Application Driven Networking with XSP

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Introduction

- Software Defined Networking and OpenFlow
  - Fine-grained control of forwarding in the data plane
  - Tremendous interest in R&E as well as industry
- Network as a service, dynamic links/circuits
  - Network applications can explicitly allocate for efficiency or determinism
  - Cloud-based infrastructure: networks complete the picture
  - Good for the network to herd the “elephant” flows
- “Northbound” interface for SDN
  - How do applications interact with services in the network
  - Support traffic engineered flows (e.g. bulk data movement), etc.
- XSP: session-based protocol framework for interaction between applications and network services

eXtensible Session Protocol (XSP)

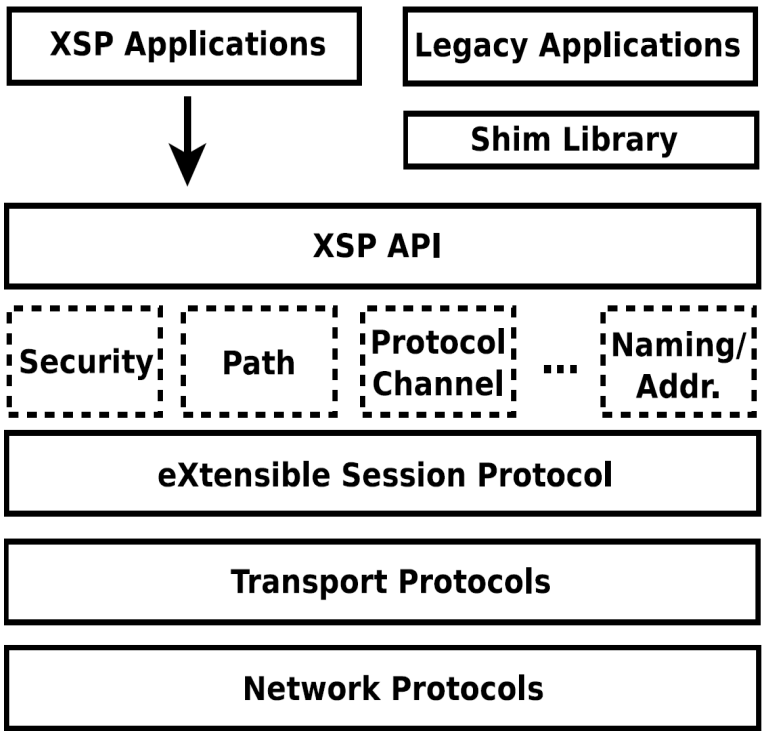
- In the spirit of the ITU-T Recommendation X.225 connection-oriented session protocol specification:
  - " … *a single protocol for the transfer of data and control information from one session entity to a peer session entity... making use of the services available from the Transport Layer*"
- XSP resides above the transport layer
  - Can encapsulate control and data PDUs into session layer PDUs
  - Inline and ongoing unlike SIP
- Provides a common set of features useful to applications, rather than being part of each app
  - Bidirectional communication between apps and network svcs
- Service interaction is session in the most literal sense:
  - "*a period of time devoted to a particular activity*"

What's in a session layer?

- End to end state
  - Session state for related parallel or serial transport connections
  - Context for mobility, multipath
- Authorization and authentication
  - X.509 or SSH credentials
- Naming and addressing
  - Session `connect()` not tied to network or transport addresses
- Explicit signaling and data channel optimizations
  - Phoebus WAN optimization
- Flexibility for new approaches and technologies
  - SDN
  - Delay tolerant flows for performance (buffer and burst)

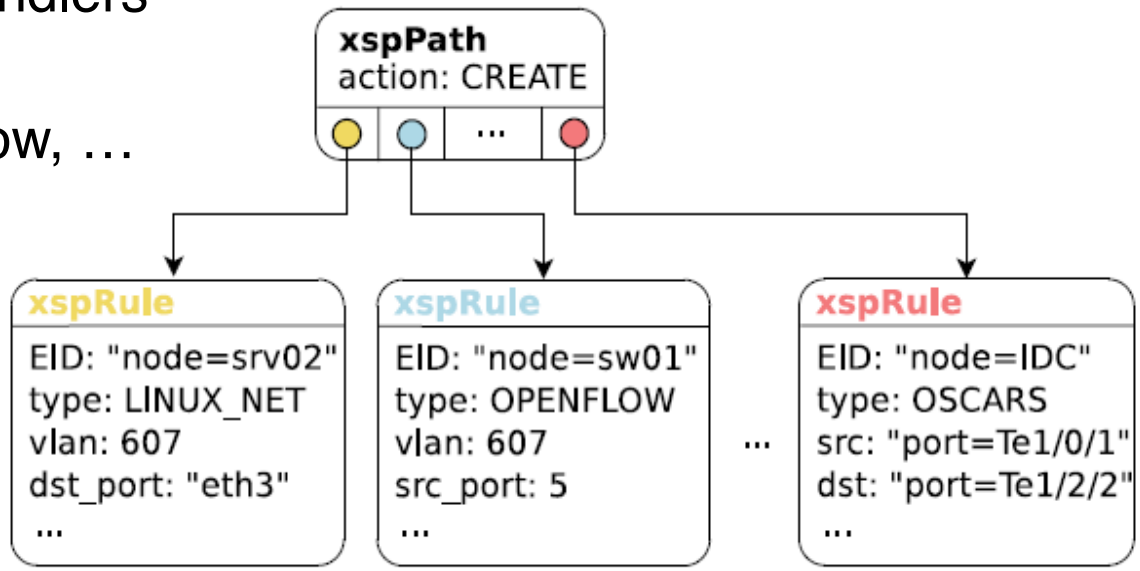
XSP architecture and library support

- Modular framework
  - Distinct “service handlers” (SH)
  - Security, Path, Protocol Channel, etc.
- XSP library: *libXSP*
- XSP-enabled services link with *libXSP*
  - Register new functionality via library hooks
  - Provide serialization / deserialization methods
- Client library for applications
  - Sockets-like interface
  - Transparent wrapper (shim library)
- XSPd (daemon)
  - Implements protocol frontend
  - Platform for development/prototyping



XSP as a network configuration interface

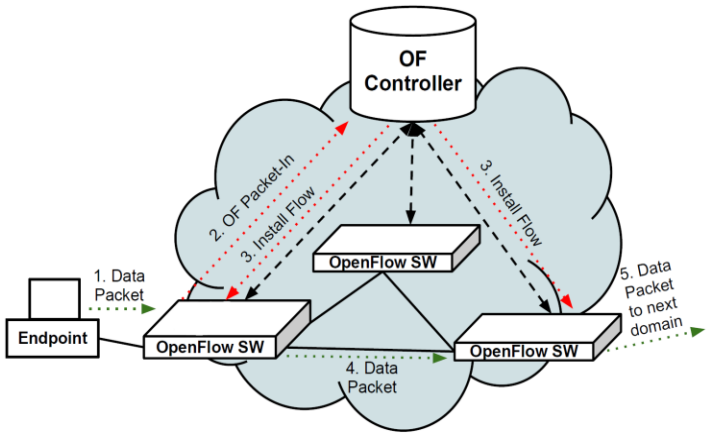
- *Path* framework
  - Modular set of service handlers for different technologies
  - Esnet OSCARS, OpenFlow, …

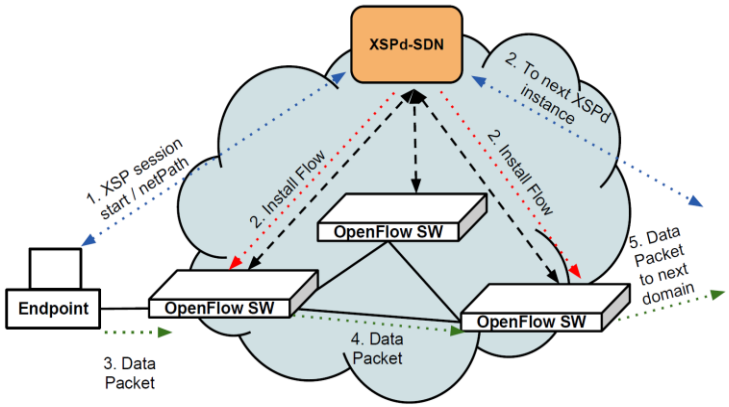


- A path is a set of rules applied in the network
- API provides a consistent abstraction
  - Access to technology-specific fields if needed
- Service called XSPd-SDN for SDN deployments

XSP and SDNs via OpenFlow

- Avoid “reactive” installation of rules
  - Potential issues with scalability and policy across domains
- XSP enables a proactive model
  - Application-driven
- Build a path across domains with user-provided credentials
- XSPd-SDN can support a hybrid approach
  - Reactive in data centers
  - Proactive for traffic engineered paths
  - Can talk to other provisioning services

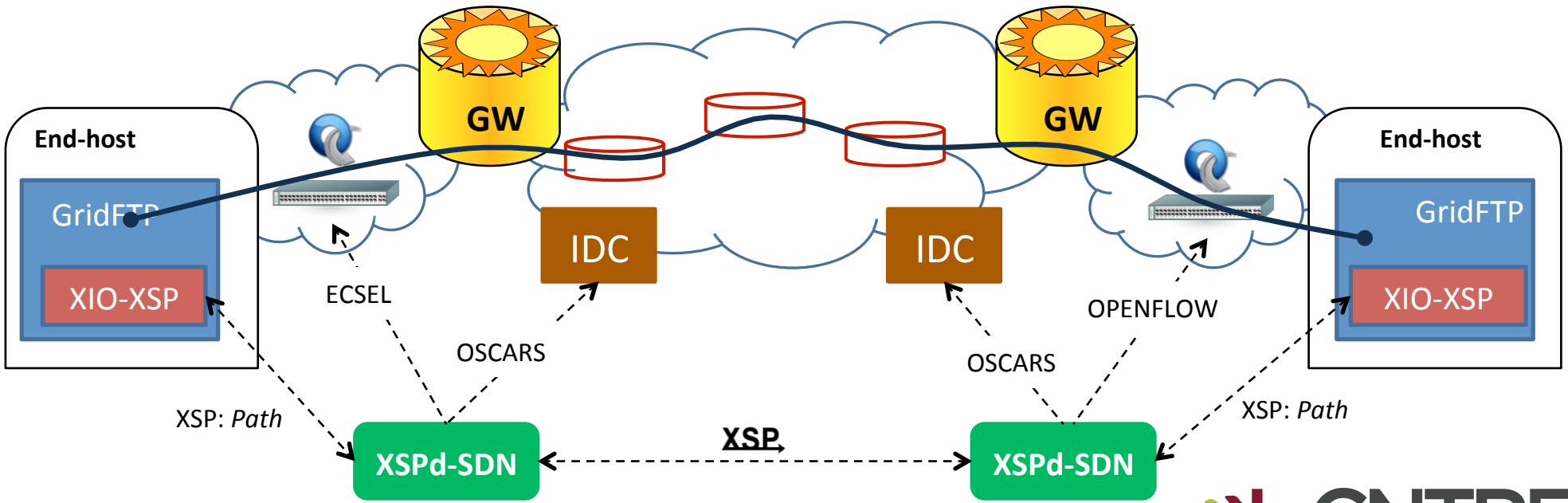




Use Case: Building end-to-end virtual paths

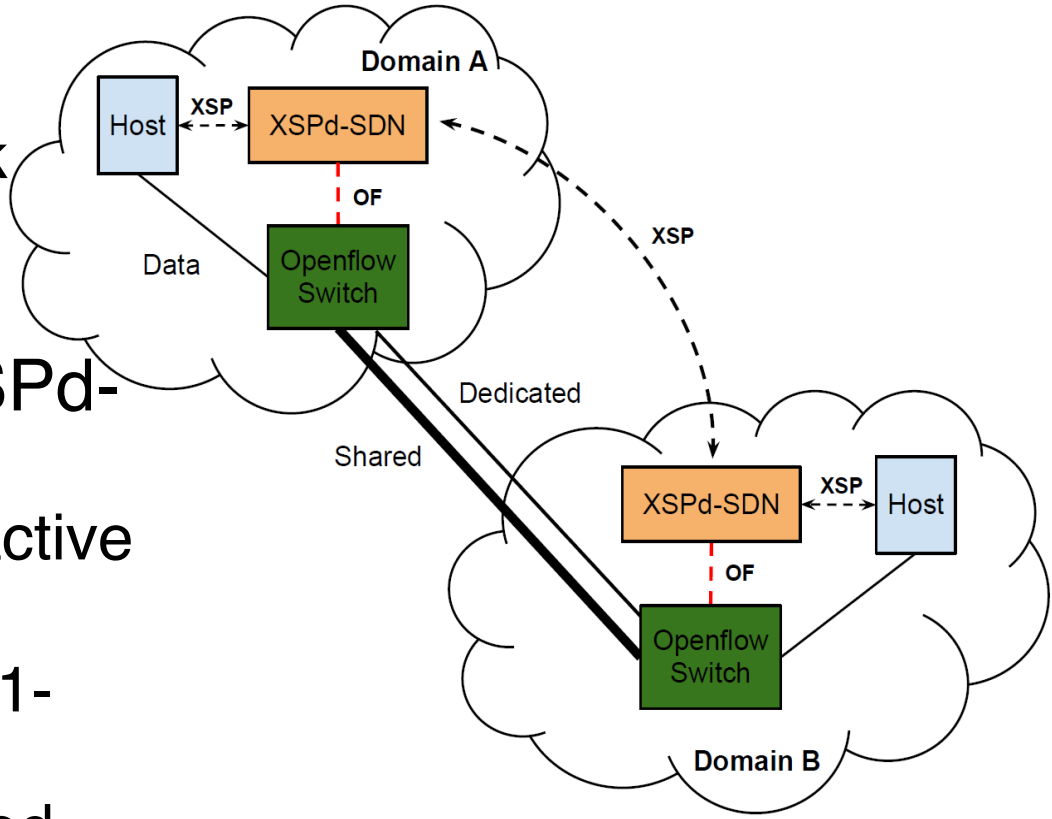
- Globus GridFTP transfer application
  - Considered the “gold standard” in Grid community for bulk data movement
- XSP driver developed within Globus XIO framework allows clients to signal the network and explicitly use network-based services
- SC11 demo with ESnet using ECSEL and OSCARS

globus-url-copy -vb -p 4 -dcstack
xsp:"xsp_hop=<XSPd-SDN>/5006;xsp_net_path=<TYPE>“, phoebus:"phoebus_path=<GW1>/5006#<GW2>/5006 "
ftp://<src host>:2811/dev/zero ftp://<dst host>:2811/dev/null



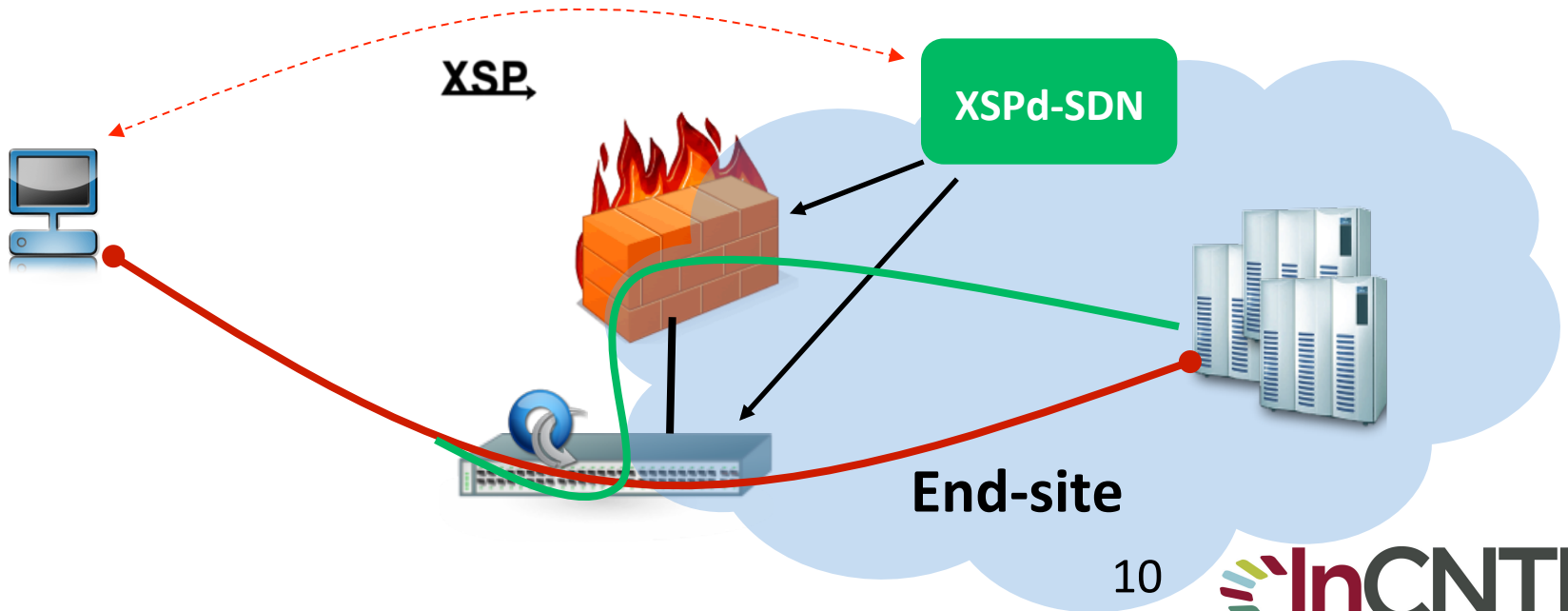
Use Case: Application-driven path selection

- Dynamically signal path selection based on:
  - Explicit threshold
  - In progress: direct network feedback
- SC11 demonstration of XSPd-SDN
  - GridFTP XSP driver with active performance threshold
  - Two domains (IU and SC11-Seattle)
  - Shared 100G and dedicated 10G path
  - 10G connected end-hosts
  - Automatic performance improvements



Use Case: Dynamic firewall

- "Default drop" router with explicit authentication
  - Prototype using JunOS SDK on MX
  - XSPd-SDN running on routing engine
  - On-demand installation of forwarding rules
- Bypass conventional firewall
  - Support high-performance flows
  - Explicit authentication installs rules for bypass



Summary

- XSP is a session-layer protocol specification and framework for the exchange of control and data between applications and in-the-network services
- Provides an interface for configuring advanced networks
  - SDNs including (but not limited to) those implemented with OpenFlow
  - “Network as a service”
- Includes extensible AuthN/AuthZ
  - SSL/X.509, SSH, password-based, etc.
- Remains flexible for future improvements
  - Easy to implement and integrate new handlers
- Demonstrated to work in a number of application-driven scenarios

Thank you for your time

Thanks to our colleagues at IU, ESnet and Internet2

Support: NSF OCI-0910812, OCI-1127349, and CNS-105011, DOE DE-SC0001421

Stay tuned for the demo!

http://damsl.cs.indiana.edu/projects/phoebus

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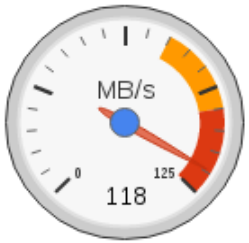
Periscope Testbed Monitoring

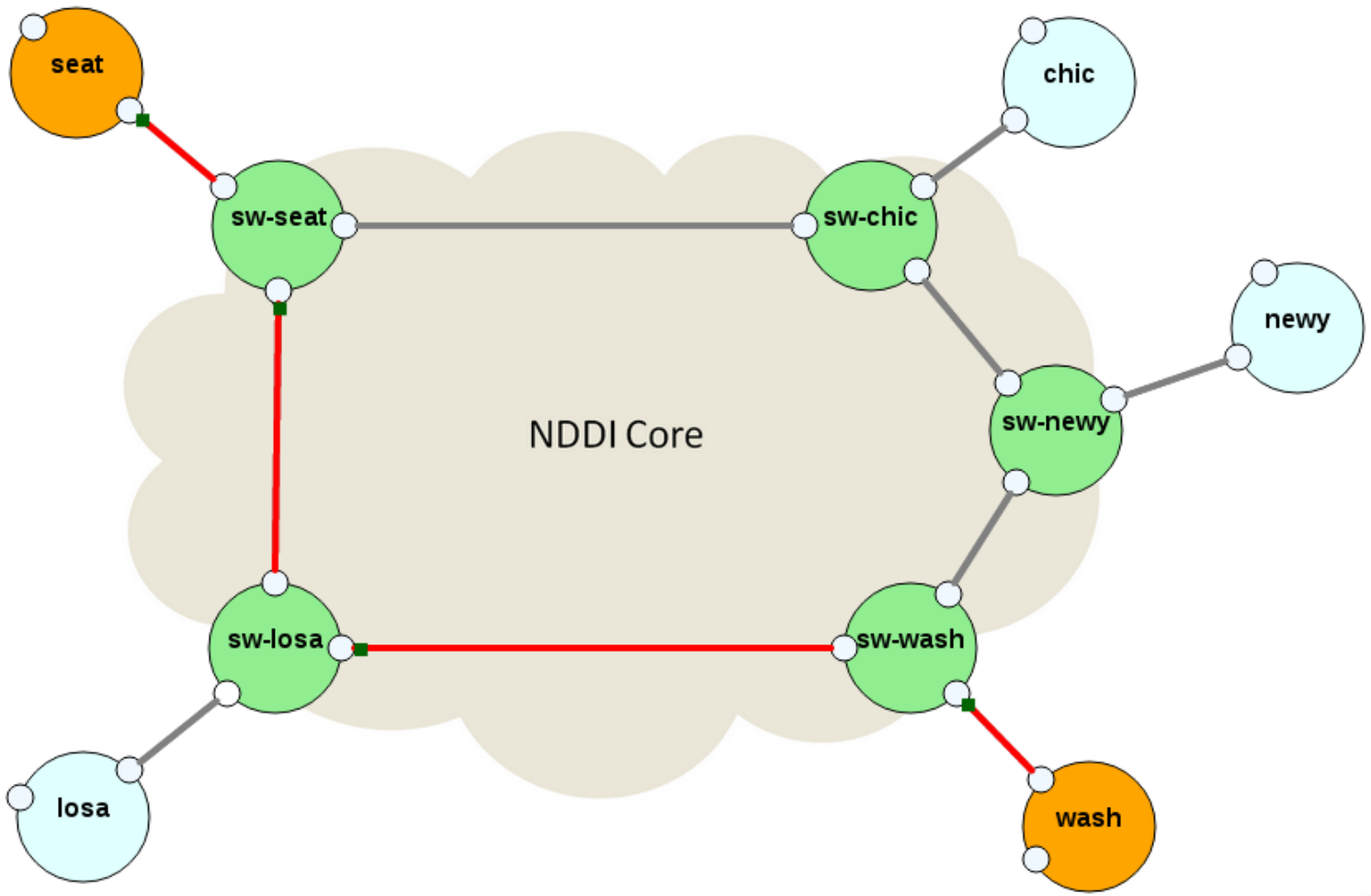
Topologies

- nddi

Misc

Transfer Rate





Delete selected paths Save topology locations

GRI	Status	Source	Destination	Start Time	Duration (s)	Misc
XSP-netPath-1804	DOWN	wash	seat	2012-07-17 13:03:13	...	...
XSP-netPath-1805	DOWN	newy	seat	2012-07-17 13:04:13	...	...
XSP-netPath-1806	DOWN	wash	seat	2012-07-17 13:05:13	...	...
XSP-netPath-1807	DOWN	newy	seat	2012-07-17 13:06:13	...	...
XSP-netPath-1808	UP	wash	seat	2012-07-17 13:07:13	...	...

Session Layer Related Work

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