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AutoBAHN: Automated Bandwidth Allocation across Heterogeneous Networks

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GLIF 2007

Prague, 17 September 2007

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AutoBAHN is…

- … a research activity for engineering, automating and streamlining the inter-domain setup of guaranteed capacity end-to-end paths
- AutoBAHN = Joint Research Activity 3 of the GN2 project
  - GN2 is an EC-funded Integrated Infrastructure Initiative (I3) project, with European R&E Networks (NRENs) as partners (DANTE: coordinator)
  - GN2 has implemented the GÉANT2 network, dark-fiber enabled infrastructure offering both IP and circuit-oriented services

GÉANT2 AutoBAHN

GÉANT2

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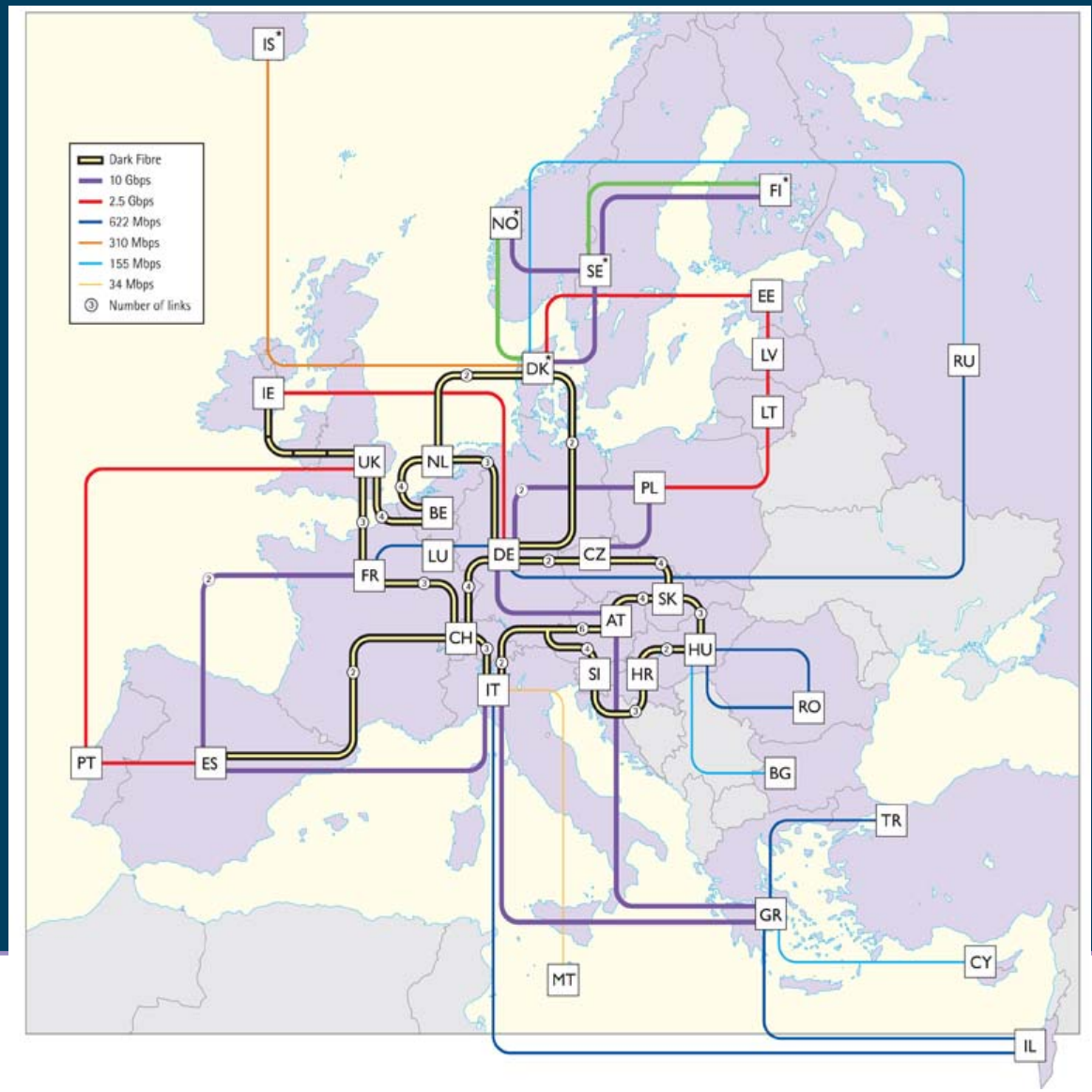

GÉANT2 TutoBAHN

End-to-end services over GÉANT2

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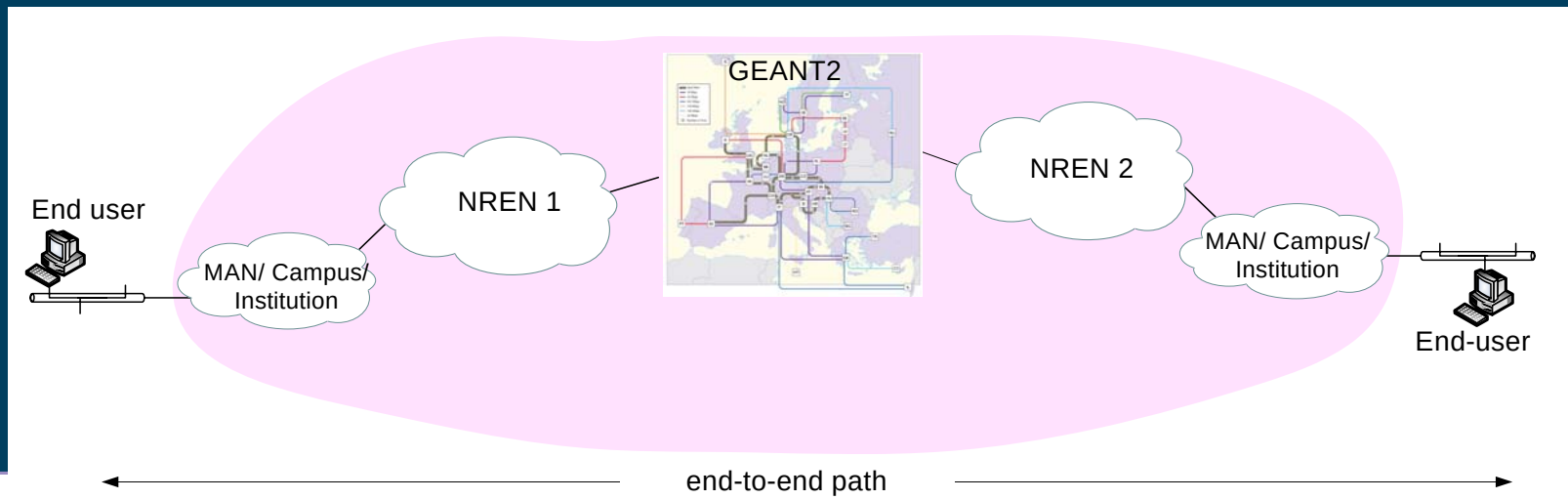
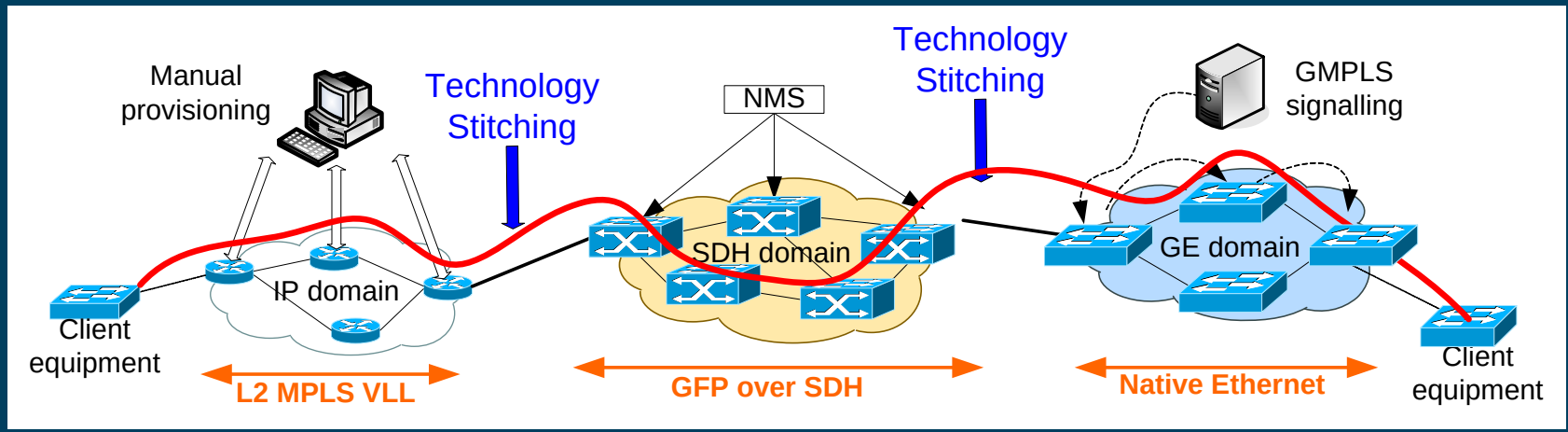
- Up to now: Packet Switched IP (Layer 3) & L2 MPLS Managed Bandwidth Services – VPNs
- From now on the hybrid NREN - GÉANT2 service model also enables:
  - Layer 2 switched e2e circuits (e.g.1 GE) involving GÉANT2 & NREN - Campus circuits
  - 10 Gig Optical Private Networks (OPNs) configured for large *e-Science* projects using GÉANT2 DWDM & NREN - Campus lightpaths



A multi-domain …

- …multi-technology, multi-disciplinary environment
- Control and provisioning has to be distributed
- Technology stitching between domains
- Business-layer related interactions include AAI, policies, advance reservations, etc.
- Privacy and control of intra-domain resources must be safeguarded



Approach

- The effort to provision end-to-end Bandwidth on Demand services in the European scenario requires specific developments in inter-domain collaboration
- Splitting intra-domain management functionalities from inter-domain ones in separate modules, allows multi-domain R&D to proceed autonomously and focus on this less standardized area
- At the same time, it allows to leverage existing inter-domain managers through wrappers/proxies and interfaces, exploiting a modular approach
- This effort can provide solid experience for brokering services other than Bandwidth on Demand

AutoBAHN key elements

- Components:
  - Inter-Domain manager (IDM)
  - Domain manager (DM)
- Topology abstraction
- Path finder
- Technology proxies
- Standardized interfaces
- Each domain participating in the BoD service provisioning needs to operate an IDM and honor the IDM-DM and IDM-IDM interfaces.
- The local DM can be any technology, a proxy is needed towards the IDM

AutoBAHN overview

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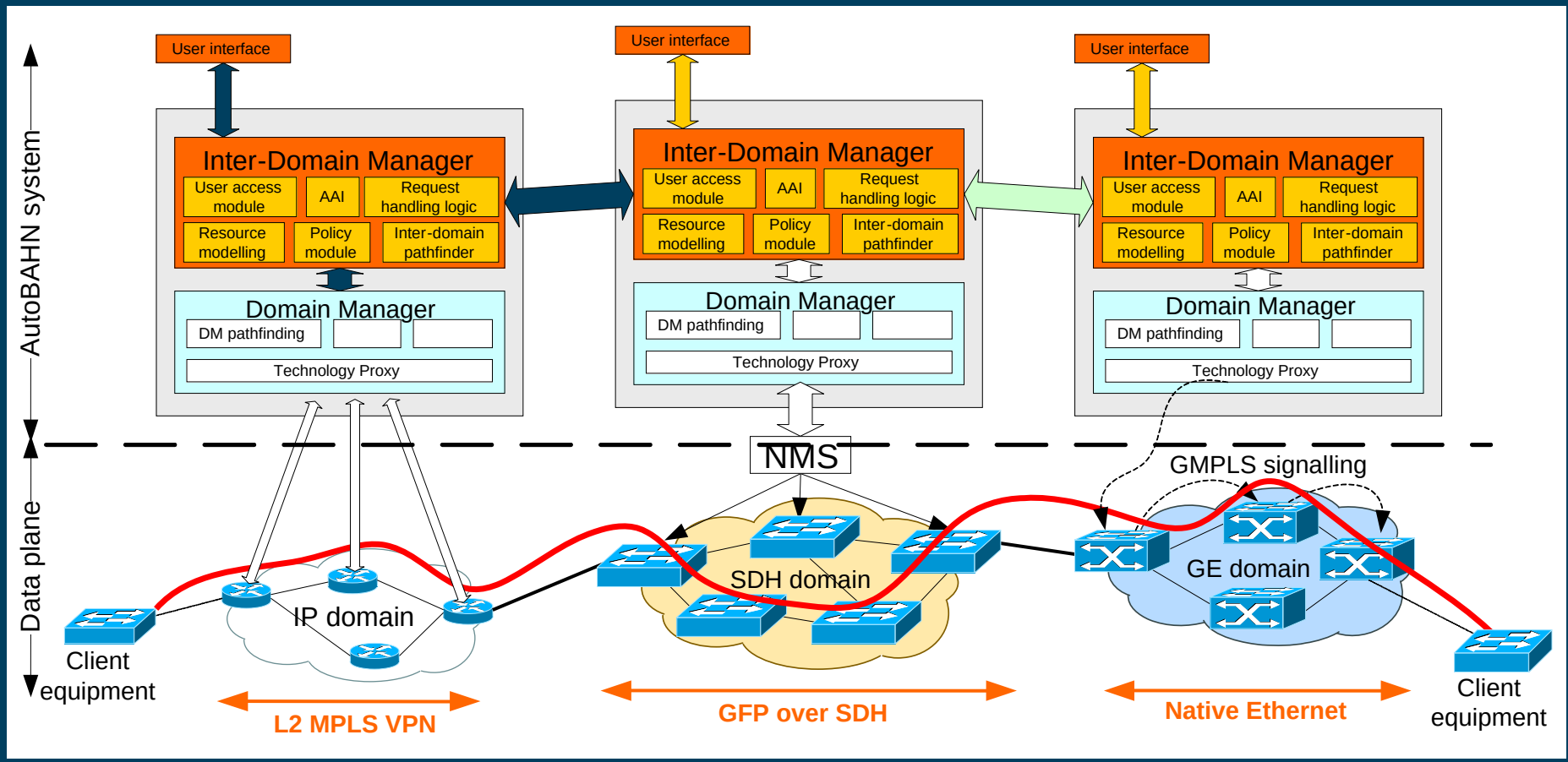

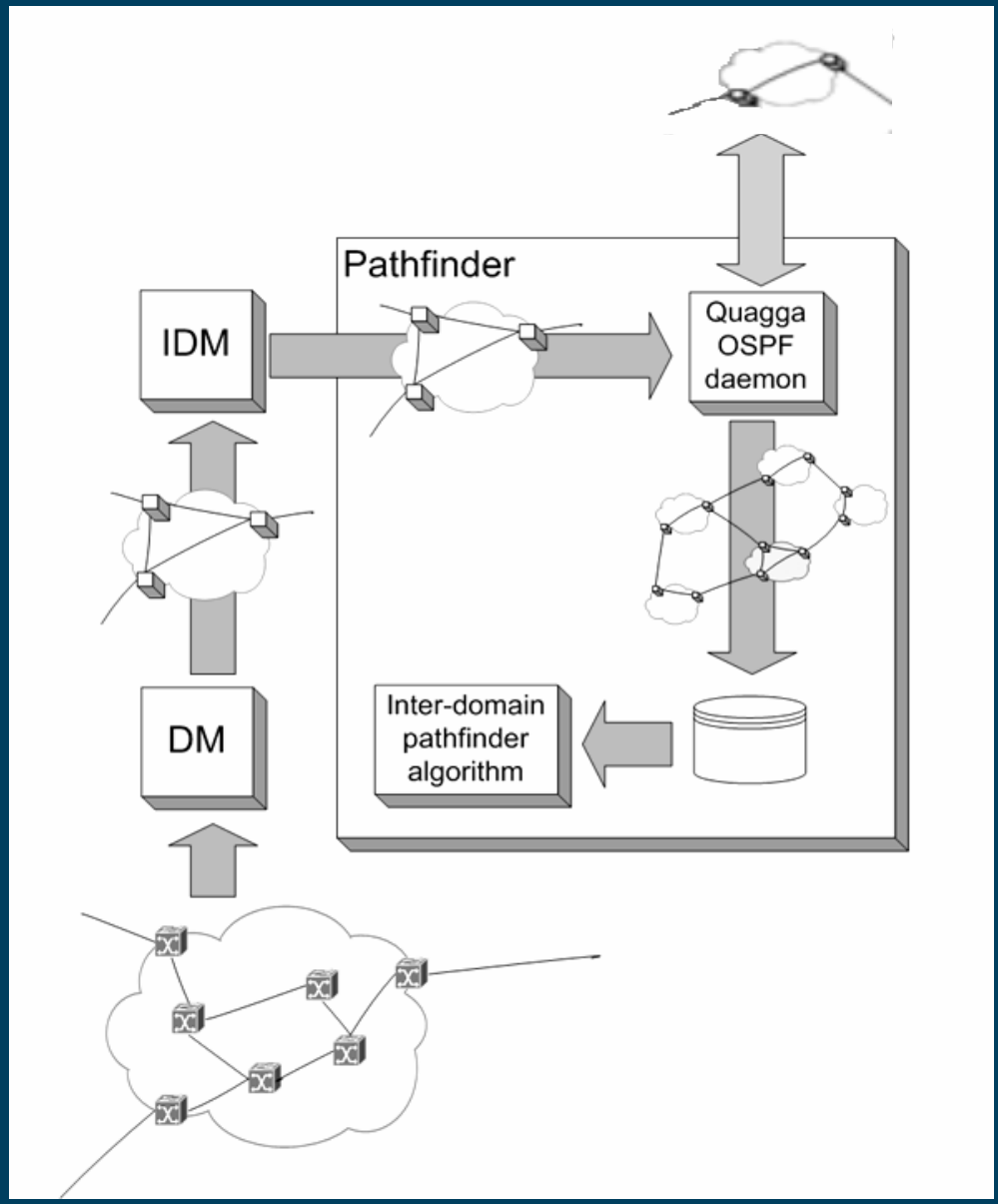

Topology abstraction and pathfinding

InterDomain Manager

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- Implements the IDM-IDM interface for negotiations with neighbouring domains
- No centralised management
  - Better resilience possibilities
- Implements south-bound (IDM-DM) interface towards the local domain for topology updates, reservation handling, provisioning
- Exports interface to end-users/applications
- Use of an abstract topology representation at the inter-domain level
  - Domain independence for resource usage policies and technological choices
  - Possibility (not mandatory) to hide domain internals
  - A common naming and addressing schema for the abstract topology based on IPv4/6 addresses
- Implements federated AAI (inter-working with eduGAIN: the federated AAI framework developed by GN2)

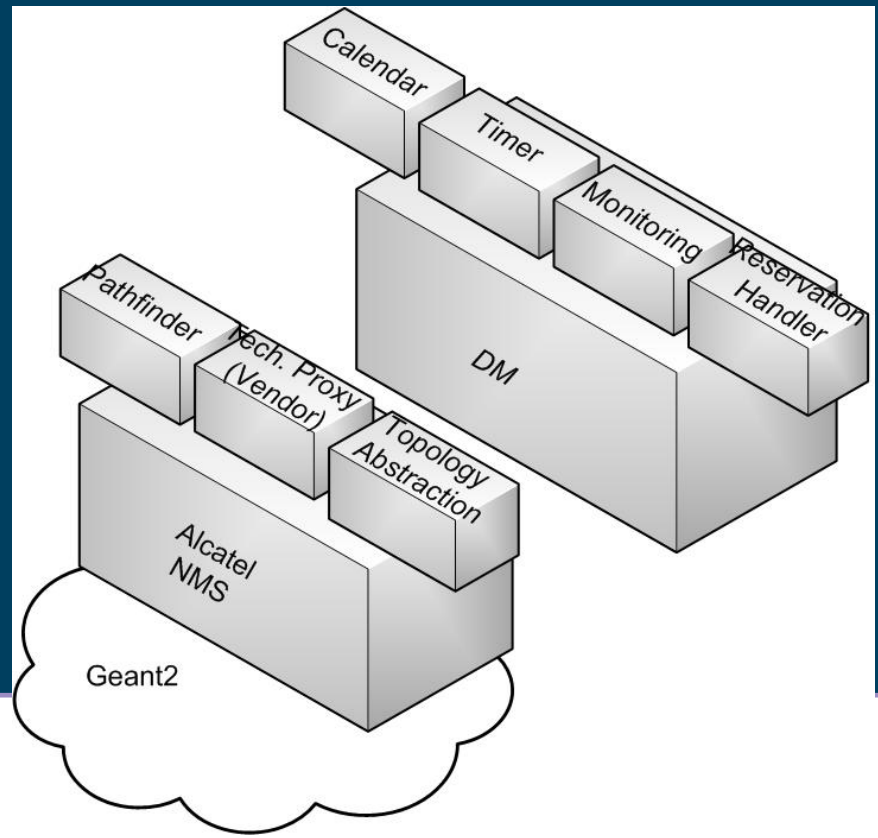
Domain Manager

- A reference implementation (WebServices based) for intra-domain operations:
  - Data plane topology handling and abstraction
  - Reservations handling
  - Intra-domain pathfinding
  - Technology proxy
    - Technology-specific parameters for end-to-end technology stitching
    - Intra-domain signaling and provisioning
  - Intra-domain monitoring

The implementation of the technology proxy is heavily dependent upon the underlying technology

Domain Manager modularity

- The Domain Manager is designed to support modularity
- Complements the missing functionality of the underlying management plane for the operations of AutoBAHN
- In the case of GÉANT2, DM functionality is distributed between the AutoBAHN DM and the NMS



Multi-domain monitoring

- Technologies: BoD Ethernet circuits over
  - One EoMPLS/switched Ethernet network (SNMP-based)
  - One SDH-based network (Monitoring based on SDH metrics from the Alcatel IOO interface)
- Metrics to be monitored, in order of priority
  - Up/down
  - Degraded/not degraded
  - Level of usage (where possible)
- User GN2-PerfSONAR methodology
- Next, work on concatenating more complex metric across multiple technologies

Multi-Domain Monitoring

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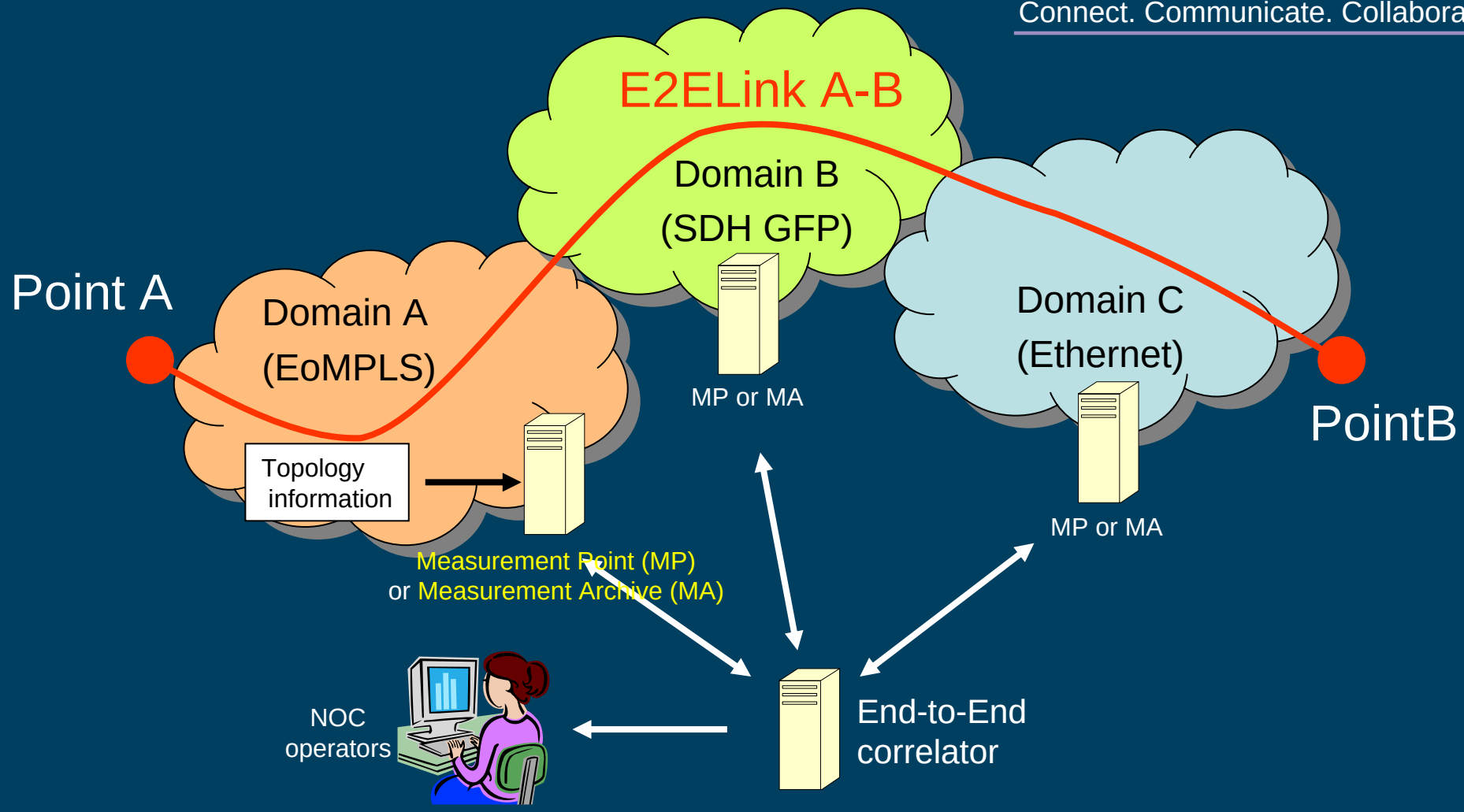

AutoBAHN demo: data plane

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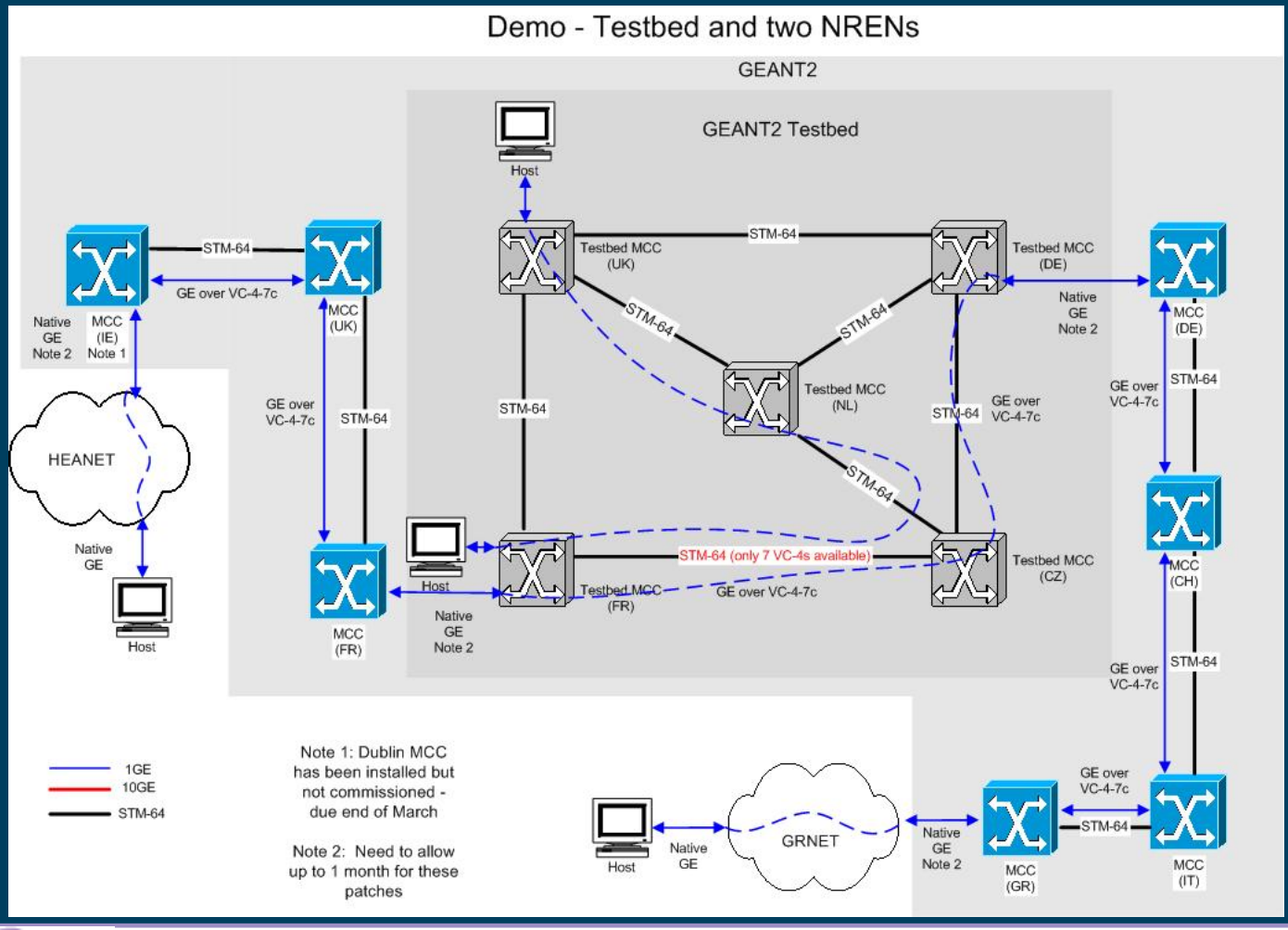

AutoBAHN demo:

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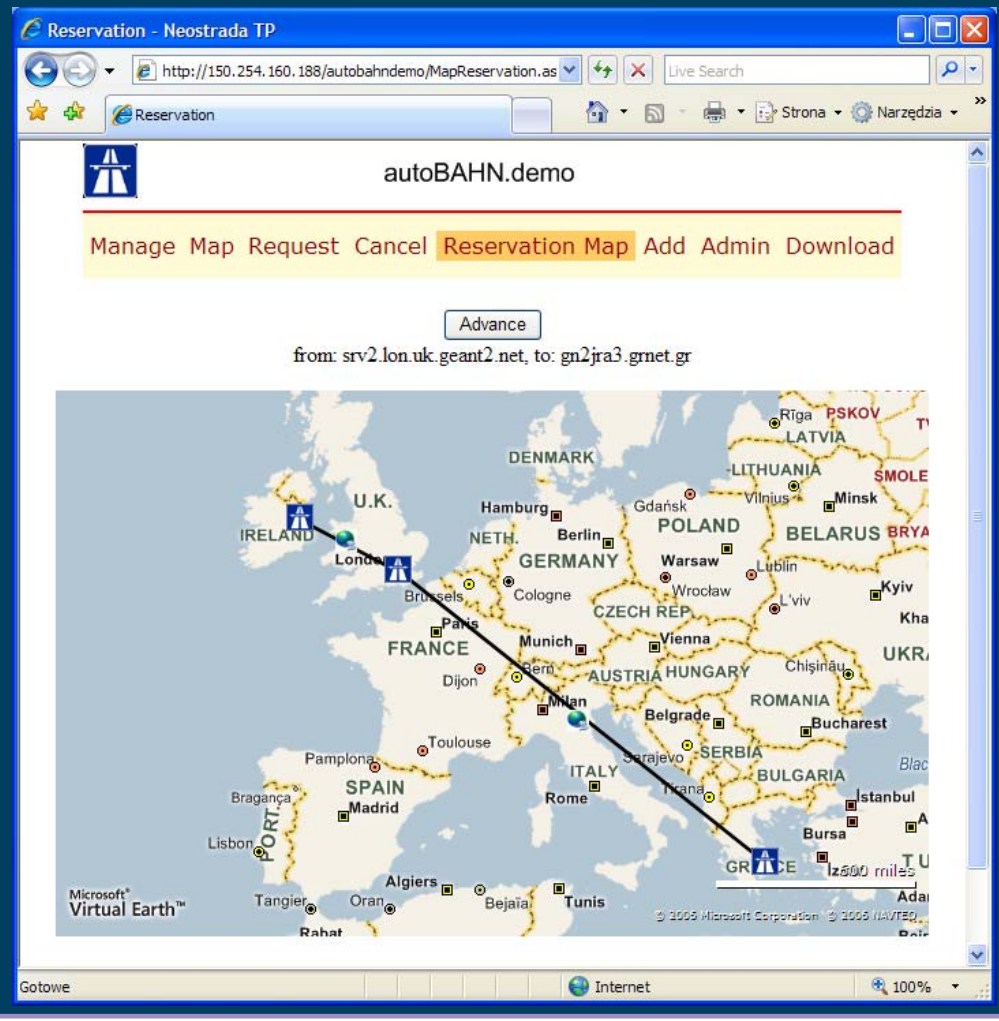
- Signaling of a GE circuit from an end-point in Greece to another in Ireland over:
  - GRNET, using ANC_Tool (L2 MPLS VPN)
  - GÉANT2, using an EVC
  - HEAnet, using BLUEnet (L2 MPLS VPN and native ethernet)



Technology stitching

- Technology stitching covers change and configuration management task
- Topology in most databases is the actual topology; used for configuration/performance/fault management
- For change management one needs to know the extendibility of the topology and the allowable range/list of parameter data (remotely configurable).
  - extendibilityability of the topology soemtimes *humans* also need to intervene if not *remotely or auto* configurable.
    - Main thing: topology (cNIS/NDL/etc.) also needs to know something about change/extendibility: metadata
  - allowable (dynamic) range/list of parameter data could solve this

Future work

- Further develop DM
- Incorporate AAI
- Interworking (like definitions of interfaces and Topology Abstraction schema) with Internet2 and ESnet
- Demonstrations; possibly SC07 together with Internet2/ESnet
- Liase e.g. GLIF Control plane WG, etc.

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Thank you !

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