

European networking research

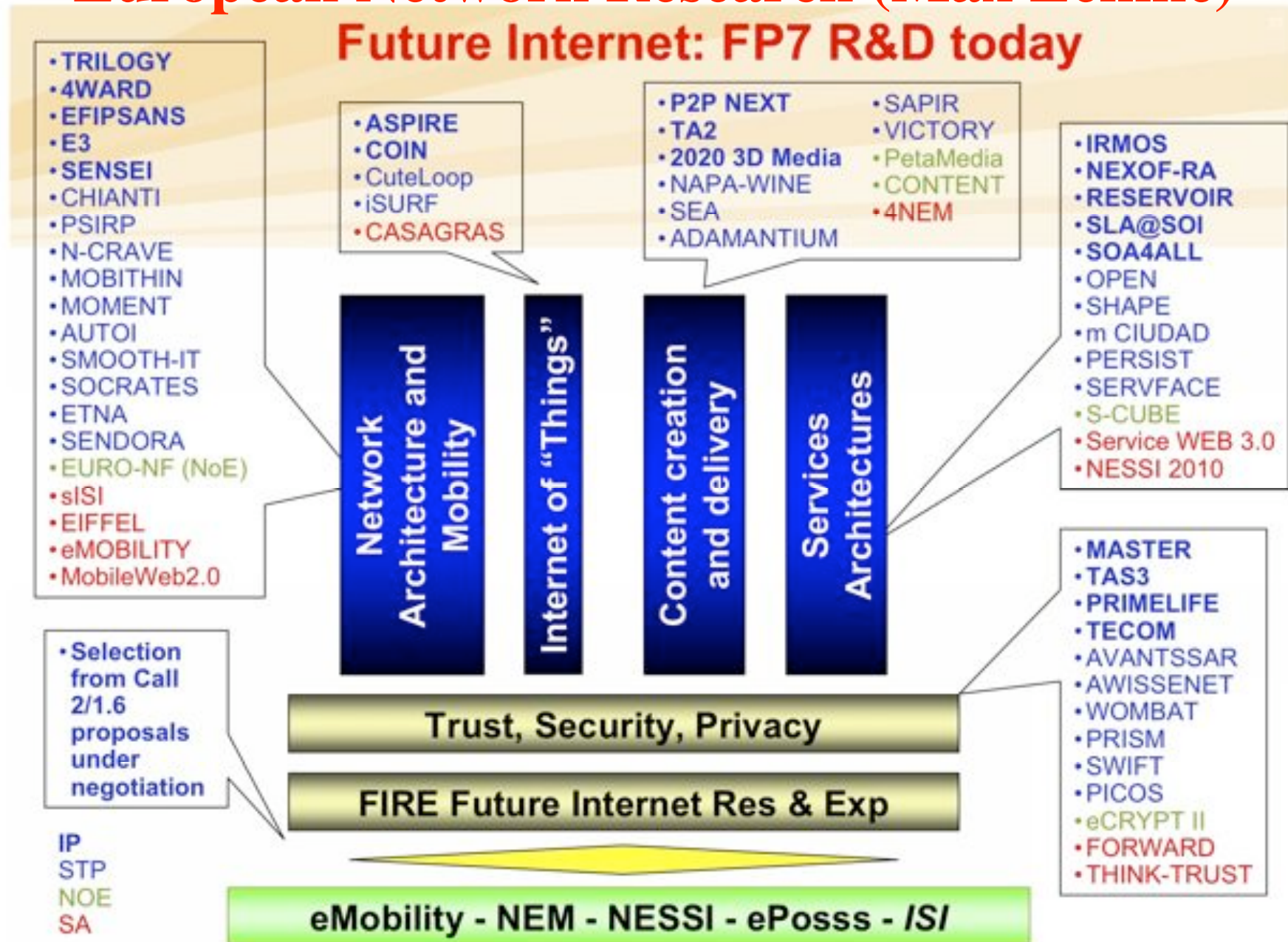
Beyond Hybrid Networking

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European Network Research (Max Lemke)



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

Testbed

Testbed

Integrated project

Focused project (STREP)

Coordination & support actions



Gradually Building the FIRE Facility

FP6: Early design & prototyping



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



PHOSPHORUS PROJECT

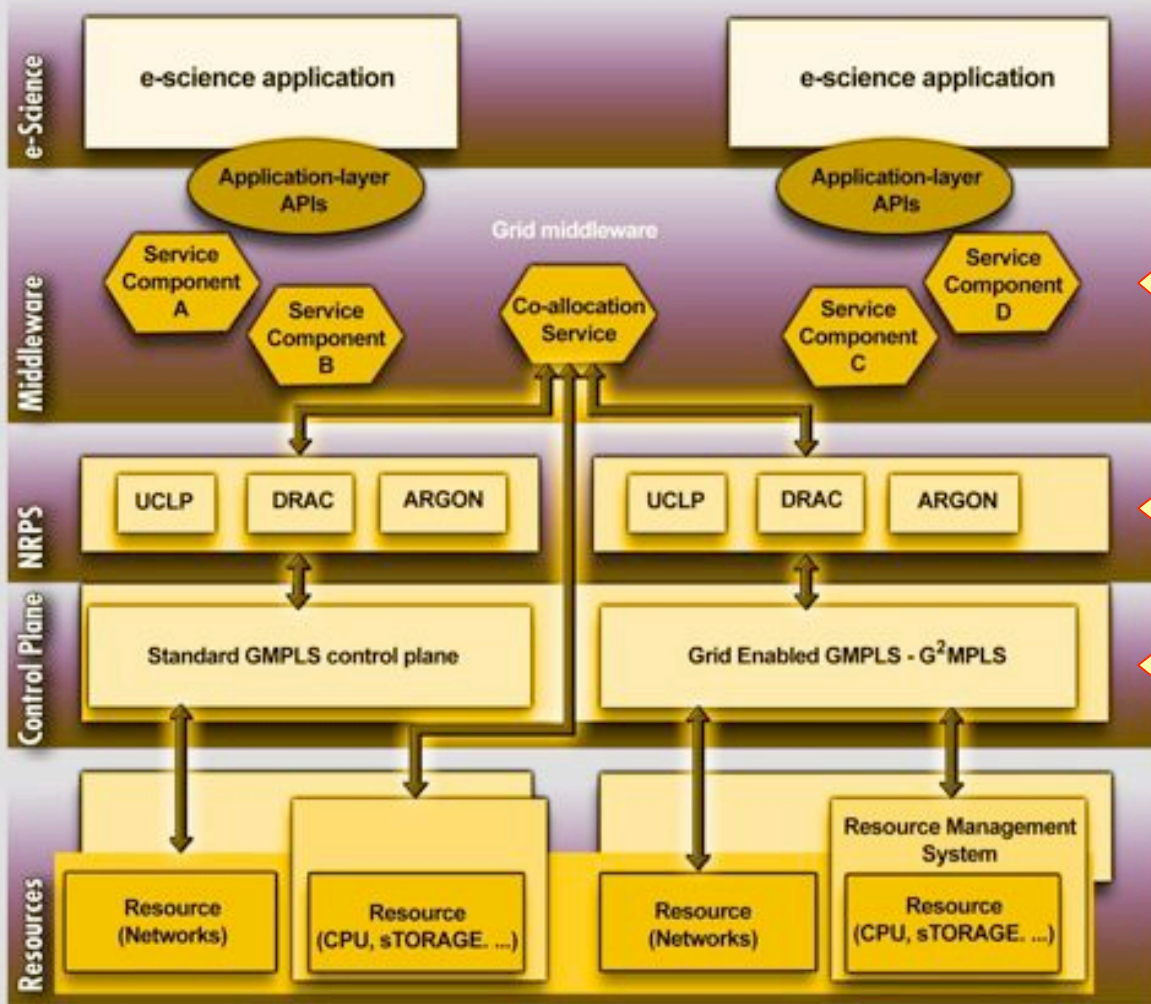


- **European and Global alliance of partners to develop advanced solution of application-level middleware and underlying management and control plane technologies**
- **Project Vision and Mission**
 - The project will address some of the key technical challenges in enabling on-demand end-to-end network 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

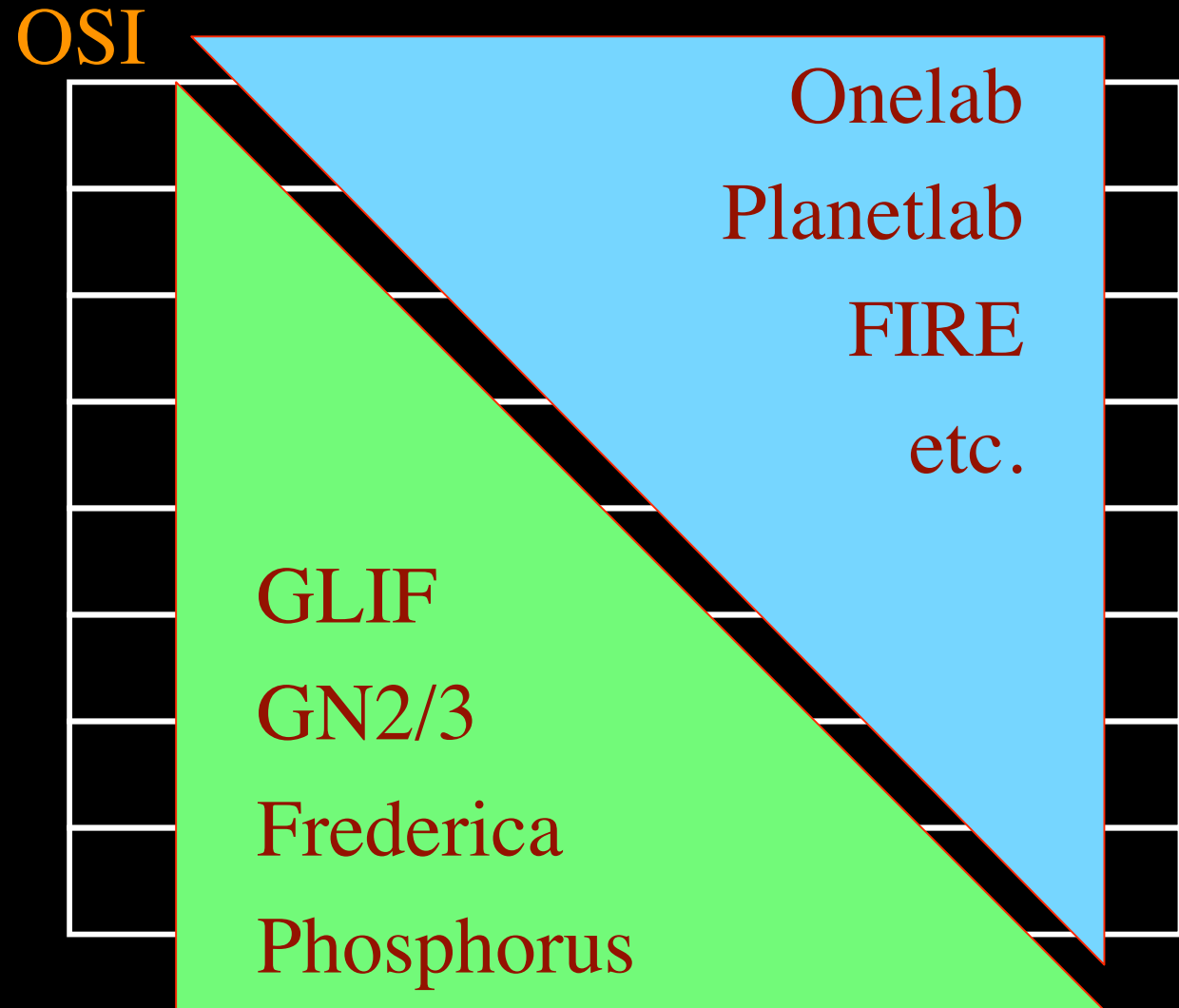


The different domains of the **Phosphorus'** test-bed will have:

- 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*)

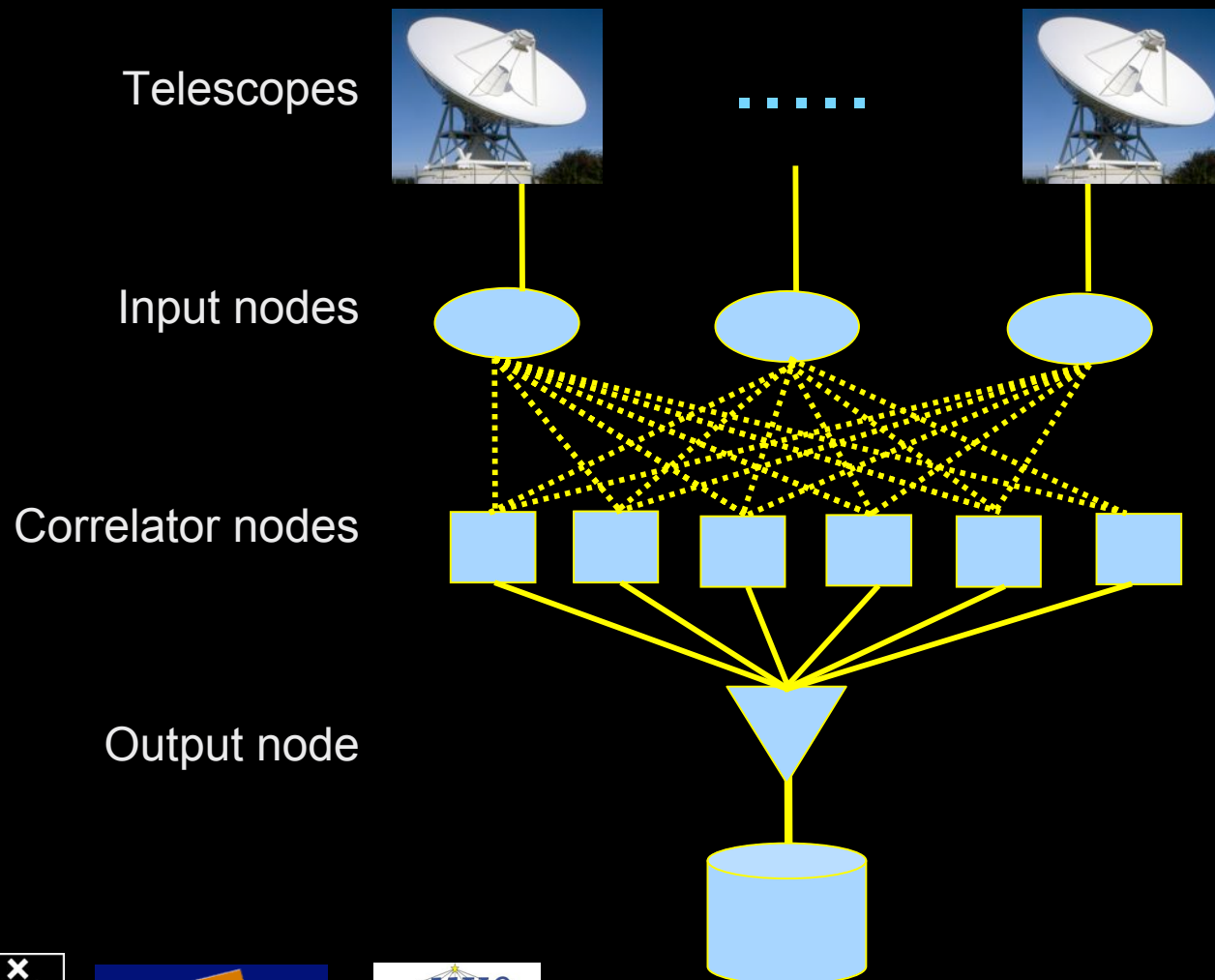
My view here

- 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 !!!**



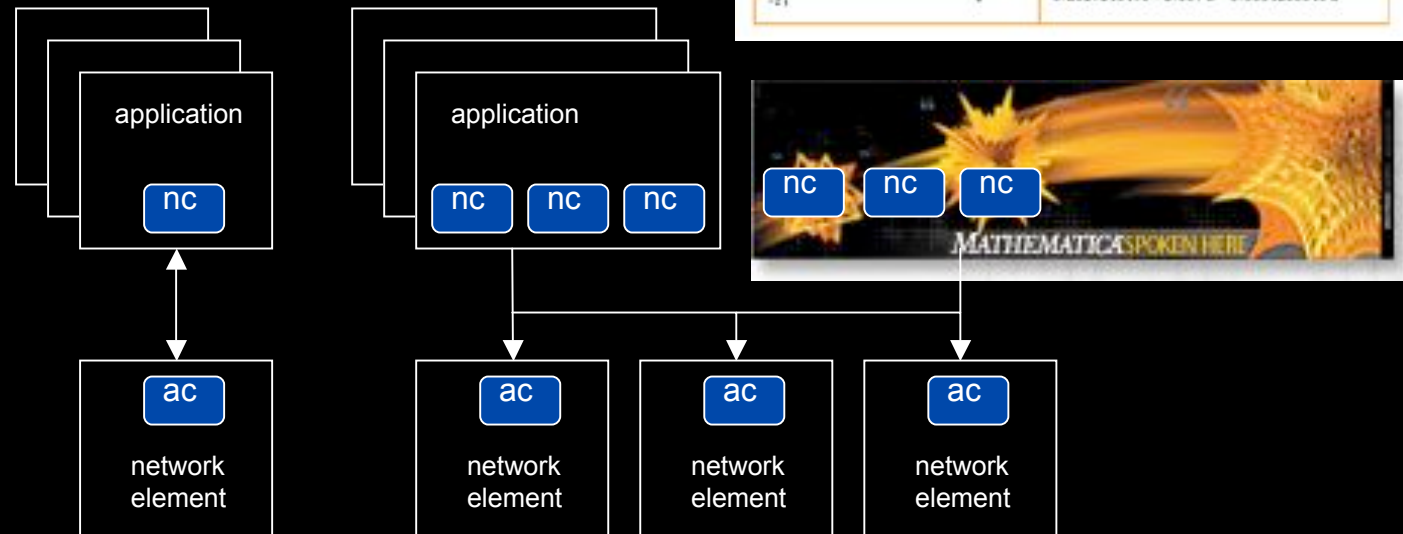
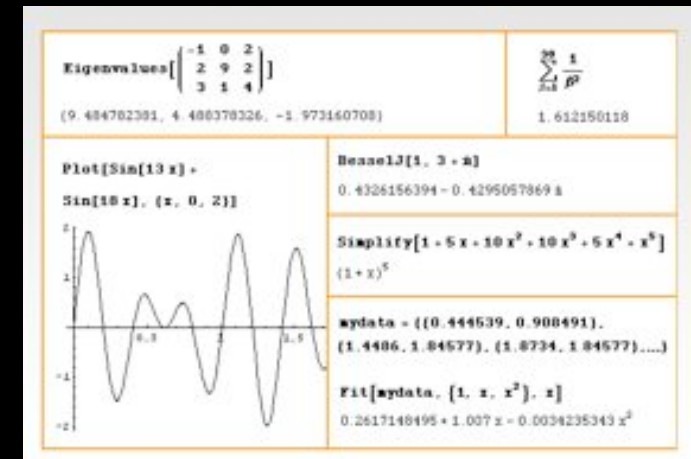
TeraThinking

- 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 -> ?



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]]
```

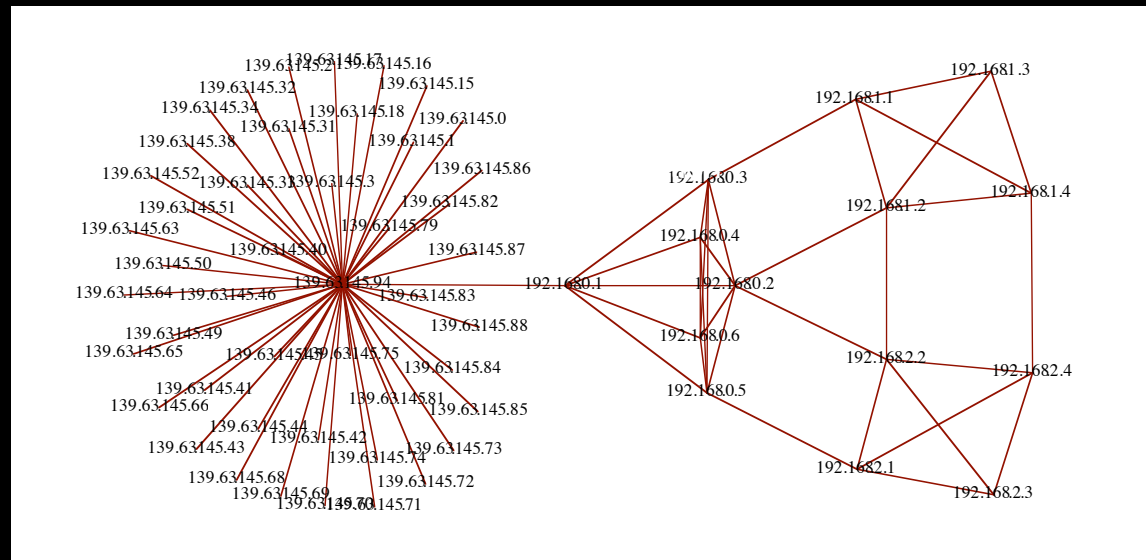
Getting neighbours of: 139.63.145.94

Internal links: {192.168.0.1, 139.63.145.94}

(...)

Getting neighbours 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];
```

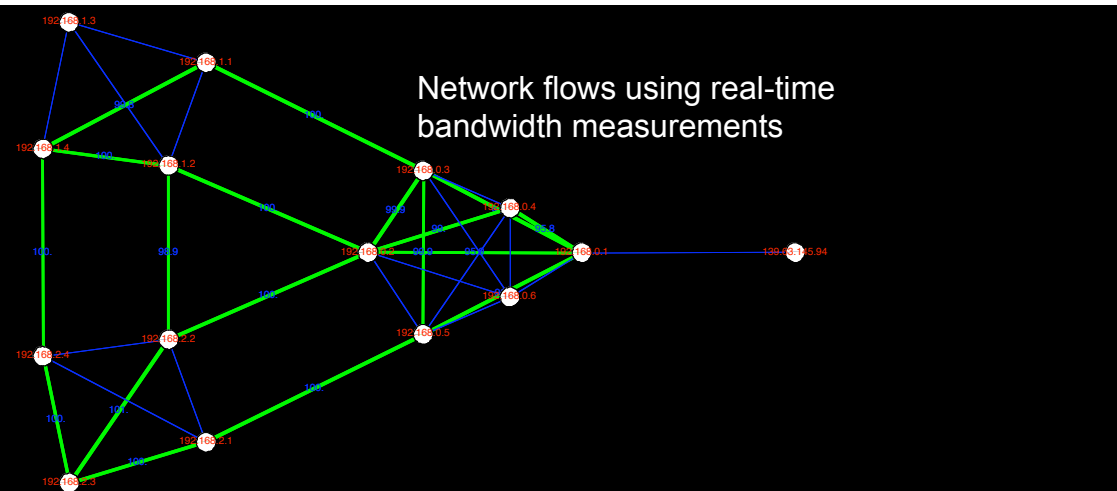
```
Print["Path: ", nodePath];
```

```
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



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



Sensor grid: instrumenting the dikes

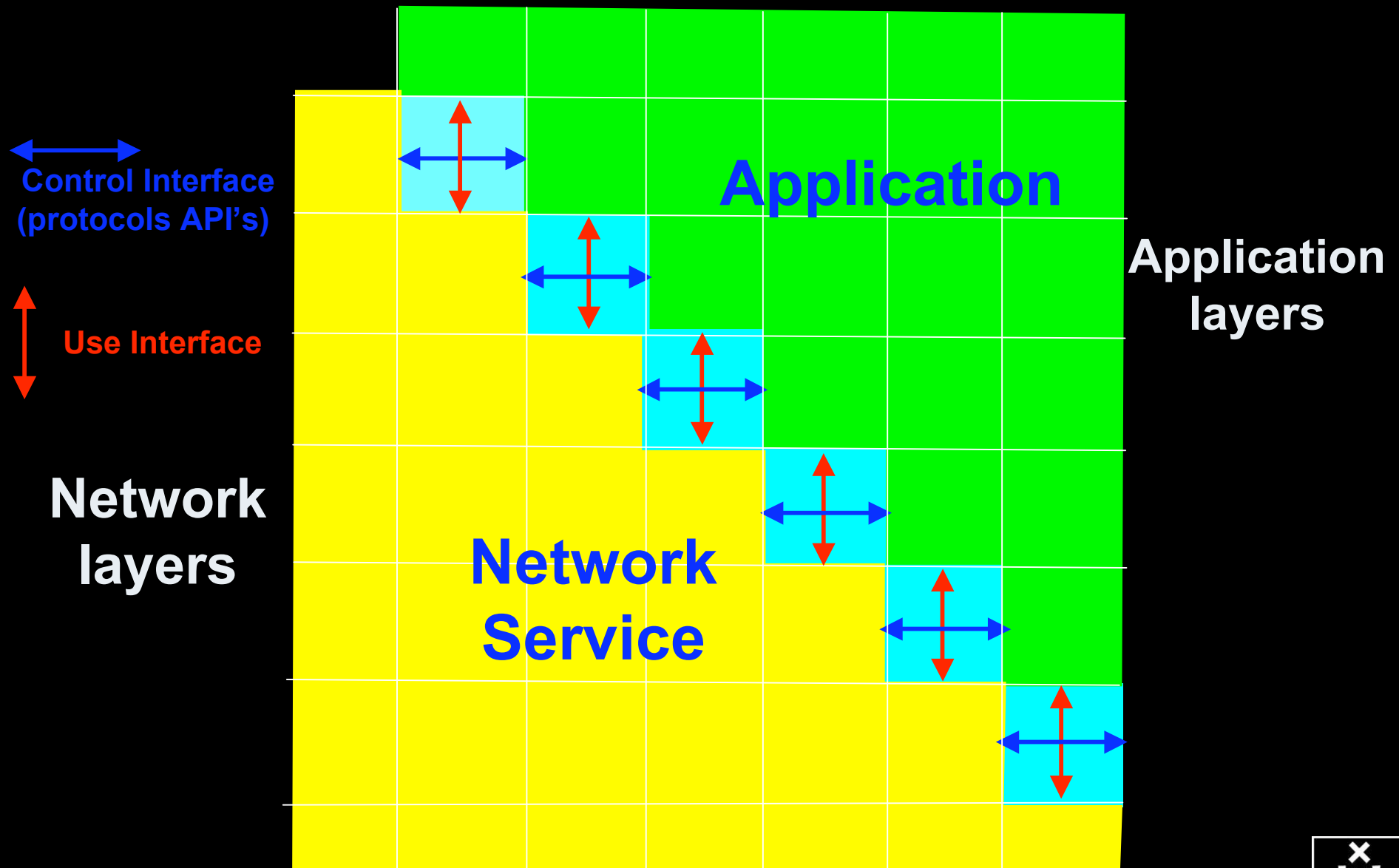
First controlled breach occurred on sept 27th '08:



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

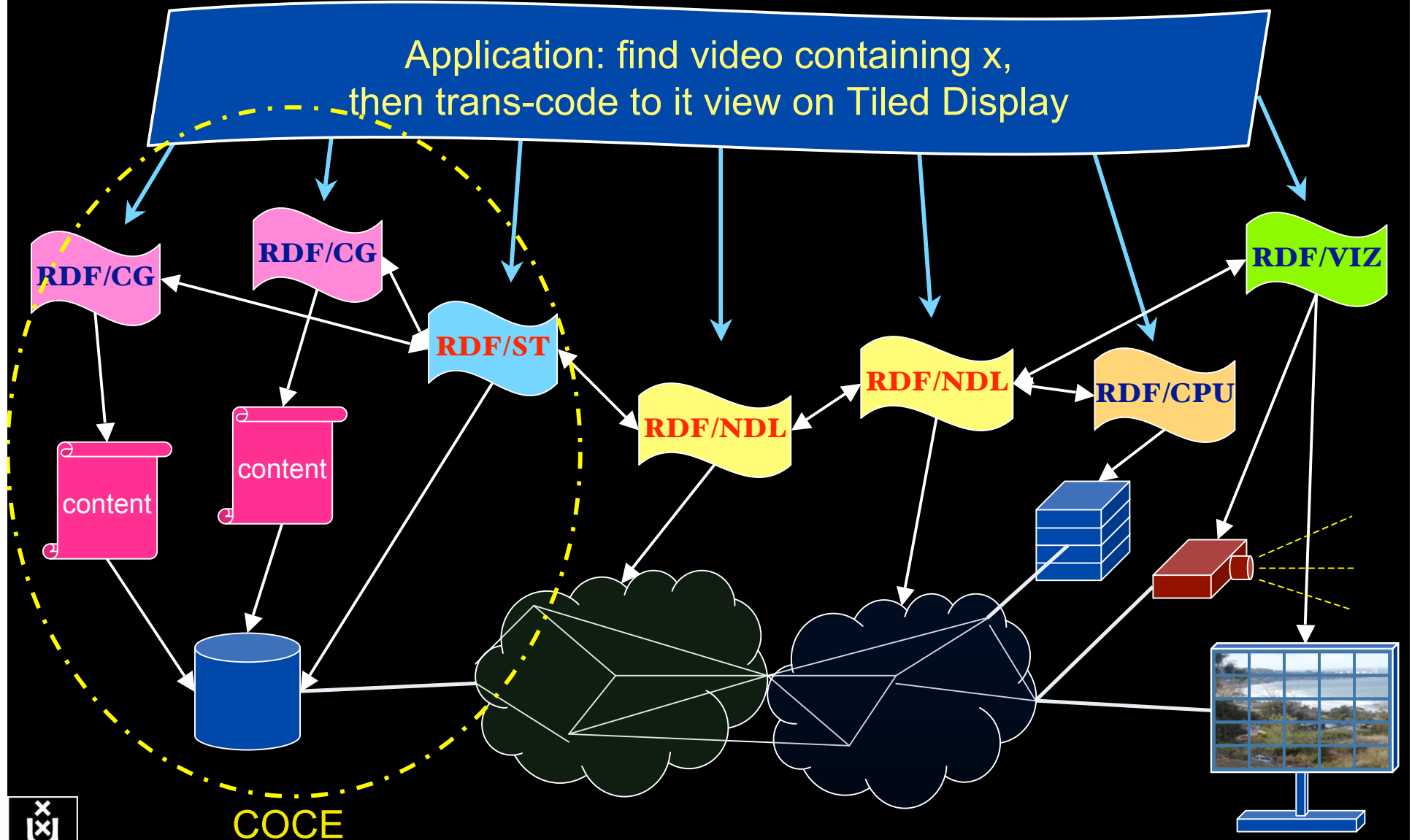


Multi Layer Service Architecture



RDF describing Infrastructure “I want”

Application: find video containing x,
then trans-code to it view on Tiled Display



Questions ?



rototyping the NGL: Phosphorus

