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APPLICATION NOTE

FOXMAN-UN
Main/Standby Solution

Hitachi Energy

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Contents

1 Executive Summary

The FOXMAN-UN Main/Standby Solution offers Network Management Redundancy in case a FOXMAN-UN System fails and thus helps protecting critical network infrastructure. Its simple concept, seamless integration into FOXMAN-UN and a clear number of components that support the operator in managing the solution makes it highly attractive for Hitachi Energy customers.

The concept of the FOXMAN-UN Main/Standby Solution is straightforward. In the beginning two servers are set up with a FOXMAN-UN system to manage the same network infrastructure. Apart from using different IP addresses, the setup of the two FOXMAN-UN systems is identical. One of the servers further on is acting as Main Server, the other one as Standby Server. The Main Server is brought into operational state, meaning FOXMAN-UN clients can connect to it and manage the network. The Standby Server is brought into standby state, meaning it is waiting to be operated in case of Main Server breakdown.

During this normal operational phase FOXMAN-UN database dumps of the Main Server are periodically copied to the Standby Server and imported to its database and IP addresses of Element Agents are properly replaced. The Standby Server on the other hand asks the Main Server at regular intervals for its state. In case the Standby Server cannot reach the Main Server or the Main Server reports to be no longer in operational state, the Standby Server deems the Main Server to be broken down. In this situation the Standby Server will behave differently depending on its type. If it is of type “Cold Standby” it will do nothing. An operator explicitly must bring it up to operational state. If it is of type “Warm Standby” it will automatically go to operational state. Now the Standby Server is ready to manage the network and FOXMAN-UN clients can connect to it.

A limited set of FOXMAN-UN components helps the operator to set up, maintain, and use the solution.

The NEM Remote Admin Tool is a Graphical User Interface which serves configuration, supervision and control of the Main/Standby solution.

The NEM Login Window displays Main/Standby-specific information whether a Server is a Standard, Main or a Standby Server and whether this Server is in “Not running”, “Standby” or “Running” state.

The NEM Host Manager displays Main/Standby-specific information whether a Server is a Standard, a Main, or a Standby Server and whether this Server is in “Not running”, “Standby” or “Running” state. It also shows the corresponding Partner Server of a Main or a Standby Server.

The NEM Desktop displays Main/Standby-specific information in the “Connected to” field whether the client is currently connected to a Standard, Main or Standby Server, or whether it has lost connection to the server.

The NEM Alarm List and Event List display alarms and events which are related to the operation of the Main/Standby solution.

2 Initial Situation

FOXMAN-UN is a Network Management System that typically is installed on one server machine (providing Server and Local Client functionality) and possibly on several client machines (providing Remote Client functionality). In case the FOXMAN-UN server breaks down for some reason, there is no redundant system available that operators can revert to. Of course, this can have fatal consequences: operators might miss critical alarms during this period which – not recognized and fixed – might lead to damage of the managed network infrastructure.

It is for above stated reason that more and more customers are seeking for a corresponding solution to the problem. Hitachi Energy' answer to the issue is called FOXMAN-UN Main/ Standby Solution.

3 Concept

The basic conceptual idea of the FOXMAN-UN Main/Standby Solution is rather simple. In the beginning two servers are set up with a FOXMAN-UN system to manage the same network infrastructure (equipment). Apart from using different IP addresses, the setup of the two FOXMAN-UN systems is identical. One of the servers further on is acting as Main Server, the other one as Standby Server.

The Main Server is brought into operational state, meaning FOXMAN-UN clients can connect to it and manage the network.

The Standby Server is brought into standby state, meaning it is waiting to be operated in case of Main Server breakdown.

During this normal operational phase FOXMAN-UN database dumps of the Main Server are periodically copied to the Standby Server and imported to its database and IP addresses of Element Agents are properly replaced.

The Standby Server on the other hand asks the Main Server at regular intervals for its state. In case the Standby Server cannot reach the Main Server or the Main Server reports to be no longer in operational state, the Standby Server deems the Main Server to be broken down. In this situation the Standby Server will behave differently depending on its type. If it is of type “Cold Standby” it will do nothing. An operator explicitly must bring it up to operational state. If it is of type “Warm Standby” it will automatically go up to operational state.

Now the Standby Server is ready to manage the network and FOXMAN-UN clients can connect to it.

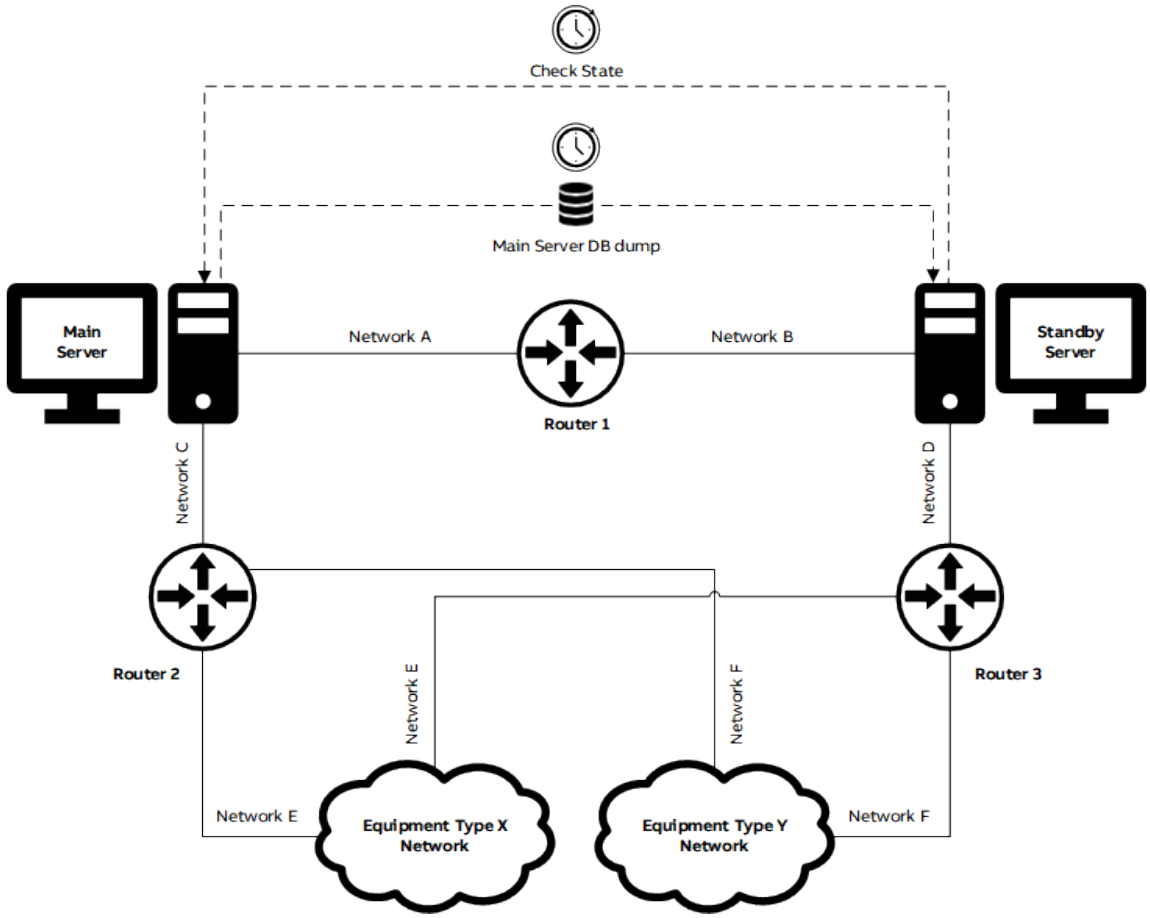

Figure 1: FOXMAN-UN Main/Standby Concept

4 Operation Modes

4.1 Terms and Abbreviations

- Standard Server

  A FOXMAN-UN machine that is not configured to make use of the Main/Standby solution.
- Main Server

  A FOXMAN-UN Machine that is configured to make use of the Main/Standby solution and is configured to act as a Main Server (which runs under normal circumstances).
- Standby Server

  A FOXMAN-UN Machine that is configured to make use of the Main/Standby solution and is configured to act as a Standby Server (which runs under the circumstances that the Main Server is broken.
- Cold Standby Server

  A Standby Server that is ready to be activated by an operator in case of Main Server breakdown.
- Warm Standby Server

  A Standby Server that is automatically activated in case of Main Server breakdown.
- Partner Server

  Main and Standby Server always build a pair of two. Thus, a Standby Server acts as Partner Server of its assigned Main Server and vis versa. A Main Server can have more than one Standby Server as a partner, but a Standby Server can always only have one Main Server as a partner (one to many relationship).
- Local Client

  A FOXMAN-UN Client that comes installed together with a FOXMAN-UN Server. Thus, both Server and Client are running on the same physical machine.
- Remote Client

  A FOXMAN-UN Client that is installed without a FOXMAN-UN Server. Thus, the Client is running remote of the FOXMAN-UN Server.
- NEM Base Services

  A number of FOXMAN-UN services (Linux services) providing a base service infrastructure needed by superordinate FOXMAN-UN services.
- NEM Core Services

  A number of FOXMAN-UN services (Linux services) providing a higher-level application infrastructure. NEM core services can only be executed if NEM base services are already running.

4.2 Server States

The operating system and the services of a FOXMAN-UN server can be in different states. In the FOXMAN-UN context these states will be mapped to so called Server States depending on whether a FOXMAN-UN server is of type Standard, Main or Standby. The possible Server States are listed in the following table:

FOXMAN-UN Services State	State of Standard Server	State of Main Server	State of Standby Server	Remark
Operating System (Linux) not running	No Connection	No Connection	No Connection	

FOXMAN-UN Services State	State of Standard Server	State of Main Server	State of Standby Server	Remark
Operating System (Linux) restarting	No Connection	No Connection	No Connection	In case of a Main or a Standby Server, restarting the OS will result in started up Base Services and not started up Cores Services. In case of a Standard Server, restarting the OS will result in started up Base and Core Services.
Base Services not running	No Connection	No Connection	No Connection	
Base Services restarting	No Connection	No Connection	No Connection	Restarting the base services will also restart the core services (if they are running).
Base Services running and Core Services not running	Not Running	Not Running	Standby	
Core Services stopping	Stopping	Stopping	Stopping	
Core Services starting	Starting	Starting	Starting	
Core Services restarting	Restarting	Restarting	Restarting	
Base and Core Services running	Running	Running	Running	Core Services can only be running if also base services are running.

4.3 Normal operation (Main Server running / Standby Server standby)

The basic concept of the Main/Standby Solution is that the Standby Server takes the role of the running server in case the Main Server breaks down. In normal operation mode the Main Server is in “Running” state and manages a network of equipment. “Running” state signifies that all FOXMAN-UN base services and all FOXMAN-UN core services are running. In normal operation mode the Standby Server is in “Standby” state. “Standby” state signifies that all FOXMAN-UN base services are running but no FOXMAN-UN core services are running. Both Servers periodically do a backup of the following information:

- FOXMAN-UN database,
- DIRAC database (if DIRAC server is installed),
- ALS Database (if ALS is installed).

As a default, the performance monitoring database (influxdb) is not backed up automatically. It can be included in a manual backup by applying the option -x when executing the “edbbackup” command.

The Standby Server is waiting to take over network management in case of a Main Server breakdown. Thereto it periodically polls the Main Server for new database backups and, if available, transfers them to itself. Immediately after the transfer has occurred the backups will be imported to the corresponding databases on the Standby Server. Server-specific information such as e.g. equipment agent IP addresses will be exchanged during import. Now the Standby Server is ready to take over network management in case of a Main Server breakdown.

4.4 Main Server breakdown

The Standby Server deems the Main Server to be broken down in the following cases:

- Main Server core services not running (state: “Not running”)
- Main Server base services not running (state: “No connection”)

- No IP connectivity to the Main Server (state: “No connection”)

To detect those breakdown conditions the Standby Server periodically pings the Main Server. If the ping-reply either equals to state “Not running” or state “No connection” the Standby Server will do the following depending on its type:

- nothing in case it is configured as Cold Standby Server
- start up its core services in case it is configured as Warm Standby Server

If the Main Server breaks down, any FOXMAN-UN client (local or remote client) connected to it will lose its connection. Thus, the operator becomes aware that there is a problem with the Main Server. Now they can connect to the Standby Server to continue managing the network. In case the Standby Server is of type “Cold Standby Server” they afore need to start up the core services on the latter manually.

4.5 Connection loss of Main to Standby Server

A special situation occurs when the Main Server in normal operation (base and core services running) loses connection to the Standby Server for the reason of a broken network cable or a broken network interface card as an example. Then the Main Server will raise a “Standby server is not reachable” alarm and event (if configured). If the Standby Server is of type “Warm Standby Server” it will automatically start up its core services and raise a “Main server is not reachable” alarm and event (if configured). Once the connection problem is fixed and core services on both servers are still running, each server will raise a “Main server and standby server running both at the same time” alarm and event (if configured).

4.6 Exceptional operation (Main Server not running / Standby Server running)

During exceptional operation the Standby Server is in “Running” state (base and core services running) and an arbitrary number of FOXMAN-UN clients might be connected to the server. The Main Server on the other hand is in another state than “Running” state. During this phase typically, the problem on the Main Server can be located and fixed.

4.7 Back to normal operation

Once the problem on the Main Server is fixed it is ready to be brought back into operation again. The suggested, semi-automatic way to do so is to use the “Make This Server Active...” button from the Remote Admin Tool main window, followed by the appropriate selection of the switch-over settings.

If the user prefers to manually bring the Main Server back into operation, it is good practice to first bring the Standby Server back to “Standby” state. This can be achieved by means of stopping its core services. Once back in “Standby” state, again all clients connected to the Standby Server will lose connection. Now, on the Main Server, the operator must import the latest database backups from the Standby Server. A new, server-specific information such as e.g. equipment agent IP addresses will be exchanged during import. Then they will start the base and core services so that Main Server becomes running again and clients can connect back to the Main Server.

Of course, one can also bring back the Main Server to “Running” state without before bringing the Standby Server back to “Standby” state (leaving it in “Running” state). In this case all FOXMAN-UN clients connected to the Main or the Standby Server will observe a “Main server and standby server running both at the same time” alarm in the FOXMAN-UN alarm list. However, having both servers in “Running” state shall be handled with care. This might increase the network load and the CPU load on the individual network elements (processing requests from two FOXMAN-UN at the same time). Far worse, some services created on one FOXMAN-UN will not be reflected to the other one because its configuration data is only stored in the local FOXMAN-UN database.

4.8 Alarms and Events

4.8.1 Alarm and Event Types

The Main/Standby Solution generates alarms and events under certain conditions that are visible in the alarm and event list of any FOXMAN-UN client connected to the Main or the Standby Server. The following table lists all possible alarms and events, their raise conditions and on which server the corresponding alarm or event is visible:

Use Case	Alarm/Event Condition	Alarm/Event	Text	Visible on Server	Remark
Standby Server periodically pings the Main Server.	Main Server not pingable.	Alarm: yes Event: yes	Switchover from Main server (hostname) to Standby server (hostname) due to a connectivity loss. Standby server is now active.	Standby	Will only be created on a Standby Server of type “Warm Standby” after its core services have automatically started up.
Main Server periodically pings the Standby Server.	Standby Server not pingable.	Alarm: yes Event: yes	Standby server (hostname) is not reachable.	Main	Will only be created in case the core services of the Main Server are running.
Both servers are running at the same time.	Core Services on Main and Standby Server are running.	Alarm: yes Event: yes	Main server (hostname) and Standby server (hostname) running both at the same time.	Main and Standby	Will only be created on the Main Server in case the core services of the Main Server are running. Will only be created on the Standby Server in case the core services of the Standby Server are running.
Scheduled Database Backup on Main Server.	Scheduled Database Backup failed.	Alarm: yes Event: yes	Periodic backup to /$/periodicbackup-x.bck has failed.	Main	Will only be created in case the core services of the Main Server are running.
Scheduled Database Backup on Standby Server.	Scheduled Database Backup failed.	Alarm: yes Event: yes	Periodic backup to /$/periodicbackup-x.bck has failed.	Standby	Will only be created in case the core services of the Standby Server are running.
Standby Server copies latest scheduled Database Backup from Main Server.	Copy operation fails.	Alarm: yes Event: no	Transfer of Database Backup from Main server (hostname) to Standby server (hostname) has failed.	Main	Will only be created in case the core services of the Main Server are running.
Standby Server imports latest copied Database Backup from Main Server.	Database import fails.	Alarm: yes Event: no	Import of Database Backup from Main server (hostname) on Standby server (hostname) has failed.	Main	Will only be created in case the core services of the Main Server are running and the core services on the Standby system are not running.
Standby Server imports latest copied Database Backup from Main Server.	Database import fails.	Alarm: yes Event: no	Import of Database Backup from Main server (hostname) on Standby server (hostname) is not possible due to a running Standby system.	Main	Will only be created in case both the core services of the Main Server are running and the core services on the Standby system are running.

Use Case	Alarm/Event Condition	Alarm/Event	Text	Visible on Server	Remark
Compatibility check between Main and Standby Server.	Server versions of Main and Standby Server do not match.	Alarm: yes Event: no	Server versions of Main server (hostname) and Standby server (hostname) are incompatible.	Main	Will only be created in case the core services of the Main Server are running.

4.8.2 Clearance of Alarms

The alarms which are generated by the Main/Standby Solution have been designed in such a way that raised alarms will be cleared under the following circumstances:

- Raised alarms will be cleared automatically by the system upon the point where the raise condition is no longer fulfilled. Exception: the “Switchover from Main server (hostname) to Standby server (hostname) due to a connectivity loss. Standby server is now active” alarm will never be cleared by the system.
- All alarms can explicitly be cleared by the user.

5 Components

The Main/Standby Solution consists of the following basic components:

- Main/Standby Services

  A number of Linux Services which keep Main and Standby Server data synchronized.
- NEM Remote Admin Tool (RAT)

  A Graphical User Interface which servesconfiguration, supervision and control of the Main/Standby solution.

Moreover, it also affects the following established FOXMAN-UN components:

- NEM Login Window

  Displaying additional information whether a Server is a Standard, Main or a Standby Server and whether this Server is in “Not running”, “Standby” or “Running” state.
- NEM Host Manager

  Displaying additional information whether a Server is a Standard, Main or a Standby Server and whether this Server is in “Not running”, “Standby” or “Running” state. It also shows the corresponding Partner Server of a Main or a Standby Sever.
- NEM Desktop

  Displaying additional information in the “connected to field” whether the client is currently connected to a Standard, Main or a Standby Server.
- FOXMAN-UN Alarm and Event List

  Displaying alarms and events which are related to theoperation of the Main/Standby solution.

6 Seamless Integration with FOXMAN-UN

The Main/Standby Solution comes seamlessly integrated with FOXMAN-UN. Below all the components where the FOXMAN-UN user gets in contact with the solution will be briefly explained.

6.1 NEM Remote Admin Tool

A new Graphical User Interface has been developed that allows for administration and configuration of the Main/Standby Solution. The tool can be started either out of the NEM Host Manager or from the NEM Desktop. It allows connection to either FOXMAN-UN server independent of it type (Standard, Main or Standby).

On its Main Window the Remote Admin Tool shows basic information of the connected server such as server name, server IP, server type, server state, database backup state and possible partner server(s).

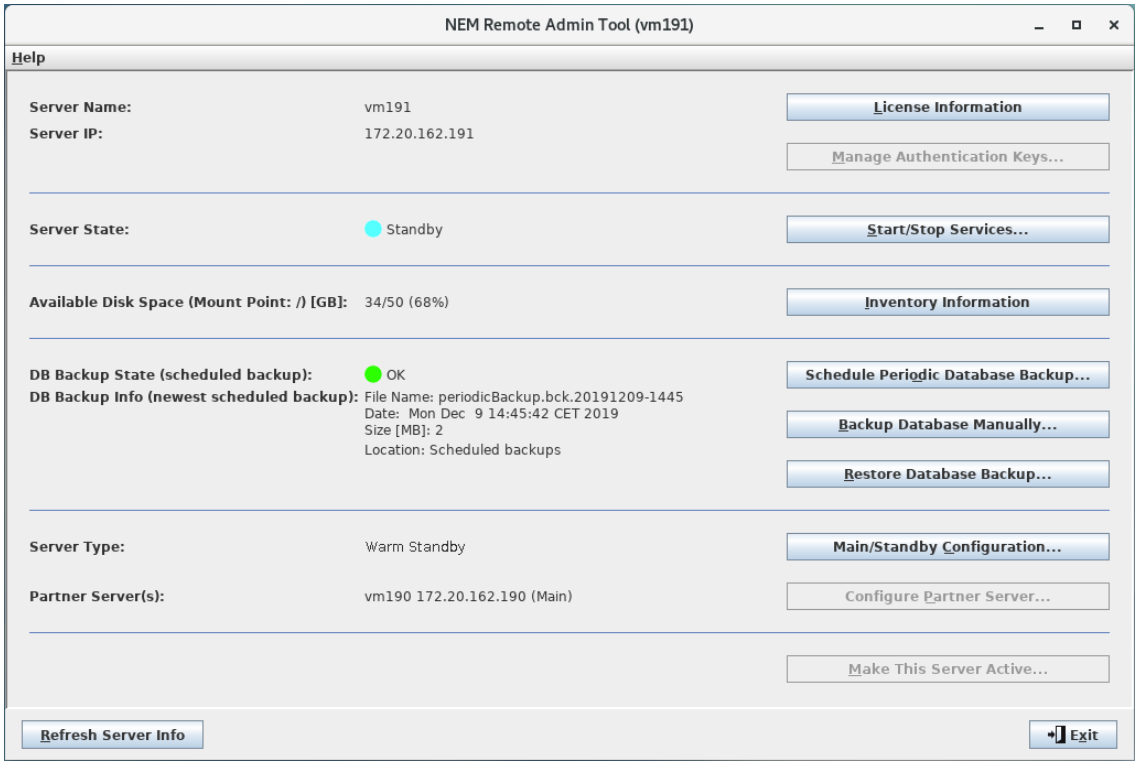

Figure 2: Remote Admin Tool connected to a Standby Server

The tool offers further dialogs to interact with the connected server. They facilitate

- retrieval of detailed licensing information
- management of authentication keys
- starting and stopping of server services
- retrieval of detailed inventory information
- scheduling of periodic FOXMAN-UN database backups
- manual backup of the FOXMAN-UN database
- manual restoration of a FOXMAN-UN database
- configuration of the Main/Standby Solution
- startup of the Remote Admin Tool for another server
- activation of a server (easy switchover)

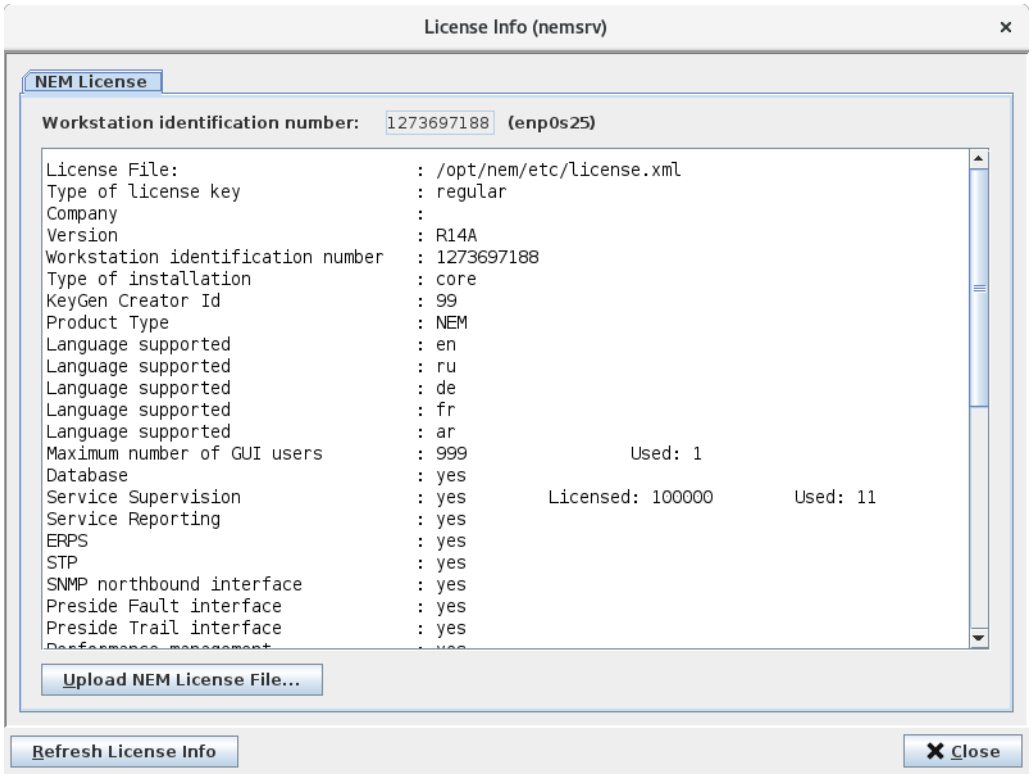

Figure 3: <License Info> dialog

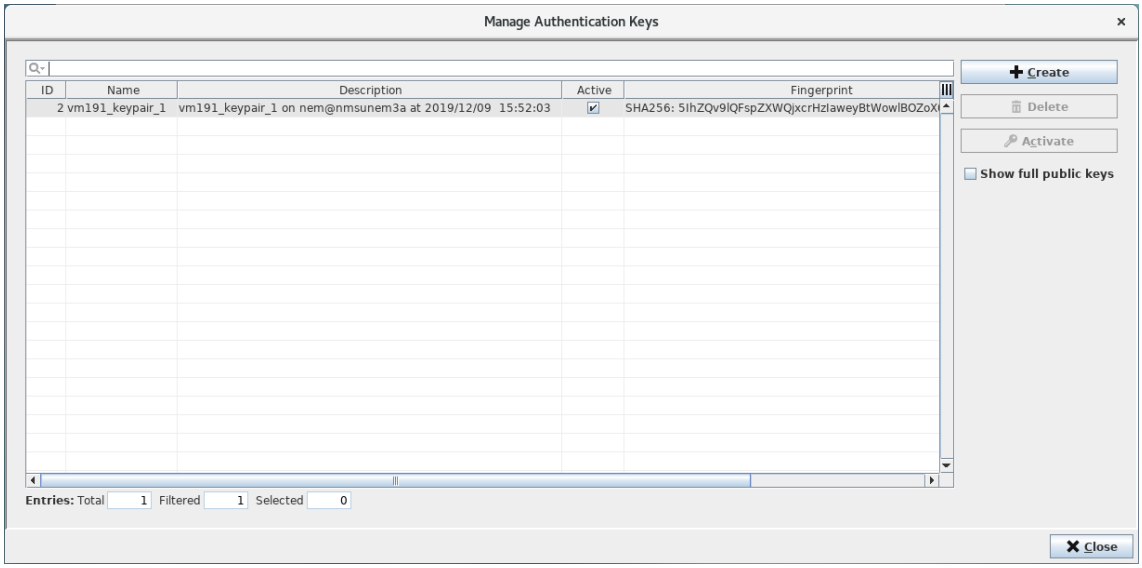

Figure 4: <Manage Authentication Keys> dialog

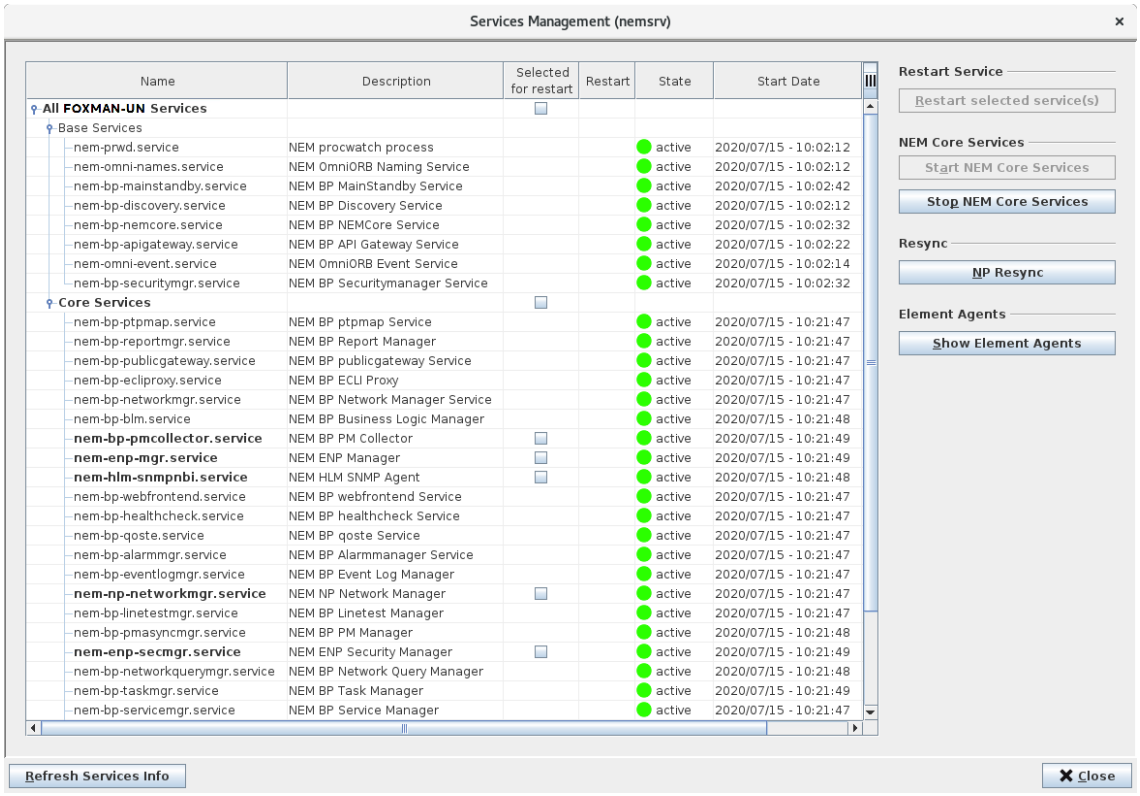

Figure 5: <Services Management> dialog

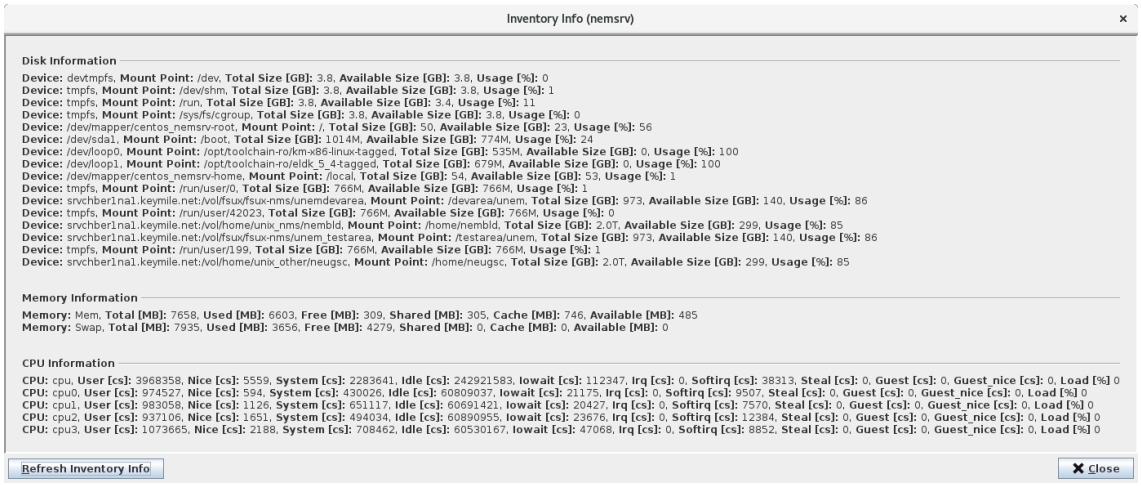

Figure 6: <Inventory Info> dialog

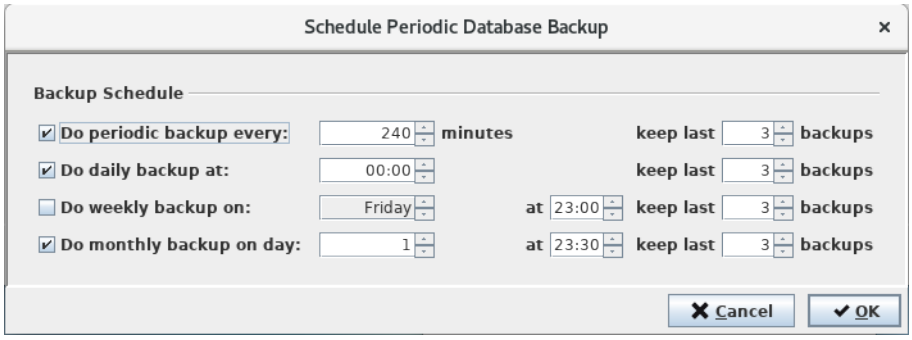

Figure 7: <Schedule Periodic Database Backup> dialog

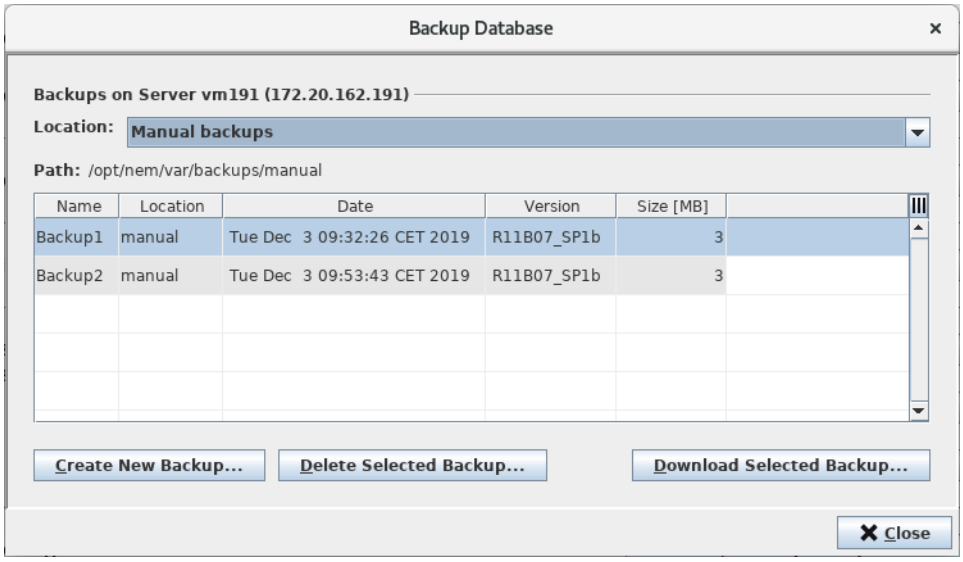

Figure 8: <Backup database> dialog

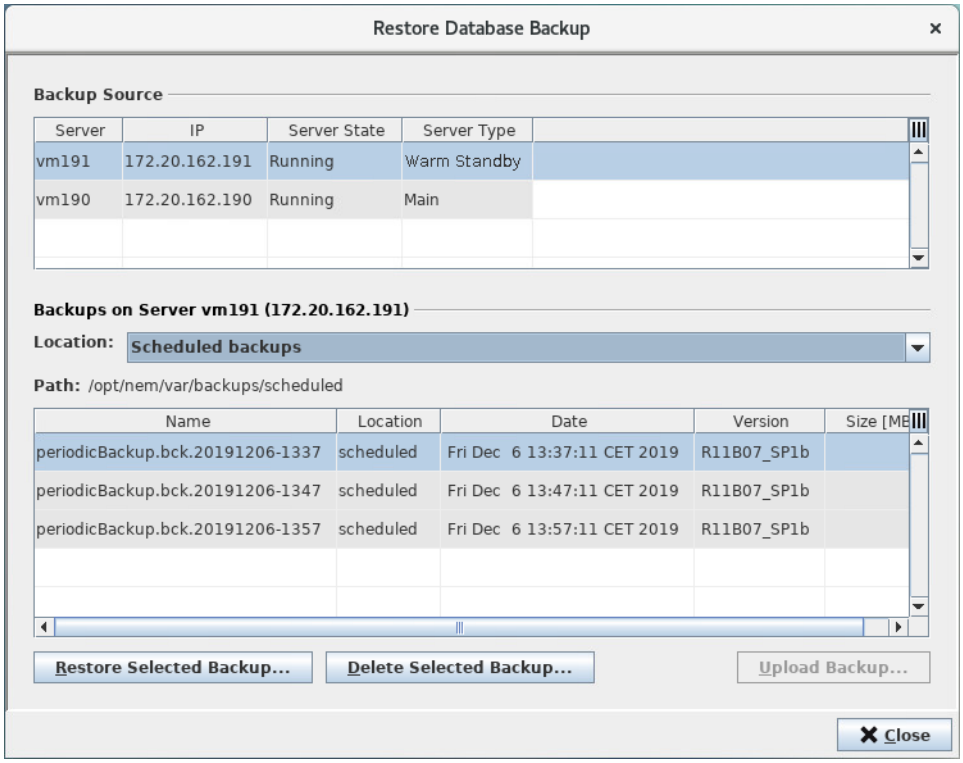

Figure 9: <Restore Database Backup> dialog

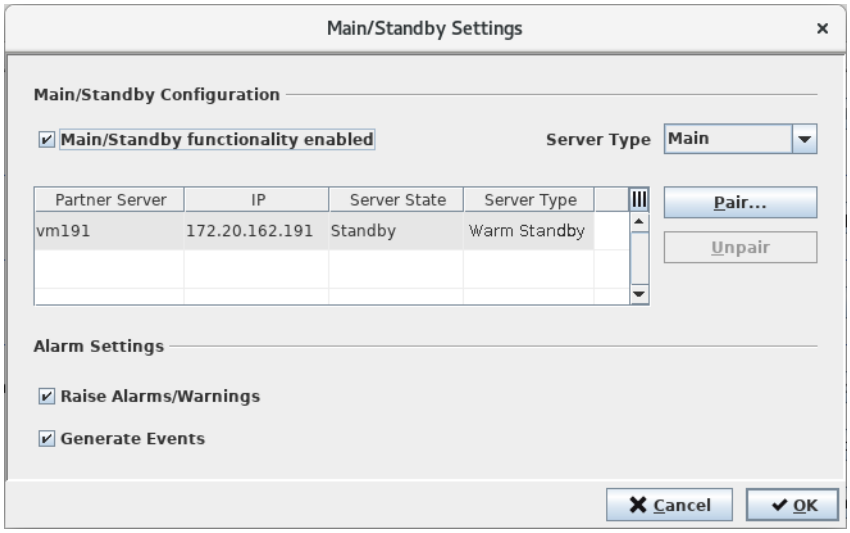

Figure 10: <Main/Standby Settings> dialog

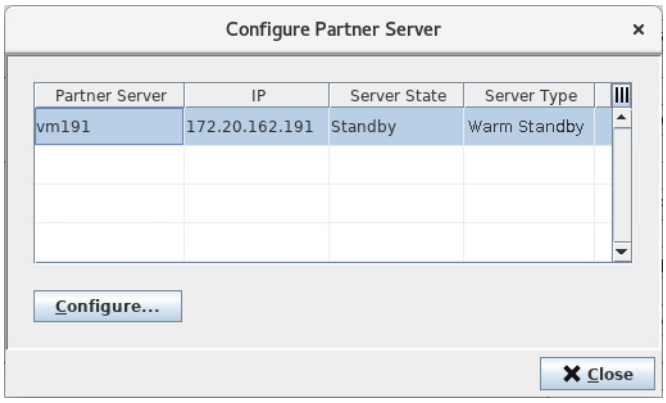

Figure 11: <Configure Partner Server> dialog

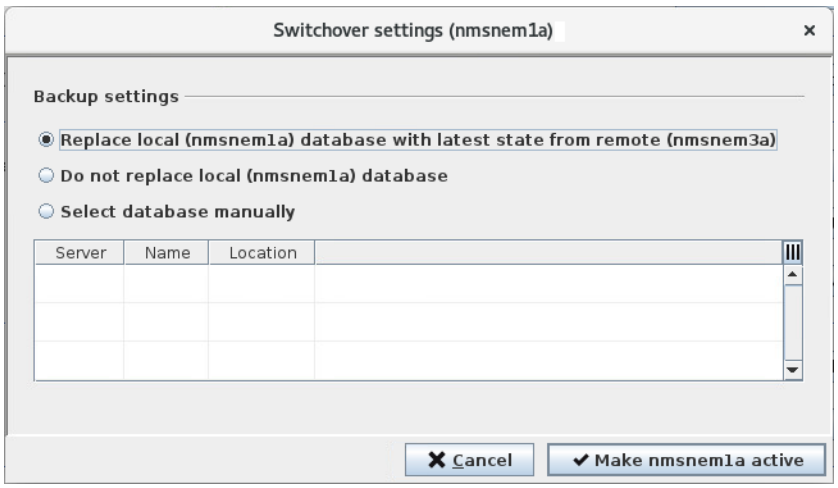

Figure 12: <Switchover settings> dialog

6.2 NEM Login Window

The NEM Login Window has been extended in such way that any FOXMAN-UN client offers login to all hosts as added in the NEM Host Manager of the respective client. Servers available in the hosts combo box are amended by the term “(Main)” if the corresponding server is of type

"Main" or by the term "(Standby)" if the corresponding server is of type "Cold Standby" or "Warm Standby". Servers of type "Standard" will not be labeled specially.

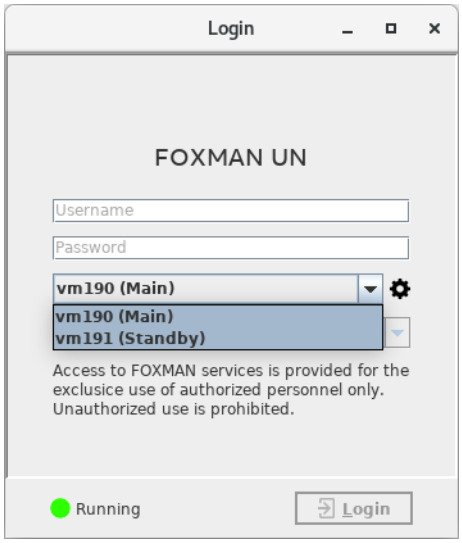

Figure 13: <NEM Login> dialog showing servers and types in combo box

The server state of a selected server together with a corresponding color icon is shown in the lower left corner of the Login Window.

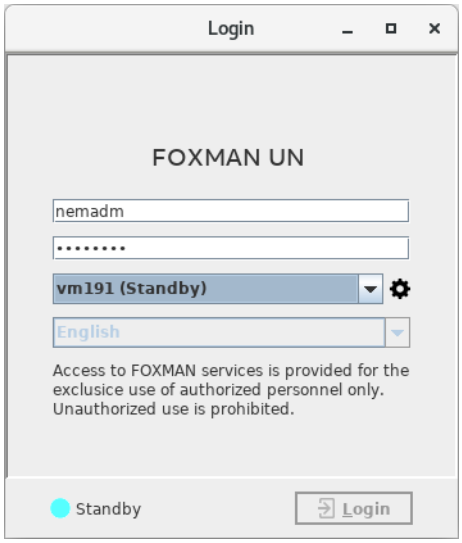

Figure 14: <NEM Login> dialog showing server state and icon in lower left corner

6.3 NEM Host Manager

The NEM Host Manager (formerly known as NEM Connection Manager) serves definition of hosts to which the user can connect from the NEM Login Window. It can be launched by clicking on the gearwheel icon ⚙ on the Login Window. Every FOXMAN-UN client needs to define its own list of hosts.

Hosts can be added in the Host Manager by means of the <+Add> button. All added hosts will be visible in the hosts list of the Host Manager with the following attributes:

- Server (hostname)
- IP Address
- State
- Type
- Partner Server

Partner servers will only be visible if they have been paired properly.

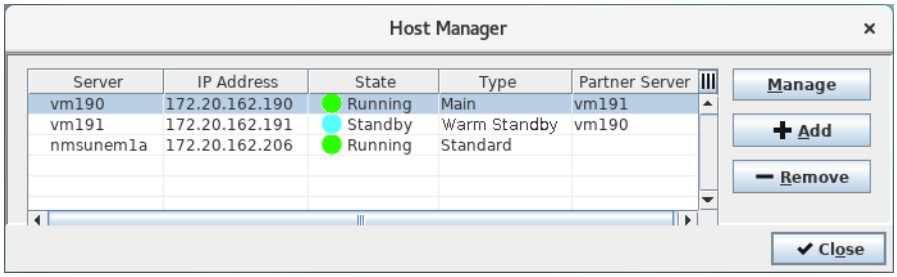

Figure 15: <Host Manager> showing three servers of different type

Selection of a server in the hosts list and clicking on the <Manage> button will start the Remote Admin Tool for the selected server. Double-clicking on a row in the hosts list will close the Host Manager and enter the respective host in the “host field” of the NEM Login Window.

6.4 NEM Desktop

Successful login to a Server from the NEM Login Window of a FOXMAN-UN client will start the NEM Desktop. In the lower right corner of the NEM Desktop Window a status field is shown, indicating to which server (host) and server type the client is currently connected. The green color of the field indicates a successful connection to the server.

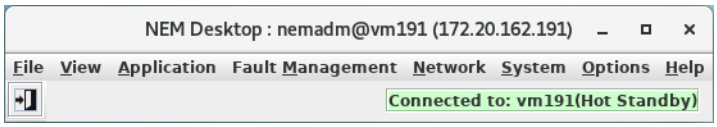

Figure 16: <NEM Desktop> showing successful connection to a Standby Server

If both the Main Server and the Standby Server are running at the same time, the Server status field is colored orange.

If the connection to a server is lost, a message box will be shown informing the user correspondingly. The status field of the NEM Desktop Window will display the text “Connection Lost” and its color changes from green to red.

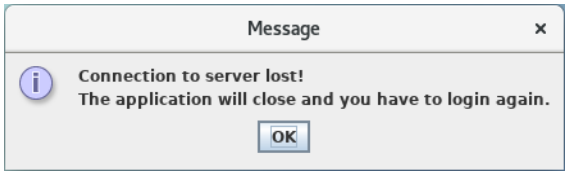

Figure 17: <Message box> displaying connection loss to the server

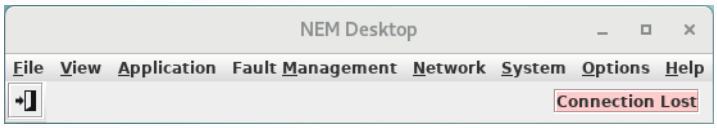

Figure 18: <NEM Desktop> showing connection loss to server

Clicking on the <OK> button of the message box will close the NEM Desktop Window and show the NEM Login Window.

6.5 NEM Alarm and Event List

The Main/Standby Solution generates alarms and events under certain conditions that are visible in the alarm and event list of any FOXMAN-UN client connected to the Main or the Standby Server.

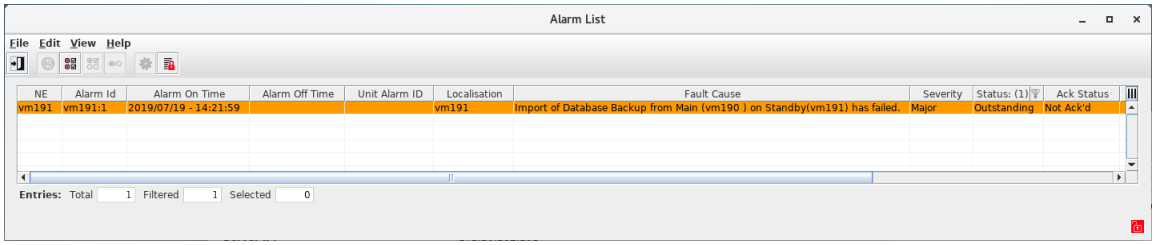

Figure 19: <NEM Alarm List> showing a Main/Standby-related alarm

7 Document History

Release	Rev.	Date	Comments
FOXMAN-UN R11B	A	2019-09-02	First document revision.
FOXMAN-UN R11B SP01	B	2019-12-11	Revised version for release R11B SP01. NEM Remote Admin Tool updated.
FOXMAN-UN R14A	A	2020-07-15	Updated screenshot in 6.1 "NEM Remote Admin Tool" for new major release. Corrected standby server type terminology.
FOXMAN-UN R14B	A	2021-01-15	Updated for the current system release. Added screenshot for new switchover feature in 6.1 "NEM Remote Admin Tool".
FOXMAN-UN R15A	A	2021-07-06	Updated for the current system release.
FOXMAN-UN R15B	A	2022-02-02	Updated for the current system release. Updated document branding.
FOXMAN-UN R16A	A	2022-08-04	Updated for the current system release.
FOXMAN-UN R16B	A	2023-02-27	Updated for the current system release.
FOXMAN-UN R17A	A	2024-08-05	Updated for the current system release.
FOXMAN-UN R18	A	June 2025	Updated for the current system release.

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