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Design issues of a multi-domain BoD-service for the NREN community

The GN2 project JRA3 activity

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GN2 project

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- Multi-Gigabit European Academic Network
- Project funded under FP6 (Research Infrastructures-Integrated Infrastructure Initiative)
  - 31 partners (NRENs, DANTE, TERENA)
  - Total expected budget: 178.643.730 €
  - EC contribution requested: 93.000.000 €
  - Duration: 4 years
- Combining in a single contract, several activities essential to reinforce research infrastructures and to provide an integrated service at the European level
  - Networking activities (including consortium management)
  - Provision of access to transnational users
  - Joint Research Activities
- Scope
  - Further develops the successful GN1 project which has created the GEANT pan-European network
  - Specific emphasis on end-to-end provision of services across multiple interconnected networks
  - Gaining improved understanding of user needs
  - Direct support and performance monitoring
  - Migration from IP services to combination of routing and switching, network control, light-paths

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Goals of JRA3 activity

- ‘Bandwidth on Demand’
- Streamline the inter-domain setup of end-to-end paths
  - shorten the provisioning time
  - reduce the amount of human intervention
  - using existing (NREN/aggregation) networks by an overarching method
- Service specification
  - end-to-end, connection oriented service for provisioning non-contended capacity
  - Layer 1, 2
  - For prototype: focus on provisioning of a deterministic non-contended bandwidth pipe between two 1Gigabit Ethernet access ports over multiple domains that employ different technologies
- Multi-technological domains:
  - E.g.: GFP over SDH, L2 MPLS VPN, Native Ethernet
- Automate the process step-by-step; focus on inter-domain coordination process
- Advance reservation (scheduled)

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JRA3 BoD system

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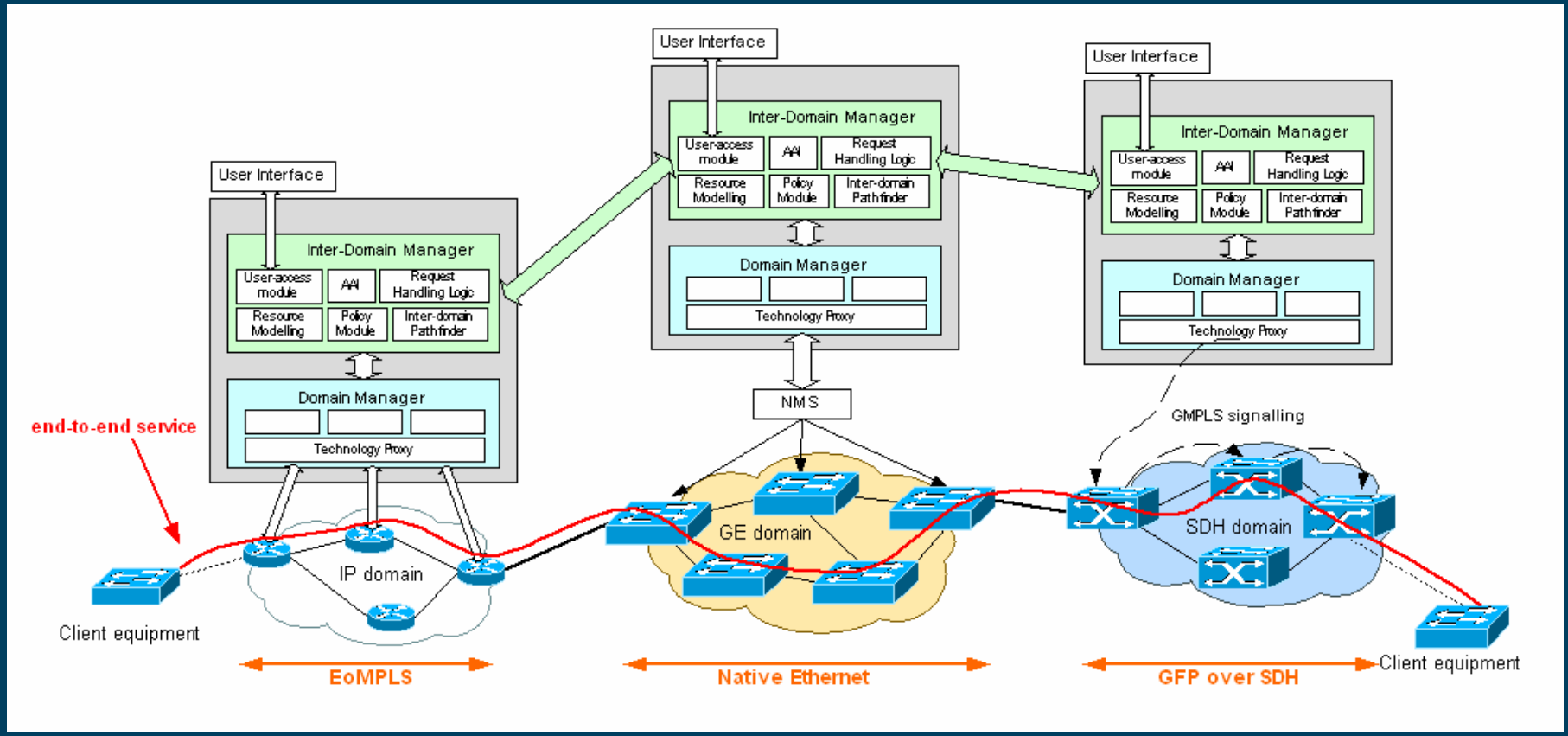

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Multi-domain provisioning (Hybrid SC – SPC)*

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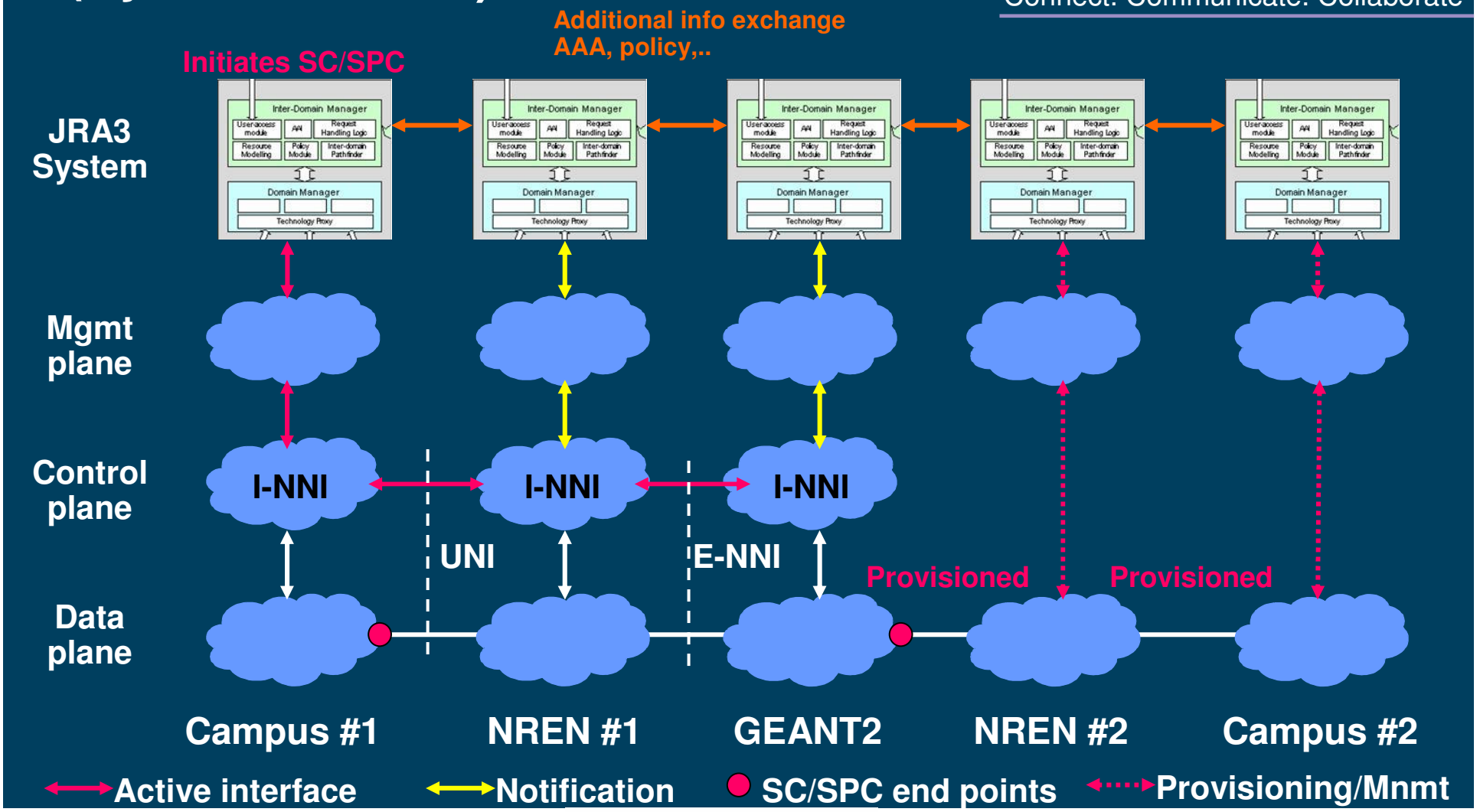

*Slide prepared by Hans-Martin Foisel (T-Systems)

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Inter Domain Manager

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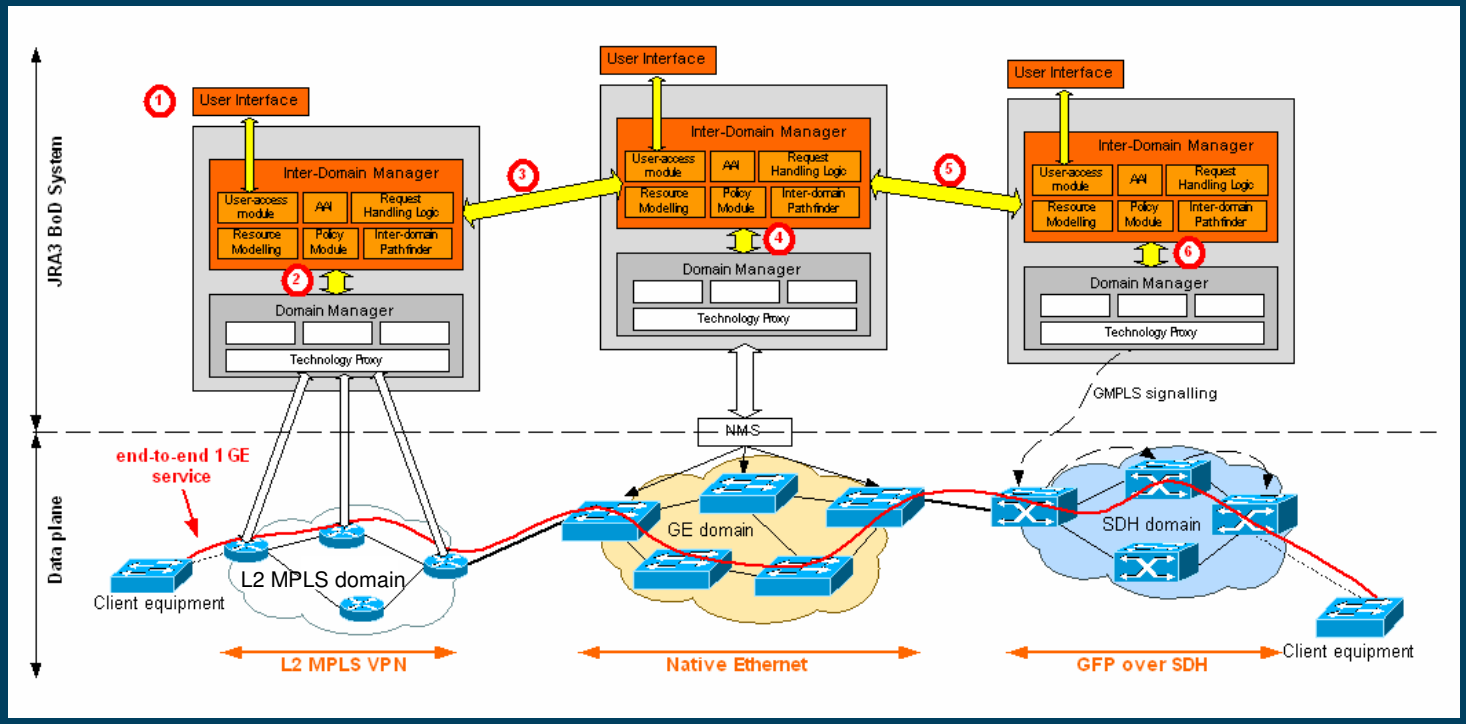

A set of automated procedures for the required non-technology specific inter-domain negotiations in order to establish an end-to-end non-contended 1 GE bandwidth pipe

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Inter Domain Manager:
Overall functionality

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- The one and only ingress point to the BoD system
- It receives and processes BoD reservation requests from users or from other IDMs of neighboring domains
- Interacts with the AAI service, when implemented, to authenticate the identity of the BoD service requestor and his authorization privileges for the BoD service
- Based on the authentication of each BoD service requestor, it implements a credit management system for the controlled allocation of bandwidth resources
- Selects the next domain to contact to establish an end-to-end path for serving a reservation request
- Selects from the list of paths through the BoD domains from end-to-end,
- Participates in a commit process between all IDMs along the end-to-end path used to serve a BoD reservation request
- Operates an accounting and logging sub-system
- Implements its own policies for allocation of BoD resources and for management of the BoD service within the domain

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Intra-domain provisioning

- Manual intra-domain configurations and provisioning processes for the establishment of the intra-domain segments of the end-to-end path
- Intra-domain provisioning design to accommodate
  - Domains that have a G.ASON/GMPLS CP “out of the box” e.g. Generic MPLS Routing Engine (distributed control plane in their Alcatel 1678 MCC OXC)
  - Domains operated via NMS
  - Domains that may decide to adopt proprietary Bandwidth Brokers
- Intra-domain modules, implemented in later phases, will comprise the so-called BoD service Domain Manager (DM)

IDM Prototype

- Objectives
  - to validate design and architectural assumptions
  - to define potential risk points and bottlenecks
  - to test IDM reservation procedures and communication schemas

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IDM Prototype

- Minimal functionality
  - IDM prototype is designed to provide minimal required functionality for test purposes. Therefore, the following limitations are introduced:
    - Simplified network abstraction schema
    - Pathfinder and DM processing are pre-defined manually
    - Authentication is based on X.509 certificates for SSL connections and authorization is based on „always allow” policy
    - Data life-time is limited to application run-time

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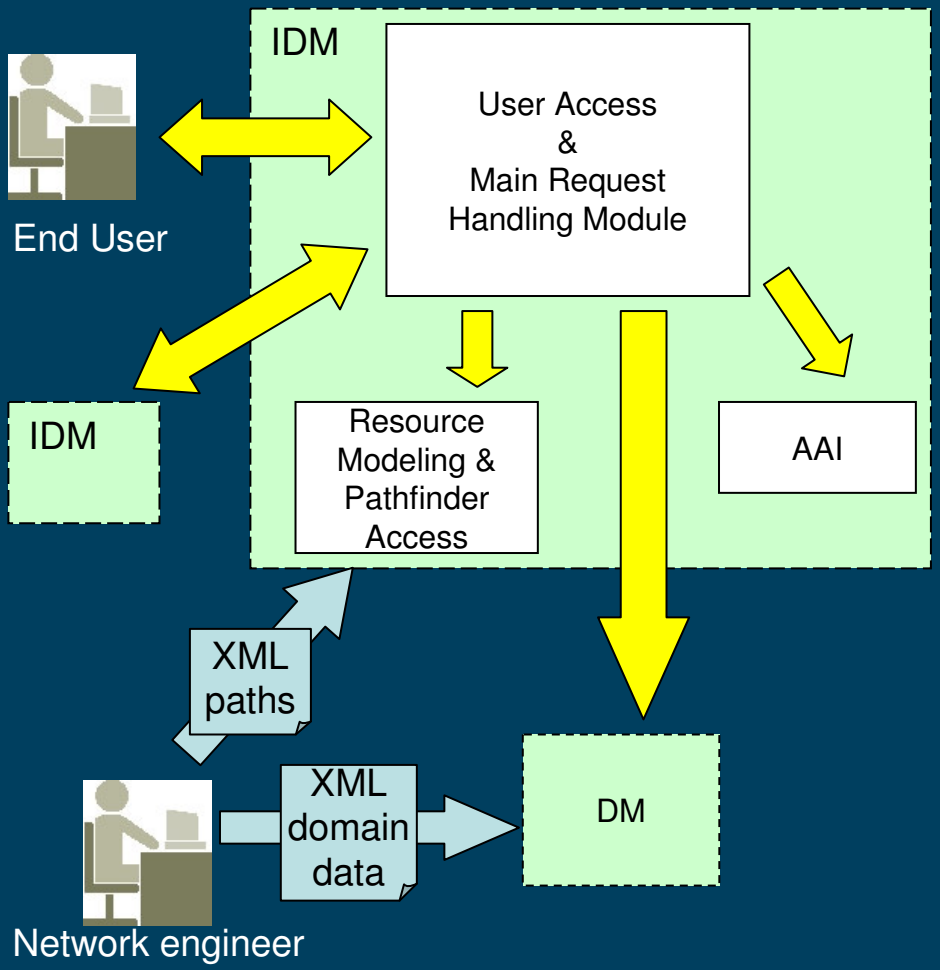
IDM Prototype



- **IDM prototype features**
  - accepts UNI service request (request, cancel, status)
  - performs reservation process at inter-domain level (interdomain link capacity check, VLAN numbers, path costs validation)
  - PF supports IDM with manually pre-defined interdomain paths
  - DM supports IDM with manually pre-defined information about domain topology
  - NNI communication is implemented, so domains can agree on reservation parameters and schedule resources bookings

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IDM Prototype

- Future development after prototype tests
  - design and implementation of DM functionality (may include manual provisioning)
  - design of database for network resources at IDM and DM level
  - database extensions to current transaction mechanism (data life-time will exceed application run-time)
  - implementation of pathfinder functionality
  - AAI extensions, regarding JRA5 requirements

Inter-domain pathfinding

- The main task of the Pathfinder module in the IDM is to provide a candidate path to fulfill BoD requests.
- The Pathfinder module applies a constraint-based algorithm to create a list of paths to be handed back to the Reservation module
  - Each path in the list represents an inter-domain route over a set of interconnected domains, and includes the ingress and egress interface in each transit domain.
- Traffic Engineering extensions are used for distributing the inter-domain routing information to be used by a separate Routing Protocol module within the IDM
  - Quagga OSPFv2 routing daemon implementation with custom defined Opaque LSAs
  - As the Quagga OSPFv2 daemon is a SPF (shortest Path First) engine and not a constraints-based SPF engine, the Pathfinder module is required to perform additional CSPF computations
- Use of IPv6 addresses to identify data plane entities at the IDM level

Technology Stitching
What is it?

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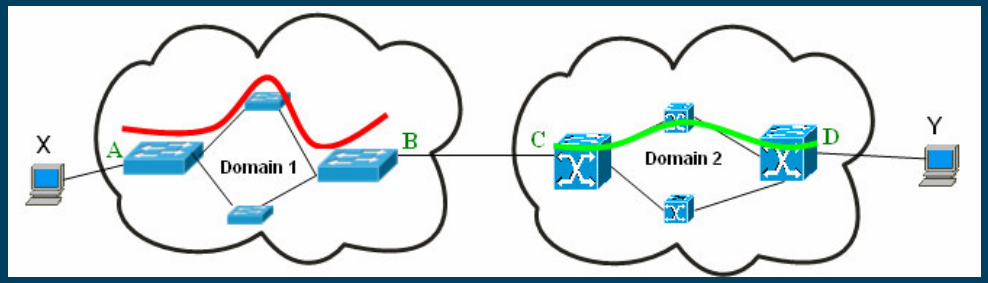

- Interconnecting different technological network domains
- Achieved using
  - Inter Domain Manager (IDM) hosts to determine best path between domains and relay requests either in-band or out-of-band
  - Domain Manager (DM) hosts to configure local network domain equipment (for instance through provisioning system)

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Technology Stitching
Why is it needed?

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- Different network technologies exist across NRENs and this is not expected to change in the near future.
- Need to provide a homogenous method to interconnect domains
- Automated Technology Stitching is the aim
- The technology stitching sub activity starts with determining/collecting (manual) procedures how to stitch technologies between two domains

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Technology Stitching
Network Technology Types

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- Based on existing NREN technologies
  - SONET/SDH
  - Ethernet based:
    - Native Ethernet
    - L2 MPLS VPN
  - DiffServ technologies
    - PIP
    - IP MPLS QoS
- 14 different interconnection scenarios in total identified

	SDH/SONET	Layer 2 MPLS VPN	PIP	IP MPLS QoS	Ethernet
SDH/SONET	x				
Layer 2 MPLS VPN	x	x			
PIP	x	x	x		
IP MPLS QoS	x		x	x	
Ethernet	x	x	x	x	x

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Technology Stitching
The testing process

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- Initially, simple manual stitching testing between one technological domain and another
- Testing will utilise many resources like: NRENs, DANTE, Internet2, CANARIE, GLIF, VIOLA, MUPBED, etc.

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JRA3 BoD Monitoring

- BoD project tries to use existing NRENs' BoD infrastructure, under a single interface
- Monitoring project tries to use existing monitoring infrastructure, feeding towards a single interface

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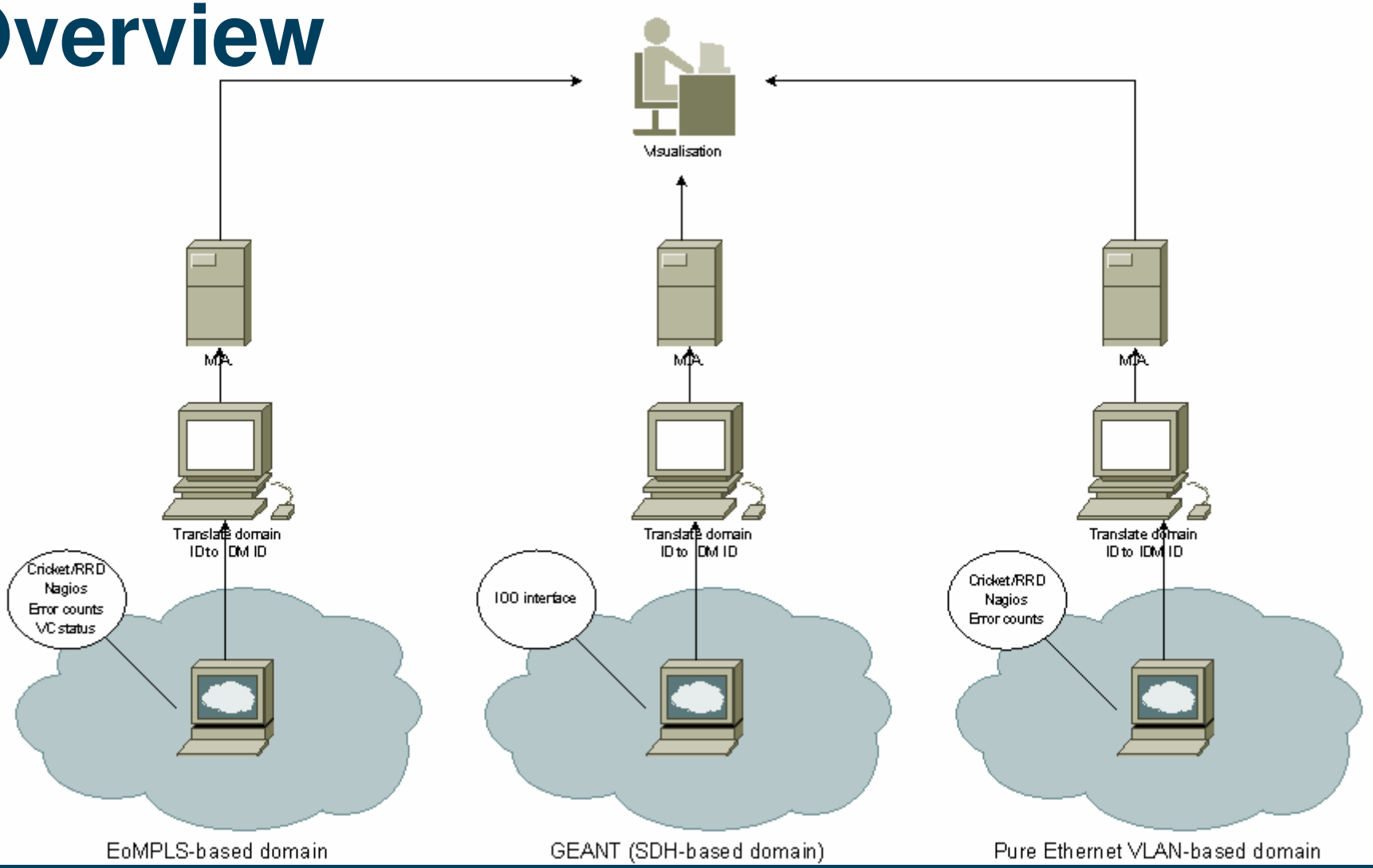
Overview


Visualisation
MA
MA
MA
Translate domain ID to IDM ID
Translate domain ID to IDM ID
Translate domain ID to IDM ID
Cricket/RRD
Nagios
Error counts
VC status
I00 interface
Cricket/RRD
Nagios
Error counts
EoMPLS-based domain
GEANT (SDH-based domain)
Pure Ethernet VLAN-based domain

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Monitoring priorities

- Technologies: BoD Ethernet circuits over
  - One EoMPLS/switched Ethernet network
  - One SDH-based network

- Metrics to be monitored, in order of priority
  - Up/down
  - Degraded/not degraded
  - Level of usage (where possible)

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Progress

- EoMPLS and Geant2 IOO monitoring now being implemented
- XML schema towards existing monitoring infrastructure finalised shortly
- First implementation (up/down status) across two domains expected this summer
- Next, work on concatenating more complex metric across multiple technologies

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JRA3 is also working on

- Definition of AAI functionality
  - Integration with federated model developed by another GN2 project Activity (GN2-JRA5)
- Looking into latest developments in standardization areas (OIF, IETF)
- Liaison with projects: MUPBED, NOBEL, DRAGON, HOPI, UCLPv2, ...
- Specifying requirements for a pan-European scale test-bed to test JRA3 prototypes and modules
- General information at: http://www.geant2.net/server/show/nav.756 (to be updated)

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