European networking research

Beyond Hybrid Networking

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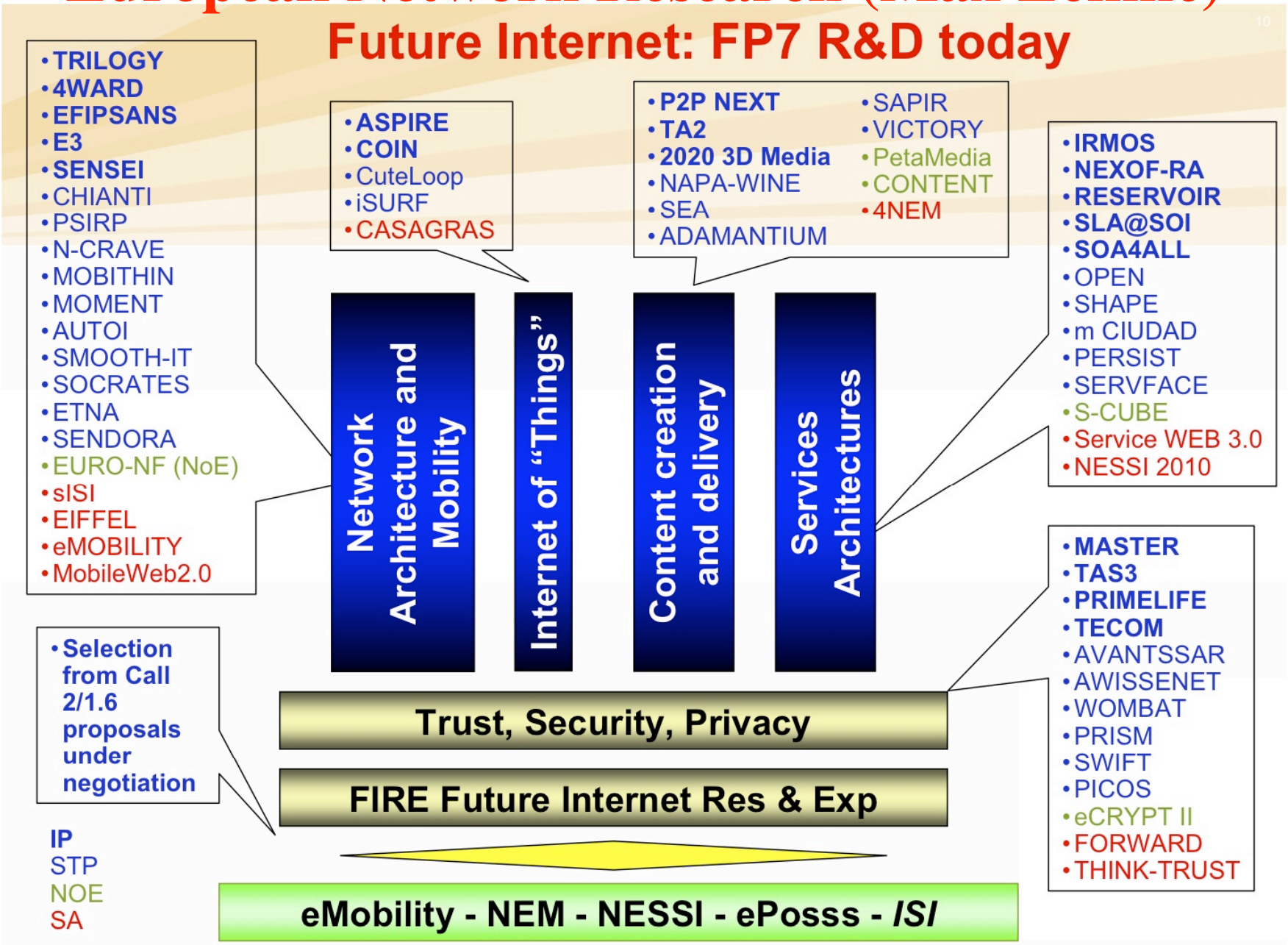


New Paradigms and Experimental Facilities (FIRE)

– Overview of Projects –

14 projects, 40,38M€

Co-ordination and Support Actions

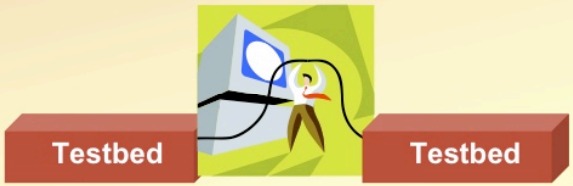
- FIREWORKS
- PARADISO

Main focus on experimentally driven advanced research for the Future Internet

- OPNEX
- ECODE
- N4C
- SmartNet
- Perimeter
- Echos
- ResumeNet
- SelfNet

Main focus on interconnecting test-beds towards building an experimental facility for the Future Internet

- VITAL++
- WISEBED
- PII
- OneLab2



Integrated project

Focused project (STREP)

Coordination & support actions

Gradually Building the FIRE Facility

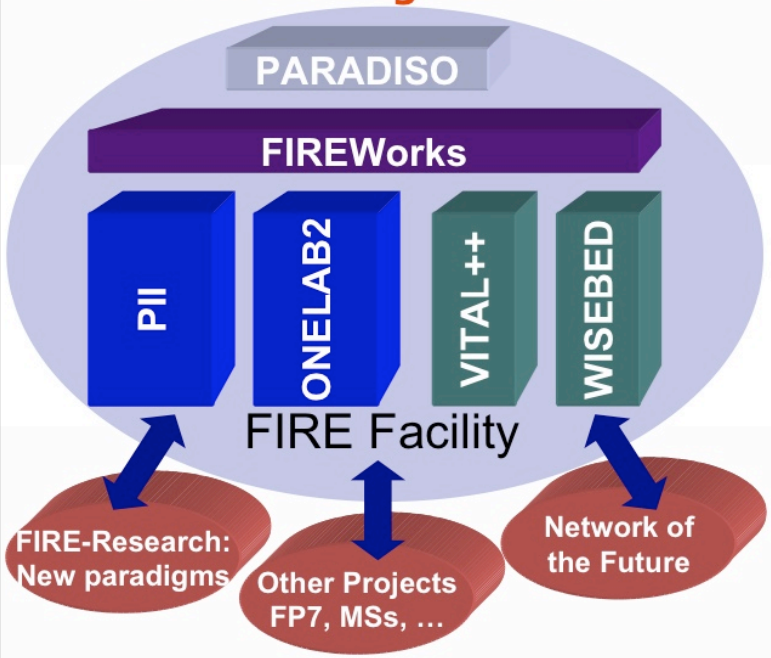
FP6: Early design & prototyping

One Lab

Panlab

TESTBED PROJECTS

FP7 – WP 2007/08: Prototyping the concept of federating testbeds



- focus on the telecom layers
- open and dynamic
- supporting academia and industry
- proof-of-concept → pre-commercial tbs
- discover the socio-economic dimension

Next: Expanding the concept & building the facility

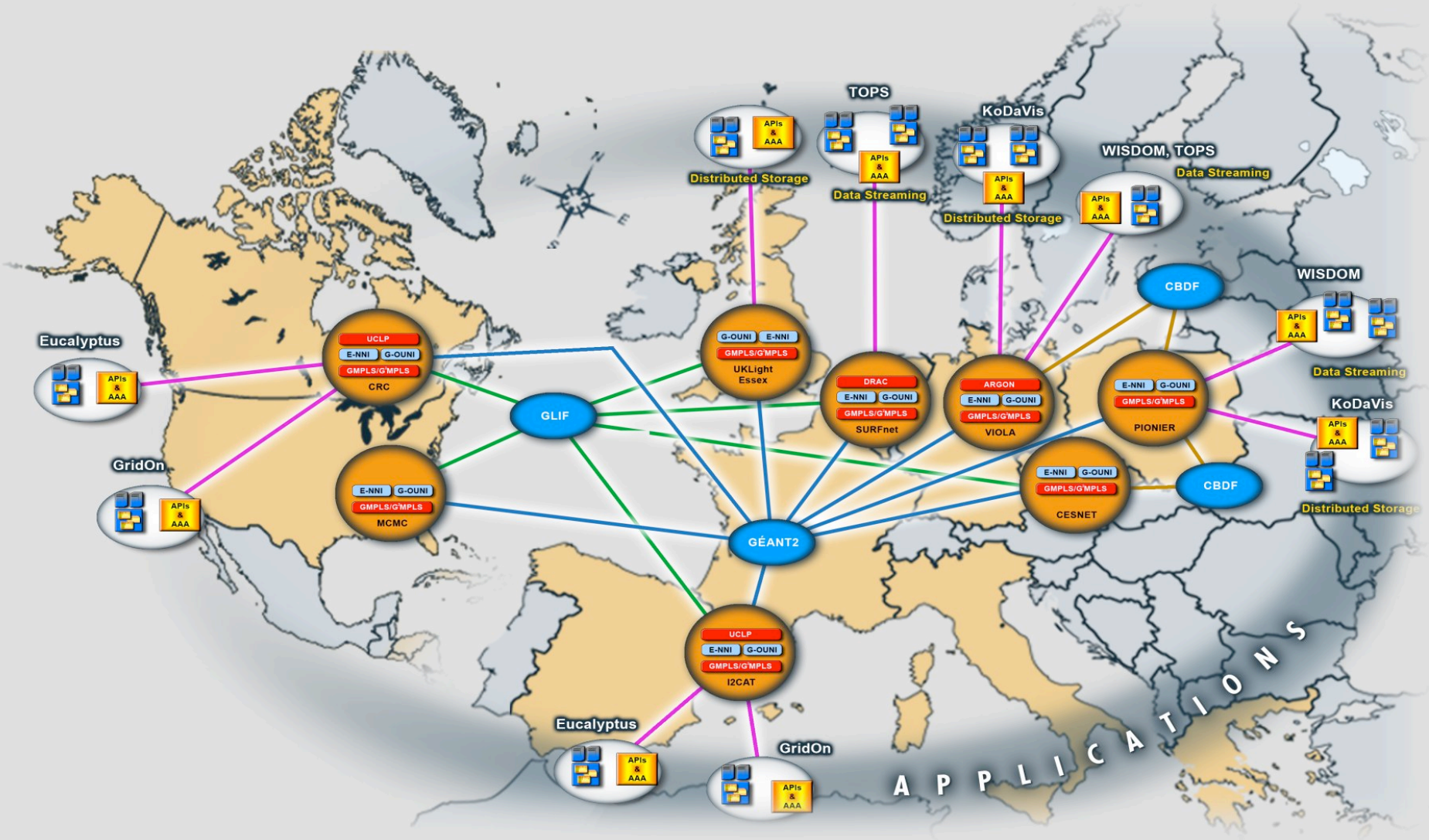
- expand to include service architectures
- support experimentation cutting across layers
- enable socio-economic impact assessment
- broaden involvement of large user communities
- support sustainability
- develop the facility in close cooperation with FIRE research projects

European Commission
Information Society and Media

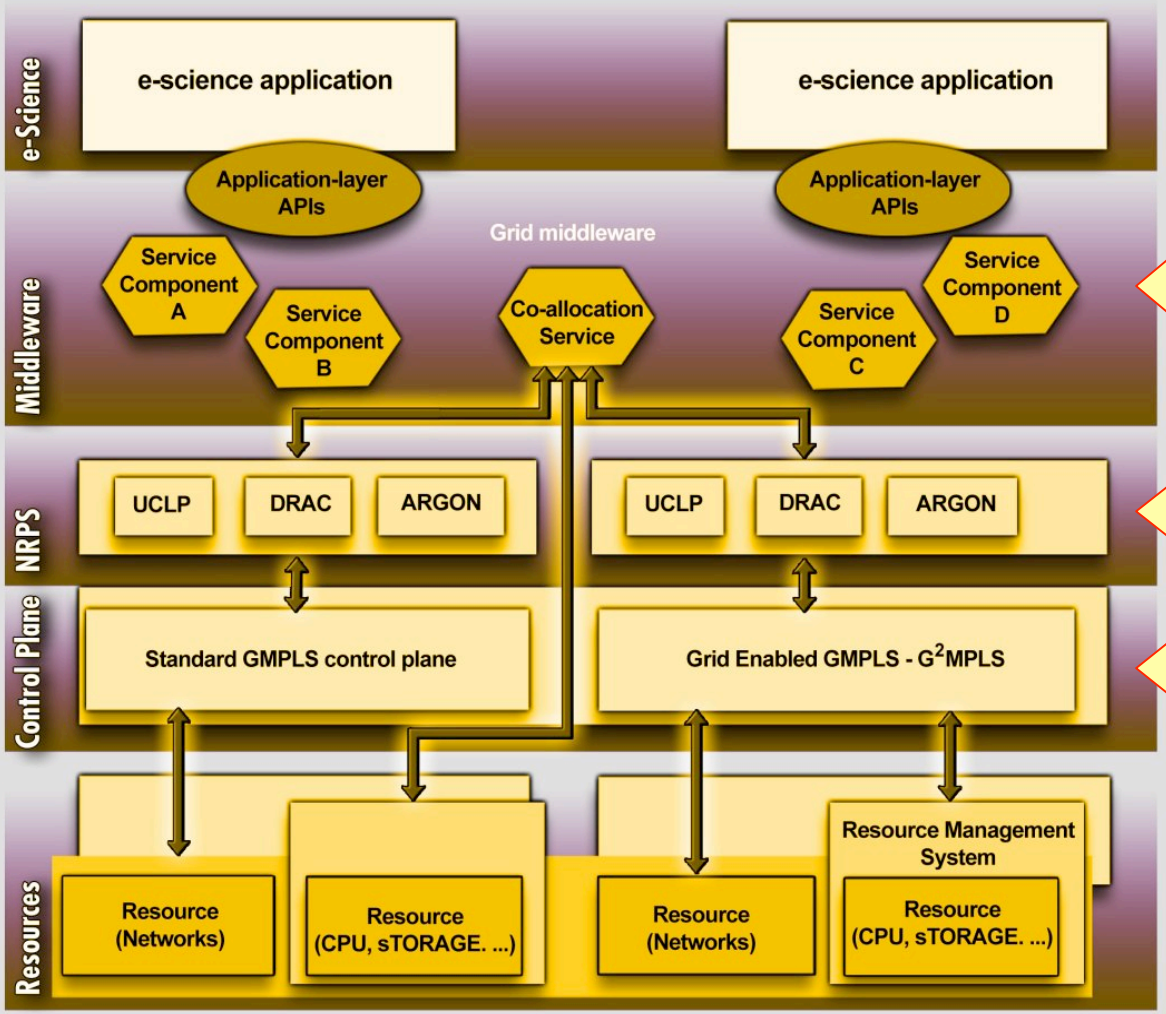
PHOSPHORUS PROJECT

- **European and Global alliance of partners to develop advanced solution of application-level middleware and underlying management and control plane technologies**
- Project Vision and Mission
  - The project will address some of the key technical challenges in enabling on-demand end-to-end network services across multiple heterogenous domains
  - In the Phosphorus' implementation the underlying network will be treated as first class Grid resource
  - Phosphorus will demonstrate solutions and functionalities across a test-bed involving European NRENs, GÈANT2, Cross Border Dark Fibre and GLIF

MULTI-DOMAIN TESTBED



PHOSPHORUS ARCHITECTURE

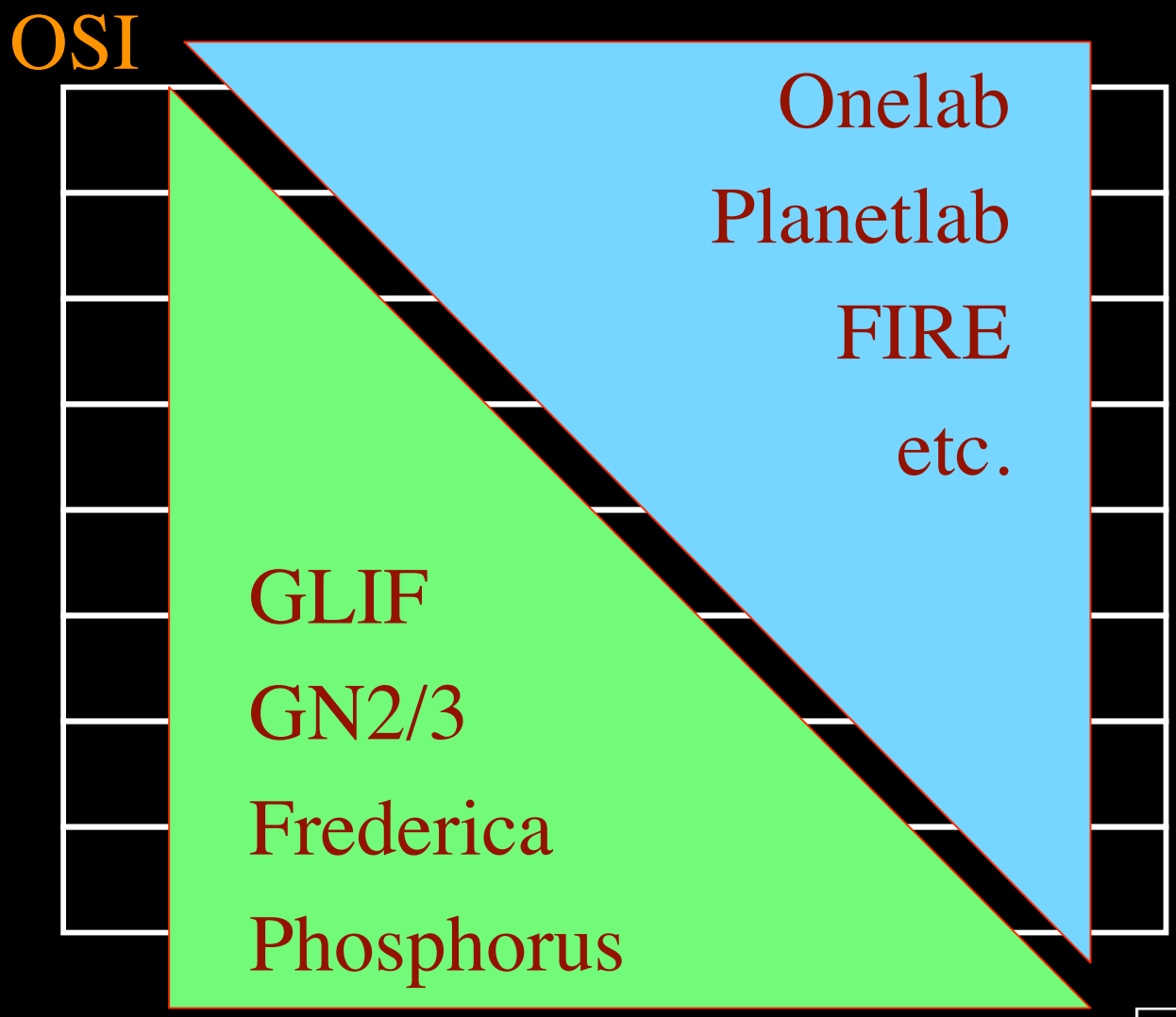


The different domains of the **Phosphorus'** test-bed will have:

- Grid middleware
  - UNICORE as a reference point
  - AAA policies
- Three types of NRPS:
  - UCLP
  - DRAC
  - ARGON
- Two "flavours" of GMPLS
  - standard (*Ph. 1*)
  - Grid-enabled (*Ph. 2*)

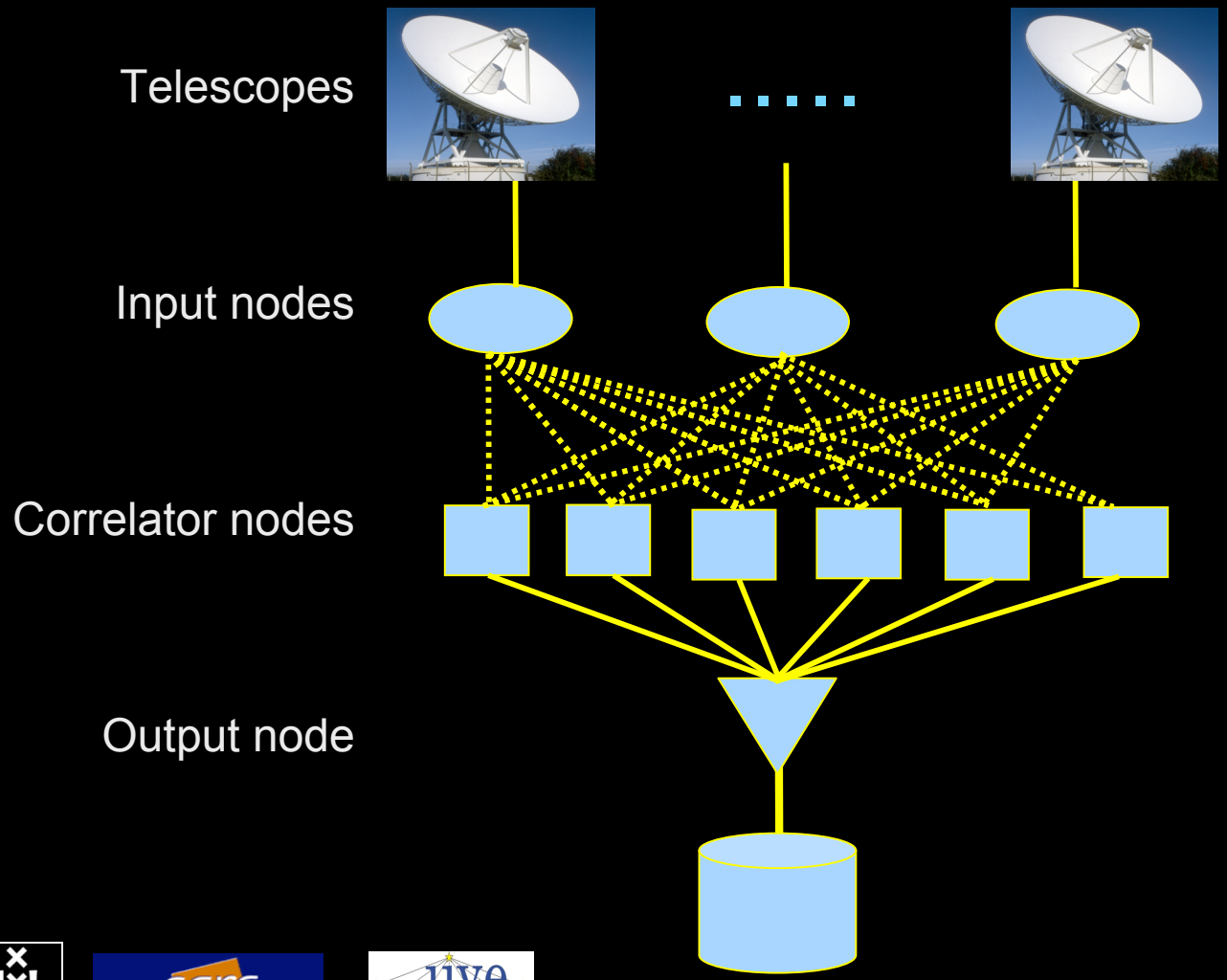
My view here

- needs repeatable experiment
- needs QoS & lightpaths
- needs infrastructure descriptions



The SCARIe project

SCARIe: a research project to create a Software Correlator for e-VLBI.
VLBI Correlation: signal processing technique to get high precision image from spatially distributed radio-telescope.



To equal the hardware correlator we need:

16 streams of 1Gbps

16 * 1Gbps of data

2 Tflops CPU power

2 TFlop / 16 Gbps =

1000 flops/byte

THIS IS A DATA FLOW PROBLEM !!!

sara Computing & Networking Services

jive JOINT INSTITUTE FOR VLBI IN EUROPE

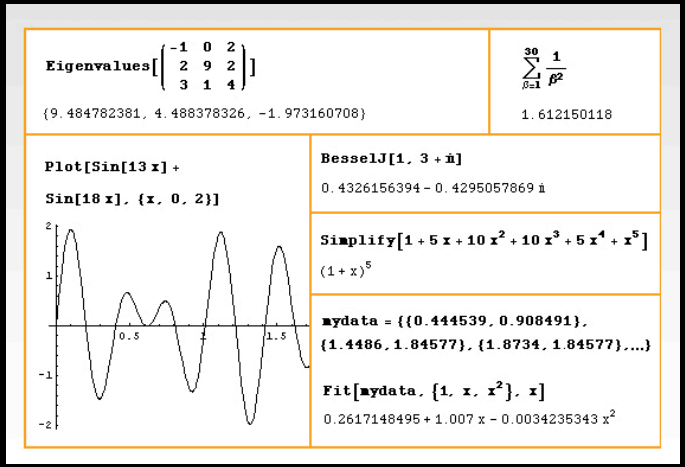
TeraThinking

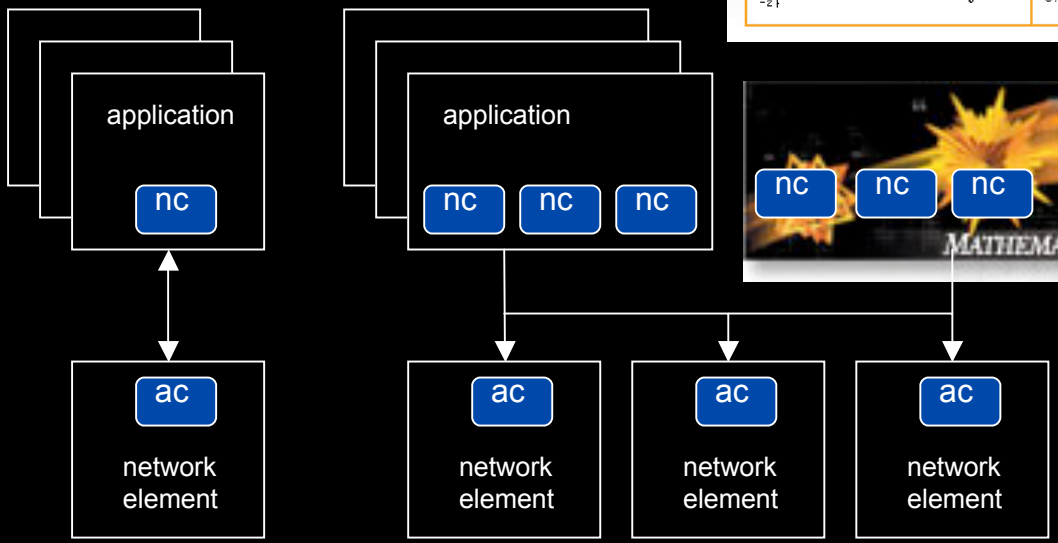
- What constitutes a Tb/s network?
- UvA has 2000 Gigabit drops ?->? Terabit Lan?
- look at 80 core Intel processor
  - cut it in two, left and right communicate 8 TB/s
- think back to teraflop computing!
  - MPI makes it a teraflop machine
- massive parallel channels in hosts, NIC's
- TeraApps programming model supported by
  - TFlops -> MPI / Globus
  - TBytes -> OGSA/DAIS
  - TPixels -> SAGE
  - TSensors -> LOFAR, LHC, LOOKING, CineGrid, ...
  - Tbit/s -> ?

ref Larry Smarr & CdL

User Programmable Virtualized Networks allows the results of decades of computer science to handle the complexities of application specific networking.

- The network is virtualized as a collection of resources
- UPVNs enable network resources to be programmed as part of the application
- Mathematica, a powerful mathematical software system, can interact with real networks using UPVNs





Mathematica enables advanced graph queries, visualizations and real-time network manipulations on UPVNs

Topology matters can be dealt with algorithmically
Results can be persisted using a transaction service built in UPVN

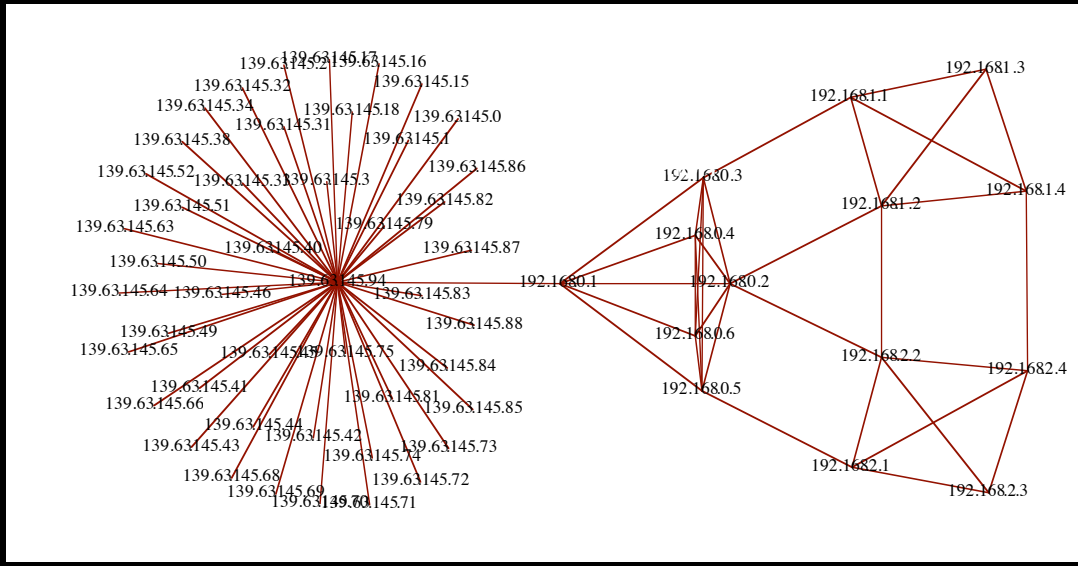
Initialization and BFS discovery of NEs

```
Needs["WebServices`"]
<<DiscreteMath`Combinatorica`
<<DiscreteMath`GraphPlot`
InitNetworkTopologyService["edge.ict.tno.nl"]

Available methods:
{DiscoverNetworkElements,GetLinkBandwidth,GetAllIpLinks,Remote,
NetworkTokenTransaction}

Global`upvnverbose = True;
AbsoluteTiming[nes = BFSDiscover["139.63.145.94"];][[1]]
AbsoluteTiming[result = BFSDiscoverLinks["139.63.145.94", nes];][[1]]

Getting neigbours of: 139.63.145.94
Internal links: {192.168.0.1, 139.63.145.94}
(...)
Getting neigbours of:192.168.2.3
Internal links: {192.168.2.3}
```

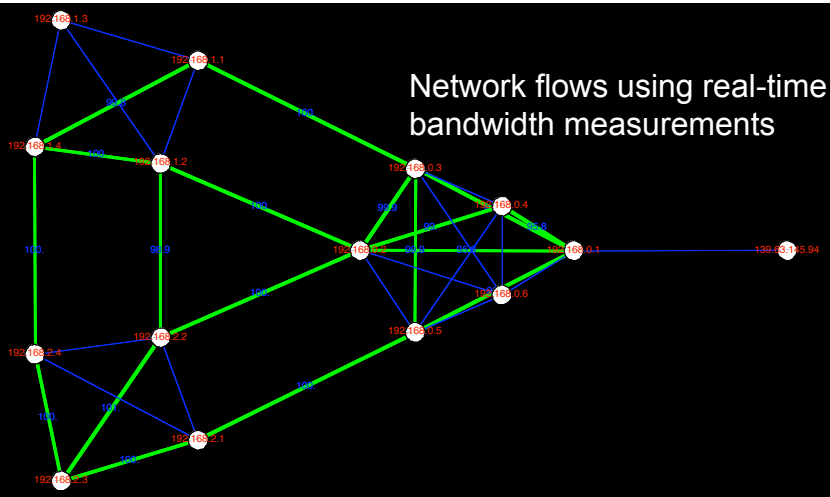


Transaction on shortest path with tokens

```
nodePath = ConvertIndicesToNodes[
                ShortestPath[ g,
                              Node2Index[nids,"192.168.3.4"],
                              Node2Index[nids,"139.63.77.49"]],
                              nids];
Print["Path: ", nodePath];
If[NetworkTokenTransaction[nodePath, "green"]==True,
        Print["Committed"], Print["Transaction failed"]];

Path:
{192.168.3.4,192.168.3.1,139.63.77.30,139.63.77.49}

Committed
```



Network flows using real-time bandwidth measurements

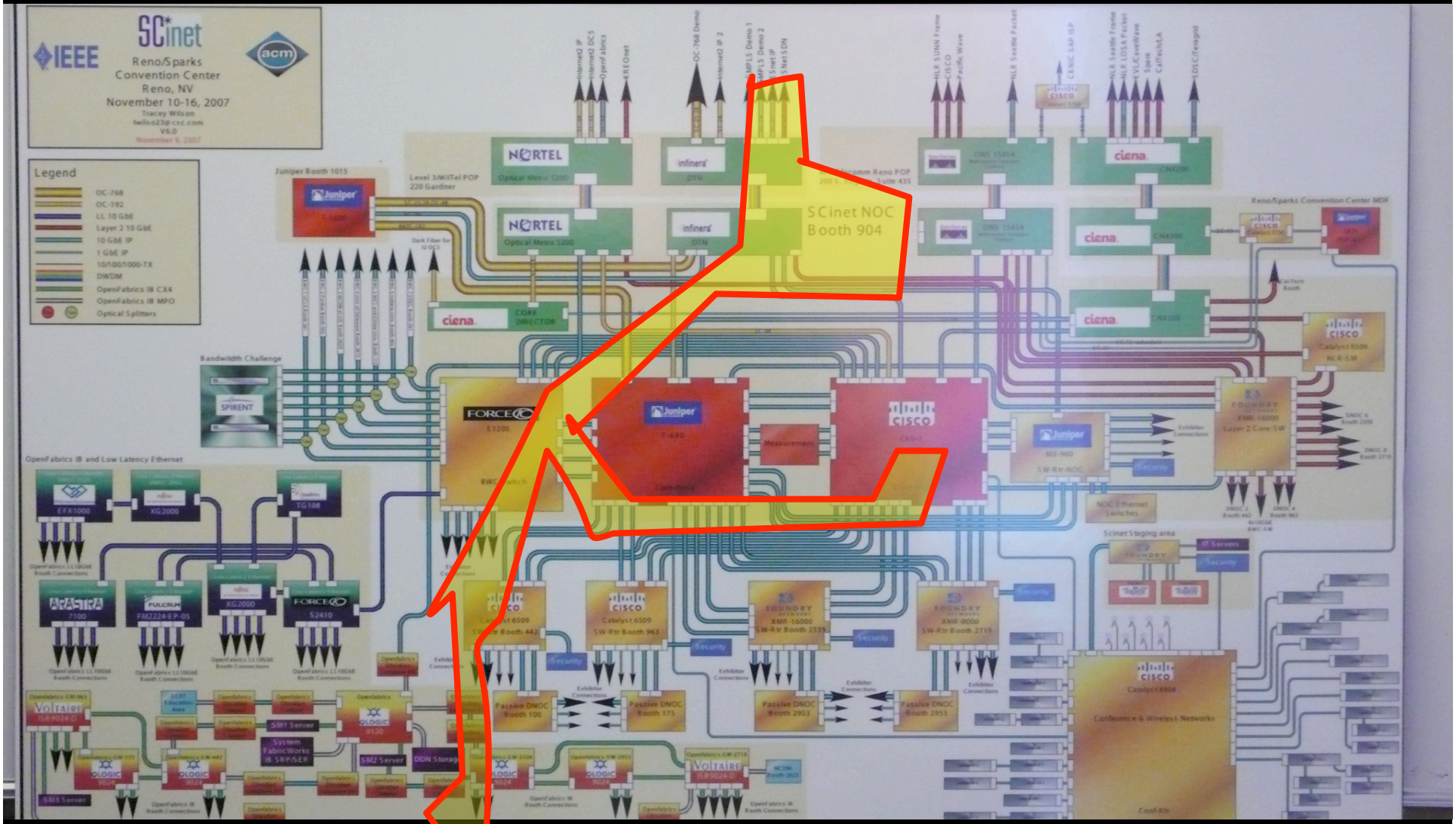
ref: Robert J. Meijer, Rudolf J. Strijkers, Leon Gommans, Cees de Laat, User Programmable Virtualiized Networks, accepted for publication to the IEEE e-Science 2006 conference Amsterdam.

Sensor grid: instrumenting the dikes

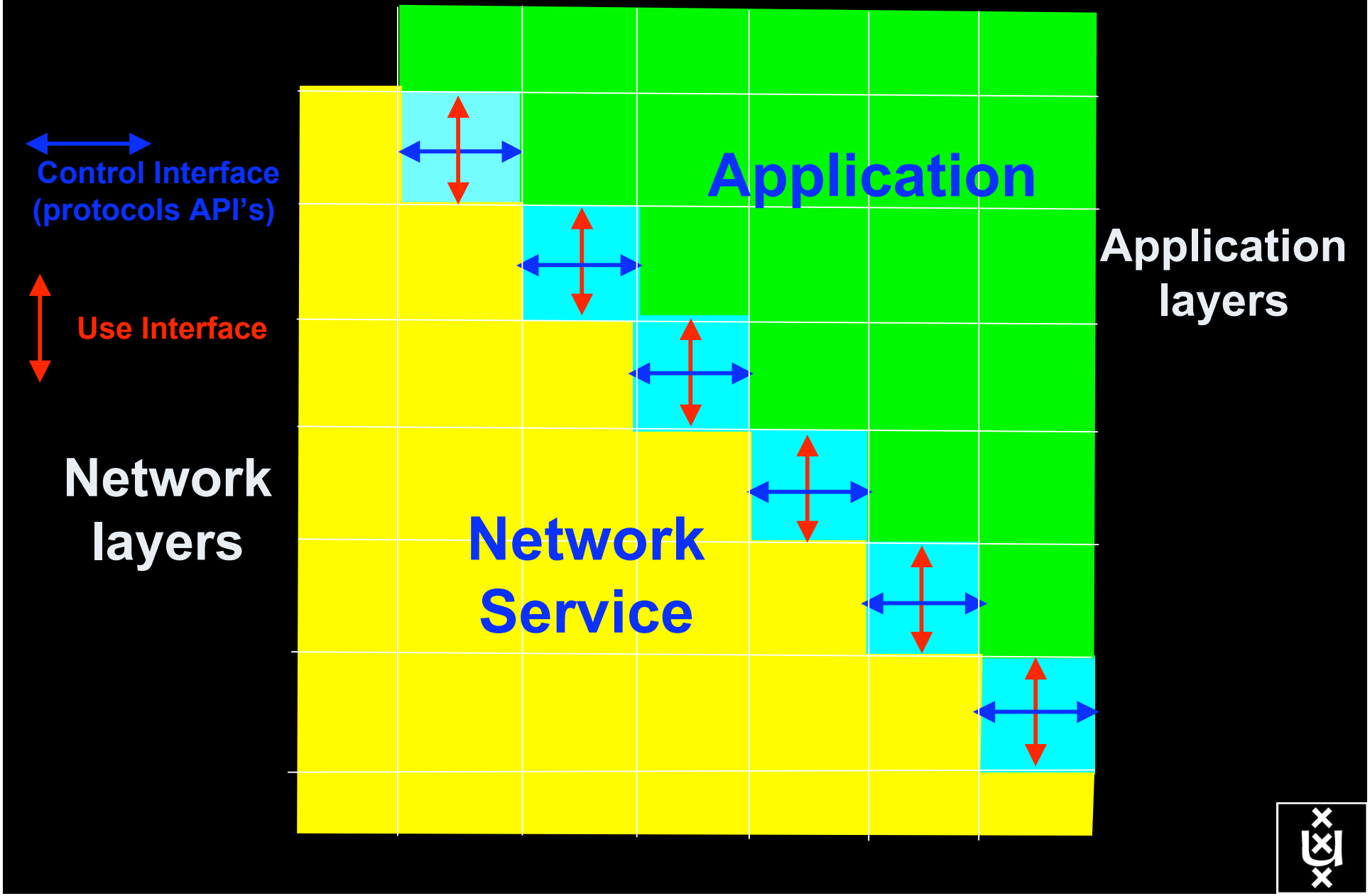
First controlled breach occurred on sept 27th ‘08:

- 30000 sensors (microphones) to cover Dutch dikes
- focus on problem area when breach is to occur

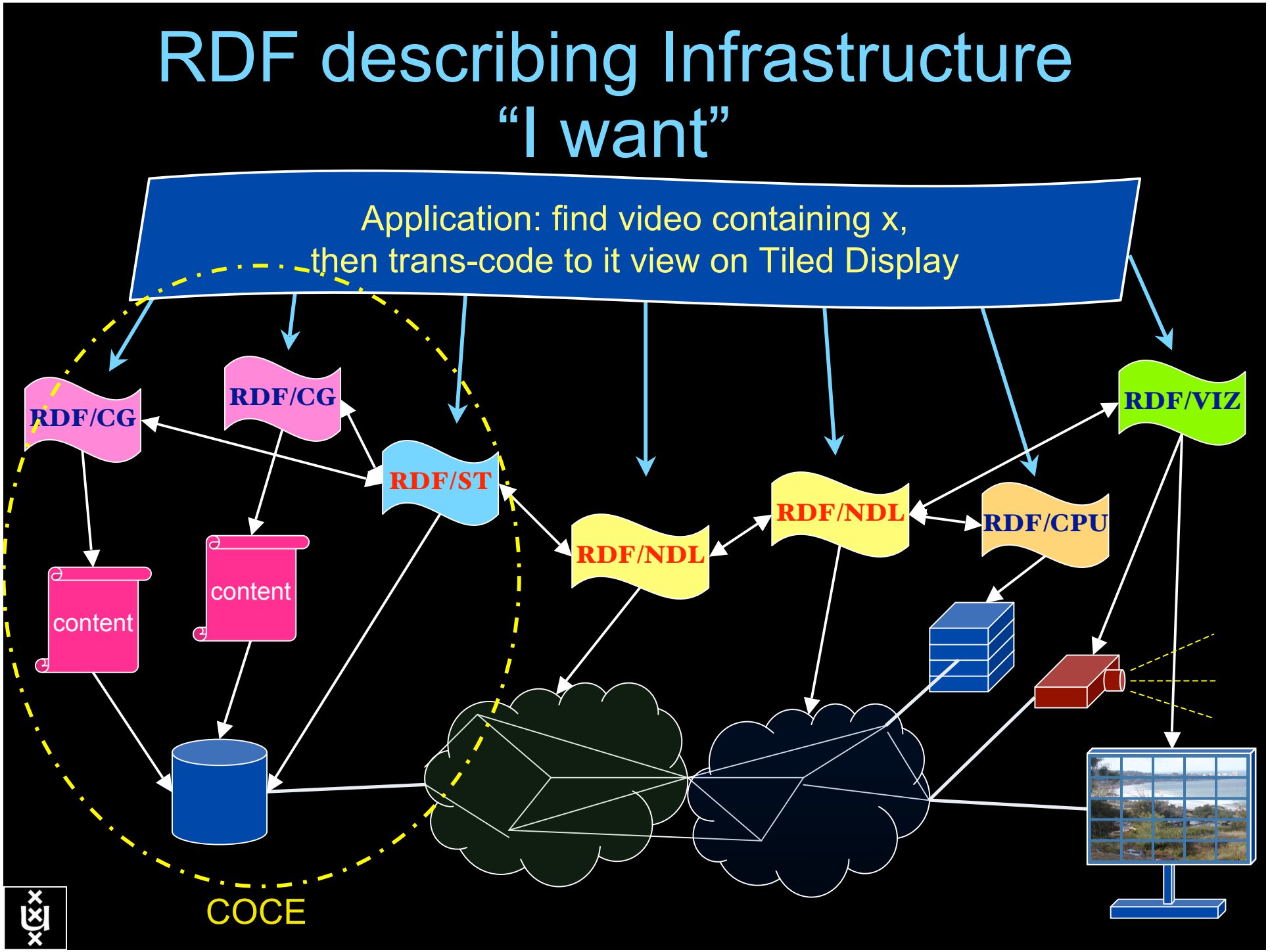
Programmable Deterministic Service



Multi Layer Service Architecture



RDF describing Infrastructure
"I want"



Questions ?

rototyping the NGI: Phosphorus

SURF NET