Data Gathering in Optical Networks with the TL1 Toolkit

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Abstract. This paper describes a new tool for gathering (performance) data from optical network devices. During the last few years many National Research and Education Networks (NRENs) have deployed hybrid networks. These hybrid networks consist of a traditional routed IP part and an innovative optical part. On the optical part *lightpath* services are offered. These lightpaths are high speed (up to 10 Gbps) circuits with a deterministic quality of service. Not all optical devices used in these networks offer full SNMP support, so the traditional management and monitoring tools cannot be used. Therefore we designed and implemented the TL1 Toolkit which supports management, data gathering and monitoring of optical devices.

1 Optical Networks and Lightpaths

In recent years many National Research and Educational Networks (NRENs) have acquired their own dark fiber infrastructure. The dark fibers are lit with DWDM and SONET/SDH equipment in order to build a circuit switched network that can be used for either transporting traditional IP traffic or so called lightpaths. Lightpaths are transparent point-to-point circuits with deterministic quality of service properties.

These optical networks provide researchers with new possibilities, but there are also significant research efforts in the infrastructure itself. The circuit switched nature of these optical networks is very different from the packet switched nature of the Internet. New technologies are being developed to monitor the health of lightpaths. Another topic of research is study which (performance) metrics are interesting to investigate in the optical networks. Section 3 discusses some of these new metrics.

2 TL1 Toolkit

The TL1 Toolkit is an open source Perl module that makes it easy to write Perl scripts that retrieve data from optical devices. Many optical devices use

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the Transaction Language 1 (TL1) [1] as command line interface. Unfortunately, the syntax of TL1 is complex and the returned answers are difficult to read. Therefore, we designed and implemented a Perl module that hides the difficult syntax from the user and returns the results in easy to use Perl data structures. With the TL1 Toolkit it becomes easy to write Perl scripts that extract all kinds of data from optical network devices.

2.1 Supported Functions

This section describes some of the functions available. Below is a simple example that shows how to connect to a device, login, execute a TL1 command, logout and disconnect again.

$tl1 = TL1Toolkit->new("node", "name", "secret");
Create a TL1Toolkit object that holds information about a TL1 session. Its arguments are:
- hostname: network element to connect to
- username: login name
- password: password
- type (optional): device type (OME6500, HDXc)
- verbose (optional): debug level (0..9)

$tl1->open();
Connect to the TL1 device and login. Returns 1 on success, 0 on failure.

my $output = $tl1->cmd($command);
The string variable $command contains a TL1 command string that will be sent to the TL1 device as is. It returns the results as ASCII text to the string variable $output.

$tl1->close();
Logout and disconnect from the TL1 device.

Another possibility is to use some of the build in functions, that will execute and parse the output of commonly used commands. A number of these build in functions are available. Examples are retrieving alarms, crossconnects, section trace data, inventory data and performance measurement data The example below retrieves the number of incoming octets on a specific interface.

my $octets = $tl1->get_inoctets(1, 3);
Returns the Ethernet input octets on the slot given as first argument and the port given as second argument. Returns an integer.

3 Metrics in Optical Networks

The (performance) metrics in optical networks are different from the metrics used in the traditional routed Internet. Traffic in optical networks is transported over circuits instead of via packets. Parameters like RTT and jitter are not very interesting because of the deterministic nature of circuits. Instead new parameters such as the timeslot usage on links become important. Timeslot usage is an essential metric used in capacity planning for optical networks. Section 4 describes how this is done in the Dutch NREN (SURFnet6).

Other interesting metrics are the parameters involving the laser equipment, like voltages, power transmitted and received, optical loss, etc. This may give early warnings about degrading of the equipment or changes in optical impairments of the fibers. In general optical and circuits switched networks offer a wide array of performance measurement data. Retrieving this data and using it for analyses has proven to be very useful.

4 Lightpath Data Retrieval in SURFnet6

The TL1 Toolkit is used to retrieve data from the SURFnet6 network. SURFnet6 is a hybrid network and currently has about 200 lightpaths. Various configuration and performance data is retrieved from the SURFnet6 network. This is done by running TL1 Toolkit scripts periodically. The retrieved data is stored in a database. This data is made available via a web interface. The next section describes how this data is used for static lightpath planning in SURFnet6.

4.1 Lightpath Planning

The SURFnet6 lightpath part of the network consists of around 100 nodes and It soon became evident that with a network of this size manual planning of lightpaths was impossible. Therefore a planning tool [4] was written for SURFnet6. This uses the TL1 Toolkit in various ways. In order to find a path from A to B, the topology of SURFnet6 must be made available to the planning tool. The Network Description Framework (NDL) [5] of the University of Amsterdam is used to model the network topology. The NDL topology file is generated automatically by running a TL1 Toolkit script that discovers the topology information from the network utilizing the SDH section trace information.

Another script retrieves the used resource data of all the lightpaths from the network. This data is stored in the database. For each lightpaths the devices, interfaces and timeslots are stored.

The planning tool uses the NDL topology file to generate a mathematical graph of the network. In this graph a constraint based shortest path algorithm (Dijkstra) is used to find paths between two points in the network. The constraints are the timeslots already in use in the network and various links weights that represent network usage policies. Typically, the paths found are first reserved in the database so that no other lightpaths can use those resources. At a later stage, when all the formalities are completed, the lightpath is provisioned in the network.

5 Conclusions and Future Work

The TL1 Toolkit has proven to be a very powerful tool for writing Perl scripts with minimal effort to extract all kind of data from optical TL1 equipment.

Our own work with the TL1 Toolkit has been focused on monitoring operational status of lightpath [3]. But because there are many interesting metrics to investigate in optical networks, we will start tracking those too.

The introduction of dynamic lightpaths will introduce a whole new line of research. There is little operational experience with dynamic lightpaths and assigning timeslots in the most efficient way will be an interesting topic. The TL1 Toolkit is very well suited to retrieve and store data about dynamic lightpaths. This will produce a whole new set of network data that has not been available yet.

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