

GN3 Architecture Principles

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(From "GN3 White Paper")

- Multi-domain, hybrid, international circuit stitching, automated provisioning, distributed monitoring infrastructure
- Collaboration, Federation, use of NREN resources, GLIF, open exchange points, international peers
- Facilitate development and experimentation
- Strong NREN involvement: lead by NRENs, executed by NRENs
- Bridging the digital divide - advanced and **affordable services** for all of Europe



- The GN3 network must be
 - Affordable
 - Effective
 - Open
 - Innovative
 - Hybrid
- The GN3 network must
 - Enable novel, ground-breaking applications
 - Reach (and give excellent service to) the entire European R&E Community
 - Facilitate collaboration
 - Serve many masters with different needs
- A few simple principles can
 - Help direct architecture and design thinking
 - Simplify choices

- **Cost**
 - Long-term sustainability
 - Reasonable cost-benefit for all partners
- **Federate**
 - Exploit partner resources & expertise
 - Work as a community
- **Virtualize**
 - Allow multiple infrastructures
 - Be adaptable to many needs, at the same time
- **Facilitate**
 - ... networks of the future
 - ... research and education of the future



- The network must
 - Be affordable to all partners
 - Provide a service not economically feasible elsewhere
 - Provide similar service as others at a lower cost
- The architecture must take into account
 - Cost control – efficiency, cost of providing service
 - Long-term financial sustainability
 - Prioritize inexpensive ways of providing core services
 - Minimize long-term financial obligations
- When doing the design
 - Understand the business model
 - Understand the alternatives – what would it cost to deliver the same service in a commercial network
- Cost-effectiveness is the key enabler



- We must
 - Work as a community
 - Jointly exploit community (NREN owned, controlled) resources
- The network architecture must
 - Develop a federated approach to core networking
 - Develop mechanisms for operation of federated networks, in a stable and reliable manner. No, I don't know how, but we'll have to figure that one out
- When designing
 - When faced with a choice, opt for federated rather than hierarchical



- We must
 - Service many communities
 - Work with international communities
- The Network Architecture must
 - Allow multiple infrastructures
 - Be adaptable to many needs, at the same time
 - Virtualize at all network layers
 - Allow integration of virtualized resources from multiple international partners
- When designing
 - Work towards integration of hybrid networking schemes through virtual networks spanning L1-L3
 - Consider virtualization techniques at L4 and up



- We must
 - Be a facilitator for the development of next-generation photonic, optical, and IP networks
 - Be a facilitator for European participation in tomorrows research and education
 - Facilitate European participation in international collaborations
- The network architecture must
 - Allow experiments, at all network layers
 - Take incremental advantage of new technologies
- When doing the design
 - Partnerships, collaboration, and JRA's are key



A Few Examples

- Principles
 - Cost
 - Federation – use NREN-owned resources
 - Facilitate – new models for network build and operations
- Implementation
 - As a rule, CBF should be deployed in the network; *not* using CBF should be the exception
 - Integrate reliable use of alien waves to reduce cost for OEO when crossing domains.
 - We must evolve methodologies for operations of a federated, optical backbone
- Advantages
 - Resource efficiency
 - Sustainability
 - Avoids cost for redundant infrastructure



- Principles
 - Cost – lower IP transit cost
 - Federate – share access to European peering points
 - Facilitate – improved NREN peerings and IP infrastructure
- Implementation
 - Use dark fiber footprint to provide a IP peering network, either shared or (virtualized) individual networks per NREN.
 - Separate overlay(s), used only for peering
- Advantages
 - More efficient IP network(s)
 - Leverage our aggregate volume and geographical footprint.



- Principles
 - Cost – maintenance, operations, NOC
 - Lends itself strongly to further virtualization
 - Federate access to core IP layer
- Implementation
 - 4 routers in Europe
 - SUNET is having excellent results with a combination of a collapsed IP core and logical routers
- Advantages
 - Makes using absolute state of the art routers affordable
 - Exploits the fully-owned L1 / L2 network
 - Flexible
- Switch where you can, route where you must

