Using the perfSONAR Visualisation Tools
ITINERARY

Wednesday 30th May – Using the perfSONAR Visualisation Tools.

Thursday 31st May and Friday 1st June – Installing and Configuring the perfSONAR Services.
This training is in support of the perfSONAR pilot. The objectives of the pilot are to:

- Provide proof of concept for the Multi Domain Monitoring service
- Create a service desk, develop and test it
- Allow the NOCs and PERT to use perfSONAR and to provide feedback on it
The objectives of the three days of training are to equip participants to:

- Provide an overview of the perfSONAR visualisation tools and services
- Cascade training on the perfSONAR Visualisation Tools to NREN users
- Install and configure the perfSONAR services
COURSE OBJECTIVES

By the end of the day you will:

• Be able to describe the range and purpose of the perfSONAR visualisation tools.

• Be able to use the perfSONAR visualisation tools.

• Be prepared to train users.
Module 1 – perfSONAR Overview
Module 2 – The perfSONAR Visualisation User Interface (UI)
Module 3 – Customer Network Management (CNM)
Module 4 – The Looking Glass UI
Module 5 – The Hades Visualisation Tool
Module 6 – Case Studies
Module 7 – Feedback on the Visualisation Tools
Module 8 – Question and Answer Session for Trainers
Module 1: perfSONAR Overview
WHAT IS PERFSONAR?

perfSONAR is:

• A project staffed by a variety of organisations and individuals
• A set of protocols that:
  • Assume a set of web services based on defined roles.
  • Define their communication syntax and semantics.
  • Allow anyone to develop an implementation of a web service.
• A set of code
  • Web service implementations and visualisation tools
WHAT ARE THE PERFSONAR WEB SERVICES?

The perfSONAR web services form a performance measurement middleware framework that is:

- Interoperable.
- Distributed.
Problem: performance data is fragmented and hard to access
Effect: it is difficult and time consuming to diagnose potential multi-domain networking problems

Key: X = locally held performance data
= path
WHY PERFSONAR? (2)

The situation today:

- Access to a network’s data is often restricted to itself
- Numerous different monitoring tools in different networks
  - Difficult to identify where the available tools are and where performance information is located
  - In order to run a test, often need first to configure machine-access
  - Different information collected and analysed in different ways
- Diagnosing multi-domain performance issues is difficult and time-consuming
  - Results in user-frustration and unwillingness to use the network
A network administrator should be able to identify obvious performance problems along the path, thus improving user support.
The goal is to facilitate the resolution of multi-domain network performance problems by:

- Revealing available tools.
- Making information from one network available to others.
- Maximising accessibility of standard network performance and management information.
- Broadening the set of management and performance information.
- Automating the extraction of key data.
- Pre-authorising machine-access and testing.
- Separate measurement, analysis and visualisation.
Many different measurement tools and measurement stores exist. For example:

- Ping
- Traceroute
- BWCTL
- Cricket
- MRTG
- Round Robin Databases (RRD)
- Relational Databases
THE ‘AS IS’ SITUATION (2)

There is a great deal of performance data available, but it is:

- Held in different formats.
- Produced by tools that are not interoperable.
- Fragmented in different domains.
Given the large number of measurement tools and archives in existence, the perfSONAR project aims to:

• Provide a framework to collect, normalise and share the data already in existence.

• Build the framework ‘on top of’ the existing measurement tools and archives.
The perfSONAR framework:

- Is middleware.
- Is distributed between domains.
- Facilitates inter-domain performance information sharing.

**perfSONAR services ‘wrap’ existing measurement tools.**
THREE TIER ARCHITECTURE (2)

Highest layer: User Interfaces (UIs)
- Purpose: allow users to view and query performance data

Middle layer: Services (the perfSONAR framework)
- Purpose:
  - Expose measurement tools and data within domain-defined security restrictions
  - Provide standard protocol for intra-domain and inter-domain performance data exchange (discovery, authentication, authorisation)

Lowest layer: Measurement Tools
- Purpose: measure network performance
PERFSONAR USE CASES (1)

• Investigate a path, based on a traceroute
  • View access link capacity and utilisation
  • Identify bottlenecks
  • Investigate output drops and the input errors (not available yet).

• Troubleshoot a routing or multicast problem
  • Use the looking glass to run commands

• Identify problems caused by selective firewalls or loss of connectivity
  • Run ping through multiple domains via the looking glass
PERFSONAR USE CASES (2)

- Test delay and throughput to determine users’ perception of performance
- Investigate routing change: delay changes and traceroute variation (alarm triggered)
- Provide dedicated information to projects
- On-demand testing to identify whether the path will adequately handle large transfers
FRAMEWORK FACILITATES NORMALISED END-TO-END PERFORMANCE DATA (SIMPLIFIED DEPICTION)
Module 2: The perfSONAR Visualisation
User Interface
THE PERFSONAR VISUALISATION UI

Purpose:

• To make network management and performance information from a range of perfSONAR services easily available

Users:

• NOC staff, PERT staff and projects with demanding network performance requirements
• End-users with basic technical background

Mode:

• Visualisation – graphs, charts and diagrams as well as figures
The perfSONAR Visualisation User Interface is:

- Open Source
- Implemented in Java
- Able to retrieve of data from:
  - RRD MA services
  - SQL MA services
  - Hades MA services
The perfSONAR Visualisation User Interface provides:

- A utilisation summary for all selected interfaces in tabular and graphical form
- Visualisation of utilisation details for a chosen interface and a selected time period
- Visualisation of:
  - One way delay between measurement points
  - IP Delay Variation between measurement points
  - Packet loss between measurement points
Path Load Visualisation:

- You can view interface utilisation data for successive traceroute hops in a multi-domain environment
  - You specify the traceroute and set the time-interval for display
  - The total load on each interface in the path over the time period is displayed in a bar-chart and radar
  - You can view a detailed ingress / egress utilisation line graph for a selected interface over the time period
USING THE PERFSONAR VISUALISATION UI (1)

Input traceroute information

Select measurement archives

Interface information

Line graph for selected interface

Timescale selection

Interface utilisation summary
Circuit Investigation:

• Select a circuit (possibly between different domains)

• Visualises One Way Delay, IP Delay Variation and Packet Loss
  • You can zoom in and out of graphs
USING THE PERFSONAR VISUALISATION UI (2)

- Endpoint selection
- Measurement details
- Query parameters
- Available source / destination pairs
- One way delay
- IP delay variation
- Packet loss
Controlling network options for a given path:
  • Correct windowsizes etc.
  • Find bottlenecks on the route

Investigate network problems on a given path:
  • Check UDP / TCP performance
  • Throughput over a given time span
    • Note: can cause high network load

Combine results with other measurements such as:
  • traceroute
  • One Way Delay (OWD)
  • Etc.
USING THE BWCTL VISUALISATION PLUG-IN

Endpoint selection

Measurement parameters

source / destination addresses

Measurement results
The perfSONAR Visualisation UI is a Java application, so:

- It requires Java 2 Runtime Environment, Standard Edition 1.5 or later.
- Will run on any operating system, provided that the correct Java Virtual Machine is installed.
You can find the latest releases at http://wiki.perfsonar.net/jra1-wiki/index.php/PerfsonarUI. The latest beta version is available through Java Web Start.

For older (stable) releases you can choose between:

- Automated installer for Microsoft Windows family of operating systems (NT, 2000, XP, 2003)
  - Best option for Windows installations
- Simple ZIP archive containing all the required files
  - For installation on non-windows operating systems
Planned next steps:

• Integrate core support for Lookup Service

• Integrate core support for Authentication and Authorisation Service
  – Continued on next slide…
Planned next steps (continued):

- Plug-in API (for service developers)
  - Enhance the BWCTL visualisation plug-in
    - Integration of BWCTL MP
    - Graphical presentation of test data
    - Comparison between measurements
  - Implement plug-ins for different metrics visualisation (e.g. interface errors / drops, CPU / memory usage, etc.)

The ultimate goal of the perfSONAR UI is to support all existing and future perfSONAR services through its powerful plug-in API.
perfSONAR Visualisation UI:

- Demonstration
- Exercise
- Feedback about the UI
  - Provide three positive points and three things to enhance
    - No inter-personal issues
    - No generalities. Be specific.
    - Make suggestions about how to improve
Module 3: Customer Network Management (CNM)
CUSTOMER NETWORK MANAGEMENT (CNM)

Purpose:

- To display network topologies with performance metrics, including current and historic link utilisation and capacity for network maps and single interfaces

Users:

- NOC / PERT staff (for easy overview), end-users, project-team members (project specific maps), non-technical NREN staff

Mode:

- Graphical, map-based, topological
FEATURES OF CNM

CNM:

- Displays hierarchical maps of network topology
- Displays statistics for current time and past time intervals
  - Set time
  - Choose between capacity, utilisation, and active measurement metrics
- Implemented using Java so is platform independent
  - Java Swing client interacts with CNM server
  - Java WebStart used for easy deployment
- Is able to Retrieve data from:
  - The RRD Measurement Archive service
  - The Hades Measurement Archive service
You would use CNM to:

- Gain a current or historic overview of a network
  - Can specifically display the network of a participating NREN
  - Easily spot:
    - High Utilisation
    - Network problems (up / down router and link status)
- Study a statistical graph of a particular link or router over a specific time period
CNM USE CASES (2)

You cannot currently view up / down information

• perfSONAR services cannot yet supply this

You can view active measurement results:

• Delay
• Jitter
• Loss
THE CNM INTERFACE (1)

- Selection tree
- Selection options
- Visual key
- Time stamp
- Hierarchical maps
- Link Metrics
- Zoom options
The PSNC network seen through CNM
The SWITCH network seen through CNM
Network data seen through the SWITCH web site.
A node in the SWITCH network, showing utilisation over 5 minutes in Mbit/s
CNM SYSTEM REQUIREMENTS

CNM is a Java application, so:

- It requires Java 2 Runtime Environment, Standard Edition 1.5 or later.
- Will run on any operating system, provided that the correct Java Virtual Machine is installed.
INSTALLING CNM

You can find the latest releases at http://sonar1.munich.cnm.dfn.de/cnm-app/def/jnlp/topoapplet.jnlp.

The latest version will ‘self-install’ through Java Web Start.
Future Developments:

- Integration of more networks (topology and utilisation data)
- Retrieval of data from Topology service (Common Network Information Service or CNIS)

Dashboard showing:
- Key performance indicators
- Top ranking links
  - E.g. links with highest jitter or sharpest utilisation increase over last 15 minutes.

Can show link / node status (up or down)
- Will do so when Measurement Archives can hold this data
Customer Network Management:

- Demonstration
- Exercise
- Feedback about the UI
  - Provide three positive points and three things to enhance
    - No inter-personal issues
    - No generalities. Be specific.
    - Make suggestions about how to improve
Module 4: The Looking Glass User Interface
Purpose:

- Front-end for the SSH / Telnet Measurement Point; used to retrieve configuration information from network devices in real-time
  - E.g. traceroute, BGP table

Users:

- NOC and PERT staff

Mode:

- Text-based UI
The Looking Glass Interface:

- Is able to retrieve data from the SSH / Telnet Measurement Point
  - Can only issue commands and parameters that are configured for the relevant instance of the SSH / Telnet MP.
    - This is for security reasons.
- Can be used to issue multiple parameters with the same command.
- Allows multiple devices to be included in one request.
- Is implemented in Java.
LOOKING GLASS USE CASES

Retrieval of configuration information from network devices:

• Retrieval of information is via an SSH / Telnet MP
  • Therefore an instance of the SSH / Telnet MP must be ‘pointing at’ the router or other network device that you want to retrieve information from.

• Looking Glass retrieves router configuration information. For example:
  • traceroute
  • BGP table
  • History
  • Information about the router’s interfaces
USING LOOKING GLASS

Select MP

Select device

Select command and parameters

Results
Looking Glass is a Java application, so:

- It requires Java 2 Runtime Environment, Standard Edition 1.5 or later.
- Will run on any operating system, provided that the correct Java Virtual Machine is installed.
- There is a Java Web Start Looking Glass available, which you can use (you can specify your MP in the menu)
INSTALLING THE LOOKING GLASS UI

You can find the latest release at http://wiki.perfsonar.net/jra1-wiki/index.php/Looking_Glass.

You can download the application or deploy it using Java Web Start.
Future enhancements / developments:

- Lookup Service integration
- The Looking Glass client will be integrated into the perfSONAR Visualisation UI via the plug-in mechanism.

- Requests For Enhancements
  - Communicate requests for enhancements through the Service Desk
The Looking Glass UI:

• Demonstration
• Exercise
• Feedback about the UI
  • Provide three positive points and three things to enhance
    – No inter-personal issues
    – No generalities. Be specific.
    – Make suggestions about how to improve
Module 5: The Hades Visualisation Tool
THE HADES VISUALISATION TOOL

Purpose:

• Visualisation of IP performance metrics data
  • One Way Delay (OWD)
  • One Way Delay Variation (OWDV)
  • Packet Loss (PL)
  • Traceroute Information

Users:

• PERT, NOC, End Users, All

Mode:

• Web / Host based Graphical visualisation of data
FEATURES OF THE HADES VISUALISATION TOOL

The Hades Visualisation Tool provides:

• Measurement Maps (Domain based)
  • “Weather Map” of Measurement Network
  • GÉANT2 Measurement Circle
  • JRA1 Measurement Circle

• Measurement Host Selection
  • Day based grid of available measurement data
  • Selection of measurements per host

• Visualisation of single measurements per host
  • Selection of available measurement types (OWD, OWDV, PL, traceroute, IPv4, IPv6)
  • Visualisation of data with zoomable graphs, variable timescale
Retrieval of network irregularities

- Measurement maps show information about delay status
- If Maps show irregularities, measurement path can be examined using the clickable map or the measurement point selection
- Measurements can exhibit reasons for network problems
Long-Term path stability visualisation

- Analysis of data over long periods shows information about path stability
- Quality control of path stability

Base for Alert System

- Automatic determination of result changes triggers alerts
Entry point: http://www.win-labor.dfn.de/ippm/
“Weather Map”: http://www.win-labor.dfn.de/cgi-bin/ipqos/map.pl?config=geant
“GÉANT2 Map”: http://www.win-labor.dfn.de/cgi-bin/ipqos/map.pl?config=geant;map=geant
“NREN Map”: http://www.win-labor.dfn.de/cgi-bin/ipqos/map.pl?config=geant;map=nrens

Click for data
USING THE HADES VISUALISATION TOOL (5)

Measurement selection:
http://www.win-labor.dfn.de/cgi-bin/ipqos/select-new.pl?config=geant

Click to select
Red: no data available
Measurement selection:
http://www.win-labor.dfn.de/cgi-bin/ipqos/select-new.pl?config=geant&mode=selectpaths&station=Amsterdam_SURFnet&date=2007/05/20

Path selection, mark to show available measurements
Measurement type selection: http://www.win-labor.dfn.de/cgi-bin/ipqos/select-new.pl?date=21.05.2007&config=geant&mode=selectpaths&station=Amsterdam_GEANT&Submit=Submit&viewroutes=Budapest_GEANT.Amsterdam_GEANT

Measurement type selection
Example for data visualisation

Format panel
Hades visualisation is web-based.

No additional software is required.
Hades visualisation is not part of perfSONAR!

• All Hades Visualisation Tools are cgi-scripts.
• Scripts are embedded into the Hades framework
• No separate release is planned for the Hades visualisation
• All features will be included into perfSONAR UI in future
No further feature enhancements are planned.

Functionality from the HADES visualisation tool will be built into the perfSONAR Visualisation UI.

Only layout enhancement are planned.
The Hades Visualisation Tool:

• Demonstration

• Feedback about the UI
  • Provide three positive points and three things to enhance
    – No inter-personal issues
    – No generalities. Be specific.
    – Make suggestions about how to improve
Module 6: Case Studies
ACTIVITIES

Case Study 1 – Network Reachability Problem
Case Study 2 – Network Performance Problem
Module 7: Feedback on the Visualisation Tools
ACTIVITIES

Please use the forms provided to give us feedback about the perfSONAR visualisation tools.
Module 8: Question and Answer Session for Trainers
FOR MORE INFORMATION

• www.geant2.net

• www.dante.net

• For latest news and factsheets http://www.geant2.net/media

• For research activities http://www.geant2.net/research

• The perfSONAR FAQ and mailing list can be found at www.perfsonar.net.

• The WIKI at wiki.perfsonar.net is also a valuable source of information.
RECAP OF COURSE OBJECTIVES

By the end of the day you will:

• Be able to describe the range and purpose of the perfSONAR visualisation tools.

• Be able to use the perfSONAR visualisation tools.

• Be prepared to train users.