



SmartSpace[®]

Automated Failover Support

From version 3.8

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Ubisense Failover

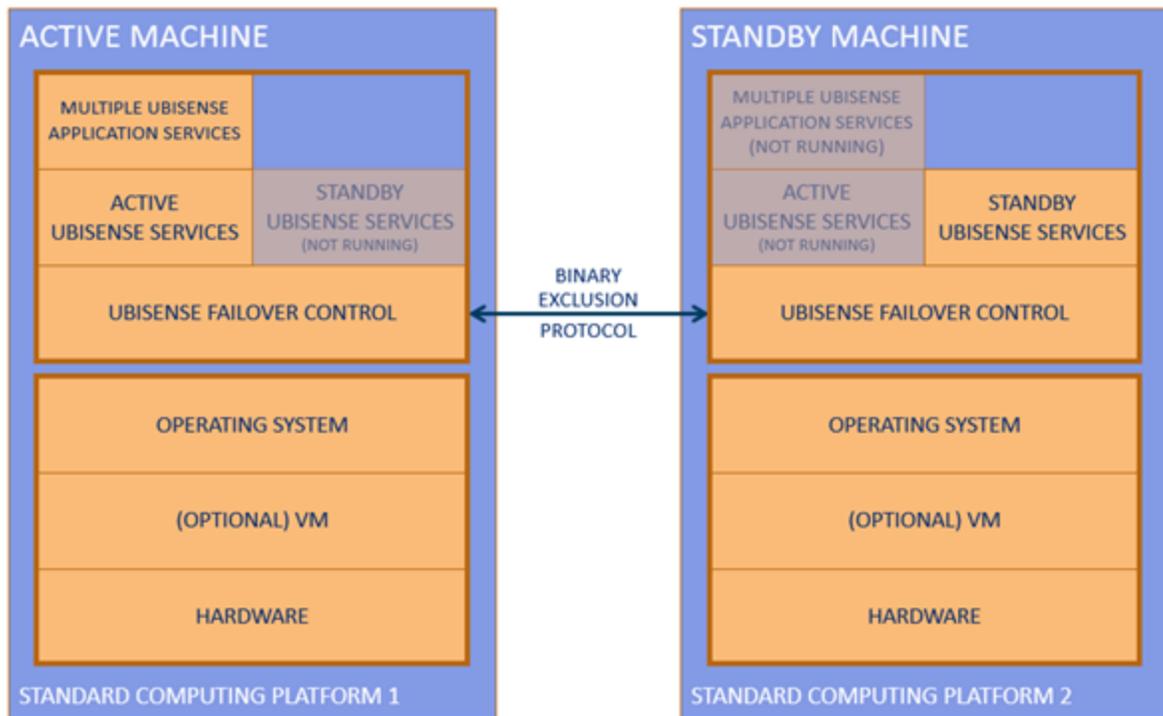
A common Ubisense failover scenario is the 'two machine' setup. In the two machine setup, at any one time one of the machines is the active machine and the other the standby machine. If the active machine stops or fails, the standby machine takes over. But it is important to ensure that both machines do not become active at the same time.

The `ubisense_failover_control` service implements a protocol between two machines to make them work in a two machine setup, controlling Ubisense services on both machines, and minimizing the likelihood of both machines simultaneously becoming active.

The following describes how the `ubisense_failover_control` service works, and describes how to set it up to provide failover for a small system, implement scheduled backups in the live system, and extend the failover support to a large system using 2N separate machines.

The Two Machine Setup

The two machine setup looks like the diagram below. Two similar machines, using standard operating systems, and whatever VM / HW configuration is required, are run in tandem. Each machine runs the `ubisense_failover_control` service. Each instance of the service controls other Ubisense services and talks to the other instance, using a binary exclusion protocol. The binary exclusion protocol ensures that one machine is running the 'active' Ubisense services (e.g. the core server, local controller, and replication sender), and the other machine is running the 'standby' Ubisense services (e.g. the replication receiver). The Ubisense local controller service on the active machine will control multiple Ubisense application services as specified by the Ubisense core server's service administration schema (see *Ubisense Architecture and Protocols* on the Ubisense Documentation Portal for details).



A two machine setup running a Ubisense system. At any one time, one machine is in the active state, and the other machine is in the standby state.

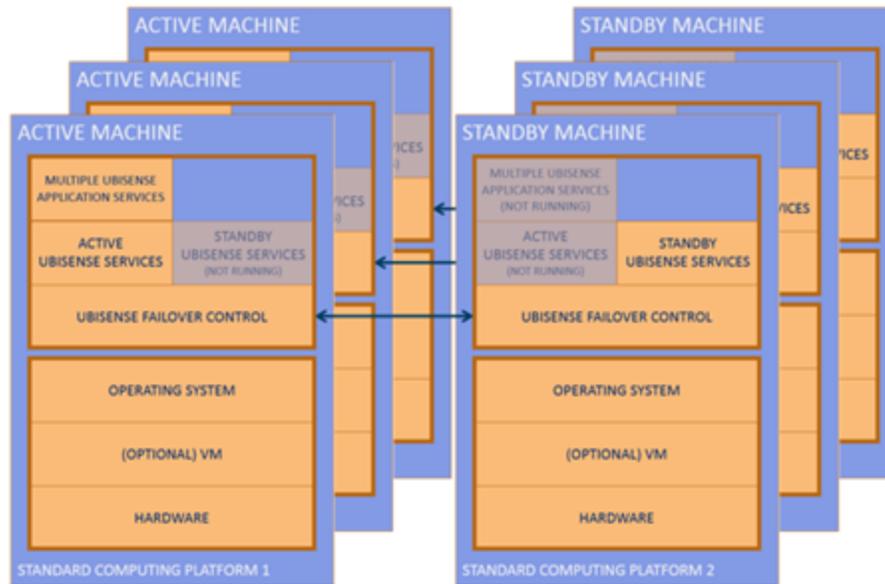
Extending the Setup to 2N Machines

In a two machine setup, the entire set of active Ubisense application services is running on one single machine (the active machine) at any one time.

But we might want to run across multiple machines for increased throughput in a large system, or we might want to run our Ubisense system on more than one operating system, for example Linux for the real-time control elements of the system and Windows for the web visibility elements. In this case we simply repeat the two machine setup multiple times. In this case for every pair of machines the active services will include the local controller service (so that Ubisense application services can be started and stopped), and one pair will also be chosen to host the Ubisense core server.

In this way we can build up a large system, possibly with different operating systems, by creating N instances of the two machine setup.

This approach can be especially convenient combined with a VM platform. In this case, it is easy to set up 2N virtual machines mapped onto a suitable set of underlying hardware resources.



Multiple two-machine setups can be combined to cover a large system. In this case we have three active machines, each of which has a standby machine.

The reliable networking assumption, errors and precautions

Like all binary failover mechanisms, the `ubisense_failover_control` service assumes that there is a reliable interconnect between it and its counterpart on the other machine. In the case of `ubisense_failover_control` this interconnect is just the standard Ethernet networking between the two machines. This means that the networking between the machines is the most critical component in the failover support process; intermittent failure of networking can result in error cases for the failover protocol.

Network isolation

The first case to consider is the temporary failure of networking on the currently active machine, leading to unintended network isolation. To the standby machine, this will look just like a failure of the active machine, so the standby machine will take over. If the networking then recovers on the isolated machine, both machines will incorrectly be active. The protocol will quickly recover from

this error case (both machines will transition to the standby state, and then one of them will become active) but during the brief 'both active' period there may be incorrect system behavior.

Network partitioning

A more serious problem could arise if networking between the active and standby machines fails, but both machines can still talk to client machines, sensor networks and external systems. In this case, each side of the failover protocol will assume that the other side is down, and so both machines will become active. This would be a serious failure: because both machines would still be able to talk to users of the Ubisense services, this could cause incorrect system behavior over a long period.

Precautions

To avoid these failure cases the following precautions are advised: when two machines are configured in a two-machine setup they should have a reliable network between them; when running VMs, when a VM network interface fails it is better to reboot the machine (allowing a standby to take over) than to attempt to recover from the network interface failure.

Implementation: the binary exclusion protocol and state machine

In the binary exclusion protocol, each side has a state consisting of two fields:

- Local status, which can be one of Running, Ready or Stopped. The meaning of the states is:
 - **Running**: this machine is the active Ubisense machine
 - **Ready**: this machine is the standby Ubisense machine
 - **Stopped**: at user request, this machine won't run any Ubisense services
- Remote status, which can be one of Running, Ready, Stopped, Waiting, or Timeout. The meanings of the states are as above, plus:
 - **Waiting**: this side of the protocol has just started, and we are waiting to hear from the remote side
 - **Timeout**: we have failed to hear from the remote side for long enough that we have exceeded some timeout.

Each side of the protocol repeatedly sends UDP packet containing its current Local status to the other side, which uses the received value to update its view of Remote status, using the Waiting and Timeout values to cover cases where it hasn't (recently) received any value.

The basic operation is simple:

- Normally, if the remote machine is Running, the local machine will be Ready, and vice versa.
- If the remote machine is Stopped or Timeout, the local machine will be Running.
- The two machines should never both be Running.
- If both machines are Ready (e.g. at start up time) the machine with the lowest IP address will transition to Running.

In detail, the operation is decided by this procedure, where the LOCAL STATUS and REMOTE STATUS define a row in the table below:

1. Ensure that the correct services are Up or Down according to the values of the ACTIVE SERVICES and STANDBY SERVICES columns below.
2. If the Local IP is less than the Remote IP, set Local status in the way described in LOW IP STATE CHANGE, otherwise set it in the way described in HIGH IP STATE CHANGE.
3. If there is a value specified for HEALTH REPORT then output it (see [Logging](#) for information on the destination of health reports).

When states are:		Applicable operations are:				
LOCAL STATUS	REMOTE STATUS	ACTIVE SERVICES	STANDBY SERVICES	LOW IP STATE CHANGE	HIGH IP STATE CHANGE	HEALTH REPORT
Running	Running	Down	Down	Ready	Ready	ERROR
Running	Stopped	Up	Down	No change	No change	NONE
Running	Ready	Up	Down	No change	No change	NONE
Running	Waiting	Down	Down	No change	No change	NONE
Running	Timeout	Up	Down	No change	No change	WARNING
Stopped	Running	Down	Down	No change	No change	NONE
Stopped	Stopped	Down	Down	No change	No change	WARNING
Stopped	Ready	Down	Down	No change	No change	NONE
Stopped	Waiting	Down	Down	No change	No change	NONE
Stopped	Timeout	Down	Down	No change	No change	WARNING

When states are:		Applicable operations are:				
LOCAL STATUS	REMOTE STATUS	ACTIVE SERVICES	STANDBY SERVICES	LOW IP STATE CHANGE	HIGH IP STATE CHANGE	HEALTH REPORT
Ready	Running	Down	Up	No change	No change	NONE
Ready	Stopped	Down	Down	Running	Running	NONE
Ready	Ready	Down	Down	Running	No change	NONE
Ready	Waiting	Down	Down	No change	No change	NONE
Ready	Timeout	Down	Down	Running	Running	WARNING

Using the `ubisense_failover_control` service

Failover Parameters

The parameters for the service are set locally using one of these mechanisms:

- An entry in the file `platform.conf` located in this folder:
 - Windows: `<installdir>\bin`
 - Linux: `/etc/ubisense`
- On Windows, string value (with the name of the parameter) in the registry key `HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Ubisense 2.1\Platform\Config` `HKLM\Software\Ubisense 2.1\Platform\Config`
- An entry in the file `platform.conf` in the folder where the service executable is executed

The following are the failover service parameters:

Parameter name	Description	Platform	Default value
ufc_local_ip	The IP address of the network interface to use on the local machine	Both	0.0.0.0
ufc_remote_ip	The IP address to send to on the remote machine	Both	0.0.0.0
ufc_port	The port to bind to on the local machine (and to send to on the remote machine)	Both	27001
ufc_timeout	The time in seconds before the remote machine is set to have status Timeout	Both	10
ufc_reboot_on_error	Reboot the local machine if an error is encountered when attempting to control the other Ubisense services on the local machine	Both	0
ufc_core	Start the Ubisense core server on the local machine when in the active state	Both	1
ufc_replication	Start the replication sender on the local machine when in the active state, and the replication receiver on the local machine when in the standby state. If the machines are using some kind of shared storage mechanism in order to ensure that they refer to the same data, then replication is not required and this can be set to 0.	Both	1
ufc_test_mode	Do not actually start or stop any services, but just print out which services would be started or stopped at any time	Both	1
ufc_bin	Location of the other Ubisense service executables on the local machine	Linux only	/home/platform/bin

The following are other parameters relevant to failover operation.

Parameter name	Description
controller_node_name	The name of the computing node to be used by the local controller. This provides the mechanism for the two machines in the two machine setup to identify themselves as the same machine, and always needs to be set when implementing failover.
failover_platform_version	This controls the name of the platform services that failover looks for. This only needs to be set if you are running a different version of platform services to the version of failover you are installing. For example, if you were installing failover alongside a version 2.1 platform, you would set failover_platform_version to 2.1 and failover would look for services named UbisenseCoreServer 2.1 and UbisenseServiceController 2.1 . The default is 3 and this parameter does not need to be set when using a version 3 platform.
replication_directory	The path of the directory where Ubisense persistent services will write their replication files. This only needs to be set when using Ubisense Replication, that is when the parameter ufc_replication above is set to 1 .
replication_receiver_address	The address of the machine to connect to when sending replication data. This only needs to be set when using Ubisense Replication services, that is when the parameter ufc_replication above is set to 1 .

Platforms

The `ubisense_failover_control` service runs on Linux and Windows, and implements the behavior described in the previous section.

Logging

The service logs important state changes and error conditions using the event log features of Windows, or the `syslog` features of Linux.

Status reporting and control files

The service provides a status reporting and control mechanism based on files in addition to the logging provided by Windows or Linux.

In the Ubisense dataset directory, the service creates a status file, which is one of:

- **ufc_running**: this machine is the active machine in the two machine setup
- **ufc_ready**: this machine is the standby machine in the two machine setup
- **ufc_stopped**: at user request, this machine is neither active or on standby, and all Ubisense services (apart from the failover service itself) are stopped.

And in the same directory, the user may request that the service transition state to Stopped by creating the file **ufc_stop**. The user can retract that request by removing the **ufc_stop** file again.

Installing Failover

The following information guides you through the steps required to install UbisenseFailover:

- [Installing Failover on Windows](#)
- [Installing Failover on Linux](#)

For information on hardware and software requirements, and for general information on installing SmartSpace, see SmartSpace Installation on the Ubisense Documentation Portal.

If you are also using UbisenseReplication, see Ubisense Replication on the Ubisense Documentation Portal for further information on its installation and configuration.

Installing Failover version 3 with earlier versions of the Ubisense platform

Failover version 3 can be installed for use with Ubisense platform version 2.1, for example if ACS is required. To enable Failover to control the 2.1 services, you must set **failover_platform_version** to 2.1. See [Failover Parameters](#) and the installation instructions that follow for further information.

Installing Failover on Windows

Follow these instructions to install and deploy Failover on a single pair of Windows machines. For information on installing Failover across several pairs of Windows machines, see [Installing on 2N Machines](#).

On each machine:

1. Install the Ubisense servers.

The server software installer, **UbisenseServers.msi**, is in the **servers\windows** directory of your SmartSpace distribution directory.

For further information on installing SmartSpace software on Windows machines, see SmartSpace Installation on the Ubisense Documentation Portal.

2. Install Replication (if required).

The replication software installer, **UbisenseReplication.msi**, is in the **servers\windows** directory of your SmartSpace distribution directory.

For further information on installing the replication software on Windows machines, see Installing Replication on Windows on the Ubisense Documentation Portal.

In particular note the following if installing Failover with Replication. On the live system, in Platform Control, the dataset setting should be set to the root directory of the Ubisense dataset. This same directory (including drive) will be used as the location of the replicated dataset on the backup system. For example, if the dataset directory on the live system is **d:\ubisense\dataset**, the replicated dataset directory will be **d:\ubisense\dataset** on the backup system. Therefore, it is important to ensure the backup system has the same hardware (drives) as the live system. On the backup system, in Platform Control, set the dataset setting to the same as the dataset setting on the live system. Although this is not necessary for the replication to work, if the backup dataset is correctly set, it will make switching from the live system to the backup system quicker and easier if the live system fails.

3. Install Failover.

The failover software installer, **UbisenseFailoverControl.msi**, is in the **servers\windows** directory of your SmartSpace distribution directory.

4. Ensure that the Ubisense servers and replication are not restarted on reboot.

- a. Run Platform Control.
- b. In Services, ensure that **start services automatically on reboot** is unchecked.
- c. Click **Apply**.

The services will now be controlled by the failover control service. By visiting **Control Panel\All Control Panel Items\Administrative Tools\Services** it should be possible to confirm that the services have startup type Manual.

5. Ensure that the failover service is restarted on reboot.
By visiting **Control Panel\All Control Panel Items\Administrative Tools\Services** set the service `UbisenseFailoverControl` to have startup type Automatic. This will ensure that the failover service is started when the machine starts up. By using the Recovery tab, it is also possible to restart the service if it fails.
6. Configure Failover in the Windows registry.
Referring to the table below and using the examples in [Failover configuration example](#), configure the failover service. Ensure that the two machines have identical configurations apart from IP addresses where the local IP on one machine is the remote IP on the other, and vice versa.

The following are the failover service parameters:

Parameter name	Description	Default value
<code>ufc_local_ip</code>	The IP address of the network interface to use on the local machine	<code>0.0.0.0</code>
<code>ufc_remote_ip</code>	The IP address to send to on the remote machine	<code>0.0.0.0</code>
<code>ufc_port</code>	The port to bind to on the local machine (and to send to on the remote machine)	<code>27001</code>
<code>ufc_timeout</code>	The time in seconds before the remote machine is set to have status Timeout	<code>10</code>

Parameter name	Description	Default value
ufc_reboot_on_error	Reboot the local machine if an error is encountered when attempting to control the other Ubisense services on the local machine	0
ufc_core	Start the Ubisense core server on the local machine when in the active state	1
ufc_replication	Start the replication sender on the local machine when in the active state, and the replication receiver on the local machine when in the standby state. If the machines are using some kind of shared storage mechanism in order to ensure that they refer to the same data, then replication is not required and this can be set to 0.	1
ufc_test_mode	Do not actually start or stop any services, but just print out which services would be started or stopped at any time	1

The following are other parameters relevant to failover operation.

Parameter name	Description
controller_node_name	The name of the computing node to be used by the local controller. This provides the mechanism for the two machines in the two machine setup to identify themselves as the same machine, and always needs to be set when implementing failover.
failover_platform_version	This controls the name of the platform services that failover looks for. This only needs to be set if you are running a different version of platform services to the version of failover you are installing. For example, if you were installing failover alongside a version 2.1 platform, you would set failover_platform_version to 2.1 and failover would look for services named UbisenseCoreServer 2.1 and UbisenseServiceController 2.1 . The default is 3 and this parameter does not need to be set when using a version 3 platform.
replication_directory	The path of the directory where Ubisense persistent services will write their replication files. This only needs to be set when using Ubisense Replication, that is when the parameter ufc_replication above is set to 1.
replication_receiver_address	The address of the machine to connect to when sending replication data. This only needs to be set when using Ubisense Replication services, that is when the parameter ufc_replication above is set to 1.

7. Start Failover and ensure the configuration is working correctly.

After the configuration has been set up appropriately, the failover service can be started.

Installing on 2N Machines

When installing Failover over multiple pairs of machines, each pair of machines should be configured as described above with the following exceptions:

- Only one machine pair should be configured to host the core server, so in step 4 the parameter `ufc_core` should be set to zero in the `platform.conf` files for all the other machine pairs
- Each machine pair needs a new controller name. For example, if there are N pairs, then each pair could have `controller_node_name` set to `linux_server_1`, ... , `linux_server_N`

Restarting the Ubisense Application Updater

When a machine fails over, `UbisenseFailoverControl` does not kill `UbisenseApplicationUpdater`. On the standby machine, `UbisenseApplicationUpdater` then (correctly) generates trace messages because it can no longer contact the Ubisense platform. These messages can eventually fill the log files and can obscure other more useful trace messages.

To prevent this happening, on *both the active and standby machines*, create a batch file to stop and restart `UbisenseApplicationUpdater` and schedule it to run once a day:

1. Create a batch file that does `net stop "UbisenseApplicationUpdater 3" ; net start "UbisenseApplicationUpdater 3"`.
2. Set it to be owned by administrator.
3. Set up a scheduled task to run once per day and execute the batch file.

Installing Failover on Linux

Follow these instructions to install and deploy Failover on a single pair of Linux machines each running the core server and local controller. For information on installing Failover across several pairs of Linux machines, see [Installing on 2N Machines](#).

If installing Failover with Replication note the following (and see Installing Replication on Linux for further information on installing and configuring Replication). On the live system, the dataset setting should be set to the root directory of the Ubisense dataset. This same directory will be used as the location of the replicated dataset on the backup system. On the backup system, set the dataset setting to the same as the dataset setting on the live system. Although this is not necessary for the replication to work, if the backup dataset is correctly set, it will make switching from the live system to the backup system easier if the live system fails.

On each machine:

1. Copy the servers, replication (if required) and failover control to a bin directory.
You can find the executables in the following locations in your SmartSpace distribution directory:

servers	servers/linux/ubisense_core_server servers/linux/ubisense_local_control
replication	servers/linux/ubisense_replication_sender servers/linux/ubisense_replication_receiver
failover	servers/linux/ubisense_failover_control

2. Create a service management script for the failover service only.
Create a suitable script for your particular Linux platform that will provide some start/stop/status support for the failover service. This service runs as a daemon, and so most standard techniques should be applicable. A common script is provided in [Example Linux init.d script for ubisense_failover_control](#).
For Red Hat® Linux, and other Linux platforms using systemd, see [Example Linux systemd scripts for ubisense_failover_control](#) for information on configuring support for the failover service.
3. Ensure that the service management script is run on machine restart.
Using a suitable method for your Linux platform, ensure that the failover service is started

on machine restart. On most platforms, it should also be possible to restart the failover service on failure.

4. Configure Failover using **platform.conf**.

Referring to the table below and using the examples in [Failover configuration example](#), configure the failover service.

Ensure that the two machines have identical configurations apart from IP addresses where the local IP on one machine is the remote IP on the other, and vice versa.

The following are the failover service parameters:

Parameter name	Description	Default value
ufc_local_ip	The IP address of the network interface to use on the local machine	0.0.0.0
ufc_remote_ip	The IP address to send to on the remote machine	0.0.0.0
ufc_port	The port to bind to on the local machine (and to send to on the remote machine)	27001
ufc_timeout	The time in seconds before the remote machine is set to have status Timeout	10
ufc_reboot_on_error	Reboot the local machine if an error is encountered when attempting to control the other Ubisense services on the local machine	0
ufc_core	Start the Ubisense core server on the local machine when in the active state	1
ufc_replication	Start the replication sender on the local machine when in the active state, and the replication receiver on the local machine when in the standby state. If the machines are using some kind of shared storage mechanism in order to ensure that they refer to the same data, then replication is not required and this can be set to 0.	1
ufc_test_mode	Do not actually start or stop any services, but just print out which services would be started or stopped at any time	1
ufc_bin	Location of the other Ubisense service executables on the local machine	/home/platform/bin

The following are other parameters relevant to failover operation.

Parameter name	Description
controller_node_name	The name of the computing node to be used by the local controller. This provides the mechanism for the two machines in the two machine setup to identify themselves as the same machine, and always needs to be set when implementing failover.
replication_directory	The path of the directory where Ubisense persistent services will write their replication files. This only needs to be set when using Ubisense Replication, that is when the parameter ufc_replication above is set to 1 .
replication_receiver_address	The address of the machine to connect to when sending replication data. This only needs to be set when using Ubisense Replication services, that is when the parameter ufc_replication above is set to 1 .

5. Start Failover and ensure the configuration is working correctly.

After the configuration has been set up appropriately, the failover service can be started.

Installing on 2N Machines

When installing Failover over multiple pairs of machines, each pair of machines should be configured as described above with the following exceptions:

- Only one machine pair should be configured to host the core server, so in step 4 the parameter **ufc_core** should be set to zero in the **platform.conf** files for all the other machine pairs
- Each machine pair needs a new controller name. For example, if there are N pairs, then each pair could have **controller_node_name** set to **linux_server_1**, ... , **linux_server_N**

Example Linux init.d script for ubisense_failover_control

This script is a commonly-used init script template, converted for running the Ubisense failover control service. It assumes the existence of a pseudo-user platform, which will run the Ubisense platform. It also needs to be configured for your platform, by setting PLATFORM_USER, UBISENSE_FAILOVER, and UCONFIG appropriately.

Example Linux init.d script for ubisense_failover_control

```
#!/bin/bash
# Init file for Ubisense failover control server
# chkconfig: 345 98 02
# description: Ubisense failover control for linux
# processname: ubisense_failover_control
# config: /etc/ubisense.conf

# source function library

if [ -e /etc/rc.d/init.d/functions ]
then
    . /etc/rc.d/init.d/functions
else
    # steal status() from /etc/rc.d/init.d/functions on a RH box
    status() {
        local base=${1##*/}
        local pid

        # Test syntax.
        if [ "$#" = 0 ] ; then
            echo $"Usage: status {program}"
            return 1
        fi

        # First try "pidof"
        pid=`pidof -o $$ -o $PPID -o %PPID -x $1 || \
            pidof -o $$ -o $PPID -o %PPID -x ${base}`
        if [ -n "$pid" ]; then
            echo $"${base} (pid $pid) is running..."
            return 0
        fi

        # Next try "/var/run/*.pid" files
        if [ -f /var/run/${base}.pid ] ; then
            read pid < /var/run/${base}.pid
            if [ -n "$pid" ]; then
                echo $"${base} dead but pid file exists"
                return 1
            fi
        fi

        # See if /var/lock/subsys/${base} exists
        if [ -f /var/lock/subsys/${base} ]; then
            echo $"${base} dead but subsys locked"
            return 2
        fi
        echo $"${base} is stopped"
        return 3
    }
fi

# pull in sysconfig settings. NB this is configuring sysconfig, not Ubisense
[ -f /etc/ubisense.conf ] && . /etc/ubisense.conf
```

Example Linux init.d script for ubisense_failover_control

```
# local configuration - change to reflect pseudo user and location of executable
PLATFORM_USER=${PLATFORM_USER:-platform}
UBISENSE_FAILOVER=/home/platform/bin/ubisense_failover_control
export UCONFIG=/etc/ubisense/platform.conf

RETVAL=0
prog="ubisense"

start()
{
    echo -n $"Starting UBISENSE_FAILOVER:"
    if [ -e /etc/rc.d/init.d/functions ]
    then
        daemon --check UBISENSE_FAILOVER --user=platform ${UBISENSE_FAILOVER}
    else
        startproc -u platform ${UBISENSE_FAILOVER}
    fi
    touch /var/lock/subsys/UBISENSE_FAILOVER
    echo
}

stop()
{
    echo -n $"Stopping UBISENSE_FAILOVER:"
    if [ -e /etc/rc.d/init.d/functions ]
    then
        killproc UBISENSE_FAILOVER
    else
        killproc ${UBISENSE_FAILOVER}
    fi
    rm -f /var/lock/subsys/UBISENSE_FAILOVER
    echo
}

case "$1" in
    start)
        start
        ;;
    stop)
        stop
        ;;
    restart)
        stop
        start
        ;;
    status)
        status UBISENSE_FAILOVER
        ;;
    *)
        echo $"Usage: $0 {start|stop|restart|status}"

```

Example Linux init.d script for ubisense_failover_control

```
RETVAL=1
esac
exit $RETVAL
```

Example Linux systemd scripts for ubisense_failover_control

The following example illustrates the use of systemd scripts for failover on a Red Hat® Linux machine.



The instructions assume the failover executable (**ubisense_failover_control**) is in **/home/platform/bin/linux**. If this is not the case, the service file (**ubisense_failover.service**) will have to be updated to reflect the location of the executable.

1. Add a target file **ubisense_service.target** in **/etc/systemd/system** containing the following:

```
[Unit]
Description=ubisense_service Target
Requires=multi-user.target
After=multi-user.target
AllowIsolate=yes
```

2. Run the following commands:

```
systemctl list-units --type service
systemctl daemon-reload
systemctl enable ubisense_service.target
systemctl isolate ubisense_service.target
ln -sf /etc/systemd/system/ubisense_service.target
/etc/systemd/system/default.target.wants/
```

3. Reboot the machine.
4. Check the status of the target using the command below to make sure the target is active and running:

```
systemctl list-units --type target
```

5. Add a service file **ubisense_failover.service** in **/etc/systemd/system** containing the following:

```
[Unit]
Description=Daemon for ubisense_failover_service
After=multi-user.target

[Service]
Type=forking
ExecStart=/home/platform/bin/i586_linux/ubisense_failover_control

[Install]
WantedBy=ubisense_service.target
```

6. Run the following commands:

```
systemctl daemon-reload
systemctl enable ubisense_failover.service
```

7. Reboot the machine.

8. To list the status of the services run the following command:

```
systemctl list-units --type service
```

Failover configuration example

In this example two Linux machines run an entire dataset with failover in a two machine setup.

- The IP addresses of the machines are 10.42.1.40 and 10.42.1.106.
- The machines both have the following Ubisense executables installed in their default location (**/home/platform/bin**): `ubisense_failover_control`, `ubisense_core_server`, `ubisense_local_control`, `ubisense_replication_sender`, and `ubisense_replication_receiver`
- The `ubisense_failover_control` service is set up to run via a standard `init.d` script.
- The machines are both configured using the `/etc/ubisense/platform.conf` file, with contents as below:

10.42.1.40 platform.conf file

```
controller_node_name: linux_server
replication_directory: /home/platform/replication
replication_receiver_address: 10.42.1.106
ufc_local_ip: 10.42.1.40
ufc_remote_ip: 10.42.1.106
ufc_test_mode: 0
```

10.42.1.106 platform.conf file

```
controller_node_name: linux_server
replication_directory: /home/platform/replication
replication_receiver_address: 10.42.1.40
ufc_local_ip: 10.42.1.106
ufc_remote_ip: 10.42.1.40
ufc_test_mode: 0
```

What Happens when the Example Runs

When the machines both start up (or both have the failover service started), the following sequence of behavior occurs:

10.42.1.40	10.42.1.106
In state Ready (remote = Waiting)	In state Ready (remote = Waiting)
In state Ready (remote = Ready)	In state Ready (remote = Ready)
Because this machine has the lower IP address Start <code>ubisense_core_server</code> , <code>ubisense_local_control</code> , <code>ubisense_replication_sender</code>	
In state Running (remote = Ready)	In state Ready (remote = Running)
	Start <code>ubisense_replication_receiver</code>
In state Running (remote = Ready)	In state Ready (remote = Running)

This is the stable state with 10.42.1.40 active and 10.42.1.106 in standby, and, because replication is enabled, the entire dataset for 10.42.1.40 is replicated in the dataset directory for 10.42.1.106.

Looking at the dataset directories on each machine, 10.42.1.40 contains the file `ufc_running`, and 10.42.1.106 contains the file `ufc_ready`.

Manually Switching between Active and Standby

Now suppose we touch the file `ufc_stop` in the dataset directory on 10.42.1.40. We get this sequence of events and actions:

10.42.1.40	10.42.1.106
In state Running (remote = Ready)	In state Ready (remote = Running)
In state Ready (remote = Ready)	In state Ready (remote = Ready)
Stop <code>ubisense_core_server</code> , <code>ubisense_local_control</code> , <code>ubisense_replication_sender</code>	
In state Stopped (remote = Ready)	In state Ready (remote = Stopped)
	Stop <code>ubisense_replication_receiver</code> Start <code>ubisense_core_server</code> , <code>ubisense_local_control</code> , <code>ubisense_replication_sender</code>
In state Stopped (remote = Running)	In state Running (remote = Stopped)

The dataset is now running on 10.42.1.106. If we now remove the **ufc_stop** file on 10.42.1.40, the failover service will change state to Ready, and start `ubisense_replication_receiver`, which was the original stable state, but with the machines reversed. So by using the **ufc_stop** file, we can instigate an immediate switchover between the two machines.

Failing over when Active Goes Down

If the Running machine now is powered down, the standby machine will detect that `remote = Timeout`, and take over as the active machine. Suppose 10.42.1.40 is the active machine, and it fails, then we get this sequence of actions:

10.42.1.40	10.42.1.106
In state Running (remote = Ready)	In state Ready (remote = Running)
MACHINE FAILS	
	In state Ready (remote = Running)
	After <code>ufc_timeout</code> seconds
	In state Ready (remote = Timeout)
	Stop <code>ubisense_replication_receiver</code> Start <code>ubisense_core_server</code> , <code>ubisense_local_control</code> , <code>ubisense_replication_sender</code>
In state Stopped (remote = Running)	In state Running (remote = Timeout)

Bringing a Single Machine Down for Maintenance or OS Patching

As part of a standard system administration maintenance process, machines will be periodically upgraded to new OS versions, be assigned new hardware, or otherwise maintained. This normally requires the machine concerned to be taken out of service. In these cases, as long as a single machine in the pair is taken out of service at a time, failover will ensure that the application will continue to run on the other machine.

The most graceful way of achieving this is to use the **ufc_stop** request, as above, to request that the machine communicate its stopped status to its partner. This will avoid a wait of `ufc_timeout` seconds before the standby machine takes over, and prevent the standby machine from logging warnings.

Hot Backup: Taking Scheduled Dataset Backups while the System is Live

Of course, failover of this kind is not a protection against disasters that take out an entire machine room, or user errors that delete important parts of a dataset. To mitigate these problems it is still necessary to take frequent backups.

The easiest guaranteed-correct way to do this is to ensure that the dataset files are not being written during the backup. In a two machine setup that includes replication this is easy to do by briefly stopping the replication receiver on the standby machine, copying the dataset backup, and starting the replication receiver again.

On Linux platforms this can be done using this procedure:

1. Change to the dataset directory.
2. If there is a file **ufc_ready**, indicating that the machine is in standby state, then
 - a. Create the file **ufc_stop**, to request that the machine transition to state **Stopped**
 - b. Wait for the file **ufc_stopped** to appear, indicating that the machine is **Stopped**
 - c. Create the backup by copying the contents of the dataset directory to a file
 - d. Remove the file **ufc_stop**.
3. Finally, copy the backup file to some suitable remote location.

As a Linux shell script, this looks like:

```
cd /home/platform/dataset
if [ -f ufc_ready ] ; then
    echo "stopping standby services"
    touch ufc_stop
    while [ ! -f ufc_stopped ] ; do
        echo "waiting to stop"
        sleep 1
    done
    echo "backing up dataset"
    tar czf ../backup.tgz .
    echo "starting standby services"
    rm ufc_stop
    echo "moving backup to a remote location"
    # Move the file ../backup.tgz to a remote location
fi
```

This script can be installed on both machines and run via a cron job at an appropriate interval. On the active machine the script will do nothing, and on the standby machine, the script will briefly stop failover while creating a backup, and then move the backup to some shared remote storage.