Grid services enabled Photonic Infrastructures in Europe

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Contents

- Quick overview of photonic infrastructures in EU
- Relevant production Grids using these infrastructures
- Overview of the LUCIFER project proposal

Pan-European optical infrastructures

- GÉANT: optical links, framing from STM-1 to STM-64
- GÉANT2
  - increased meshing and bandwidth + 10 GE + dark fibres
  - 96 x 10 G links; 12,000 km of fibres with > 400 elements (OADMs, EDFAs, etc.)
  - GN2 JRA4 WI2 testing activities: IP over WDM, inter-domain GFP encapsulated Ethernet, GMPLS and EoMPLS
- EUMEDconnect
  - Covering the Mediterranean area
  - Links up to STM-4
- SEEREN / SEEREN2
  - Covering the South-East European area
  - Links: STM-1, 3 x 1 GE
- Cross Border (Dark) Fibre
  - Pan-European interconnections among NRENs and to GÉANT2
  - Links: PT-ES, FR-DE, NL-DE, DE-CH-IT, DE-PL, PL-CZ
  - [2x]STM-64 + 10 GE optical links

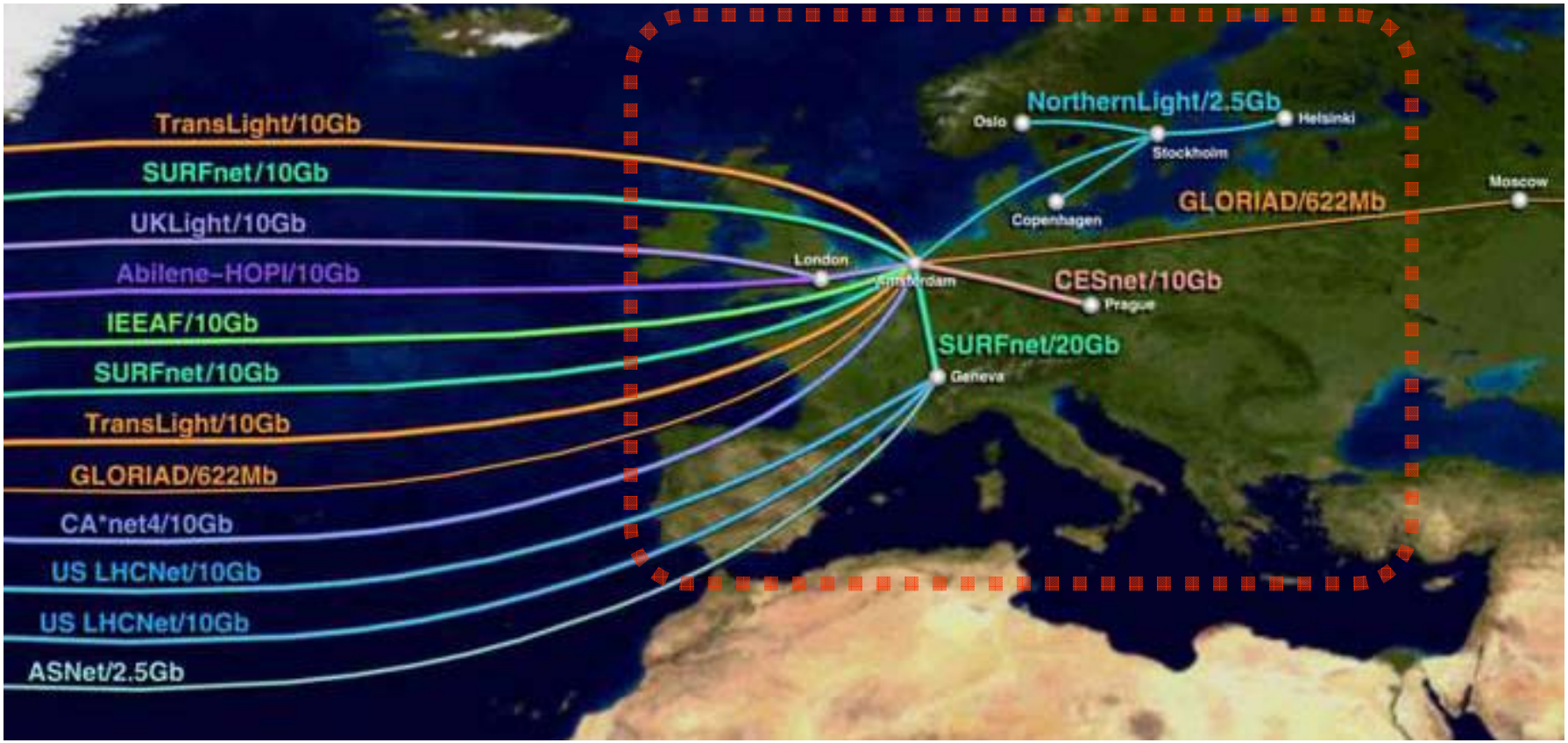
EU National optical infrastructures [1]

- National Research & Education Networks
  - 30 participating in GÉANT2, with varying degrees of optical infrastructure
  - Almost all have optical links (but some: Austria, Romania, Bulgaria, Iceland and Baltic states)
- Examples of relevant national test-beds & NRENs facilities recently put into operation
  - SURFnet6 (new production SURFnet) [NL]
    - Packet + lightpath services for end-users
    - 4/8x 1/10 GE optical links
  - NetherLight (Internet exchange) [NL]
    - SONET/SDH cross connect + Gigabit Ethernet switching facility
    - STM-16/OC-48 or STM-64/OC-192 international links + 1/10 GE
    - Connecting: GÉANT, SURFnet, NORDUnet, CESNET, CERN, UKLight, UvA LightHouse, MAN LAN NY, Canarie, StarLight
  - PIONIER (the Polish Optical Internet) [PL]
    - DWDM-32 optical links (2 lambdas operational): 10 GE + 10 Gb/s POS
  - CzechLight [CZ]
    - Optical links: OC-192 + 1 GE
  - CESNET2 (production) [CZ]
    - Optical links: 1/10 GE + OC-48 POS

EU National optical infrastructures [2]

- Relevant national and NRENs test-beds [cont'd]
  - VIOLA (Vertically Integrated Optical Testbed for Large Applications Overview) [DE]
    - Preparatory test-bed for X-Win
    - Optical links: STM-64 + 10 GE
  - X-Win (G-Win successor, operational since Jan '06) [DE]
    - Optical links: STM-16/64, 1/10 GE, dark fibres
  - UKLight + SuperJANET 5 extension [UK]
    - International Point of Access in London, with links towards StarLight and NetherLight
    - Other PoP in UK will access it with planned extensions to SuperJANET
    - International links: STM-64 + 10 GE to NetherLight; national extensions: STM-64 + dark fibres
  - NorthernLight [SE]
    - Exchange point connecting Scandinavian capitals and Netherlight
    - Links with multiple 1/10 GE lambdas
- International initiatives
  - GLIF (Global Lambda Integrated Facility)

GLIF connections to/from Europe



As of Aug ‘05

Relevant production Grid users [1]

- **LHC** (Large Hadron Collider) (production 2Q 2007)
  - experiments: ALICE, ATLAS, CMS, LHCb
  - LHC network nodes: **Tier 0** (sources), **Tier 1** (1st level processing), **Tier 2** (universities, research institutes)
  - **T0 – T1: 10 G lightpaths** provided by **GÉANT2** and involved EU NRENs (X-Win, SURFnet6, NORDUnet, RedIRIS, SuperJANET, GARR-G)
  - **T1 – T1**: **GÉANT2** lightpaths + **CBDF** links
  - **T1 – T2** and **T2 – T2**: L3 services by each NREN
- **DEISA** (Distributed European Infrastructure for Supercomputing Applications)
  - Integration of national HPC infrastructures: IDRIS-CNRS (fr); FZJ, LRZ, RZG, HLRS (de), CINECA (it), EPCC (uk), CSC (fi), SARA (nl), BSC (es)
  - Served by
    - GÉANT (phase 1): 1 G Premium IP / IP Priority LSPs
    - **GÉANT2** (phase 2): n x 10 G, e2e wavelengths (2006: n = 1; 2008: n ≥ 2)
    - NRENs: Renater, GARR, DFN, SURFnet

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It would be nice to assign Grid users to serving networks...
But how can we be sure about who's really using what?

I know that currently only e-VLBI and EGEE/ATLAS are using gigabit channels.
artur, 22/02/2006

Relevant production Grid users [2]

- **e-EVN** (European VLBI Network)
  - interferometric array of radio telescopes spread throughout Europe
  - 15 observatories worldwide + 3 correlator centres: MPIfR (de), JIVE (nl), IRA (it), ASTRON (nl), OSO (se), Jodrell Bank & Cambridge (uk), …
  - Served by
    - GÉANT2: 2,5 / 10 G links
    - Involved NRENs (SurfNET, SuperJANET, GARR-G, PSNC, DFN X-Win, NORDUnet)
- **EGEE[-II]** (Enabling Grids for E-SciencE) (+ SEE-Grid + BalticGrid)
  - Infrastructure for production Grid services
  - 27 countries involved
  - SA1 (Network Resource Provision [1] / Networking Support [2]) and JRA4 (Network Service Development [1])

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The steps forward

- Diversity of
  - transport infrastructures (SDH, SONET, GE, dark fibre)
  - network resource provisioning systems / control planes
  - demanding requirements from advanced users (e.g. Grids)
- *Need to find a leading overall architecture to address this EU-specific environment*
- **GN2 JRA3 & JRA5** work to provide an operational solution for this
  - A pan-European umbrella for single control and management facility for network resources provisioning (Bandwidth-on-Demand, inter-domain operations, AAI – Authentication and Authorization Infrastructure)
  - Tend to preserve the specificity of network resource provisioning systems within the various NRENs
- **LUCIFER** will
  - define, implement and assess a new, integrated architecture for NRENs' resource provisioning (based on both Control Plane and NRPSs)…
  - …for Grid-specific network services
  - involve additional choices of experimental network facilities (CBDF, GLIF)

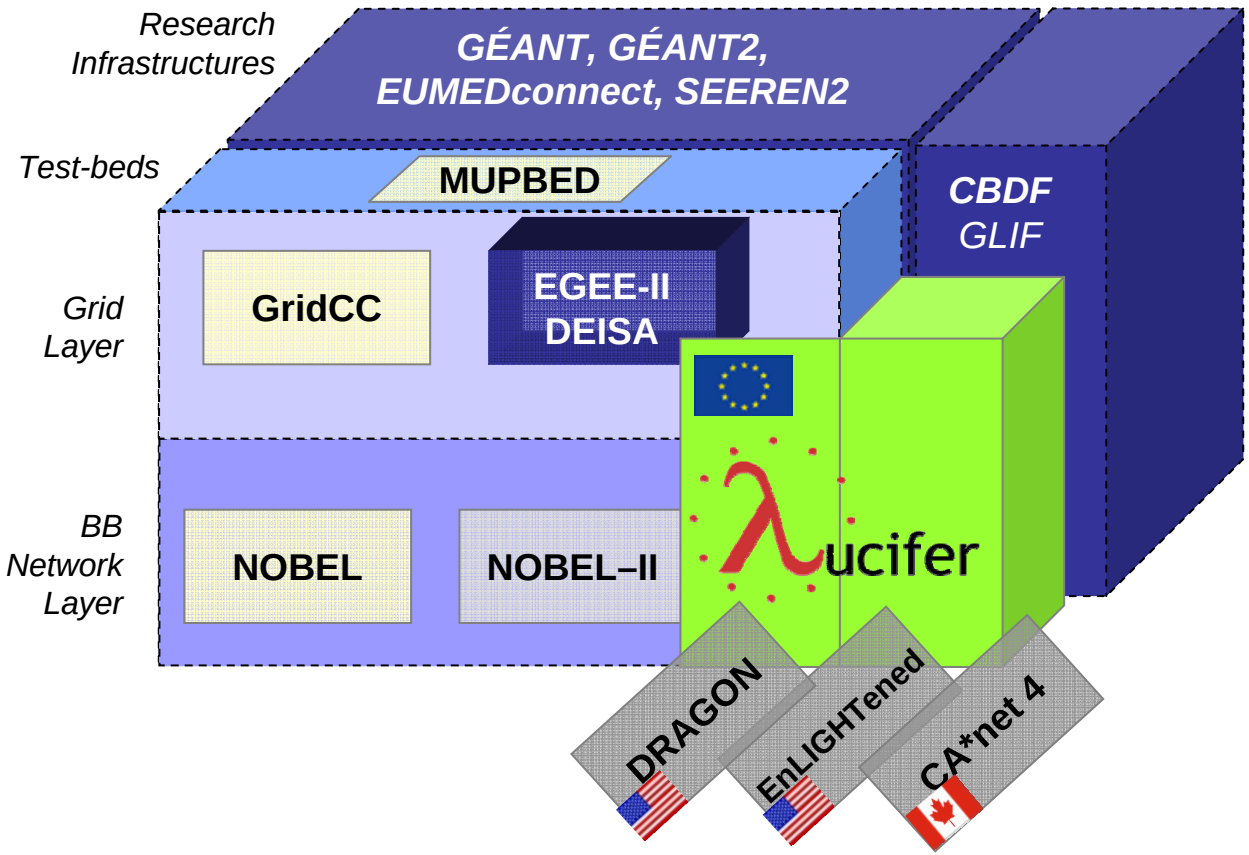
Lambda User Controlled Infrastructure For European Research

- **Lu·ci·fer** (lū'sə-fər) [Lat.,= *light-bearing, light-carrier*]
- EU Research Networking Test-beds FP6 IST program
  - 30 months project, to begin in 3Q 2006
- Partners and supporters
  - Research Networks: CESNET, PSNC, SURFnet, FCCN, RedIRIS, GARR + GN2 + Canarie
  - National test-beds: Viola, OptiCAT, UKLight
  - Equipment Manufacturers: Adva, Hitachi, Nortel
  - Tech SMEs: Nextworks
  - Research & Academic Institutions: RESIT - AIT, Fraunhofer SCAI, Fraunhofer IMK, Fundaciò i2CAT, IBBT, Research Centre Jülich, University of Amsterdam, University of Bonn, University of Essex, University of Wales-Swansea, SARA
  - Non-EU Research Institutes: MCNC (US), CCT (US), CRC (Canada), UCSD (US)
- Vision & Mission
  - Address some of the key technical challenges that enable on-demand, end-to-end Grid network services across multiple domains
  - Treat the underlying network as first-class Grid resource
  - Demonstrate solutions and functionalities across a test-bed involving GÈANT2, European NRENs, CBDF and GLIF facilities

Technical scope and rationale

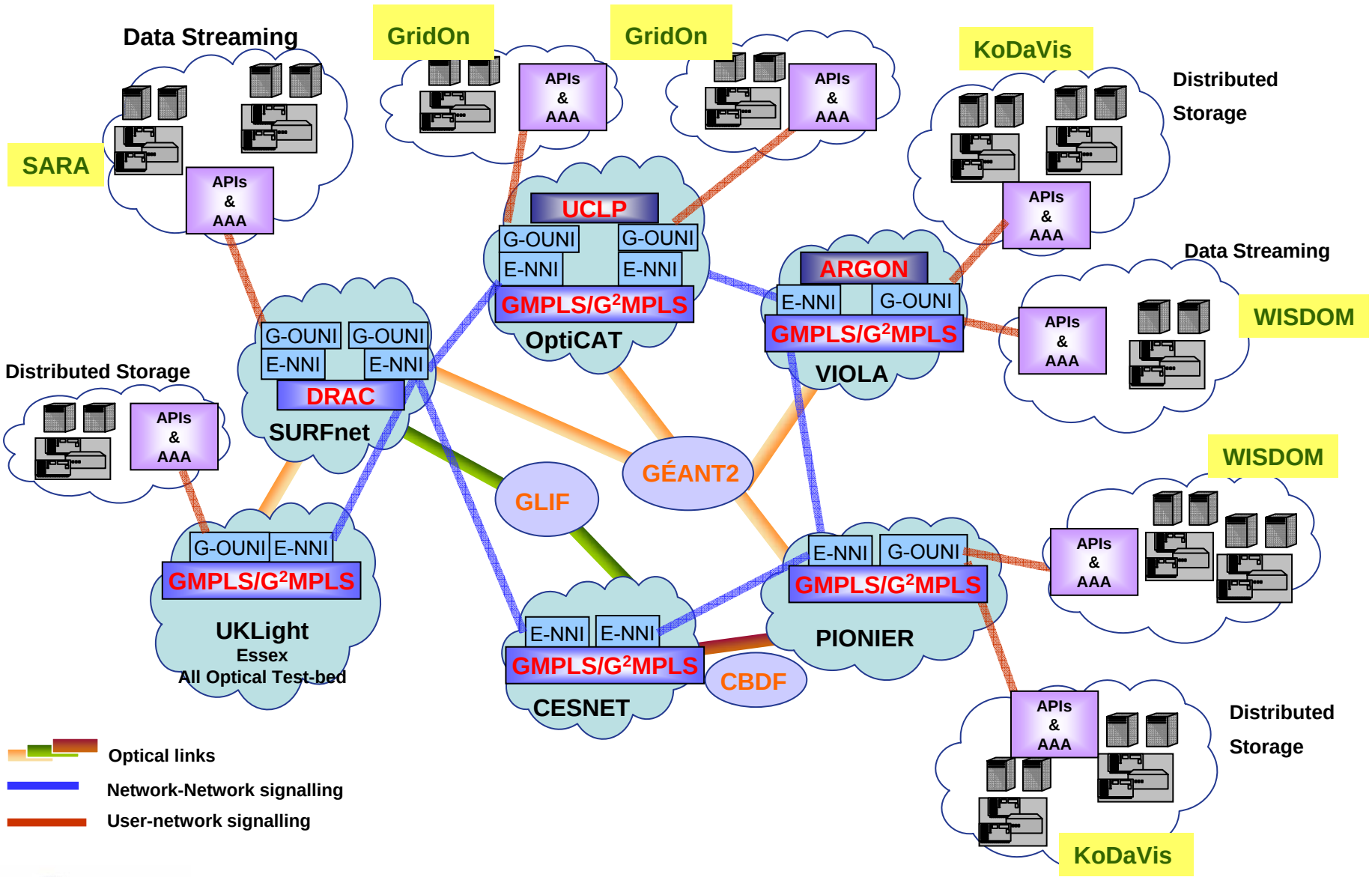
- 3-layers wide perspective:
  - Application Service Plane (Grids)
  - Network Resource Provisioning plane (D-RAC, UCLP, ARGON)
  - Network Control Plane (Grid-GMPLS – G²MPLS)
- Network should support generic transport services for both Grids and 'less' demanding users... but with a *special care for Grids*
- Network & Grid-specific resources are controlled and set-up *at the same time* and *with the same priority*, with a set of seamlessly integrated procedures
- The Service and Control Planes (Grid middleware, NRPS, GMPLS / G²MPLS) will be integrated in a hierarchy of architectures that interwork to build the GNS (→ GGF-GHPN)
- Optical test-bed
  - @ Optical Network Layer (G²MPLS, inter-NRPS communications)
  - @ Grid Layer (Middleware extensions, APIs & policies)
  - EU wide, spanning to US and Canada

LUCIFER in the overall picture

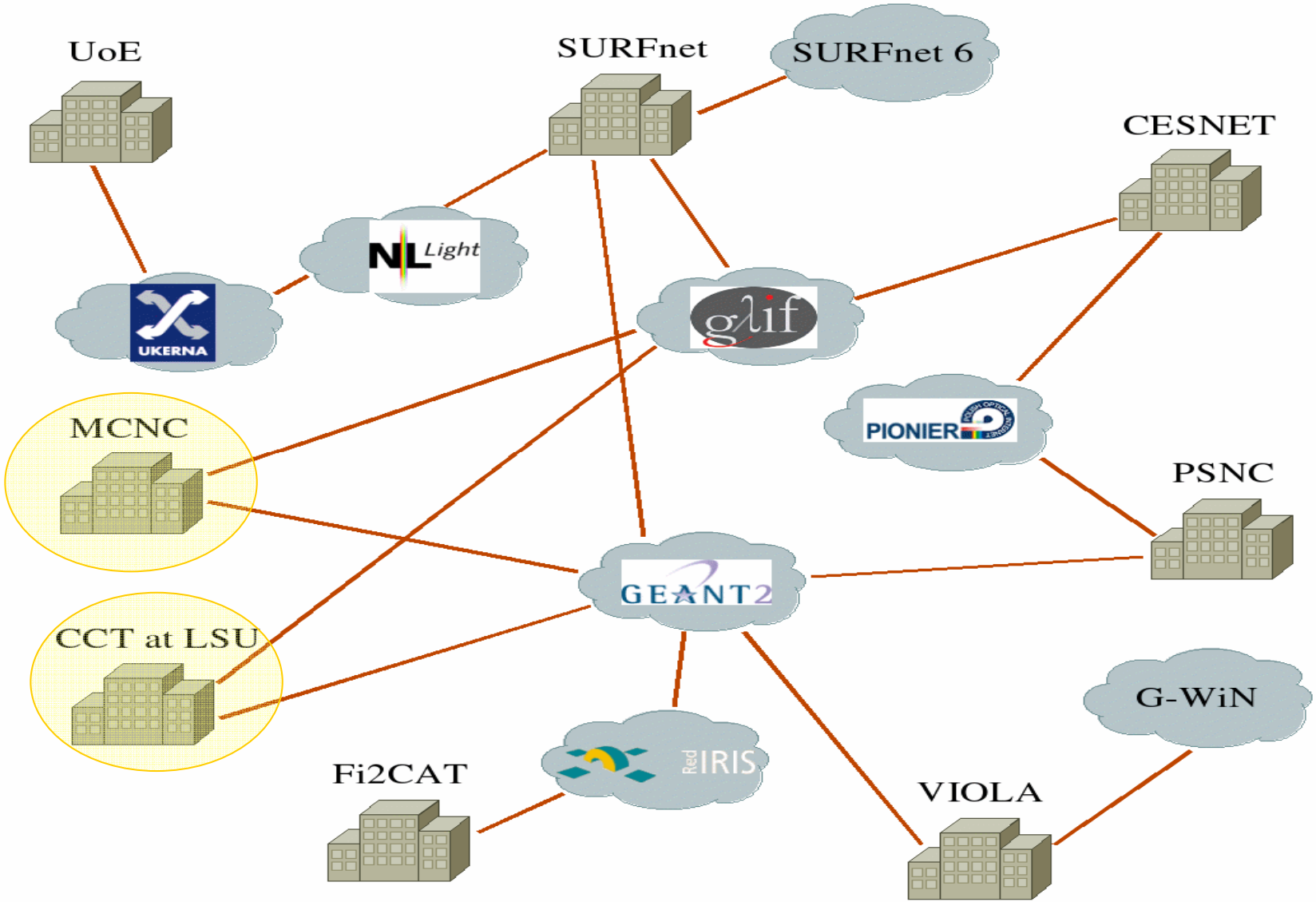


- LUCIFER will interact with:
  - GÉANT2 (GN2 JRA3, JRA1 & JRA 5)
  - International activities: DRAGON, EnLIGHTened
- possible relationships with other EU projects
  - focused on network layer technologies: NOBEL 1 & 2, EuQoS
  - focused on Grid layer: EGEE-II, GridCC
  - test-bed oriented: MUPBED

An overview of the LUCIFER test-bed



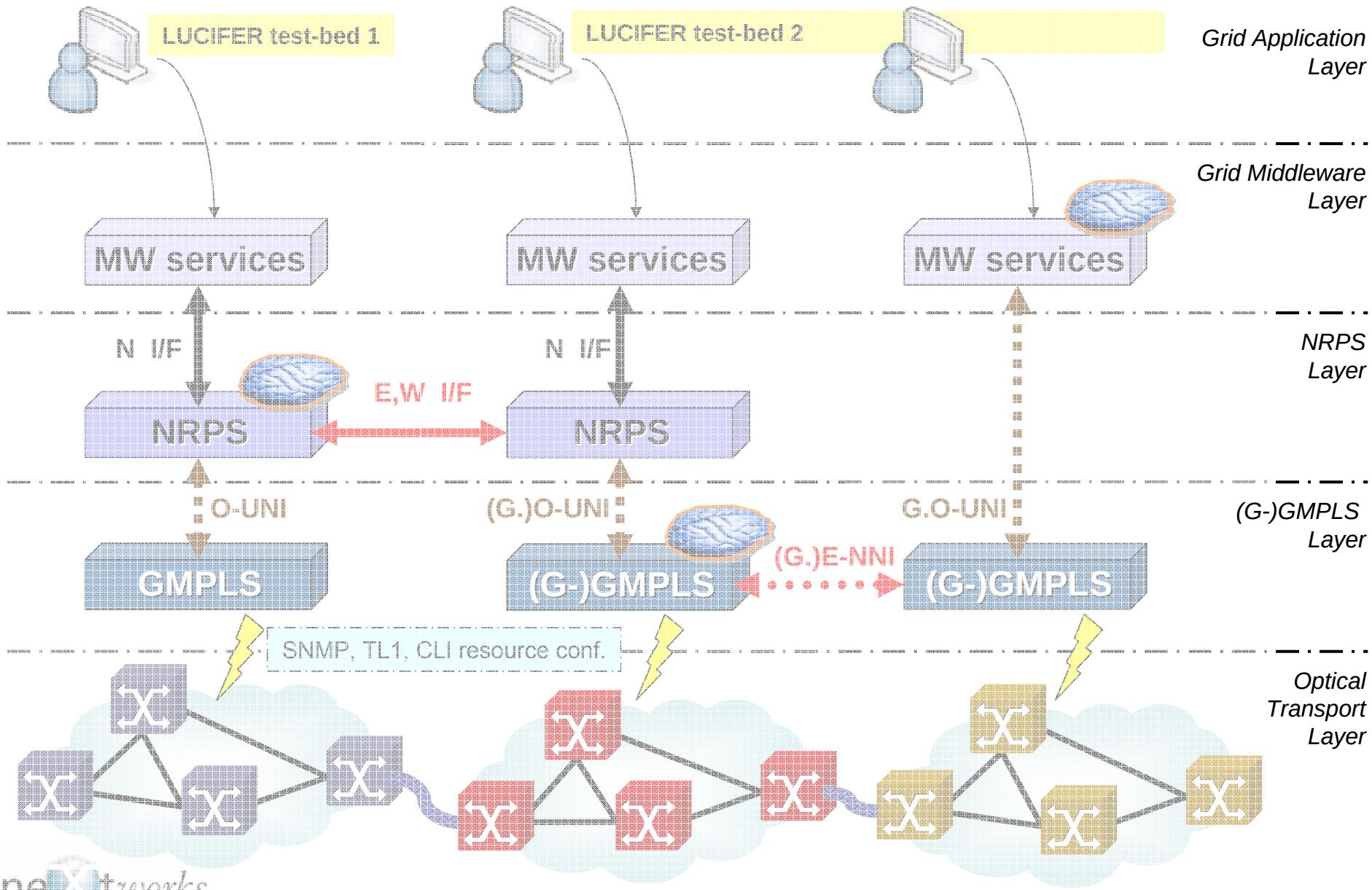
International extensions



Initial Grid applications

- WISDOM - Wide In Silica Docking On Malaria:
  - large scale molecular docking on malaria to compute million of compounds (in silico experimentation)
  - in LUCIFER: deployment of a CPU-intensive application generating large data flows to test the Grid infrastructure, compute and network services
- KoDaVis - Distributed visualisation
  - to be adapted to the LUCIFER environment to make scheduled synchronous reservations of its resources via the UNICORE middleware
    - Compute capacity on the data server and the visualisation clients
    - Allocate network bandwidth and QoS between server and clients
- Streaming of Ultra High Resolution Data Sets over Lambda Networks (FHG, SARA)
- Distributed Data Storage Systems

Integration & interoperation of architectures



Thank you…
Questions ?

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