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# Deploying perfSONAR-based End-to-End monitoring for production US CMS networking

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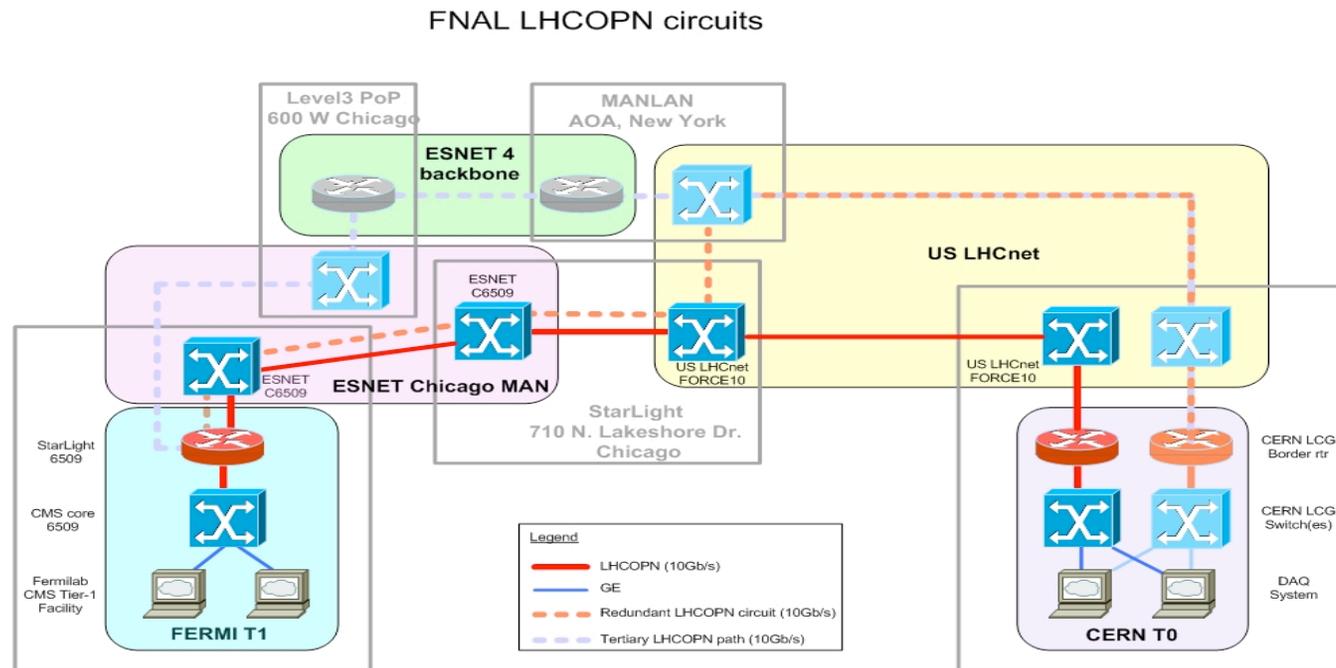
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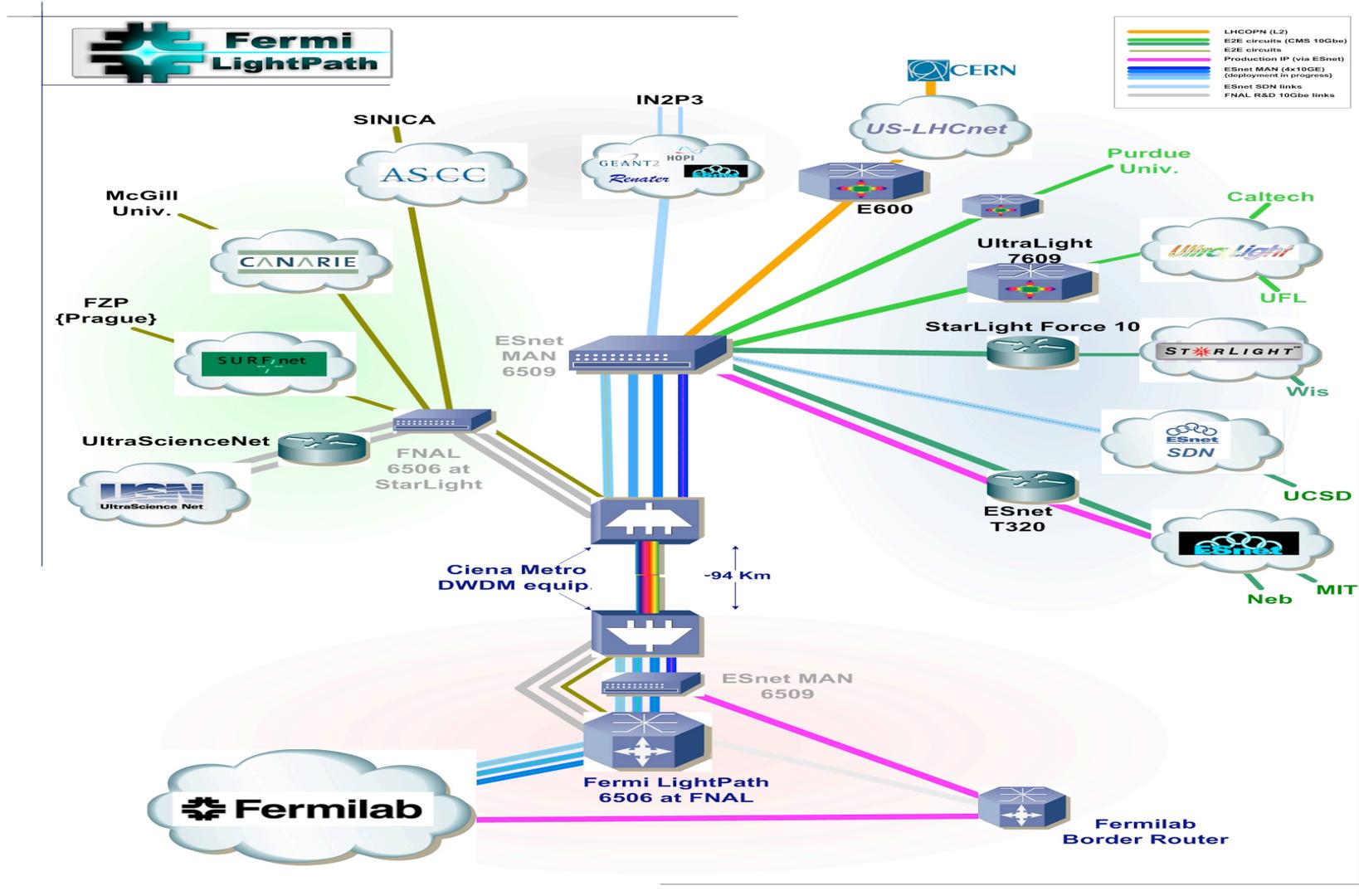
# The problem ...



- This is just *one thin slice* of the LHC Optical Private Network (LHCOPN)
  - How do we monitor availability and quality of this, let alone the entire OPN?



# A site can have the same problem ...



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# perfSONAR

- monitoring middleware
- service oriented architecture, Java API
- uses NMWG v2 XML schemas
- open source API, independent discoverable webservices
- visualization (perfSONAR UI, traceroute visualization)
  
- Deployed services at Fermilab:
  - E2E status MP/MA and E2E monitoring system
  - Utilization (round robin database) Measurement Point (MP) and Measurement Archive (MA)



# perfSONAR-PS

- perfSONAR API made easy for network admins
- Joint effort by Internet2, ESnet, SLAC, Fermilab, IU, University of Delaware and Georgia Tech
- perl based, modular reusable OO architecture
- Deployed Services at Fermilab:
  - SNMP MP/MA (utilization)
  - PingER MP/MA (active monitoring for US CMS Tier2 sites)
- Plans to deploy Topology MP/MA, OWAMP MA/MP, BWCTL MP/MA, Status MP/MA and Lookup Service MP when production version will be available



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# More on deployed monitoring services

- utilization MA/MP
  - octet counters by SNMP
  - utilized by traceroute visualization
- PingER MA/MP
  - collaborative effort by FNAL and SLAC
  - upgrade for 10 years old PingER project
  - RTT, loss, jitter
  - can identify Layer3 problems when Layer2 is OK
  - in ideal case PingER MP should be installed on every Tier2 end host



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# E2E monitoring

- LHCOPN VLAN monitoring
  - E2E Measurement Point (MP)
    - physical interface monitoring (by SNMP)
    - VLAN operational state monitoring (by SNMP)
    - optional BGP session monitoring
    - templates based, publishes status to **E2ECU (DANTE)** and to the local MA
  - local SQL Measurement Archive (MA) for historical view
  - local E2E Monitoring system (enhanced version of DFN E2E Monitoring)



# Current view of E2E monitoring system webpage with most recent problems and links status

The screenshot shows the E2E Link Monitoring System interface. On the left, there are navigation links for 'E2ECU view', 'Domain/NREN view', and 'Project view'. The main content area displays a table of link statuses, categorized by domain (FERMI, ESNET, USLHCNET). The table includes columns for Link Structure, Type, Local Name, State Oper., State Admin., and Timestamp. The status of the links is shown as 'Up' or 'Normal Oper.' in green text.

Domain	FERMI				ESNET				USLHCNET		
Link Structure	EP	↔	DP	↔	DP	↔	DP	↔	DP	DP	
Type	EndPoint	Domain Link	Demarc	ID Part.Info	ID Part.Info	Demarc	Domain Link	Demarc	ID Part.Info	ID Part.Info	Demarc
Local Name	FERMI-T1	md2	FERMI-ESNET	md8	CERN-FERMI-LHCOPN-001-Site-Tail	ESNET-FERMI	CERN-FERMI-LHCOPN-001-FERMI-STARLIGHT	ESNET-STARLIGHT	CERN-FERMI-LHCOPN-001-STARLIGHT-Tail	-	USLHCNET-CHI
State Oper.	-	Up	-	Up	Up	-	Up	-	Up	-	-
State Admin.	-	Normal Oper.	-	Normal Oper.	Normal Oper.	-	Normal Oper.	-	Normal Oper.	-	-
Timestamp	-	2007-08-24 T15:35:01.0-6:00	-	2007-08-24 T15:35:01.0-6:00	2007-08-24 T15:35:34.0	-	2007-08-24T15:35:34.0	-	2007-08-24 T15:35:34.0	-	-



# Configuration Management for E2E monitoring system

- Make it easy for network admin

## FERMI E2E Configuration Manager

**Monitored Global Links**

CERN-FERMI-LHCOPN-001	FERMI-T1-FERMI-ESNET
CERN-FERMI-LHCOPN-002	FERMI-ESNET-ESNET-FERMI
FERMI-IN2P3-IGTMD-001	Create new sub-link:
FERMI-IN2P3-IGTMD-002	CERN-FERMI-LHCOPN-001

Add new Global Link: Name (MetaData ID will be generated)

**FERMI DOMAIN Topology Points (Nodes)**

FERMI-STARLIGHT
FERMI-USLHCNET
FERMI-IGTMD
FERMI-T1

Add and Configure new Domain Node (MetaData ID will be generated)

**Nodes in other DOMAIN (External)**

USLHCNET
ESNET

Add new External Node:

Save MP response XML Template | Save SQL MA Config

Reset

**LINK CONFIGURATION MENU**

Link Name: CERN-FERMI-LHCOPN-001 Type: DOMAIN\_LINK

Change type of the link: DOMAIN\_LINK

Change Name: CERN-FERMI-LHCOPN-001

Configure Sub-Link

Router Name Interface

loopback.r-cms-fcc3	198.151.133.
r-s-starlight-fnal-dr	192.16.166.2

Add new monitoring point

Router Name Interface

Submit new monitoring point

Save SNMP Config

**link:**

neighbour	VLAN ID

**link:**

neighbour	VLAN ID

```
graph TD
    subgraph FERMILAB
        FERMI_T1((FERMI-T1))
        FERMI_ESNET((FERMI-ESNET))
    end
    subgraph ESNET
        ESNET_FERMI((ESNET-FERMI))
    end
    FERMI_T1 ---|DOMAIN_LINK| FERMI_ESNET
    FERMI_ESNET ---|ID_LinkPartialInfo| ESNET_FERMI
```



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## Future development plans

- full US CMS Tier2 coverage with PingER MPs
- production PingER MA
- AAA service
- visualization (PingER plugin for perfSONAR UI)
- data analysis (alerts ?)
- resolving scalability issues (XML parsing, XML DB)



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## Useful links

- perfSONAR – <http://www.perfsonar.net>
- perfSONAR traceroute Visualizer (by ESnet)  
<https://performance.es.net/cgi-bin/perfsonar-trace.cgi>
- perfSONAR-PS project,  
<https://wiki.internet2.edu/confluence/display/PSPS/Home>
- Fermilab E2E Monitoring page [http://lhcopnmon1-mgm.fnal.gov:9090/FERMI-E2E/G2\\_E2E\\_index.html](http://lhcopnmon1-mgm.fnal.gov:9090/FERMI-E2E/G2_E2E_index.html)
- E2ECU monitoring page [http://cnmdev.lrz-muenchen.de/e2e/lhc/mon/G2\\_E2E\\_index\\_ALL.html](http://cnmdev.lrz-muenchen.de/e2e/lhc/mon/G2_E2E_index_ALL.html)



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Questions ?

