conf/ca/private/cacert.key`
- ✓ Create server certificate `conf/ca/certs/server_<HOSTNAME>.crt` and its corresponding key `conf/ca/private/server_<HOSTNAME>.key`
- ✓ Install the CA certificate, server certificate and key in the conf directory

Important

This command creates a Certificate Authority certificate with the default subject name (that is "SafeKit Local Certificate Authority"). To customize the subject name, run the command with an extra parameter:

```
./initssl sca "/O=My Company/OU=My Entity/CN=My Company
Private Certificate Authority"
```

11.3.1.4 Generate certificates on non-CA server

During this step, on non-CA servers, local certificate requests are created, signed certificates are retrieved from the CA server, and finally certificates are installed at their expected locations.

Apply the following procedure sequentially on each non-CA servers:

1. Log on as administrator/root and open a command shell window
2. Change to the directory `SAFE/web/bin`
3. List server DNS names and IP addresses

   By default, the server certificate includes all the locally defined IP addresses and DNS names. They are listed into the files: `SAFE/web/conf/ipv4.json`, `SAFE/web/conf/ipv6.json` and `SAFE/web/conf/ipnames.json`. For building these files, run the command:

   ➩ In Linux

   ```
   ./getipandnames
   ```

   This command relies on the `host` command delivered with the bind-utils package. Install it if necessary or manually fill the DNS names into the file `SAFE/web/conf/ipnames.json`.

   ➩ In Windows

   ```
   ./getipandnames.ps1
   ```

Important

If the service will be accessed using another DNS name or IP address, edit the corresponding file to insert the new value before executing the `initssl` command. This is required for instance in the clouds using NAT, where the server has a public address mapped on a private address.

4. Run the command:

   ```
   ./initssl req https://CAserverIP:9001 CA_admin
   ```

   where `CAserverIP` is the DNS name or IP address of the CA server.

   Then enter, each time it is required, the password you specified when you started the CA web service on the CA server (for instance, `PasW0rD`)

   Or

```
./initssl req https://CAserverIP:9001 CA_admin:PasW0rD
```

Important

If necessary, set the environment variables `HTTPS_PROXY` and `HTTP_PROXY` to adequate values.

Note

If you get the error "Certificate is not yet valid", it means the system clock of the server is not synchronized with the system clock of the CA server. You should synchronize your server clocks and re-run the `initssl` command if the time difference is not acceptable.

11.3.1.5 Enable HTTPS on CA server and non-CA server

To enable HTTPS, on all SafeKit servers:

- copy `SAFE/web/conf/httpd.webconsolessl.conf` to `SAFE/web/conf/ssl/httpd.webconsolessl.conf`
- On Linux run :
  ```
  chown safekit:safekit SAFE/web/conf/ssl/httpd.webconsolessl.conf
  chmod 0440 SAFE/web/conf/ssl/httpd.webconsolessl.conf
  ```
- run `safekit webserver restart`

(where `SAFE=C:\safekit` in Windows if System Drive=C: and `SAFE=/opt/safekit` in Linux)

11.3.1.6 Configure the firewall on CA server and non-CA server

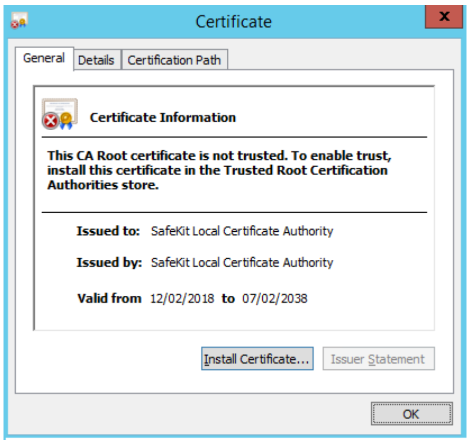
When the SafeKit web service runs in HTTPS mode, it is safe to allow network communication with this server and configure the firewall. For this, apply the instructions described in 10.3 page 156.

11.3.1.7 Set the HTTPS SafeKit Web console

If the CA certificate has not been imported, the browser issues security alerts when the user connects to the web console with his client certificate. If the import has not already been done, apply the procedure below in Windows:

1. Log-in the user’s workstation
2. Download from the CA server the CA certificates (`cacert.crt` file) located into `SAFE/web/conf/ca/certs`.

3. Click on the downloaded `cacert.crt` file for opening the certificate window. Then click on Install Certificate button



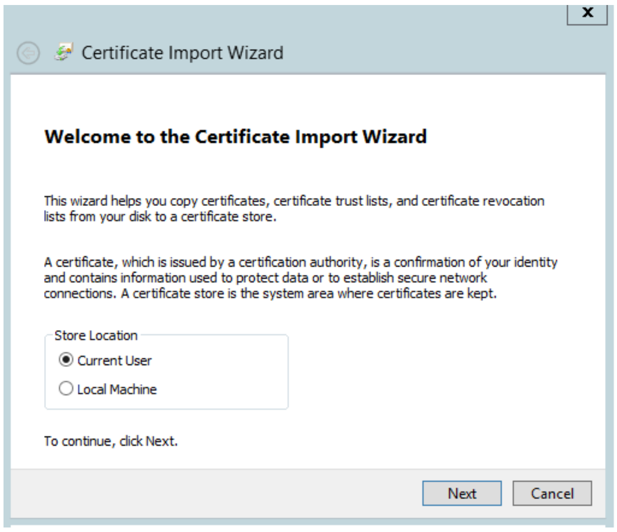
This CA Root certificate is not trusted. To enable trust, install this certificate in the Trusted Root Certification Authorities store.

Issued to: SafeKit Local Certificate Authority

Issued by: SafeKit Local Certificate Authority

Valid from 12/02/2018 to 07/02/2038

4. It opens the Certificate Import Wizard. Select Current User and click on the Next button



Welcome to the Certificate Import Wizard

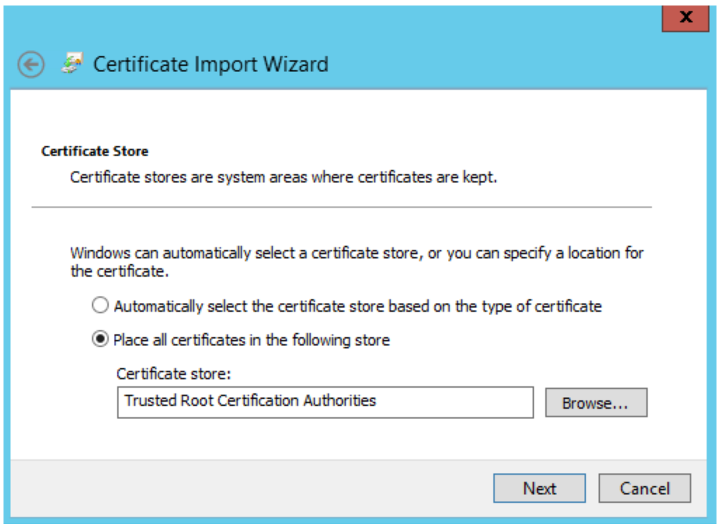
This wizard helps you copy certificates, certificate trust lists, and certificate revocation lists from your disk to a certificate store.

A certificate, which is issued by a certification authority, is a confirmation of your identity and contains information used to protect data or to establish secure network connections. A certificate store is the system area where certificates are kept.

Store Location
[✓ Current User]
Local Machine

To continue, click Next.

5. Browse stores to select the Trusted Root Certification Authorities store. Then click on Next button



Certificate Store
Certificate stores are system areas where certificates are kept.

Windows can automatically select a certificate store, or you can specify a location for the certificate.

Automatically select the certificate store based on the type of certificate
[✓ Place all certificates in the following store]

Certificate store: Trusted Root Certification Authorities

6. Then complete the certificate import.

11.3.1.8 Stop the CA web service on CA server

Once all SafeKit servers have been configured, it is recommended to bring the CA web service (`safecaserv` service) offline on the CA server, to limit the risk of accidental or malicious access.

For stopping the SafeKit CA web service with the command line:

1. Log as administrator/root and open a command shell window
2. Change to the directory `SAFE/web/bin`
3. Run the command `./stopcaserv`

Note: On Windows, this command also removes the service entry to prevent any accidental start of the service afterwards. On Linux, the 9001 port is automatically closed on local firewall.

When all foreseeable certificate generation and installation is done, it is a good practice to make sure files unnecessary at production time are not accessible. This step is not mandatory.

The files that constitute the CA, i.e., the `SAFE/web/conf/ca` file tree (especially the private keys stored under `SAFE/web/conf/ca/private/*.key`s) should be stored for future use on a removable storage media and removed from the server. Store the removable media in a secure place (i.e., a vault). This also applies to the files located under the `SAFE/web/conf/ca` directory of non-CA servers. The CA files should be restored into the same location before using the CA again (for example, if adding a new SafeKit cluster node).

11.3.1.9 SafeKit PKI advanced configuration

11.3.1.9.1 Renewing certificates

Every certificate has an expiration date. The default expiration date of the CA certificate is set to 20 years after the CA installation date. The default expiration date of the server certificates is set to 20 years after the certificate request date.

Expired server certificates will trigger warnings when the browser connects to the server. Expired CA certificates cannot be used to validate issued certificates.

It is possible to renew certificates using the original certificate requests and the private keys stored under the `SAFE/web/conf/ca` directory tree. You may also create a new certificate request using the existing private key. The procedure to do so is beyond the scope of this document, see openssl (or your certificate authority) documentation.

Creating a new set of certificates (and private keys) will have the side effect of renewing all certificates. To create a new set of certificates:

1. Erase the `web/conf/ca` directory on all SafeKit servers related to the CA, including the CA SafeKit server itself
2. Suppress existing certificates from the client machines certificate stores
3. Apply the full procedures described in 11.3 page 178

11.3.1.9.2 Revoking certificates

It is possible to modify the SafeKit web service configuration to use a CRL containing the revoked certificates list. Setting up such a configuration is beyond the scope of this document. Refer to the Apache and openssl documentation.

Creating a new set of certificates and replacing the old set with the new one will have the side effect of effectively revoking the previous certificate set, since the CA certificate is different.

11.3.1.9.3 Commands for certificate generation

These commands are located, and must be run from, the `SAFE/web/bin` directory.

All paths below are relative to `SAFE/web` directory.

initssl sca [<subject>]

Parameters

`<Subject>`: the optional CA certificate subject, that identify in human readable form the owner of the CA.

Examples

```
initssl ca "/O=My Company/OU=My Unit/CN=My Company Private Certificate
Authority"
```

Description

This command :

- Create a CA certificate `conf/ca/certs/cacert.crt` and its associated key `conf/ca/private/cacert.key`
- Create server certificate `conf/ca/certs/server_<HOSTNAME>.crt` and its corresponding key `conf/ca/private/server_<HOSTNAME>.key`
- Install the CA certificate, server certificate and key in the conf directory

It's initialize a conf/ca file tree needed for the SafeKit PKI related commands.

Note

Note that the best practice is to protect private keys with a password, but it needs more complex configuration on the server and is beyond the scope of this document. See the Apache and OpenSSL documentation for more information.

initssl rca

Description

As *initssl sca*, but reuse the existing CA infrastructure to reissue the server certificate and key (re)install the CA certificate , server certificate and key in the conf directory

initssl req <url> <user>[:<password>]]

Parameters

- `<url>`: URL of the CA service. (https://CA_server:9001)

- `<user>,<password>`: user and password used to authenticate against the CA web service.

  `<user>` preconfigured value is `CA_admin`. `<password>` is the one entered by the administrator at the start of CA web service. If these optional field are not present, the password will be asked interactively several times, when needed.

Example

`initssl req https://192.168.0.1:9001 CA_admin:PasW0rD`

Description

This command :

- Creates a certificate request for a server certificate that includes all the locally defined IP addresses and DNS names. The certificate request is stored in `conf/ca/private/server_<hostname>.csr`. The corresponding key is stored in `conf/ca/private/server_<hostname>.key`.
- Creates a certificate request for a client certificate with the Admin role (to be used by the distributed commands). The certificate request is stored in `conf/ca/private/user_Admin_<hostname>.csr`. The corresponding key is stored in `conf/ca/private/user_Admin_<hostname>.key`.
- Retrieves the CA certificate from the CA server
- Retrieves signed certificates corresponding to the certificate requests above, from the CA server (using provided login)
- Installs certificates and keys in the conf directory
- Checks certificates are OK

If no <url> is given, the command stops after having generated the certificate requests corresponding to:

- The local server, in the `conf/ca/private/server_<hostname>.csr`
- An Admin role client certificate, in `conf/ca/private/user_Admin_<hostname>.csr`

  Those certificate requests are stored in a base64 encoded file ready to be submitted to an external certificate authority such as Microsoft Active Directory Certificate Services (refer to the Microsoft documentation on how to submit a base64 encoded certificate request file).

makeusercert <name> <role>

Parameters

`<name>` is the subject's CN name of the certificate, usually the subject's username.

`<role>` is subject's role as a console user. The valid value is `Admin` or `Control` or `Monitor`.

Examples

```
makeusercert administrator Admin
```

```
makeusercert manager Control
makeusercert operator Monitor
```

Description

Creates a client certificate request (and certificate + pkcs12 file containing certificate and key if started on the CA SafeKit server) for the `<name>` and `<role>`.

When the pkcs12 file is generated, the command asks twice for a password to protect the file. The generated unencrypted private key is stored into `conf/ca/private/user_<role>_<name>.key` file. If applicable, the generated certificate and pkcs12 files are stored into `conf/ca/certs/user_<role>_<name>.crt` and `conf/ca/private/user_<role>_<name>.p12` files respectively.

Client certificates could be used as an authentication method on an HTTPS server. They are transmitted to the web service by the browser and verified on the server as part of the HTTPS connection handshake. A certificate corresponding to the desired role must be installed in the browser certificate store before the SafeKit web console can be used.

11.3.1.9.4 SafeKit CA web service

The SafeKit CA web service configuration is stored in `SAFE/web/conf/httpd.caserv.conf` file.

This service implements limited PKI.

➩ CA certificates are accessible at the https://CAserverIP>:9001/certs/<certificate name>.crt URL.

For example, the CA certificate is accessible at https://CAserverrIP>:9001/certs/cacert.crt.

Certificate signature requests are processed by posting a form at the URL: https://<CA server IP>:9001/caserv .

The form takes the following parameters:

action = signrequest

name = <certificate name>

servercsr = <file content of the server certificate request>

Or

usercsr = <file content of the client certificate request>

11.3.2 HTTPS setup using an external PKI

Apply steps below to setup HTTPS with your trusted certification authority (your enterprise PKI or commercial PKI).

11.3.2.1 Get and install server certificates

11.3.2.1.1 Get certificate files

You must get server certificates from the PKI with the expected format.

CA	The certificate of the Certification Authority CA used to issue the server certificates
S1	The server certificate to assert the S1 identity.
S2	The server certificate to assert the S2 identity.
`s1.crt` `s2.crt`	➾ X509 certificate file in PEM format The subfield `CN` (`Common Name`) into the `subject` field, or the `Subject Alternative Name` field of the certificate, must contain : ✓ S1 name(s) and/or IP address(es) for `s1.crt` ✓ S2 names and/or IP address(es) for `s2.crt` Be aware that you must provide all names and/or IP addresses, for S1 and S2, which are used for HTTPS connections: ✓ those included into the SafeKit cluster configuration file ✓ Those used in the browser URL to load the web console from a cluster node, and which are not present into the cluster configuration See the example in 11.3.2.1.3 page 189.
`s1.key` `s2.key`	➾ The private, *unencrypted* key corresponding to the certificates `s1.crt` and `s2.crt`

11.3.2.1.2 Install files in SafeKit

Install the certificates as follow (where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

S1
`s1.crt`
`s1.key`
	On S1:
	➾ copy `s1.crt` to `SAFE/web/conf/server.crt`
	➾ copy `s1.key` to `SAFE/web/conf/server.key`

S2 `s2.crt`	On S2: ➾ copy `s2.crt` to `SAFE/web/conf/server.crt`

`s2.key`	➩ copy `s2.key` to `SAFE/web/conf/server.key`

On Linux, on S1 and S2, run:

```
chown safekit:safekit SAFE/web/conf/server.crt SAFE/web/conf/server.key
chmod 0440 SAFE/web/conf/server.crt SAFE/web/conf/server.key
```

You can check the installed certificates with:

```
cd SAFE/web/bin
checkcert -t server
```

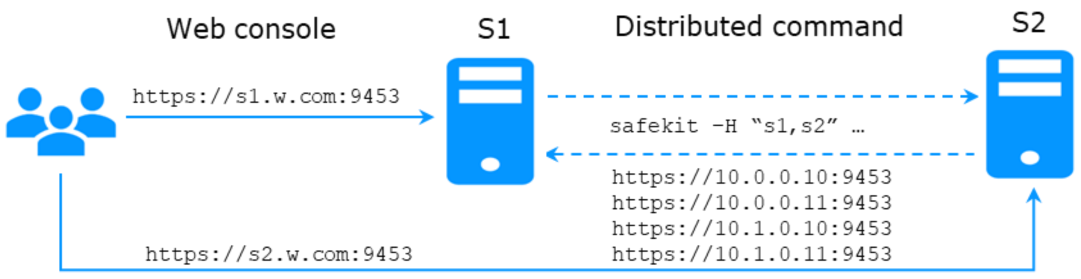
It returns a failure if an error is detected.

You can check that the certificate contains some DNS name or IP address with:

```
checkcert -h ”DNS name value”
checkcert -i ”Numeric IP address value”
```

11.3.2.1.3 Example

Consider the following architecture:



The corresponding SafeKit cluster configuration file, `SAFEVAR/cluster/cluster.xml` must contain these values into `addr` field:

```
<?xml version="1.0"?>
<cluster>
<lans>
  <lan name="default">
    <node name="s1" addr="10.0.0.10"/>
    <node name="s2" addr="10.0.0.11"/>
  </lan>
  <lan name="private">
    <node name="s1" addr="10.1.0.10"/>
    <node name="s2" addr="10.1.0.11"/>
  </lan>
</lans>
</cluster>
```

The server certificates must contain the same values (DNS names and/or IP addresses) as those in the cluster configuration and the values used to connect the web console. If not, the SafeKit web console and distributed commands will not work properly.

To check that the certificate file is correct:

1. Copy the `.crt` (or `.cer`) file on a Windows workstation

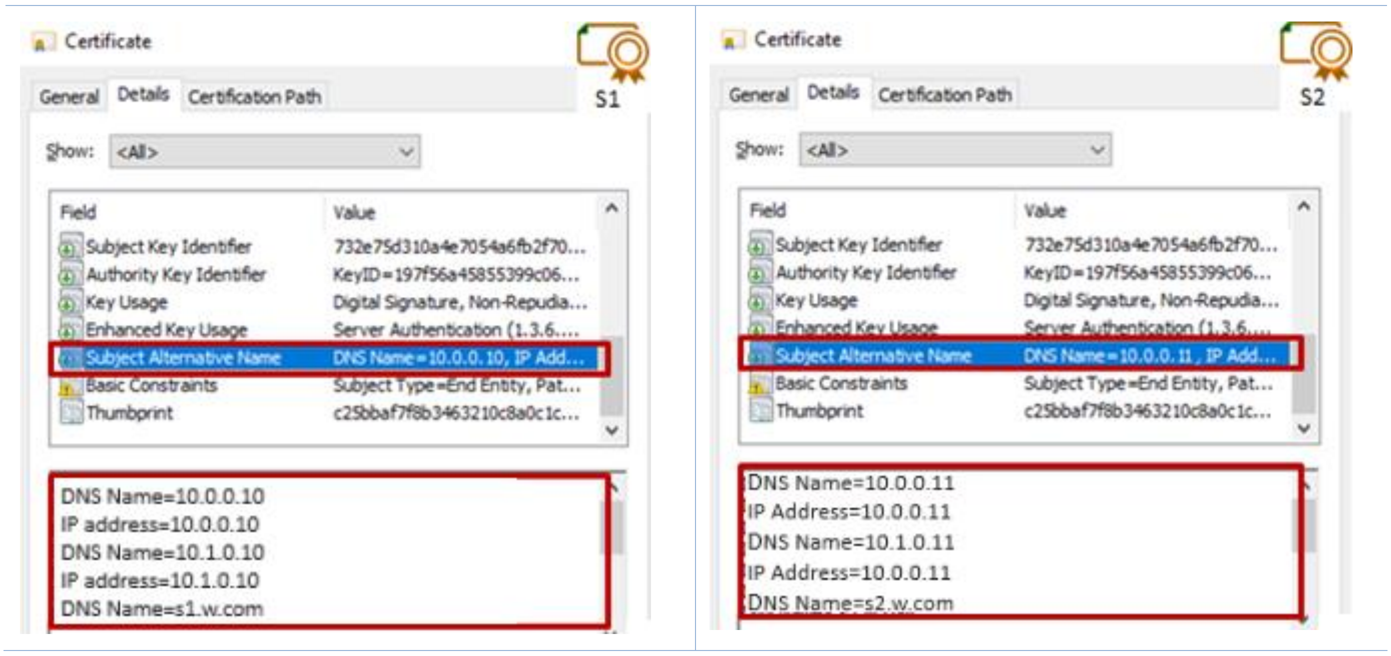
2. Double click on this file to open it with Crypto Shell Extensions
3. Click on the Details tab
4. Verify the `Subject Alternative Name` field

Note

If you prefer the command line interface, you can run on each the SafeKit node:

```
SAFE/web/bin/openssl.exe x509 -text -noout -in SAFE/web/conf/server.crt
```

and look for the value after `Subject Alternative Name`



Certificate — S1

General | Details | Certification Path

Show: <All>

Field	Value
Subject Key Identifier	732e75d310a4e7054a6fb2f70...
Authority Key Identifier	KeyID=197f56a45855399c06...
Key Usage	Digital Signature, Non-Repudia...
Enhanced Key Usage	Server Authentication (1.3.6....
Subject Alternative Name	DNS Name=10.0.0.10, IP Add...
Basic Constraints	Subject Type=End Entity, Pat...
Thumbprint	c25bbaf7f8b3463210c8a0c1c...

```
DNS Name=10.0.0.10
IP address=10.0.0.10
DNS Name=10.1.0.10
IP address=10.1.0.10
DNS Name=s1.w.com
```

Certificate — S2

General | Details | Certification Path

Show: <All>

Field	Value
Subject Key Identifier	732e75d310a4e7054a6fb2f70...
Authority Key Identifier	KeyID=197f56a45855399c06...
Key Usage	Digital Signature, Non-Repudia...
Enhanced Key Usage	Server Authentication (1.3.6....
Subject Alternative Name	DNS Name=10.0.0.11, IP Add...
Basic Constraints	Subject Type=End Entity, Pat...
Thumbprint	c25bbaf7f8b3463210c8a0c1c...

```
DNS Name=10.0.0.11
IP Address=10.0.0.11
DNS Name=10.1.0.11
IP Address=10.0.0.11
DNS Name=s2.w.com
```

11.3.2.2 Get and install the CA certificate

11.3.2.2.1 Get certificate file

You must get these certificates from the PKI with the expected format.

CA cacert.crt	The Certification Authority CA certificate used to issue the server certificates. ⇨ X509 certificate file in PEM format The chain of certificates for the root and intermediates CA	S1 S2 Server certificates for S1 and S2

If you have trouble retrieving this file from the PKI, you can build it using the procedure described in 7.18 page 127.

11.3.2.2.2 Install file in SafeKit

Install certificates files as follow (where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

CA
cacert.crt
	On S1 and S2:
	➾ copy `cacert.crt` to `SAFE/web/conf/cacert.crt`
	➾ On Linux, run:
	`chown safekit:safekit SAFE/web/conf/cacert.crt`
	`chmod 0440 SAFE/web/conf/cacert.crt`

You can check the installed certificates with:

```
cd SAFE/web/bin
checkcert -t CA
```

It returns a failure if an error is detected.

You must also check that the `cacert.crt` contains the chain of certificates for the root and intermediates Certification Authorities.

11.3.2.3 Configure and restart the web service

To enable HTTPS, on all servers :

- ➾ copy `SAFE/web/conf/httpd.webconsolessl.conf` to `SAFE/web/conf/ssl/httpd.webconsolessl.conf`
- ➾ On Linux, run :

  ```
  chown safekit:safekit SAFE/web/conf/ssl/httpd.webconsolessl.conf
  chmod 0440 SAFE/web/conf/ssl/httpd.webconsolessl.conf
  ```
- ➾ run `safekit webserver restart`

(where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux)

11.3.2.4 Change the firewall rules

You can run the `safekit firewallcfg` command to change the firewall rules. It set SafeKit rules into the operating system default firewall (in Windows, `Microsoft Windows Firewall` ; in Linux, `firewalld` or `iptables`).

Firewall	On S1 and S2: ➾ run `SAFE/safekit firewallcfg add`

Don't run this command if you want to configure the firewall yourself or if you use a different firewall than the system one. For the list of SafeKit processes and ports, see 10.3 page 156.

11.4 User authentication setup

Setup one of the following user authentication methods:

- ➾ 11.4.1 "File-based authentication setup" page 192

- 11.4.2 “LDAP/AD authentication setup” page 194
- 11.4.3 “OpenID authentication setup” page 197

At the end of this setup, you can start using the secure SafeKit web console.

11.4.1 File-based authentication setup

File-based authentication setup can be applied in HTTP or HTTPS. It relies on the following files:

user.conf	User file configuration that defines authorized users
Admin Control Monitor group.conf	Optional file to restrict the user’s role. If the `group.conf` file is not present, all authenticated users will have the Admin role.

11.4.1.1 Manage users and groups

The users and groups must be identical on S1 and S2, as well as passwords. It is defined by the files `user.conf` and `group.conf` into `SAFE/web/conf` directory (`SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux).

Note

During the default setup initialization, described in 11.2.1 page 175, the user named `admin` has been created and thus is present into `user.conf`. You can decide to remove this user if you create others.

- Create a new user

  Users are created with the `SAFE/web/bin/htpasswd` command.

  For instance, to add the new user `manager` and set its password `managerpassword`, run:

```
SAFE/web/bin/htpasswd -bB SAFE/web/conf/user.conf manager managerpassword
```

  The new user is inserted into `SAFE/web/conf/user.conf` the file.

user.conf	`admin:$2y$05$oPquL6Z2Y78QcXpHIako.O58Z6lWfa5A86XD.eCbEnbRcguJln9Ce`
	`manager``:$apr1$U2GLivF5$x39WKmSpq6BGmLybESgNV1`
	`operator1:$apr1$DetdwaZz$hy5pQzpUlPny3qsXrIS/z1`
	`operator2:$apr1$ICiZv2ru$wRkc3BclBhXzc/4llofoc1`

- Assign the role of the users

By default, all users have the Admin role. If you want to assign distinct roles to different users, you must create the `SAFE/web/conf/group.conf` file and assign user's role. The group file can contain the 3 groups Admin, Control, Monitor. Users in these groups will have the corresponding roles.

Note: Each line of the group file must contain the group name followed by a colon, followed by the member users name separated by spaces. See the example above.

For instance, assign the Control role to the new user `manager`:

group.conf	`Admin : admin`
	`Control : **manager**`
	`Monitor : operator1 operator2`

Note: If you enable the role management, you must insert the user `admin` into `group.conf`. Otherwise, this user will no longer be operational.

⇨ Delete a user, …

Use `htpasswd -?` for all user management commands (add/delete, ...).

11.4.1.2 Install files

Install the files as follow (where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

user.conf	On S1 and S2: ⇨ copy `user.conf` to `SAFE/web/conf/user.conf`
group.conf	On S1 and S2 if groups are set: ⇨ copy `group.conf` to `SAFE/web/conf/group.conf`

On Linux, on S1 and S2, run:

```
chown safekit:safekit SAFE/web/conf/user.conf SAFE/web/conf/group.conf
chmod 0440 SAFE/web/conf/user.conf SAFE/web/conf/group.conf
```

These files must be identical on all nodes.

11.4.1.3 Configure and restart the web service

To configure the file-based authentication (where `SAFE=C:\safekit` in Windows if System Drive=C: ; and `SAFE=/opt/safekit` in Linux):

httpd.conf	On S1 and S2: ➾ edit `SAFE/web/conf/httpd.conf` file ➾ if necessary uncomment `usefile` `Define usefile`
	On S1 and S2: ➾ run `safekit webserver restart`

This is the default content of `httpd.conf`.

11.4.1.4 Test the web console and distributed command

The setup is complete; you can now test that it is operational.

➾ Test the web console

1. Start a browser on the user's workstation
2. Connect it to the default URL `http://host:9010` (where `host` is the name or Ip address of one of the SafeKit nodes). If HTTPS is configured, there is an automatic redirection to `https://host:9453`
3. In the login page, specify in the user's name and password

   With the SafeKit default configuration, you can log-in with the user `admin` by giving the password you assigned during initialization.
4. The loaded page only allows access authorized by the user's role. If the groups have not been defined, all users have the Admin role.

➾ Test the distributed command

1. Connect on S1 or S2 as administrator/root
2. Open a system console (PowerShell, shell, …)
3. Change directory to `SAFE`
4. Run `safekit -H "*" level`

   that should return the level for all nodes

11.4.2 LDAP/AD authentication setup

LDAP/AD authentication setup can be applied in HTTP or HTTPS. It requires:

	LDAP/Active Directory account configuration used to assert the user identity

ADMIN CONTROL MONITOR	Optional LDAP/Active Directory group configuration to restrict the user's role. When groups are not defined, all authenticated users have the Admin role.

Note

On some Linux distributions (such as RedHat 8 and CentOS 8), the web server start fails when it is configured with LDAP/AD authentication. In this case, apply the solution described in SK-0092.

Apply the steps described below after verifying that S1 and S2 can connect to the LDAP controller domain port (default is 389).

11.4.2.1 Manage users and groups

If necessary, ask your LDAP administrator to create users of the SafeKit web console.

If you want to define user's role, ask your LDAP administrator to create groups for Admin, Control, Monitor roles and assign users to groups. When groups are not defined, all users will have the Admin role.

11.4.2.2 Configure and restart the web service

To configure the LDAP/AD authentication (where `SAFE=C:\safekit` in Windows if `%SYSTEMDRIVE%`=C: ; and `SAFE=/opt/safekit` in Linux):

On S1 and S2:

Initialize the authentication for the distributed command. This may have already been done if you initialized the default configuration after SafeKit installation. Otherwise:

➩ Run `webservercfg -rcmdpasswd pwd`

where `pwd` is the password for the private user `rcmdadmin`. You don't need to memorize it.

httpd.conf

On S1 and S2:

➩ edit `SAFE/web/conf/httpd.conf` file

➩ uncomment `useldap`

```
Define useldap
```

➩ Locate the following lines and replace bold values according to your LDAP/AD service configuration:

```
Define binddn "CN=bindCN,OU=bindOU1,OU=bindOU2,DC=domain,DC=fq,DC=dn"
Define bindpwd "Password0"
Define searchurl "ldap://ldaporad.fq.dn:389/OU=searchou, DC=domain, DC=fq,
DC=dn?sAMAccountName, memberOf?sub?(objectClass=*)"
```

➾ the `binddn` and `bindpwd` variables must contain the credentials of an account with search rights on the directory

➾ the `searchurl` variable defines the RFC2255 search URL to authenticate the user

Note

`CN`: common name

`OU`: organization unit

`DC`: domain component (one field for each part of the FQDN)

If the group configuration is not enabled, all authenticated users will have the Admin role.

On S1 and S2

To enable group management:

➾ edit `SAFE/web/conf/httpd.conf` file

➾ uncomment the following lines and replace bold values according to your LDAP/AD service configuration:

```
Define admingroup
"CN=Group1CN,OU=Group1OU1,OU=Group1OU2,DC=domain,DC=fq,DC=dn"
Define controlgroup
"CN=Group2CN,OU=Group2OU1,OU=Group2OU2,DC=domain,DC=fq,DC=dn"
Define monitorgroup
"CN=Group3CN,OU=Group3OU1,OU=Group3OU2,DC=domain,DC=fq,DC=dn"
```

Users set into the LDAP/AD groups associated to `admingroup`, `controlgroup` and `monitorgroup`, will respectively have Admin, Control and Monitor roles.

For more sophisticated authentication, read Apache web service documentation (see http://httpd.apache.org).

On S1 and S2:

➾ run `safekit webserver restart`

11.4.2.3 Test the web console and distributed command

The setup is complete; you can now test that it is operational.

➾ Test the web console

1. Start a browser on the user’s workstation
2. Connect it to the default URL `http://host:9010` (where `host` is the name or Ip address of one of the SafeKit nodes). If HTTPS is configured, there is an automatic redirection to `https://host:9453`
5. In the login page, specify in the user’s name and password
6. The loaded page only allows access authorized by the user's role. If the groups have not been defined, all users have the Admin role.

➩ Test the distributed command

1. Connect on S1 or S2 as administrator/root
2. Open a system console (PowerShell, shell, …)
3. Change directory to `SAFE`
4. Run `safekit -H "*" level`

   that should return the level for all nodes

11.4.3 OpenID authentication setup

OpenID authentication relies on the mod_auth_openidc Apache module. It requires:

	OpenID Identity provider client application registration and account configuration used to assert the user identity
ADMIN CONTROL MONITOR	Optional OpenID claims configuration to restrict the user's role. When claims are not defined, all authenticated users have the Admin role.

Note

On some Linux distributions you may need to install the mod_auth_openidc module from the distribution repository.

Apply the steps described below after verifying that S1 and S2 can connect to the OpenID Identity Provider. You may need to setup a proxy configuration, see relevant `httpd.conf` section and `mod_auth_openidc` documentation for details.

11.4.3.1 Manage app, users and groups

If necessary, ask your OpenID administrator to create users of the SafeKit web console.

Ask your OpenID administrator to register the webconsole App into the OpenID provider (OP) and retrieve the assigned credentials (ClientID and ClientSecret) values (you will need those values during the httpd.conf configuration step below).

Set the app's redirect uri to **Erreur ! Référence de lien hypertexte non valide.** FQDN>:9453/openid or **Erreur ! Référence de lien hypertexte non valide.** FQDN>:9010. If you plan to connect to more than one server, enter the url of each connection server.

If you want to define user's role on the Identity Provider, ask your OpenID administrator to create groups or roles for Admin, Control, Monitor roles and assign users to the created groups or roles, then fill in the `AdminClaim`, `ControlClaim` and `MonitorClaim` variables in `httpd.conf` with the corresponding claims. When the above is not defined, all authenticated users will have the Admin role.

You may also define the groups on the SafeKit Web Server by filling in the `group.conf` file as in the File-based authentication case (see "Assign the role of the users" in section 11.4.1.1 page 192).

11.4.3.2 Configure and restart the web service

To configure the OpenID authentication (where `SAFE=C:\safekit` in Windows if `%SYSTEMDRIVE%=C:` ; and `SAFE=/opt/safekit` in Linux):

On S1 and S2:

Initialize the authentication for the distributed command. This may have already been done if you initialized the default configuration after SafeKit installation. Otherwise:

- Run `webservercfg -rcmdpasswd pwd`

  where `pwd` is the password for the private user `rcmdadmin`. You don't need to memorize it.

httpd.conf

On S1 and S2:

- edit `SAFE/web/conf/httpd.conf` file
- uncomment `useopenid`

```
Define useopenid
```

- Locate the following lines and replace values according to your OpenID service configuration:

```
OIDCProviderMetadataURL <Your OpenId provider metadata URL>
OIDCClientID <Your OpenID client ID>
OIDCClientSecret <Your OpenID client secret>
OIDCRemoteUserClaim <The Claim in ID token that identifies the user, if not
set, defaults to sub>
## openid connect scope request; this defines which claims are returned by
the IDP.
OIDCScope "openid email"
```

  - ✓ the `OIDCClientID` and `OIDCClientSecret` variables must contain the credentials of the registered app in the OpenID Identity Provider.
  - ✓ the `OICDScope` variable defines the scopes needed to return the `RemoteUser` and optionally roles claims. `openid` should always be specified.

If neither the `AdminClaim`, `ControlClaim` and `MonitorClaim` configuration nor the group.conf configuration is enabled, all authenticated users will have the Admin role.

On S1 and S2

To enable role claim management:

- edit `SAFE/web/conf/httpd.conf` file
- uncomment the following lines and replace the values according to your OpenID service configuration:

```
# Define AdminClaim roles:SKAdmin
# Define ControlClaim roles:SKControl
# Define MonitorClaim roles:SKMonitor
```

Users' tokens bearing the claims defined by the AdminClaim, ControlClaim and MonitorClaim, will respectively have Admin, Control and Monitor roles.

For more details, see the `mod_auth_openidc` documentation (GitHub - OpenIDC/mod_auth_openidc: OpenID Certified™ OpenID Connect Relying Party implementation for Apache HTTP Server 2.x).

On S1 and S2:

- run `safekit webserver restart`

11.4.3.3 Test the web console and distributed command

The setup is complete; you can now test that it is operational.

- Test the web console

3. Start a browser on the user's workstation
4. Connect it to the default URL `http://host:9010` (where `host` is the name or Ip address of one of the SafeKit nodes). If HTTPS is configured, there is an automatic redirection to `https://host:9453`
5. In the login page, specify in the user's name and password
6. The loaded page only allows access authorized by the user's role. If the groups have not been defined, all users have the Admin role.

- Test the distributed command

1. Connect on S1 or S2 as administrator/root
2. Open a system console (PowerShell, shell, …)
3. Change directory to `SAFE`
4. Run `safekit -H "*" level`

   that should return the level for all nodes

12. Cluster.xml for the SafeKit cluster configuration

SafeKit uses the configuration file `cluster.xml`. This file defines all the servers that make up the SafeKit cluster as well as the IP address (or name) of these servers on the networks used to communicate with the cluster nodes. These are global cluster and module internal communications; these communications are encrypted. This network is also used for executing the global `safekit` command (with argument `-H`).

You must define at least one network that includes all nodes in the cluster. It is recommended to define several networks to tolerate at least one network failure.

12.1 Cluster.xml file

Each network (`lan`) has a logical name that will be used in the configuration of the modules to name the monitoring networks:

- ⇨ into the heartbeat section for a mirror module (for details, see 13.3 page 211)
- ⇨ into the lan section for a farm module (for details, see 13.4 page 213)

The node name is the one that is used by the SafeKit administration service (`safeadmin`) for uniquely identifying a SafeKit node. You must always use the same name for designing a given server on different networks. This name is also used by the SafeKit web console when displaying the node's name.

12.1.1 Cluster.xml example

In the example below, two networks are defined. The network named `private` can be dedicated to file replication.

```
<cluster>
   <lans>
      <lan name="default">
         <node name="node1" addr="192.168.1.67"/>
         <node name="node2" addr="192.168.1.68"/>
         <node name="node3" addr="192.168.1.69"/>
         <node name="node4" addr="192.168.1.70"/>
      </lan>
      <lan name="repli">
         <node name="node1" addr="10.0.0.1"/>
         <node name="node2" addr="10.0.0.2"/>
         <node name="node3" addr="10.0.0.3"/>
         <node name="node4" addr="10.0.0.4"/>
      </lan>
   </lans>
</cluster>
```

In the example below, a unique network is used, but in a Network address translation (NAT) configuration. For each node two addresses must be defined: the local one `laddr` (defined on local interface) and the external one `addr` (as seen by other servers).

```
<cluster>
   <lans>
      <lan name="default">
         <node name="node1" addr="server1.dns.name" laddr="10.0.0.1"/>
         <node name="node2" addr="server2.dns.name" laddr="10.0.0.2"/>
      </lan>
   </lans>
</cluster>
```

All nodes must be able to communicate to the others via the NATted addresses.

12.1.2 Cluster.xml syntax

```
<cluster>
  <lans [port="4800"]>
    <lan name="lan_name" [command="on|off"] >
      <node name="node_name" addr="IP1_address"|"IP1_name"
           [ laddr="local_IP1_address" ]/>
      <node name="node_name" addr="IP2_address"|"IP2_name"
           [ laddr="local_IP2_address" ] />
      …
    </lan>
    …
  </lans>
</cluster>
```

12.1.3 <lans>, <lan>, <node> attributes

`<lans`	Begin the definition of the cluster nodes and network topology.
`[port="xxxx"]`	Defines the UDP port with which the membership protocol is exchanged. Default: `4800`
`[pulse=”xxxx”]`	Defines the period of the membership protocol messages emission. Longer pulse makes the membership protocol use less bandwidth but react more slowly.
`[mlost_count=”xx”]`	Defines the number of periods elapsed without message before electing a new leader.
`[slost_count=”xx”]`	Defines the number of periods elapsed without messages before declaring a follower node offline.
`<lan`	Definition of a LAN (i.e., IPv4 broadcast domain, IPv6 link) on which the membership protocol will be transmitted. At least one LAN must be defined. Define one such tag per used LAN.

`name="lan name"`	Single logical name for the lan. This name is used into module configuration to name networks used by the module.
`command="on"|"off"`	Set `command="on"` to use this network for running distributed commands on the cluster. In this case, this `<lan>` section must include all nodes in the cluster. You can set only one `<lan>` section with `command="on"`. When this attribute is not set, it is the first `<lan>` section that is used for running distributed commands on the cluster. Default: `off`
`<node`	Definition of one node in the SafeKit cluster. Define as many <node> tags as there are nodes in the cluster (at least 2).
`name="node name"`	Single logical name to the SafeKit server. You must always use the same name for designing a given server on different lans.
`addr= "IP_address"| "IP_name"`	IPv4 or IPv6 address, or name of the node as it is known by other nodes on this LAN (IP address recommended to be independent from a DNS server). On NAT configuration, it must be the external address. When defining an IPv6 address, use literal format: the address is enclosed in square brackets (e.g. `[2001::7334]`)
`laddr= "local_IP_address"`	Local IP address on this LAN. To be used only on NAT configurations, where local address is different from external one. IPv4 address or literal IPv6 address.

Note

In SafeKit < 8.2, the cluster configuration had attributes `console` and `framework` on `<lan>` tag. These attributes were necessary for the legacy web console and are obsolete with the new one. If presents, these attributes are ignored in SafeKit 8.2.

12.2 SafeKit cluster Configuration

12.2.1 Configuration with the SafeKit web console

The SafeKit web console provides a configuration wizard for editing the `cluster.xml` file and applying the configuration on all the cluster nodes.

Note

- ✓ The cluster configuration requires to log in the web console with a user having Admin role
- ✓ If the cluster is not configured, the web console automatically opens the Cluster configuration wizard
- ✓ When the cluster is configured, the current cluster configuration is loaded from the connection node specified in the browser URL

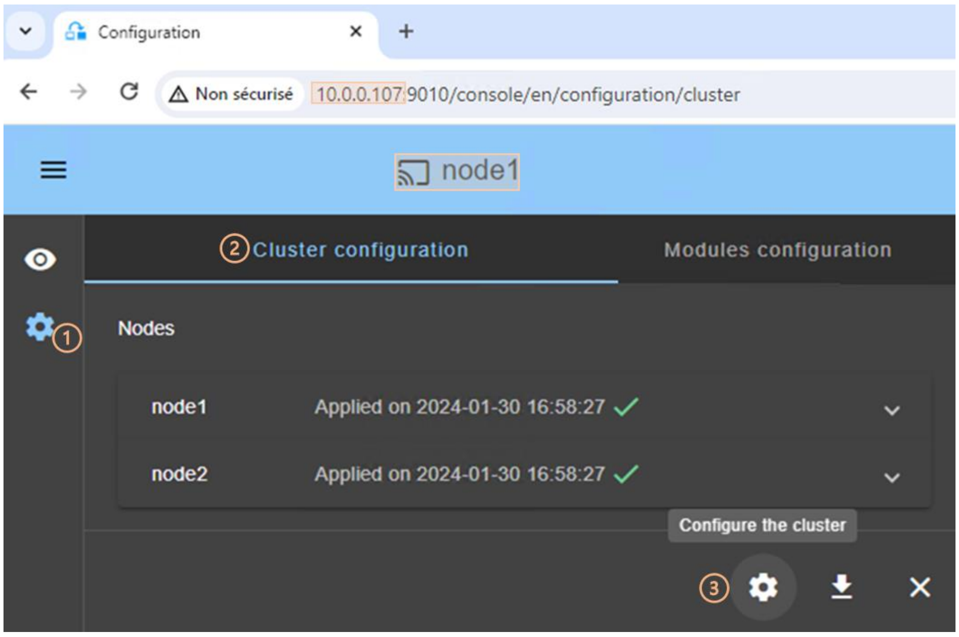
Open the cluster configuration wizard:

✓ Directly via the URL http://host:9010/console/en/configuration/cluster/config

Or

✓ Navigate in the console

In this example, the console is loaded from `10.0.0.107`, which corresponds to `node1` in the existing cluster. This is the connection node.


Configuration
Non sécurisé
10.0.0.107:9010/console/en/configuration/cluster
node1
2 Cluster configuration
Modules configuration
1
Nodes
node1
Applied on 2024-01-30 16:58:27 ✓
node2
Applied on 2024-01-30 16:58:27 ✓
Configure the cluster
3

- (1) Click on ⚙Configuration in the navigation sidebar
- (2) Click on Cluster configuration tab
- (3) Click on ⚙Configure the cluster button

For details on the cluster configuration wizard, see section 3.2.1 page 39.

12.2.2 Configuration with command line

For the full description of commands, refer to 9.3 page 142.

The commands for configuring the cluster with a new cryptographic key are:

```
1. safekit cluster config [<filepath>]
```

where `filepath` is the path for the new `cluster.xml`

when `filepath` is not set, the current configuration is kept and only encryption key is generated

2. `safekit -H "*" -G`

   it applies the local configuration, defined into `cluster.xml`, on all cluster nodes

The commands line for re-configuring without cryptographic key are:

1. `safekit cluster delkey`
2. `safekit -H "*" -G`

The commands for re-generating the cryptographic key are:

1. `safekit cluster genkey`
2. `safekit -H "*" -G`

12.2.3 Configuration changes

When changing the cluster configuration, the new configuration must be applied on all cluster nodes. When the configuration is applied only on a subset of the nodes present into the cluster configuration, only this subset will be able to communicate with each other. This is also the case when the cryptographic key is not identical on all nodes. This can have the effect of disrupting the operation of the modules installed on servers.
For a correct behavior, you must re-apply the configuration on all the nodes that belong to the cluster as described above.

Note

You can check the configuration by running the command `safekit cluster confinfo` on each node (see section 9.3 page 142). When the configuration is operational, this command must return on all nodes, the same list of nodes and the same value for the configuration signature.

Changing the cluster configuration could have important impact on module configurations since the lan names set into the cluster configuration are used into the module's configuration. Any change in the cluster configuration, will trigger modules updates: each module will reload its configuration to adapt the changes. Such changes could lead to module stop in case of incompatibility (for example if a lan used by a module is removed from the cluster configuration). So, great care must be taken when modifying cluster configuration when modules are running.

13.Userconfig.xml for a module configuration

Each time you modify `userconfig.xml`, the configuration must be applied to all the nodes of the cluster onto which the module is installed, to become the active configuration. Apply the new configuration, modified on `node1`, on all nodes with (replace `node1, node2` by the nodes name and `AM` by the module name) :

- ✓ the web console by navigating to ⚙Configuration/Modules configuration/ ⚙Configure the module/
- ✓ or the web console by directly entering the URI /console/en/configuration/modules/AM/config/
- ✓ or the command `safekit config -H "node1,node2" -m AM` executed on `node1`

Example of `userconfig.xml`:

```
<safe>
  <!-- Insert below <macro> <service> tags -->
</safe>
```

Important

With the web console, the module must be stopped before applying the configuration.

With command line, it is possible to apply a new configuration while the module is running, but only in ✓ALONE (Ready) or ○WAIT (NotReady) states. This feature is called *dynamic configuration*. Only a restricted subset of parameters could be changed. If the new configuration cannot be deployed, an error message is displayed. The attributes that can be dynamically modified are reported hereafter.

13.1 Macro definition (<macro> tag)

13.1.1 <macro> example

```
<macro name="ADDR1" value="aa.bb.com"/>
```

An example of macros usage is given in 15.4 page 275.

13.1.2 <macro> syntax

```
<macro
     name="identifier"
     value="value"
/>
```

13.1.3 <macro> attributes

`<macro`	
`name="identifier"`	A character string that identifies the macro.
`value="value"`	The value that will replace each occurrence of `%identifier%` in the rest of `userconfig.xml`.
`/>`	

Note

The syntax `%identifier%` can also be used in `userconfig.xml` to represent the value of an environment variable named `identifier`. In case of conflict, it is the macro value that is expanded.

13.2 Farm or mirror module (<service> tag)

13.2.1 <service> example

Example for a mirror module:

```
<service mode="mirror" defaultprim="alone" maxloop="3" loop_interval="24"
failover="on">
  <!-- Insert below <hearbeat> <rfs> <vip> <user> <vhost> <errd> <check>
<failover> tags -->
</service>
```

Example for a farm module:

```
<service mode="farm" maxloop="3" loop_interval="24">
  <!-- Insert below <farm> <vip> <user> <vhost> <errd> <check> <failover> tags --
>
</service>
```

See examples of <service> definition for a mirror module in 15.1 page 272 and, for a farm module, in 15.2 page 273.

13.2.2 <service> syntax

```
<service mode="mirror"|"farm"|"light"
  [boot="off"|"on"|"auto"|"ignore"]
  [boot_delay="0"]
  [failover="on"|"off"]
  [defaultprim="alone"|"server_name"|"lastprim"]
  [maxloop="3"] [loop_interval="24"]
  [automatic_reboot="off"|"on"]>
</service>
```

Note

Only `boot`, `maxloop`, `loop_interval` and `automatic_reboot` attributes can be changed with a dynamic configuration.

13.2.3 <service> attributes

`<service`	Top level section of `userconfig.xml`
`mode= "mirror"| "farm"| "light"`	`The mirror` keyword sets the module behavior to mirror architecture mode. The synchronization protocol between the 2 servers is defined in section 13.3 page 211. See mirror.safe application module for an example. `The farm` keyword sets the module behavior to farm architecture mode. The definition of the synchronization protocol between servers is described in section 13.4 page 213. See farm.safe application module for an example. `The light` keyword sets the module behavior to the minimum needed for one server with software error detection and local restart only
`[boot= "on"| "off"| "auto"| "ignore"]`	If set to `on`, the module is automatically started at boot time. If set to `off`, the module is not started at boot time. If set to `auto`, the module is automatically started at boot time, if it was started before the reboot. Before SafeKit 7.5, the configuration to start the module at boot was done with the command `safekit boot -m AM on | off` (which had to be executed on each node). If you prefer to continue using this command, remove the `boot` attribute or set it to `ignore` (the default). The module will not be started at boot time unless the `safekit boot -m AM on` command is executed.

	The state of the boot configuration is visible in the `usersetting.boot` resource. The status of resources is visible in web console/ Control/Select the node/Resources tab/; with the command `safekit state -m AM -v` Default value: `ignore`
`[boot_delay="0"]`	The delay, in seconds, before starting the module at boot. Default value: `0` (no delay)
`[failover= "on"| "off"]`	For mirror module only. If set to `on`, an automatic failover on the secondary server is triggered if the primary fails or stops. If set to `off`, when the primary server fails or stops, the secondary server waits (no automatic failover is triggered). Only the `prim` command can start the secondary server as primary. See description in 0 page 101 Default value: `on`
`[defaultprim= "alone"| "server_name"| "lastprim"]`	For mirror module only. `defaultprim` specifies which server among two servers is the default primary server for an application module. This option is useful when a module is `ALONE` on a server and the module is started on the other server. With `defaultprim="alone"`, the `ALONE` module becomes `PRIM` while the module on the other server becomes `SECOND`. Value recommended avoiding swap of application after reintegration. With `defaultprim="server_name"`, when the module is running on two servers, the primary server among the two servers is the one set in defaultprim. This value can be useful for active/active or N-1 architectures see section 1.5.1 page 20 or section 1.5.2 page 20. With `defaultprim="lastprim"`, the restarted module becomes `PRIM` if it was `PRIM` before its last stop. Default value: `alone`
`[maxloop="3"]`	Number of successive error detections before stop. This attribute defines the maximum number of "restart" or "stopstart" sequences that can be automatically triggered by failure detectors before the module locally stops. The counter is reset to its initial value at the expiration of the `loop_interval` timeout and upon `safekit start, restart, swap, stopstart…` administrative commands execution. Note that a `safekit` command sent by a detector passes the `-i identity` parameter and decrements the counter, whereas administrator issued commands do not. For more information, see 13.18.4 page 262.

	Note This attribute's value can be changed with a dynamic configuration. The `maxloop` is represented by the resource `heart.stopstartloop`. Its current value corresponds to the date on which the counter was initialized (in the form of a Unix Epoch timestamp); and its assignment date corresponds either to its initialization or to a `stopstart`, `restart`. View the resource history to see each increment of the loop counter. Default value: `3`
`[loop_interval ="24"]`	Time interval during which `maxloop` applies. If set to 0, the `maxloop` counter becomes inactive. Default value: 24 hours. Note This attribute's value can be changed with a dynamic configuration.
`[automatic_reboot ="off"| "on"]`	If set to `on`, "stopstart" triggers a reboot instead of stopping and restarting the module. Default value: `off` Note This attribute's value can be changed with a dynamic configuration.

13.3 Heartbeats (<heart>, <heartbeat > tags)

Heartbeats must be used only for mirror architecture. For farm architecture, see section 13.4 page 213.

The basic mechanism for synchronizing two servers and detecting server failures is the heartbeat, which is a monitoring data flow on a network shared by a pair of servers. Normally, there are as many heartbeats as there are networks shared by the two servers. In normal operation, the two servers exchange their states (`PRIM`, `SECOND`, the resource states) through the heartbeat mechanism and synchronizes their application start and stop procedures.

If all heartbeats are lost, it is interpreted as if the other server was down, and the local server switches to the `ALONE` state. Although not mandatory, it is better to have two heartbeat channels on two different networks for synchronizing the two servers to avoid the split-brain case.

13.3.1 <heart> example

```
<heart>
   <heartbeat name=”default” ident="Hb1" />
   <heartbeat name=”net2” ident="Hb2" />
</heart>
```

13.3.2 <heart> syntax

```
<heart
  [port="xxxx"] [pulse="700"] [timeout="30000"]
  [permanent_arp="on"]
>
 <heartbeat
  [port="xxxx"] [pulse="700"] [timeout="30000"] name=”network” [ident="name"]
 >
 [<!-- syntax for SafeKit < 7.2 -->
  <server addr="IP1_address"|"IP1_name" />
  <server addr="IP2_address"|"IP2_name" />
 ]
</hearbeat>
 …
</heart>
```

Note

The `<heart>` tag and full subtree can be changed with a dynamic configuration.

13.3.3 <heart>, <heartbeat > attributes

`<heart`	
`[port="xxxx"]`	UDP port on which all the heartbeats are exchanged. Default: depends on the id of the application module. Returned by the `safekit module getports` command.
`[pulse="700"]`	The delay, in milliseconds, between two heartbeat packets. Default value: `700` ms
`[timeout="30000"]`	Timeout value for heartbeat loss detection. Default value: `30 000` ms
`<heartbeat`	Definition of one heartbeat. There are as many `<heartbeat>` tags as there are networks used to probe servers' mutual connectivity. At least one heartbeat must be defined.
`[port="xxxx"]`	Redefines the UDP port for the heartbeat. Default value is the same as the one defined in <heart> tag.
`[pulse="700"]`	Redefines the delay in milliseconds between two heartbeat packets. Default value is the same as the one defined in <heart> tag.
`[timeout="30000"]`	Redefines the timeout value for heartbeat loss detection. Default value is the same as the one defined in <heart> tag.

`name="network"`	Network named used by the heartbeat. `network` must be the name of a network set into the SafeKit cluster configuration (for details, see 12 page 201). This attribute is mandatory in new config syntax (since SafeKit 7.2).
`[ident="name"]`	Set how the heartbeat will be labelled in the web console and in internal "resources", i.e.: The internal resource `heartbeat.name` can be used in the failover machine described in 13.18 page 261. If no ident attribute is present the value of the name attribute will be used. Important: `ident="flow"` is a reserved name associated with a heartbeat declared on a replication flow. If you set a heartbeat with ident="flow", automatically the replication flow will be set on the same network. If you set `ident="flow"` without <rfs> configuration, the module start blocks in `WAIT` state.
`[permanent_arp="on"|"off"]`	Regularly, heart sets a permanent ARP entry for the ip addresses associated with the heartbeats. On some Linux systems, it may cause heart to freeze. Set this parameter to `off` in this case and manually set permanent arp for the remote server on boot. On Linux, this can be done by inserting the following line into a script that is executed at boot: arp -s hostname hw_addr Default value: `on`
`[<server addr="IP1_address />]`	Definition of the server address in the heartbeat. The `<server>` tag is a legacy syntax used in previous SafeKit version (before SafeKit 7.2). It's supported for compatibility reason but must not be used for new modules. Important: In the same `userconfig.xml`, you must not use the syntax for SafeKit 7.1 and the one for SafeKit 7.2.

13.4 Farm topology (<farm>, <lan> tags)

The basic mechanism to synchronize a farm of servers is a group communication protocol which automatically detects the available members of the farm. Normally, the membership protocol is configured on all networks connecting the N servers.

13.4.1 <farm> example

```
<farm>
   <lan name="default" />
   <lan name="net2" />
</farm>
```

For examples of <farm> configuration, see section 15.5 page 276.

13.4.2 <farm> syntax

```
<farm [port="xxxx"]>
   <lan name="network" >
     [<!-- syntax for SafeKit < 7.2 -->
      <node name="server1" addr="IP1_address" />
      <node name="server2" addr="IP2_address" />
     ]
   </lan>
   …
</farm>
```

Note: The `<farm>` tag and subtree cann**ot** be changed with a dynamic configuration.

13.4.3 <farm>, <lan> attributes

`<farm`	Begin the definition of a farm topology.
`[port="xxxx"]`	UDP port with which the membership protocol is exchanged. Default: depends on the id of the application module. Returned by the command `safekit module getports`.
`[pulse="xxxx"]`	The period of the membership protocol messages emission. Longer pulse makes the membership protocol use less bandwidth but reacts more slowly.
`[mlost_count="xx"]`	Number of periods elapsed without message before electing a new leader.
`[slost_count="xx"]`	Number of periods elapsed without messages before declaring a follower node offline.
`<lan`	Definition of a LAN (i.e., IPv4 broadcast domain, IPv6 link) on which the membership protocol will be transmitted. At least one LAN must be defined. Define one such tag per used LAN.
`name="network"`	Define the name of network used. `network` must be the name of a network set into the SafeKit cluster configuration (see 12 page 201). This attribute is mandatory in new config syntax (since SafeKit 7.2).
`[<node name="identity" addr= "IP1_address" />]`	Address and name of the node on this lan. The node tag is a legacy syntax used in previous SafeKit version (before SafeKit 7.2). It's supported for compatibility reason but must not be used for new modules. Important: In the same `userconfig.xml`, you must not use the syntax for SafeKit 7.1 and the one for SafeKit 7.2.

13.5 Virtual IP address (<vip> tag)

Important

If you install and run several application modules on the same server, the virtual IP addresses must be different for each application module.

13.5.1 <vip> example in farm architecture

The following example configures load balancing to port 80 and virtual IP address between nodes in an on-premises cluster:

```
<vip>
    <interface_list>
      <interface check="on" arpreroute="on" arpinterval="60" arpelapse="10">
        <virtual_interface type="vmac_directed">
          <virtual_addr addr="192.168.1.222" where="alias" check="on"/>
        </virtual_interface>
      </interface>
    </interface_list>
    <loadbalancing_list>
       <group name="FarmProto">
         <rule port="80" proto="tcp" filter="on_port"/>
       </group>
    </loadbalancing_list>
  </vip>
```

See also the example in section 15.2 page 273.

13.5.2 <vip> example in mirror architecture

The following example configures the virtual IP address on the primary node of an on-premises cluster:

```
<vip>
    <interface_list>
        <interface check="off" arpreroute="on">
           <real_interface>
               <virtual_addr addr="192.168.1.222" where="one_side_alias"
check="on"/>
          </real_interface>
        </interface>
    </interface_list>
  </vip>
```

See also the example in 15.1 page 272.

13.5.3 Alternative to <vip> for servers in different networks

The configuration of a virtual IP address with a <vip> section in `userconfig.xml` requires servers in the same IP network (network rerouting and load balancing made at level 2).

If servers are in different IP networks, the <vip> section cannot be configured. In this case, an alternative is to configure the virtual IP in a load balancer. The load balancer routes packets to the physical IP addresses of servers by testing an URL status named health check and managed by SafeKit.

So, SafeKit provides a health check for SafeKit modules. For this, configure the health check in the load balancer with:

- HTTP protocol
- port 9010, the SafeKit web service port
- URL /var/modules/AM/ready.txt, where AM is the module name

In a mirror module, the health check:

- returns OK, that means that the instance is healthy, when the module state is ✓`PRIM(Ready)` or ✓`ALONE(Ready)`
- returns NOT FOUND, that means that the instance is unhealthy, in all other states

In a farm module, the health check:

- returns OK, that means that the instance is healthy, when the farm module state is ✓`UP (Ready)`
- returns NOT FOUND, that means that the instance is out of service, in all other states

Another alternative is that you implement a special DNS configuration and a DNS rerouting command inserted in the SafeKit restart scripts.

13.5.4 <vip> syntax

13.5.4.1 Virtual IP loadbalancing in farm architecture

```
<vip [tcpreset="off"|"on"]>
 <interface_list>
  <interface
    [check="off"|"on"]
    [arpreroute="off"|"on"]
    [arpinterval="60"]
    [arpelapse="1200"]
  >

   <virtual_interface
   [type=""vmac_directed”|”vmac_invisible”]
   [addr="xx:xx:xx:xx:xx"]
   >
     <virtual_addr
      addr="virtual_IP_name"|"virtual_IP_address"
      [where="alias"]
      [check="off"|"on"]
      [connections="off"|"on"]
     />
     …
   </virtual_interface>
  </interface>
 </interface_list>
 <loadbalancing_list>
   <group name="group_name"
     <cluster>
        <host name="node_name" power="integer" />
      …
     </cluster>
     <rule
       [virtual_addr="*"|"virtual_IP_name"|"virtual_IP_address"]
       [port="*"|"value"]
        proto="udp"|"tcp"
        filter="on_addr"|"on_port"|"on_ipid"
     />
     …
   </group>
   …
 </loadbalancing_list>
</vip>
```

The `<vip>` tag and subtree **cannot** be changed with a dynamic configuration.

13.5.4.2 Virtual IP failover in mirror architecture

For on-premises SafeKit cluster:

```
<vip [tcpreset="off"|"on"]>
 <interface_list>
  <interface
    [check="off"|"on"]
    [arpreroute="off"|"on"]
    [arpinterval="60"]
    [arpelapse="1200"]
  >

   <real_interface>
    <virtual_addr
      addr="virtual_IP_name"|"virtual_IP_address"
      where="one_side_alias"
      [check="off"|"on"]
      [connections="off"|"on"]
    />
    …
   </real_interface>
  </interface>
  …
 </interface_list>

</vip>
```

13.5.5 <vip><interface_list>, <interface>, <virtual_interface>, <real_interface>, <virtual_addr> attributes

`<vip`	

`[tcpreset="off"|"on"]`	Before unconfiguring the virtual IP address, all connections with the virtual IP address as IP source are reset. The reset is disabled when set to `off`. Default value: `on`
`<interface_list>`	
`<interface`	Definition of an interface with virtual IP addresses. Define as many <interface> sections as there are network interfaces to configure.
`[check="off"|"on"]`	Set an interface checker on the interface to stop the service and put it in the WAIT state when the interface is down. The name of the interface checker is `intf.<network_IP_mask>` (`intf.192.168.0.0`). Default value: `on` For more information, see 13.13 page 254.
`[arpreroute="off"|"on"]`	Automatically broadcast gratuitous ARP on virtual IP addresses defined in <real_interface> section. Default value: `off`.
`[arpinterval="60"]`	Time in seconds between two gratuitous ARP. Default value: `60` s
`[arpelapse="1200"]`	Time during which gratuitous ARP are sent. Default value: `1200` s
`[name="interface name"]`	Linux only. You can specify the name of the network interface on which the virtual IP addresses will be set. Ex.: `name="bond0"` Default: no value, SafeKit detects the network interface with virtual IP addresses set on it.

13.5.5.1 <virtual_interface>, <virtual_addr> attributes in farm architecture

Use with farm modules for virtual IP load-balancing:

`<virtual_interface`	Definition of virtual IP addresses configured on an Ethernet interface.

`type=`
 	
`"vmac_directed"|`
 	
`"vmac_invisible"`
	`vmac_directed`: advertise the MAC address of one of the servers as the associated mac address, as with normal traffic. No promiscuous mode needed. For details, see 13.5.7.3 page 222.
	
	`vmac_invisible`: virtual MAC address never visible in Ethernet headers to allow broadcasting of switch.

	Needs promiscuous mode. For details, see 13.5.7.2 page 222 Note: can be used for a mirror module with a need of transparent rerouting.
`[addr="xx:xx:xx:xx:xx"]`	Unicast virtual MAC address value. If not set, default is the concatenation of "5A:FE" (Safe) and the first configured virtual IP address in hexadecimal. Ignored in `vmac_directed` mode.
`<virtual_addr`	Definition of one Virtual IP address. Set as many `<virtual_addr>` sections as there are virtual IP addresses on the interface.
`addr="virtual_IP_name"|"virtual_IP_address"`	Name or address of the virtual IP (prefer an IP address to be independent from the name server). IPv4 or IPv6 address.
`where="alias"`	Configuration for farm module: the virtual IP address is defined on all servers as an alias IP address. Load balancing rules apply only for this type of virtual IP addresses. Note : when VMAC is used with a mirror module, set here `where="one_side_alias"`
`[check="off"|"on"]`	Defines an ip checker on the virtual IP address to stopstart the module when the virtual IP is deleted or in conflict. The name of the ip checker is `ip.<addr value>` (`ip.192.168.1.99`). Default value: `on` For more information, see 13.14 page 255
`[connections="off"|"on"]`	Enables counting of the number of active connections on the virtual address. This count is stored in the resource named `connections.<virtual addr value>` (for example: `connections.192.168.1.99`) which is assigned every 10 seconds. This value is provided as a guideline only. Default value: off
`netmask="defaultnetmask"`	Linux and IPV4 only. By default, the netmask of the network interface on which the virtual IP address is set. Set the netmask if there are several netmasks on the interface.
`</virtual_interface>`	

13.5.5.2 <real_interface>, <virtual_addr> attributes in mirror architecture

Use with mirror modules for virtual IP failover:

`<real_interface>`	Definition of virtual IP addresses associated with the real MAC address of the interface.
`<virtual_addr`	Definition of one virtual IP address. Set as many `virtual_addr` sections as there are virtual IP addresses on the interface.
`addr= "virtual_IP_name"| "virtual_IP_address"`	Name or address of the virtual IP (prefer an IP address to be independent from the name server). IPv4 or IPv6 address.
`where="one_side_alias"`	The Virtual IP address will be aliased on the server on which the module becomes `PRIM` or `ALONE`.
`[check="off"|"on"]`	Defines an ip checker on the virtual IP address to stopstart the module when the virtual IP is deleted or in conflict. The name of the ip checker is `ip.<addr value>` (`ip.192.168.1.99`). Default value: `on` For more information, see 13.14 page 255.
`[connections="off"|"on"]`	Enables counting of the number of active connections on the virtual address. This count is stored in the resource named `connections.<virtual addr value>` (for example: `connections.192.168.1.99`) which is assigned every 10 seconds. This value is provided as a guideline only. Default value: off
`netmask="defaultnetmask"`	Linux and IPV4 only. By default, the netmask of the network interface on which the virtual IP address is set. Set the netmask if there are several netmasks on the interface.
`</real_interface>`	

13.5.6 <loadbalancing_list>, <group>, <cluster>, <host> attributes

For load-balancing examples, see 15.5 page 276.

Use with farm module.

`<loadbalancing_list>`	

`<group`	Definition of a load balancing group. Define as many sections as there are groups. An example is given in 15.5.3 page 277.
`name="group_name"`	Name of the load balancing group.
`<cluster`	Definition of the server set on which the load current group balancing will be applied. If no `<cluster>` section is defined, the rules apply to all servers of the farm.
`<host`	Definition of one node in the cluster. Define as many hosts sections as there are nodes configured for the module.
`name = "node_name"`	Define the name of the host. `node_name` must be the name of a node name set into the SafeKit cluster configuration (see 12 page 201).
`power = "value"`	Relative weight to apply to the current node in this load balancing group's cluster. Can be equal to 0, which means no traffic will be dispatched to this node. See section 13.5.7.4 page 222 for more information.
`</cluster>`	
`<rule`	Definition of a load balancing rule for the group. Define as many sections as there are load balancing rules for this group.
`[virtual_addr= "*" | "virtual_IP_address"| "virtual_IP_name"]`	Virtual IP name or address scope of the rule. By default, all virtual IP addresses: `*`
`[port="*"|"value"]`	TCP or UDP port to which the load balancing rule applies. By default, all ports: `*`

`proto="udp" | "tcp" | "arp"`	`proto="udp"`
	Load balancing rule applies to the UDP protocol.
	`proto="tcp"`
	Load balancing rule applies to the TCP protocol.
	`proto="arp"`
	Load balancing rule applies to the IP<->MAC resolution protocol (arp or neighbour discovery)

`filter="on_addr" | "on_port" | "on_ipid"`	`filter="on_addr"`
	Load balancing criteria is the source IP address (client, far end of the connection) (see 15.5.1 page 276).
	`filter="on_port"`
	Load balancing criteria is the source port (client, far end of the connection) (see 15.5.1 page 276).
	`filter="on_ipid"`
	Load balancing is made on the client ip_id at input.

	Useful for UDP. No sense for TCP and for IPv6 addresses (see example in 15.5.2 page 277).

13.5.7 <vip> Load balancing description

13.5.7.1 <vip> prerequisites

See network prerequisites described in 2.3.2 page 31.

13.5.7.2 What is the vmac_invisible type?

When `type="vmac_invisible"`, a virtual MAC address is mapped on the virtual IP address with a unicast MAC Ethernet address on several network nodes. When a network device tries to resolve the virtual IP address into its corresponding MAC address, the SafeKit servers respond with the virtual MAC address. However, SafeKit servers use its physical MAC address to communicate. To "see" the packets sent to the virtual MAC address the interface is set to promiscuous mode. So, the virtual MAC address is invisible to layer 2 network devices. Ethernet switches therefore forward virtual MAC address directed packets to all the ports in the same vlan as the source, reaching all the servers of the farm. A kernel module running on each farm server is responsible for filtering out the packets that should not be processed by a given farm node, according to the load balancing rules defined.

With the virtual MAC address technology, the failover time is null. There is no network rerouting after a failure: all network equipment keeps their mapping virtual IP address, virtual MAC address.

To test a virtual MAC address in your network, see 4.3.7 page 82

13.5.7.3 What is the vmac_directed type?

When `type="vmac_directed"`, there is in fact no virtual MAC address. Farm servers reply to virtual IP resolution requests with their own physical MAC address. A kernel module running on each farm server is responsible for filtering and dispatching the packets to their designated target farm node according to the load balancing rules defined. In vmac_directed mode there is a short failover time for clients that have resolved the virtual IP address as the MAC address of the failed server. This is comparable to what happens in "real interface" mode. Clients that have another farm server's MAC address in their cache are not affected.

To help minimize failover time in ipv4, set the arpreroute attribute to "on" on the corresponding "<interface>" tag, and tune the arpelapse and arpinterval attributes to the desired values. Ipv6 does not need arpreroute, it has a built-in mechanism that takes care of the failover.

13.5.7.4 How does load balancing work?

On all the servers of the farm, the load balancing algorithm filters received packets according to the identity of the sender. The criteria to check is defined by configuration in `userconfig.xml`: client IP address, client port… (i.e.: level 3 load balancing), or requestor address (arp rules, i.e., level 2 load balancing). The criteria are hashed into a value representing the server on which the packet is to be accepted.

When a server fails, the membership protocol reconfigures the filters to re-balance the traffic of the failed server on the available servers.

Each server can have a power (=1, 2…) and then takes more or less traffic. The power is implemented by the number of bits set to 1 in the hash table (a bitmap of 256 bits).

A bitmap example is given in 4.3.5 page 80.

13.6 File replication (<rfs>, <replicated> tags)

For mirror modules only.

In Linux, you must set the same value for uid/gid on the two nodes for replicating file permissions. When replicating a filesystem mount point, you must apply a special procedure described in 13.6.4.2 page 232.

In Windows, it is strongly recommended to enable the USN journal on the drive that contains the replicated directory as described in 13.6.4.3 page 233.

Important

If you install and run several application modules on the same server, the replicated directories must be different for each application module.

13.6.1 <rfs> example

Example in Windows:

```
<rfs async="second">
         <replicated dir="c:\safedir" mode="read_only"/>
</rfs>
```

Example in Linux:

```
<rfs async="second">
         <replicated dir="/safedir" mode="read_only"/>
</rfs>
```

See also the example in 15.4 page 276.

13.6.2 <rfs> syntax

```
<rfs
     [acl="on"|"off"]
     [async="second"|"none"]

     [iotimeout="nb seconds"]
     [roflags="0x10"|"0x10000"]
     [locktimeout="100"]
     [sendtimeout="30"]

     [nbrei="3"]
     [ruzone_blocksize="8388608"]
     [namespacepolicy="0"|"1"|"3"|"4"]
     [reitimeout="150"]
     [reicommit="0"]
     [reidetail="on"|"off"]
     [allocthreshold="0"]
     [nbremconn ="1"]

     [checktime="220000"]
     [checkintv="120"]
     [nfsbox_options="cross"|"nocross"]
     [scripts="off"]
     [reiallowedbw="20000"]
     [syncdelta="nb minutes"]
     [syncat="synchronization scheduling"]
>
  [<flow name="network" >
    [<!-- syntax for SafeKit < 7.2 -->
     <server addr="IP_address_1" />
     <server addr="IP_address_2" />
    ]
  </flow>]
  <replicated dir="absolute path of a directory"
  [mode="read_only"]
>
  <tocheck path="relative path of a file or subdir" />
  <notreplicated path="relative path of a file or subdir" />
  <notreplicated regexpath="regular expression on relative path of a file or
subdir" />
  …
 </replicated>
</rfs>
```

Note

Only `async`, `nbrei`, `reitimeout` and `reidetail` attributes of `<rfs>` tag can be changed with a dynamic configuration. The `<flow>` tag, describing the replication flow, can also be changed dynamically.

13.6.3 <rfs>, <replicated> attributes

`<rfs`	
`[mountoversuffix = "`*`suffix`*`"]`	Linux only. During the module configuration, the replicated directory "`/a/dir`" is renamed "`/a/dir`*`suffix`*". The directory **`/a/dir`** is created and it is: ➩ a mount point to `/a/dir`*`suffix`* when the module is started ➩ a link to "`/a/dir`*`suffix`*" when the module is stopped By default, *suffix* value is "_For_SafeKit_Replication". Note If there is a hard failure, then the symbolic link will not be restored. In this case, you must restore the symbolic link manually.

	Important **Restriction** You cannot explicitly specify a root file system as a replicated directory (because of the directory rename that is not allowed across a file system). The work around is to manipulate the fstab file as described in a KB on https://support.evidian.com. Important When the module is started, NEVER ACCESS files in "`/a/dir`*`suffix`*", otherwise the modifications will not be replicated, and the system will become inconsistent. ALWAYS ACCESS replicated files through "`/a/dir`".
`[acl= "on" | "off"]`	Setting acl to `on` activate the replication of ACL on files and directories. Default value: `off` Importan **Restrictions for Windows** ACL replication will not work if the SYSTEM account does not have the "Full control" access right on all the replicated forest. File ACLs are replicated literally (as SID values), therefore ACL granted to locally defined users and groups will be meaningless on the remote system. File encryption and file compression attributes are not supported.
`[async= "second" | "none"]`	Setting async mode to `second` is a way to improve file replication performances: modification operations are cached on the secondary server and the acknowledgements are sent more quickly to the primary server. Setting async mode to `none` ensures more robustness: modification operations are put on disk of the secondary before sending acknowledgement to the primary. With `async="second"`, in case of double failure at the same time of both `PRIM` and `SECOND` servers, if the `PRIM` server cannot restart, then the `SECOND` server does not have up-to-date data on its disk. There is data loss if the `SECOND` server is forced to start as primary with the prim command. Default value: `second` Note This attribute's value can be changed with a dynamic configuration.
`[packetsize]`	Linux only. Maximum size in bytes for NFS replication packets. It must be lower than the maximum size allowed by the NFS server of both servers.

	When it is set into the configuration, it is used as mount options for rsize and wsize. By default, the size is the one of the NFS server.
`[reipacketsize="8388608"]`	Maximum size in bytes of reintegration packets. In Linux, this value must be less or equal to `packetsize`. Default value in Linux: value of `packetsize` if it is set into the configuration and is lower than `8388608`; else `8388608` Default value in Windows: `8388608` bytes
`[ruzone_blocksize="8388608"]`	Size of a zone for the modification bitmap of a file. It must be a multiple of `reipacketsize` attribute. Default value: value of `reipacketsize` if it is set into the configuration; else `8388608`
`[iotimeout]`	Windows only. IO time out in seconds in the Windows file system filter. If an IO cannot be replicated and if the timeout expires in the filter, then the `PRIM` server becomes `ALONE`. If not set, the default value is dynamically calculated.
`[roflags="0x10"|"0x10000"]`	Windows only. To ensure the consistency of the data replicated on the 2 servers, the modification of the replicated directories/files must only take place on the `PRIM` server. If changes are made on the `SECOND` server, they are notified in the module log with the identification of the process responsible so that the administrator can correct this anomaly. This is the behavior with `roflags="0x10"`. Since SafeKit 7.4.0.31, the module can also be stopped on the `SECOND` server by setting `roflags="0x10000"`. Default value: `0x10`
`[locktimeout="100"]`	Timeout in seconds for replication requests. If a request cannot be served within this timeout, the `PRIM` server becomes `ALONE`. Default value: `100` seconds
`[sendtimeout="100"]`	Since SafeKit > 7.4.0.5 Timeout in seconds for sending TCP packets to the remote node. If a packet cannot be sent within this timeout, the `PRIM` server becomes `ALONE`. Increase this value in case of low networks. Default value: `30` seconds Note: In SafeKit 7.4.0.5, the default value was 12O seconds.
`[nbrei="3"]`	Number of reintegration threads running in parallel for resynchronizing files.

	Default value: `3` Note This attribute’s value can be changed with a dynamic configuration.
`[namespacepolicy="0"|"1"|"3"|"4"]`	In Windows, with `namespacepolicy="1"`, zone reintegration after reboot when the module has been properly stopped is not active. To enable it in Windows, set `namespacepolicy="3"`. It activates the USN change journal on the volume containing the replicated directories (see `fsutil usn` command for creating USN change journal on a volume). Even with this configuration, full reintegration is used instead of zone reintegration when: ⇨ the USN change journal associated with the volume has been deleted/recreated for administration reasons ⇨ discontinuity in the USN journal is detected When zone synchronization is not possible (on the first reintegration or when zones are not available), the files that need to be synchronized are fully copied. If this reintegration does not complete, the next one will copy again these files. To avoid this, set `namespacepolicy="4"`. This option also enables USN journal checking in Windows. Set `namespacepolicy="0"` to deactivate the zone reintegration on Windows or Linux. Default value: `4` since SafeKit > 7.4.0.5 (not supported in previous releases)
`[reitimeout="150"]`	Timeout in seconds for reintegration requests. The timeout can be increased to avoid reintegration failure on heavy load of the primary server. Default value: `150` seconds Note This attribute’s value can be changed with a dynamic configuration.
`[reicommit="0"]`	Linux only. Set `reicommit="nb blocks"` to commit every (nb blocks)* `reipacketsize` when reintegrating one file (in addition to the commit at the end of the copy). This can help to succeed reintegration of big files but slows down reintegration time. Default value: `0` that means no intermediate commit
`[reidetail="on"|"off"]`	Detailed logging for reintegration. Default value: `off`

	Note: This attribute's value can be changed with a dynamic configuration.
`[allocthreshold="0"]`	Windows only. Size in Gb to apply the allocation policy before reintegration. When `allocthreshold> 0`, enable fast allocation of disk space for files to be synchronized on the secondary node. This feature avoids a timeout when the primary writes at the end of the file, when the file is large (> 200 Gb) and not yet completely copied. Since SafeKit 7.4.0.64, the allocation policy has changed and is applied for: ⇨ Newly created files (files that did not exist on the secondary when the reintegration starts) ⇨ Files with size on the primary >= `allocthreshold (size in Go)` ⇨ Full synchronization: • on first reintegration • on start with full synchronization (`safekit second fullsync`) • when synchronization by zones is disabled (`namespacepolicy="0"`) Default value: `0` (that disables the feature)
`[nbremconn="1"]`	Number of TCP connections between the primary and the secondary nodes. This value may be increased to improve the replication and synchronization throughput when the network has high latency (in cloud for instance). Default value: 1
`[checktime="220000"]`	Linux only. Timeout in milliseconds for the null request that checks the local replicated file system. Run the `safekit stopstart` command when the timeout is reached. Default value: `220 000` milliseconds
`[checkintv="120"]`	Linux only. Interval in seconds between two null requests. Default value: `120` seconds
`nfsbox_options="cross"|"nocross"`	Windows only.

	It specifies the policy to apply when a reparse point of type `MOUNT_POINT` is present in the replicated directory tree. This policy applies to all replicated directories. `MOUNT_POINT` reparse points in NTFS can represent two types of objects: an NTFS mount point (for example the `D:\` directory) or an NTFS "directory junction" (a form of "symbolic link" to another part of the file system namespace). When `nfsbox_options="cross"`, the `MOUNT_POINT` reparse point object itself is not replicated/reintegrated. It is evaluated, and the reintegration/replication process the target content as it would do for the content of a standard directory. This is useful for instance when a replicated directory is a mount point (e.g., replicating a "drive letter" root). This is the default configuration value. When `nfsbox_options="nocross"`, the `MOUNT_POINT` reparse point object itself is replicated/reintegrated, but not evaluated. Reintegration does not descend into the target of the reparse point. This is useful for instance when a replicated directory tree contains NTFS "junctions" that point to another part of the replicated tree (e.g., when replicating a PostgreSQL database, as PostgreSQL is known to need such objects). Default value: `cross`
`[scripts= "on" | "off"]`	`scripts="on"` activates _rfs_* script callbacks used to implement external data replication management (see Linux drbd.safe module for more information) Default value: `off`
`[reiallowedbw="20000"]`	When defined, this attribute specifies the maximum bandwidth that the reintegration phase may use (for instance 20000 KB/s), in kilo bytes per second (KB/s). Due to implementation trade-off, a +/-10% fluctuation of the effectively used bandwidth is to be expected. Note: The replication bandwidth is not affected by this parameter. By default, the attribute is not defined, and the bandwidth used by the reintegration is not limited
`[syncdelta="nb minutes"]`	When <=1, the attribute is ignored and the default failover and start policy is applied: only an up-to-date server can start as primary or run a failover. When >1, it changes the default failover and start policy. The not up-to-date server can become primary but only if the elapsed time, in minutes, since the last synchronization is lower than the `syncdelta` value (see 13.6.4.4 page 234). Default value: `0` minutes

`[syncat="synchronization scheduling"]`	Default: real-time replication and automatic synchronization (no scheduling)
	
	Use `syncat` for scheduling the synchronization of replicated directories on the secondary node (see 13.6.4.10 page 240). The module must be started for enabling this feature. Once synchronized, the module blocks in the `WAIT (NotReady)` state until the next synchronization.
	
	The scheduling is based on native job scheduler:
	⇨ On Unix, the job is defined in the safekit user's crontab
	⇨ On Windows, the job is defined as a system task
	
	You must configure `syncat` with the syntax of the native job scheduler. For instance, for synchronizing daily, after midnight:
	⇨ in Windows
	`syncat="/SC DAILY /ST 00:01:00"`
	⇨ in Unix
	`syncat="01 0 * * *"`
	
	Note: See `crontab` documentation in Unix and `schtasks.exe` documentation in Windows, for the full syntax of scheduled date and time.
	
	Important: Since SafeKit configuration is just a front end to the job scheduler, when scheduling is not working, please check first for syntax errors.

`[<flow name="network”> [<server addr="IP_1" /> <server addr="IP_2" /> ] </flow>]`	Obsolete configuration preserved for backwards compatibility. When this section is not defined, the replication flow uses the same network as the heartbeat with `ident="flow"` if there is one, if not it uses the first heartbeat (see 13.3 page 211). If you define this section, be coherent with heartbeat `ident="flow"`, if there is one, because default failover rules apply to this heartbeat (see 13.18.5 page 263). Note: This `<flow>` tag subtree can be changed with a dynamic configuration for setting a new replication flow for instance. The name attribute of `<flow>` define the network used for replication flow. It must present in global cluster configuration (see 12 page 201). The `<server>` tag is a legacy syntax used in previous SafeKit version (before 7.2). It's supported for compatibility reason but must not be used for new modules.

	Important In the same `userconfig.xml`, you must not use the syntax for SafeKit 7.1 and the one for SafeKit 7.2.
`<replicated`	Begin the definition of replicated directories. Set as many lines as there are replicated directories.
`dir="/abs_path"`	Absolute path of a directory to replicate.
`[mode= "read_only"]`	Read-only access rights on the secondary machine for replicated directories to avoid corruption
`<notreplicated path="relative" />`	Relative path of a file or sub-directory in a replicated directory. The file (or sub-directory) is not replicated. Set as many lines as there are non-replicated files or sub-directories.

`<notreplicated regexpath="regular expression" />`	Regular expression on the name of entries under the replicated directory :
	➾ **Replicate all except** entries matching the regular expression
	For example, to avoid replicating entries with the extension `.tmp` or `.bak` in the `/safedir` directory or its sub-directories :
	`<replicated dir="/safedir">`
	` <notreplicated regexpath=".*\.tmp$" />`
	` <notreplicated regexpath=".*\.bak$" />`
	`</replicated>`
	Note that `/safedir/conf/config.tmp.swap` is replicated.
	➾ **Replicate only** those entries in the directory that match the regular expression after the **!**
	For example, to replicate only entries with the extension `.mdf` or `.ldf` in the `/safedir` directory or its sub-directories :
	`<replicated dir="/safedir">`
	` <notreplicated regexpath="!.*\.mdf$" />`
	` <notreplicated regexpath="!.*\.ldf$" />`
	`</replicated>`
	Important Rename between not replicated and replicated files is not supported.
	The regex engine is POSIX Extended regex (see POSIX documentation):
	✓ in Windows, case insensitive mode
	✓ in Linux, case sensitive mode
	Important As regular expressions are defined inside the XML file `userconfig.xml`, special characters interpreted by XML like '`<`' or '`>`' cannot be used in regular expressions.

`<tocheck path="relative" />`	Relative path of a file or sub-directory in a replicated directory. Checks the presence of the file or sub-directory before starting the replication mechanism. Avoids errors such as starting replication on an empty file system. Set as many lines as there are files or sub-directories to check.

13.6.4 <rfs> description

13.6.4.1 <rfs> prerequisites

See file replication prerequisites described in 2.2.4 page 30.

13.6.4.2 <rfs> Linux

On Linux, interception of data is based on a local NFS mount. And the replication flow between servers is based on NFS v3 / TCP protocol.

The NFS mount of replicated directories from remote Unix clients is not supported. The NFS mount of other directories can be made with standard commands.

Procedure for replicating a mount point

When replicating a mount point in Linux, the module configuration fails with the error:

```
Error: Device or resource busy
```

In the following, we take the example of PostgreSQL module that set as replicated directories `/var/lib/pgsql/var` and `/var/lib/pgsql/data`. The `userconfig.xml` of the module contains:

```
<rfs … >
         <replicated dir="/var/lib/pgsql/var" mode="read_only" />
         <replicated dir="/var/lib/pgsql/data" mode="read_only" />
</rfs>
```

These directories are mount points as shown by the result of the command `df -H`. It returns for instance:

```
/dev/mapper/vg01-lv_pgs_var … /var/lib/pgsql/var

/dev/mapper/vg02-lv_pgs_data … /var/lib/pgsql/data
```

You must apply the following procedure for configuring the module to replicate these directories.

Important: It is the same procedure for all mounts points that must be replicated.

- umount the file systems by running the commands:

  ```
  umount /var/lib/pgsql/var

  umount /var/lib/pgsql/data
  ```

- configure the module by running the command:

  ```
  /opt/safekit/safekit config -m postgresql
  ```

  The configuration should succeed (no errors)

- check the symbolic links created by running the command `ls -l /var/lib`. It returns:

```
lrwxrwxrwx 1 root var -> var_For_SafeKit_Replication
lrwxrwxrwx 1 root data -> data_For_SafeKit_Replication
```

- edit `/etc/fstab` and change the two lines:

  ```
  /dev/mapper/vg01-lv_pgs_var /var/lib/pgsql/var ext4…
  /dev/mapper/vg02-lv_pgs_data /var/lib/pgsql/data ext4…
  ```

  with

  ```
  /dev/mapper/vg01-lv_pgs_var
  /var/lib/pgsql/var_For_SafeKit_Replication ext4…
  /dev/mapper/vg02-lv_pgs_data
  /var/lib/pgsql/data_For_SafeKit_Replication ext4..
  ```

- mount the file systems by running the commands:

  ```
  mount /var/lib/pgsql/var_For_SafeKit_Replication
  mount /var/lib/pgsql/data_For_SafeKit_Replication
  ```

Important

Apply this procedure on both nodes if replicated directories are mount point on both nodes. Once applied, you can use the module as usual: i.e., safekit start stop etc ...

Note

To protect the start of the module on a non-mounted and empty directory, you can insert in `userconfig.xml` the checking of a file inside the replicated directory. Example for `/var/lib/pgsql/var` (do the same for `/var/lib/pgsql/data` with a file inside this directory which is always present):

```
<replicated dir="/var/lib/pgsql/var" mode="read_only">
    <tocheck path="postgresql.conf" />
</replicated>
```

If you want to unconfigure the module (or uninstall whole SafeKit package), you must reverse this procedure by:

- umount the file systems with:

  ```
  umount /var/lib/pgsql/var_For_SafeKit_Replication
  umount /var/lib/pgsql/data_For_SafeKit_Replication
  ```

- de-configure the module with `/opt/safekit/safekit deconfig -m postgresql`
- edit `/etc/fstab` to undo previous editing
- mount the file systems with:

  ```
  mount /var/lib/pgsql/var
  mount /var/lib/pgsql/data
  ```

13.6.4.3 <rfs> Windows

On Windows, interception of data is based on a file system filter. And the replication flow between servers is based on NFS v3 / TCP protocol.

The <rfs> filter may not work correctly with some anti-viruses.

On Windows, you can mount remotely a replicated directory from a workstation. If you want to mount with the virtual name instead of the digital virtual IP address, you must set the two following registry keys on the server side:

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Lsa]
"DisableLoopbackCheck"=dword:00000001
```

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\lanmanserver\paramete
rs] "DisableStrictNameChecking"=dword:00000001
```

In Windows, to enable zone reintegration after server reboot, when the module has been successfully stopped, the <rfs> component uses the NTFS USN log to verify that the information recorded on the zones is still valid after the reboot. When the control succeeds, the zone reintegration can be applied to the file; otherwise, the file must be fully copied.

By default, only the system drive has a USN log active. If the replicated directories are located on a different drive than the system drive, you must create the log (with `fsutil usn command`). See SK-0066 for an example.

13.6.4.4 <rfs> replication and failover

With its file-replication function, mirror architecture is particularly suitable for providing high availability for back-end applications with critical data to protect against failure. The reason is that the secondary server data is strongly synchronized with the primary server data. A synchronized server is considered as up-to-date and only an up-to-date server can start as primary or run a failover.

If the application availability is more critical than the application data, this default policy can be relaxed by allowing a server to become primary if the time elapsed since the last synchronization is below a configurable delay. This is configured by setting the `syncdelta` attribute of the <rfs> tag:

- `syncdelta` <= 1

  The attribute is ignored and the default failover and start policy is applied. The default value is 0.

- `syncdelta` > 1

  When the last up-to-date server is not responding, the not up-to-date server can become primary but only if the elapsed time since the last synchronization is lower than the `syncdelta` value (in minutes).

This feature is implemented with:

- `rfs.synced` resource

  When `syncdelta` is > 1, the `rfs.synced` resource is managed. This resource is `UP` if the replicated data are consistent and if the elapsed time, in minute since the last synchronization is lower than the `syncdelta` value.

- `syncedcheck` checker

  When `syncdelta` is > 1, this checker is running. It sets the value for the `rfs.synced` resource.

- `rfs_forceuptodate` failover rule

  When `syncdelta` is > 1, the following failover rule is valid:

`rfs_forceuptodate`: *if (heartbeat.* == down && cluster() == down && rfs.synced == up && rfs.uptodate == down) then rfs.uptodate=up;*

This rule leads to the primary start of the server when the up-to-date server is not responding and if the server is isolated and can be considered as synchronized according to `syncdelta` value.

13.6.4.5 <rfs> replication verification

You can check for the module, named AM, that files are identical on the primary and the secondary, by running the following command on the `SECOND` server: `safekit rfsverify -m AM`. Run `safekit rfsverify -m AM > log` to redirect the command output into the file named `log`.

This output of the command is a log like that of the reintegration in which the files to be copied (therefore different) are indicated. When on the primary, there is activity on the replicated directories, an anomaly may be detected while there is no difference between the files in the following cases:

- on Windows because modifications are made on disk before being replicated
- with `async="second"` (default) because reads can bypass the asynchronous writes.

To check if there is really an inconsistency, you must re-run the command on the secondary server making sure that there is no more activity on the primary.

On Windows, some files are systematically seen as erroneous by the verifier while there is no difference. This occurs when files are modified with `SetvalidData`: files are extended without resetting the new extension and the reads return random data from the disk.

Note

It is strongly recommended to run this command only when there are no accesses to the replicated directories on the primary.

13.6.4.6 <rfs> file changes since the last synchronization

Before starting a secondary server, it may be useful to evaluate the number of files and data that have been changed on the primary server since the secondary server has stopped. This feature is provided by running the following command on the `ALONE` server: `safekit rfsdiff -m AM`. Run `safekit rfsdiff -m AM > log` to redirect the command output into the file named `log`.

This command runs on-line checks of regular files content of the module `AM`. It scans the entire replicated tree and displays the number of files that have been modified as well as the size that need to be copied. It also displays estimation for the synchronization duration. This is only estimation since only regular files are scanned and some other modifications may occur until the synchronization is run by the secondary server.

This command must be used with caution on a production server since it leads to an overhead on the server (for reading trees and files with locking). On Windows, rename of files can fail during the evaluation.

Note

It is strongly recommended to run this command only when there are no accesses to the replicated directories.

13.6.4.7 <rfs> replication and reintegration bandwidth

The replication component monitors, on the `PRIM` server, the bandwidth used by replication and reintegration write requests.

Two resources (`rfs.rep_bandwidth` and `rfs.rei_bandwidth`) reflect the average bandwidth used by replication and reintegration respectively during the last 3 seconds, expressed in kilo bytes per second (KB/s).

If the replication load is IO intensive, the reintegration phase may saturate the network link and significantly slow down the application. In such a case, the `<rfs> reiallowedbw` attribute may be used to limit the bandwidth taken by the reintegration phase (see 13.6.3 page 224). Please note that limiting the reintegration bandwidth will make the reintegration phase longer.

There are also 2 resources that reflect the network bandwidth (in in Kbytes/sec) used between nfsbox processes, that run on each node to implement replication and reintegration:

- `rfs.netout_bandwidth` is the network output bandwidth
- `rfs.netin_bandwidth` is the network input bandwidth

You can observe the value of `rfs.netout_bandwidth` on the primary or `rfs.netin_bandwidth` on the secondary to know the modification rate at the time of observation (write, create, delete, …). The history of the resource values gives an overview of its evolution over time.

The value of the bandwidth depends on the application, system, and network activity. Its measurement is available for information purposes only.

13.6.4.8 <rfs> synchronization by date

SafeKit 7.2 offers a new command `safekit secondforce -d date -m AM` that forces the module `AM` to start as secondary after copying only files modified after the specified date.

Important

This command must be used with cautions since the synchronization will not copy files modified before the specified date. It is the administrator’s responsibility to ensure that these files are consistent and up-to-date.

The date is in the format of YYYY-MM-DD[Z] or "YYYY-MM-DD hh:mm:ss[Z]" or YYYY-MM-DDThh:mm:ss[Z], where:

- YYYY-MM-DD indicates the year, month, and day
- hh:mm:ss indicates the hours, minutes, and seconds
- Z indicates that the time is in UTC time zone; when not set the time is in local time zone

For instance:

- `safekit secondforce -d 2016-03-01 -m AM` for copying only files modified after the 1st of March 2016
- `safekit secondforce -d "2016-03-01 12:00:00" -m AM` for copying only files modified after the 1st of March 2016 at 12h, local time zone

- `safekit secondforce -d 2016-03-01T12:00:00Z -m AM` for copying only files modified after the 1st of March 2016 at 12h, UTC time zone

This command may be useful in the following case:

- the module is stopped on the primary server and a backup of the replicated data is done (on a removable drive for instance)
- the module is stopped on the secondary server and the replicated data is restored from the backup. It may be the first start-up or the repair of the secondary server.
- the module is started on the primary server that becomes `ALONE`
- the module is started on the secondary with the command `safekit secondforce -d date -m AM` where the date is the backup date

In this case, only the files modified since the backup date will be copied (full copy), instead of the full copy of all files.

Important

In Windows, the file modification date on the secondary server is changed when the file is copied by the synchronization process. Therefore, `safekit secondforce -d date -m AM`, where date is prior to the last reintegration on this server, has no interest.

13.6.4.9 <rfs> external synchronization

On the first synchronization, all replicated files are fully copied from the primary node to the secondary node. During the following synchronizations, necessary when the secondary node comes back, only zones modified, during the secondary downtime, of files that have been modified on the primary node during the secondary node downtime. When the replicated directories are voluminous, the first synchronization can take a lot of time especially if the network is slow. For this reason, since SafeKit> 7.3.0.11, SafeKit provides a new feature to synchronize a large amount of data that must be used in conjunction with a backup tool.

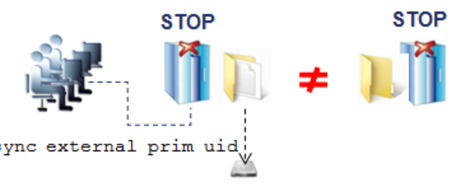
On the primary node, simply back up the replicated directories and pass the synchronization policy to the external mode. The backup is transported (using an external drive for instance) and restored to the secondary node, which is also configured to perform external synchronization. When the module is started on the secondary node, it copies only the file areas that were modified on the primary node since the backup

The external synchronization relies on a new SafeKit command `safekit rfssync` that must be applied on both nodes to set the synchronization policy to `external`. This command requires as arguments:

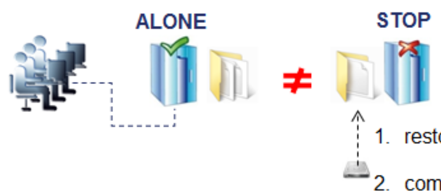
- the role of the node (`prim | second`)
- a unique identifier (`uid`)

External synchronization procedure

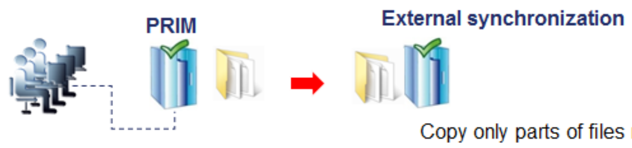
The external synchronization procedure, described below, is the procedure to be followed in the case of a cold backup of the replicated directories. In this case, the application must be stopped, and any modification of the replicated directories is prohibited until the module and the application are started, in ✓ `ALONE (Ready)`. The order of operations must be strictly adhered to.



1. command: `safekit rfssync external prim uid`
2. cold backup on external drive
3. command: `safekit prim`

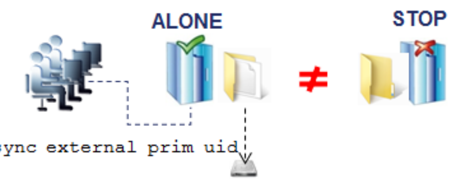


1. restore from the external drive
2. command: `safekit rfssync external second uid`
3. command: `safekit second`

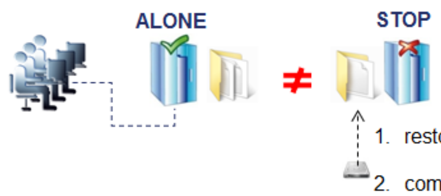


Copy only parts of files modified since the backup

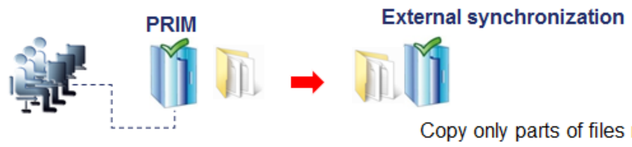
The external synchronization procedure, described below, is the procedure to be followed in the case of a hot backup of replicated directories. In this case, the module is ✓ `ALONE (Ready)`; the application is started and changes to the contents of the replicated directories are allowed. The order of operations must be strictly adhered to.



1. command: `safekit rfssync external prim uid`
2. hot backup on external drive



1. restore from the external drive
2. command: `safekit rfssync external second uid`
3. command: `safekit second`



Copy only parts of files modified since the backup

`safekit rfssync` command

`safekit rfssync external prim <uid> [-m AM]`	Set the synchronization policy to `external`. It is identified by the value of `uid` (at max 24 char). The node is the primary one, the source for synchronizing data.
`safekit rfssync external second <uid> [-m AM]`	Set the synchronization policy to `external`. It is identified by the value of `uid` (at max 24 char). The node is the secondary one, the destination for synchronizing data
`safekit rfssync -d prim <uid> [-m AM]` `safekit rfssync -d second <uid> [-m AM]`	Disable the replicated directories change detection between the cold backup/restore and the start of the module. Important: Use this option with caution since the external synchronization may not properly detect all changes to be copied.
`safekit rfssync full [-m AM]`	Set the synchronization policy to `full`. This will copy all files in their entirety on the next synchronization.
`safekit rfssync`	Display the current synchronization policy

Internals

The synchronization policy is represented by module's resources: `usersetting.rfssyncmode`, `usersetting.rfssyncrole`, `usersetting.rfssyncuid` and `rfs.rfssync`:

- `usersetting.rfssyncmode="default"`

  `(usersetting.rfssyncrole="default", usersetting.rfssyncuid="default")`

  These values are associated with the standard synchronization policy, which is applied by default. It consists of copying only the modified areas of the files. When this policy cannot be applied, the modified files are copied in their entirety.
- `usersetting.rfssyncmode="full"`

  (`usersetting.rfssyncrole="default"`, `usersetting.rfssyncuid="default"`)

  These values are associated with the `full` synchronization policy. It is applied:
  - the first time the module is started after its first configuration
  - on `safekit` commands (`safekit second fullsync` ; `safekit rfssync full ; safekit primforce ; safekit config ; safekit deconfig`)
  - on change of pairing for the module

The `full` synchronization policy will copy all files in their entirety on the next synchronization.

- `usersetting.rfssyncmode=”external”`, `usersetting.rfssyncrole=”prim | second”` and `usersetting.rfssyncuid=”uid”`

  These values are associated with the `external` synchronization policy assigned with the commands `safekit rfssync external prim uid` and `safekit rfssync external second uid`. The next synchronization will apply the `external` synchronization policy.
- `rfs.rfssync=”up | down”`

  This resource is only `up` when the synchronization policy, defined by the previous resources, can be applied.

When the synchronization policy is not the default policy, the synchronization policy automatically returns to the default mode after successful synchronization.

In some cases, external synchronization cannot be applied, and the secondary node stops with an error specified in the module log. In this situation, you must either:

- complete the external synchronization procedure if this has not been done in its entirety on the 2 nodes
- fully reapply the external synchronization procedure on the 2 nodes
- revert to the `full` synchronization policy (`safekit rfssync full` command)
- apply the synchronization by date, using the date of the backup (see 13.6.4.8 page 236). Unlike external synchronization, synchronization by date will copy the files, modified on the primary node, in their entirety (instead of just modified parts).

13.6.4.10 <rfs> scheduled synchronization

By default, SafeKit provides real-time file replication and automatic synchronization. On heavy loaded server or high latency network, you may want to let the secondary node weakly synchronized. For this, you can use the `syncat` attribute for scheduling replicated directories synchronization on the secondary node. The module must be started for enabling this feature. Once synchronized, the module blocks in the `WAIT (NotReady)` state until the next synchronization schedule. It is implemented with:

- the resource `rfs.syncat` that is set to `up` on the scheduled dates and set to `down` after the data synchronization
- the failover rule `rfs_syncat_wait` that blocks the module into the state `WAIT (NotReady)` until the `rfs.syncat` resource is `up`

If you want to manually force the synchronization, you can run the command: `safekit set -r rfs.syncat -v up -m AM` while the module is in the `WAIT (NotReady)` state.

With `syncat`, you just have to configure the scheduled time for the synchronization with the syntax of the native job scheduler: `crontab` in Linux and `schtasks.exe` in Windows (see 13.6.3 page 224).

13.7 Enable module scripts (<user>, <var> tags)

This section describes only the configuration options available for `<user>` tag. Refer to 14 page 265 for a full description of module scripts.

13.7.1 <user> example

```
<user logging="userlog" >
      <var name="VARENV" value="V1" />
</user>
```

See also the mirror module example in 15.1 page 272.

13.7.2 <user> syntax

```
<user
   [nicestoptimeout="300"]
   [forcestoptimeout="300"]
   [logging="userlog"|"none"]
   [userlogsize="2048"]
 >
      <var name="ENVIRONMENT_VARIABLE_1" value="VALUE_1" />
      …
</user>
```

Note

The `<user>` tag and full subtree can be changed with a dynamic configuration.

13.7.3 <user>, <var> attributes

`<user`	
`[nicestoptimeout="300"]`	Timeout delay in seconds to execute the `stop_xx` script. Default value: `300` seconds
`[forcestoptimeout="300"]`	Timeout delay in seconds to execute the `stop_xx` –force script. Default value: `300` seconds
`[logging="userlog"|"none"]`	stdout and stderr messages of the application started in scripts. When `logging="userlog",` messages are redirected into the log `SAFEVAR/modules/AM/userlog_<year>_<month>_<day>T<time>_<script name>.ulog`where AM is the module name (`SAFEVAR=C:\safekit\var` on Windows and `SAFEVAR=/var/safekit` on LINUX). When `logging="none",` messages are not logged.

	Default value: `userlog`
`[userlogsize="2048"]`	Limit in KB of the size of the userlog On module start, the file is truncated to 0 if the size has reached this limit. Default value: `2048` KB
`<var name="ENV_VARIABLE_1" value="VALUE_1" />`	The environment variable and its value are exported before the execution of module scripts. Define as many var sections as there are environment variables to export.

13.8 Virtual hostname (<vhost>, <virtualhostname> tags)

13.8.1 <vhost> example

```
<vhost>
  <virtualhostname name="vhostname" envfile="vhostenv"/>
</vhost>
```

See also the example in 15.6 page 278.

13.8.2 <vhost> syntax

```
<vhost>
  <virtualhostname
     name="virtual_hostname"
     envfile="path_of_a_file"
    [when="prim"|"second"|"both"]
  />
</vhost>
```

Note

The `<vhost>` tag and subtree cannot be changed with a dynamic configuration.

13.8.3 <vhost>, <virtualhostname> attributes

`<vhost>`	
`<virtualhostname`	
`name="virtual_hostname"`	Definition of the virtual hostname.

`envfile="path_of_envfile"`	Path of the environment file automatically generated by SafeKit during configuration command If the path of the file is relative, the file will be generated in the runtime environment of the application module i.e.: `SAFEUSERBIN` This generated environment file is used in module scripts to set the virtual hostname before starting and stopping the application. See the module template `vhost.safe` delivered with Linux and Windows package.
`[when="prim"|"second"|"both"]`	Define when the virtual hostname must be returned to the application instead of the physical one. Default value: `prim` means when the server is primary (`PRIM` or `ALONE`).
`/>`	
`</vhost>`	

13.8.4 <vhost> description

Some applications need to see the same hostname on all SafeKit servers (typically, because it is stored in a replicated file). With the virtual hostname, these applications see the virtual name whereas other applications see the physical name.

See 15.6 page 278 for a complete example.

⇨ On Linux

Implementation is based on the LD_PRELOAD environment variable: `gethostname` and `uname` functions are overloaded.

⇨ On Windows

Implementation is based on the CLUSTER_NETWORK_NAME_ environment variable: the query API (GetComputerName, GetComputerNameEx, gethostname) functions take this variable into account. To use vhost for a service, use the command `vhostservice <service> [<file>]` before/after the service start/stop.

13.9 Process or service death detection (<errd>, <proc> tags)

Important

`<errd>` section requires `<user/>` section.

13.9.1 <errd> example

13.9.1.1 Process monitoring

Linux and Windows, `myproc` is the command name of the process to monitor:

```
<errd>
  <proc name="myproc" atleast="1" action="restart" class="prim"/>
```

```
</errd>
```

Linux only (since SafeKit > 7.2.0.29), `oracle_.*` is a regular expression on the command name of the process to monitor:

```
<errd>
  <proc name="oracle" nameregex="oracle_.*" atleast="1" action="restart"
class="prim"/>
</errd>
```

See also the example in 15.7 page 280.

13.9.1.2 Service monitoring

`myservice` is the name of the Windows service (since safekit > 7.3) or Linux systemd service (since safekit > 7.4.0.19) to monitor:

```
<errd>
<proc name="myservice" service="yes" atleast="1" action="restart" class="prim" />
</errd>
```

13.9.2 <errd> syntax

```
<errd
  [polltimer="10"]
>
  <proc name="command name and/or resource name for the monitored process (or
service in Windows)"
        [service="no|yes"]
        [nameregex=="regular expression on the command name"]
        [argregex="regular expression on process arguments, including command
name"]
        atleast="1"
        action="stopstart"|"restart"|"stop"|"executable_name"
        class="prim"|"both|"pre"|"second"|"sec"|"othername"]
        [start_after="nb polling cycles"]
        [atmax="-1"]
  />
  …
</errd>
```

Note

The `<errd>` tag and full subtree can be changed with a dynamic configuration.

13.9.3 <errd>, <proc> attributes

`<errd`	
`polltimer="30"`	Time delay, in seconds, between two polls of the list of processes. Default value: `30` seconds
`<proc`	Definition of a process to monitor. Set as many proc sections as there are processes.

	A resource is associated with each <proc>, it is named `proc.<value of the attribute name>` (e. g `proc.process_name`). The resource is `up` when the monitoring condition is true; else `down` if false.
`name="command_name"`	`name` is the command name of the process to monitor. It is also the name of the resource associated with the monitored process. At max 15 characters in Linux (the command name can be truncated); 63 in Windows. Example: on Linux, `name="vi"` and on Windows `name="notepad.exe"`. Important Windows only. The name is automatically converted to lower case. See 13.9.4 page 248 for help on retrieving the process command name.

Or
`name="command_name"`
`nameregex="regular expression on the command name"`
	Linux only
	`nameregex` is a regular expression applied on the command name for selecting the process to monitor.
	`name` is name of the resource associated with the monitored process.
	.
	Important As regular expressions are defined inside the XML file `userconfig.xml`, special characters interpreted by XML like '`<`' or '`>`' cannot be used in regular expressions.
	Example: set `nameregex="oracle _. *"` `name="oracle"` for monitoring oracle process that match the regular expression
	The associated resource is `proc.oracle`
	The `nameregex` attribute is optional

Or
`name="service_name"`
`service="yes"`
	`name` is the name of the service to monitor. It is also the name of the resource associated with the monitored service.
	At max 63 characters.
	Example:
	set `name="W32Time" service="yes"` for monitoring the Windows Time service

	set `name="ntpd" service="yes"` for monitoring the Linux Time service (systemd ntpd.service) The `service` attribute is optional, and the default value is `no`

`class=`
`"prim"|`
`"both"|`
`"pre"|`
`"second"|`
`"sec"|`
`"othername"`
	The process belongs to a class.
	The monitoring of a class starts only when the command `safekit errd enable "classname" -m AM` is executed.
	Activation/deactivation of `prim`, `both`, `pre`, `second`, and `sec` classes are automatically done by SafeKit in the `<user/>` component with `start_prim/stop_prim`, `start_both/stop_both`, `start_second/stop_second`, `start_sec/stop_sec`. For scripts details, see 14 page 265.
	With `another` class name, you must explicitly activate/deactivate process monitoring after/before the start/stop of the process.

`[argregex="regular expression on process arguments"]`	Regular expression matching the list of arguments of the process to monitor, including the executable name. Optional parameter.
	The regex engine is POSIX Extended regex (see POSIX documentation):
	✓ in Windows, case insensitive mode
	✓ in Linux, case sensitive mode
	Important: As regular expressions are defined inside the XML file `userconfig.xml`, special characters interpreted by XML like `'<'` or `'>'` cannot be used in regular expressions.
	See 13.9.4 page 248 for help on retrieving the list of arguments of a process.
	
	⇨ Linux examples with `vi` editor on `myfile`
	`<proc name="vi" argregex=".*myfile.*" …`
	`<proc name="vi" argregex="/myrep/myfile.*" …`
	`<proc name="vi" argregex="/myrep/myfile" …`
	
	⇨ Windows examples with `notepad` editor on `myfile`
	`<proc name="notepad.exe" argregex=".*myfile.*" …`
	`<proc name="notepad.exe"`
	`argregex="c:\\myrep\\myfile.*" …`
	`<proc name="notepad.exe"`
	`argregex="c:\\myrep\\myfile" …`

`atleast="1"`	Minimum number of processes that must be running. If this minimum is not reached, then SafeKit triggers an action Example: `name="oracle" argregex=".*db1.*" atleast="1"` means that an action will be triggered if less than one `oracle` instance is running on `db1`. When set to `-1`, this criterion is meaningless. Default value: `1`

`action=`
`"restart"|`
`"stopstart"|`
`"stop"|`
`"noaction"|`
`"executable_name"`
	Action (or handler) to execute on the application module.
	
	`noaction` means logging a message, `restart` triggers a local restart and `stopstart` triggers a failover.
	
	To avoid a loop on reproducible fault, a `maxloop` counter is incremented at each restart/stopstart command. For the `maxloop` definition, see section 13.2 page 208.
	
	To define a special handler, either set an absolute path or a path relative to the "bin" directory of the module: `SAFE/modules/AM/bin/`. We recommend a relative path and a handler defined inside the module.
	
	When defining a special handler, a new class name must be associated with the monitored process.
	
	For a special handler on Linux, on success, end with `exit 0`
	
	For a special handler on Windows, on success, end with `%SAFEBIN%\exitcode 0`
	
	With a different value, SafeKit performs a `stopstart` command.
	
	When running special handlers, the `maxloop` counter is not incremented. To increment it:
	
	`safekit incloop -m AM -i <handler name>`
	
	This command increments the counter and returns 1 when the limit has been reached.
	
	Default value: `stopstart`

`start_after=[nb polling cycles]`	Without the `start_after` attribute the monitoring of processes is immediately effective. Otherwise, it is delayed for `(n-1)*polltimer` (in seconds) where: ⇨ `n` is the value given in `start_after` parameter ⇨ `polltimer` is the value set on the errd flag (30 seconds by default) For example, if `start_after="3"`, the server is delayed for 60 seconds ((3-1)*30).

	The start_after parameter is useful if the process takes a certain time to start. Default value: `0`
Advanced parameters	
`atmax="-1"`	Maximum number of processes that can run. If this maximum is reached, then SafeKit triggers an action. `atmax="-1"` means that this criterion is meaningless. With `atmax="0"`, an action is triggered each time the process is started. Default value: `-1` this criterion is meaningless
`</errd>`	

13.9.4 <errd> commands

Note

If the command is used inside a module script, then the `SAFEMODULE` environment variable is set and the `-m AM` parameter is not necessary

`safekit -r errdpoll_running`	This command prints into the file **`SAFEVAR/errdpoll_reserrd`** (`SAFEVAR=/var/safekit` on Linux and `SAFEVAR=c:\safekit\var` on Windows if c: is the installation drive), one line for each running process with following fields: <pid> <command name> <command full name and arguments list> (parent=<parent pid>) In Windows, the command name is displayed in lower case. Useful to find the process name and its arguments for an <errd> configuration
`safekit errd disable "classname" -m AM`	Suspends the monitoring of the processes included in the class `classname` (for the application module `AM`). Must be explicitly done in stop_... scripts before stopping the application, for processes in class different from `prim`, `both`, `second`, `sec`.
`safekit errd enable "classname" -m AM`	Resumes the monitoring of the processes defined with the class `classname` (for the application module `AM`). Must be explicitly done in start_... scripts after starting the application, for processes in class different from `prim`, `both`, `second`, `sec`.

`safekit errd suspend -m AM`	Suspends the monitoring of all processes except SafeKit processes (for the application module `AM`). Useful when stopping manually the application without triggering error detection.
`safekit errd resume -m AM`	Resumes the monitoring of processes suspended with `safekit errd suspend` (for the application module `AM`).
`safekit errd list -m AM`	Lists all processes monitored by SafeKit (including SafeKit processes) and defined in the application module `AM`. The list displayed may be truncated due to internal limits. The full list can be found in the file **`SAFEVAR/modules/AM/errdlist`**. `SAFEVAR=/var/safekit` on Linux and `SAFEVAR=c:\safekit\var` on Windows if c: is the installation drive.

`safekit kill -name="process_name" [-argregex="…"] -level="kill_level"`	`<errd>` component must run.
	
	`level="test"`: only display the process list
	
	`level="terminate"`: kill processes
	
	`level="9"`: send SIGKILL signal to processes (Linux only)
	
	`level="15"`: send SIGTERM signal to processes (Linux only)
	
	Windows examples ("class CatlRegExp" for more information):
	
	`safekit kill -name="notepad.exe" -argregex=".*myfile.*" -level="terminate"`
	
	`safekit kill -name="notepad.exe" -argregex="c:\\myrep\\myfile.*" -level="terminate"`
	
	Linux examples ("man regex" for more information) :
	
	`safekit kill -name="vi" -argregex=".*myfile.*" -level="9"`
	
	`safekit kill -name="vi" -argregex="/myrep/myfile.*" -level="9"`

13.10 Checkers (<check> tag)

SafeKit brings built-in checkers with failover rules (for default failover rules details, see 13.18.5 page 263). The checkers are:

⇨ 13.11 “TCP checker (<tcp> tags)” page 251

13.10.1 <check> example

All built-in checkers are configured under a single `<check>` section:

```
<check>
  <!-- Insert below <tcp> <ping> <intf> <ip> <custom> <module> <splitbrain> tags
-->
</check>
```

13.10.2 <check> syntax

```
<check>
  <tcp …>
    <to …/>
  </tcp>
  …
  <ping …>
    <to …/>
  </ping>
  …
  <intf …>
    <to …/>
  </intf>
  …
  <ip …>
    <to …/>
  </ip>
  …
  <custom …/>
  …
  <module …>
    [<to …/>]
  </module>
…
  <splitbrain …/>
</check>
```

Note

The `<check>` tag and full subtree can be changed with a dynamic configuration.

13.11 TCP checker (<tcp> tags)

Important

By default, a <tcp> checker makes a local restart of the application when the checked tcp service is down.

13.11.1 <tcp> example

```
<check>
  <tcp ident="R1test"  when="prim" >
    <to  addr="R1" port="80"/>
  </tcp>
</check>
```

Important

Insert the <tcp> tag into the <check> section if this one is already defined.

See also example in 15.8 page 282.

13.11.2 <tcp> syntax

```
  <tcp
    ident="tcp_checker_name"
    when="prim|second|both|pre"
  >
    <to
     addr="IP_address" or "name_to_check"
     port="TCP_port_to_check"
     [interval="10"]
     [timeout="5"]
     />
  </tcp>
```

13.11.3 <tcp> attributes

`<tcp`	Set as many `<tcp>` sections as there are TCP checkers.
`ident="tcp_checker_name"`	TCP checker name.
`when="prim|second|both"`	Use this value for a TCP checker related to the application. The `when` value sets the checker start and stop schedule respectively after and before the application's eponym start and stop scripts (`start_prim/stop_prim`, `start_second/stop_second`, `start_both/stop_both`). Action in case of failure: `safekit restart` of the application module. For default failover rules detail, see 13.18.5 page 263. At each restart, the `maxloop` counter is incremented. For its definition, see 13.2.3 page 209.

`when="pre"`	Use this value for a TCP checker not related to the application. The checker is started/stopped after/before module scripts `prestart/poststop`. You must add a special failover rule for this "tcp" checker. Typically: `external_tcp_service: if (tcp.tcp_checker_name == down) then wait();` This rule executes a stopwait and puts the application module in the `WAIT` state while the external TCP service is not responding. See 13.18 page 261 for more information. At each stopwait, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).
`<to`	
`addr="IP_@" or "name"`	IP address or name to check (ex.: `127.0.0.1` for a local service). IPv4 or IPv6 address.
`port="value"`	TCP port to check.
`[interval="10"]`	Interval in seconds between two connections trials. Default value: `10` seconds
`[timeout="5"]`	Connection establishment timeout in seconds. Default value: `5` seconds
`</tcp>`	

13.12 Ping checker (<ping> tags)

Important

By default, a <ping> checker stops the module and waits for the ping to be up.

13.12.1 <ping> example

```
<check>
  <ping ident="testR2" >
    <to addr="R2"/>
  </ping>
</check>
```

Important

Insert the <ping> tag into the <check> section if this one is already defined.

See also the example in 15.9 page 282.

13.12.2 <ping> syntax

```
<ping
  ident="ping_checker_name"
  [when="pre"]
>
  <to
   addr="IP_address" or "name_to_check"
   [interval="10"]
   [timeout="5"]
   />
</ping>
```

13.12.3 <ping> attributes

`<ping`	Set as many ping sections as there are ping checkers.
`ident="ping_checker_name"`	Ping checker name as displayed in the command `safekit state -v -m AM`. Name of checkers must be unique.
`[when="pre"]`	Default if not set. Started/stopped after/before module scripts `prestart/poststop`. Executes a stopwait and puts the application module in the `WAIT` state if there is no reply to the ICMP ping requests (see default failover rules definition in 13.18.5 page 263). At each stopwait, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).
`<to`	
`addr="IP_@ or name"`	External IP address or name to check. IPv4 or IPv6 address.
`[interval="10"]`	Interval in seconds between two ping requests. Default value: `10` seconds
`[timeout="5"]`	Reply timeout in seconds to the ping. Default value: `5` seconds
`</ping>`	

13.13 Interface checker (<intf> tags)

Important

By default, a <intf> checker stops the module and waits for the network interface to come back up.

13.13.1 <intf> example

```
<check>
  <intf  ident="test_eth0">
    <to  local_addr="192.168.1.10"/>
  </intf>
</check>
```

Important

Insert the <intf> tag into the <check> section if this one is already defined.

See also the example in 15.10 page 283.

13.13.2 <intf> syntax

```
  <intf
    ident="intf_checker_name"
    [when="pre"]
       >
    <to
     local_addr="interface_physical_IP_address"/>
  </intf>
```

13.13.3 <intf> attributes

`<intf`	Note <intf> sections are automatically generated on network interface when `<interface check="on">` is set (see the virtual IP definition in 13.5 page 215).
`ident="intf_checker_name"`	Interface checker name
`[when="pre"]`	Default. Started/stopped after/before module scripts `prestart/poststop`. Execute a stopwait and put the application module in the `WAIT` state if `intf` is "down" (see the default failover rules in 13.18.5 page 263). At each stopwait, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).
`<to local_addr="IP_@ />`	Physical IP address configured on the network interface to check. IPv4 or IPv6 address.

`</intf>`	

13.14 IP checker (<ip> tags)

In LINUX and Windows, this checker checks that the IP address is locally defined; in Windows it also detects IP conflicts.

Important

By default, a <ip> checker makes a local stopstart of the module when the checked ip address is down.

13.14.1 <ip> example

```
<check>
  <ip  ident="ip_check" >
    <to  addr="192.168.1.10" />
  </ip>
</check>
```

Important

Insert the <ip> tag into the <check> section if this one is already defined.

See also the example in 15.11 page 284.

13.14.2 <ip> syntax

```
  <ip
    ident="ip_checker_name"
    [when="prim"]
  >
    <to
     addr="IP_address" or "name_to_check"
     [interval="10"]
     />
  </ip>
```

13.14.3 <ip> attributes

`<ip`	Set as many ip sections as there are ip checkers.
`ident="ip_checker_name"`	ip checker name as displayed in the `safekit state -v -m AM` command. Name of checkers must be unique.
`[when="prim"]`	Default if not set. The checker is started/stopped after/before the module scripts `start_prim/stop_prim`. Action in case of failure: `safekit stopstart` of the application module (see the default failover rules in 13.18.5 page 263). At each stopstart, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).

`<to`	
`addr="IP_@ or name"`	Local IP address or name to check. IPv4 or IPv6 address.
`[interval="10"]`	Interval in seconds between two checks. Default value: `10` seconds
`</ip>`	

13.15 Custom checker (<custom> tags)

A custom checker is a program (script or other) that you develop for your module. It is a loop performing a test at an appropriate periodicity. According to the result of the test, the program sets the state of a resource ("up" or "down"). Then a special failover rule decides which action must be taken when the resource is down.

13.15.1 <custom> example

```
<check>
  <custom ident="AppChecker" when="prim" exec="mychecker" action="restart"/>
</check>
```

Important

Insert the <custom> tag into the <check> section if this one is already defined.

See the example in 15.12 page 284.

13.15.2 <custom> syntax

```
<custom
   ident="custom_checker_name"
   when="pre|prim|second|both"
   exec="executable_path"
   arg="executable_arguments"
   action="wait|stop|stopstart|restart"
/>
```

13.15.3 <custom> attributes

`<custom`	Set as many custom sections as there are custom checkers.
`ident="custom_checker_name"`	Custom checker name (network IP address). A custom checker must set its associated resource state itself, using the command `safekit set -r custom.custom_checker_name -v up|down`.

`when="pre"`	The checker is started/stopped after/before module scripts `prestart/poststop`. You must also set the action attribute to `action="wait"`. This executes a `stopwait` and puts the application module in the `WAIT` state while the resource is down. Note that SafeKit automatically initializes the state of the associated resource to `init`, and the failover machine stays in the `WAIT` state if the state of the custom checker is not evaluated to `up`. For more information on the failover machine, see 13.18 page 261. At each `stopwait`, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition). Important In SafeKit < 8, the action was configured by adding a failover rule into `<failover>` tag. For instance: `wait_custom_checker: if (custom.custom_checker_name == down) then wait();`
`when="prim"|"second"|"both"`	The checker is started/stopped after/before module scripts `start_prim/stop_prim`, `start_second/stop_second`, `start_both/stop_both`. You must also set the action attribute to `action="stop|stopstart|restart"`. At each error detection, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition). Important In SafeKit < 8, the action was configured by adding a failover rule into `<failover>` tag. For instance: `restart_custom_checker: if (custom.custom_checker_name == down) then restart();`

`exec="executable_path"`	Defines the executable path of the custom checker. Can be a binary executable or a script file. When the path of `executable_path` is relative, it is relative to `SAFEUSERBIN`. In this case, put your executable file in `SAFE/modules/AM/bin/` of your application module and use a relative path. See 10.1 page 153 for more information on path values. We recommend a relative path and an executable inside the module. In Windows, the executable can be a binary or a ps1, vbs or cmd script In Linux, the executable can be a binary or a shell script
`arg="executable_arguments"`	Defines the executable arguments when the custom checker is started.
`action="wait|stop|stopstart|restart"`	Generates the failover rule associated with the resource that will perform the specified action if the resource is `down`. The failover rule is named : `c_<ident value>`.

13.16 Module checker (<module> tags)

The module checker checks the availability of another module. It is started/stopped in the `prestart` /`poststop` phase before the start of the application. When the module checker detects that the external module is `down`, SafeKit executes a `stopwait` and puts the server in the `WAIT` state until the external module is detected as `up` by the module checker. The module checker also triggers a `stopstart` when it detects that the external module is stopping or has been restarted (either by a SafeKit `stopstart`, `restart` or failover). See 13.18.5 page 263 for the default failover rules.

At each `stopwait` or `stopstart`, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).

The module checker connects to the SafeKit web service on the node running the module to get the module state (see 10.6 page 164 for details on the web service).

13.16.1 <module> example

Example for the default configuration of the SafeKit web service (protocol: HTTP, port: 9010):

```
<check>
  <module name="mirror">
    <to  addr="M1host" port="9010"/>
  </module>
</check>
```

Example for the secured configuration of the SafeKit web service (protocol: HTTPS, port: 9453):

```
<check>
  <module name="mirror">
    <to  addr="M1host" port="9453" secure="on"/>
  </module>
</check>
```

Important

Insert the <module> tag into the <check> section if this one is already defined.

For examples, see 15.3 page 275 and 15.13 page 286.

13.16.2 <module> syntax

```
  <module
    [ident="module_checker_name"]
    name="external_module_name">
    [<to
     addr=" IP_@ or name the Safekit server running the external module"
     port="port of the SafeKit httpd server"
     [interval="10"]
     [timeout="5"]
     [secure="on"|"off"]
     />]
  </module>
```

13.16.3 <module> attributes

`<module`	Set as many `<module>` sections as there are module checkers.
`name="external_module_name"]`	Name of the module checker.
`[ident="module_checker_name"]`	Name of the external SafeKit module to check. Default: `external_module_name_<IP_@ or name of the server>`
`[<to`	Definition of the server(s) running the external module to check. Default is the local server.
`addr="IP_@ or name of the server"`	IP address or name of the external module. IPv4 or IPv6 address.
`port="port of the SafeKit web service"`	Port of the SafeKit web service. `9010` for HTTP ; `9453` for HTTPS
`[interval="10"]`	Interval in seconds between two checks. Default value: `10` seconds.

`[timeout="5"]`	Check reply timeout in seconds. Default value: `5` seconds
`[secure="on"|"off"]`	Use HTTP protocol (`secure="off"`) or HTTPS (`secure="on"`) Default value: `off`
`/>]`	
`</module>`	

13.17 Splitbrain checker (<splitbrain> tag)

SafeKit provides a splitbrain checker that is suits mirror architectures. Split brain is a situation where, due to temporary failure of all network links between SafeKit nodes, and possibly due to software or human error, both nodes switched to the primary role while isolated. This is a potentially harmful state, as it implies that the application is running on both nodes. Moreover, when file replication is enabled, modifications to the data are made on the two nodes.

The split-brain checker detects the loss of all connectivity between nodes and selects only one node to become the primary. The other node is not up-to-date anymore and goes into the `WAIT` state until:

⇨ the heartbeat becomes available again

or

⇨ the administrator runs `safekit` commands to force the start as primary (`safekit stop` then `safekit prim`).

The primary node election is based on the ping of an IP address, called the **witness**. The network topology must be designed so that only one node can ping the witness in case of split brain. If this is not the case, both nodes will go primary.

Important

Ping between nodes and witness must be enabled.

13.17.1 <splitbrain> example

```
<check>
  <splitbrain ident="SBtest" exec="ping" arg="192.168.1.100"/>
</check>
```

Important

Insert the <splitbrain> tag into the <check> section if this one is already defined.

13.17.2 <splitbrain> syntax

```
  <splitbrain
```

```
     ident="witness"
     exec="ping"
     arg=" witness IP address "
  />
```

13.17.3 <splitbrain> attributes

`<splitbrain`	Set only one splitbrain checker.
`ident="witness"`	Name displayed in the `safekit state -v -m AM` command for the witness state.
`[when="pre"]`	Fixed value. Started/stopped after/before module scripts prestart/poststop. The witness state is stored in `splitbrain.witness`. It can be displayed using the `safekit state -v -m AM` command. On splitbrain detection, the server with `splitbrain.witness="up"` goes primary; the other one with `splitbrain.witness="down"` sets the resource `splitbrain.uptodate` to `down` and goes into the `WAIT` state (for default failover rules, see 13.18.5 page 263). At each stopwait, the `maxloop` counter is incremented (see 13.2.3 page 209 for its definition).
`exec="ping"`	Fixed value. Use a pinger to ping the witness and set `splitbrain.witness` state.
`arg="IP_@ or name"`	External IP address or name for the witness to ping. IPv4 or IPv6 address.
`</splitbrain>`	

13.18 Failover machine (<failover> tag)

SafeKit comes with checkers (network interface, ping, TCP, custom, module checkers) which regularly (by default every 10 seconds) check resources and set the state to `up` or `down` (see 13.10 page 249 for checkers definition). The failover machine regularly (by default every 5 seconds) evaluates the global state of all resources and triggers a failover according to failover rules programmed in a simple language.

In farm architecture, the failover machine can work only on the states of local resources whereas in mirror architecture, the failover machine can work on the states of local and remote resources. As the states of resources are exchanged on heartbeat channels, it is better to have several heartbeat channels (see 13.3 page 211 for heartbeats definition).

13.18.1 <failover> example

```
<failover>
  <![CDATA[
    ping_failure: if (ping.testR2 == down) then stopstart();
  ]]>
</failover>
```

13.18.2 <failover> syntax

```
<failover [extends="yes"] [period="5000"] [handle_time="15000"]>
<![CDATA[
  label: if (expression) then action;
  …
]]>
</failover>
```

Note

The `<failover>` tag and subtree cannot be changed with a dynamic configuration.

13.18.3 <failover> attributes

`<failover`	
`[extends="yes"|"no"]`	If set to `yes`, the new failover rules extend the default failover rules (see 13.18.5 page 263 for its definition). If set to `"no"`, the new failover rules overwrite the default one (avoid this configuration). Default value: `yes`.
`[period="5000"]`	Period in milliseconds between two evaluations of failover rules. Default value: `5000` milliseconds (5 seconds)
`[handle_time="15000"]`	A failover action must be stable (the same) at least during the time `handle_time` (in milliseconds) before being applied by the failover machine. Default value: `15000` milliseconds (15 seconds). `handle_time` must be a multiple of the `period` value.

13.18.4 <failover> commands

`safekit set [-m AM] -r resource_class.resource_id -v resource_state`
 	
`[-n] [-l]`
	This command sets the state of one resource:
	Examples:
	`safekit set -r custom.myresource -v up`
	`safekit set -r custom.myresource -v down`

	Each assignment of the main resources is stored in a log to keep track of their status. Use `-n` to disable this logging or `-l` to force it.
`safekit stopwait -i "identity"`	Equivalent to `wait()` command of the failover machine (see 13.18 page 261). With stopwait, (1) `poststop` and `prestart` scripts are not executed and (2) checkers `when="pre"` are not stopped.

The other commands (`restart()`, `stopstart()`, `stop()`, `swap()`) of the failover machine are equivalent to control commands (with the `-i identity` parameter) described in 9.4 page 144.

Important

`maxloop / loop_interval / automatic_reboot` are applied if `-i identity` is passed to commands (for these attributes details, see 13.2 page 208). This is the case when called from the failover machine.

13.18.5 Failover rules

The default failover rules for the SafeKit checkers are:

```
<failover>
<![CDATA[
/* rule for module checkers */
module_failure: if (module.? == down) then wait();
/* rule for interface checkers */
interface_failure: if (intf.? == down) then wait();
/* rule for ping checkers */
ping_failure: if (ping.? == down) then wait();
/* rule for tcp checkers */
tcp_failure: if (tcp.? == down) then restart();
/* rule for ip checkers */
ip_failure: if (ip.? == down) then stopstart();
/* rules for splitbrain */
splitbrain_failure: if (splitbrain.uptodate == down) then wait();
]]>
</failover>
```

They are defined into **`SAFE/private/conf/include/failover.xml`**.

There are also failover rules dedicated to file replication management.

The `WAKEUP` command is automatically generated when no `wait()` rule applies.

Note

Since SafeKit 7.5, default failover rules are using a new syntax, and rules for the rfs component are set into the file **`SAFE/private/conf/include/rfs.xml`**.

In addition to the default rules, the user can define his own rules (for a custom checker for example) using the following syntax:

```
label: if ( expression ) then action;
```

with:

- label ::= **string**
- action ::= stop() | stopstart() | wait() | restart() | swap()
- expression ::= **(** expression **)**

```
  | ! expression
  | expression && expression
  | expression || expression
  | expression == expression
  | expression != expression
  | resource ::= [local. | remote.] 0/1resource_class.resource_id
  | resource_state
```

The syntax to design the resources is as follows:

```
resource ::= [local. | remote.] 0/1resource_class.resource_id   (default: local)
resource_class ::= ping | intf | tcp | custom | module | heartbeat | rfs
resource_id ::= * | ? | name
resource_state ::= init | down | up | unknown
```

`init`	Special initialization state of a resource when the checker is not started. If a resource in the `init` state is used in a failover rule, SafeKit does evaluate the rule.
`up`	Resource OK.
`down`	Resource KO.
`unknown`	Special state of a remote resource; the remote state is unknown at the test time (ex.: when the remote module is stopped).

14.Scripts for a module configuration

To enable scripts call, `<user>` tag must be defined in `userconfig.xml` as described in 13.7 page 241. This tag could be added or removed dynamically.

Scripts must executables:

- ✓ in Windows, an executable with the extension and type: `.cmd`, `.vbs`, `.ps1`,`.bat` or `.exe`
- ✓ in Linux, any type of executable

Each time you update scripts, you must apply the module configuration onto the servers (with the SafeKit console or command).

Examples of scripts are given in 15.1 page 272 for a mirror module, and in 15.2 page 273 for a farm module.

Note During the configuration phase, scripts are copied from `SAFE/modules/AM/bin` in the execution environment directory `SAFE/private/modules/AM/bin` (=`SAFEUSERBIN`, do not touch scripts at this place) where AM is the module name.

14.1 List of scripts

Below the list of scripts that can be defined by the user. The essential scripts start/stop are those that start and stop the application within the module.

14.1.1 Start/stop scripts

`start_prim` `stop_prim`	**Scripts for a mirror module.** To start & stop application on the `ALONE` or `PRIM` server
`start_both` `stop_both`	**Scripts for a farm module.** To start & stop application on all `UP` servers in a farm cluster In the special case they are defined in a mirror module, they are also executed on both servers (`PRIM`, `SECOND` or `ALONE`)
`start_second` `stop_second`	**Special scripts for a mirror module** To start & stop application on the "`SECOND`" server Note When the secondary server becomes the primary one, `stop_second` followed by `start_prim` is executed

start_sec stop_sec	**Special scripts for a mirror module**
stop_[both, prim, second, sec] force	**Scripts for all modules** The stop scripts are called twice: once for a graceful shutdown of the application (without force as first argument), a second time with a force parameter for a rapid shutdown (with `force` as first argument).
prestart poststop	**Scripts for all modules** Executed at the very beginning of the module start and at its end. By default, `prestart` contains `stop_sec`, `stop_second`, `stop_prim`, `stop_both` to stop application before starting the module under the control of SafeKit.
transition	**Script for all modules** This script is executed on state transitions described in 14.2 page 267

14.1.2 Other scripts

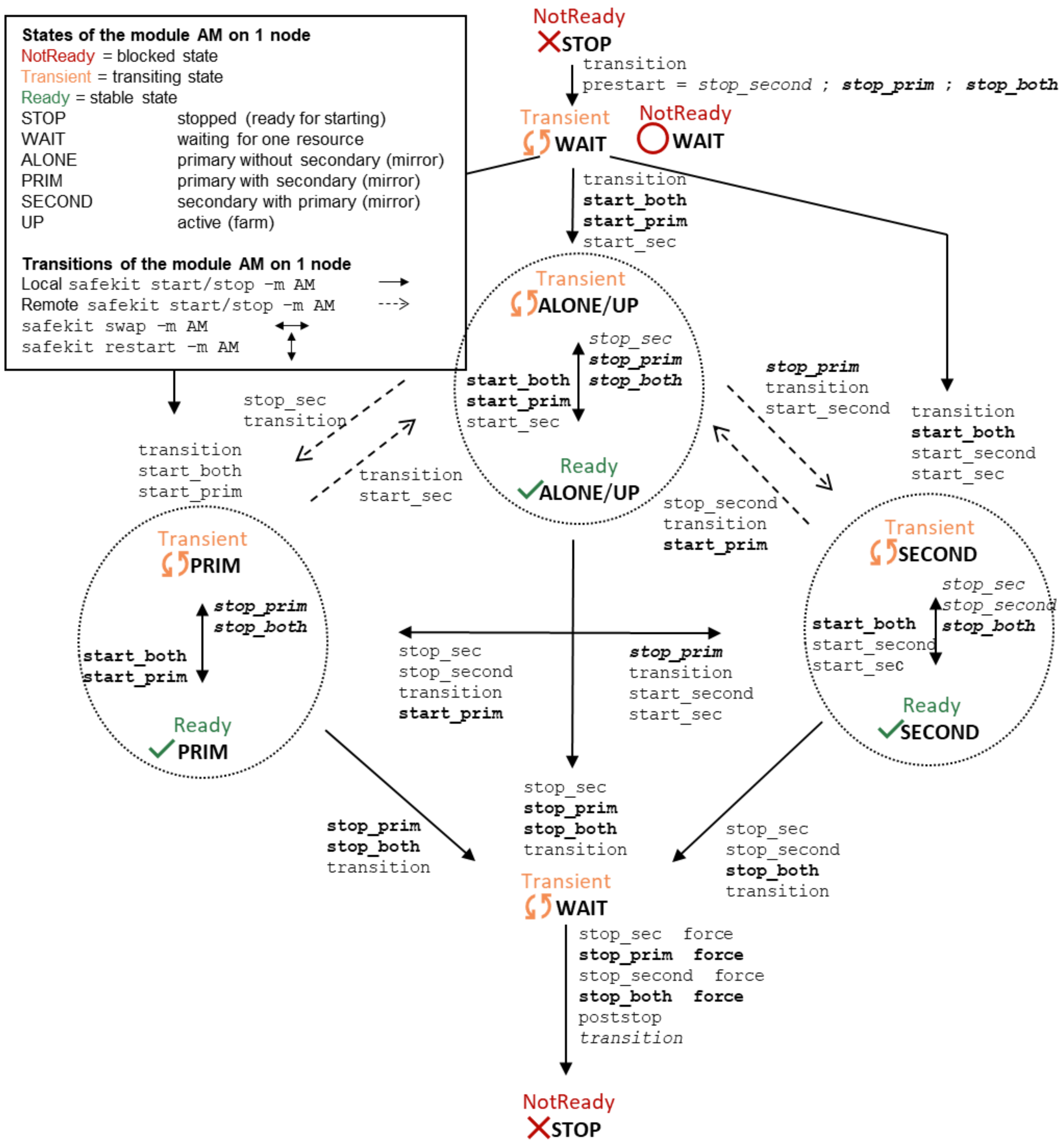
config	`config` is called when executing the `safekit config -m AM` command on the application module. You can make a special application configuration in this script.
deconfig	`deconfig` is called when executing the `safekit deconfig -m AM` command, which is itself called at the application module uninstallation. You can remove a special application configuration made previously in the `config` script.
confcheck	`confcheck` is called when executing the `safekit confcheck -m AM` command on the application module. You can add in this script some tests for checking changes on the application configuration files.
state	`state` is called when executing the `safekit state -v -m AM` command on the application module. You can display a special state of the application.
level	`level` is called when executing the `safekit level -m AM` command on the application module. You can display the application version.

14.2 Script execution automaton

Important

Example: first transition from `STOP` to `WAIT` calls the script `transition STOP WAIT start` is called.

Most of the time, stop scripts are called twice (without the `force` parameter and then with the `force` parameter). In that case the script name is written in italic.



14.3 Variables and arguments passed to scripts

All scripts are called with 3 parameters:

- ✓ the current state (`STOP,WAIT,ALONE,PRIM,SECOND,UP`),
- ✓ the next state (`STOP,WAIT,ALONE,PRIM,SECOND,UP`)
- ✓ the action (`start`, `stop`, `stopstart` or `stopwait`).

The stop scripts are called twice:

- ✓ a first time for a graceful shutdown of the application
- ✓ a second time with a `force` parameter for a forced shutdown (with `force` as first argument)

The environment variables that can be used inside scripts are:

- ✓ `SAFE, SAFEMODULE, SAFEBIN, SAFEUSERBIN, SAFEVAR, SAFEUSERVAR` (for details, see 10.1 page 153)
- ✓ all variables defined in `<user>` tag of `userconfig.xml` (see 13.7 page 241).

14.4 SafeKit special commands for scripts

Special commands are installed under `SAFE/private/bin`. Special commands can be called directly in module scripts with `%SAFEBIN%\specialcommand` or `$SAFEBIN/specialcommand`. Outside module scripts, use `safekit -r` command.

`safekit -r <special command> [<args>]`	<special command> <args> executed within the SafeKit environment. When the command name is not an absolute path, the command is searched in `SAFEBIN=SAFE/private/bin` directory. Note: If you use special commands outside SafeKit scripts, prefix them with `safekit -r specialcommand`

14.4.1 Commands for Windows

14.4.1.1 sleep, exitcode, sync commands

On Windows, you can use the following basic commands:

➩ `%SAFEBIN%\sleep.exe <timeout value in seconds>`

To be used inside stop scripts because net stop service is not synchronous

➩ `%SAFEBIN%\exitcode.exe <exit value>`

To return an error value when the script exits

➩ `%SAFEBIN%\sync.exe \\.\<drive letter:>`

To sync file system cache of a disk

14.4.1.2 namealias command

➩ `%SAFEBIN%/namealias [-n | -s ] <alias name>`

`-n` to add a new NetBIOS name (set into `start_prim`) or `-s` to suppress the NetBIOS name (set into `stop_prim`)

You can also use the SafeKit command `netnames` (or the windows command `nbtstat`) to list NetBIOS information.

14.4.2 Commands for Linux

14.4.2.1 Managing the crontab

`$SAFEBIN/gencron`	
`[del	add]`	`del` to disable the entries in `stop_prim` (by inserting comments) or `add` to enable the entries in `start_prim` (by removing comments).
`<user name>`	User name in the crontab.
`[all |<command name>]`	`all`: to apply on all entries or to apply on the name of the command
`-c "<comment>"`	Header of the comment that will be inserted.

For example, to disable/enable the entry from the admin's crontab,

```
5 0 * * * $HOME/bin/daily.job >> $HOME/tmp/out 2>&1
```

Insert into `stop_prim`:

```
$SAFEBIN/gencron del admin daily.job -c "SafeKit configuration for
$SAFEMODULE"
```

And insert into `start_prim`:

```
$SAFEBIN/gencron add admin daily.job -c "SafeKit configuration for
$SAFEMODULE"
```

14.4.2.2 Bounding command

```
$SAFEBIN/boundcmd <timeout value> <command path> [<args>]
```

Bound a command with a timeout

`boundcmd` returns the exit code of the command when the command terminates before the timeout; otherwise, it exits with the value 2.

For example, to flush data on disk with a timeout of 30 seconds, run:

```
$SAFEBIN/boundcmd 30 /bin/sync 1>/dev/null 2>&1
```

14.4.2.3 Commands for Windows and Linux

`safekit -r processtree list | kill …`	List running processes as a tree (except for `all`) and optional kill
	➩ `safekit -r processtree list all`
	List all running processes.
	➩ `safekit -r processtree list <process command name>`
	List all running processes with the specified command name.
	➩ `safekit -r processtree kill <process command name>`
	List and kill all running processes with the specified command name.
	➩ `safekit -r processtree list | kill <process command name>| all <regular expression on the full command –path and arguments>`
	List (and kill) all running process with the specified command name and arguments.
	
	Windows examples ("class CatlRegExp" for more information):
	`safekit -r processtree kill notepad.exe ".*myfile.*"`
	`safekit -r processtree list all “mirror”`
	Linux examples ("man regex" for more information) :
	`safekit -r processtree kill vi ".*myfile.*"`
	`safekit -r processtree list all “mirror”`

`safekit incloop`
`-m AM -i <handler name>`
	SafeKit provides a `maxloop` counter, the number of `restart` and `stopstart` of the module on error detection. The module is stopped when this counter reaches the `maxloop` value over the `loop_interval` period.
	When running special handlers, the `maxloop` counter is not incremented. To increment it, use the command:
	`safekit incloop -m AM -i <handler name>`
	It increments the `maxloop` counter for the module `AM` and returns 1 when the limit has been reached.

`safekit resetloop`
`-m AM [-i <handler name>]`
	Reset the `maxloop` counter to the value 0

`safekit checkloop -m AM`	For checking the `maxloop` counter for the module `AM`, use the command: `safekit checkloop -m AM` ➩ It returns 0 when the `maxloop` counter is not reached or the last increment occurred outside `loop_interval` ➩ It returns 1 when the `maxloop` counter is reached and the last increment occurred during `loop_interval`

15.Examples of userconfig.xml and module scripts

Some examples are taken from the modules delivered with the SafeKit package, under `SAFE/Application_Modules`. You can install them with the web console (see 3.3.1 page 44) to examine the configuration file and module scripts in detail.

Other examples of integration are described under https://www.evidian.com/products/high-availability-software-for-application-clustering/cluster-configuration/.

Important

The .safe are platform dependent and therefore different in Windows and Linux.

In the following, the examples use this global cluster configuration:

```
<cluster>
   <lans>
      <lan name="net3">
         <node name="node1" addr="10.1.0.2"/>
         <node name="node2" addr="10.1.0.3"/>
         <node name="node3" addr="10.1.0.3"/>
      </lan>
      <lan name="default">
         <node name="node1" addr="192.168.1.1"/>
         <node name="node2" addr="192.168.1.2"/>
      </lan>
      <lan name="repli">
         <node name="node1" addr="10.0.0.2"/>
         <node name="node2" addr="10.0.0.3"/>
      </lan>
   </lans>
```

```
</cluster>
```

15.1 Generic mirror module example with `mirror.safe`

Below is the configuration file and module scripts of the generic mirror module, `mirror.safe`, in Windows. For Linux, please refer to the `mirror.safe` delivered with the Linux package.

`conf/serconfig.xml` - see 13 page 207

```
<!-- Mirror Architecture with Real Time File Replication and Failover -->
<!DOCTYPE safe>
<safe>
   <service mode="mirror" defaultprim="alone" maxloop="3" loop_interval="24"
failover="on">
      <heart pulse="700" timeout="30000">
         <heartbeat name="default" ident="flow"/>
      </heart>
      <rfs async="second" acl="off" locktimeout="100" nbrei="3" iotimeout="300">
         <replicated dir="c:\test1replicated" mode="read_only"/>
         <replicated dir="c:\test2replicated" mode="read_only"/>
      </rfs>
      <vip>
         <interface_list>
            <interface check="on" arpreroute="on">
               <real_interface>
                  <virtual_addr addr="192.168.4.10" where="one_side_alias"/>
               </real_interface>
            </interface>
         </interface_list>
      </vip>
      <user nicestoptimeout="300" forcestoptimeout="300" logging="userlog"/>
   </service>
</safe>
```

`bin/start_prim.cmd` - see 14 page 265

```
@echo off
rem Script called on the primary server for starting application services
rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"

rem stdout goes into Scripts log
echo "Running start_prim %*"
set res=0

rem Fill with your services start call
rem net start "myservice" /Y

set res=%errorlevel%

if %res% == 0 goto end

:stop
"%SAFE%\safekit" printe "start_prim failed"
rem uncomment to stop SafeKit when critical
rem "%SAFE%\safekit" stop -i "start_prim"
```

```
:end
```

`bin/stop_prim.cmd` - see 14 page 265

```
@echo off
rem Script called on the primary server for stopping application services
rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"

rem ----------------------------------------------------------
rem
rem 2 stop modes:
rem
rem - graceful stop
rem   call standard application stop with net stop
rem
rem - force stop (%1=force)
rem   kill application's processes
rem
rem ----------------------------------------------------------

rem stdout goes into Scripts log
echo "Running stop_prim %*"

set res=0

rem default: no action on forcestop
if "%1" == "force" goto end

rem Fill with your service(s) stop call
rem net stop "myservice" /Y

rem If necessary, uncomment to wait for the stop of the services
rem "%SAFEBIN%\sleep" 10

if %res% == 0 goto end

"%SAFE%\safekit" printe "stop_prim failed"

:end
```

15.2 Generic farm module example with `farm.safe`

Below is the configuration file and module scripts for the generic farm module, `farm.safe`, in Windows. For Linux, please refer to the `farm.safe` delivered with the Linux package.

`conf/userconfig.xml` - see 13 page 207

```
<!-- Farm Architecture with Load-Balancing and Failover -->
<!DOCTYPE safe>
<safe>
   <service mode="farm" maxloop="3" loop_interval="24">
      <!-- Cluster Configuration -->
      <!-- Set nodes on your network -->
      <farm>
         <lan name=”default” />
         <lan name =”net3” />
      </farm>
      <vip>
         <interface_list>
            <interface check="on" arpreroute="on">
               <virtual_interface type="vmac_directed">
                  <virtual_addr addr="192.168.4.20" where="alias"/>
               </virtual_interface>
            </interface>
         </interface_list>
         <loadbalancing_list>
            <group name="FarmProto">
               <!-- Set load-balancing rule -->
               <rule port="9010" proto="tcp" filter="on_port"/>
            </group>
         </loadbalancing_list>
      </vip>
      <user nicestoptimeout="300" forcestoptimeout="300" logging="userlog"/>
   </service>
</safe>
```

`bin/start_both.cmd` - see 14 page 265

```
@echo off

rem Script called on all servers for starting applications

rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"

rem stdout goes into Scripts log
echo "Running start_both %*"

set res=0

rem Fill with your services start call
rem net start "myservice" /Y

set res=%errorlevel%

if %res% == 0 goto end

:stop
set res=%errorlevel%
"%SAFE%\safekit" printe "start_both failed"

rem uncomment to stop SafeKit when critical
rem "%SAFE%\safekit" stop -i "start_both"

:end
```

`bin/stop_both.cmd` - see 14 page 265

```
@echo off

rem Script called on all servers for stopping application

rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"
rem ----------------------------------------------------------
rem
rem 2 stop modes:
rem
rem - graceful stop
rem   call standard application stop with net stop
rem
rem - force stop (%1=force)
rem   kill application's processes
rem
rem ----------------------------------------------------------

rem stdout goes into Scripts log
echo "Running stop_both %*"

set res=0

rem default: no action on forcestop
if "%1" == "force" goto end

rem Fill with your services stop call
rem net stop "myservice" /Y

rem If necessary, uncomment to wait for the stop of the services
rem "%SAFEBIN%\sleep" 10

if %res% == 0 goto end

"%SAFE%\safekit" printe "stop_both failed"

:end
```

15.3 A Farm module depending on a mirror module example

In the example below, the farm module can only start if the mirror module is started. This architecture can be used to link an IIS farm module to a Microsoft SQL server mirror module. It is based on the configuration of a module checker in the farm module. For details, see 13.16 page 258.

`farm/conf/userconfig.xml` - see 13 page 207

```
…
  <!-- Checker Configuration: module dependency to mirror + local TCP checker -->
  <check>
    <module name="mirror">
     <to addr="192.168.1.31" port="9010"/>
    </module>
   </check>
…
```

Note

Note that the module dependency can be used when you deploy farm and mirror modules on the same SafeKit cluster or when you deploy farm and mirror modules on two different clusters.

15.4 Dedicated replication network example

The attribute `ident="flow"` on the heartbeat, allows to identify the replication flow. For details, see 13.6 page 223.

`conf/userconfig.xml` - see 13 page 207

```
…
  <heart>
    <heartbeat name="default" />
    <!— 2nd heartbeat special for dedicated replicated network -->
    <heartbeat name="repli" ident="flow" />
  </heart>
…
```

15.5 Network load balancing examples in a farm module

15.5.1 TCP load balancing example

With the following **`userconfig.xml`** configuration file, you are defining a farm of 3 servers with network load balancing and failover on TCP services 9010 (SafeKit web service), 23 (Telnet), 80 (HTTP), 443 (HTTPS), 8080 (HTTP proxy) and 389 (LDAP).

Note

With HTTP and HTTPS, network load balancing is set on the client IP address (`"on_addr"`) and not on the client TCP port (`"on_port"`), to ensure that the same client is always on the same server over several TCP connections (stateful versus stateless servers: see 1.4 page 18)

`conf/userconfig.xml` – see 13 page 207

```
<!DOCTYPE safe>
<safe>
<service mode="farm">
  <farm>
    <lan name="net3" />
  </farm>
  <vip>
    <interface_list>
      <interface check="on" arpreroute="on">
        <virtual_interface type="vmac_directed">
          <virtual_addr addr="192.168.1.50" where="alias" />
        </virtual_interface>
      </interface>
    </interface_list>
    <loadbalancing_list>
       <group name="tcpservices" >
         <cluster>
           <host name="node1" power="1" />
           <host name="node2" power="1" />
           <host name="node3" power="1" />
         </cluster>
         <rule port="9010" proto="tcp" filter="on_port" />
         <rule port="23"   proto="tcp" filter="on_port" />
         <rule port="80"   proto="tcp" filter="on_addr" />
         <rule port="443"  proto="tcp" filter="on_addr" />
         <rule port="8080" proto="tcp" filter="on_addr" />
         <rule port="389"  proto="tcp" filter="on_port" />
       </group>
    </loadbalancing_list>
  </vip>
</service>
</safe>
```

15.5.2 UDP load balancing example

With the following **userconfig.xml** configuration file, you are defining a farm of 3 servers with network load balancing and failover on UDP services 53 (DNS), 1645 (RADIUS).

conf/userconfig.xml - see 13 page 207

```
<!DOCTYPE safe>
<safe>
<service mode="farm">
  <farm>
    <lan name="net3" />
  </farm>
  <vip>
    <interface_list>
      <interface check="on">
        <virtual_interface type="vmac_invisible">
          <virtual_addr addr="192.168.1.50" where="alias" />
        </virtual_interface>
      </interface>
    </interface_list>
    <loadbalancing_list>
       <group name="udpservices" >
         <cluster>
           <host name="node1" power="1" />
           <host name="node2" power="1" />
           <host name="node3" power="1" />
         </cluster>
         <rule port="53"    proto="udp" filter="on_ipid" />
         <rule port="1645"  proto="udp" filter="on_ipid" />
       </group>
    </loadbalancing_list>
  </vip>
</service>
</safe>
```

Note

With `"on_ipid"`, the load balancing is made on the IP identifier filed in the packet IP header. The load balancing works even if the client always presents the same client IP address and client port at input.

15.5.3 Multi-group load balancing example

With the following **userconfig.xml** configuration file, you are defining a farm of 3 servers with a priority for HTTP traffic on the 1st server, HTTPS on the 2nd server and proxy HTTP on the 3rd server.

conf/userconfig.xml - see 13 page 207

```
<!DOCTYPE safe>
<safe>
<service mode="farm">
```

```
  <farm>
    <lan name=”net3” />
  </farm>
  <vip>
    <interface_list>
      <interface check="on" arpreroute=”on”>
        <virtual_interface type="vmac_directed">
          <virtual_addr addr="192.168.1.50" where="alias" />
        </virtual_interface>
      </interface>
    </interface_list>
    <loadbalancing_list>
       <group name="http_service" >
         <cluster>
           <host name="node1" power="3" />
           <host name="node2" power="1" />
           <host name="node3" power="1" />
         </cluster>
         <rule port="80"   proto="tcp" filter="on_addr" />
       </group>
       <group name="https_service" >
         <cluster>
           <host name="node1" power="1" />
           <host name="node2" power="3" />
           <host name="node3" power="1" />
         </cluster>
         <rule port="443"   proto="tcp" filter="on_addr" />
       </group>
       <group name="httpproxy_service" >
         <cluster>
           <host name="node1" power="1" />
           <host name="node2" power="1" />
           <host name="node3" power="3" />
         </cluster>
         <rule port="8080"   proto="tcp" filter="on_addr" />
       </group>
    </loadbalancing_list>
  </vip>
</service>
</safe>
```

15.6 Virtual hostname example with `vhost.safe`

The demonstration module `vhost.safe` shows how to set a virtual hostname (for details, see 13.8 page 242)

`conf/userconfig.xml` - see 13 page 207

```
…
  <vhost>
    <virtualhostname name="virtualname" envfile="vhostenv.cmd" />
  </vhost>
…
```

In addition to this configuration, special commands must be executed in the module scripts. Below is an example of Windows scripts. For Linux, please refer to the `vhost.safe` delivered with the Linux package.

`bin/start_prim.cmd` - see 14 page 265

```
@echo off
rem Script called on the primary server for starting application services
rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"

rem stdout goes into Scripts log
echo "Running start_prim %*"

rem Set virtual hostname
CALL "%SAFEUSERBIN%\vhostenv.cmd"

rem Next commands use the virtual hostname
FOR /F %%x IN ('hostname') DO SET servername=%%x
echo "hostname is "%servername%

rem WARNING: previous virtual hostname setting is insufficient to change the
hostname for services
rem If one service needs the virtual hostname, you need also to uncomment the rem
following

rem "%SAFE%\private\bin\vhostservice" SERVICE_TO_BE_DEFINED

set res=0

rem Fill with your services start call

set res=%errorlevel%

if %res% == 0 goto end

:stop
"%SAFE%\safekit" printe "start_prim failed"
rem uncomment to stop SafeKit when critical
rem "%SAFE%\safekit" stop -i "start_prim"

:end
```

`bin/stop_prim.cmd` - see 14 page 265

```
@echo off
rem Script called on the primary server for stopping application services
rem For logging into SafeKit log use:
rem "%SAFE%\safekit" printi | printe "message"
rem ----------------------------------------------------------
rem
rem 2 stop modes:
rem
rem - graceful stop
rem   call standard application stop with net stop
rem
rem - force stop (%1=force)
rem   kill application's processes
rem
rem ----------------------------------------------------------
rem stdout goes into Scripts log
echo "Running stop_prim %*"

set res=0

rem Reset virtual hostname
CALL "%SAFEUSERBIN%\vhostenv.cmd"

rem Next commands use the real hostname
FOR /F %%x IN ('hostname') DO SET servername=%%x
echo "hostname is "%servername%

rem default: no action on forcestop
if "%1" == "force" goto end

rem Fill with your services stop call
rem If necessary, uncomment to wait for the stop of the services
rem "%SAFEBIN%\sleep" 10

if %res% == 0 goto end

"%SAFE%\safekit" printi "stop_prim failed"

:end
rem WARNING: if the virtual hostname was set for services in start_prim.cmd,
rem uncomment the following to restore the real hostname in last stop phase :

rem "%SAFE%\private\bin\vhostservice" SERVICE_TO_BE_DEFINED
```

15.7 Software error detection example with `softerrd.safe`

The `softerrd.safe` module is a demonstration of the software error detection for mirror architecture (for configuration details , see 13.9 page 243).

The module monitors the presence of:

- `mybin` and `myappli` started/stopped on the primary node with `start_prim`/`stop_prim`
- `myotherbin` started/stopped on the secondary node with `start_second`/`stop_second`

Detecting the shutdown of:

- `mybin` causes the module to `restart`
- `myappli` causes the execution of a special handler `restart_myappli.cmd`. This script increments the `maxloop` counter and restarts the `myappli` process
- `myotherbin` causes a stop of the module

The tests consist in killing the `mybin`, `myotherbin` or `myappli` processes with the `safekit kill` command.

Below is an extract of `softerrd.safe` for Windows. For Linux, look at the one delivered with the Linux package.

`conf/userconfig.xml` - see 13 page 207

```
…
```

```
      <errd>
         <proc name="mybin.exe" atleast="1" action="restart" class="prim"/>
         <proc name="myotherbin.exe" atleast="1" action="stop" class="second"/>
         <proc name="myappli.exe" atleast="1" action="restart_myappli"
class="myappli"/>
      </errd>
…
```

`bin/start_prim.cmd` - see 14 page 265

Note the call to `%SAFE%\safekit errd enable myappli` for starting the monitoring of the processes with `class="myappli"`

```
@echo off

%SAFE%\safekit printi "start mybin"
start %SAFEUSERBIN%\mybin.exe 10000000

%SAFE%\safekit printi "start myappli"
start %SAFEUSERBIN%\myappli.exe 10000000
%SAFE%\safekit errd enable myappli

:end
```

`bin/stop_prim.cmd` - see 14 page 265

Note the call to `%SAFE%\safekit errd disable myappli` for stopping the monitoring of the processes with `class="myappli"`

```
@echo on

rem default: no action on forcestop
if "%1" == "force" goto end

%SAFE%\safekit printi "stop mybin"
%SAFE%\safekit kill -level="terminate" -name="mybin.exe"

%SAFE%\safekit printi "stop myappli"
%SAFE%\safekit errd disable myappli
%SAFE%\safekit kill -level="terminate" -name="restart_myappli.cmd"
%SAFE%\safekit kill -level="terminate" -name="myappli.exe"

:end
```

`bin/restart_myappli.cmd`

Note the increment of the loop counter and the stop of the module when `maxloop` is reached

```
@echo off

rem Template for script called by errd on error detection instead of standard
restart
%SAFE%\safekit printi "restart_myappli"

rem first disable monitoring of the application
%SAFE%\safekit errd disable myappli
```

```
rem increment loop counter
%SAFE%\safekit incloop -i "restart_myappli"
if  %errorlevel% == 0 goto next
rem max loop reached
%SAFE%\safekit stop -i "restart_myappli"
%SAFEBIN%\exitcode 0

:next
rem max loop not reached : go on restarting the application
%SAFE%\safekit printi "Restart myappli"
%SAFE%\safekit kill -level="terminate" -name="myappli.exe"
start %SAFEUSERBIN%\myappli.exe 10000000

rem finally, enable monitoring of the application
%SAFE%\safekit errd enable myappli
```

15.8 TCP checker example

Below is an example of tcp checker definition that tests the Apache web service (for configuration details, see 13.11 page 251).

The default action when the tcp service is down is to restart locally the module (see 13.18.5 page 263 for the default failover rules description).

`conf/userconfig.xml` - see 13 page 207

```
  …
  <check>
    <tcp
         ident="Apache_80"
         when="both"
    >
         <to
         addr="172.21.10.5"
         port="80"
         interval="120"
         timeout="5"
         />
    </tcp>
   </check>
…
```

15.9 Ping checker example

The next example is the configuration of a ping checker that tests a router at 192.168.1.1 IP address (for configuration details, see 13.12 page 252). The default action when the router is down is to stop locally the module and to wait for the ping to be up (see 13.18.5 page 263 for the default failover rules description).

`conf/userconfig.xml` - see 13 page 207

```
…
<check >
  <ping ident="router">
  <to addr="192.168.1.1"/>
  </ping>
```

```
</check>
…
```

15.10 Interface checker example

Below is the example of an interface checker configuration automatically generated when `<interface check="on">` is set (for configuration details, see 13.5 page 215). In the `userconfig.xml`, the virtual IP address is defined as follows:

conf/userconfig.xml - see 13 page 207

```
<vip>
 <interface_list>
  <interface check="on">
   <real_interface>
    <virtual_addr addr="192.168.1.32" where="one_side_alias"/>
   </real_interface>
  </interface>
 </interface_list>
</vip>
```

The default action when the interface checker is down is to stop locally the module and to wait for the interface to be up (see 13.18.5 page 263 for the default failover rules).

To generate the configuration of the interface checker, SafeKit computes the hardware network interface, network and first IP address corresponding to the virtual IP address.

⇨ configuration generated in Windows

```
<check>
 <intf when="pre" ident="192.168.1.0"
       intf="{8358A0EE-2F3F-4FEE-A33B-EDC406C0C858}">
  <to local_addr="192.168.1.228"/>
 </intf>
</check>
```

Where `{8358A0EE-2F3F-4FEE-A33B-EDC406C0C858}` is the identity of the network interface for the network 192.168.1.0 and with the IP address 192.168.1.228 as first IP address (`safekit –r vip_if_ctrl –L`).

⇨ configuration generated in Linux

For instance, a configuration generated on Linux is:

```
<check>
 <intf when="pre" ident="192.168.1.0" intf="eth2">
  <to local_addr="192.168.1.20"/>
 </intf>
</check>
```

where eth2 is the identity of the network interface for the network 192.168.1.0 with the IP address 192.168.1.20 as first IP address (all this information is get from the `ifconfig –a ipconfig` or `ip addr show` command).

For configuration details, see 13.13 page 254.

15.11 IP checker example

Below is the example of an ip checker configuration automatically generated when `<virtual_addr check="on" …>` is set (for configuration details, see 13.5 page 215). In the `userconfig.xml`, the virtual IP address is defined as follows:

`conf/userconfig.xml` - see 13 page 207

```
…
<vip>
 <interface_list>
  <interface check="on" arpreroute="on">
   <real_interface>
    <virtual_addr addr="192.168.1.99" where="one_side_alias" check="on"/>
   </real_interface>
  </interface>
 </interface_list>
</vip>
…
```

The default action when the ip checker is down is to stopstart locally the module (see 13.18.5 page 263 for the default failover rules).

➾ configuration generated in Windows and Linux

The ip checker configuration generated is (for more information, see 13.14 page 255):

```
<check>
 <ip ident="192.168.1.99" when="prim">
  <to addr="192.168.1.99"/>
 </ip>
</check>
```

15.12 Custom checker example with `customchecker.safe`

The `customchecker.safe` module is a demonstration mirror module with a custom checker (see 13.15 page 256).

➾ This custom checker tests the presence of a file on the primary server (`when="prim"`). The associated resource is called `custom.checkfile` (`ident="checkfile"`). It is set to `up` (file present) or `down` (file missing)

➾ The associated failover rule (configured in `<failover>`), is named `c_checkfile` and causes the module to `restart` if the resource is `down` (see 13.18.5 page 263 for failover rules). Since SafeKit 8, this failover rule is automatically generated according to `action` attribute value.

This example can be used as a basis for writing your own checker.

`conf/userconfig.xml` for SafeKit >= 8 - see 13 page 207

```
…
  <check>
    <custom ident="checkfile" exec="checker.ps1"
            arg="c:\safekit\checkfile" when="prim" action="restart"/>
  </check>
  <user></user>
…
```

`conf/userconfig.xml` for SafeKit < 8 - see 13 page 207

```
…
  <check>
    <custom ident="checkfile" exec="checker.ps1"
            arg="c:\safekit\checkfile" when="prim"/>
  </check>
  <user></user>
  <failover>
      <![CDATA[
         c_checkfile:
         if( custom.checkfile == down ) then restart();
         ]]>
  </failover>
…
```

`bin/checker.ps1`

Note the call to `safekit set -r custom.checkfile -m AM` to set the resource status (`up` or `down`)

```
param([Parameter(Mandatory = $true, ValueFromPipeLine = $true,
position=1)][String]$ModName,
      [Parameter(Mandatory = $true, ValueFromPipeLine = $true,
position=2)][String]$RName,
      [Parameter(Mandatory = $true, ValueFromPipeLine = $true,
position=3)][String]$Arg1Value,
      [Parameter(Mandatory = $false, ValueFromPipeLine = $false,
position=4)][String]$Grace="2",
      [Parameter(Mandatory = $false, ValueFromPipeLine = $false,
position=5)][String] $Period="5"
      )
# return up on success | down on failure
Function test([String]$Arg1Value)
{
         $res="down"
    # Replace the following by your test
    if (Test-Path "$Arg1Value")
         {
         $res="up"
         }
         return $res
}

$customchecker=$MyInvocation.MyCommand.Name
$safekit="$env:SAFE/safekit.exe"
$safebin="$env:SAFEBIN"
$gracecount=0
$prevrstate="unknown"
# wait a little
Start-Sleep $Period

while ($true){
         Start-Sleep $Period
         $rstate = test($Arg1Value)
```

```
        if($rstate -eq "down"){
                $gracecount+=1
        }else{
                $gracecount = 0
                if($prevrstate -ne $rstate){
                        & $safekit set -r "$RName" -v $rstate -i
$customchecker -m $ModName
                        $prevrstate = $rstate
                }
        }
        if($gracecount -ge $Grace){
                if($prevrstate -ne $rstate){
                        & $safekit set -r "$RName" -v $rstate -i
$customchecker -m $ModName
                        $prevrstate = $rstate
                }
                $gracecount = 0
        }
}
```

The executable associated with the checker is automatically called with at least 2 arguments:

- The 1st argument is the module name
- The 2nd is the name of the resource to be assigned

If the `<custom>` configuration contains the `arg` attribute, its value is passed as the next arguments.

The checker script is written with the following precautions:

- The resource is only assigned if its value has changed
- When the resource is down, the checker consolidates this state (`grace` times) before assigning it. This can help to avoid false error detections.

Important

Each time you modify the custom checker script in `SAFE/modules/AM/bin/`, you must apply the new configuration.

15.13 Module checker example with `leader.safe` and `follower.safe`

This example describes the two application modules `leader.safe` and `follower.safe` delivered with SafeKit:

- The leader module defines shared SafeKit resources between followers like virtual IP addresses and replicated directories
- The follower modules contain individual start and stop of several applications that are then isolated in different modules. Each follower module can be started and stopped independently without stopping the other modules.

The leader module is configured for a mirror architecture. It also includes the start and stop of the follower modules.

Each follower module is configured for a light architecture with module scripts and error detectors. The follower modules depend on the leader failover with the following module checker:

`follower/conf/userconfig.xml` - see 13 page 207

```
<check>
  <module name="leader"/>
</check>
```

This is a shortcut for:

```
<module name="leader">
 <to addr="127.0.0.1" port="9010"/>
</module>
```

Important If you change the listening port for the SafeKit web service (as described in 10.6 page 164), replace the short configuration with the full one and change the port value.

15.14 Mail notification example with `notification.safe`

The `notification.safe` module is a mirror demonstration module for sending notification on main module state changes. The following example is for sending an e-mail but you can replace it by any other notification mechanism. In Windows, it uses the `Send-MailMessage` from the Microsoft Powershell Utility. In Linux, it uses the `mail` command.

Important Each time you modify a script in `SAFE/modules/AM/bin/`, you must apply the new configuration.

15.14.1 Notification on the start and the stop of the module

The following lines, inserted into at the end of the `prestart` script of a module (named `AM`), send an e-mail with the name of the module and server on which the module is started:

➩ In Windows: **`c:\safekit\modules\AM\bin\prestart.ps1`**

```
$sub    = (Get-Item env:SAFEUSERBIN).Value
$safebin    = (Get-Item env:SAFEBIN).Value
$module    = (Get-Item env:SAFEMODULE).Value
$action = $args[2]
$retval = 0
$hostname=(Get-Item env:computername).Value

if ( $action -eq "start" ) {
  echo "*** Start of module $module on $hostname"
  # insert here your notification: the module is starting
  # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -Subject 'Start of
module $module on $hostname' -Body 'Running prestart'
}
```

⇨ In Linux: **/opt/safekit/modules/AM/bin/prestart**
```
if [ "$3" = "start" ]; then
  echo "*** Start of module $SAFEMODULE on " `hostname`
  # insert here your notification: the module is starting
  #echo "Running prestart" | mail -s " Start of module $SAFEMODULE on
`hostname`" admin@mydomain.com
fi
```

When the module is stopping, it can be notified using the `poststop` script. This one is not delivered by default and can be created as follow (for the module named `AM`):

⇨ In Windows: **c:\safekit\modules\AM\bin\poststop.ps1**
```
# Script called on module stop
# after resetting SafeKit resources
echo "Running poststop $args"

try{
    $module    = (Get-Item env:SAFEMODULE).Value
    $hostname=(Get-Item env:computername).Value
    $action = $args[2]
    $retval = 0
    if ( $action -eq "stop" ) {
         echo "*** Stop of module $module on $hostname"
        # insert here your notification: the module is stopping
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -Subject
'Stop of module $module on $hostname' -Body 'Running poststop'
    }

}catch{
    $retval=-1
}finally{
    echo "poststop exit ($retval)"
    exit $retval
}
```

⇨ In Linux: **/opt/safekit/modules/AM/bin/poststop**
```
#!/bin/sh
# Script called on module stop
# after resetting SafeKit resources

# For logging into SaKit log use:
# $SAFE/safekit printi | printe "message"

echo "Running poststop $*"

if [ "$3" = "stop" ]; then
  echo "*** Stop of module $SAFEMODULE on " `hostname`
  # insert here your notification: the module is stopping
  #echo "Running poststop" | mail -s " Stop of module $SAFEMODULE on `hostname`"
admin@mydomain.com
fi
```

15.14.2 Notification on module state changes

The module script `transition` can be used to send an e-mail on main local state transitions of the module. For instance, it may be useful to know when the mirror module is going `ALONE` (on failover for instance). The script `transition` is not delivered by default and can be created as follow.

For a farm module, change the state values.

➾ In Windows: **`c:\safekit\modules\AM\bin\transition.ps1`**

```
# Script called on module state change
echo "Running transition $args"

try{
    $module    = (Get-Item env:SAFEMODULE).Value
    $hostname=(Get-Item env:computername).Value
    $from = $args[0]
    $to = $args[1]
    $retval = 0

        if ( $from -eq "WAIT" -and $to -eq "ALONE" ) {
        echo "*** Start ALONE of $module on $hostname"
        # insert here your notification: the module is starting as ALONE
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Start ALONE of module $module on $hostname' -Body 'Running
prestart'
    }
        if ( $from -eq "WAIT" -and $to -eq "PRIM" ) {
        echo "*** Start PRIM of $module on $hostname"
        # insert here your notification: the module is starting as PRIM
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Start PRIM of module $module on $hostname' -Body 'Running
prestart'
    }
        if ( $from -eq "WAIT" -and $to -eq "SECOND" ) {
        echo "*** Start SECOND of $module on $hostname"
        # insert here your notification: the module is starting as SECOND
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Start SECOND of module $module on $hostname' -Body 'Running
prestart'
    }
        if ( $from -ne "WAIT" -and $to -eq "ALONE" ) {
        echo "*** Go ALONE of module $module on $hostname"
        # insert here your notification: the module is going ALONE
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Go ALONE of module $module on $hostname' -Body 'Running prestart'
    }
        if ( $from -ne "WAIT"  -and $to -eq "PRIM" ) {
        echo "*** Go PRIM of module $module on $hostname"
        # insert here your notification: the module is going PRIM
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Go PRIM of module $module on $hostname' -Body 'Running prestart'
    }
        if ( $from -ne "WAIT"  -and $to -eq "SECOND" ) {
        echo "*** Go SECOND of module $module on $hostname"
        # insert here your notification: the module is going SECOND
        # Send-MailMessage -From 'SafeKit' -To 'admin@mydomain.com' -
Subject 'Go SECOND of module $module on $hostname' -Body 'Running prestart'
    }
}catch{
    $retval=-1
}finally{
    echo "transition exit ($retval)"
    exit $retval
}
```

⇨ In Linux: **`/opt/safekit/modules/AM/bin/transition`**

```
#!/bin/sh
# Script called on module state change

# For logging into SaKit log use:
# $SAFE/safekit printi | printe "message"

echo "Running transition $*"

hostname=`hostname`

if [ "$1" = "WAIT" -a "$2" = "ALONE" ] ; then
  echo "*** Start ALONE of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is starting as ALONE
  #echo "Running poststop" | mail -s " Start ALONE of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi
if [ "$1" = "WAIT" -a "$2" = "PRIM" ] ; then
  echo "*** Start PRIM of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is starting as PRIM
  #echo "Running poststop" | mail -s " Start PRIM of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi
if [ "$1" = "WAIT" -a "$2" = "SECOND" ] ; then
  echo "*** Start SECOND of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is starting as SECOND
  #echo "Running poststop" | mail -s " Start SECOND of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi

if [ "$1" != "WAIT" -a "$2" = "ALONE" ] ; then
  echo "*** Go ALONE of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is going ALONE
  #echo "Running poststop" | mail -s " Go ALONE of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi
if [ "$1" != "WAIT" -a "$2" = "PRIM" ] ; then
  echo "*** Go PRIM of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is going PRIM
  #echo "Running poststop" | mail -s " Go PRIM of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi
if [ "$1" != "WAIT" -a "$2" = "SECOND" ] ; then
  echo "*** Go SECOND of module $SAFEMODULE on $hostname"
  # insert here your notification: the module is going SECOND
  #echo "Running poststop" | mail -s " Go SECOND of module $SAFEMODULE on
$hostname" admin@mydomain.com
fi
```

16.SafeKit cluster in the cloud

You can install, configure, and administer SafeKit modules that run on virtual servers in the cloud instead of on-premises physical servers. This requires a minimum of cloud and/or server settings, especially to implement the virtual IP address.

16.1 SafeKit cluster in Amazon AWS

In the following, we suppose that you are familiar with:

- Amazon Elastic Compute Cloud (Amazon EC2) that offers computing capacity in the Amazon Web Services (AWS) cloud. For more information about the features of Amazon EC2, see the Amazon EC2 product page
- AWS CloudFormation that helps deploying instances and applications on Amazon EC2. It permits to save a lot of time and effort so that you can spend less time managing EC2 resources and more time focusing on your applications that run in AWS.

Before implementing a SafeKit module, the administrator must :

1. Create instances (2 for a mirror module)
2. Make settings for AWS, instances, and SafeKit.
3. Then, apply specific settings for implementing your SafeKit module.

AWS settings

You must set AWS to:

- associate public addresses to each instance if you want to administer them with the SafeKit web console from the internet
- configure the security groups associated with network(s) to enable the communications of the SafeKit framework and the SafeKit web console. The ports to open are described in 10.3.3.2 page 159
- use a high-bandwidth, low-latency network if real-time replication is used in a mirror module

Instances settings

In each instance, you must also:

- install the SafeKit package
- apply the HTTPS configuration to secure the SafeKit web console (described in 11 page 173)

SafeKit settings

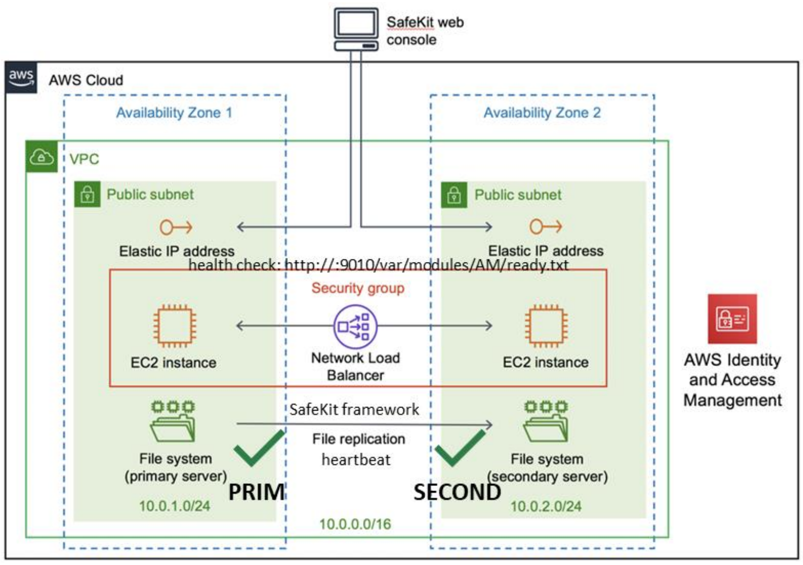
Finally, you must enter the SafeKit cluster configuration and apply it to all nodes (for details on cluster configuration, see 12 page 201). For example, the SafeKit cluster configuration file would be:

```
<cluster>
<lans>
 <lan name="default">
  <node name="Server1" addr="10.0.11.10"/>
  <node name="Server2" addr="10.0.12.10"/>
 </lan>
</lans>
</cluster>
```

The `default` lan is used for SafeKit framework communications between cluster nodes.

16.1.1 Mirror cluster in AWS

Mirror module features are operational in the AWS cloud (real-time file replication, failover, process death detection, checkers, …), except the virtual IP address failover. Anyway, you can set up a SafeKit mirror module on the cluster and use the Elastic load balancing provided by AWS (see Elastic load balancing products in AWS) in such way that all the traffic is routed only to the primary node. An IP address and/or DNS name is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the AWS load balancer and the security group.

For the load balancer, you must:

- ➾ specify the rules for your application
- ➾ set the SafeKit cluster nodes in the target group
- ➾ configure the `health check`. It tests whether the instance is in a healthy state or an unhealthy state.

The load-balancer routes the traffic only to healthy instances. It resumes routing requests to the instance when this one has been restored to a healthy state.

SafeKit provides a health checker for SafeKit modules. For this, configure it in the load balancer with:

- HTTP protocol
- port 9010, the SafeKit web service port
- URL `/var/modules/AM/ready.txt`, where AM is the module name

In a mirror module, the health checker:

- returns `OK`, that means that the instance is healthy, when the module state is ✓`PRIM (Ready)` or ✓`ALONE (Ready)`
- returns `NOT FOUND`, that means that the instance is out of service, in all other states

The AWS network security group must be at least configured to enable communications for the following protocols and ports:

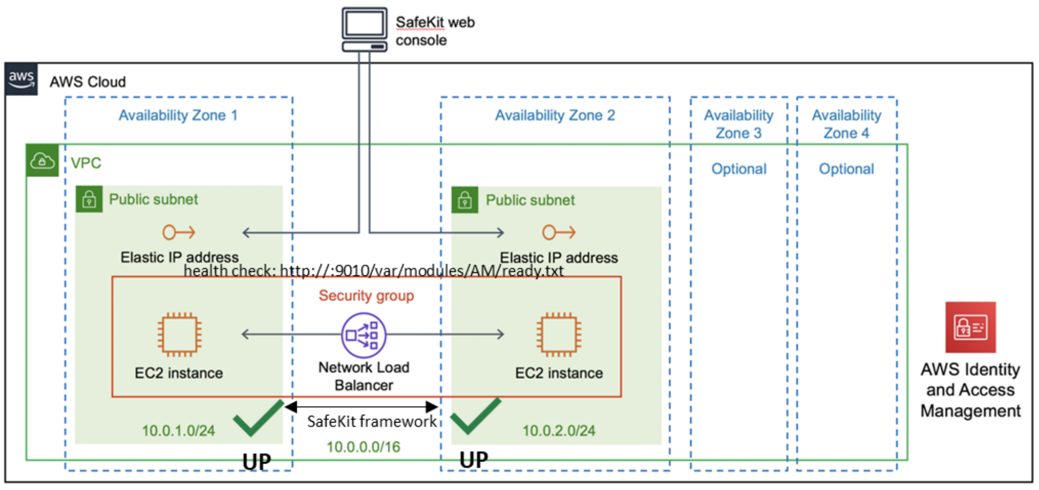
- UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)
- UDP - 8888 for the module heartbeat (between SafeKit cluster nodes)
- TCP – 5600 for the module real time file replication (between SafeKit nodes)
- TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP
- TCP – 9453 for the SafeKit web console in HTTPS
- TCP – 9001 for configuring the SafeKit web console for HTTPS

Important

The module's port value depends on the module id (for details, see 10.3.3.2 page 159).The previous values are the one for the first module installed on the node.

16.1.2 Farm cluster in AWS

Most farm module features are operational in the AWS cloud (process death detection, checkers), except the virtual IP address with load-balancing. Anyway, you can set up a SafeKit farm module on the cluster and use the Elastic load balancing provided by AWS (see Elastic load balancing products in AWS). An IP address and/or DNS name is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the AWS load balancer and the security group.

For the load balancer, you must:

⇨ specify the rules for your application

⇨ set the SafeKit cluster nodes in the target group

⇨ configure the `health check`. These tests whether the instance is in a healthy state or an unhealthy state.

The load-balancer routes the traffic only to healthy instances. It resumes routing requests to the instance when this one has been restored to a healthy state.

SafeKit provides a health check for SafeKit modules. For this, configure it in the load balancer with:

⇨ HTTP protocol

⇨ port 9010, the SafeKit web service port

⇨ URL `/var/modules/AM/ready.txt`, where AM is the module name

In a farm module, the health check:

⇨ returns `OK`, that means that the instance is healthy, when the module state ✓`UP (Ready)`

⇨ returns `NOT FOUND`, that means that the instance is out of service, in all other states

The AWS network security group must be at least configured to enable communications for the following protocols and ports:

⇨ UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)

⇨ TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP

⇨ TCP – 9453 for the SafeKit web console in HTTPS

⇨ TCP – 9001 for configuring the SafeKit web console for HTTPS

16.2 SafeKit cluster in Microsoft Azure

In the following, we suppose that you are familiar with Microsoft Azure that is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through a global network of Microsoft-managed data centers. For more information about the features and use of Azure, see the Microsoft Azure portal.

Before implementing a SafeKit module, the administrator must :

1. Create virtual machines (2 for a mirror module)
2. Make settings for Azure, virtual machines, and SafeKit.
3. Then, apply specific settings for implementing your SafeKit module.

Azure settings

You must set Azure to:

⇨ associate public IP addresses and DNS name to virtual machines if you want to administer them with the SafeKit web console from the internet

⇨ configure the network security group to enable the communications of the SafeKit framework and the SafeKit web console. The ports to open are described in 10.3.3.2 page 159

⇨ use a high-bandwidth, low-latency network if real-time replication is used in a mirror module

Virtual machines settings

On each virtual machine, you must also:

⇨ install the SafeKit package

⇨ apply the HTTPS configuration to secure the SafeKit web console (described in 11 page 173)

SafeKit settings

Finally, you must enter the SafeKit cluster configuration and apply it to all nodes (for details on cluster configuration, see 12 page 201). For example, the SafeKit cluster configuration file would be:

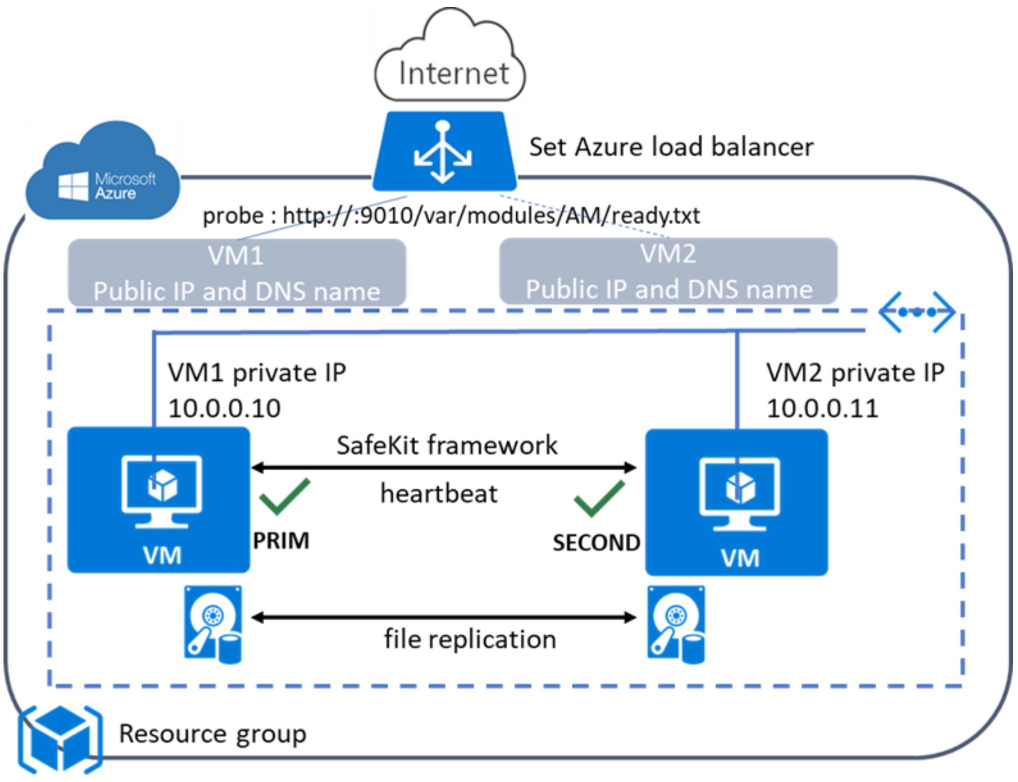
```
<cluster>
<lans>
 <lan name="default">
  <node name="Server1" addr="10.0.0.10"/>
  <node name="Server2" addr="10.0.0.11"/>
 </lan>
</lans>
</cluster>
```

The `default` lan is used for SafeKit framework communications between cluster nodes.

16.2.1 Mirror cluster in Azure

Mirror module features are operational in the Azure cloud (real-time file replication, failover, process death detection, checkers, …) except the virtual IP address failover.

Anyway, you can set up a SafeKit mirror module on the cluster and use the load balancing provided by Azure (see Load Balancer in Azure) and route request only to the primary node. An IP is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the Azure load balancer and the network security group.

For the load balancer, you must:

- specify the rules for your application
- set the SafeKit cluster nodes into the backend pool
- configure the `probe`. It tests whether the instance is in a healthy state or an unhealthy state.

The load balancer routes traffic only to healthy instances. It resumes routing requests to the instance when the instance has been restored to a healthy state.

SafeKit provides a probe for SafeKit modules. For this, configure the probe in the load balancer with:

- HTTP protocol
- port 9010, the SafeKit web service port
- URL `/var/modules/AM/ready.txt`, where AM is the module name

In a mirror module, the probe:

- returns `OK`, that means that the instance is healthy, when the module state is ✓`PRIM (Ready)` or ✓`ALONE (Ready)`
- returns `NOT FOUND`, that means that the instance is out of service, in all other states

The Azure network security group must be at least configured to enable communications for the following protocols and ports:

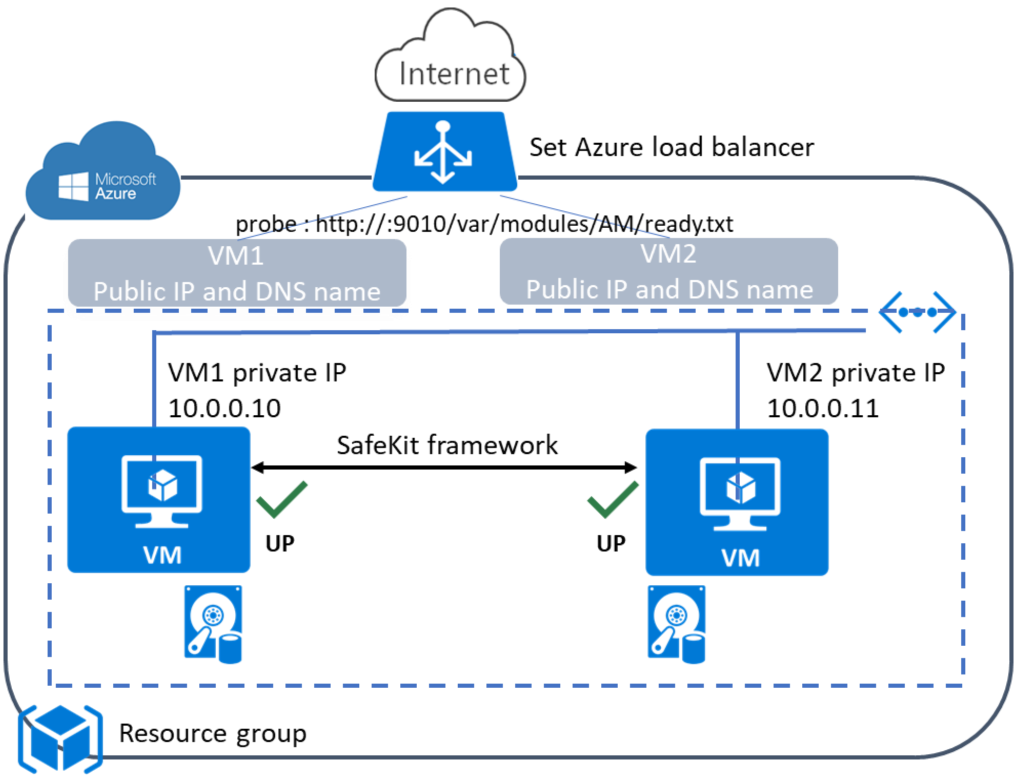
- UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)
- UDP - 8888 for the module heartbeat (between SafeKit cluster nodes)
- TCP – 5600 for the module real time file replication (between SafeKit nodes)
- TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP
- TCP – 9453 for the SafeKit web console in HTTPS
- TCP – 9001 for configuring the SafeKit web console for HTTPS

Important

The module's port value depends on the module id (see 10.3.3.2 page 159).The previous values are the one for the first module installed on the node.

16.2.2 Farm cluster in Azure

Most farm module features are operational in the Azure cloud (process death detection, checkers), except the virtual IP address with load-balancing. Anyway, you can set up a SafeKit farm module on the cluster and use the load balancing provided by Azure (see Load Balancer in Azure). An IP is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the Azure load balancer and the network security group.

For the load balancer, you must:

- ➾ specify the rules for your application
- ➾ set the SafeKit cluster nodes as backend
- ➾ configure the `probe`. It tests whether the instance is in a healthy state or an unhealthy state.

The load balancer routes traffic only to healthy instances. It resumes routing requests to the instance when the instance has been restored to a healthy state.

SafeKit provides a probe for SafeKit modules. For this, configure the probe in the load balancer with:

- ➾ HTTP protocol
- ➾ port 9010, the SafeKit web service port
- ➾ URL `/var/modules/AM/ready.txt`, where AM is the module name

In a farm module, the probe:

- ➾ returns `OK`, that means that the instance is healthy, when the farm module state is ✓`UP (Ready)`
- ➾ returns `NOT FOUND`, that means that the instance is out of service, in all other states

The Azure network security group must be at least configured to enable communications for the following protocols and ports:

- ➾ UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)
- ➾ TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP
- ➾ TCP – 9453 for the SafeKit web console in HTTPS
- ➾ TCP – 9001 for configuring the SafeKit web console for HTTPS

16.3 SafeKit cluster in Google GCP

In the following, we suppose that you are familiar with Google Cloud Platform (GCP) that delivers virtual machines running in Google's innovative data centers and worldwide fiber network. For more information about the features and use of Google Cloud Platform, see the Google Cloud Computing documentation.

Before implementing a SafeKit module, the administrator must :

1. Create virtual machines (2 for a mirror module)
2. Make settings for Google Compute Engine (GCP), virtual machines, and SafeKit.
3. Then, apply specific settings for implementing your SafeKit module.

GCP settings

You must set GCP to:

- associate an external IP address (and optionally DNS name) to each virtual machine instance if you want to administer them with the SafeKit web console from the internet
- configure the firewall rules for the Virtual Private Cloud (VPC) network to enable the communications of the SafeKit framework and the SafeKit web console. The ports to open are described in 10.3.3.2 page 159
- use a high-bandwidth, low-latency network if real-time replication is used in a mirror module

Virtual machines settings

On each virtual machine, you must also:

- install the SafeKit package
- apply the HTTPS configuration to secure the SafeKit web console (described in 11 page 173)

SafeKit settings

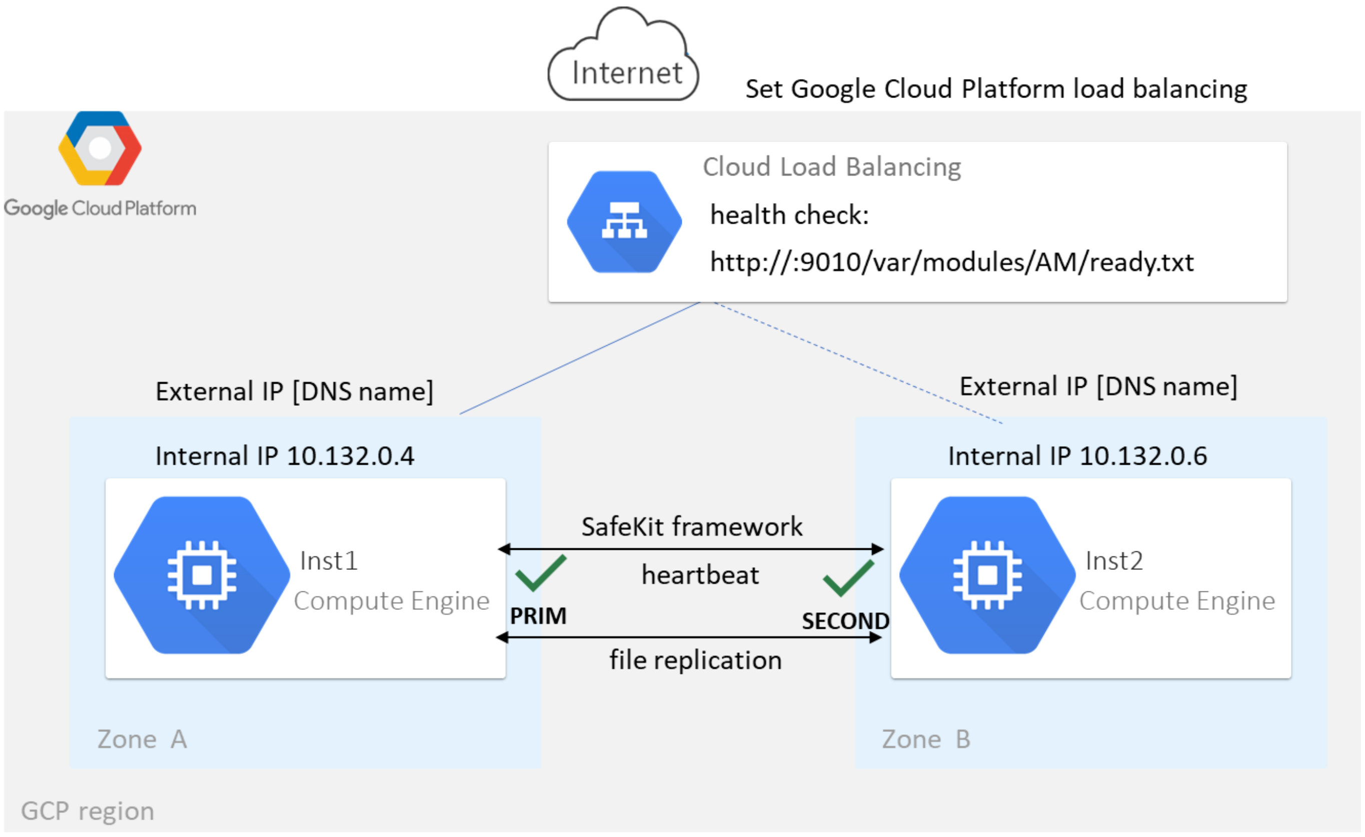
Finally, you must enter the SafeKit cluster configuration and apply it to all nodes (for details on cluster configuration, see 12 page 201. For example, the SafeKit cluster configuration file would be:

```
<cluster>
<lans>
 <lan name="default">
  <node name=" Inst1" addr="10.132.0.4"/>
  <node name=" Inst2" addr="10.32.0.6"/>
 </lan>
</lans>
</cluster>
```

The `default` lan is used for SafeKit framework communications between cluster nodes.

16.3.1 Mirror cluster in GCP

Mirror module features are operational in the Google Cloud Platform (real-time file replication, failover, process death detection, checkers, …) except the virtual IP address failover. Anyway, you can set up a SafeKit mirror module on the cluster and use the load balancing provided by GCP (see Load Balancer in GCP) and route request only to the primary node. An IP is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the Google load balancer and the network firewall.

For the load balancer, you must:

- ➾ specify the rules for your application
- ➾ set the SafeKit cluster nodes as backend
- ➾ configure the `health check`. It tests whether the instance is in a healthy state or an unhealthy state.

The load balancer routes traffic only to healthy instances. It resumes routing requests to the instance when the instance has been restored to a healthy state.

SafeKit provides a health check for SafeKit modules. For this, configure the health check in the load balancer with:

- ➾ HTTP protocol
- ➾ port 9010, the SafeKit web service port
- ➾ URL `/var/modules/AM/ready.txt`, where AM is the module name

In a mirror module, the health check:

- ➾ returns `OK`, that means that the instance is healthy, when the module state ✓`PRIM (Ready)` or ✓`ALONE (Ready)`
- ➾ returns `NOT FOUND`, that means that the instance is unhealthy, in all other states

The network firewall must be at least configured to enable communications for the following protocols and ports:

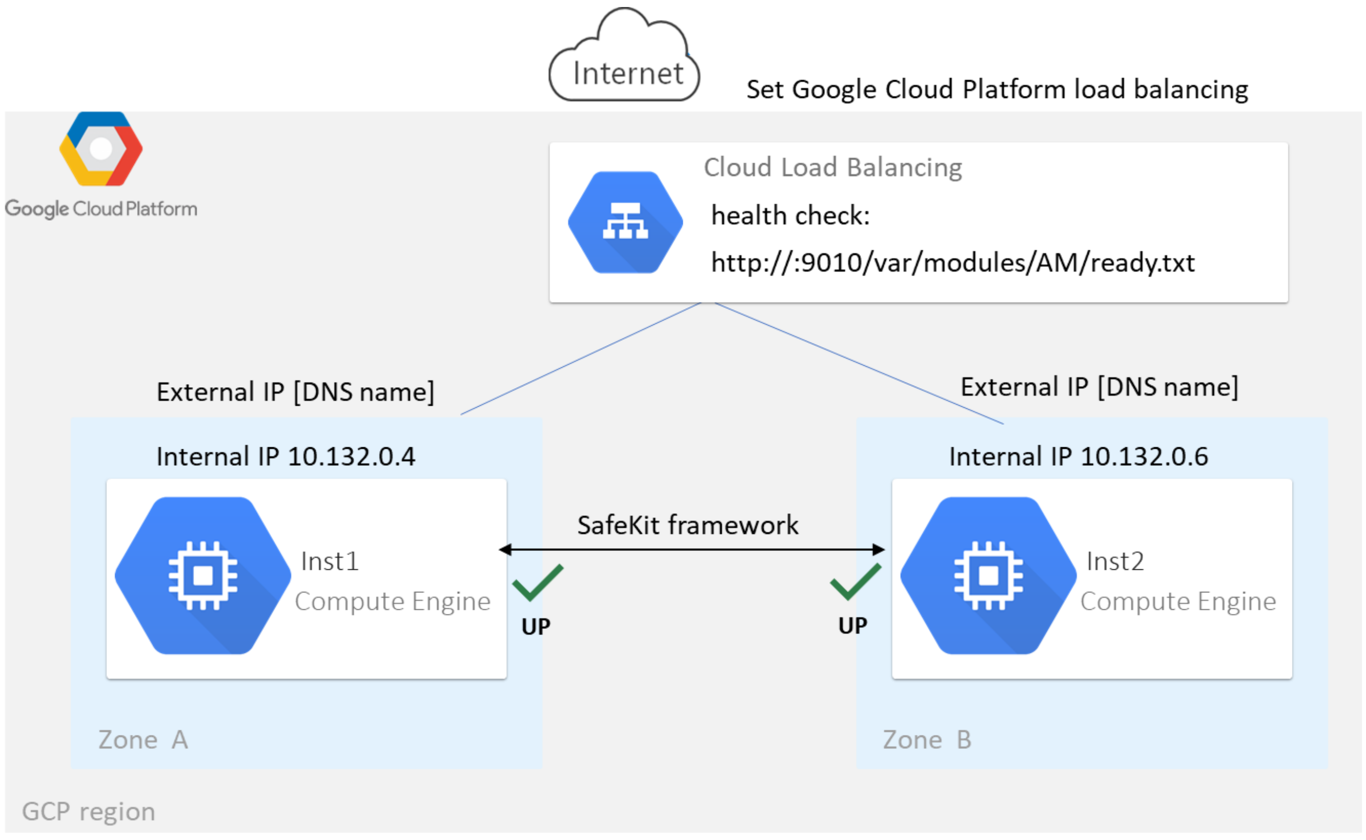
- UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)
- UDP - 8888 for the module heartbeat (between SafeKit cluster nodes)
- TCP – 5600 for the module real time file replication (between SafeKit nodes)
- TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP
- TCP – 9453 for the SafeKit web console in HTTPS
- TCP – 9001 for configuring the SafeKit web console for HTTPS

Important

The module's port value depends on the module id (see 10.3.3.2 page 159).The previous values are the one for the first module installed on the node.

16.3.2 Farm cluster in GCP

Most farm module features are operational in the Google Cloud Platform (process death detection, checkers), except the virtual IP address with load-balancing. Anyway, you can set up a SafeKit farm module on the cluster and use the load balancing provided by GCP (see Load Balancer in GCP). An IP is associated with the load balancer that plays the role of the virtual IP.



You must configure yourself the Google load balancer and the network firewall.

For the load balancer, you must:

- specify the rules for your application

- set the SafeKit cluster nodes as backend
- configure the `health check`. It tests whether the instance is in a healthy state or an unhealthy state.

The load balancer routes traffic only to healthy instances. It resumes routing requests to the instance when the instance has been restored to a healthy state.

SafeKit provides a health check for SafeKit modules. For this, configure the health check in the load balancer with:

- HTTP protocol
- port 9010, the SafeKit web service port
- URL `/var/modules/AM/ready.txt`, where AM is the module name

In a farm module, the health check:

- returns `OK`, that means that the instance is healthy, when the farm module state is ✓`UP (Ready)`
- returns `NOT FOUND`, that means that the instance is out of service, in all other states

The network firewall must be at least configured to enable communications for the following protocols and ports:

- UDP - 4800 for the `safeadmin` service (between SafeKit cluster nodes)
- TCP – 9010 for the load-balancer health check and the SafeKit web console in HTTP
- TCP – 9453 for the SafeKit web console in HTTPS
- TCP – 9001 for configuring the SafeKit web console for HTTPS

17.Third-Party Software

SafeKit comes with the third-party software listed below.

For licenses details, refer to the links or the license files into the `SAFE/licenses` directory (`SAFE=/opt/safekit` in Linux and `SAFE=C:\safekit` in Windows if `%SYSTEMDRIVE%`=C:).

libnet	Packet Construction and Injection Libnet license - license Used for arpreroute and ping
swagger-ui	https://github.com/swagger-api/swagger-ui Apache2 License - https://github.com/swagger-api/swagger-ui/blob/master/LICENSE Swagger UI is a collection of HTML, JavaScript, and CSS assets that dynamically generate beautiful documentation from a Swagger-compliant API Used for to visualize the SafeKit API
Sqlite3	https://www.sqlite.org/about.html Public Domain License - https://www.sqlite.org/copyright.html SQLite is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine Used by SafeKit framework

And on Windows OS only :

libxml	http://xmlsoft.org MIT license - http://www.xmlsoft.org/FAQ.html#License Used by the SafeKit framework
libxslt	http://xmlsoft.org/XSLT/ MIT license - https://gitlab.gnome.org/GNOME/libxslt/blob/master/Copyright Used by the SafeKit framework
Net-SNMP	http://net-snmp.sourceforge.net BSD like and BSD license - http://www.net-snmp.org/about/license.html Used by SafeKit SNMP agent in Windows
HTTP server	https://httpd.apache.org/ Apache license - https://www.apache.org/licenses/LICENSE-2.0 Used by the SafeKit web service for the web console, the distributed commands, and the module checker
APR	https://apr.apache.org/

	Apache license - https://www.apache.org/licenses/LICENSE-2.0 Used by the Apache HTTP server
PCRE	http://www.pcre.org/ BSD license - https://www.pcre.org/licence.txt Used by the Apache HTTP server
libexpat	https://github.com/libexpat/libexpat BSD license - https://github.com/libexpat/libexpat/blob/master/expat/COPYING Used by the Apache HTTP server
mod_auth_openidc	https://github.com/OpenIDC/mod_auth_openidc Apache2 License - https://github.com/OpenIDC/mod_auth_openidc/blob/master/LICENSE.txt mod_auth_openidc is an OpenID Certified™ authentication and authorization module for the Apache 2.x HTTP server that implements the OpenID Connect Relying Party Used by the Apache HTTP server
cURL	http://curl.haxx.se Curl license - https://github.com/curl/curl/blob/master/docs/LICENSE-MIXING.md Used by the distributed commands and the module checker
OpenSSL	http://www.openssl.org dual OpenSSL and SSLeay license - https://www.openssl.org/source/license.html Used when securing the web console, the distributed commands, and the module checker
Lua	http://www.lua.org MIT license - https://www.lua.org/license.html Used by SafeKit framework and the web service
Info-ZIP	http://info-zip.org BSD like license - http://infozip.sourceforge.net/license.html Used to pack/unpack a .safe module

SafeKit uses the following third-party packages for the SafeKit web console:

Angular	https://angular.io MIT License - https://github.com/angular/angular-cli/blob/main/LICENSE Angular is an application-design framework and development platform for creating efficient and sophisticated single-page apps. @angular/animations, @angular/cdk, @angular/common, @angular/core, @angular/forms, @angular/material, @angular/material-moment-adapter, @angular/platform-browser, @angular/router
jszip	https://stuk.github.io/jszip/ MIT OR GPL-3.0-or-later license - https://github.com/Stuk/jszip/blob/main/LICENSE.markdown A library for creating, reading, and editing .zip files with JavaScript, with a lovely and simple API.
material-icons	https://github.com/marella/material-icons Apache-2.0 license - https://github.com/marella/material-icons/blob/main/LICENSE
moment	https://github.com/urish/angular-moment#readme MIT license - https://github.com/urish/angular-moment?tab=MIT-1-ov-file
ngx-logger	https://github.com/dbfannin/ngx-logger#readme MIT license - https://github.com/dbfannin/ngx-logger?tab=MIT-1-ov-file NGX Logger is a simple logging module for angular
rxjs	https://github.com/ReactiveX/rxjs Apache2 License – https://github.com/ReactiveX/rxjs/blob/master/LICENSE.txt Reactive Extensions For JavaScript
tslib	https://www.typescriptlang.org/ 0BSD Copyright (c) Microsoft Corporation Runtime library for typescript
vlq	https://github.com/Rich-Harris/vlq/blob/master/README.md MIT license - https://github.com/Rich-Harris/vlq/blob/master/LICENSE Convert integers to a Base64-encoded VLQ string, and vice versa
zone.js	https://github.com/angular/zone.js MIT license - https://angular.io/license Implements Zones for JavaScript

This list is available in file : safekit/web/htdcos/console//en/3rdpartylicenses.txt .

Log Messages Index

"Action …" messages

File replication and reintegration messages

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