We have an opportunity...
because we do not understand what you do and how you go about doing it

...and you think of us as a utility
I believe other E-Infrastructures think of networks as closed utility systems that are simply available when needed.

GEANT wants, needs and is capable of providing more value to PRACE than a simple pipe.
Any network can be built to be an open and programmable system so users of it can influence its behaviour.
How do we build a network to be open and programmable?

Slow & inflexible service development, constrained network evolution, high cost & challenging renewal, vendor lock-in

- CORBA, MTOSI, SOAP, TL-1, SNMP, CLI, NETCONF, RESTCONF, Netflow etc.
What does disaggregation mean?

Networks built from multiple specialised not generalised elements and vendors
What benefits and opportunities does disaggregation provide?

- **Data Centre density, economics and hardware architectures moving into WAN**
- **Separation of software from hardware**
- **Open programmable hardware and software**
- **Multivendor integration**

- Reduced space & power costs
- Opportunity to own control plane
- Agile service development
- Choose most appropriate vendors per set of requirements
- Cheaper hardware Pizza box approach
- Reduced form factor
- Opportunity to expose software & hardware through APIs
- Open programmable hardware and software
- Ability to differentiate
- Integration complexity is being simplified by vendors
What does this look like in terms of elements
Open Line System: Opening the lowest networking layer

- Support for multiple technologies/vendors over a single line system
- Offer alien wave transport as a managed service
- Integrated 3rd party DWDM pluggables available in various terminal technologies and vendors
- Still benefit from a single vendor providing end-to-end optical management
  - channel & span equalization, DCN connectivity (OSC), ALS, Alarm reporting.
Disaggregation of Hardware - Muxponders
Data Centre architectures and economics moving into WAN

- Next gen of merchant silicon will match WAN performance of proprietary chipsets
- Data centre style pizza box stackable form factor.
- Up to 5 times reduction in cost over traditional telecoms equipment architectures
- Significant increase in density
- Modular – easy to scale up
- Easy upgrade path to new technology: simply replace old generation pizza box for another

- Loss of equipment integrity – not designed to be highly available as per ETSI etc.
  - No internal hardware redundancy
  - No in-service upgrades
  - Restricted temperature operation
Packet Optical Integration. Reducing complexity, increasing ease of interoperation between domains

Packet over Optical Transport is a network either composed by Packet Optical Transport Systems or by routers with coloured interface integrated as DWDM systems.
Switching & Routing
Highly Programmable Edge; enables innovative service offerings

- Multi-context **VIRTUALIZATION**
- Massive **PACKET BUFFER** depth: 48Gb
- Line-rate **THROUGHPUT** 100GBPS
- Traffic metering, policing and **SHAPING**
- Supports **OPENFLOW 1.5**

- Independent control plane
- Multiple **FLOW TABLES** with wide match
- Over a **MILLION ACTIVE FLOWS**
- Fast **FLOW MODS/SEC** of >10,000 mods/sec
- **PER FLOW STATISTICS**
Disaggregation of Software: Simplifies software, reducing vendor R&D burden; can own control plane to drive differentiation

- Router operating systems contain at least 30 million lines of code - all completely obscured in a binary.
- 80% of it is completely unnecessary in the average environment
- Disaggregated software means the control plane can be made modular
  - We can choose to only develop / deploy what is necessary for the required function
  - Simply core/underlay
  - Feature rich edge/overlay
- Service development much more agile
- Bug fixes and regression testing simpler
What does this mean for PRACE?
We can leverage the work going on to deliver the MDVPN service.

- High scalability
- Easy to deploy
  - No Capex
- VPN multiplexed
- Lead-time reduced
- Configure only at the edge

An end-to-end extensible and flexible service:
- Reliable
- Flexible
- Resilient
- Cost-effective

VPN Provisioning as easy as in a single-domain.

Configure only at the edge.

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PRACE MDVPN deployment

PRACE MD-VPN

NCSA
CastoRC
VSB-TuO
Icheck
UIO
UHeM
CSCS

IPsec
Gateway

Central PRACE router
DFN/GÉANT
Frankfurt

NRENs
GÉANT

BSC
CEA
IDRIS
CINECA
CSC
FZJ
HLRS
RZG
LRZ
EPCC
SURFSARA
CYFRONET
PSNC
WCSS

10 Gb/s wavelength
10 Gb/s Ethernet IP
1 Gb/s IPsec Tunnels (Shared)
1 to 10 Gb/s GÉANT+ L2 VPN Service

NIIF
GRNET

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To build services specific to PRACE

Keep the core efficient enough to serve the 50M users

Add a layer of intelligence and low-cost high capacity edges to serve the “science traffic”

Science traffic gets to ‘program’ the network
The network interoperating with PRACE HPC

- IaaS/PaaS providers expose selected orchestration capabilities
- Request for inter-domain/WAN services via agreed Network Service Descriptors
- GÉANT/NRENs serving as specialized/on-demand network service providers for all HPC sites
We can leverage the performance of R&E networks to build high performance services for HPC

Proof that R&E networks are providing real value to the research community.
With open standards based software, integration and interoperation can occur above the network.
1. Networks are now intelligent and programmable; users can control and influence their behaviour

2. We can develop smarter end to end services between HPC and the network

3. GEANT, PRACE and our users need to work together, using these new capabilities to deliver Exascale
This is how you can help us build a better network in four easy steps:

**Step 1**
Be more demanding of your network operator / NREN.

**Step 2**
Think seriously about how R&E networks could help you do your job better.

**Step 3**
Engage with us to define the future GEANT network.

**Step 4**
Work together towards Exascale.

We have an opportunity to build a better network; let's not miss that opportunity.
Exascale requires more than a network of dumb pipes

It requires smart end to end services across all the high performance infrastructures in the chain
Thank you and any questions? Any questions