Network monitoring with simple network monitoring protocol in optical feeder network

Riikka Lemminkäinen
VTT Information Technology, Telecommunications

Supervisor: Professor Jorma Jormakka
Instructor: Kari Seppänen, Lic.Sc. (Tech.)

Contents
- OAN (Optical Access Networking) project
- Network monitoring in OAN network
- Extending SNMP agent
- Conclusions and further work
OAN (Optical Access Networking) project
- TEKES funded, 2001-2003 (VTT, HUT, Nokia, Elisa)

OAN protocol stack
- WDM, optics
- SDH, transport layer, prevailing protocol
  + VC, efficient bandwidth allocation
  + LCAS, dynamic bandwidth re-allocation,
- GFP, adaptation layer for both block-coded or packet-oriented data
  + GFP-MD, VTT extension, supports multicast and provides faster packet forwarding

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td></td>
</tr>
<tr>
<td>MPLS</td>
<td></td>
</tr>
<tr>
<td>PPP</td>
<td></td>
</tr>
<tr>
<td>GFP (GFP-MD)</td>
<td></td>
</tr>
<tr>
<td>SDH/SONET (VC + LCAS)</td>
<td></td>
</tr>
<tr>
<td>WDM</td>
<td></td>
</tr>
</tbody>
</table>
OAN network monitoring

- Mostly network performance monitoring
- Speeds up failure locating

OAN management system

Monitor node cards connected in the system
Monitor IO cards connected in the system
Monitor the interfaces of the system

Which node card the IO cards are connected with?
Which card the interfaces are related to?

OAN network monitoring with SNMP (Simple Network Monitoring Protocol)

- Standardized by IETF, kept as simple as possible
- Presents management information as objects defined in management information bases (MIBs)
- Third version (SNMPv3) offers security and data encryption
- Extendable SNMP agent/manager software available (Net-SNMP)
Layered Network Management Scheme

- Combination of readily standardized MIBs and OAN-specific MIBs
- System management information: MIB-II, IETF RFC 1213
- Interfaces management information:
  + basic information: Interfaces MIB, IETF RFC 2863
  + SDH information: SONET/SDH MIB, IETF RFC 2558
  + VC, LCAS extensions: OAN project (further work)
  + GFP, GFP-MD: OAN project (further work)
  + overlay protocols: IETF RFCs
- OAN components management information
  + node cards + lasers: VTT-IT-OAN-NODECARD-MIB
  + IO cards: OAN project

Monitoring OAN node cards and lasers 1/2

- One OAN management system may contain several nodes
- Each OAN node card includes four lasers: two tunable, two fixed
- OAN node card management information: index, name, description, status, type of laser A and laser B
- Laser management information: different for fixed and tunable lasers
Monitoring OAN node cards and lasers 2/2

- The operating point of a tunable laser is set with three values: temperature (wavelength), bias current, and modulation current.

From use cases to SNMP MIBs

- MIBs are ASN.1 descriptions (readable both for machine and human).
- The needed management information (data-type, access rights) must be defined and placed into the MIB tree structure.

```asn1
voNcLaserBTemperature OBJECT-TYPE
SYNTAX    Integer32
MAX-ACCESS read-write
STATUS    current
DESCRIPTION "A read-write integer representing the temperature (wavelength) of the laser B in the OAN node card. The temperature is in hundredths of degrees of Celsius (0.01 °C)."
::= { voNodeCardEntry 11 }
```

- ASN.1 description for node card management information in VTT-IT-OAN-NODECARD-MIB.
- Two traps for reporting about aged lasers: voNcLaserAEndOfLife and voNcLaserBEndOfLife.
From MIBs to SNMP agent source code

- Net-SNMP package includes mib2c compiler that produces agent-attachable C code from ASN.1 MIB descriptions
- Command mib2c voNodeCards produces two code files: voNodeCards.h and voNodeCards.c
- Produced code is only a skeleton which has to be fleshed out
- Programmer does not need to understand the deep internals of the SNMP agent - extending the agent is straightforward
- Only functions for module initializing, variable handling, and value setting need to augmented
Including the module to SNMP agent

- Ready C-code must be compiled into a module and included into SNMP agent
- voNodeCards.c and the driver library liboan.so are compiled into shared object, voNodeCards.so
- voNodeCards module is linked dynamically into Net-SNMP agent by configuring agent configuration file
- Agent loads dynamic modules during re-start
- New module is tested by getting and setting the OAN node card management information
- Also the sending of laser A/B end-of-life traps must be tested

OAN test network

- System administrator
  - SSH
  - System administrator: espok70867.ad.vtt.fi
  - 130.188.54.188

- Management station
  - tt2196.tte.vtt.fi
  - 130.188.55.196
  - SNMP applications
  - snmptrapd

- SNMP request / response
- SNMP trap (only upstream) (over UDP)

- OAN rack
  - 130.188.54.239
  - SNMP agent (snmpd)
  + voNodeCards module

- OAN library

- Kernel driver

- OAN node card

- OAN ring

SSH
Conclusion

- SNMP is easy to take in use due to ready tools and standardized MIBs
- The MIB structure does not support complex data types (such as arrays) or advanced queries (such as, all active node cards)
- SNMP does not support creating or deleting rows, returning parameters or executing functions, which could be nice if the network should really be managed instead of bare monitoring
- SNMP is applicable for simple network monitoring, extensive network monitoring is difficult
- The simple nature of SNMP makes things complex.

Further work

- MIB for LCAS and VC extensions of SONET/SDH protocol
- MIB for GFP (and GFP-MD) protocols
- Extending the agent to support SONET/SDH MIB and OAN-specific MIBs
- Extending the driver to provide needed management information
- User interface hiding the complexity of MIB tree structure