

Operation & Measurement in APAN-JP

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JGN-X/TEIN3-JP NOCs

Research Symposium on Future Internet Architecture and Technologies
(In remembrance of Dr. Masaki Hirabaru)

Aug. 26th 2013

Agenda

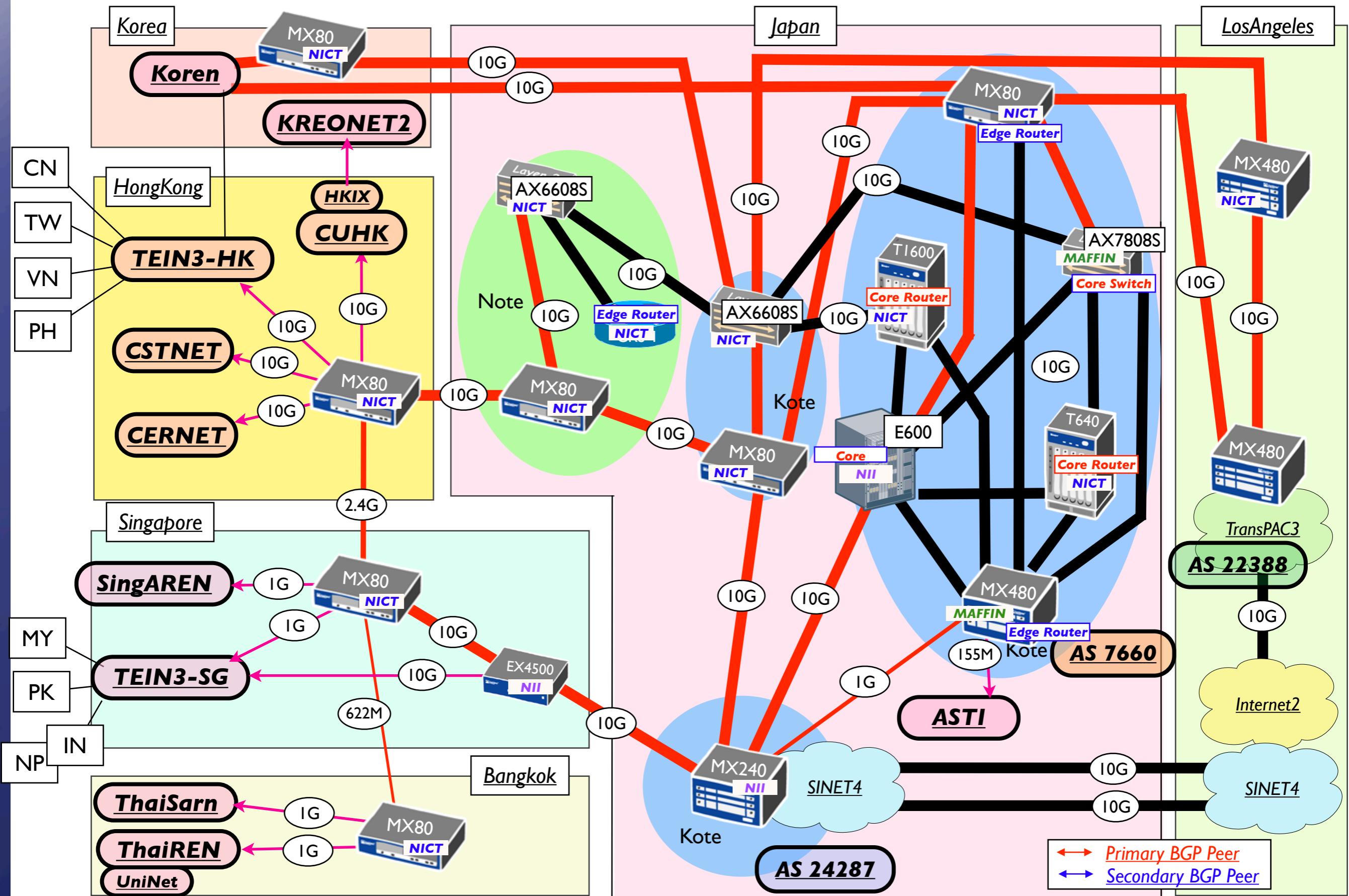
1. Introduction of APAN-JP Network and NOC
2. Measurement Technologies in APAN-JP
 - 1) Routing Monitoring
 - 2) Traffic Monitoring
 - 3) Network Performance
 - 4) PerfSONAR
3. Current efforts and Future work
 - 1) APAN Performance Matrix
 - 2) Measurement of SDN based Slice Network

Asia-Pacific Backbone Topology



As of July 17th, 2013

The Network Topology around APAN-JP



I. Introduction of APAN-JP Network and NOC

2. Measurement Technologies in APAN-JP

- 1) Routing Monitoring
- 2) Traffic Monitoring
- 3) Network Performance
- 4) PerfSONAR

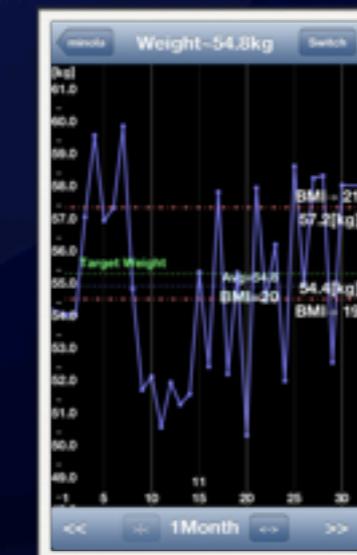
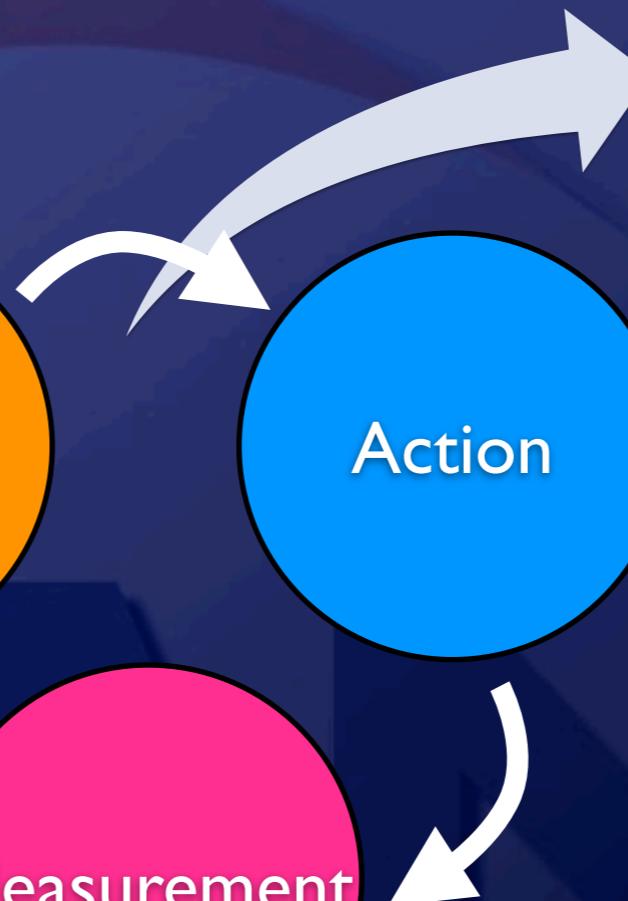
3. Current efforts and Future work

- 1) APAN Performance Matrix
- 2) Measurement of SDN based Slice Network

Measurement and Action

Target

- Improvement
- Success



Operation from Measurement

Control

- Traffic Engineering
- Traffic Shaping
- Path selection
- p2p peer selection



Alarm

- Connectivity problem
- Performance degradation
- Security incident



Measurement

Planning

- Upgrade of link
- Design of network configuration
- Upgrade of equipment

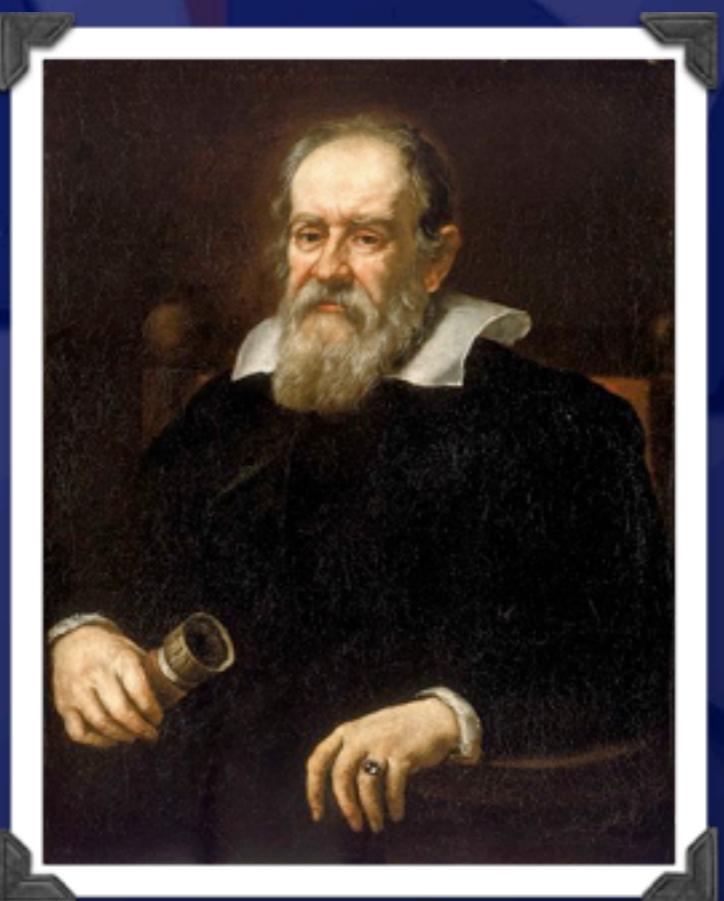


Verify

- Network performance
- Expected behavior



"Measure what is measurable,
and make measurable what is
not so"

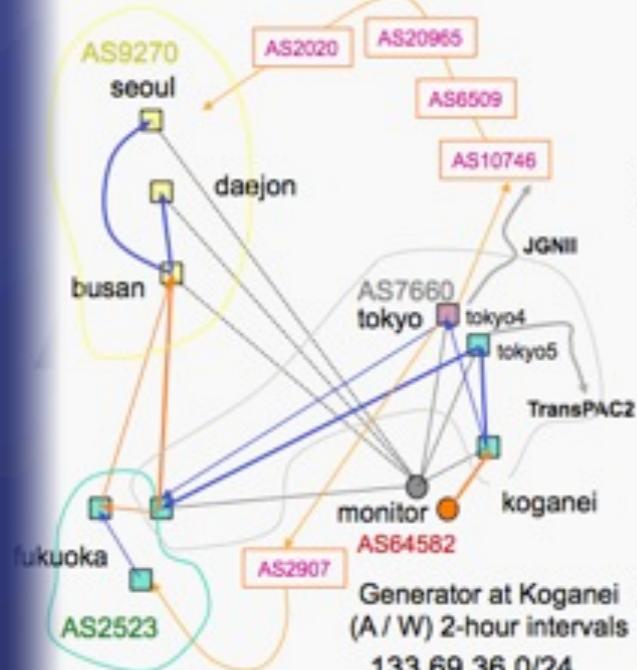


- Galileo Galilei

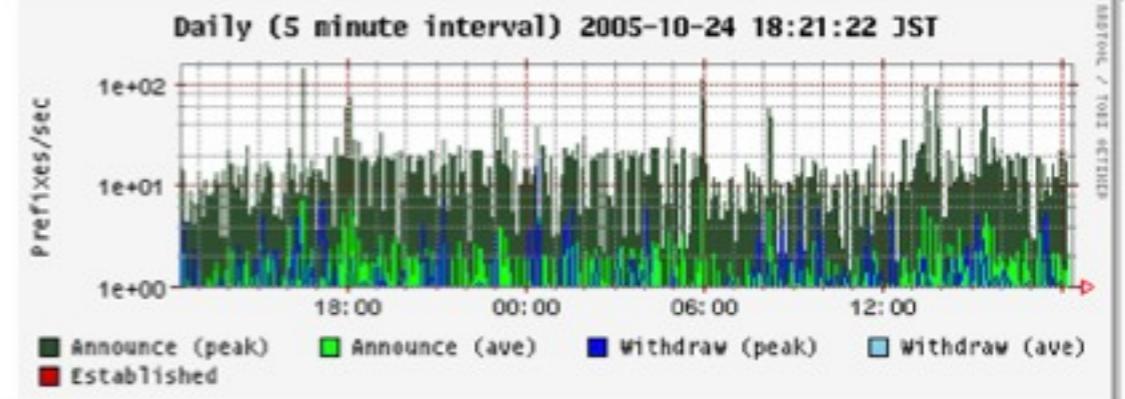
Routing Measurement

Hirabaru-san's activities in APAN-JP

Case 2: APII Route Propagation Delays



Daily (5 minute interval) 2005-10-24 18:21:22 JST



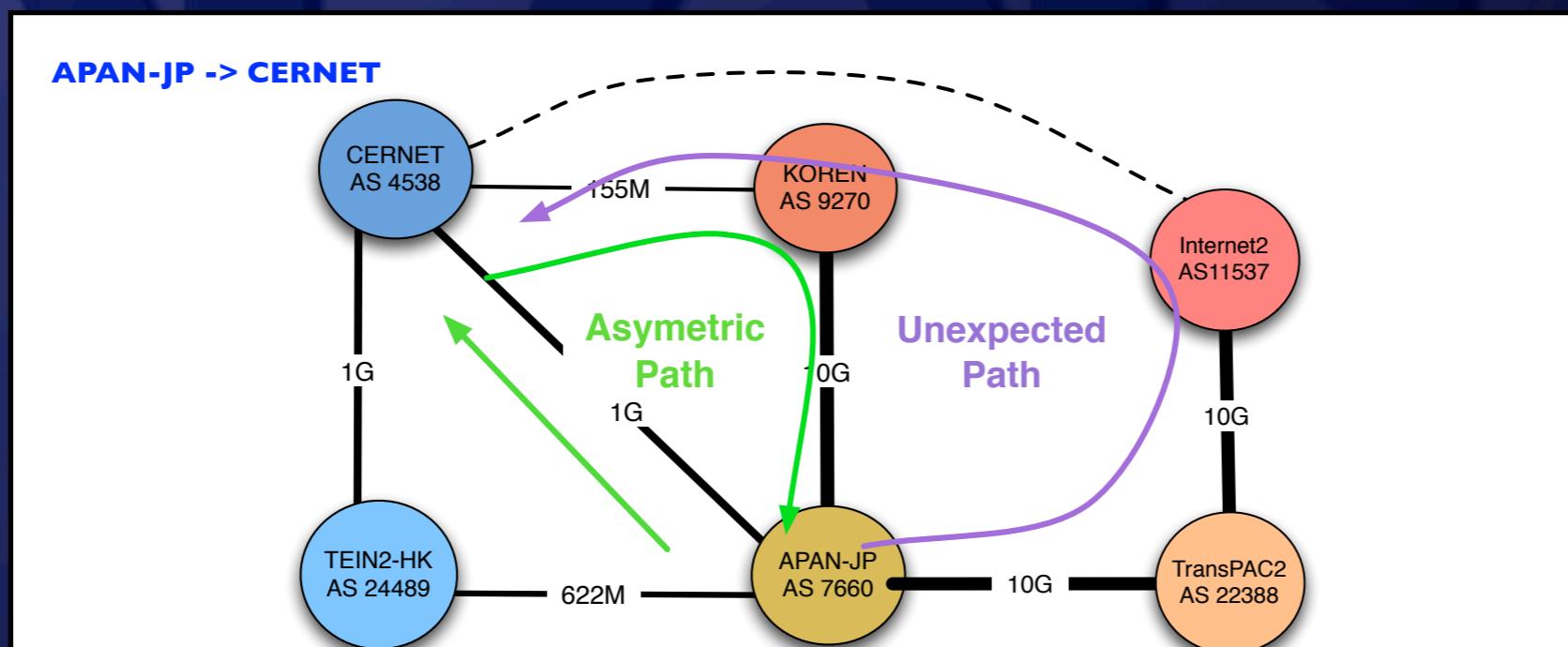
Peakflow-SP



Wrong routes detection system

- Background

- The connectivity of R&E networks are improving.
- Most user are expecting the high performance to the networks.
- Network operators have to support such user's research or demonstration. And if there is any problem with networks, they have to resolve the problem as soon as possible.
- Layer3 routings are becoming complex. Also, router configuration tend to be complex. it increase the burden on network operators with routing control.
- Unexpected routings or asymmetric routings are generated.
- It is difficult to collect network's or organization's information.



ComPath Project

<http://compath.jp.apan.net/>

APAN-JP Zebra Server

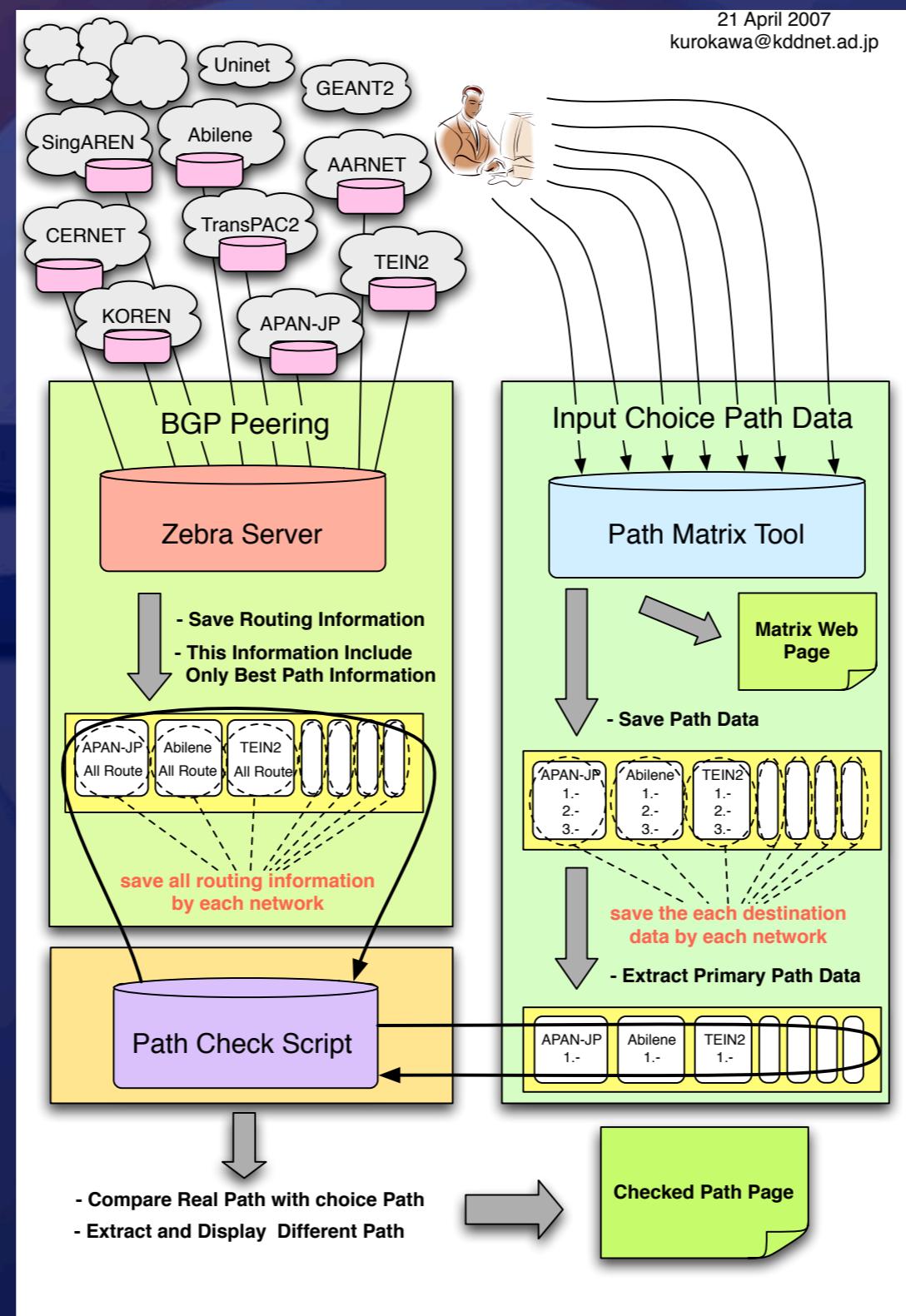
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BGP Table of APAN-JP_tpr6

BGP table version is 9, local router ID is 203.181.248.35
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, R Removed
Origin codes: l = OSPF, e = BGP, ? = incomplete

Network      Next_Hop     Metric LocPrf Weight Path
+> 6.1.0.0/16 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.2.0.0/22 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.3.0.0/18 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.4.0.0/16 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.5.0.0/19 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.6.0.0/16 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.7.0.0/16 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.8.0.0/20 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.9.0.0/20 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.10.0.0/15 203.181.248.144 0 0 7440 22388 11537 648 l
+> 6.14.0.0/15 203.181.248.144 0 0 7440 22388 11537 648 l
+> 8.6.268.0/23 203.181.248.144 0 0 7440 22388 11537 11096 4356 l
+> 8.6.265.0/24 203.181.248.144 0 0 7440 22388 19601 11096 l
+> 9.1.0.0/16 203.181.248.144 0 0 7440 22388 11537 20965 559 l
+> 12.0.0.0/20 203.181.248.144 0 0 7440 22388 11537 10578 1742 l
+> 12.6.208.0/28 203.181.248.144 0 0 7440 22388 11537 10578 1742 l
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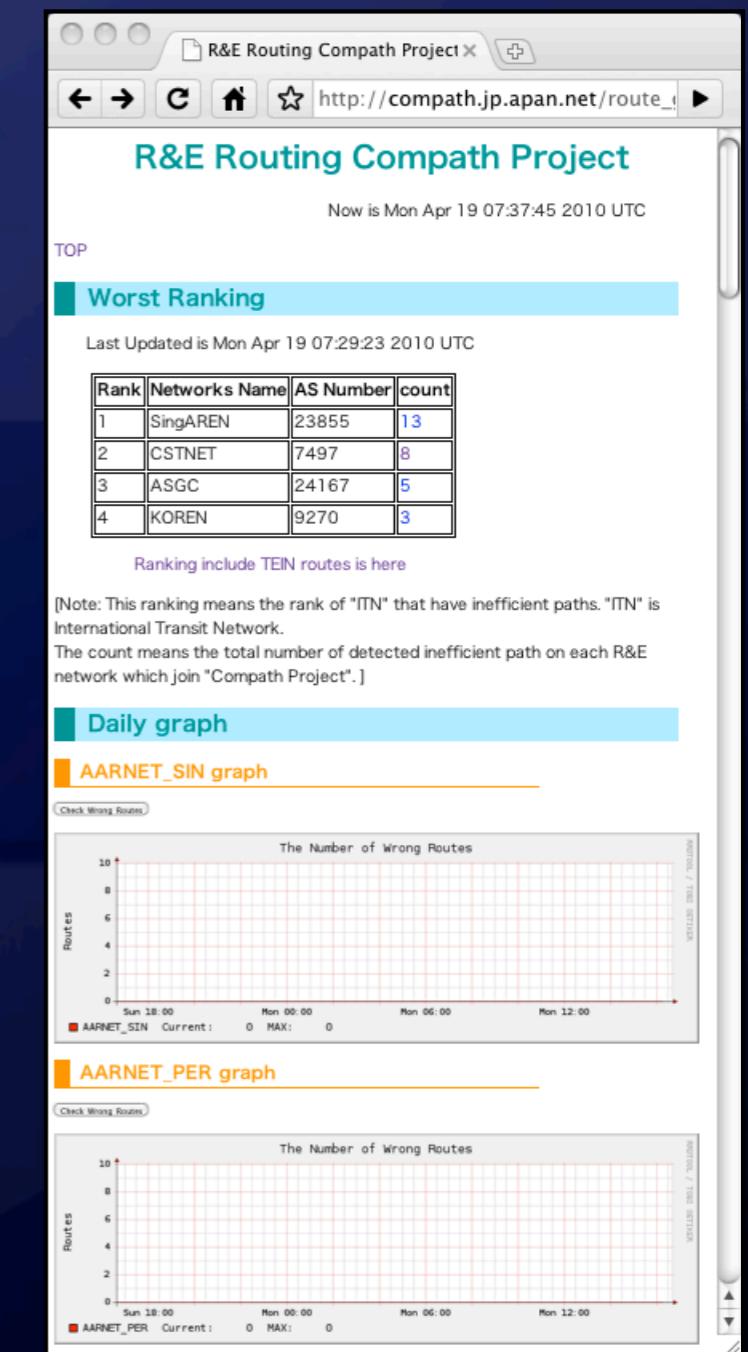
- Save BGP routing information
- View BGP routing information.

RouteView server
Peer with 25 R&E nets



21 April 2007
kurokawa@kddnet.ad.jp

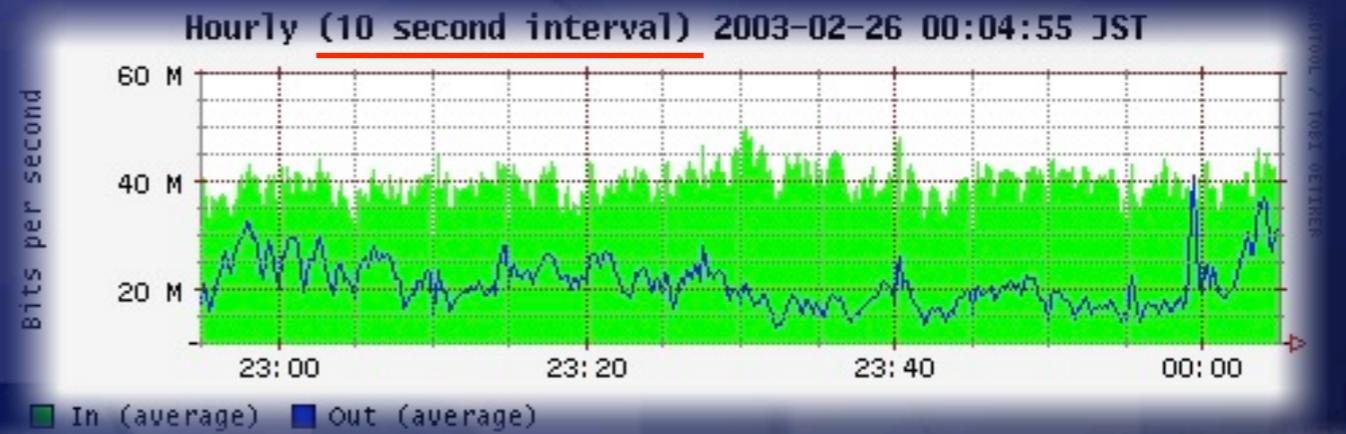
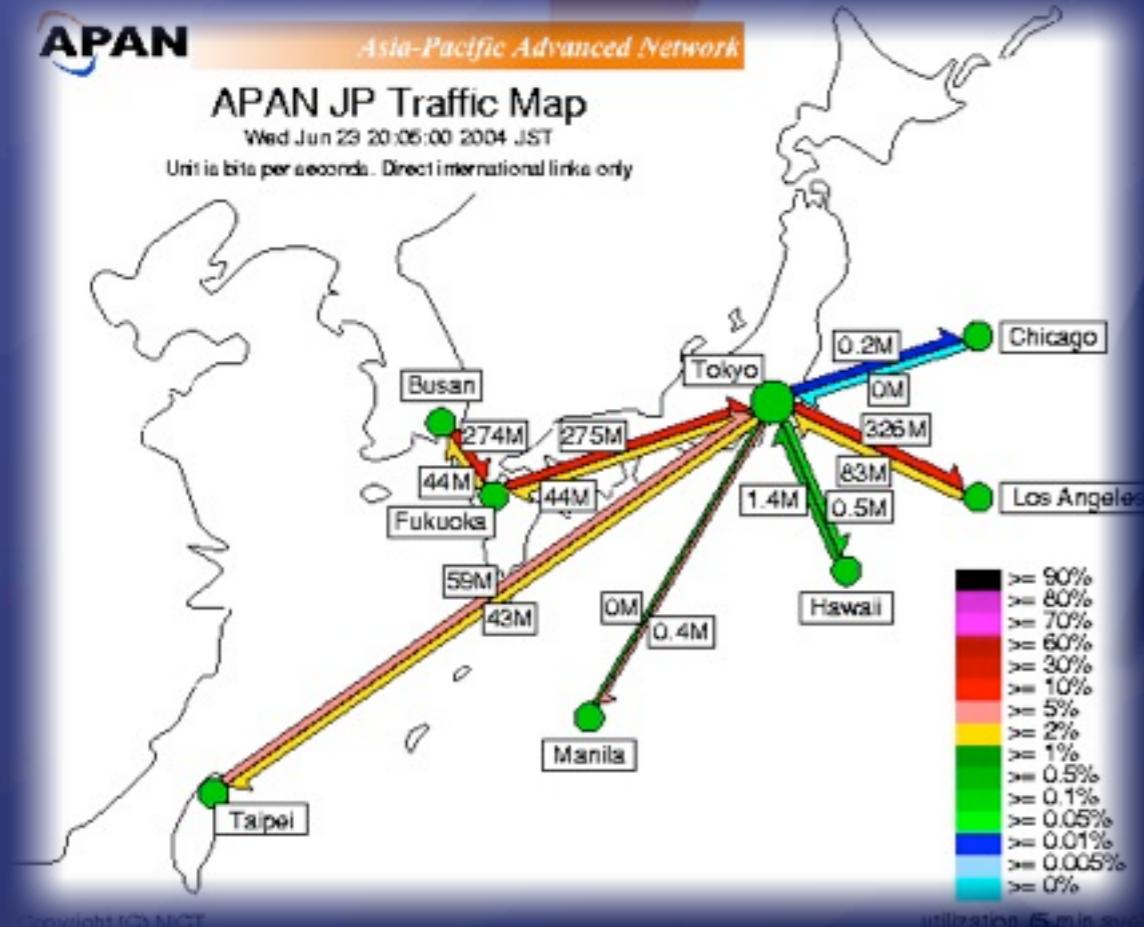
ComPATH Tool



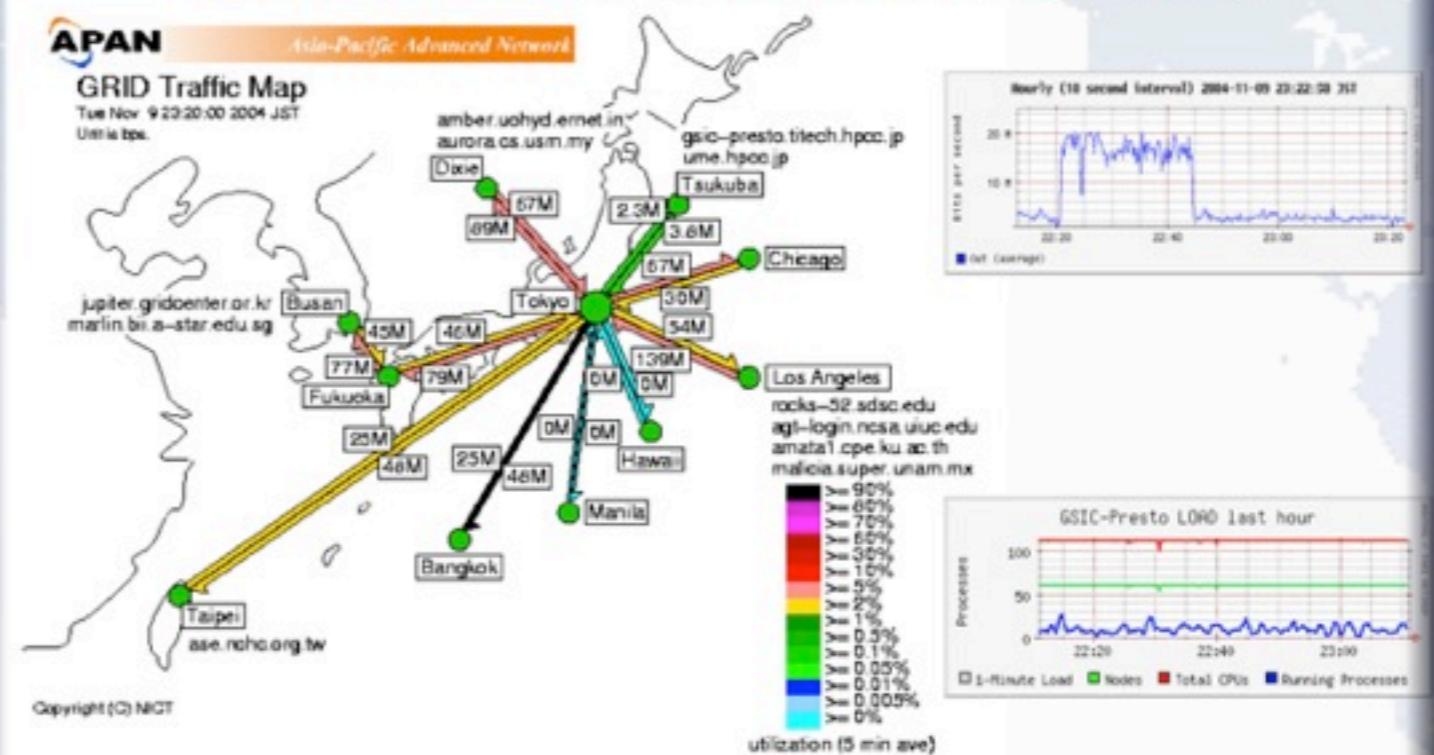
- View inefficient information.

Traffic Monitoring

Hirabaru-san's activities in APAN-JP



Collaboration with APAN
<http://mrt.a.koanei.itrc.net/mmap/grid.html>



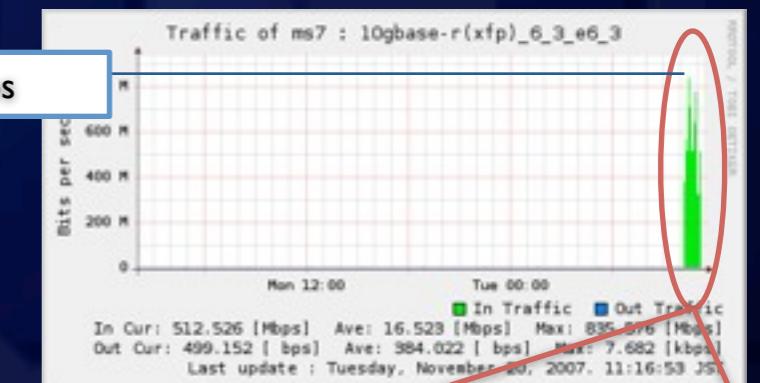
Thanks: Dr. Hirabaru and APAN Tokyo NOC

High time resolution Traffic Graph

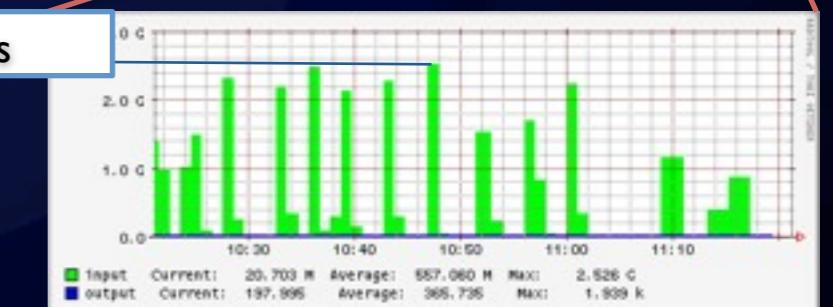
- Collect MIB data with high time resolution(10 seconds)
- Graph display every ten seconds by RRD Tool
- SNAPP
 - Front-end of RRDtool
 - Developed by IU GlobalNOC
 - <http://sourceforge.net/projects/snapp/>
- APAN-JP NOC data
 - <http://nms2.jp.apan.net/snapp/>

[Advantages]

- Enable to display more detailed/accurate traffic pattern and peak value than general MRTG which collects data 5 minutes interval
- Since the graph is displayed after 10 seconds traffic generating, we can monitor the traffic in Quasi-real-time



Cricket (5min)



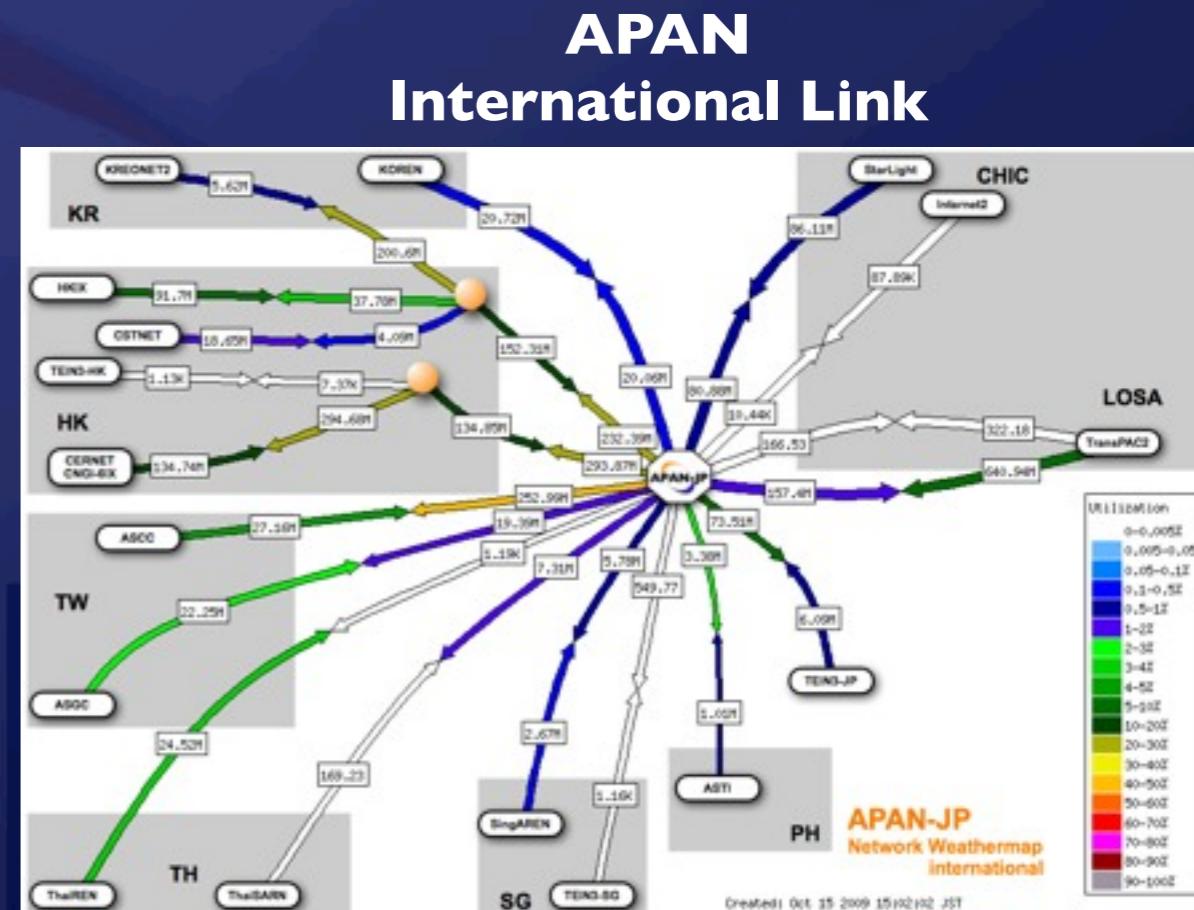
SNAPP (10sec)

Traffic Weather MAP

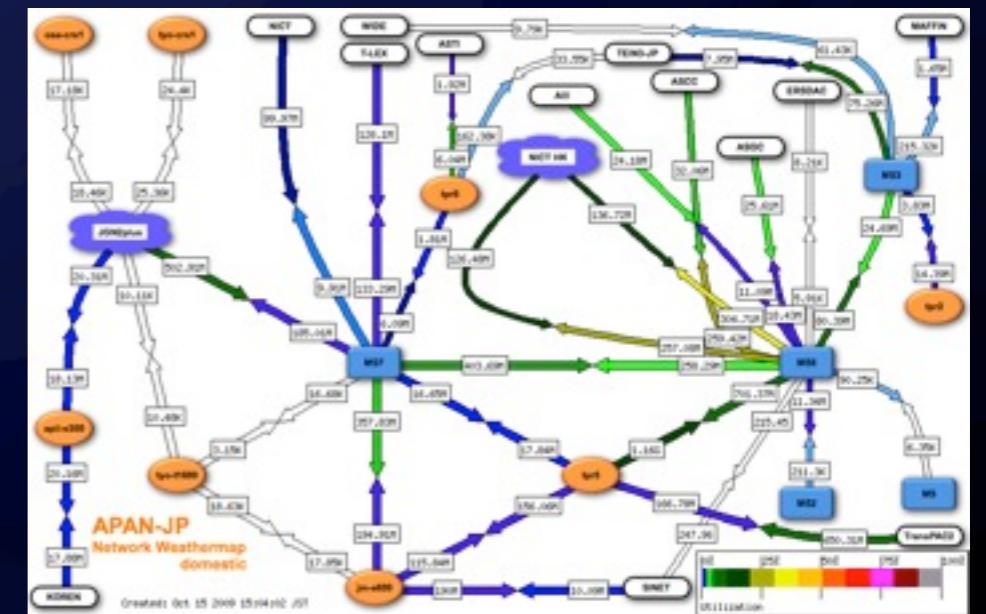
- Display link usage on topology MAP
- Use RRD Data
- APAN-JP Traffic Weather MAP
 - <http://monitor.jp.apan.net/weathermap/>

[Advantages]

- Enable us to confirm current link usage over multiple links
- Map shows the incoming and outgoing traffic at a glance
- Useful for the detection of cross traffic at the demonstration or event



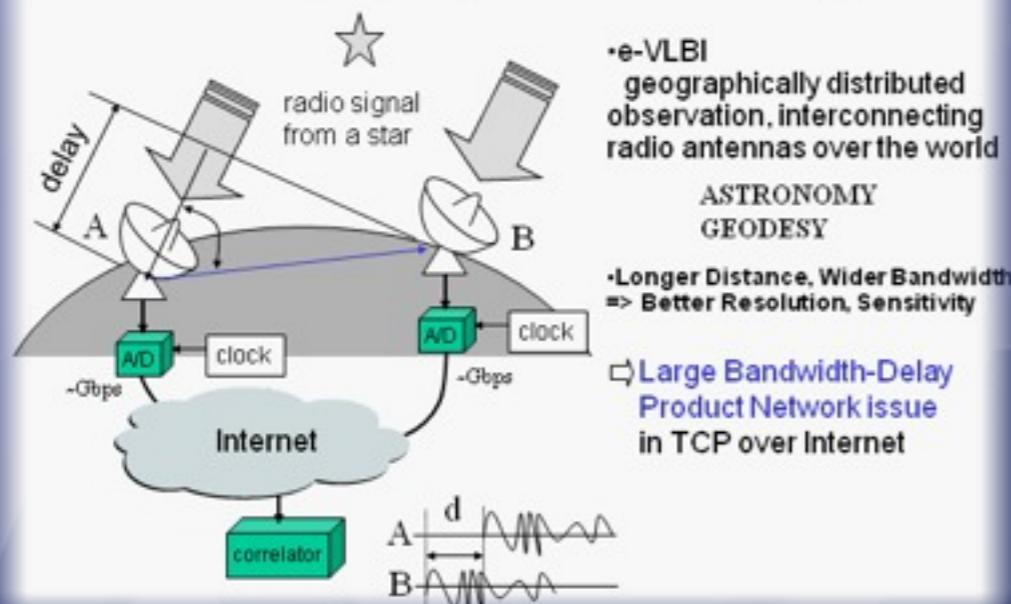
APAN Internal Link



Performance measurement

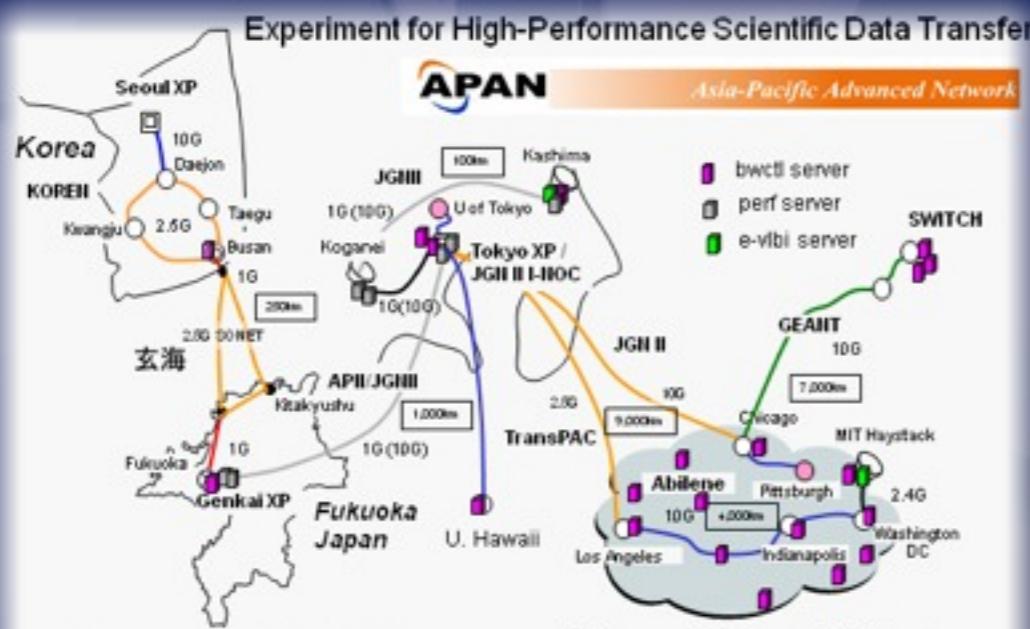
Hirabaru-san's activities in APAN-JP

Large Bandwidth-Delay Product Network Issue in VLBI (Very Long Baseline Interferometry)

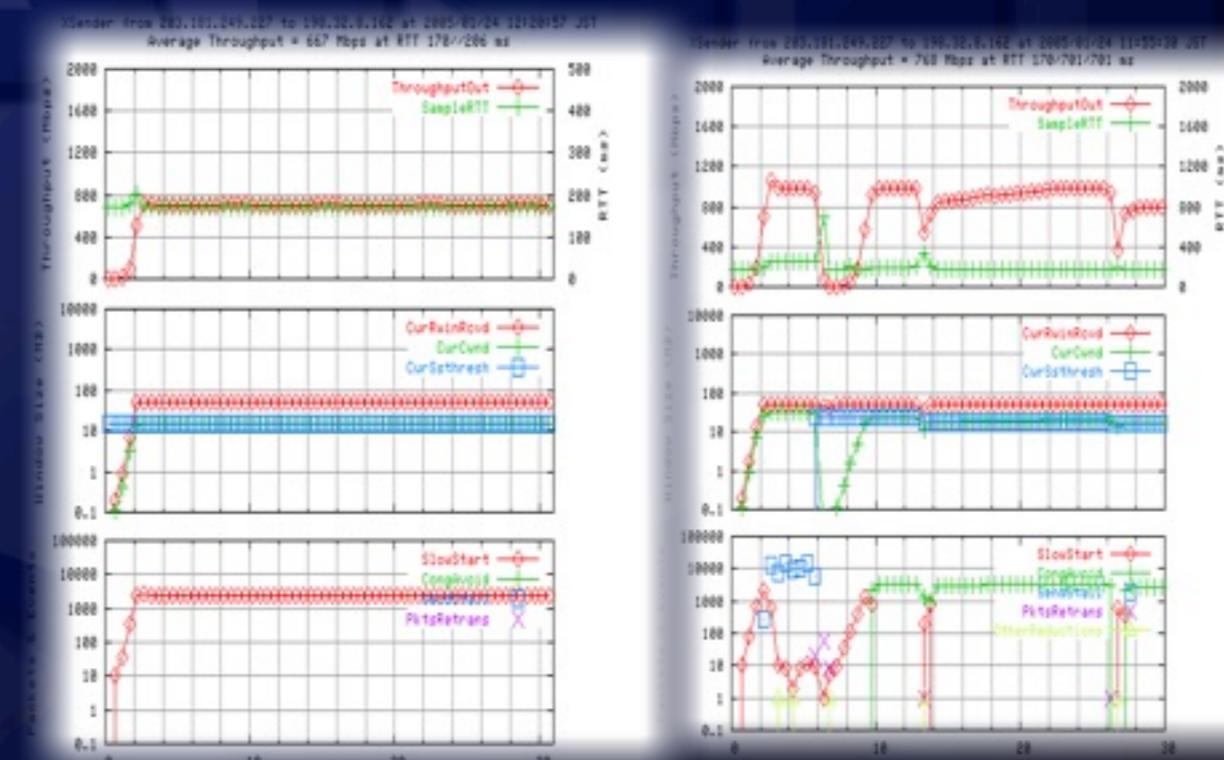


- MIT Haystack – CRL Kashima e-VLBI Experiment on August 27, 2003 to measure UT1-UTC in 24 hours
 - 41.54 GB CRL => MIT 107 Mbps (~50 mins)
 - 41.54 GB MIT => CRL 44.6 Mbps (~120 mins)
 - RTT ~220 ms, UDP throughput 300-400 Mbps However TCP ~6-8 Mbps (per session, tuned)
 - BBFTP with 5 x 10 TCP sessions to gain performance

Analyzing of TCP behavior



International collaboration to support for science applications

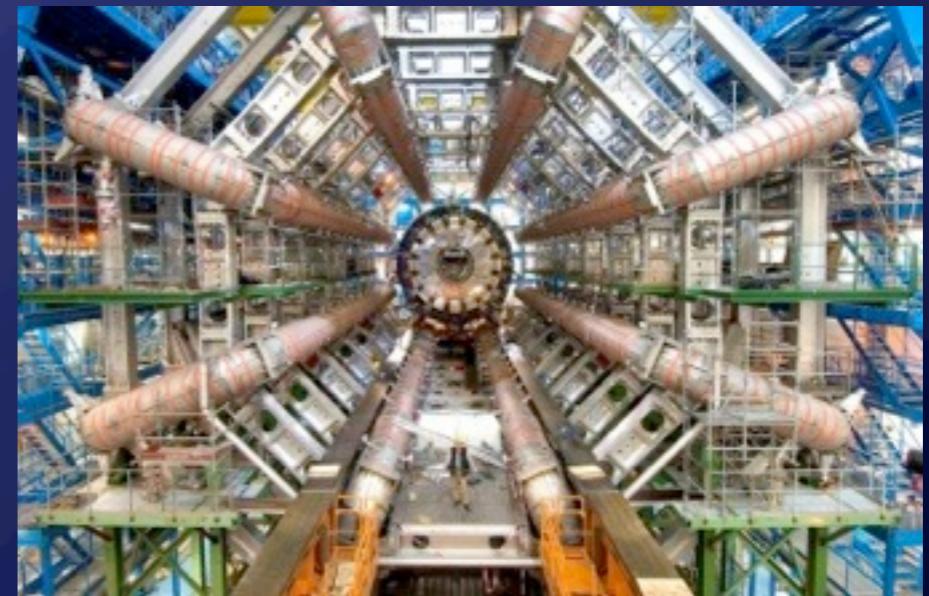


Global Projects

Tele-Medicine / Tele-education
(APAN medical WG, SOI)



High Energy Physics
(LHC, ITER)



Radio Astronomy Observatory
(e-VLBI, ALMA)



Hi-definition Video Transfer
(CineGrid)



perfSONAR

- Measurement middleware over the multi-domain
 - The framework for network measurement between domains
 - perfSONAR services act as an intermediate layer, between the performance measurement tools and the diagnostic or visualization applications
 - perfSONAR services “wrap” existing measurement systems
- In the multi-domain network environment,
 - Measure network performance
 - Exchange and share measurement data

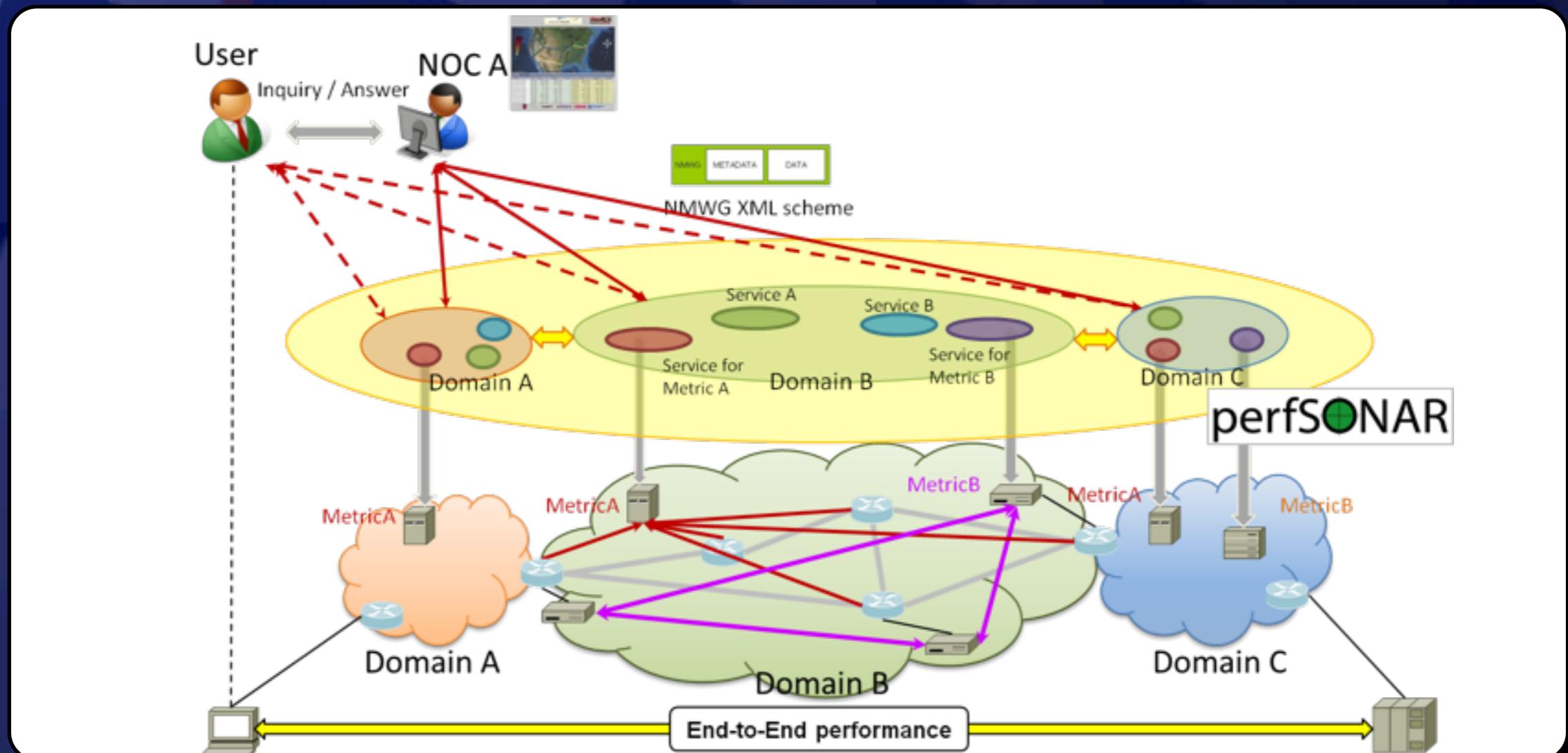
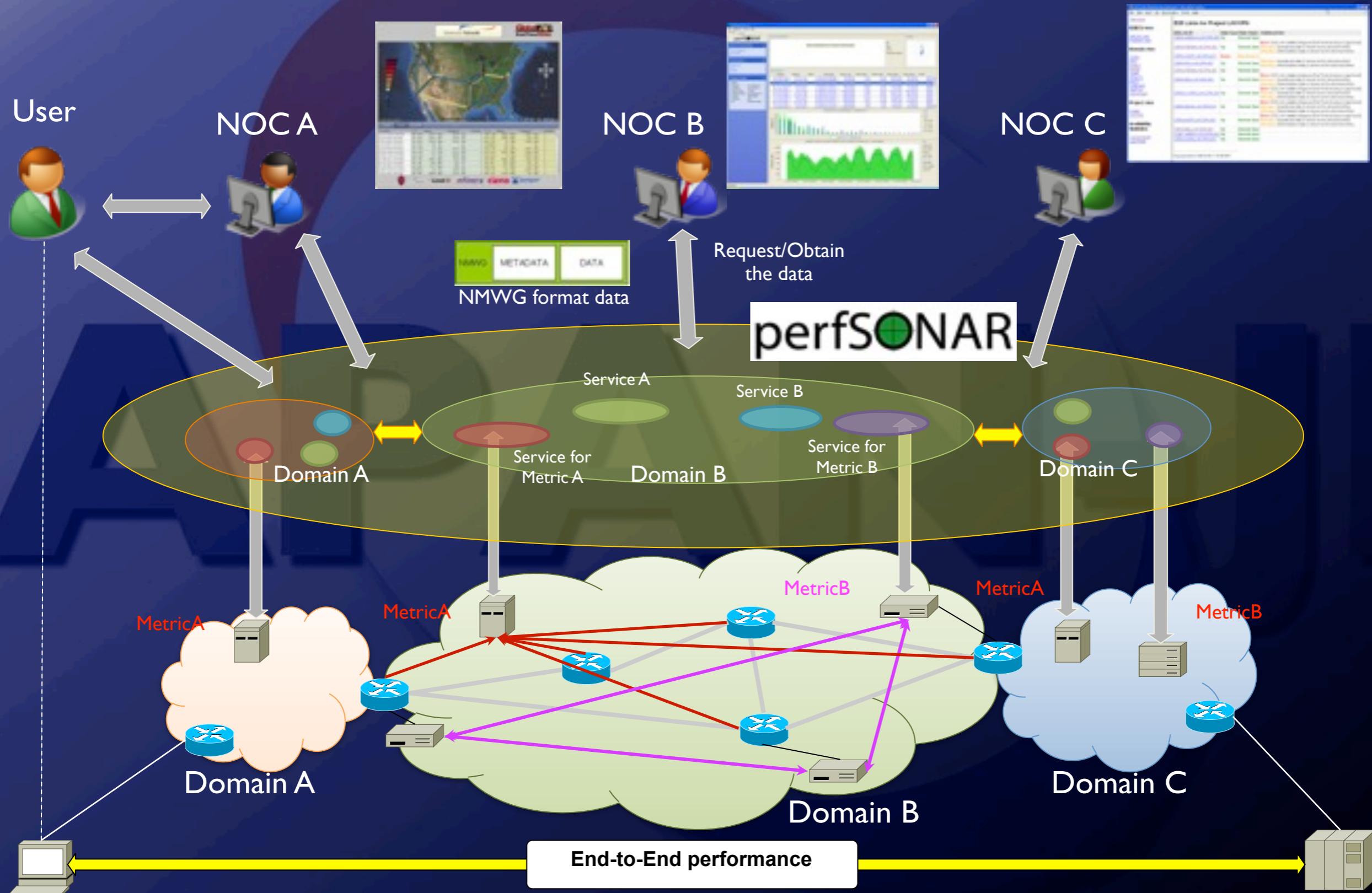
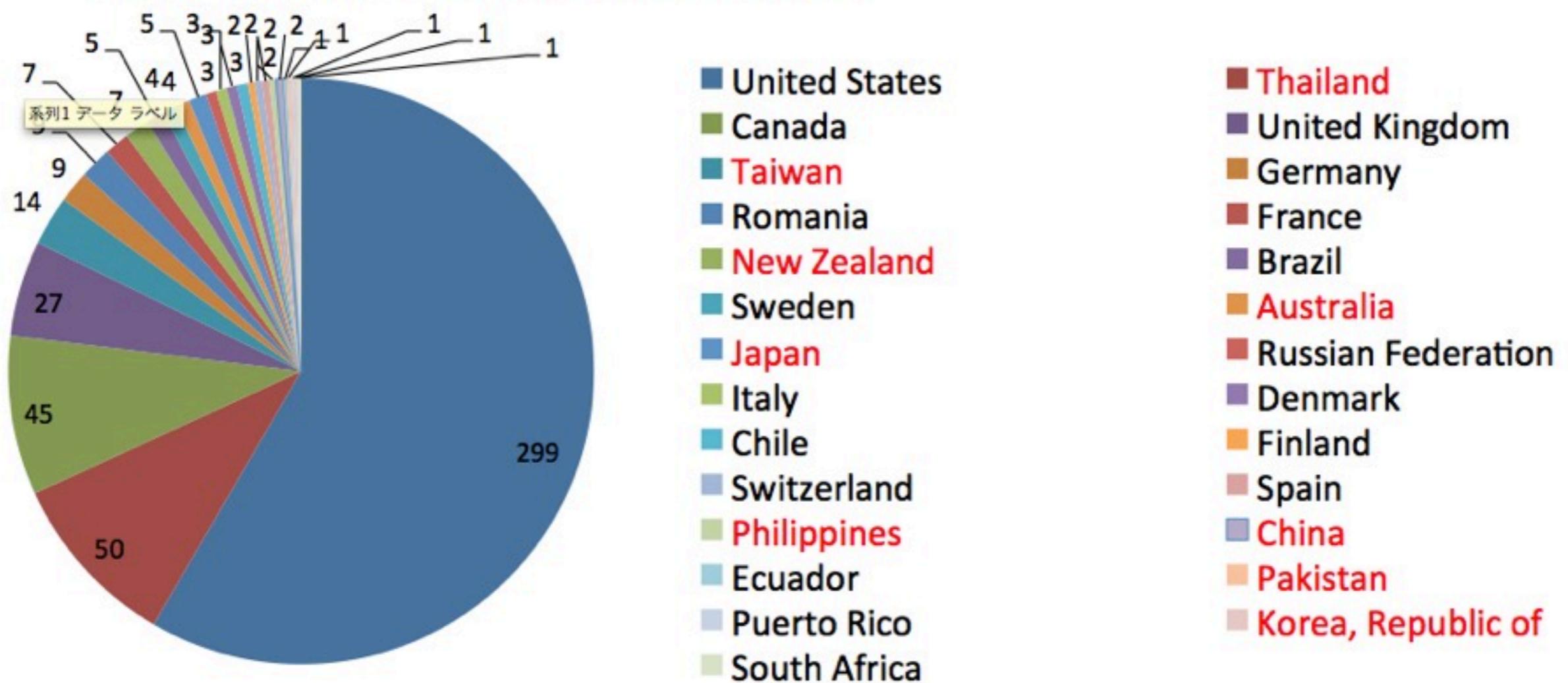


Diagram of perfSONAR



Deployment in the world

- 3799 services in the world
- 512 Toolkit in 27 countries



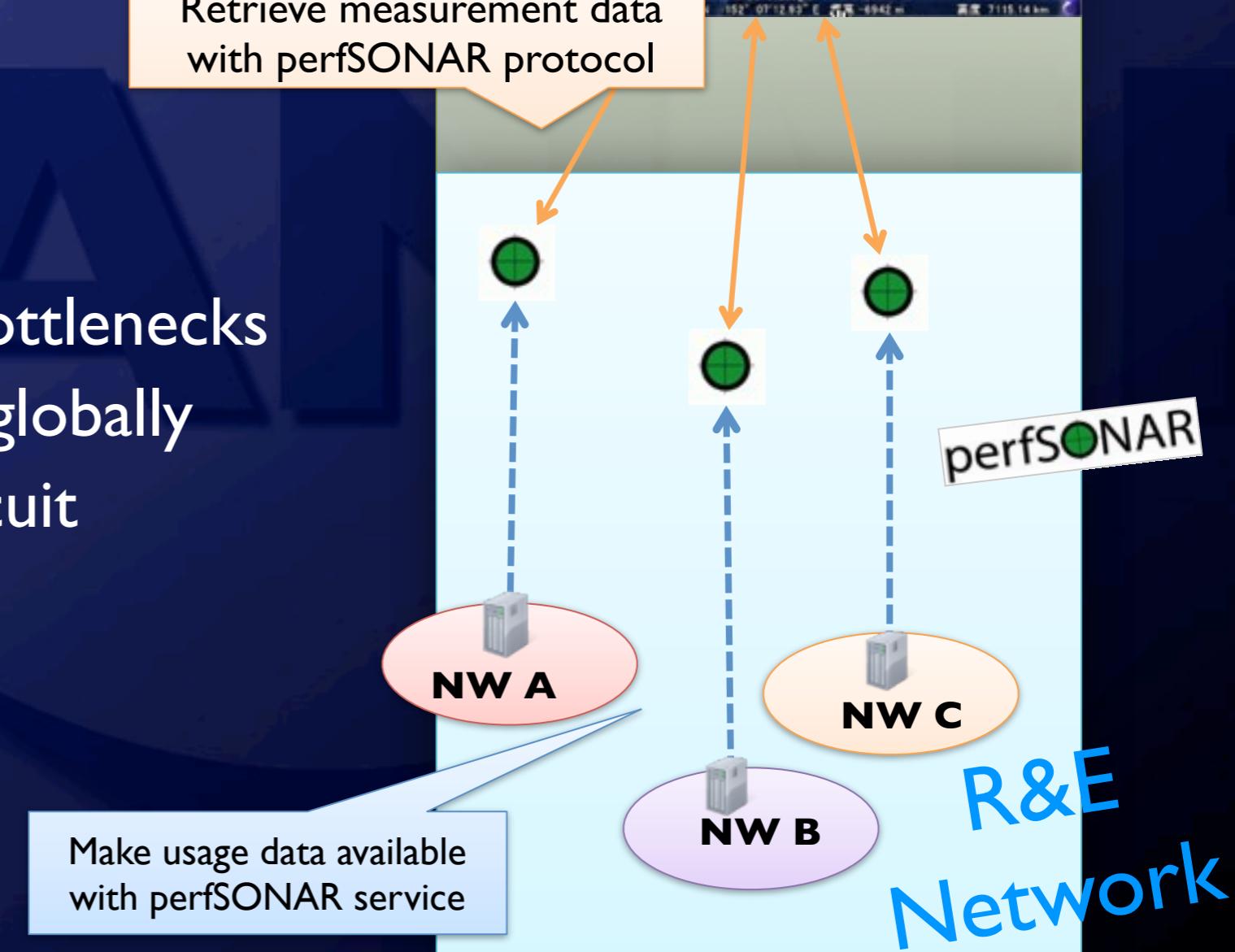
Global Traffic Weather MAP on Google Earth

Visualize the link usage of multi-domain network on the Google Earth

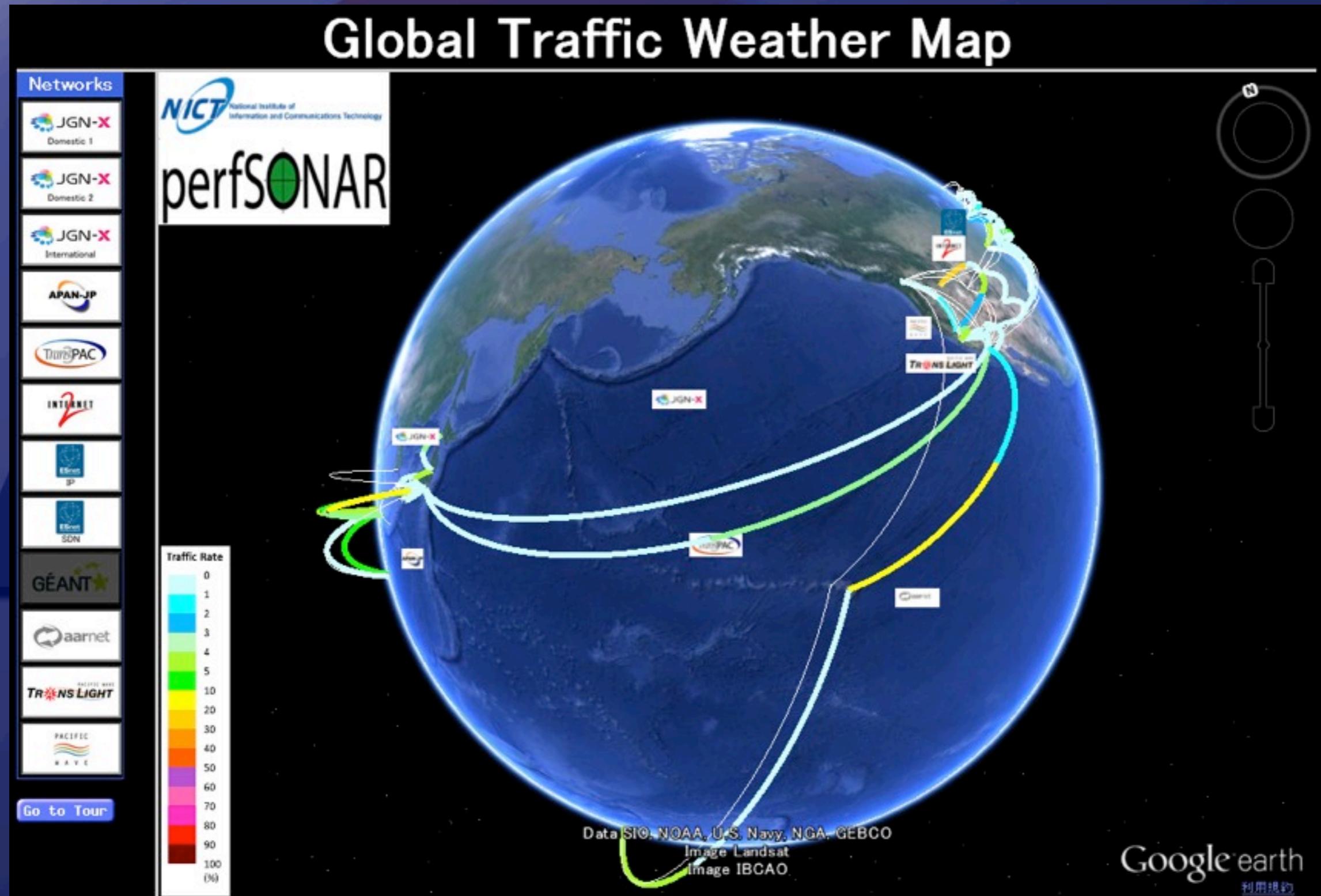
- perfSONAR Service
 - SNMP_MA (MA)
- Benefit
 - Quick detection of the bottlenecks
 - Verification of the traffic globally
 - Easy to recognize the circuit geographically



Retrieve measurement data
with perfSONAR protocol



Global Traffic Weather MAP on Google Earth



<http://kote-ps-l.ps.jgn-x.jp/ps/ps-gearth/>

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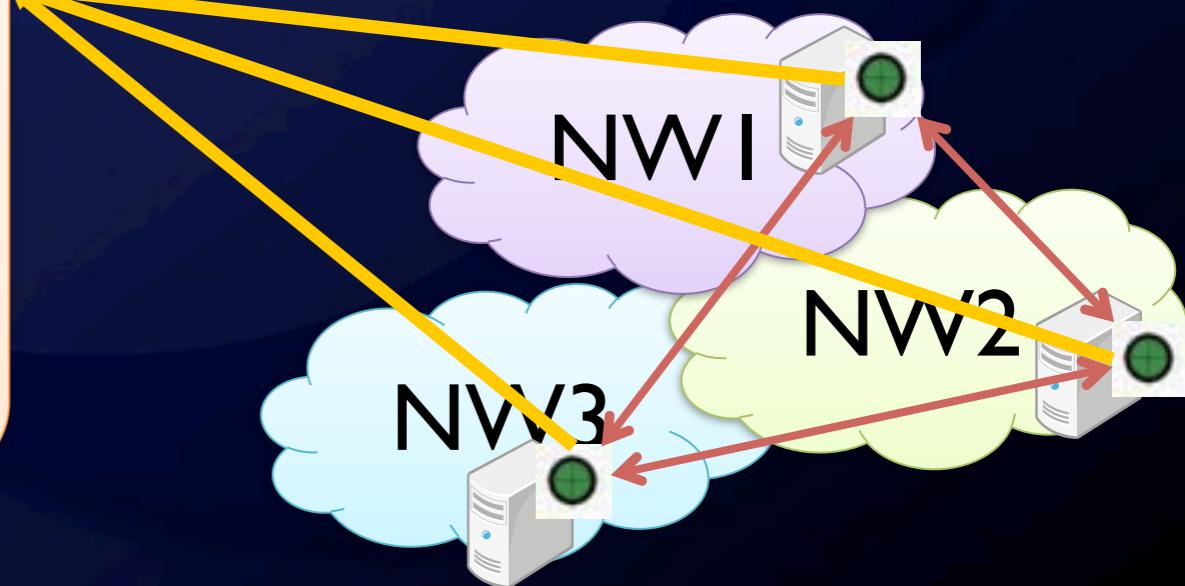
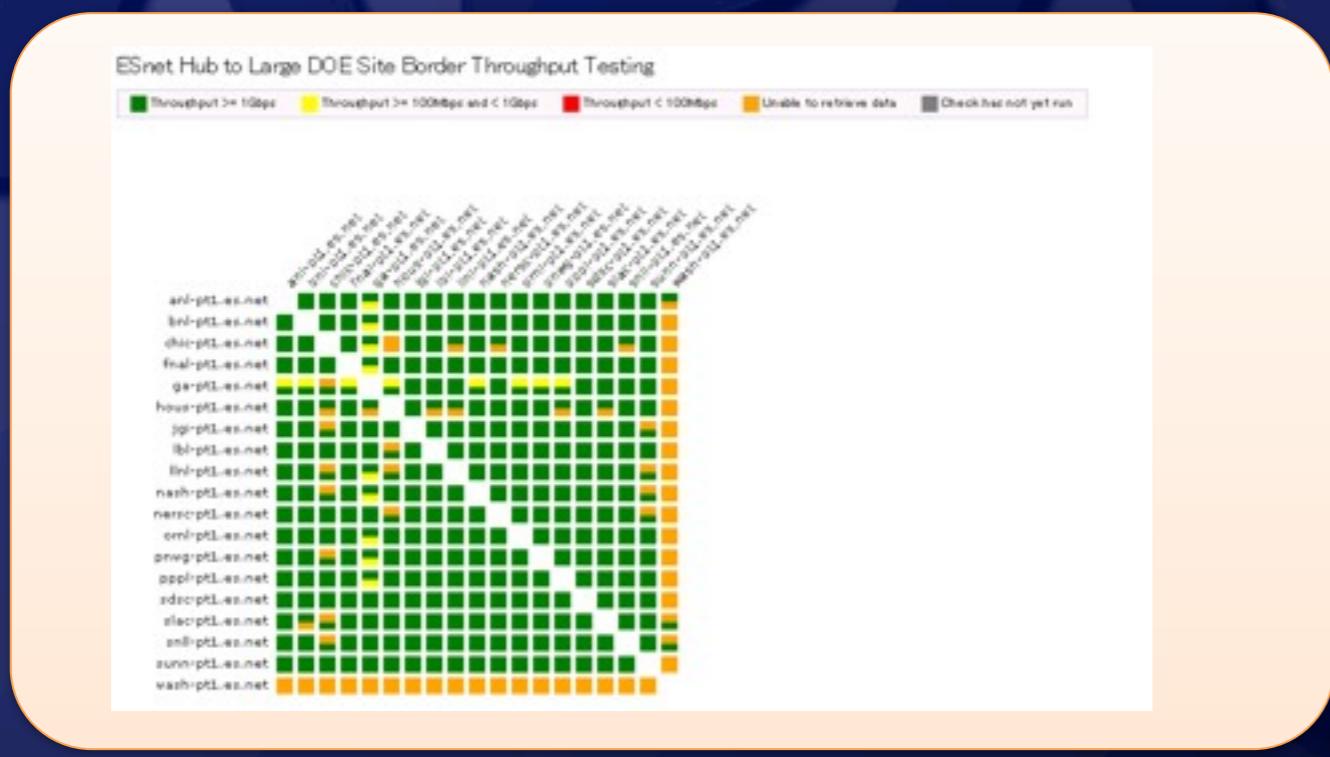
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3. Current efforts and Future work

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APAN Performance Matrix

- Displaying the result of performance measurement among APAN members in the matrix
 - Doing periodical measurement among APAN members
 - Showing that result in matrix to easy to understand the performance in APAN network
- Alerting the performance degradation
 - When the performance degradation occurs, the alerts are sent to contact point of the network



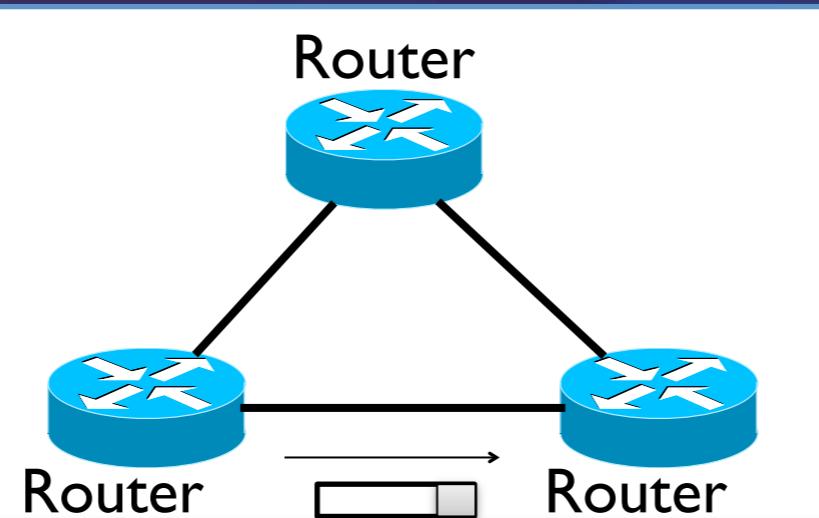
APAN Performance Matrix

- URLs -

- Web Site
 - <http://ps1.jp.apan.net/maddash-webui/>
- How to
 - <http://www.jp.apan.net/noc/perfSONAR/man-apan-matrix.shtml>
 - Install pS-performance Toolkit
 - Install & setup perfSONAR-MeshConfig module

Operational difficulty is increasing

Traditional



Measurement and Monitoring is essential !

Present

Multi-layer network

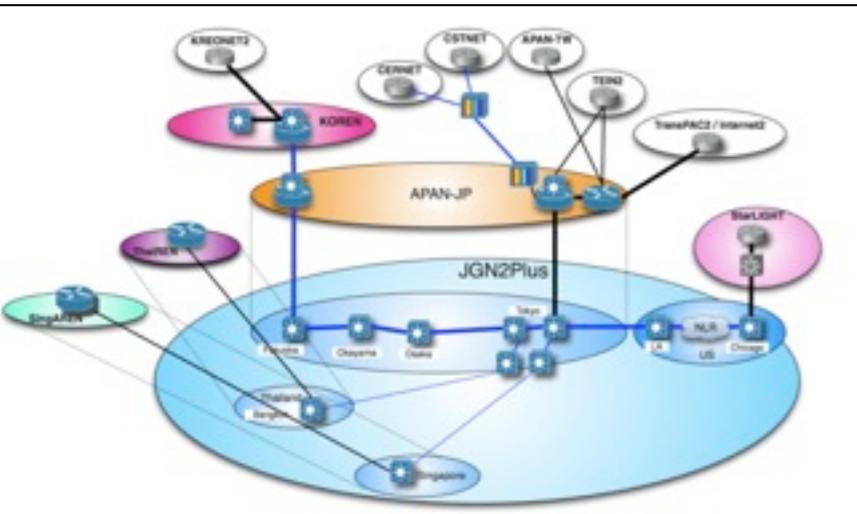


Diagram: Jin Tanaka

Virtualized network

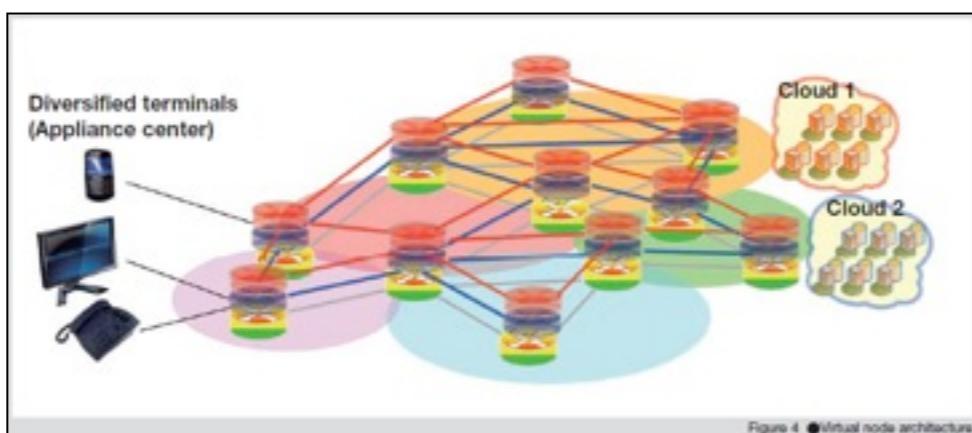


Diagram: Aki Nakao

Software defined network

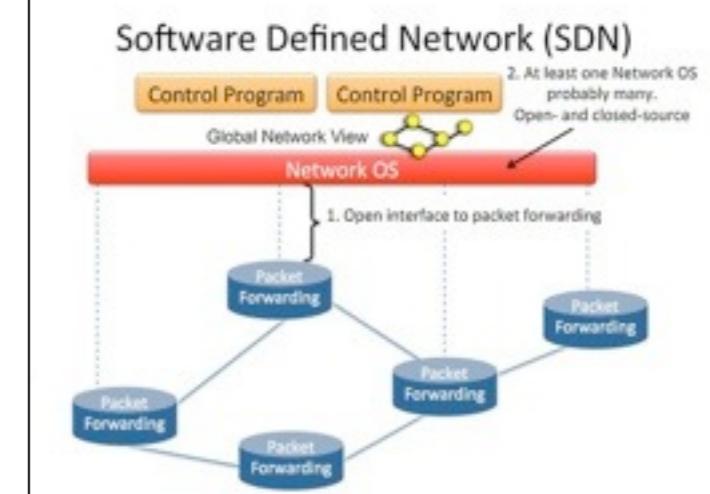


Diagram: Nick McKeown

Project Objectives

FELIX Project

FEderated Test-beds for Large-scale Infrastructure eXperiments

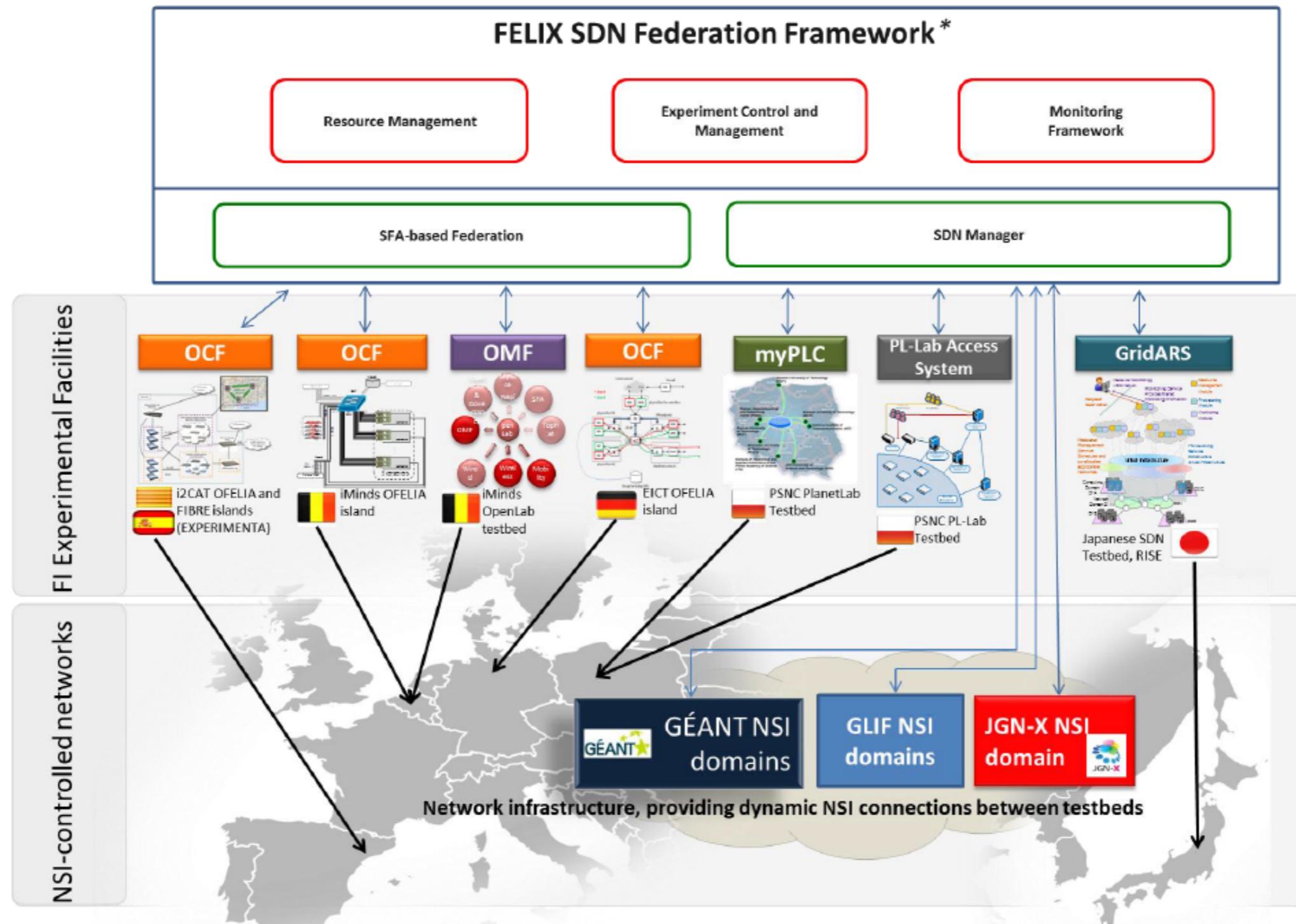
Collaboration project between EU and Japan

- Create a common framework for Future Internet experimental research -

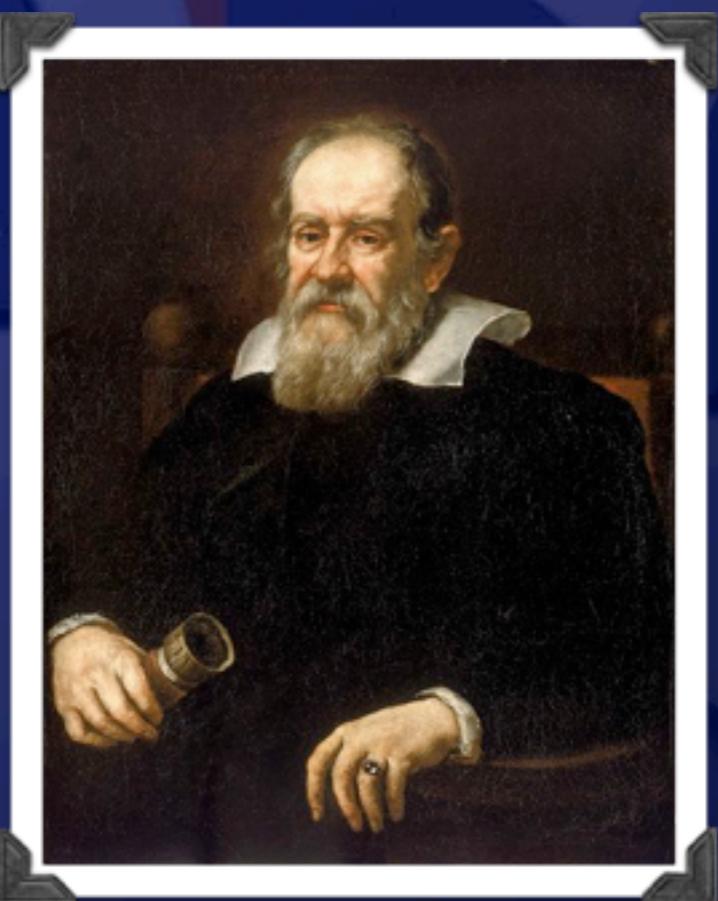
- Create an integrated Europe-Japan SDN test-bed
 - Utilize functionality of OpenFlow and NSI for creation of Federated SDN Services
 - Introduce new APIs and logic for globally distributed heterogeneous SDN and IT islands
 - Enable interchange of resources information, share overall resource pools
 - Provide dynamic network interconnectivity between and within islands
- Exploit inter-domain dynamic connection provisioning standard, **NSI**, which is being deployed in many R&E networks
- Facilitate Europe-Japan collaboration on new standards for infrastructure management (both IT and network resources)



FELIX Architecture

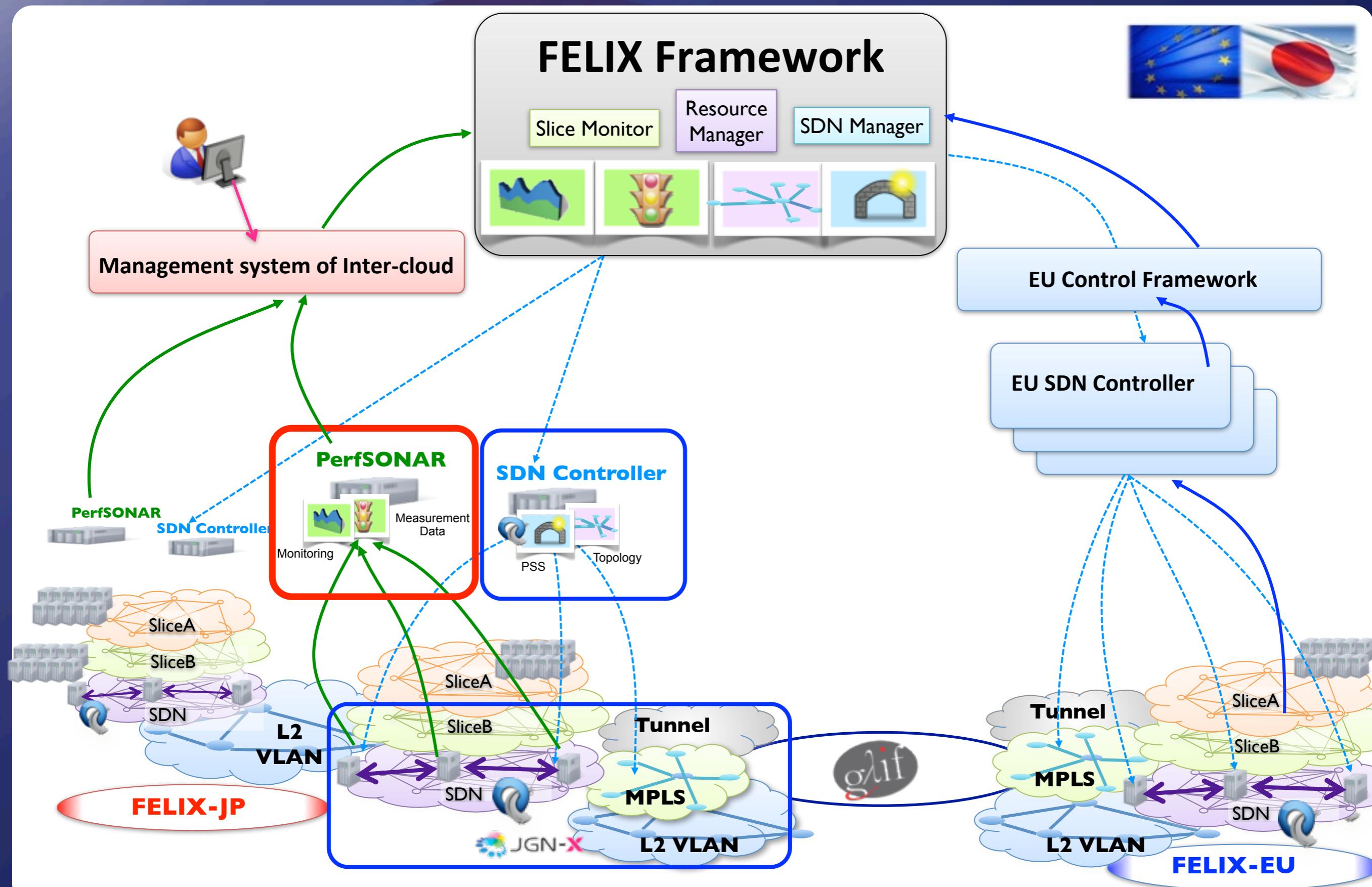


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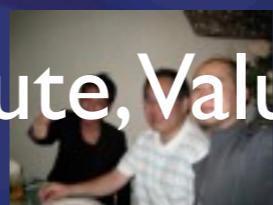


- Galileo Galilei

Measurement of SDN based Sliced Network



Memories of Hirabaru-san “Immeasurable Man”



Influence, Contribute, Value...



References

- Hirabaru-san's presentation
<http://apan.net/meetings/busan03/materials/meetings/engineering-team/Hirabaru.ppt>
<http://www.apan.net/meetings/bangkok2005/presentation/Hirabaru-APAN-Bangkok-Pipes-2005-1-27.ppt>
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[http://www.apan.net/meetings/singapore2006/presentations/noc/Network Engineering.ppt](http://www.apan.net/meetings/singapore2006/presentations/noc/Network%20Engineering.ppt)
- perfSONAR
<http://www.perfsonar.net/>
- perfSONAR-Wiki
http://wiki.perfsonar.net/jral-wiki/index.php/PerfSONAR_Wiki
- perfSONAR-PS
<http://www.internet2.edu/performance/pS-PS/>
- pS-Performance Toolkit
<http://psps.perfsonar.net/toolkit/>
- APAN-JP PerfSONAR
<http://www.jp.apan.net/noc/perfSONAR/>
- perfSONAR-PS MeshConfig
<https://code.google.com/p/perfsonar-ps/wiki/MeshConfigurationInstallation>
- Maddash (Monitoring and Debugging Dashboard)
<http://code.google.com/p/perfsonar-ps/wiki/MaDDashInstall>
- OGF NSI (Network Services Interface) WG
http://www.gridforum.org/gf/group_info/view.php?group=nsi-wg
- EU-JP FELIX Project
<http://www.ict-felix.eu>