

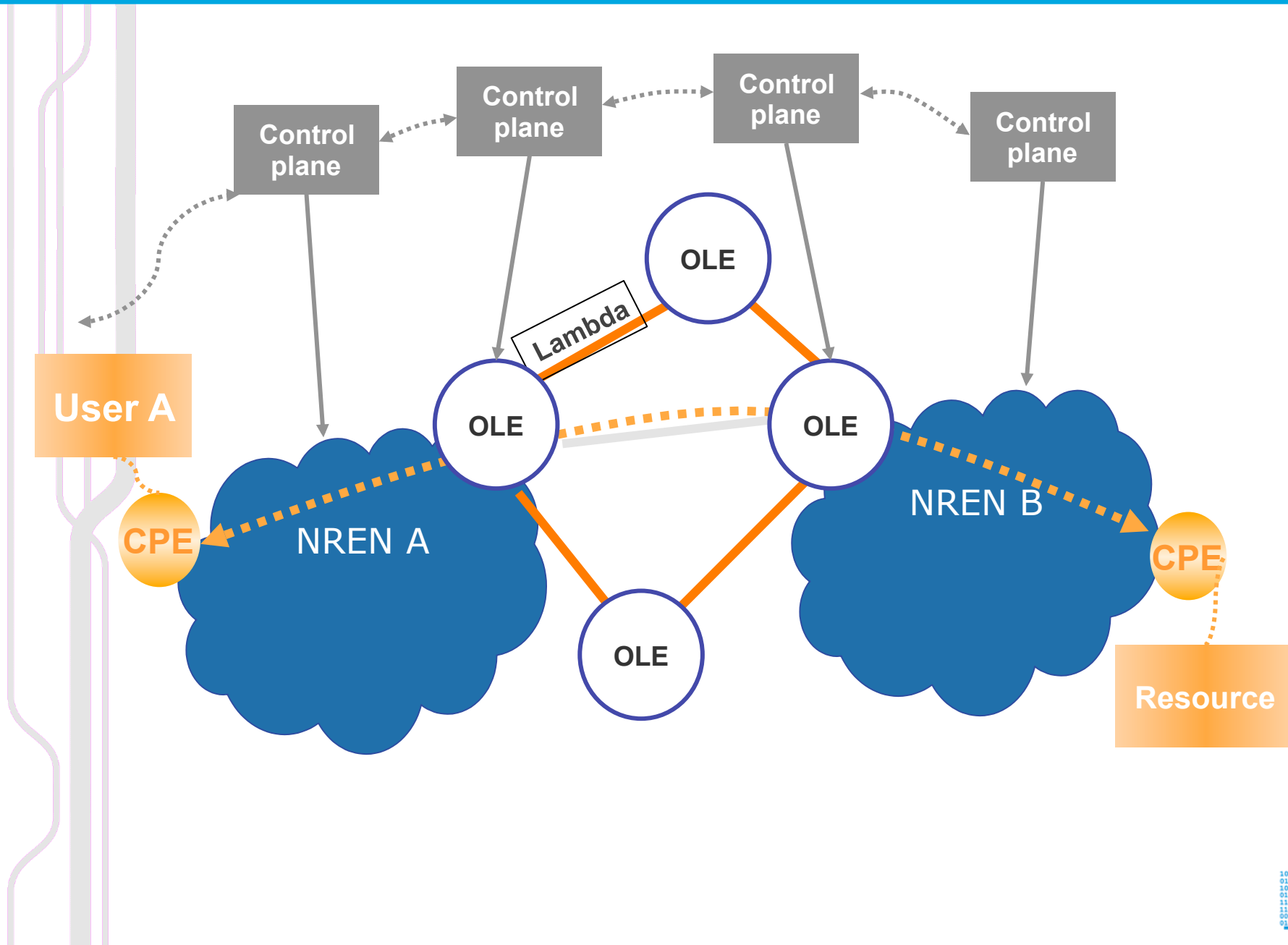
Deploying Standards-based, Multi-domain, Bandwidth-on-Demand

Lars Fischer

**28th NORDUnet Conference
Uppsala, 23 September 2014**



- Hybrid networking – starting 2000
 - LHCOPN, 2005
 - But ... circuits?
- Automation – GLIF, elsewhere
 - Starting 2007
- Experiments, demos, trials, single-domain systems
 - AutoBAHN, OSCARS, OpenDRAC
 - GLIF AutoGOLE
- Multidomain, inter-operability
 - DICE Collaboration



- NSI = Framework for Network Services
- NSI CS = Connection Service
 - Allows users to setup dynamic circuits
 - Bandwidth guaranties (or not)
 - Traffic engineering, directing flows
 - Or just L2 connectivity between sites
- Allows multi-domain circuit routing
- Allows multiple implementations
- ... but still has had a hard time getting beyond the demo

- Chicken / egg situations
 - Lack of use for lack of comprehensive facilities
 - Lack of deployment for lack of user request
 - Lack of deployment for lack of peers
 - There's never really been a usable interdomain circuit service
- Recognize that it's not longer a technology problem
 - All the bits are there
 - Creating a multi-domain deployment is mostly a matter of several networks deciding to do it, together
- Decision to partner and act
 - NORDUnet & SURFnet
 - ... with GÉANT, DeIC, FUNET, others

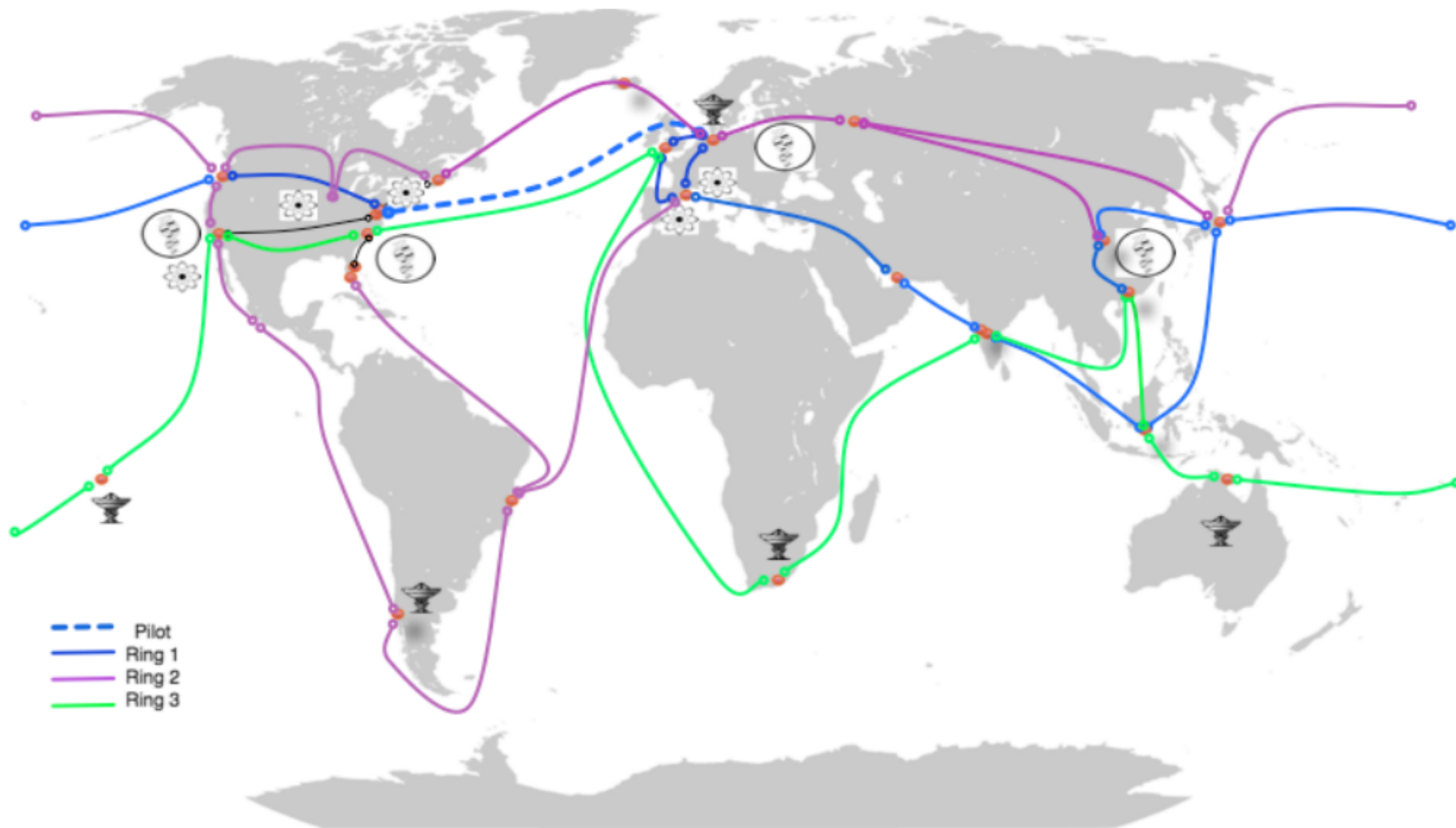


- Small core group
 - Gerben van Malenstein, SURFnet
 - Migiel de Vos, SURFnet
 - Hans Trompert, SURFnet
 - Henrik Thostrup Jensen, NORDUnet
 - Alin Pastrama, NORDUnet
 - Kim Kramaric, NORDUnet
 - Erik-Jan Bos, NORDUnet
- Joint project plans, timelines, specifications
 - Open to input, discussion, collaboration
 - Agile – iterations, deadlines, demo early
- Announce intentions early in community

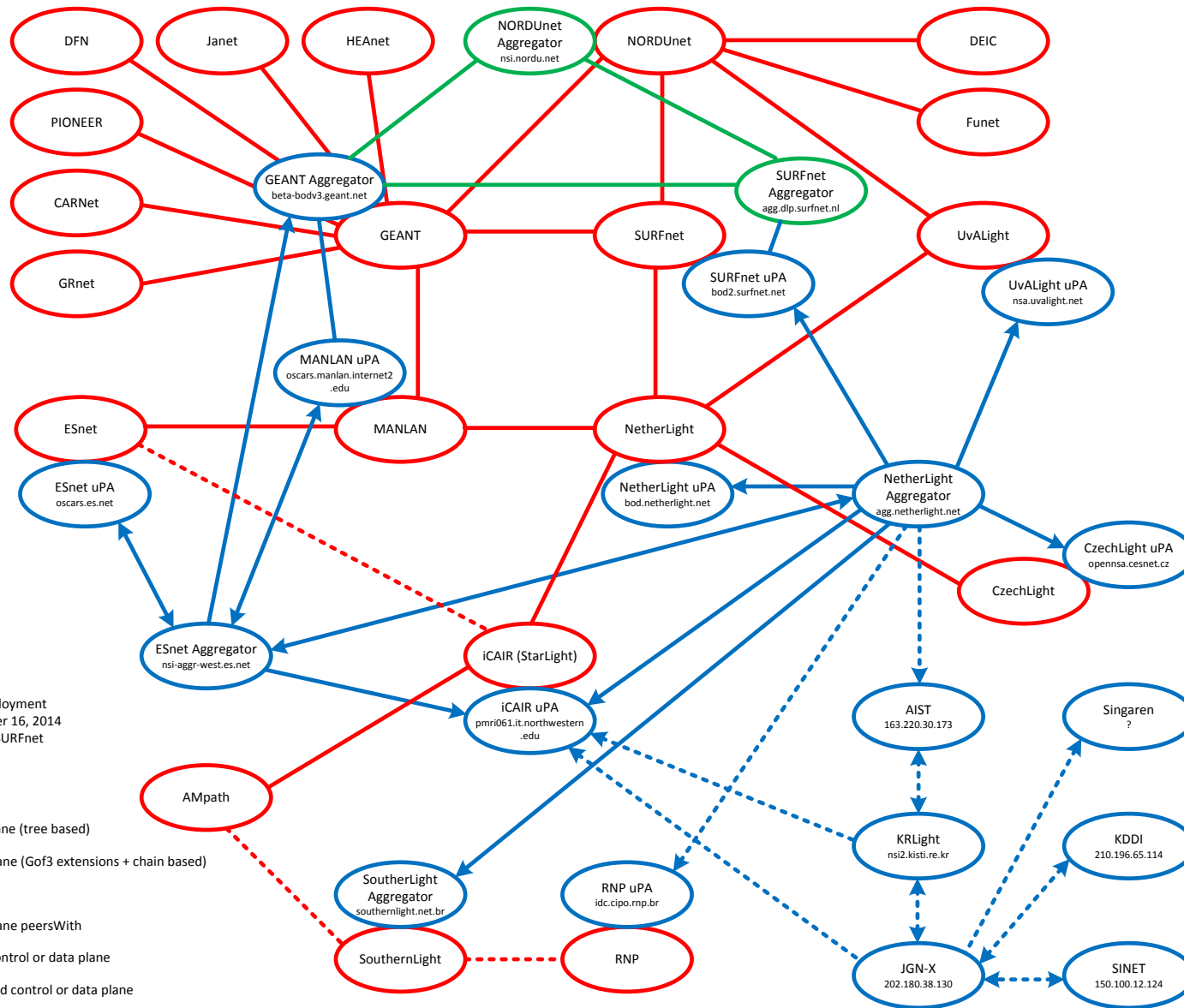
- Facilitate users & applications
 - Enable initial users
- Building an NSI/BoD service alone is boring
 - And largely useless
 - Joint effort: SURFnet, NORDUnet, & GÉANT
 - Offer: An integrated BoD service in Europe
 - Multi-domain / multi-provider / multiple technologies
- Standards-based circuit capability
 - NSI 2.0 – it's the only game in town
 - Commitment to standards process
 - Advance the standards

- Close collaboration on
 - AAI, Security
 - Topology distribution & Path-finding
 - Policies
 - Not covered in NSI CS2 specification
 - Get to usable, not to perfection
- AuthZ happens on endpoints
 - Typically with OAuth2 tokens or user attributes
 - No provisioning without authenticated access & endpoint Authorization
- Transit links are generally used w/o authentication
- Peering = data + control plane connectivity
 - Control plane is over TLS with bidirectional AuthZ
 - Trust your peer, or don't bother





- Deployment on production platforms
 - Well working NSI 2.0 CS implementations
 - Not another demo – offer full capacity
 - Initial users
- Well tested, connects SURFnet, NORDUnet, and GEANT
 - Have connected UvaLight , FUNET, ...
 - Demo at TNC 2014
 - Connecting most of Europe
 - Reaching further w/ AutoGOLE



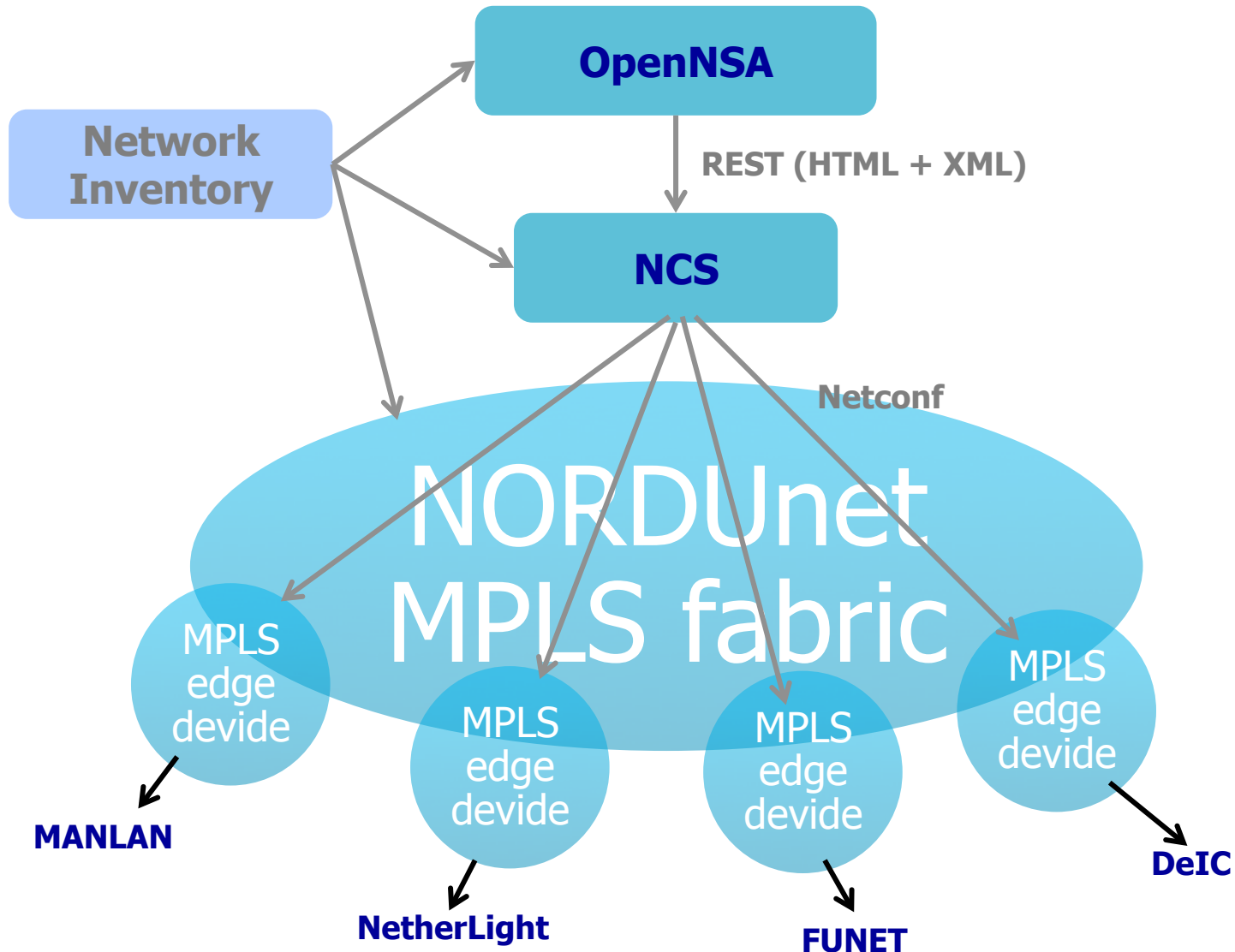
- Authorization for NSI CS
- Multi-domain topology & pathfinding
 - chaining that works
- Major gaps filled
 - We've come a long way in <10 months
 - Essential for production service
- Consensus on Authorization fell into place faster than expected
- Consensus on pathfinding is taking a little longer; NSI community favours support for tree model

- BoD E2E Service
 - Service offering not well understood
 - Range of options from manual provisioning to web interface to application integrations
- We're not sure we understand what a service should look like, but we *do* know that they will never learn unless we enable the service to happen
- Network **Circuit Capability** a pre-requisite for
 - Experiments
 - Engaging in European / Global projects
 - Building end-user services
 - Engage with campuses and user communities



- Provisioning
 - Tail-F NCS: production management platform for NORDUnet MPLS / IP infrastructure.
 - In production for managing IP peers
 - Speaks Netconf towards (edge) devices
- OpenNSA
 - Open source NSI v2 CS service agent
 - At NORDUnet, use REST+HTML towards NCS
 - Supports many other backends
- BoD Transport
 - MPLS tunnels over production network
 - Available on MPLS edge
 - Initially London, Amsterdam, Helsinki, Copenhagen
 - Eventually entire NORDUnet MPLS fabric
 - Control plane security with TLS and user attributes/tokens for authN





Home Connections

Future connections filtered: now before start time

ConnectionId	Description	LSM	RSM	PSM	DSM
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Current connections filtered: now between start time and end time

ConnectionId	Description	LSM	RSM	PSM	DSM
NO-da9736645b	Enlighten Your Research Global, CSC-SURFsara path	Created	ReserveStart	Provisioned	True
NO-8bb810105c	Enlighten Your Research Global, CSC-SURFsara path	Created	ReserveFailed	Released	False
NO-c1e47e9d8f	Enlighten Your Research Global, CSC-SURFsara path	Created	ReserveFailed	Released	False

Past connections filtered: end time no older than a week

ConnectionId	Description	LSM	RSM	PSM	DSM
NO-af83b1ff91	kostas	Terminated	ReserveStart	Released	False
NO-8340acbff	test	Created	ReserveStart	Provisioned	False
NO-80cf19f0e2	test	Created	ReserveStart	Provisioned	False
NO-5b0bc02188	Test Connection	Created	ReserveStart	Provisioned	False
NO-cf21797fac	Test Connection	Created	ReserveStart	Provisioned	False
NO-3fd57d16cd	Test Connection	Created	ReserveStart	Provisioned	False
NO-42d6326c7f	Test Connection	Created	ReserveStart	Provisioned	False
NO-15f3632df4	Test Connection	Created	ReserveStart	Provisioned	False
NO-3397312c01	Test Connection	Created	ReserveStart	Provisioned	False
NO-83e30c9169	Test Connection	Created	ReserveStart	Provisioned	False
NO-5d5f2d9c94	Test Connection	Created	ReserveStart	Provisioned	False



The screenshot shows a web browser window at nsi.nordu.net:5011/connections. The page is divided into four sections: Future connections, Current connections, and Past connections. The 'Current connections' section is expanded to show details for a specific connection.

Future connections (filtered: now before start time)

ConnectionId	Description	LSM	RSM	PSM	DSM
NO-da9736645b	Enlighten Your Research Global, CSC-SURFsara path	Created	ReserveStart	Provisioned	True

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Details for NO-da9736645b:

- Start: 2014-09-04 15:15:00
- End: 2014-09-18 15:00:00
- Bandwidth: 1000
- Version: 0
- Global id: um:ogf:network:funet.fi:2013:topology-1409843609792
- Requester: um:ogf:network:funet.fi:2013:nsa-nordu.net:2013:topology:funet?vlan=2031
- Source: surfnet.nl:1990:production7:19523?vlan=2077
- Destination:

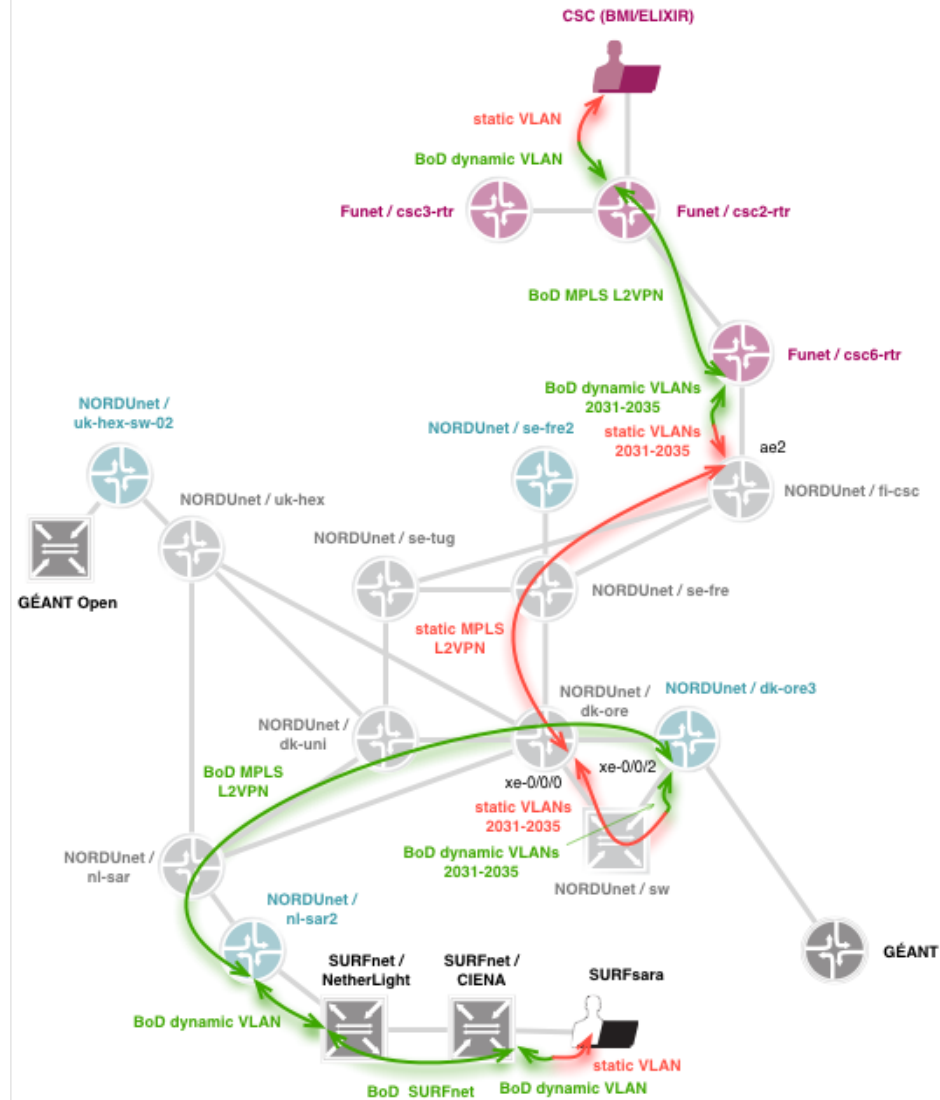
Child connection ID	NSA	LSM	RSM	PSM	DSM	Error?
NO-da9736645b	um:ogf:network:nordu.net:2013:nsa	Created	ReserveStart	Provisioned	True	none
4b7b912e-bdd2-49db-90a0-701a6b00a23	um:ogf:network:surfnet.nl:1990:nsa:safnari	Created	ReserveStart	Provisioned	True	none

Past connections (filtered: end time no older than a week)

ConnectionId	Description	LSM	RSM	PSM	DSM
NO-af83b1ff91	kostas	Terminated	ReserveStart	Released	False
NO-8340acbff	test	Created	ReserveStart	Provisioned	False
NO-80cf19f0e2	test	Created	ReserveStart	Provisioned	False
NO-5b0bc02188	Test Connection	Created	ReserveStart	Provisioned	False



Enlighten Your Research Global, CSC-SURFsara



- More standards work
 - Link policy; policing of traffic
 - AAI & Topology Standardization
- Monitoring
 - NOC Tools
 - PerfSONAR
 - Performance Verification
- Finalize operations deployment
 - Security, Audits
 - NOC support / handover
- Committed to maintaining a NSI production capability

- Partners
 - The TEAM
 - SURFNET
 - GEANT
- ... and also
 - UvA
 - FUNET
 - DeIC
 - Friends in the NSI WG – specifically ESnet
 - GLIF – NSI Imp & AutoGOLE
 - LHC community
 - Enlighten your research initiative

- Consider
 - Transport – circuit capability ✓
 - Cross-connect – circuit capability ✓
 - Authentication ✓
 - Identity Management (✓)
 - Security (✓)
 - Topology Exchange (✓)
 - Link Policy management
 - Performance Verification for end-to-end
 - Service Level management
 - Virtualization
 - OLE service architecture
- Much to do!

Thank You

Lars Fischer
lars@nordu.net

<http://www.nordu.net>

