G E N I

Global Environment for Network Innovations

Milestone S2.h-part2
Specifications for the Measurement Handler Software

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1   Document Scope

This section describes this document's purpose, its context within the overall GENI project, the set of related documents, and this document's revision history.

1.1   Executive Summary

This technical note presents the results obtained in work package "Milestone S2.h-part2: Specifications for the Measurement Handler Software" of Project Nr. 1733, "Programmable Measurements over Texas-based Research Network: LEARN" [LEARN_1].

The milestone on the drafting of the data file format for the transfer of measurement data between the Infinera Digital Transport Node (DTN) [Infinera_1, Infinera_2] and the Integrated Measurement Framework [IMF_1] has been submitted during GEC6, November 16th, 2009 [LEARN_2]. We explained how the measurement data file format is based on the TL1 command format of the Infinera DTN [Infinera_3, Infinera_4]. Also in [LEARN_2], we examined two specific TL1 commands that are of particular interest for the GENI measurement framework: an optical power measurement and the bit-error rate (BER) measurement.

This document is a report on the specifications for the Measurement Handler Software, which will utilize an existing interface (TL1 over SSH) into the Infinera DTN to make optical measurements.

1.2   Related Documents

The following documents are related to this document, and provide background information, requirements, etc., that are important for this document.

1.2.1   GENI Documents

Document ID	Document Title and Issue Date
GENI-S2H-LEARN-Nov09	Draft Measurement Data File Format, November 16, 2009
ERM_S2a_Dec09	Unified Measurement Framework: NetFPGA Cube Prototype, December 03, 2009

1.3   Document Revision History

The following table provides the revision history for this document, summarizing the date at which it was revised, who revised it, and a brief summary of the changes. This list is maintained in chronological order so the earliest version comes first in the list.

Revision	Date	Revised By	Summary of Changes
1.0	07 Jan 2010	D. Gurkan	Initial draft
1.0	09 Jan 2010	C. Lai	Revised update
1.0	10 Jan 2010	M. Wang	Revised update

2   Introduction

The "Data Plane Measurements" project during Spiral-1 has identified all instruments and network hardware (to be referred to as network elements – NEs – from this point on) present in the aggregates of Spiral-1 control frameworks [DMEAS_1]. Similar NEs are expected to reside in future aggregates joining the GENI infrastructure. The main purpose of this study was the determination of available measurements for the physical layer in embedded form; that is, a user can retrieve measurements via a remote connection to the NE. The access method for each NE has been also identified as part of this study. Milestone reports of the study are posted on GENI wiki for "Data Plane Measurements" project [DMEAS_2].

LEARN project [LEARN_1] will build on top of the "Data Plane Measurements" by recommending and (when possible) implementing Measurement Handler Software (MHS) modules for NEs with various remote access mechanisms. During the first year of LEARN, MHS will be created specifically for accessing the Infinera Digital Transport Nodes (DTNs) that reside on BEN through collaborations with ORCA-BEN and ERM projects. At the end of the first year, a recommended list of possible MHS modules will be delivered as stated in the milestone on LEARN project:

Based upon results of Data Plane Measurements project, collaborate with GPO and other projects in Cluster D, to establish a list of measurement handlers that are needed for commercial transport and measurement equipment that will be used in GENI. (7/20/10, GEC8)

MHS acts as the interface mechanism for the Unified Measurement Framework (UMF) [ERM_1] to access an NE and retrieve measurements in however format they may be delivered by the NE. This document is for an Infinera Digital Transport Node (DTN) [Infinera_1, Infinera_2] that resides on BEN in Cluster D.

Milestone related to the specification of such a MHS module is:

Collaborate with the ERM project to draft data file format for transfer of measurement data between the Measurement Handler software and the Integrated Measurements Framework; complete specifications for the Measurement Handler software, which will utilize an existing interface (TL1 over SSH) into the Infinera Digital Transport Node (DTN) to make optical measurements. (11/16/09, GEC6)

The first part of the milestone (*Collaborate with the ERM project to draft data file format for transfer of measurement data between the Measurement Handler software and the Integrated Measurements Framework;*) has been delivered at GEC6 in collaboration with the ERM project as [LEARN_2]. This is the second part of the milestone (*complete specifications for the Measurement Handler software, which will utilize an existing interface (TL1 over SSH) into the Infinera Digital Transport Node (DTN) to make optical measurements*): specify the measurement handler software that accesses the Infinera Digital Transport Node (DTN) in turn to be integrated with the Unified Measurement Framework (UMF) as designed in [ERM_1]. Commands are issued to the Infinera DTN in the Transaction Language 1 (TL1) format, which is a vendor-independent network management protocol. These commands are encoded in plain ASCII text, resulting in easy readability and greater interoperability.

This part of the deliverable has been delayed due to lack of equipment access by the LEARN team. When this milestone was first drafted, Dr. Gurkan's lab was hosting an Infinera DTN through an evaluation agreement between LEARN of Texas and Infinera. However, the evaluation period expired at the same time as the start of the project. The ORCA-BEN project has graciously given the LEARN

team a login and access to their DTN boxes to perform this milestone. An NDA has been issued between the teams and Infinera during the second week of December of 2009.

In Section 3, we present the workings of the MHS. Further, we examine in more detail all subroutines that will reside in MHS including any outside modules that will be used to parse and create TL1 commands. Then, in Section 4, we illustrate the modules and subroutines of this MHS for Infinera DTN with example code segments following the recommendations from Dr. Yufeng Xin of RENCI.

3   Measurement Handler Software Overview

The Measurement Handler Software (MHS) module manages the issuing and parsing of various TL1 commands (RTRV-PM) and the corresponding responses of the Infinera DTN to make optical measurements. The specific commands to be implemented in this project are outlined in more detail in [LEARN_2]. The software will utilize the existing interface to interface with the Infinera DTN (i.e., SSH). A perl module will be used to create the subroutines necessary to retrieve power, and pre- and post-FEC BER measurements. In addition, there will be subroutines that allow UMF and higher layers in ORCA to access the particular instrument and its available measurements.

The TL1 commands and the responses will be parsed using the general toolkit published in [SARA_1] whenever applicable. The toolkit provides the mechanisms of using and parsing of TL1 commands at a high level. It also allows for any particular commands that do not exist in the toolkit to be included using a `cmd()` subroutine. If all functions from Infinera DTN were included in the TL1 module, a perl script would suffice to access an NE. However, this toolkit has been written to retrieve functions specific for Nortel OME6500, Nortel DWDM CPL, Nortel HDXc, and Cisco ONS15454. Therefore, an expansion of the capabilities of the toolkit for the Infinera DTN is necessary.

In order to expand the capabilities of this module, another perl module that would include subroutines for the Infinera DTN will be created. The subroutines will specifically parse commands for the Infinera DTN and its access through ORCA/BEN infrastructure.

A perl script will be written that will use these two perl modules to access and provide the results of performance measurement commands to the Infinera DTN.

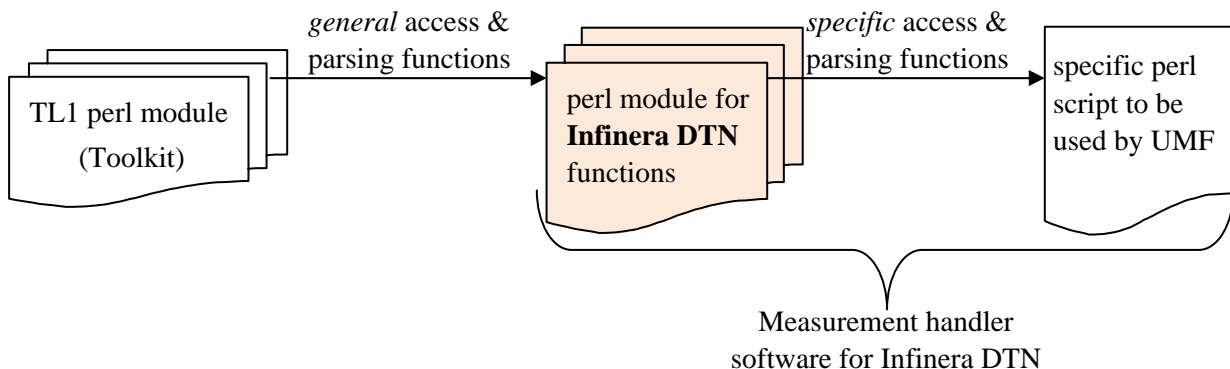The dependencies of these modules and the script are displayed in the figure 1.

Figure 1. TL1 Toolkit [SARA_1] provides the general access and parsing functions for TL1 interfaces. A perl module for specific functions of Infinera DTN and its hosting aggregate is the main module for the measurement handler software (MHS). Finally, a perl script will use both TL1 module and the Infinera-specific module to provide the measurements to UMF.

For example, a telnet function is used in order to start a TL1 session with the Infinera DTN. Once the hostname is identified, the IP address of the unit will be retrieved according to the static IP address list provided by the aggregate. In this particular project, all Infinera DTNs reside on the ORCA/BEN architecture with presences on BEN, RENCI, Duke, and UNC: e.g., when the network site is Duke, the hostname/IP address of the DTN box is `dtn-1.duke.ben` and `192.168.202.5`. The perl module will return the IP address according to the network name provided by the requesting program, e.g., UMF.

After the hostname is determined, the perl module's subroutine that allows the login to the DTN will be called. Once a successful login is achieved, specific measurement commands will be sent to the DTN. Responses will be parsed by the module's corresponding subroutines and measurement results will be written into a text file to be used by the UMF project. To summarize, the MHS has three stages of operation:

(i) Login to the DTN TL1 interface;

(ii) Retrieve what measurement is needed from the command of UMF and compose the TL1 command that corresponds to the measurement;

(iii) Send command to the DTN and if successfully retrieved, parse the response to extract the measured value to write into a text file.

3.1   Login

Login to the DTN is achieved using regular telnet routine followed by TL1 login to retrieve measurements from the instrument. A sample general subroutine from the tl1 toolkit is included below from [SARA_1]:

```
sub login() {
    my ($self) = @_;
    $self->verbose( 3, "starting login to $self->{'hostname'}.\n" );
    my $out = $self->cmd("ACT-USER::$self->{'username'}:$self-
>{'ctag'}::$self->{'password'};\n");
    my $check = check_resp ($out);
    return $check;
}
```

Where, the synopsis of a new tl1 session starts with:

```
$tl1 = tl1->new(
        hostname => 'host.example.com',
        type => 'OME6500',
        username => 'user',
        password => 'password',
        peerport => 23,
        verbose  => 0
    );
```

3.2   Measurements

The Measurement Handler Software uses the "RTRV-PM" command to retrieve various performance-monitoring data. Its command and response formats have been outlined in [LEARN_2].

Command:
```
RTRV-PM-
{OC768|OC192|OC48|OC12|OC3|STM256|STM64|STM16|STM4|STM1|1GBE|10GBE|
OCH|OCG|OTS|BAND|TRIB|DTPCTP|DCF|OSC|GTP|VCG}:[<TID>]:<AID>:<CTAG>::
[<montype>],[1-UP],[NEND],[RCV|TRMT],[15-MIN|1-
DAY],[<mondat>],[<montm>];
```
Response:
```
<cr><If><lf>
^^^<SID>^<Date>^<Time><cr><lf>
M^^<CTAG>^<CMPLCDE><cr><lf>
<Text Block><Terminator>
```
The <Text Block> segment of the command response contains the detailed measured results of the input command. Command and response of two specific measurements, namely, optical power and BER will be programmed into the MHS.

3.3   Output of Measurement Handler Software (MHS)

During the first demonstration of the MHS and integration with UMF, the software output will be written into a text file.

4   Example Code from Perl Modules and Perl Script

Hostname will be mapped to the static IP address that the instrument has on that particular host network by:
```
sub getHostname{
   my ($self,$site)=@_;
   my $hostname="0";
   if($site eq "Renci"){
        $hostname="192.168.201.5";
   }
   elsif($site eq "UNC"){
                $hostname="192.168.203.5";
        }
   elsif($site eq "Duke"){
                $hostname="192.168.202.5";
        }
   elsif($site eq "NCSU"){
                $hostname="192.168.204.5";
   }
   return $hostname;
}
 sub loginDTN{
        my ($self,$hostname)=@_;
        my $username="geniuser";
        my $password="*******";
        my $port="9090";
        my $logincmd="act-user::$username:1::$password;";
```

```
#print STDERR "Login Hostname:", $hostname,"\n";
      my $tl1 = tl1->new(
            hostname => $hostname,
            username => $username,
            password => $password,
            type=>'Infinera',
            peerport => '9090',
            verbose  => 0,
      );
      # connect and login
      if ($tl1->open() == 0) {
            print STDERR "$0: Could not connect to $hostname\n";
            exit 1;
      }
      return $tl1;
}
```

The following functions from the TL1 toolkit will be utilized when necessary to retrieve measurements from the Infinera DTN:

```
$tl1->open();
$tl1->cmd($cmd);
$tl1->retr_cardtype();
$tl1->retr_swversion();
$tl1->retr_outoctets();
$tl1->retr_inoctets();
$tl1->retr_inoctets();
$tl1->retrieve_alarms();
$tl1->retrieve_circuits();
$tl1->check_resp();
$tl1->get_ess();
$tl1->get_oc48_ports();
$tl1->print_resp($ouput);
```

In addition, three more modules will be written to retrieve measurements (power and BER) and then parse and write responses to a text file. As an initial step of integration, the UMF will have access to this text file and be able to retrieve the received optical power, pre-FEC, and post-FEC BER values, as desired by the experimenter.

4.1   Measuring Received Power

The command to measure the received optical power of a specific optical channel (in a specific DLM of a specific chassis) is defined as:

rtrv-pm-och::<TID>:<CTAG>::opr;

example:

rtrv-pm-och::1-A-4-L1-8:tag_rx_power::opr;

(Measures received optical power from chassis 1, DLM slot 4, and optical channel 8)

The response format of this command is defined in Section 3.2 with the following <Text Block> field:

"<TID>,OCH:OPR,<Optical Power Value in dB>,,NEND,RCV,,"

example:

"1-A-4-L1-8: OCH:OPR: -27.84,,NEND,RCV,,"

(Optical power received from chassis 1, DLM slot 4, and optical channel 8 is -27.84 dB)

The subroutine in the Infinera DTN's perl module will use these commands and the response format to retrieve the optical power of the designated channel (and when necessary, the chassis and DLM slots will also be specified) and return into a text file together with the date/time of the measurement.

```
my $rtrvpowercmd= "rtrv-pm-och::1-A-4-L1-8:tag_rx_power::opr;\n";
my $resp=$tl1->cmd($rtrvpowercmd);
```

4.2   Measuring BER

The Infinera DTN performs the FEC encoding/decoding function for every optical channel. Further, the DTN is used to compute the effective BER on each optical channel. In fact, it can calculate both the FEC-corrected, as well as the uncorrected BER (i.e. the post-BER and pre-BER values). The command formats of BER measurement over a specific optical channel (in specific DLM of a specific chassis) is defined as:

rtrv-pm-och::<TID>:<CTAG>::corrber;
rtrv-pm-och::<TID>:<CTAG>::uncorrber;

example:
rtrv-pm-och::1-A-4-L1-8:tag_rx_power::corrber;
(Measures corrected BER from chassis 1, DLM slot 4, and optical channel 8)

The response format of these two BER commands are precisely as defined in Section 3.2 with the following <Text Block> fields:

"<TID>,OCH:CORRBER,< Corrected BER>,,NEND,RCV,,"
"<TID>,OCH:UNCORRBER,<Uncorrected BER>,,NEND,RCV,,"

example:

"1-A-4-L1-8: OCH:CORRBER: 10e-22,,NEND,RCV,,"

(*Corrected BER from chassis 1, DLM slot 4, and optical channel 8 is 10e-22)*

The subroutine in the Infinera DTN's perl module will use these commands and the response format to retrieve the BER at the designated channel (and when necessary, chassis and DLM slots will also be specified) and return into a text file together with the date/time of the measurement. Corrected BER measurements:

```
my  $rtrvCBERcmd=  "rtrv-pm-och::1-A-4-L1-8:tag_rx_power::opr;\n"; my
$resp=$tl1->cmd($rtrvCBERcmd);
```

5   Summary and Conclusions

In this report, we drafted the specifications for the measurement handler software. We previously defined the measurement data file format as the TL1 response format of the Infinera DTN.

6   Bibliography

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