Description of the LDAP schema and DIT for network monitoring — Version 2

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1 Introduction

This document describes version 2 of the network monitoring LDAP publication schema and DIT. The expected audience is designers of information providers. It also describes the procedure for including information providers in the official releases.

2 Network Element ID

A network element is a set of links from one site to another. A network monitor machine measures the performance of a subset of those links, and the measurements are used to predict the performance of all the links. All SEs, CEs and NMs will be associated with at least one network element.

A network element is a fairly abstract concept, and so the construction of a unique ID is an interesting task. However, it is clear that a network element ID will be some globally unique string.

A NE will generally be associated with a site, or possibly a group of sites. It is predicted that if no network monitoring took place at a particular site, then that site could associate itself with the NE of a different but nearby site, with the object of using network performance monitoring for that NE; thus an NE may be associated with more than one site.

It is also predicted that in some situations, more than one NE may be associated with a single site.

As a first approximation to a globally unique NEID format, I propose that the NEID is formed from a URL-like string representing the main site with which it is associated and a number, optionally followed by a slash (/) and a string. For example: "ucl.ac.uk" or "cnaf.infn.it/general". If more than one NE is associated with a site, then the trailing string can be used to identify each NE. At it's simplest, the trailing string would be just a number. Matching on this string would be case *in*sensitive.

This format would be used for SourceNE, DestNE and LocalNE in the network monitoring schema; it would also be used for any reference to NEs in other information providers.

3 Schema and DIT

The entities available in the Testbed 1, version 2 release have attributes as shown in Tables 1, 2, 5, and 6, and should be organised into a tree similar to that shown in Figure 1.

3.1 NetworkMonitorElement

This entity describes a monitoring element, that is a tool on a host. Many different tools may exist on the same host, and would be described as separate elements.

nmId is constructed from the hostname and the tool, as ⟨hostname⟩/⟨tool⟩, for example, edgmon.hep.ucl.ac.uk/pinger.

LocalHost should be the hostname of any machine which is the source or destination of any measurement at the current site or network element. Usually this will take one value which is the hostname on which the tool resides, and makes measurements from. A "dummy" tool is available to list the hosts that a centralised tool may make measurements too. For example, if NWS installed on nwsmon.cern.ch at CERN makes measurements from edgmon.hep.ucl.ac.uk to net-
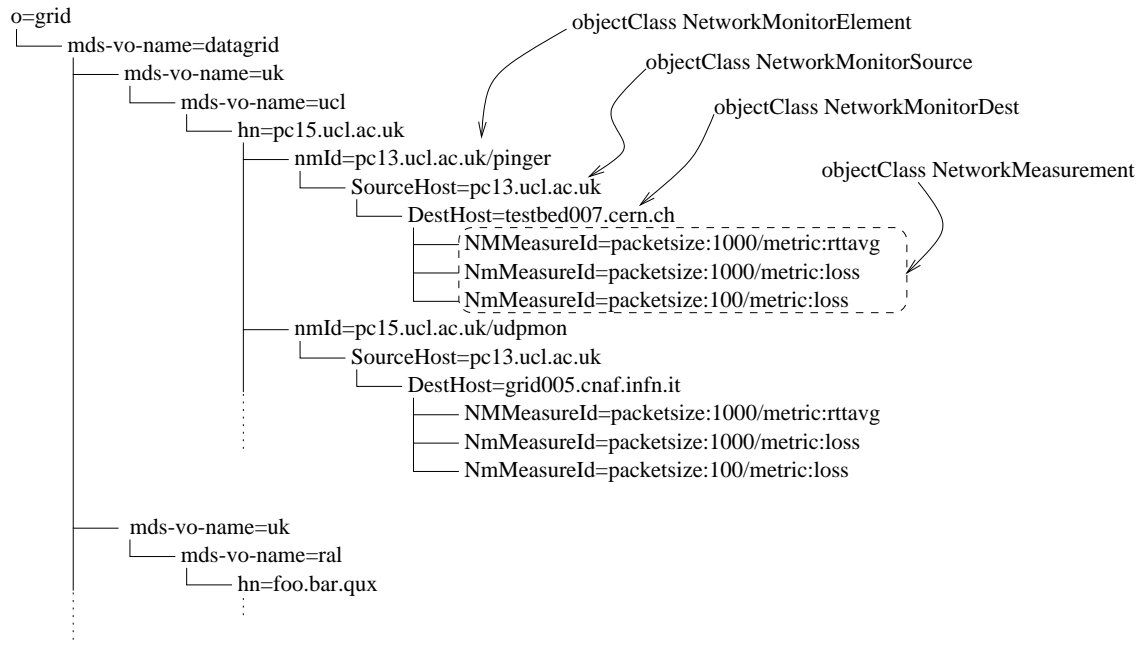
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Figure 1: The tree structure where network monitoring data can be found in the testbed release. Note that tree structure to the left of the nmId=∗ entities is my best guess, and may not exactly match what might be seen in the testbed in the end.

ObjectClass	Attribute	Meaning
NetworkMonitorElement	nmId	an identifying name for a monitoring tool/host combination
	LocalHost	the FQDN of a measuring host to and from which measurements may be made
	LocalSite	(optional) the site that this NM represents
	LocalNE	the network element that this NM represents
	MonitorToolIsLocal	TRUE if the monitor tool is local, i.e. LocalHost can be found in the tree below
	MonitorTool	(optional) the tool used to take measurements of a metric

Table 1: The entity which describes a network monitoring element.

mon.in2p3.fr, then the dummy tool at UCL would list edgmon.hep.ucl.ac.uk as a LocalHost, and the dummy tool at IN2P3 would list netmon.in2p3.fr as a LocalHost; the "NWS" tool at CERN would probably list nwsmon.cern.ch as its LocalHost.

LocalSite and **LocalNE** list the site and Network Element that the LocalHost and monitoring tool is associated with.

MonitorToolIsLocal is simply used to determine if a less costly search only on the subtree of the NetworkMonitor entity would be useful. For PingER, IperfER and UDPMon it always is, because the monitoring tool always comprises the source of a measurement. For tools like rTPL and NWS which make measurements between many host pairs and store their data centrally the measurements are likely to be published at a remote site, so MonitorToolIsLocal would be TRUE (probably) at that remote site, but FALSE at the monitored sites.

MonitorTool should be the full name of the tool, mostly for information purposes only.

3.2 NetworkMeasurement

This is the most important entity, and its fields are shown in Table 2. It describes a single measurement of a particular metric.

NMMeasureId can be any arbitrary locally unique name. For the PingER information provider, it is constructed as follows:
tool:⟨toolname⟩/packetsize:⟨packetsize⟩/⟨rtt[min|max|avg]⟩.

SourceHost This is the host from which a measurement was made. That is, the source of a "ping" to find RTT, for example.

SourceSite and **SourceNE** are the site and network element from which the measurement was made.

DestHost, **DestSite** and **DestNE** are the destination host, site and network element to which the measurement was made.

MonitorTool should be the name of the tool with which the measurement was made, and should probably be the same as the MonitorTool attribute in NetworkMonitorElement.

MetricName: the metric names currently in use are shown in Table 3. If at all possible try to make sure that one of these is used to describe a metric. If it turns out that a completely new metric is in use, then it should be added to this table —

contact pdm@hep.ucl.ac.uk. If at all possible, the unit for the metric should be the one given.

MetricValue is the measured value of the metric.

MetricUnit should be clearly written in SI form, with each unit separated by either a space or a slash ("/"). Unit prefixes should be one of p, n, u, m, k, M, G, T (u for micro). Powers as just a number. E.g. "Mbit/s" or "Mbit s-1"; "mbit N/s2" or "mbit N s-2". This is just made up, if anyone can find a better standard, please email me.

MetricTime should be in the following format: yyyymmddHHMMSS.sZ. Note the trailing Z indicates Zulu time or GMT.

Parameter should be a parameter which further describes the measurement, like ⟨parameter⟩:⟨value⟩. For example, packetsize:100 would mean the measurement was made with 100 byte packets. A list of parameter names is shown in Table 4. Buffersize is, admittedly, simplistic; I expect that more precise names for buffersizes will appear before long.

3.3 NetworkPrediction

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This describes a prediction. All the attributes are equivalent to the attributes in NetworkMeasurement, except for the following:

MetricPrediction is the predicted value of the metric.

PredictTime is the time at which a prediction is valid instandard LDAP time format. If **PredictExpire** is also present, then the prediction will be valid between PredictTime and PredictExpire.

3.4 Other objectclasses

Two other objectclasses, NetworkMonitorSourceHost and NetworkMonitorDestHost, shown in Table 6, are available to generate a tree structure, if that helps. The PingER, IperfER and UDPMon information providers generate a full tree using both of these classes.

ObjectClass	Attribute	Meaning
NetworkMeasurement	NMMeasureId	a name for the measurement. There is no specification for what it should be.
	SourceHost	the host from which measurements are made
	SourceSite	(optional) the site from which measurements are made
	SourceNE	the network element from which measurements are made
	DestHost	the host to which measurements are made
	DestSite	(optional) the site to which measurements are made
	DestNE	the network element to which measurements are made
	MonitorTool	(optional) the tool used to take measurements of a metric
	MetricName	the name of the metric measured. Valid names are listed later
	MetricValue	the value of the metric
	MetricUnit	(optional) the unit in which the metric was measured
	MetricTime	the time at which the measurement was made
	Parameter	(optional) name:value pairs of parameters

Table 2: The entity which describes a measurement.

Metric name		Description	Unit
onewaydelay		One-way delay	ms
rtt		Round-trip time (two-way delay)	ms
	rttmin	Minimum RTT (as returned by ping)	ms
	rttavg	Average RTT (as returned by ping)	ms
	rttmax	Maximum RTT (as returned by ping)	ms
onewayloss		One-way loss	%
twowayloss		Two-way loss	%
onewayipdv		One-way inter-packet delay variation	μs
twowayipdv		Two-way inter-packet delay variation	μs
tcpthroughput		Achieved TCP throughput	bit/s
udpthroughput		Achieved UDP throughput	bit/s
wirerate		Raw wire rate	bit/s
hopcount		Hop count	
gridftpthroughput		Grid FTP throughput	bit/s

Table 3: The current list of valid metric names

Metric name	Description
packetsize	Total packet size in bytes including headers
streams	The number of streams
buffersize	Buffer size, in bytes

Table 4: The current list of valid parameter names

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ObjectClass	Attribute	Meaning
NetworkPrediction	NMPredictId	a name for the prediction. There is no specification for what it should be.
	SourceHost	the host from which measurements are made
	SourceSite	(optional) the site from which measurements are made
	SourceNE	the network element from which measurements are made
	MonitorTool	(optional) the tool used to make the prediction
	DestHost	the host to which measurements are made
	DestSite	(optional) the site to which measurements are made
	DestNE	the network element to which measurements are made
	MetricName	the name of the metric predicted. Valid names are listed later
	MetricPrediction	the value of the metric
	MetricUnit	the unit
	PredictTime	the time from/at which this measurement is valid
	PredictExpire	(optional) the time after which this measurement is no longer valid
	Parameter	(optional) name:value pairs of parameters

Table 5: The entity which describes a prediction.

ObjectClass	Attribute	Meaning
NetworkMonitorSourceHost	SourceHost	the host from which measurements are made
	SourceSite	(optional) the site from which measurements are made
	SourceNE	(optional) the network element from which measurements are made
NetworkMonitorDestHost	DestHost	the host to which measurements are made
	DestSite	(optional) the site to which measurements are made
	DestNE	(optional) the network element to which measurements are made

Table 6: Entities which appear for the benefit of information providers to allow them to make a more structured tree.

4 Utilities

4.1 wp7_netmon_common.pm

The file bin/wp7_netmon_common.pm is a library file containing some Perl utility functions.

4.1.1 glob2pat(glob)

Convert a shell-style glob to a Perl pattern

4.1.2 hostnameToSite(matchFile,host)

Convert a hostname (or textual IP) to a site name. wp3deploy should be the location of the wp3 deploy directory. This function reads $matchFile.

4.1.3 hostnameToNE(matchFile,host)

Convert a hostname (or textual IP) to a Network element name wp3deploy should be the location of the wp3 deploy directory. This function reads $matchFile.

4.1.4 ipToHostname(ip)

Convert an textual ip address to a hostname. Uses gethostbyaddr.

4.2 wp7-discover-nm

This program attempts to automatically discover the mapping between hostnames and sites and network elements.

Usage wp7-discover-nm [-H ⟨ldaphost⟩] [-b ⟨basedn⟩] [-s ⟨sitefile⟩] [-n ⟨nefile⟩]

⟨ldaphost⟩ is the name of a host to search. It should be a full URI. The default value is "ldap://testbed007.cern.ch:2135".

⟨basedn⟩ is the default base DN for the search. It is, by default, "mds-vo-name=datagrid,o=grid".

⟨siteFile⟩ is the filename to write host/site mappings to. It is "/opt/edg/info/mds/etc/wp7-hostnameToSite" by default.

⟨neFile⟩ is the filename to write host/network element mappings to. It is "/opt/edg/info/mds/etc/wp7-hostnameToNE" by default.

The host to site or network element mapping files are the ones that should be specified when calling hostnameTo∗ from wp7_netmon_common.pm.

5   Schema

The version 2 network monitoring schema follows. The LDAP form of this schema is available in package edg-info-main or the EDG CVS repository.

```
NAMESPACE DataGrid {

  OBJECTCLASS NetworkMonitorToolName {
      OID {  1.3.6.1.4.1.8005.666.2.4.21  }
      DESCRIPTION {  Describes a network monitoring tool.  Abstract:  do not use.    }
      KIND {  ABSTRACT  }
      INHERITSFROM {  DataGridTop  }
      MUSTCONTAIN {
         MonitorTool ::  single-valued, cis, { Name of a tool found on the monitoring
         host }
      }
  }

  OBJECTCLASS NetworkMonitorMetric {
      OID {  1.3.6.1.4.1.8005.666.2.4.22  }
      DESCRIPTION {  Describes a single metric and its parameters.  Abstract:  do not
      use.    }
      KIND {  ABSTRACT  }
      INHERITSFROM {  NetworkMonitorToolName  }
      MUSTCONTAIN {
         MetricName ::  single-valued, cis, { The name of the metric measured }
         MetricUnit ::  single-valued, cis, { The unit in which the metric was measured
         }
      }
      MAYCONTAIN {
         Parameter ::  multi-valued, cis, { A parameter used in the creation of this
         tool, of the form parm:value }
      }
  }
```

```
OBJECTCLASS NetworkMonitorElement {
    OID {  1.3.6.1.4.1.8005.666.2.4.23  }
    DESCRIPTION {  Describes a network monitoring element.  Contains a list of the
    hostnames which are referenced by other machines which are listed on the local
    site.    }
    KIND {  STRUCTURAL  }
    INHERITSFROM {  NetworkMonitorToolName  }
    MUSTCONTAIN {
        nmId ::  single-valued, cis, { Hostname of network monitor }
        LocalHost ::  multi-valued, cis, { Hostname of a machine which acts as one end
        of a measurement, and is at "this site" }
        MonitorHost ::  single-valued, cis, { The monitoring host }
    }
    MAYCONTAIN {
        LocalSite ::  multi-valued, cis, { Name of a site at which this tool is
        situated.  Use this for Host/Site matching }
        LocalNE ::  multi-valued, cis, { Name of a network element which this tool
        measures.  Use this for Host/NE matching }
        MonitorToolIsLocal ::  single-valued, boolean, { TRUE if this tool is local,
        ie SourceHost IN LocalHost }
    }
}

OBJECTCLASS NetworkMonitorSource {
    OID {  1.3.6.1.4.1.8005.666.2.4.24  }
    DESCRIPTION {  Describes a network monitoring host from which measurements are
    made.  This is here to help the with implementation.    }
    KIND {  STRUCTURAL  }
    INHERITSFROM {  DataGridTop  }
    MUSTCONTAIN {
        SourceHost ::  single-valued, cis, { Hostname of source of measurement }
    }
    MAYCONTAIN {
        SourceSite ::  single-valued, cis, { Name of the source site }
        SourceNE ::  single-valued, cis, { Name of the network element on which the
        source sits }
    }
}
```

```
OBJECTCLASS NetworkMonitorDest {
    OID {  1.3.6.1.4.1.8005.666.2.4.25  }
    DESCRIPTION {  Describes a network monitoring host to which measurements are
    made.  This is here to help the with implementation.    }
    KIND {  STRUCTURAL  }
    INHERITSFROM {  DataGridTop  }
    MUSTCONTAIN {
        DestHost ::  single-valued, cis, { Hostname of destination of measurement }
    }
    MAYCONTAIN {
        DestSite ::  single-valued, cis, { Name of the dest site }
        DestNE ::  single-valued, cis, { Name of the network element on which the
        destination sits }
    }
}

OBJECTCLASS NetworkMeasurement {
    OID {  1.3.6.1.4.1.8005.666.2.4.26  }
    DESCRIPTION {  Describes a single measurement.    }
    KIND {  STRUCTURAL  }
    INHERITSFROM {  NetworkMonitorSource, NetworkMonitorDest, NetworkMonitorMetric  }
    MUSTCONTAIN {
        NMMeasureId ::  single-valued, cis, { A unique id for the measurement.
        Perhaps based on tool name, parameters, measurement type, perhaps, just a
        unique integer }
        MetricValue ::  single-valued, cis, { The value of the metric at the time
        measured }
        MetricTime ::  single-valued, cis { The time at which the metric was measured
        }
    }
}
```

```
OBJECTCLASS NetworkPrediction {
    OID {  1.3.6.1.4.1.8005.666.2.4.27  }
    DESCRIPTION {  Describes a single predicted measurement.  Still uses the
    nmMeasureId key, though.  Probably ought to add a prefix or suffix to it,
    otherwise things will get confusing.    }
    KIND {  STRUCTURAL  }
    INHERITSFROM {  NetworkMonitorSource, NetworkMonitorDest, NetworkMonitorMetric  }
    MUSTCONTAIN {
        NMPredictId ::  single-valued, cis, { A unique id for the measurement.
        Perhaps based on tool name, parameters, measurement type, perhaps, just a
        unique integer }
        MetricPrediction ::  single-valued, cis, { The value of the metric at the time
        measured }
        PredictTime ::  single-valued, cis, { The time from/at which this measurement
        is valid }
    }
    MAYCONTAIN {
        PredictExpire ::  single-valued, cis, { The time after which this measurement
        is no longer valid }
    }
  }
}
```

References