hp Unified Correlation Analyzer

Unified Correlation Analyzer
for
Event Based Correlation
Version 3.1

Topology Extension

Edition: 1.0

For the HP-UX (11.31) and Linux (RHEL 5.8 & 6.3) Operating Systems

April 2014

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Preface

This manual is dedicated to the Unified Correlation Analyzer for Event Based Correlation Topology Extension. It encompasses both the installation and configuration guide, and the user's guide.

Product Name: Unified Correlation Analyzer for Event Based Correlation

Product Version: V3.1

Intended Audience

Here are some recommendations based on possible reader profiles:

- Solution Developers
- Software Development Engineers

Software Versions

The term UNIX is used as a generic reference to the operating system, unless otherwise specified.

The software versions referred to in this document are as follows:

Product Version	Supported Operating systems
UCA for Event Based Correlation Server Version 3.1	• HP-UX 11.31 for Itanium • Red Hat Enterprise Linux Server release 5.8 & 6.3
UCA for Event Based Correlation Channel Adapter Version 3.1	• HP-UX 11.31 for Itanium • Red Hat Enterprise Linux Server release 5.8 & 6.3
UCA for Event Based Correlation Topology Extension Version 3.1	• HP-UX 11.31 for Itanium • Red Hat Enterprise Linux Server release 5.8 & 6.3
UCA for Event Based Correlation Software Development Kit Version 3.1	• Windows XP / Vista • Windows Server 2007 • Windows 7 • Red Hat Enterprise Linux Server release 5.8 & 6.3

Table 1 - Software versions

Typographical Conventions

`Courier` Font:

- Source code and examples of file contents.
- Commands that you enter on the screen.
- Pathnames

- Keyboard key names

Italic Text:

- Filenames, programs and parameters.
- The names of other documents referenced in this manual.

Bold Text:

- To introduce new terms and to emphasize important words.

Associated Documents

The following documents contain useful reference information:

References

[R1] *Unified Correlation Analyzer for Event Based Correlation Reference Guide*

[R2] *Unified Correlation Analyzer for Event Based Correlation Value Pack Development Guide*

[R3] *OSS Open Mediation Installation and Configuration Guide*

[R4] *Unified Correlation Analyzer for Event Based Correlation Installation Guide*

Support

Please visit our HP Software Support Online Web site at www.hp.com/go/hpsoftwaresupport for contact information, and details about HP Software products, services, and support.

The Software support area of the Software Web site includes the following:

- Downloadable documentation,
- Troubleshooting information,
- Patches and updates,
- Problem reporting,
- Training information,
- Support program information.

Chapter 1

Introduction

This guide is a document dedicated to the Topology Extension of the UCA for EBC product.

The Topology extension allows developing Value packs that require topology knowledge for implementing the correlation use case.

The following chapters will describe:

- The installation procedure.
- The configuration of the extension.
- The development guide for Value Packs using the Topology.

Throughout this document, we use the `${UCA_EBC_HOME}` environment variable to reference the root directory ("static" part) of UCA for EBC. The default value for the `${UCA_EBC_HOME}` environment variable is `/opt/UCA-EBC`. The `${UCA_EBC_HOME}` environment variable thus references the `/opt/UCA-EBC` directory unless UCA for EBC "static" part has been installed in an alternate directory.

We also use `${UCA_EBC_DATA}` environment variable to reference the data directory ("variable" part) of UCA for EBC. The default value for the `${UCA_EBC_DATA}` environment variable is `/var/opt/UCA-EBC`. The `${UCA_EBC_DATA}` environment variable thus references the `/var/opt/UCA-EBC` directory unless UCA for EBC "variable" part has been installed in an alternate directory.

Since UCA-EBC V2.0, on Linux and HP-UX systems, the `${UCA_EBC_DATA}` directory may contain multiple instances of UCA-EBC. In this document, we will use the value `${UCA_EBC_INSTANCE}` for referring to `${UCA_EBC_DATA}/instances/<instance-name>` directory on Linux/HP-UX systems and to `${UCA_EBC_DATA}` on Windows systems.
Note that at installation time on Linux/HP-UX, a single <instance-name> is configured: default.

For more information on the UCA for EBC product, please refer to the *Unified Correlation Analyzer for Event Based Correlation Reference Guide* and *Unified Correlation Analyzer for Event Based Correlation Value Pack Development Guide*.

Chapter 2

UCA for EBC Topology Extension installation

The UCA for EBC Topology Extension product is delivered as a tar file named:

uca-ebc-topo-kit-3.1-<os>.tar

where <*os*> is *linux* on **Linux** and *hpux* on **HP-UX** systems.

This chapter describes the software prerequisites, the installation steps, and gives a brief content description of the UCA for EBC Topology kit.

2.1 Licensing

After you first start UCA for EBC Server, UCA for EBC will activate a trial license for 90 days (Instant-On license) that enables all features of the product (including the 'UCA for EBC Topology Extension' feature) for a trial period. After expiration of this trial period, a commercial license is needed to continue using the product.

A valid license key is required to activate the 'UCA for EBC Topology Extension' feature after the trial period.

In case you are using the Topology extension (the 'uca.ebc.topology' property set to 'embedded', or 'external' in the uca-ebc.properties file). If you have no valid license key for the 'UCA for EBC Topology Extension' feature after the trial period, UCA for EBC Server will not start.

Notes

As soon as a permanent license is installed in the *license.txt* file, the UCA for EBC Instant-On feature (that lets you use all features of UCA for EBC for a 90 day period so that you can evaluate the product) will be disabled.

In this case, you must add all the permanent licenses corresponding to the UCA for EBC features that you need to the *license.txt* file. For example, if you need the UCA for EBC Topology Extension feature, you need to add a UCA for EBC Topology Extension permanent license to the *license.txt* file.

Please refer to [R4] *Unified Correlation Analyzer for Event Based Correlation Installation Guide* chapter 2.1 "*Licensing*" for more information on how to retrieve and install UCA for EBC license keys.

2.2 Disk requirements

Here are the disk requirements for UCA for EBC Topology Extension kit:

On HP-UX:

Type	Disk requirements
Temporary disk space used during installation	280 MB minimum: • 140 MB minimum for the uca-ebc-topo-kit-3.1-hpux.tar file • 140 MB minimum for the install-uca-ebc-topology.sh and UCAEBCTOPOV310.depot files (expanded from the uca-ebc-topo-kit-3.1-hpux.tar file)
Permanent disk space	140 MB minimum for UCA for EBC Topology Extension V3.1 installed on the system

Table 2 - Disk Requirements for UCA for EBC Topology Extension on HP-UX

On Linux:

Type	Disk requirements
Temporary disk space used during installation	280 MB minimum: • 140 MB minimum for the uca-ebc-topo-kit-3.1-linux.tar file • 140 MB minimum for the install-uca-ebc-topology.sh and UCA-EBCTOPO-V3.1.noarch.rpm files (expanded from the uca-ebc-topo-kit-3.1-linux.tar file)
Permanent disk space	140 MB minimum for UCA for EBC Topology Extension V3.1 installed on the system

Table 3 - Disk Requirements for UCA for EBC Topology Extension on Linux

2.3 Software prerequisites

2.3.1 UCA for EBC Server

The UCA for EBC Topology Extension package must be installed on top of the UCA for EBC Server product.

Software	Package Reference
UCA for Event Based Correlation Server Version V3.1	UCA-EBC.UCAEBCSERVERV310

Table 4 - Software Prerequisites for UCA for EBC Topology Extension (HP-UX)

Software	Package Reference
UCA for Event Based Correlation Server Version V3.1	UCA-EBCSERVER-V3.1

Table 5 - Software Prerequisites for UCA for EBC Topology Extension (Linux)

On HP-UX:

To check if you already have the UCA for EBC Server product installed:

```
$ swlist UCA-EBC
```

You should get an output similar to the following:

```
# UCA-EBC                          V310      UCA-EBC
  UCA-EBC.UCAEBCSERVERV310         V310        HP UCA EBC Server
Version V3.1 Level 00 Rev B
```

On Linux:

To check if you already have UCA for EBC Server product installed (as root):

```
$ rpm -qa | grep UCA-EBC
```

You should get an output similar to the following:

```
UCA-EBCSERVER-V3.1
```

2.3.2 Java

The UCA for EBC Topology Extension (based on Neo4J 1.9 Graph Database) needs Oracle(R) Java(TM) Runtime Environment 7.

Red Hat Enterprise Linux Server comes with OpenJDK Java VM, and unfortunately this JVM is not supported by Neo4J 1.9 Graph Database.

Therefore it is recommended that you download (for free) the latest Java packages (HotSpot Java VM) from Oracle from http://java.com/en/download/manual.jsp. If this is installed (usually under /usr/java), you should get an output similar to the followings:

```
jdk-1.6.0_23-fcs.x86_64
jre-1.7.0_21-fcs.x86_64
```

Then you will have to set the $JAVA_HOME variable of user *uca* accordingly.

2.4 UCA for EBC Topology Extension package installation

2.4.1 Untar the archive in a temporary directory

As **root** user, untar the archive in a temporary local directory (For example: /tmp):

On HP-UX:

```
$ cd /tmp
$ tar -xvf <kit location>/uca-ebc-topo-kit-3.1-hpux.tar
```

On Linux:

```
$ cd /tmp
$ tar -xvf <kit location>/uca-ebc-topo-kit-3.1-linux.tar
```

2.4.2 Run the installation script

Still as root user, run the package installation script:

On both HP-UX and Linux:

```
$ install-uca-ebc-topology.sh [ -r <UCA-EBC root directory> ]
```

The <UCA-EBC *root Directory*> parameter value represents the absolute path of the Root directory of the UCA for EBC Server product. It corresponds to the value of the ${UCA_EBC_HOME} environment variable.

Note

The default value for the UCA for EBC Server root directory is */opt/UCA-EBC*.

However, since UCA for EBC Server may have been installed at an alternate location, please check with your system administrator to obtain the correct installation directory.

2.4.3 File organization

UCA for EBC Topology Extension files are installed under the <UCA-EBC *root Directory*> directory (the default is `/opt/UCA-EBC`).

The UCA for EBC Topology Extension package installation augments the UCA for EBC package directories as described in the table below.

Subdirectories	Description
bin	Augmented with the uninstall-uca-ebc-topology script.
lib	Augmented with all libraries required for the implementation of the topology feature

Table 6 - UCA for EBC Topology Extension provided files

2.5 Un-installation of UCA for EBC Topology Extension

The UCA for EBC Topology Extension product can be easily uninstalled by running the ***uninstall-uca-ebc-topology*** script provided in the *${UCA_EBC_HOME}/bin* directory.

This uninstall utility must be run with **root** privileges.

When the ***uninstall-uca-ebc-topology*** tool is launched, it checks for all UCA for EBC Topology native packages installed on your system and prompts you for the number associated with the package to be uninstalled:

On both HP-UX and Linux:

```
$ /opt/UCA-EBC/bin/uninstall-uca-ebc-topology
```

You should get an output similar to the following text:

```
Here is the list of installed UCA-EBC TOPOLOGY packages:


        [0]     UCA-EBCTOPO-V3.1

Enter the index number of UCA-EBC TOPOLOGY version to un-
install:
```

By entering **'0'** (as in the example above), UCA for EBC Topology version V3.1 will be removed.

Chapter 3

UCA for EBC Topology Extension Configuration

3.1 Configuring the topology extension

After installation of the UCA for EBC Topology extension package, the topology features are not enabled by default.

To be able to use the topology features, the first requirement is to start a topology server. This can be done in two ways:

- Start an embedded topology Server
- Use an external topology Server

3.1.1 Starting an Embedded Topology server

This is the easiest way to start the topology server because in this case the topology server is started in the same process as the UCA for EBC server without any additional commands.

This is accomplished by setting the following property in the *${UCA_EBC_INSTANCE}/conf/uca-ebc.properties* file:

```
uca.ebc.topology=embedded
```

When the topology server starts for the first time (or in case the database repository is not found) it creates the database repository. The default database repository location is:

${UCA_EBC_INSTANCE}/neo4j

This location can be changed by setting the `uca.ebc.topology.location` property to point to another directory. However, it is not recommended to change this default location (the backup tool will restore neo4j DB under ${UCA_EBC_INSTANCE}/neo4j)

For example:

```
uca.ebc.topology.location=/data/uca-ebc-database
```

The topology server implements a web server in order to serve REST http requests or GUI http requests. This web server is started on the default port number: 7474. If this value conflicts with a port used by another application then you can change the port number by setting the `uca.ebc.topology.webPort` property.

For example:

```
uca.ebc.topology.webPort=7475
```

The backup tool delivered with UCA for EBC is using the neo4j online backup facility that allows backup of a DB while the server is running without requiring a lock. To configure this facility, it is compulsory to set the `neo4j.config.online_backup_enabled` property as following:

```
neo4j.config.online_backup_enabled=true
```

The default port used for the online backup is also configurable. The default instance uses port 6362 if it is not configured.

If you are running multiple instances of UCA for EBC with neo4j topology server, it is mandatory to change this port number by setting the `neo4j.config.online_backup_port` property.

For example:

```
neo4j.config.online_backup_port=6462
```

With UCA for EBC V2.0 the two above properties online_backup_[enabled|port] are not defined by default. **Make sure you have them well defined in uca-ebc.properties file if you intend to use the backup utility.**

3.1.1.1 Additional Neo4J Server configuration

The embedded Neo4J Server may need additional configurations by the use of some specific neo4j properties (cache size, mapped memory size, etc..).

In such case, these neo4j properties must be set in the uca-ebc.properties file with the prefix “neo4j.config.”

Example:

To set the *neostore.nodestore.db.mapped_memory* neo4j property to a value of 25M, the following must be defined in the uca-ebc.properties file :

```
neo4j.config.neostore.nodestore.db.mapped_memory=25M
```

3.1.2 Using an external Topology server

The use of an external topology server can be useful in some specific conditions (High Availability for example).

When using an external server we assume this server is started and monitored externally.

The UCA for EBC Topology Extension is designed to work with Neo4J 1.9 Graph Database as the topology server.

For the external topology server configuration, the installation and configuration of this product is a prerequisite.

This topology server can run on the same host as the UCA for EBC server or on a remote host.

Configuring UCA for EBC to use an external topology server requires the following properties to be defined in the *uca-ebc.properties* file:

- The `uca.ebc.topology` property is set to ‘external’

- The `uca.ebc.topology.serverhost` is set to the hostname of the system hosting the external topology server.
- The `uca.ebc.topology.webPort` is set to the web port used by the external topology server

Configuration example:

```
uca.ebc.topology=external
uca.ebc.topology.serverhost=poolv1.gre.hp.com
uca.ebc.topology.webPort=7474
```

Additional optional properties may be defined in the *uca-ebc.properties* file:

- The uca.ebc.topology.https.enabled property is by default set to false. It configures the HTTP channel of the REST API of the neo4j server to be secure if it is set to true. Please note that the certificates should be previously well configured on client/server sides.

```
uca.ebc.topology.https.enabled=true
```

3.2 Configuring the topology data load function

The topology data-load function is performed by a specific topology plug-in that runs on the server.

The role of this plugin is to parse and load the topology information contained in CSV files into the Neo4j graph database. This is fully detailed in a subsequent chapter, “Topology Data load”, further in this document.

With an embedded server configuration, there is no additional configuration to be performed.

With an external server configuration, the data-load plugin, which is installed as part of the “UCA for EBC topology Extension”, must be manually copied to the ‘plugins’ directory of the external topology server.

The following files should be copied to the NEO4j topology server 'plugins' directory:

- `${UCA_EBC_HOME}/lib/opencsv-2.3.jar`
- `${UCA_EBC_HOME}/lib/scalalogging-slf4j_2.10-1.0.1.jar`
- `${UCA_EBC_HOME}/lib/uca-ebc-topology-dataload-3.1.jar`
- `${UCA_EBC_HOME}/lib/config-0.5.2.jar`

3.3 Configuring the topology dataload scheduler

The topology data-loading is performed by pushing dataload CSV files to the ‘import/csv’ directory of the Neo4J server.

For embedded topology server this directory is located at: *${UCA_EBC_INSTANCE}/neo4j/import/csv*.

Once the CSV files are pushed to the correct location, the dataload operation must be triggered.

This can be done through the UCA for EBC GUI in the following panel:

UCA for EBC > Topology Management > DataLoad

Clicking the “Topology Dataload” button will trigger the dataload.

The Dataload can also be triggered, by the Dataload Scheduler, on a (configurable) regular basis.

The Dataload Scheduler works regardless of the topology server configuration (embedded or external).

Two parameters can be configured for the Topology Dataload Scheduler:

- The start time

  The start time indicates the time for the first dataload.

- The period

  The period indicates the time (in hours) between subsequent data loads

Example1:

Start time = 03:00:00

Period = 6

Data load will occurs at: 03:00:00, 09:00:00, 15:00:00, 21:00:00

Example2:

Start time = 06:00:00

Period = 8

Data load will occurs at: 06:00:00, 14:00:00, 22:00:00

Example3:

Start time = 06:00:00

Period = 5

Data load will occurs at: 06:00:00, 11:00:00, 16:00:00, 21:00:00, 02:00:00

The Topology Dataload Scheduler is configured by setting properties in the *uca-ebc.properties* file.

Enabling the Topology Dataload Scheduler:

This is done by setting the `uca.ebc.topology.dataload.usescheduler` property to ‘true’

For example:

```
uca.ebc.topology.dataload.usescheduler=true
```

Setting the data load scheduler start time:

This is done by setting the `uca.ebc.topology.dataload.starttime` property to the start time of the data-load in HH:MM:SS format.

The Default value if this property is not specified is: 03:00:00.

Example:

```
uca.ebc.topology.dataload.starttime=04:00:00
```

This will schedule a topology dataload at 4:00 AM.

Setting the data load scheduling period

This is done by setting the `uca.ebc.topology.dataload.period` property to the number of hours between subsequent data loads.

The default value if this property is not specified is: 4.

Example:

```
uca.ebc.topology.dataload.starttime=04:00:00
uca.ebc.topology.dataload.period=4
```

This will schedule a topology dataload at 4 AM and then every 4 hours.

NOTE: These properties are taken in to account at application start-up. Any changes will require restarting the UCA-EBC server.

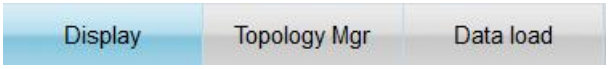
Chapter 4

Managing the Topology from the UCA for EBC GUI

The UCA for EBC Web interface provides a new menu when the topology is enabled. This new “Topology Management” menu can be reached from the main menu under the “UCA for EBC” entry:

UCA for EBC > Topology Management

This menu gives access to the Topology Management panel that offers three sections in the horizontal menu:



4.1 The graph display Panel

The graph display panel allows displaying the topology graph in the neighborhood of Point Of Interest and depending on some view profiles.

This feature is fully described in section 8.4 “Using the Graph ” of this document.

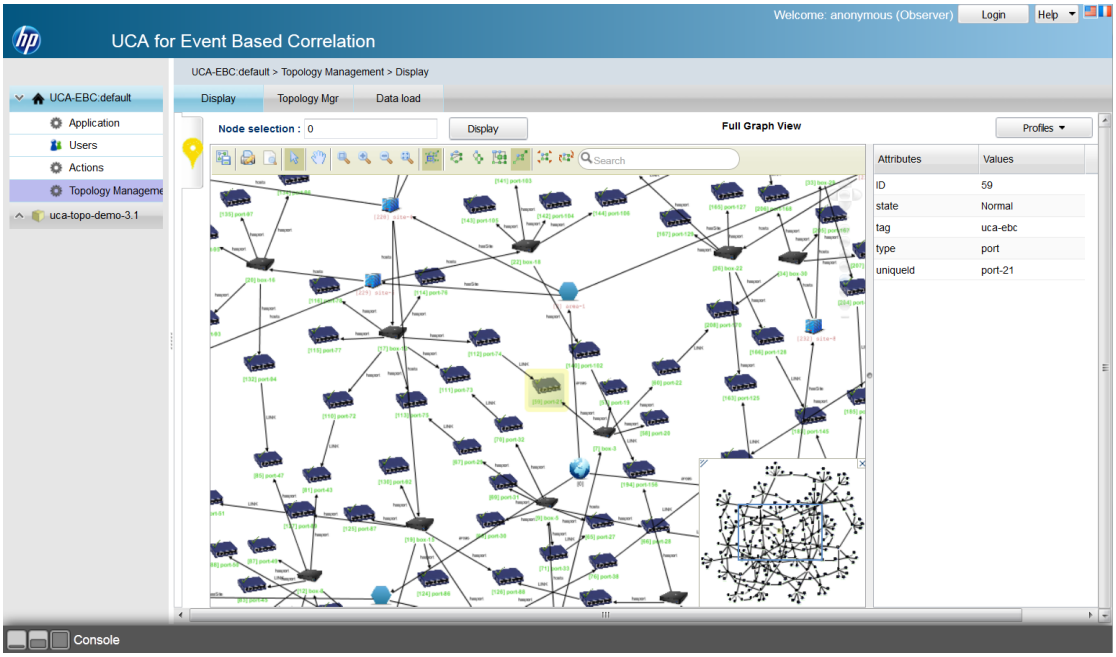


Figure 1: Graph display panel

4.2 The Topology Manager Panel

The Topology Manager Panel displays the legacy Neo4j web manager. It appears as shown below:

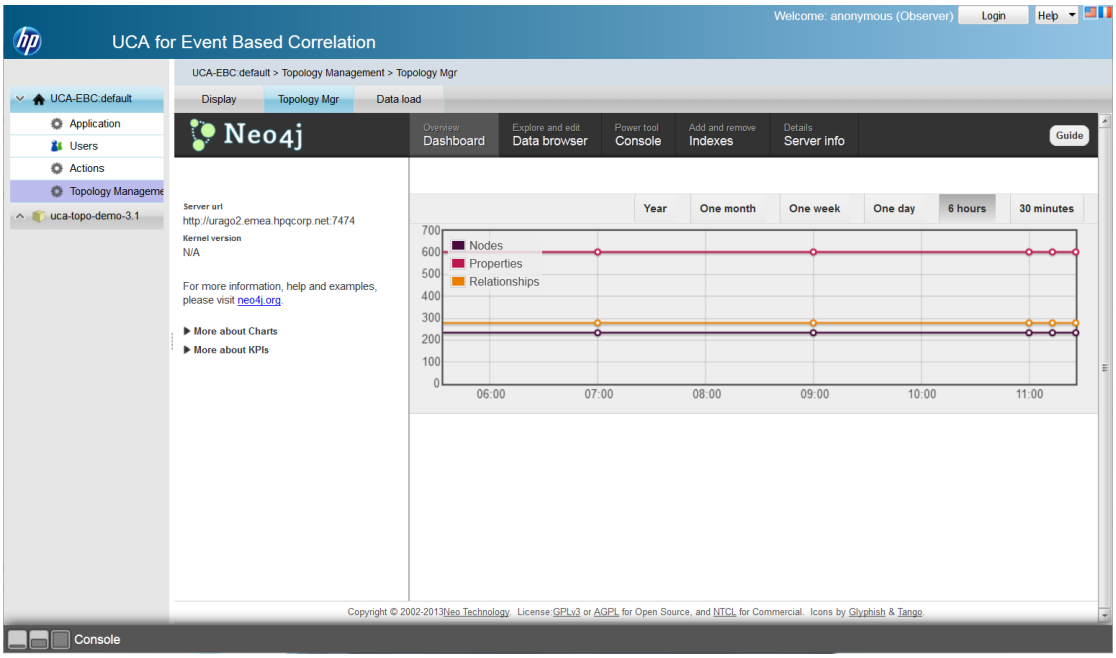


Figure 2: the Neo4J Manager panel

The Neo4j web manager has several entries. The default one is a dashboard indicating the number of graph database objects and a graph showing the evolution of this number over time.

You should refer to the Neo4J documentation for detailed explanations on the Neo4J Web Manager interface at the following URL: http://docs.neo4j.org/chunked/stable/tools-webadmin.html.

4.3 The Data load Panel

This panel is specific to the UCA for EBC Topology extension. From this panel, it is possible to trigger a data-load on the Neo4j server thanks to the “Topology data load” button. Note that this button is enabled only for user having a ‘developer’ or ‘administrator’ roles.

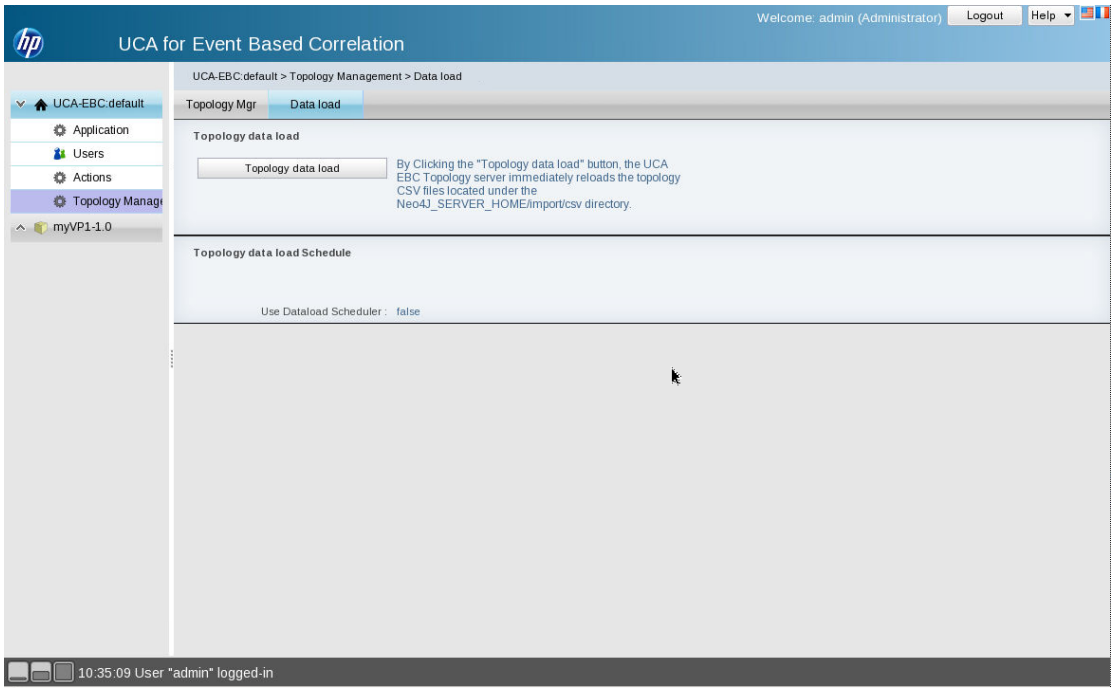


Figure 3: The topology data load panel

On “Topology Data load” button click, the server reloads all CSV files present in the import/csv directory as detailed in the “Topology Data load” Chapter in this document.

Chapter 5

Developing a topology aware Value Pack

5.1 Introduction

Topology aware Value Packs, like “regular” Value Packs, are developed using the UCA for EBC Development Toolkit under the Eclipse development environment.

Please refer to the *Unified Correlation Analyzer for Event Based Correlation Value Pack Development Guide* Document if you are not familiar with the UCA for EBC Value Pack development environment.

The UCA for EBC Development toolkit V3.1 has been enhanced to provide:

- The libraries required for retrieving topology information.
- The topology database framework used by the Junit tests in order to validate topology aware Value Packs.
- The necessary tools to perform basic dataloading.
- An example of a topology Value Pack (named topology-example)

5.2 Topology aware Value Pack principles

Topology aware Value Packs are mainly based on the “Alarm Enrichment” feature provided by the UCA for EBC product.

Alarm enrichment consists in adding extra data to Alarms. For topology aware Value Packs, this extra information usually comes from the topology database and takes the form of extra topology-related Alarm attributes.

These new topology-related Alarm attributes can then be used in Drools Rules just like any other standard Alarm attributes.

The following picture shows the alarm enrichment process in UCA for EBC, for topology aware Value Packs:

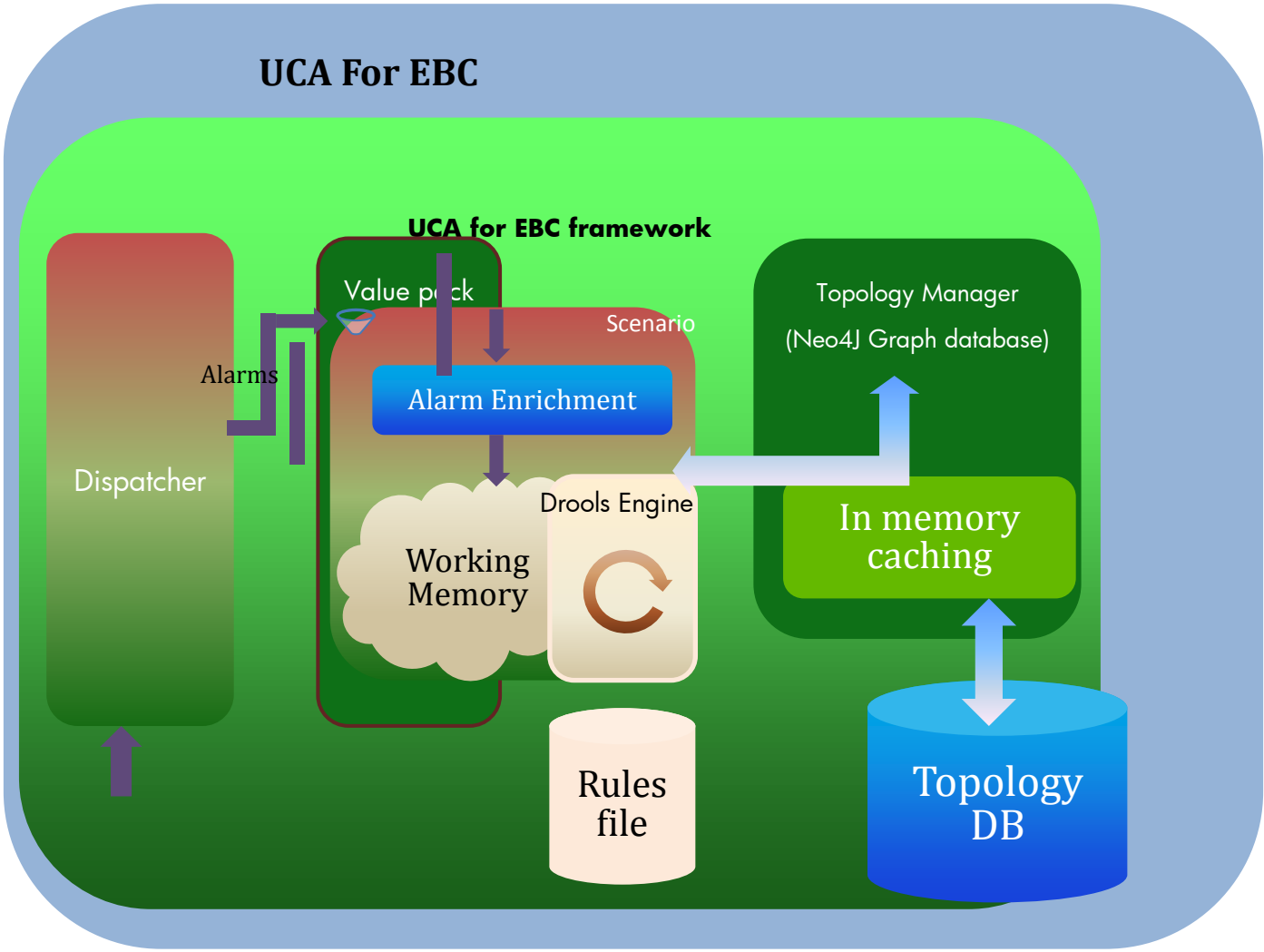


Figure 4 - Alarm enrichment with topology information

5.3 Alarm enrichment with topology information

Alarm enrichment is performed in several steps:

1. Provide one or more new Alarm Object classes that extend the Alarm Object (or one of the AlarmDeletion, AlarmStateChange or AlarmAttributeChange objects), which can hold extra topology-related attributes
2. Implement the topology requests that will set the value of the extra topology-related Alarm attributes.
3. Configure the Value Pack framework to take into account the Alarm Enrichment process

5.3.1 Alarm Object extension

An extended Alarm must extend one of the Alarm classes provided by the UCA for EBC Framework. The Alarm classes are:

`com.hp.uca.expert.alarm.Alarm`

`com.hp.uca.expert.alarm.AlarmDeletion`

`com.hp.uca.expert.alarm.AlarmStateChange`

`com.hp.uca.expert.alarm.AlarmAttributeValueChange`

The extended alarm must implement setters and getters for the new attributes (this will ease the process of writing rules).

Below is an example of such an extended Alarm, as provided in the topology-example Value Pack:

```
package com.hp.uca.ebc.topoexample;

import javax.xml.bind.annotation.XmlRootElement;
import org.neo4j.graphdb.Relationship;
import com.hp.uca.expert.alarm.Alarm;
import com.hp.uca.expert.alarm.AlarmHelper;

@XmlRootElement
public class LinkdownEnrichedAlarm extends Alarm {

	private static final String F_TOPONODE = "associated Node ";
	private static final String F_LINKNAME = "link Name       ";

	/**
	 *
	 */
	private static final long serialVersionUID = -5235137849600943223L;

	/**
	 * Alarm extension attributes
	 */

	/**
	 * Stores the Unique Identifier of the topology Node (Port) this alarm
	 *  is mapped to.
	 */
	private String associatedNodeUniqueId;
	/**
	 * pointer to the 'LINK' relation the  {@link associatedNodeUniqueId} is
	 * associated to
	 */
	private Relationship link;

	/**
	 * LinkDownEnrichedAlarm Constructor
	 */
	public LinkdownEnrichedAlarm() {
		super();
	}

	/**
	 * LinkDownEnrichedAlarm Copy Constructor.
	 *
	 * This constructor constructs an Extended Alarm and uses the Alarm provided as
	 * parameter to set all the standard alarm fields
	 */
	public LinkdownEnrichedAlarm(Alarm alarm) {
		super(alarm);

		// initialize the associated Node.
		// use the instance mapping facility
```

```
            // check the linkdown/mappers.xml file to see how the mapping is done
            associatedNodeUniqueId =alarm.doMapping("NetworkInstance");

            // set the link information if any
            link = LinkdownTopoAccess.getPortLink(associatedNodeUniqueId);
    }

    /**
     * Clones the provided Extended Alarm object
     * @return a copy of the current object
     * @throws CloneNotSupportedException
     */
    @Override
    public LinkdownEnrichedAlarm clone() throws CloneNotSupportedException {
            LinkdownEnrichedAlarm newAlarm = (LinkdownEnrichedAlarm) super.clone();
            newAlarm.link = this.link;
            newAlarm.associatedNodeUniqueId = this.associatedNodeUniqueId;
            return newAlarm;
    }

    /**
     * returns the {@link link} attribute
     * @return the {@link link} attribute
     */
    public Relationship getLink() {
            return link;
    }

    /**
     * sets the {@link link} attribute
     */
    public void setlink(Relationship link) {
            this.link = link;
    }

    /**
     * returns the {@link link} name attribute
     * @return the {@link link} name attribute
     */
    public String getLinkName() {

            return LinkdownTopoAccess.getLinkName(link);
    }

    /**
     * returns the {@link link} state attribute
     * @return the {@link link} state attribute
     */
    public String getLinkState() {

            return LinkdownTopoAccess.getLinkState(link);
    }

    /**
     * sets the {@link link} state attribute
     */
    public void setLinkState(String state) {
            LinkdownTopoAccess.setlinkState(link, state);
    }

    /**
     * returns the {@link associatedNodeUniqueId} attribute
     * @return the {@link associatedNodeUniqueId} attribute
```

```
	 */
	public String getAssociatedNodeUniqueId() {
		return associatedNodeUniqueId;
	}

	/**
	 * sets the {@link associatedNodeUniqueId} attribute
	 */
	public void setAssociatedNodeUniqueId(String associatedNodeUniqueId) {
		this.associatedNodeUniqueId = associatedNodeUniqueId;
	}

	/*
	 * (non-Javadoc)
	 *
	 * @see com.hp.uca.expert.alarm.AlarmCommon#toFormattedString()
	 */
	@Override
	public String toFormattedString() {
		StringBuffer toStringBuffer= AlarmHelper.toFormattedStringBuffer(this);

		AlarmHelper.addFormatedItem(toStringBuffer, F_LINKNAME, getLinkName());
		AlarmHelper.addFormatedItem(toStringBuffer, F_TOPONODE,
                                            getAssociatedNodeUniqueId());
		return toStringBuffer.toString();
	}
}
```

5.3.2 Activating Alarm Enrichment

The Alarm Enrichment process is implemented by a Java Class that extends the `com.hp.uca.expert.lifecycle.alarm.AlarmLifeCycle` class provided by the UCA for EBC framework.

Activating Alarm Enrichment is fully detailed in the "*Unified Correlation Analyzer for Event Based Correlation Reference Guide*" Chapter 3.4.5 "Alarm Enrichment".

Below is an example of how to activate the Alarm Enrichment process, as provided in the topology-example Value Pack:

```
package com.hp.uca.ebc.topoexample;

import org.apache.commons.logging.Log;
import org.apache.commons.logging.LogFactory;
import com.hp.uca.common.trace.LogHelper;
import com.hp.uca.expert.alarm.Alarm;
import com.hp.uca.expert.alarm.AlarmCommon;
import com.hp.uca.expert.lifecycle.alarm.AlarmLifeCycle;
import com.hp.uca.expert.scenario.Scenario;

// Just an example of extension of analyzer
public class LinkdownLifeCycle extends AlarmLifeCycle {

	private static Log log = LogFactory.getLog(LinkdownLifeCycle.class);

	public LinkdownLifeCycle(Scenario scenario) {
		super(scenario);
	}

	@Override
	public AlarmCommon onAlarmCreationProcess(Alarm alarm) {
```

```
                LogHelper.enter(log, "onAlarmCreationProcess()");

                LinkdownEnrichedAlarm enrichedAlarm = new LinkdownEnrichedAlarm(alarm);

                LogHelper.exit(log, "onAlarmCreationProcess()");
                return enrichedAlarm;
        }
}
```

The use of this new LifeCycle class must be indicated in the ValuePackConfiguration.xml file, in the corresponding scenario section. This is done by setting the <customLifeCycleClass> XML element as follows:

```
<customLifeCycleClass>
    com.hp.uca.ebc.topoexample.LinkdownLifeCycle
</customLifeCycleClass>
```

5.3.3 Topology requests implementation

The UCA for EBC Topology extension provides a static Java class, `com.hp.uca.expert.topology.TopoAccess`, that gives access to the Neo4J database through the `getGraphDB()` method.

The getGraphDB() method of the TopoAccess class returns a Neo4J `GraphDatabaseService` instance which is the starting point for any Topology request.

For a full description of the services provided by the `GraphDatabaseService` Class, please refer to the Neo4J documentation at the following URL: http://docs.neo4j.org/

In order to ease the scenario development, the topology queries can be defines in the 'mappers' configuration file. These queries can be retrieved depending on the alarm context and executed using the com.hp.uca.expert.topology.CypherQuery utility class.

Here is an example of the cypher query definition in the mappers.xml. in addition to the usual mapper definition, the cypherQuery tag allows defining some cipher queries

```
<mappers xmlns="http://hp.com/uca/expert/instancemapper">
   <mapper name='NetworkInstance'>
        <extract>
            <fieldName>originatingManagedEntity</fieldName>
            <matcher>BOX (.*) CARD .* PORT (.*)$</matcher>  <!-- maps the last word of the
originatingmanagedEntity -->
            <mappedTo>topo-example-$1$2</mappedTo>
        </extract>
    </mapper>

    <cypherQuery name='GetPortLink'>
        <query><![CDATA[START n=node:PortsByUniqueId(uniqueId = {portName}) MATCH (n)<-
[link:LINK]->() RETURN link]]></query>
    </cypherQuery>

    <cypherQuery name='GetRemotePort'>
        <query><![CDATA[START n=node:PortsByUniqueId(uniqueId = {portName}) MATCH (n)<-
[link:LINK]->(m) RETURN m]]></query>
    </cypherQuery>

</mappers>
```

Here is an example of how to retrieve topology information using the configured Cypher query: in this case, retrieve the 'LINK' relation from a node using the node index:

```
public static String PORT_UNIQUEID = "uniqueId";
public static String PORT_TAG = "Tag";
public static String PORT_INDEX = "PortsByUniqueId";

/**
 * This method retrieves the link associated to this Port (if any defined)
 * @param portName
 * @return
 */
public static Relationship getPortLink(String portName) {
    Relationship link=null;

    // Get the Scenario associated to the current thread
    Scenario theScenario = ScenarioThreadLocal.getScenario();

    // retrieve the Cypher query from configuration
    String query = theScenario.getMappers().getCypherQuery("GetPortLink");

    Map<String,Object> params = new HashMap<String, Object>();
    params.put("portName", portName);
    ExecutionResult result = CypherQuery.executeAndreturnResult(query, params);

    Iterator<Relationship> links = result.columnAs("link");
    // assume there is a single one link per port.
    // but according to Neo4J documentation we must iterate to the last
    // iterator element.
    while (links.hasNext()) {
        link  = links.next();
    }
    return link;
}
```

Neo4J offers many ways to retrieve topology information. You should especially focus on:

- The "Neo4J graph database" at URL:
  http://docs.neo4j.org/chunked/stable/graphdb-neo4j.html
- The "Neo4J Cypher Query Language" at URL:
  http://docs.neo4j.org/chunked/stable/cypher-query-lang.html
- The "Neo4J Execute Cypher queries from Java" at URL:
  http://docs.neo4j.org/chunked/stable/tutorials-cypher-java.html

5.3.4 Writing rules based on topology data

In most cases, the topology data is retrieved during the Alarm Enrichment phase. This means that once the Drools rules are executed there is no need for additional topology access, thus improving the performance of the Drools rules engine.

Rules are evaluated on alarm fields (or Alarm methods) regardless of whether these fields (or methods) are returning values coming from topology enrichment or values coming from standard alarm fields.

Here is an example of a rule based on topology information:

```
//
// This rule detects when there is an alarm on each port of a connection link.
//
```

```
// In such case it sets the Link state to 'Down'.
rule "Set Link down"
no-loop
when
    $alarm1 : LinkdownEnrichedAlarm(
              linkState == LinkdownTopoAccess.LINK_STATE_UP)
    $alarm2 : LinkdownEnrichedAlarm(
              aboutToBeRetracted == false,
              identifier != $alarm1.identifier ,
              linkName == $alarm1.linkName )
then
    LogHelper.enter(theScenario.getLogger(), drools.getRule().getName());

    if ($alarm1.getLink() != null) {
        try {
            theScenario.getLogger().info("The link : "+$alarm2.getLinkName()+ " was detected
down !");

            $alarm1.setLinkState(LinkdownTopoAccess.LINK_STATE_DOWN);
            $alarm2.setLinkState(LinkdownTopoAccess.LINK_STATE_DOWN);

        }
        catch (Exception e) {
            // catch any topology access exceptions
            theScenario.getLogger().error("Topology Database access failed", e);
            theScenario.setStatusAndLogAndUpdateVPStatus(e.getMessage(),
ScenarioStatus.Degraded);
        }

        theScenario.getSession().update($alarm1);
        theScenario.getSession().update($alarm2);
    } else  {
        theScenario.getSession().retract($alarm1);
    }

    LogHelper.exit(theScenario.getLogger(), drools.getRule().getName());
end
```

In this example, the 'linkName' extended alarm attribute is updated during the Enrichment phase, based on the Originating Entity of the Alarm and extra topology information retrieved from the topology database.

The rule simply says that if there are two alarms on port nodes connected by the same 'link' (`linkname == $alarm1.linkName`), then it implies that the link has failed.

5.4 Managing In-Memory Topology element attributes

5.4.1 Introduction

With standard (i.e. non-Topology aware value packs) the result of the correlation is usually based on alarms: alarm grouping, alarm reduction, creation of new alarm, etc…

If this is still true for Topology aware value packs, the correlation result for such value packs can also be some changes in the Topology itself:

1. Node's state change indicating for example:
    - that a network element is down or malfunctioning

- that a service is impacted

2. a relation's state change indicating:

- that the connection between to node elements is broken or degraded

It is therefore necessary for a value pack to be able to change Nodes and relations attributes of the topology elements.

However, changing attribute values directly in the Neo4J database and using the database queries from rules may have a very high performance impact on rule evaluation.

Moreover, the attribute initial state in database is a problem: When a value pack is started, the collection flow is resynchronized (all alarm resent from the event source). The good value for a state attribute is the one resulting from the correlation at the end of the resynchronization. In the case the states attributes are stored in the data base, the result will be polluted by the original state stored in the database.

To prevent such situation UCA for EBC Development toolkit V3.1 provides a Class allowing managing topology element attributes **In-Memory**. This class is a Utility class:
`com.hp.uca.expert.topology.attrmgr.InMemoryAttributeManager`

It allows storing and retrieving topology elements (nodes and relations) attributes. As the implementation is done in-memory, the access to attribute value is extremely efficient and can be used in rule evaluation.

In addition, The In-Memory Attribute Manager manages the attribute values on a per value pack basis meaning that when a value pack is stopped, all the attributes set by this value pack are removed from the Manager. This guaranties that at value packs restart (and after the collection flow resynchronization) the computed in-memory attributes are always accurate.

5.4.2 In-Memory Attribute Manager API

The In-Memory Attribute manager offers API for:

- Adding attributes to the Manager
- Retrieving attributes values from the Manager
- Removing attributes from the Manager

Note that when a value pack is stopped, all the attributes that have been created by this value pack are removed from the manager.

Refer to the Java documentation provided with the UCA for EBC Development Toolkit for full details on the `InMemoryAttributeManager` class methods.

5.4.2.1 Adding attributes to the Manager

```
static synchronized public void
setAttribute(TopologyRelationAttribute attribute);
```

This method adds or overwrites a Relation's attribute in the Manager.

```
static synchronized public void
setAttribute(TopologyNodeAttribute attribute);
```

This Method adds or overwrites a Node's attribute in the Manager.

Note: it is not necessary that the attribute exists in the neo4J database to be added to the in-Memory state manager. Any new attribute can be created dynamically. However, remember it will be volatile, having the lifetime of the value pack that created it.

5.4.2.2 Retrieving attribute values from the Manager

```
static synchronized public String getRelationAttribute(Long relationId, String attributeName);
```

This method returns the relation's attribute value given the relationId and the attributeName parameters, or null if the attribute is not found.

```
static synchronized public Map<String, TopologyRelationAttribute> getRelationAttributes(Long relationId);
```

Returns all relation's attributes of the relation identified by the relationId parameter. **Note**: only the In-Memory relation's attributes are returned.

```
static synchronized public String getNodeAttribute(Long nodeId, String attributeName);
```

This method returns the node's attribute value given the nodeId and the attributeName parameters, or null if the attribute is not found.

```
static synchronized public Map<String, TopologyNodeAttribute> getNodeAttributes(Long nodeId);
```

Returns all node's attributes of the Node identified by the nodeId parameter. **Note**: only the In-Memory node's attributes are returned.

5.4.2.3 Removing attributes from the Manager

```
static synchronized void clearNodeAttribute(String nodeId, String attributeName)
```

Remove the node's attribute corresponding to the provided arguments: relationId and attributeName

```
static synchronized void clearRelationAttribute(String relationId, String attributeName)
```

Remove the relation's attribute corresponding to the provided arguments: relationId and attributeName

5.4.3 In-Memory Attribute Manager API Example.

The topology value pack example provided with the UCA for EBC Development Toolkit is an example of the use of the In-Memory Attribute manager.

```
/**
 * sets the associated {@link port} state to Failed
 */
public void setPortFailedState() {
      if (port != null) {
              // set the port state
              TopologyNodeAttribute portState = new TopologyNodeAttribute(port.getId(),
LinkdownTopoAccess.PORT_STATE, LinkdownTopoAccess.PORT_STATE_FAILED);
              InMemoryAttributeManager.setAttribute(portState);
              . . .
      }
```

```
}

/**
 * sets the associated {@link port} state to Normal
 */
public void setPortNormalState() {
      if (port!=null) {
              // set the port state
              TopologyNodeAttribute portState = new TopologyNodeAttribute(port.getId(),
LinkdownTopoAccess.PORT_STATE, LinkdownTopoAccess.PORT_STATE_NORMAL);
              InMemoryAttributeManager.setAttribute(portState);
              . . .
      }
}
```

5.5 Defining Topology “Points Of Interest”

5.5.1 Introduction

Visualization of the topology is a key point for correlation solution developers and operators. However, the visualization of graphs with more than few hundreds of nodes quickly becomes a big dark cloud that is not usable. The zooming functions don’t help much because the amount of information and the complexity off the drawing makes the visual analysis difficult.

It is therefore necessary to simplify the graph in several ways:

- Focus only on the neighborhood of some ‘points of interest’ in the graph,
- Adapt the visualization to the context of visualization. For example, the visualization of the same graph may not be the same depending on the operator interest (Health, Performance, security, service impact, root cause, etc…)

The point of interest can therefore be seen as a way to quickly focus on points in the graph that require attention from the operator.

Such Points of interest are positioned by the value packs depending on their correlation functionalities. Usually the POI will be associated to a Problem (in the sense of Problem Detection).

POIs are created by the value pack during the correlation process thanks to the `com.hp.uca.expert.topology.poi.POIManager` utility class.

5.5.2 POI Manager API

The POIManager class offers API for:

- Adding `TopologyPOI` object to the Manager
- Retrieving `TopologyPOI` from the Manager
- Deleting `TopologyPOI` from the manager

Note that when a value pack is stopped, all the POIs that have been created by this value pack are removed from the manager.

Refer to the Java documentation provided with the UCA for EBC Development Toolkit for full details on the `POIManager` class methods.

A `TopologyPOI` object is made of:

- nodeId : the identifier of the Neo4J Node object thei POI is related to.

- presentationName: String identifier of the POI (usually set to the node's Name)
- description: String describing the reason for this POI
- category: the category is important as it allows to classify the POIs. The visualization profiles will specify the categories of POIs that will be associated to a given view. Note that several POIs can be created with the same nodeId and with different categories.
  Refer to Chapter 8 of this document for a full description of the visualization Profiles.
- eventTime: the time at which this POI was created.
- importance: the level of importance of the POI. Importance can be 'Low', 'Medium', 'High' or 'Critical'.

5.5.2.1 Adding a TopologyPOI to the Manager

```
static synchronized public void addPoi(TopologyPOI poi);
```

This method adds a TopologyPOI to the POI Manager.

5.5.2.2 Removing a TopologyPOI from the Manager

```
static synchronized public List<TopologyPOI> getPois(String
category);
```

This method returns all the POIs with the category given as parameter.

```
static synchronized public List<TopologyPOI> getPois();
```

This method returns all the defined POIs.

5.5.2.3 Deleting a TopologyPOI from the Manager

```
static synchronized public void removePoi(long nodeId, String
category);
```

This method removes a POI from the POIManager for the given category. A POI is usually removed when the correlation scenario decides the topology node is not remarkable anymore (Ex node status back to normal).

```
static synchronized public void removePoi(TopologyPOI poi)
```

Same behavior as above. The nodeId and categories are taken from de given TopologyPOI object.

5.6 Topology Value Pack example description

The UCA for EBC Development toolkit V3.1 comes with an example Value Pack called "topology-example" located under the %UCA_EBC_DEV_HOME% directory, i.e. the *C:\UCA-EBC-DEV* directory by default.

This example is a good starting point for developing new topology aware Value Packs.

This is also the same example that is created when the UCA for EBC Eclipse plug-in is used to create a new topology aware Value Pack project.

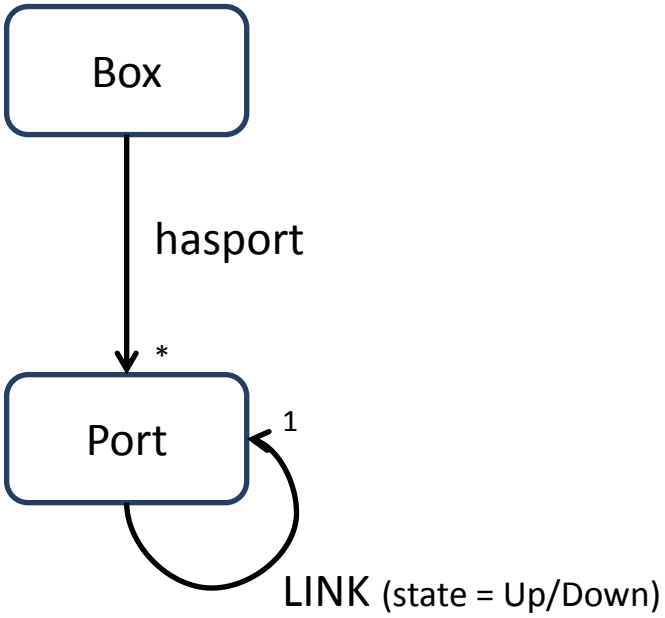
Note

☞ Please refer to Chapter 6 “Creating a new topology aware Value Pack using the UCA eclipse plug-in” for full details on the UCA for EBC Eclipse plug-in usage.

5.6.1 Objectives

The objective of this Value Pack example is to demonstrate a “link down” detection use case.

For this use case the topology model is the following:



In this model, a ‘Box’ node can have several Ports and a Port can be linked to another Port.

When an alarm is received, the OriginatingManagedEntity alarm attribute is used to identify the corresponding topology object (Port).

The Alarm is enriched with a field containing a reference to the LINK relation between the Port this alarm corresponds to and the other Port it is connected to. Then the alarm is inserted into the working memory.

A simple rule detects if two alarms have the same LINK reference with an ‘Up’ LINK state (meaning that the two ends of the LINK have just failed because there are alarms on each Port at both ends of the LINK, but the LINK state is wrongly set to ‘Up’). In such a case, the action part of the rule is executed and state of the LINK is set to ‘Down’.

In the ‘topology-example’ Value Pack, in addition to the LINK ‘Down’ rule that is described above, a similar rule deals with the LINK ‘Up’ use case.

An additional rule is executed when the Value Pack is re-synchronized in order to set all the LINK states to ‘Up’ at initialization time.

5.6.2 Topology aware Value Pack validation

The behavior of a topology aware Value Pack (just like for any “regular” value pack) can be validated by JUnit tests.

Some JUnit tests are provided for the topology-example Value Pack.

The requirement for the topology aware Value Pack tests is that the testing environment provided by the UCA for EBC Development toolkit must implement a topology database server ready to be used when the tests are executed.

There are two ways to configure the topology server when running unit tests:

1. As an embedded full server
2. As an impermanent server

Each of these two configurations has pros and cons:

- The ‘embedded’ full server is a real neo4j server. As such, one can connect on it with the Neo4j Web interface. This may be useful when tuning tests and until they are working correctly. On the other hand, starting a full real neo4j server is costly in term of performance.
- The ‘impermanent’ server is an in-memory version of the neo4j server that should be used only for testing. The main advantage is that it is very fast and does not need any DB cleanup on disk after running the test. However, there is no way to connect the neo4j web interface on such DB.

The approach will be therefore to tune the junit tests using an ‘embedded’ configuration and then, when the test is operational, switch to the ‘impermanent’ configuration.

5.6.2.1 Configuring the Topology JUnit tests with an ‘embedded’ server

This is done by setting the following properties in the *uca-ebc.properties* file located in the Value Pack `src/test/resources` directory:

```
uca.ebc.topology=embedded
uca.ebc.topology.location=target/neo4jDB
uca.ebc.topology.webPort=7475
```

The `uca.ebc.topology` property indicates that a topology server must be embedded during the test.

The `uca.ebc.topology.location` indicates where the database should be created (the target directory is a temporary data directory when building or testing a Value Pack).

The `uca.ebc.topology.webPort` indicates the topology server port. This port should not conflict with the default Neo4j port: 7474, in case a Neo4j server using the default port number is running on the same system.

5.6.2.2 Configuring the Topology JUnit tests with an ‘impermanent’ server

This is done by setting the following property in the *uca-ebc.properties* file located in the Value Pack `src/test/resources` directory:

```
uca.ebc.topology=impermanent
```

All other topology properties are not used.

The `uca.ebc.topology` property indicates that an impermanent topology server must be used during the test.

5.6.2.3 Preparing the Topology Dataload for tests

The tests themselves must prepare the topology environment before beginning to process incoming alarms. Especially the topology objects used by the tests must be present in the Database before the first test is executed.

This is usually done in a @Before section of the Junit test. The utility class 'Loader' is used to load object from CSV files. In the example below these CSV files are located in the valuepack/linkdown/topologyDataload directory of the valuepack.

Note that the CSV files are first copied ion a temporary directory because the loader does modify it.

Refere to the "Topology Data load" Chapter of this manual for a full description of the CSV dataload principle.

Below is an example on how to use the topology data loading in a Junit test:

```
private static TmpDir tmpDir = null;

@BeforeClass
public static void init() {
        removeTopologyDB(); // Cleanup existing DB if any
        tmpDir = new TmpDir("valuepack/linkdown/topologyDataload");
}

@AfterClass
public static void cleanup() {
        tmpDir.cleanup();
}

/**
 * @throws java.lang.Exception
 */
@Before
public void setUp() throws Exception {
        log.info(Constants.TEST_START.val() + linkdownTest.class.getName());

        Loader loader = new Loader(LinkdownTopoAccess.getGraphDB(),
                                   tmpDir.tmpCsvPath());
        Report report = loader.loadAll();

        log.info(report.toString());

}
```

Please refer to the source code of the topology-example Value Pack for the full implementation of the topology-example Value Pack JUnit tests.

5.6.3 Building and Deploying the topology-example Value Pack

In terms of build and deployment, a topology aware Value Pack is very similar to any other UCA for EBC Value Pack.

The Value Pack is built and unit tested using Apache Ant, based on the build.xml file provided with the Value Pack.

The built package can then be deployed on a UCA for EBC server by copying the Value Pack ZIP file generated by the build procedure to the 'valuepacks' directory of the UCA for EBC server.

From the UCA for EBC GUI, the Value Pack can then be deployed and started as usual.

Before sending alarms to the Value Pack, the topology data must be loaded in the topology database. This is done using the topology data load CSV files provided with the Value Pack under the *${UCA_EBC_INSTANCE}/deploy/topology-example-1.1/linkdown/topologyDataload* directory.

The full set of files must be copied to the *${UCA_EBC_INSTANCE}/neo4j/import/csv* directory on the UCA for EBC server and a data load request must be performed from the GUI panel:

UCA for EBC > Topology Management > DataLoad

Clicking on the "Topology Dataload" button will trigger the data load.

When this is done the alarm samples provided with the topology-example Value Pack can be sent using the UCA for EBC alarm injector command-line tool: *${UCA_EBC_HOME}/bin/uca-ebc-injector*.

The two alarm samples are as follows:

- *${UCA_EBC_INSTANCE}/deploy/topology-example-1.1/Alarms_linkdown.xml*
- *${UCA_EBC_INSTANCE}/deploy/topology-example-1.1/Alarms_linkup.xml*

You can send the sample alarm files to UCA for EBC by executing the following commands:

```
[uca]$ cd ${UCA_EBC_INSTANCE}/deploy/topology-example-1.1
[uca]$ ${UCA_EBC_HOME}/bin/uca-ebc-injector -file Alarms_linkdown.xml
[uca]$ ${UCA_EBC_HOME}/bin/uca-ebc-injector -file Alarms_linkup.xml
```

Chapter 6

Creating a new topology aware Value Pack using the UCA eclipse plug-in

6.1 Topology aware Value Pack project creation

The UCA for EBC Value Pack development kit comes with an Eclipse plugin that helps creating UCA for EBC eclipse projects.

The" UCA for EBC Value Pack development Guide" fully describes how to install the Eclipse plugin and create a new UCA for EBC project with the help of this plugin.

This plugin can be used to create topology aware Value Packs.

This is done by selecting the "topology aware Scenario" template from the project creation wizard as shown in the following picture:

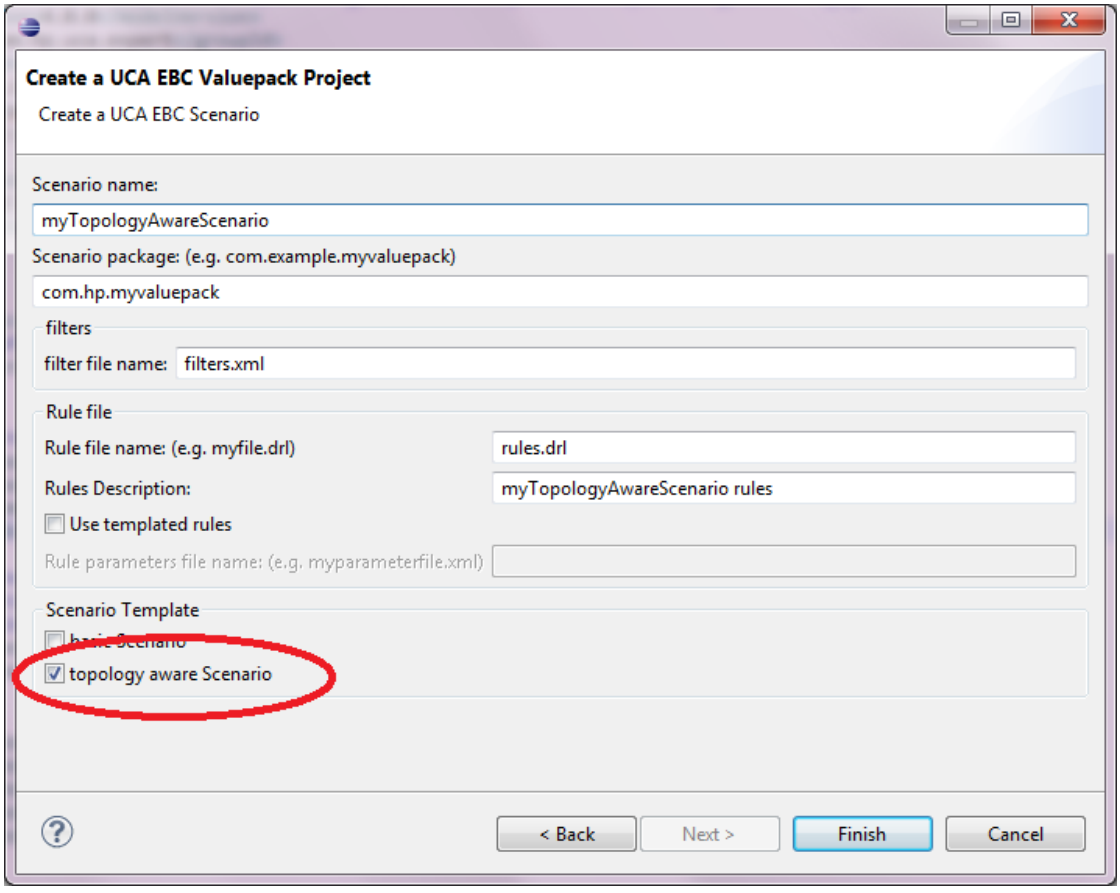


Figure 5 - Topology aware scenario creation using the Eclipse plugin

Choosing this template, the plugin will create a new project based on the 'linkdown' topology aware Value Pack example described earlier in this document.

You will then have to modify some files (topology access java classes, rules, tests) in order to implement your own scenario.

There is no action needed on your part to reference the proper UCA for EBC and UCA for EBC Topology libraries from your new project. Your new project automatically references the necessary libraries from the `%UCA_EBC_DEV_HOME%\lib` directory.

A specific *`uca-ebc.properties`* file is present and configured in your Value Pack in order for the JUnit tests to automatically run an embedded instance of the Neo4j* server. The execution of these JUnit tests will allow you to properly unit test your topology aware Value Pack.

Notes

*Neo4j is the name of the Graph Database used in UCA for EBC to store topology information. For more information on Neo4j please see the following URL: http://neo4j.org

**In the current version of the UCA for EBC Eclipse plugin, when the Topology aware Scenario Template is chosen, the "use templated rules" option has no effect. The plugin will generate non-templated rules.

If you want to use templated rules, you must manually configure the *`ValuepackConfiguration.xml`* file of your ValuePack accordingly.

Chapter 7

Topology Data load

7.1 Introduction

UCA for EBC Topology Extension comes with a data loading tool that can help you populate your UCA for EBC (Neo4j) topology database. This tool reads CSV (Comma-Separated Values) files as input.

The CSV Neo4j loader can be used to insert, update or delete nodes or relationships into a local Neo4j database. When developing a UCA value pack, this is particularly useful for unit or integration testing, to easily upload sample topology data required in the various correlation use cases.

In production, the preferred UCA/Neo4j loading application is the HP Unified Topology Manger (UTM). In fact, UTM generates CSV files behind the scene and invokes the UCA Neo4j CSV loader automatically. In such situations, the CSV loader is hidden to the UCA administrator or users.

The loader has three different forms:

- A Neo4j server plugin. If the Neo4j server is embedded in UCA, the loader plugin is installed by default.
- A java API, accessible in the JUnit tests of a Value Pack project. The main class of the API is: org.neo4j.loader.csv.Loader
- A standalone command line application (made of a unique jar file), useful to test CSV files or visualize test topology data.

7.2 CSV files location

The loader reads input CSV files from a unique directory on disk. The location of this directory is given as a parameter of the data load command. If absent, a default value is used (see below for examples). This input directory is also called the “import” directory.

The procedure to perform a topology data load is the following:

1. Drop some CSV files in the import directory
2. Invoke the data load command (see below for examples), giving the import directory as a parameter (or just rely on the default location if omitted).

These steps can be automated (Junit, UTM) or manual (command line, REST call).

As soon as the data load command is invoked, the input CSV files are moved automatically in an archive directory inside the import directory. A new archive directory is created at each data load attempt. Its name contains a timestamp to make it unique and to keep a clear history of successive load attempts (for

instance as a scheduled operation). This move prevents subsequent imports of the same files.

Typical locations of the import directory on disk are:

- *${UCA_EBC_INSTANCE}/neo4j/import/csv* for embedded database configurations or
- *${NEO4J_HOME}/import/csv* for external database configurations

The Neo4j server process must have **read and write permissions** on this folder. This will be the case by default for embedded Neo4j server configurations. For external configurations, it's better to verify that the permissions on the *${NEO4J_HOME}/import/csv* folder are properly set.

7.3 CSV files names

There are four types of input CSV files, identified by their extension:

- Insert/update Node files, ending with a ".node.csv" extension
- Insert/update Relationship files, ending with a ".rel.csv" extension
- Delete node files, ending with a ".node.delete.csv" extension
- Delete relationship files, ending with a ".rel.delete.csv" extension

The number of files in the import directory is not limited. All *.node.csv, *.rel.csv, *.node.delete.csv, *.rel.delete.csv files present in this directory (excluding sub-directories) are considered by the loader. Files with other extensions are ignored.

As said previously, loaded CSV files are moved to an archive sub-directory (for example: `dataload_2012-06-11_03_29_33/`) to prevent them from being imported again at the next data load request. They keep their original names in the archive directory.

7.4 CSV files format

The first two rows in the CSV files are reserved for the file header. The remainder of the file correspond to nodes or relationships to be inserted, deleted or updated in/from the persistent Neo4j graph database.

Columns in the CSV files are nodes' or relationship's properties values.

Each CSV file must have a special two-line header, providing useful formatting information to the loader through properties' "annotations".

The remaining lines (rows) in the file are properties' values, for nodes (in .nodes.csv files) or relationships (in .rel.csv files). All properties values must comply with the format given in the second line of the header.

Columns are separated by the current CSV separator character, which is traditionally a comma, but which can be customized.

Note that traditionally, standard CSV files have a unique header line. For the Neo4j CSV loader however, the header is always made of two lines. Also, the header contains important information used during the data load process. It is

therefore parsed by the loader, and its syntax must be valid for the file to be loaded correctly.

If the header syntax is invalid, the entire file can be discarded. If some lines in the file do not correspond to the header format (for instance some columns are missing) then only these invalid lines are discarded.

The second line of the header corresponds to a standard CSV header, providing the description for the various columns. The main information for each column is the property name. This name can also be annotated to provide extra information to the loader. Thus, a property can be typed as an integer (instead of a string), if annotated as follows:

```
@type(int)MyProperty
```

Likewise, the loaded node or relationship can be indexed according to a special property if the latter is prefixed with the @index annotation:

```
@index(MyIndex)MyProperty
```

The full syntax of the various headers and annotations, which are specific to each file, is described in the following sections.

Important note: in the syntax description we assume that the column separation character is a comma ‘,’.

Square brackets [] indicate optional fields.

Curly brackets {} indicate fields that can be repeated.

In all descriptions, an example is provided, which should be readable and self-explanatory.

Blank or tab characters are allowed between header elements or after /before the annotations’ brackets.

7.4.1 Node files: *.node.csv

A node file must start with a two-line header of the following format:

```
@ref([rel_name]) {[,
[@const(value)][@type(data_type)]property_name]}
@index(index_name) [@type(data_type)] property_name
{[,[@index(index_name)] [@type(data_type)]
property_name]}
```

For example, for storing rock bands as nodes in the graph, we could define the following node file header:

```
@ref(band), @const(band)type
@index(bands)name, genre, popularity
```

In this example, we store rock bands as nodes in the Neo4j server. Each node has a property name “type” set to a string value “band” (for instance to differentiate these nodes from the others in the graph). The nodes also have three other properties (name, genre and popularity) whose values are given in the respective CSV columns.

7.4.1.1 First line

The **@ref(relation_name) annotation**

This annotation is mandatory. It tells the loader if newly created nodes should be automatically attached to the Neo4j Reference Node. Just leave the brackets empty (i.e. "@ref()") if you don't want to create any relationship.

If a string is provided instead (i.e. "@ref(band)"), each newly created node will be linked automatically to the Reference Node with a relationship named "band". No additional property can be attached to this relationship.

The **@const(property_value)property_name annotation**

This annotation tells the loader if a constant value property should be created for each node (i.e. each row) defined in the file. This is especially useful if you want to tag nodes with a "class" name for example, according to an inherent data "model" in your graph. It avoids creating an extra column containing the same value repeated for all rows. As the property has a constant value (among rows), it cannot be used to index corresponding nodes or relationships. Therefore, @const annotations cannot be mixed with @index ones.

Often, a graph stores an object model (as in UML for example) and nodes are instances of some classes in the model, while properties are attributes of these classes.

For example, if you load some "Book" nodes in the graph, you probably want to add a special property to indicate that these nodes are effectively "books". You can do this easily with the @const annotation as follows:

```
@ref(),@const(Book)class
```

Mixing annotations

You can have as many @const annotations as required, for example:

```
@ref(),@const(Book)class,@const(csv_import)loaded_by,...
```

7.4.1.2 Second line

The second line in the header is the most important one, as it provides the full description and format for all properties' values to be found in the files. It can be seen as the standard "column" description header found in regular CSV files.

The number of entries (i.e. columns) in this header must match exactly the number of columns in each row of the CSV file. If the number of column entries in each row does not match the header count, the row is discarded, as it cannot be parsed correctly according to the given format.

The format of the second line is a simple comma-separated list of property names, which can be annotated.

Here is the second line grammar:

```
@index(index_name) [@type(data_type)] property_name
{[,[@index(index_name)] [@type(data_type)]
property_name]}
```

For example, for describing “book” nodes:

```
@index(title), author, genre, date_of_publication
```

Properties can be annotated, for instance to be automatically indexed or stored in the database with a special data type.

The first property in the header line must be indexed (meaning annotated with @index), with a unique id.

Managing unique indexes is one strong constraint of the CSV loader. This ensures that we can use readable peer names when creating relationships between nodes. It also prevents from creating duplicate entries and later updates using the exact same node file syntax.

The **@index(index_name)property_name annotation**

An `@index(index_name)`annotation can be used if you want to index the corresponding node, with this property as the key.

For instance, consider the following header second line:

```
@index(Books)title,author,genre,date of publication,...
```

This will use the "Books" index to hold book nodes based on their "title" property. All nodes to be connected by a future relationship must be indexed. It's through an index look up that relationships ends ("from" or "to" peers) are referenced in relationship files (*.rel.csv).

The **@type(data_type)property_name annotation**

The @type(data_type) annotation lets you associate a data type to a property, so that the property values are stored natively in this data type in the Neo4j store.

If no type is given (i.e. no annotation) the property is stored as a String. It is then equivalent to @type(String).

Here is an example of a typed property:

```
@type(int)number_of_records
```

This indicates that the "number_of_records" property values should be stored as an integer value. Of course, the values to be found in the corresponding column in the CSV file should be convertible to an int. For instance it should "12" and not "twelve".

If the loader cannot "cast" the property value into the data type specified in the header, the property value is not set at all, not even in its String format.

The data types currently supported are the following (data type names are not case sensitive):

- int or int[]
- long or long[]
- boolean or boolean[]
- string (this is the default data type if no @type annotation is specified) or string[]
- float or float[]

- double or double[]
- char or char[]
- short or short[]

If another un-supported data type is given in the annotation (for example `@type(my_unkwown_type)`, then the "String" data type is used instead.

The square brackets [] refer to “arrays”. In this case, the value is cast to a Java array of the same type. The provided string value is parsed to retrieve the elements of the array. The default separator character is “!” but this can be customized. For example, here is a valid array definition:

```
@type(int[])days_in_month
31!28!31!30!31!30!31!31!30!31!30!31
```

Mixing annotations

Properties descriptions in the header second line can support several annotations, as long as you respect the following order:

```
@index(my_index) @type(my_data_type) my_property_name
```

For example, if one wants to index nodes with a special "ID" property, which is a Long integer, it can be written as follows:

```
@index(NodesById)@type(long)ID
```

7.4.1.3 Node definitions

Node definitions are the remaining lines in CSV node files. They should follow the format provided in the second line of the header.

For example, a short books.node.csv file can look like this (including the two-line header):

```
@ref(),@const(Book)class,@const(csv_import)loaded_by
@index(Books)title,author,genre
Les Miserables,Victor Hugo,novel
The art of computer programming,Donald Knuth,computing
...
```

7.4.2 Relationship files: *.rel.csv

A relationship file must start with the following two-line header:

```
@rel([rel_name]) {[,
[@const(value)][@type(data_type)]property_name]}

@from(index_name) [@type(data_type)] property_name ,
@to(index_name) [@type(data_type)] property_name
{[,[@index(index_name)] [@type(data_type)]
property_name]}
```

For example:

```
@rel(knows)

@from(persons)name, @to(persons)name
```

7.4.2.1 First line

`@rel(relationship_name)` annotation

This annotation just gives the name of the relationship to be created. Currently, the name of the relationship has to be a String value. Typical relationship names in a social graph can be "knows", "follows", "contains" or whatever. In a telecom network it can be “connected to”, “impacting” or else.

If @rel() is left empty, the file name prefix is used as the relationship name. For instance, if the file name is: knows.rel.csv, then the relationship name will be "knows".

`@const(value)` annotation

This annotation is the same as for node files: Please refer to section 7.4.1.1 “First line” above.

7.4.2.2 Second line

As for node files, the second line provides the format of the CSV columns. It must begin with two @from and @to annotations, which are special forms of the @index one. They represent both ends of the new relationship to create (or delete or update).

@from(index_name)key_name annotation

The "from" node of the relationship will be retrieved from an index called "index_name", with the property named "key_name".

For instance, if you want to say that "The Beatles" band has “John Lennon” as a member, here’s how to do it:

```
@rel(member)

@from(bands)name, @to(musicians)name

The Beatles, John Lennon
```

@to(index_name,key_name) annotation

The @to annotation has the exact same syntax as the @from one.

@type(data_type) annotation

The indexed properties can be typed. For instance, if we use a Long Id as in a previous example, we can use it in the @from or @to annotations as follows:

```
@from(NodesAsId)@type(int)ID,@to(NodesAsId)@type(int)ID
12,4
```

To know the list of supported data types, please refer to the same node file section.

@index(index_name)

Relationship can also be indexed. To do this, use the indexed annotation as for nodes. For instance, if the “member” relationship has uniqueId property that you want to add in the “members” index, here is how you can do it:

```
@rel(member)
@from(bands)name, @to(musicians)name, @index(members) @type(int) uniqueId
The Beatles, John Lennon, 42
```

7.5 Updates

Since all nodes are indexed, and all relationships are uniquely identified (by their name and node ends), the CSV loader is always able to detect automatically if a node or a relationship is already present in the database or not. If a CSV record (node or relationship) is already there, it is then treated as an update instead of an insert. Existing properties will be updated and new ones created. Old properties not present in the new CSV line are kept (not deleted) in the database. This is to allow “incremental” updates of records. If you wish to delete some properties, the only solution is first to delete the node or relationship before creating it again with the desired new set of properties.

Note that deleting a node will delete all relationships from or to this node.

“Insert” or “update” files are fully identical and can’t be differentiated, even with their names. The loader decides whether to perform an update or an insert based on the current content of the graph. As a side effect, a same file can therefore contain “inserts” or “updates” data indifferently.

7.6 Deletions

Delete files have a special “.node.delete.csv” or “.rel.delete.csv” extension. Apart from that, their syntax is exactly the same than their respective “insert” (.node.csv or .delete.csv extensions) counterpart. The only difference is just that most columns are ignored if provided.

For node files, only the first column, containing the unique index value is considered during a delete operation. This is indeed enough to retrieve the corresponding node from the graph and to delete it. When deleting a node, all relationships, incoming or out-coming, from this node are deleted

automatically as well. The corresponding unique entry is also removed from the node index.

For relationship files, only the “@to” and “@from” columns are considered. This is enough to retrieve the corresponding relationship (identified with its name) and delete it from the graph.

7.7 Neo4j transactions

The loader uses one Neo4j transaction per CSV file. It means that if the file is big, the memory consumption may increase significantly. In this case, you can split the file to several ones that will be manage it different sessions.

7.7.1 Examples

Here follow two simple but complete examples of CSV data files that can be loaded in Neo4j thanks to the UCA for EBC data loading tool.

7.7.2 Rocks bands

This example is made of three files (2 node files and 1 relationship file):

- band.node.csv
- musician.node.csv
- member.rel.csv

It demonstrates a basic database of rock bands and musicians linked by a “member of” relationship.

band.node.csv:

```
@ref(band),@const(band)type
@index(bands)name,genre,popularity
The Beatles,pop,fantastic
The Rolling Stones,rock,great
```

musician.node.csv:

```
@ref(),@const(musician)type
@index(musicians)name,instrument
Paul McCartney,bass
John Lennon,guitar
Georges Harrison,guitar
Ringo Star,drums
Mick Jagger,singer
Keith Richards,guitar
Brian Jones,guitar
Charlie Watts,drums
Bill Wyman,bass
```

member.rel.csv:

```
@rel(member)
@from(bands)name,@to(musicians)name
The Beatles,Paul McCartney
The Beatles,John Lennon
The Beatles,Georges Harrison
The Beatles,Ringo Star
The Rolling Stones,Mick Jagger
The Rolling Stones,Keith Richards
The Rolling Stones,Brian Jones
The Rolling Stones,Charlie Watts
The Rolling Stones,Bill Wyman
```

7.7.3 Network entities

In this other example, we simulate a basic IT network with servers and routers as nodes and wire connections as relationships between nodes.

$ ls *csv

router_connections.rel.csv

routers.node.csv

server_connections.rel.csv

servers.node.csv

$ cat router_connections.rel.csv

```
@rel(connectedTo)
@from(routers)name,@to(routers)name,bandwidth
Router1, Router2, 10 Gbps
```

$ cat routers.node.csv

```
@ref(router)
@index(routers)name, vendor
Router1, Cisco
Router2, 3Com
```

$ cat server_connections.rel.csv

```
@rel(connectedTo)
@from(servers)IP,@to(routers)name,bandwidth
1.1.1.1, Router1, 1 Gbps
1.1.1.2, Router1, 1 Gbps
1.1.1.3, Router1, 1 Gbps
1.1.1.4, Router1, 1 Gbps
2.2.2.1, Router2, 1 Gbps
2.2.2.2, Router2, 1 Gbps
2.2.2.3, Router2, 1 Gbps
2.2.2.4, Router2, 1 Gbps
```

$ cat servers.node.csv

```
@ref(),@const(server)type
@index(servers)IP,vendor,OS
1.1.1.1,HP,Linux
1.1.1.2,HP,Linux
1.1.1.3,HP,Linux
1.1.1.4,HP,Linux
2.2.2.1,HP,Linux
2.2.2.2,HP,Linux
2.2.2.3,HP,Linux
2.2.2.4,HP,Linux
```

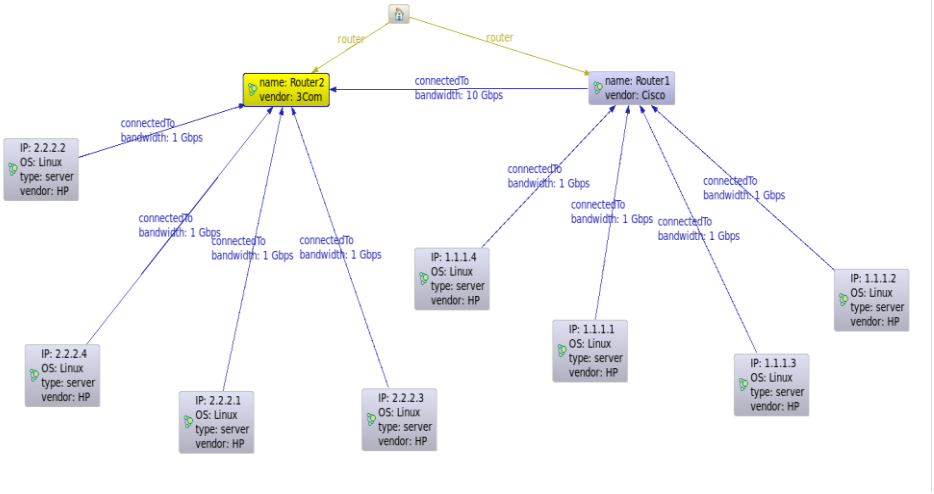


Figure 6 - Graph visualization in Neoclipse

7.8 Run the data load

In a UCA runtime environment, the Neo4j data loader is installed as a Neo4j server plug-in. In a UCA development, the loader can be invoked from a Junit test case using a Java API.

7.8.1 From UTM

The UTM populator hides the usage of the CSV loader. Please refer to the UTM documentation for details on how configuring the UCA populator.

7.8.2 From the UCA GUI

Once some CSV files have been placed in the import directory, the UCA GUI can be used to perform the data load manually. In the “Data load” panel, just push the “topology data load” button. Please refer to this section for more details: 4.3.

7.8.3 From Java or Scala code (in Unit tests)

The main direct usage of the CSV loader is probably in the Unit Tests of a UCA Value Pack. This is useful to test correlation rules that make use of topology information in their decision process. A sample topology is then created for the lifetime of the tests. This sample topology can be defined as a set of CSV files, which is loaded in the embedded Noe4j server at the

beginning of a test suite. This is more convenient than creating a graph manually using the Neo4j Java API.

In this case, the CSV loader is invoked through the org.neo4j.loader.csv.Loader class. In particular, this class has a LoadAll() method that will upload all files present in the import directory.

The procedure to use the CSV loader from Java is the following:

1. Create an instance of the org.neo4j.loader.csv.Loader class using the class constructor:

   ```
   Loader loader = new
   Loader(ExtendedTopoAccess.getGraphDB(),
   tmpDir.tmpCsvPath);
   ```

   The first argument is the GraphDatabaseService object representing the access point to the Neo4j server we wish to use. Within a UCA environment it can be retrieved through the static method: ExtendedTopoAccess.getGraphDB().

   The second argument of the constructor is the import directory where to find the CSV files to be loaded. It is usually a temporary directory on disk (like /tmp on Linux). It can be flushed safely at the end of the test.

2. Copy the desired CSV in the temporary import directory. Be careful in this step to make real copies of the files in a temporary directory. Especially, do not be tempted to directly use the location of some resource files from your development Project (e.g. Maven or Eclipse): remember that the CSV loader will move the CSV files automatically in an archive directory once the data load is complete!

3. Call the LoadAll() method:

   ```
   Report report = loader.loadAll();
   ```

   It returns an org.neo4j.loader.csv.Report instance holding useful statistics about the performed data load. It can be dumped with the toString() method.

7.8.4 Through the Neo4j server plugin and REST API

The CSV loader Neo4j server plug-in is installed by default when UCA for EBC is set up to use an embedded Neo4j server (i.e. when the ***uca.ebc.topology*** property is set to "**embedded**" in the *${UCA_EBC_INSTANCE}/conf/uca-ebc.properties* file).

Alternatively, if an external Neo4j server is used (i.e. when the ***uca.ebc.topology*** property is set to "**external**" in the *${UCA_EBC_INSTANCE}/conf/uca-ebc.properties* file) then you have to finalize the installation of the data loading plug-in manually as explained in chapter 3.2 "Configuring the topology data load function" of this document.

Once the Neo4j server (embedded in UCA or external) is started, should see a "load_csv" REST service available:

```
$ curl -v http://localhost:7474/db/data/
```

```
    "LoadCsv" : {
      "load_csv" :
"http://localhost:7474/db/data/ext/LoadCsv/graphdb/load_c
sv"
    },
  }
```

To trigger a data load, issue a post request to the corresponding service (change the URL accordingly).

```
$ curl -X POST
http://localhost:7474/db/data/ext/LoadCsv/graphdb/load_cs
v
```

By default, the CSV loader Neo4j server plugin reads CSV files from a specific directory on disk: $NEO4J_HOME/import/csv. In this case, $NEO4J_HOME is the root directory of the Neo4j server on your system. Another location can be given as argument as follows:

```
$ curl -X POST
http://localhost:7474/db/data/ext/LoadCsv/graphdb/load_cs
v \
  -H "Content-Type: application/json" \
  -d '{"csvpath":"your_import_directory"}'
```

7.9 Data Load output

7.9.1 Load Report

As a result of the data load, a new directory is always created, suffixed by the date and time of the data load. For example:

```
dataload_2012-06-11_03_29_33/
```

The original CSV files are moved to this directory, to prevent them from being imported again at the next load request.

The directory also contains a “report.txt” file, summarizing the data load outcome.

For example:

```
CSV Import from: /opt/UCA-EBC/neo4j/import/csv, at : Mon Jun 11 15:29:34 CEST
2012
----------------
musician.node.csv: complete load: 9 loaded sucessfully, 0 discarded, in 387 ms
band.node.csv: complete load: 2 loaded sucessfully, 0 discarded, in 41 ms
member.rel.csv: load complete: 9 loaded sucessfully, 0 discarded, in 187 ms
---------
Total: 20 nodes or relationships inserted (0 discarded), in 616 ms
```

7.9.2 Discarded entities

It may happen that some rows in the CSV files are badly formatted (for instance some columns are missing). In this case, the row is discarded (resulting in no node or relationship being created) and pushed to a ".discarded" file: this file has the same name than the input CSV file, with an additional “.discarded” extension.

The main situation where relationship entries get discarded is when the nodes that make up a relationship referenced using @from or @to annotations cannot be found in the indexes. This typically happens when a node has been previously discarded because a property was missing. As a result all relationships from or to this node will be discarded as well.

7.10 Configuration

The loader can be configured through the following configuration files:

- csv-loader.conf , located wherever on the application classpath
- reference.conf, located wherever on the classpath. This is the fallback configuration file (that can be shared with other applications) in case the csv-loader.conf one is not found.

The file syntax follows the Typesafe config conventions:

```
csv-loader {
    separator = ","
    arraySeparator = "!"
    dumpReport = true
    bulkCommit = 1000
}
```

The following configuration values can be customized:

separator: this is the separator character used to distinguish columns in the CSV files. This is traditionally the comma character: “,”, as in “Comma” Separated Values. It can be changed to any other character. The new character value has to be given between double quotes (as a string).

arraySeparator: this is the character used to separate elements in case a Neo4j property is set to be an “array” data type, through the @type header annotation.

For example if an header property is defined as follows, with 2 example rows:

```
@type(string[])an_array_property
Hello%uca%world!
The%meaning%of%life%is%42
```

The arraySeperator character must be set to “%” so that the values are parsed correctly and stored as arrays of string in Neo4j.

dumpReport: this is to tell the loader either to dump or not the report about how many nodes or relationships have been loaded or discarded in what amount of time. This could be useful for statistic purpose and to verify that the loading was fully successful or not.

bulkCommit: this is to support bulk transactions in the graph DB. When not specified, only one single transaction is opened for an entire CSV file, and the commit is done at the end.

If the input file contains many lines of data to load, this could lead to a memory overflow of the JVM because current update is kept in memory for a possible rollback. To avoid such problem, when specifying this value, the loader will perform a commit at regular intervals, interval which is specified by the value (by default 1000).

Note that this value can have a big influence on the performance and memory consumption of the loader (and embedding JVM). The bigger it is, the best the performance is, but more memory is used.

For information, with default settings during a test, the CSV loader has successfully performed a load of 7 million nodes and relationships without any problem in about 1 hour (on a small VM).

The configuration values take effect for all CSV files to be loaded. A fine, per-fine tuning is not possible.

7.11 Logging

UCA-EBC embedded neo4j server:

The traces are activated through the UCA-EBC logging mechanism.

The following logger from the uca-ebc-log4j.xml configuration file controls the Neo4J CSV data load logging:

```
<logger name="org.neo4j.loader.csv" additivity="false">
     <level value="INFO" />
     <appender-ref ref="TOPODATALOAD" />
     <appender-ref ref="CONSOLE" />
     <appender-ref ref="FILE" />
     <appender-ref ref="DB" />
 </logger>
```

By using this logger, traces are put on the Console, in the uca-ebc.log file, in the UCA-EBC log database and on a specific file dedicated to the CSV loading though the TOPODATALOAD appender.
This specific file is `uca-ebc-TopologyDataload.log`

External Neo4J server:

The CSV loader uses logback has a default logging back end.

Logging levels can then be set in the logback.xml file, if found on the application classpath.

The package name to use is “org.neo4j.loader.csv”. The default log level is “INFO”.

Thus, to activate debug traces, just change the following line the logback.xml file (replacing “INFO” by “DEBUG”).

```
<logger name="org.neo4j.loader.csv" level="DEBUG"/>
```

Chapter 8

Visualizing the topology graph

8.1 Introduction

The UCA for EBC Topology Extension version 3.1 provides a specific User Interface extension for displaying the topology as a graph.

The intention here is in general not to visualize the full graph but instead, focus specifically on areas that could be of a specific point of interest.

The point of interest a defined at the Value pack level, in general associated to ‘Problems’ (in the sense of Problem Detection).

This visualization of the graph in the neighborhood of a POI is fully driven by the selected ‘visualization profile’. In fact, the way the topology drawing is to be rendered is dependent on the domain of interest on which the user focuses. The rendering should be therefore different depending on the interest of the user (service impact, root cause, performance, security violation etc…) this is what is called a ‘visualization profile’ or simply ‘profile’

A visualization profile is a set of definitions allowing specifying how the graph should be rendered. This covers:

- ✓ The drawing configuration:
  - The drawing icons
  - The node’s displayed names
  - The text color and font
  - The relationship line style (line, dotted lines, arrows etc…)
  - The relationship’s displayed names
- ✓ The overlay icons configuration
  - Allows selecting which node’s attributes and values will be used for displaying overlay icons.
  - Specify the overlay icons.
- ✓ Graph drawing configuration:
  - The policy for retrieving node neighborhood can be defined for each node Type.
  - Automatic retrieval of node neighborhood
  - Support of virtual links
- ✓ The Point of Interest categories the profile is associated to.

8.2 License policy

IMPORTANT NOTE: In order to use this 'UCA for EBC Graph Display' feature, you need to obtain a valid license key for the **Unified OSS Console** product and install it in the *license.txt* file located in the *${UCA_EBC_DATA}/instances/<instance name>/licenses* folder.

If you have no valid license key for the 'UCA for EBC Graph Display' feature, UCA for EBC Server will start but the 'UCA for EBC Graph Display' feature will not be activated.

8.3 Defining visualization profiles

The profiles are defined the file ${UCA_EBC_DATA}/conf/GraphDisplayProfiles.xml using an XML format.

The Profile definition simplified schema is as follow:

```
<?xml version="1.0" encoding="UTF-8"?>
<Profiles xmlns="http://config.graphdisplay.ebc.uca.hp.com/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <Profile>
        <DefaultNode>
            <Icon>
                <MainIcon>
                <Decorations>
                    <Decoration>
                </Decorations>
            </Icon>
            <Text>
                <Color>
                <Font>
                <Size>
                <Emphasis>
                <DisplayedName>
            </Text>
            <GetNeighbors>
                 <Queries>
                     <Query>
                </Queries>
            </GetNeighbor>
        </DefaultNode>
        <DefaultRelationship>
            <LineType>
            <SourceHead>
            <TargetHead>
            <DisplayedName>
            <Colors>
                <Color>
            </Colors>
        </DefaultRelationship>
        <Nodes>
            <Node>
                <Icon>
                    <MainIcon>
                    <Decorations>
                        <Decoration>
                    </Decorations>
                </Icon>
                <Text>
                    <Color>
```

```
                    <Font>
                    <Size>
                    <Emphasis>
                    <DisplayedName>
                </Text>
                <GetNeighbors>
                    <Queries>
                        <Query>
                    </Queries>
                </GetNeighbor>
            </Node>
        </Nodes>
        <Relationships>
            <Relationship
                <LineType>
                <SourceHead>
                <TargetHead>
                <DisplayedName>
                <Colors>
                    <Color>
                </Colors>
            </Relationship>
        </Relationships>
    </Profile>
</Profiles>
```

Profiles

'Profiles' defines a collection of view profiles.

Element	Type	Description
Profiles	List<Profile>	Set of Profile definitions.

Profile

'Profile' defines a view Profile.

Attributes	Type	Description
name	String	The Profile short name. (mandatory)
displayedName	String	Profile displayed name. (mandatory)
POICategories	String	Coma separated list of POI categories associated with this profiles. If not specified, all POIs will be available. (optional)
defaultProfile	Boolean	If true, indicates this profile is the default profile (i.e. the one active by default) (default=false)
InitialLayout	String	Specify the Initial Layout for such profile (the user can then change it from the toolbar) Possible values are : • Hierarchical • Orthogonal • Circular • Symmetric

- The POICategories gives a coma separated list of POI Categories associated to this profile. By selecting this profile, the POI list will be filtered in order to present only those POIs having a category listed here.

Elements	Type	Description
DefaultNode	DefaultNode	Default Node definition. (optional)
DefaultRelationship	DefaultRelationship	Default Relationship definition. (optional)
Nodes	List<Node>	Set of Node definitions.
Relationships	List<Relationship>	Set of Relationship definitions.

- The DefaultNode definition is the Node rendering definition for nodes that don't appear in the Nodes definition list.
- The DefaultRelationship definition is the Relationship rendering definitions for relations that don't appear in the Relationships definition list.

DefaultNode

Defines the default Nodes rendering.

Elements	Type	Description
Icon	Icon	Default Node Icons definition (optional)
Text	Text	Default Node label definition. (optional)
GetNeighbors	GetNeighbors	Default Node 'getNeighbor' policy: set of cypher queries for getting Node's neighbors. (optional)

DefaultRelationship

Defines the default relationship rendering.

Elements	Type	Description
LineType	Enumeration: Line, dash, smalldash, dot, dashdot, dashdotdot	Line rendering. (optional)
SourceHead	Enumeration: None, arrow, openarrow, losange, circle, doublearrow, halffilledarrow.	Begin of line rendering. (optional)
TargetHead	Enumeration: None, arrow, openarrow, losange, circle, doublearrow, halffilledarrow.	End of line rendering. (optional)
DisplayedName	String	Relationship displayed name

Colors	Colors	Color rendering of the default relationship

The displayedName is the text string displayed near the relation line. This String may contain placeholders representing relationship's attributes. Example: if the relationship has an attribute named 'type' you can use the string `${type}` to display the content of the 'type' attribute near the relation line. There is no restriction on the number of placeholders that can be used in the displayedName string.

Node

Defines the Node rendering for Nodes having an attribute specified by 'attributeName' with value of 'attributeValue'.

Attributes	Type	Description
attributeName	String	Specify a Node's attribute. (mandatory)
attributeValue	String	Specify the value for the attribute specified above. (mandatory)

Elements	Type	Description
Icon	Icon	Node's Icons definition (optional)
Text	Text	Node's label definition. (optional)
GetNeighbors	GetNeighbors	Node's 'getNeighbor' policy: set of cypher queries for getting Node's neighbors. (optional)

Relationship

Defines the relationship rendering for Relations having an attribute specified by 'attributeName' with value of 'attributeValue'.

Attributes	Type	Description
attributeName	String	Specify a Relationship's attribute. (mandatory)
attributeValue	String	Specify the value for the attribute specified above. (mandatory)

Elements	Type	Description
LineType	Enumeration: Line, dash, smalldash, dot, dashdot, dashdotdot	Line rendering. (optional)
SourceHead	Enumeration: None, arrow, openarrow, losange, circle, doublearrow, halffilledarrow.	Begin of line rendering. (optional)

TargetHead	Enumeration: None, arrow, openarrow, losange, circle, doublearrow, halffilledarrow.	End of line rendering. (optional)
DisplayedName	String	Relationship displayed name
Colors	Colors	Color rendering of this relationship

The displayedName is the text string displayed near the relation line. This String may contain placeholders representing relationship's attributes. Example: if the relationship has an attribute named 'type' you can use the string `${type}` to display the content of the 'type' attribute near the relation line. There is no restriction on the number of placeholders that can be used in the displayedName string.

Icon

Defines the Node's Icons.

Elements	Type	Description
MainIcon	String	Main icon file name
Decorations	Decorations	Overlay icons definitions (optional)

The MainIcon filename represent a relative path of the icon file. This path must be part of the UCA-EBC server classpath. It is recommended to store customer's icon directories under the `${UCA_EBC_DATA}/conf/` as the `conf` directory is part of the class path. As an example, if an icon file named 'myicon.png' is stored under `${UCA_EBC_DATA}/conf/images` the MainIcon definition should be:

```
<MainIcon>images/myicon.png</MainIcon>
```

Text

Defines the Node's label rendering.

Elements	Type	Description
Color	String	String representing the text color (RGB format) Ex: Black: 0 0 0 Red: 255 0 0 Green: 0 255 0 Blue: 0 0 255
Font	String	The font name Ex: SansSerif
Size	Integer	The Font size
Emphasis	Enumeration: Plain, bold, italic, bold italic	The text emphasis
DisplayedName	String	The Node's displayed name

The displayedName is the text string displayed as the node's label. This String may contain placeholders representing node's attributes. Example: if the node has an attribute named 'name' you can use the string `${name}` to display the content of the 'name' attribute near the node's icon. There is no restriction on the number of placeholders that can be used in the displayedName string.

Exemple: `<DisplayedName>${ID}:${name}</DisplayedName>`

GetNeighbor

Defines the graph queries to perform when the 'getNeighbors' action is requested from the UI or when the node is initially displayed.

Attributes	Type	Description
automatic	Boolean	If true, as soon as this node is displayed on the graph, the defined queries are executed and the queried neighbors displayed in turn. (optional)
level	Integer	This is to limit the level of getNeighbors recursions. The level value indicates the graph depth (i.e. the number of automatic getNeighbors from the displayed root node). (optional)

Element	Type	Description
Queries	List<Query>	Set of Cypher Queries

Colors

Defines the Relation's color rendering

Attributes	Type	Description
attributeName	String	Relationship attribute Name of the attribute used for selecting the color (mandatory)
default	String	String representing the default line color. (Used for values not defines in the Color list). (RGB format) Ex: Black: 0 0 0 Red: 255 0 0 Green: 0 255 0 Blue: 0 0 255 (optional)

Element	Type	Description
Color	List<Color>	Set of color settings per attribute value

Color

Defines the color setting for a given relationship attribute value

Attribute	Type	Description
attributeValue	String	Relationship attribute value (optional)

Element	Type	Description
	String	String representing the line color (RGB format) Ex: Black: 0 0 0 Red: 255 0 0 Green: 0 255 0 Blue: 0 0 255

Example of relationship's colors definition:

```
<Colors attributeName="state" default="0 0 255">
          <Color attributeValue="Warning">255 128 0</Color>
          <Color attributeValue="Failed">255 0 0</Color>
          <Color attributeValue="Normal">0 0 255</Color>
</Colors>
```

Decorations

Defines the Node decorations (overlay icons configuration)

Attribute	Type	Description
attributeName	String	Node's attribute Name of the attribute used for selecting the overlay icon (mandatory)
default	String	Default overlay icon file name. (Used for values not defines in the Decoration list). (optional)

Element	Type	Description
Decoration	List<Decoration>	Set of Decoration settings per attribute value

Decoration

Defines overlay icons decoration for a node given node's attribute value.

Attribute	Type	Description
attributeValue	String	Node attribute value (optional)

Element	Type	Description
	String	Overlay icon file name.

Example of node's decorations definition:

```
<Decorations attributeName="state"
             default="images/unknown.png">
      <Decoration attributeValue="Degraded">
```

```
            images/warningLarge.png
        </Decoration>
        <Decoration attributeValue="Error">
            images/error-icon.png
        </Decoration>
        <Decoration attributeValue="Normal">
            images/check-icon.png
        </Decoration>
</Decorations>
```

Query

Defines the cypher query used to retrieve node's neighbors.

Element	Type	Description
Query	String	Cypher Query.

To be valid, the Cypher Query must comply with the following restrictions:

- The start node (identifying the node for which the neighbors are queried) is identified as the '`startNode`. It must be defined as "`startNode = node({nodeID})`" in the Query.
- The returned neighbors are identified by '`endNode`'
- The relation between the startNode and endNode is identified as '`relationship`'.
- The returned values **MUST** be :
    - `startNode, relationship, endNode;`

  or

    - `startNode, endNode;`

  In the last case (when the '`relationship`' is not returned) this relationship between the startNode and the endNode is considered as being '**virtual**'. A virtual relation may not correspond really to an existing topology relationship but is the constructed result of the graph query. This allows having graphical representations of the graph that are not the exact view of what the topology is. 'Virtual' relationships are usually used for providing simplified topology views.

Examples of Valid Cypher Queries:

- Get all immediate neighbors:

```
<Query><![CDATA[START startNode = node({nodeID})  MATCH
(startNode)-[relationship]->(endNode) RETURN startNode,
relationship, endNode;]]></Query>
```

- Get all immediate neighbors related with a relationship of type 'LINK':

```
<Query><![CDATA[START startNode = node({nodeID})  MATCH
(startNode)-[relationship:LINK]->(endNode) RETURN startNode,
relationship, endNode;]]></Query>
```

Examples of queries returning a virtual relationship:

```
<Query><![CDATA[START startNode = node({nodeID})  MATCH
(startNode)-[:hasport]->(b)<-[:LINK]->(c)<-[:hasport]-
(endNode) RETURN startNode, endNode;]]></Query>
```

```
<Query><![CDATA[START startNode = node({nodeID})  MATCH
(startNode)-[:hasport|LINK*1..3]-(endNode) RETURN startNode,
endNode; ]]></Query>
```

8.4 Using the Graph Visualization tool

As explained above the graph visualization tool allows viewing the graph in the neighborhood of some remarkable points (or Points Of Interest) and with specific rendering.

The association of the rendering definitions (icons, colors, overlay icons etc…) and the 'Points Of Interest' categories is done through the Profiles.

The Profile selection is therefore the main thing to consider when trying visualizing the graph. This selection is made with the profile selection button located on the right hand side of the drawing panel as shown in the picture below:

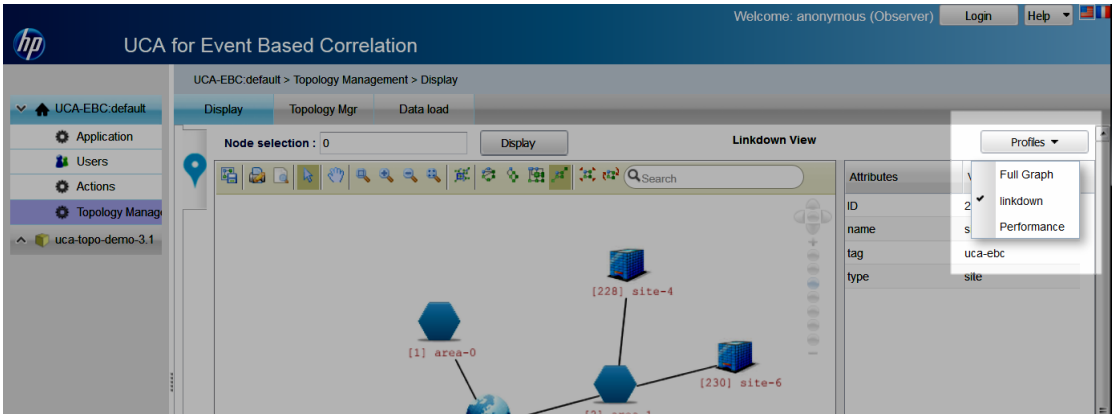


Figure 7 - Profile selection

8.4.1 Displaying the graph in the neighborhood of a given Node:

If the user knows in advance the node ID of the root node to visualize, the 'node selection' tool can be used:

Just enter the node Id (integer value) and click on the 'Display' button.

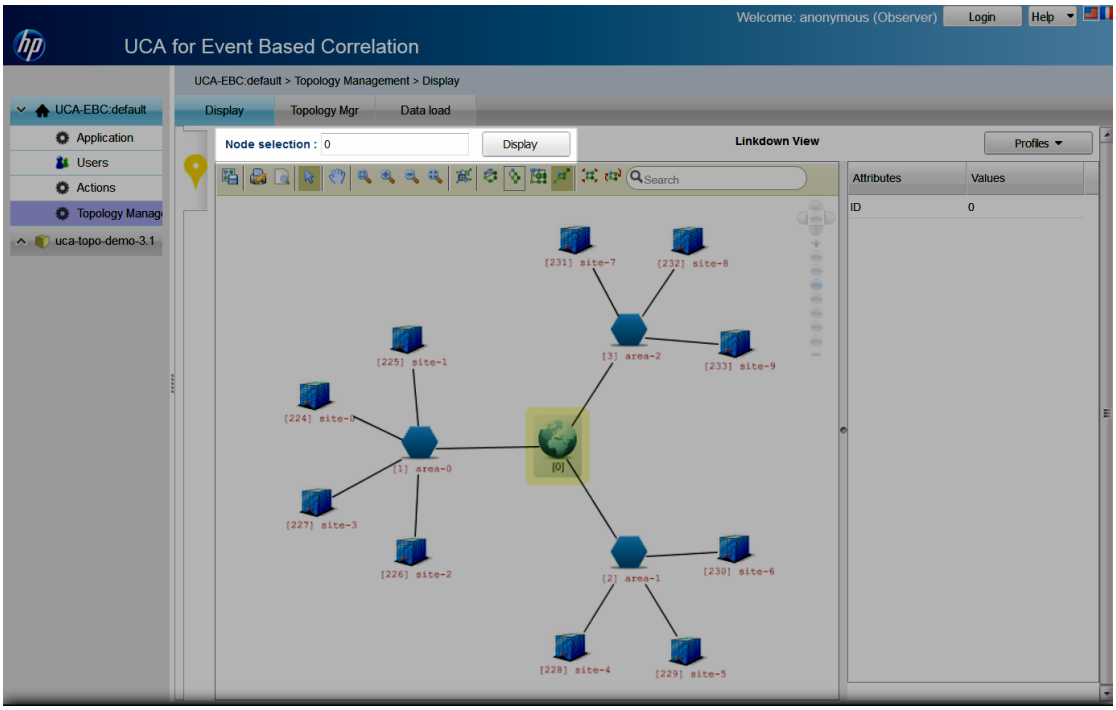


Figure 8 - Root node selection tool

At this stage, the part of the graph represented in the drawing view is fully driven by the definition profile: The graphic rendering as well as the sub-graph itself which is the result of the Cypher queries defined in the selected profile.

8.4.2 Displaying the graph in the neighborhood of a 'Point of interest'

When a profile is selected, the view title is changed according to the profile display name, and the rendering of the current graph is changed to comply with the rendering definitions in the profile.

Moreover the POI list is changed in order to list only the POIs that have a category which is part of the Profile's 'POIcategories' list.

To view the POI list the user must click on the left hand side vertical Tab as shown in the picture below:

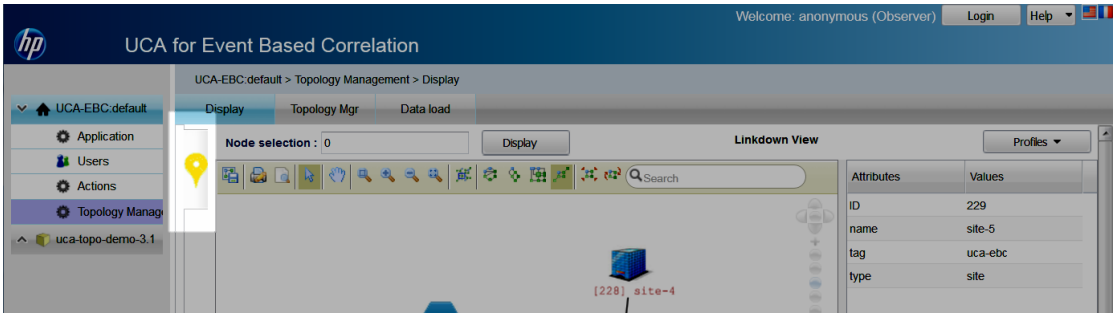


Figure 9 - POI Tab

When this tab is clicked the POI tables expends allowing selecting a:

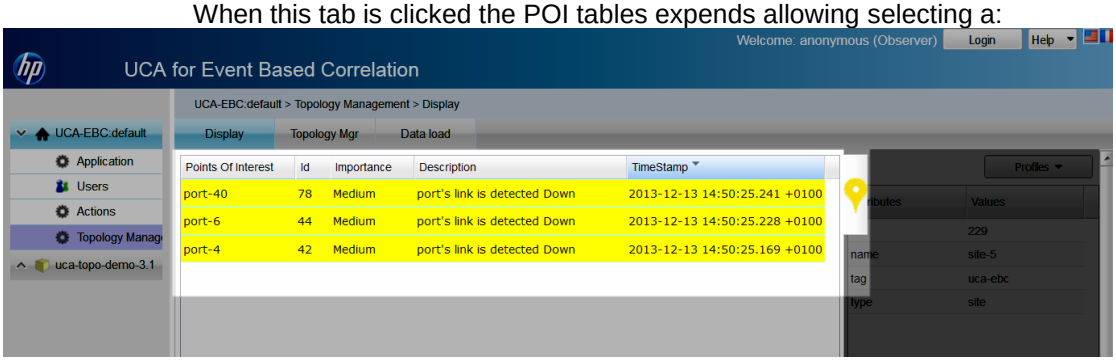


Figure 10 - POI Table

By clicking in one of the POI lines, the POI table closes and the topology node associated to the POI becomes the root node of the topology view displayed in the main drawing panel:

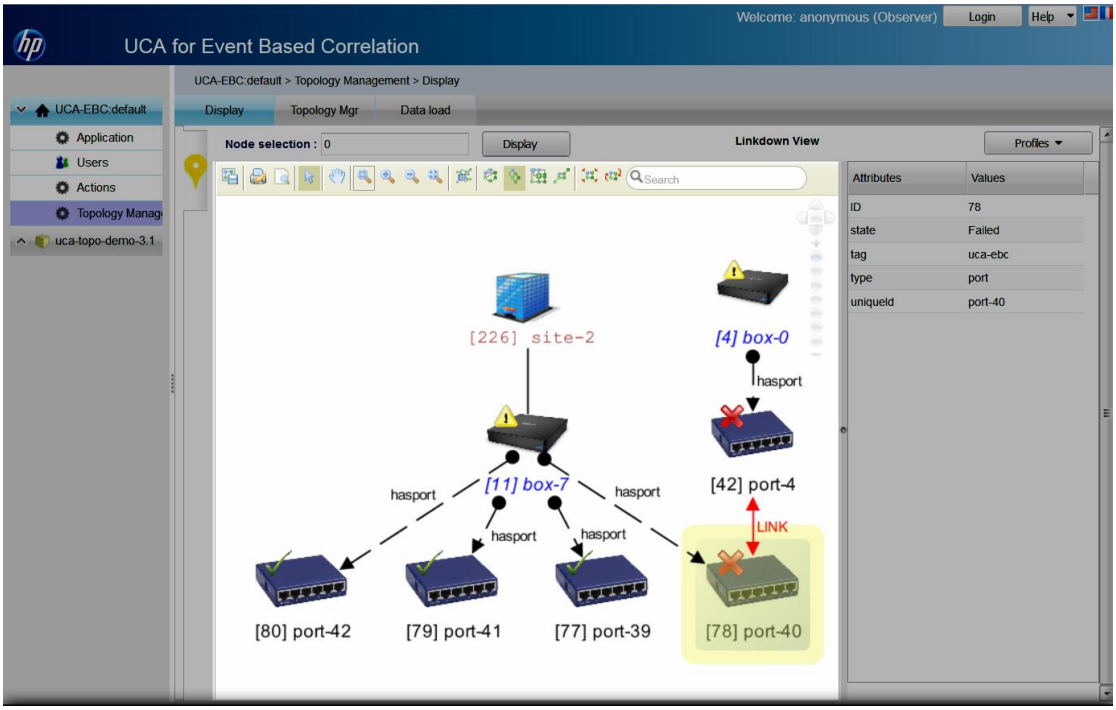


Figure 11 - Drawing the graph from POI

Again, the part of the graph represented in the drawing view is fully driven by the definition profile: The graphic rendering as well as the sub-graph itself that is the result of the Cypher queries defined in the selected profile. The decoration icons and their association with node attributes and values are also defined in the profile.

8.4.3 Extending the displayed graph

By right clicking on a displayed node a “Get Neighbors” action is available:

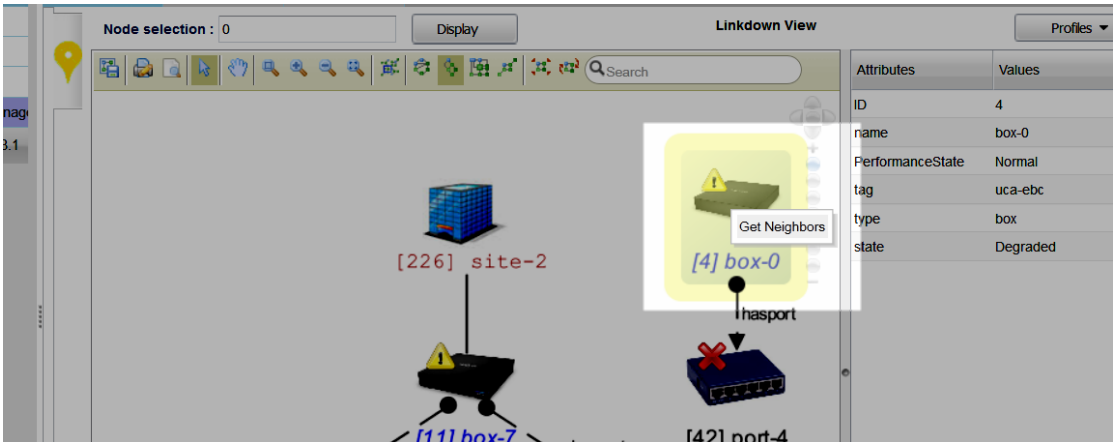


Figure 12 - Get Neighbors action

This allows extending the graph from the clicked node. The retrieved neighbors are the result of the cypher query defined in the profile for this given node type:

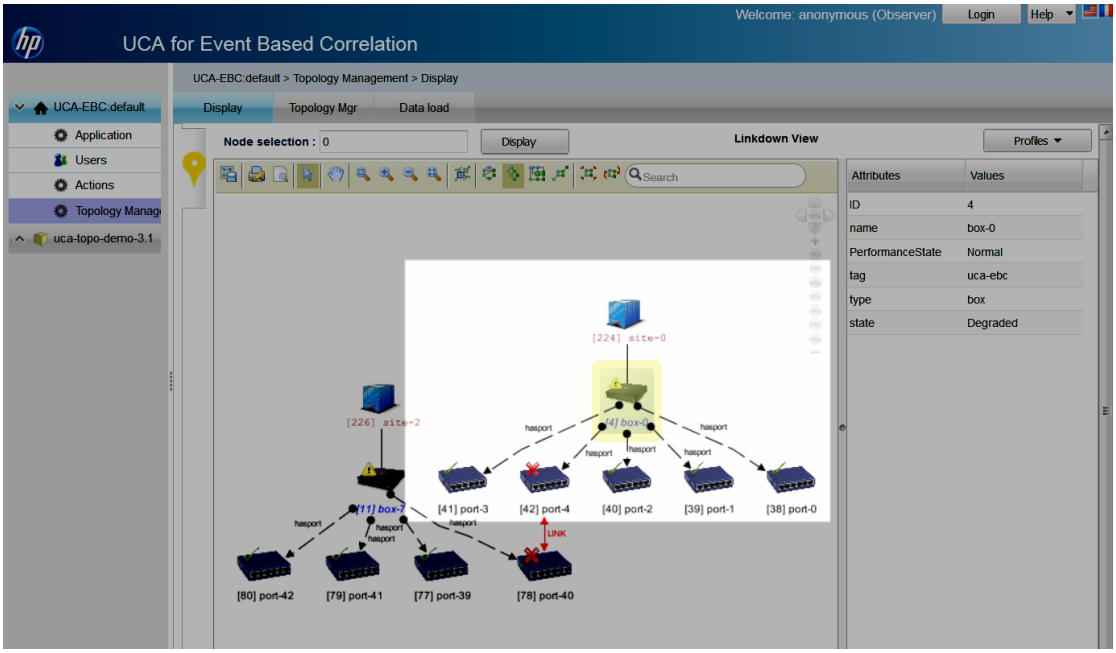


Figure 13 - Extended graph

8.4.4 The drawing view Toolbar

The drawing view toolbar gives access to a set of tools allowing mainly playing with the displayed graph layout:

Among them:

- Zoom-in
- Zoom-out
- Overview
- Circular Layout
- Hierarchical Layout
- Orthogonal layout
- Symmetrical Layout
- Global Layout
- Searching Tool

8.4.5 The Inspector view

Left clicking on a node or relationship in the ‘graph view’ makes an update of the ‘Inspector View’ with information from this clicked node or relationship.

The inspector view displays the element’s attributes values as follow as they are retrieved directly from the neo4jDatabase (or from memory for those attributes that are managed by the In-Memory attribute manager).

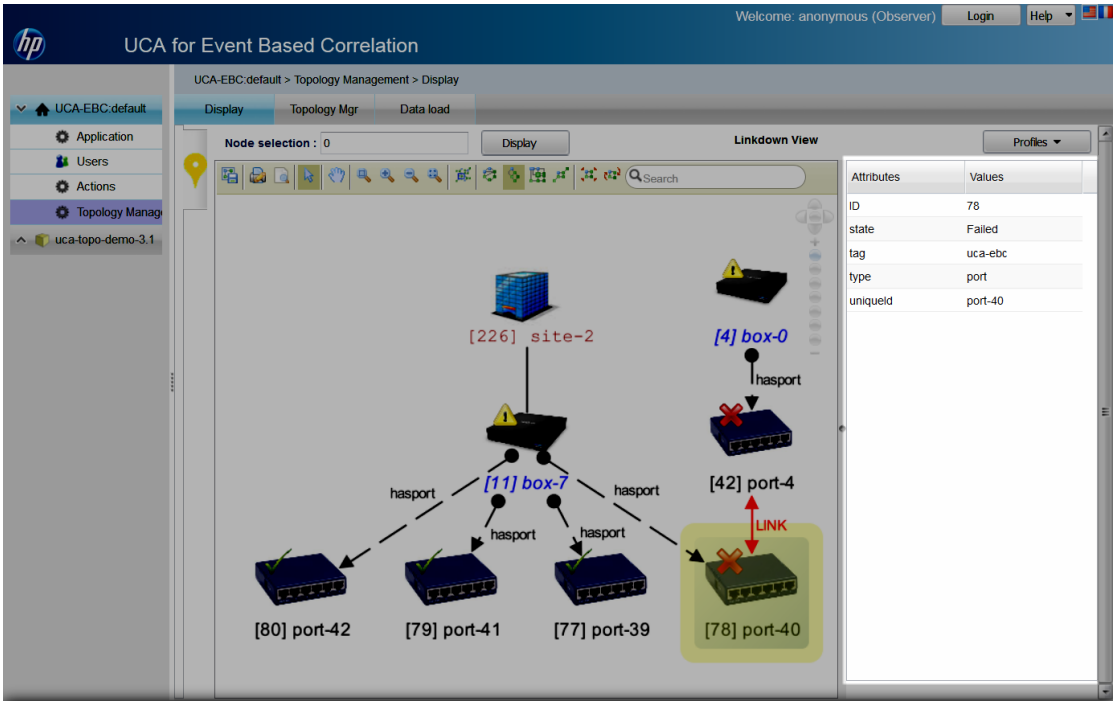


Figure 14 - Inspector view

Glossary

CSV: Comma-Separated Values

DRL: Drools Rule file

EBC: Event Based Correlation

EVP: UCA for EBC Value Pack

Inference Engine: Process that uses a Rete algorithm

IP: Installation Package for OSS Open Mediation V7.0

JDK: Java Development Kit

JMS: Java Messaging Service

JMX: Java Management eXtension, used to access or process action on the UCA for EBC product

JNDI: Java Naming and Directory Interface

JRE: Java Runtime Environment

UCA: Unified Correlation Analyzer

X733: Standard describing the structure of an Alarm used in telecommunication environment

XML: Extensible Markup Language

XSD: Schema of an XML file, describing its structure