Optical Internetworking Forum

World Interoperability Tests and Demonstrations

Hans-Martin Foisel

T-Systems/Deutsche Telekom

OIF Carrier WG Chair

Deutsche Telekom

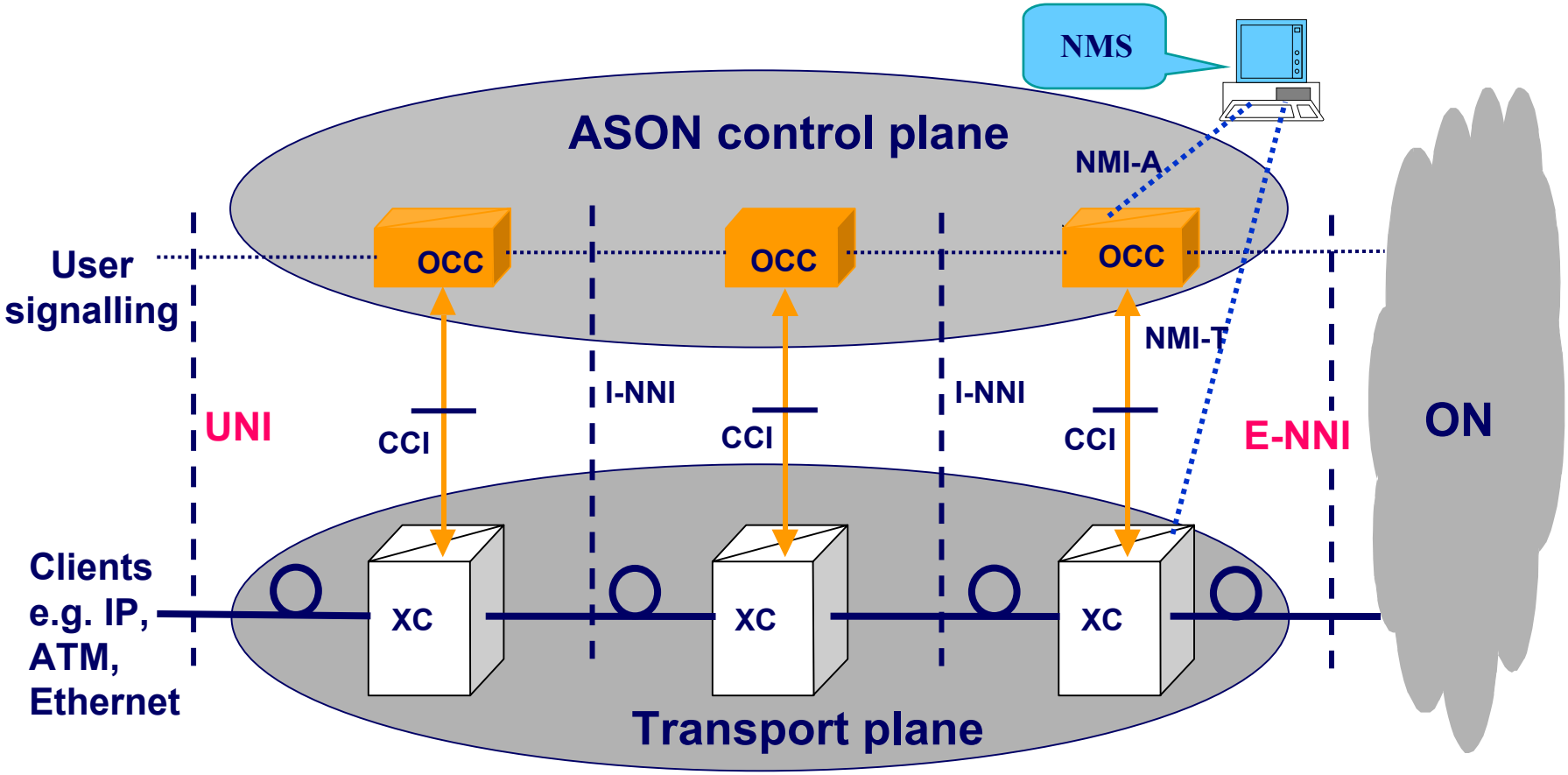
OIF OPTICAL INTERNETWORKING FORUM

Optical Internetworking Forum - OIF

- **Launched in April 1998 to foster development of low-cost scaleable internet using optical technology**
- **The only industry group bringing together professionals from the data and optical communities**
- **Open forum: 120+ member companies**
  - **Carriers**
  - **Component and systems vendors**
  - **Testing and software companies**
- **Mission: To foster the development and deployment of interoperable products and services for data switching and routing using optical networking technologies**
- **OIF website: www.oiforum.com**

ITU-T ASON Architecture – G.8080

Control Plane Interfaces: UNI, NNI

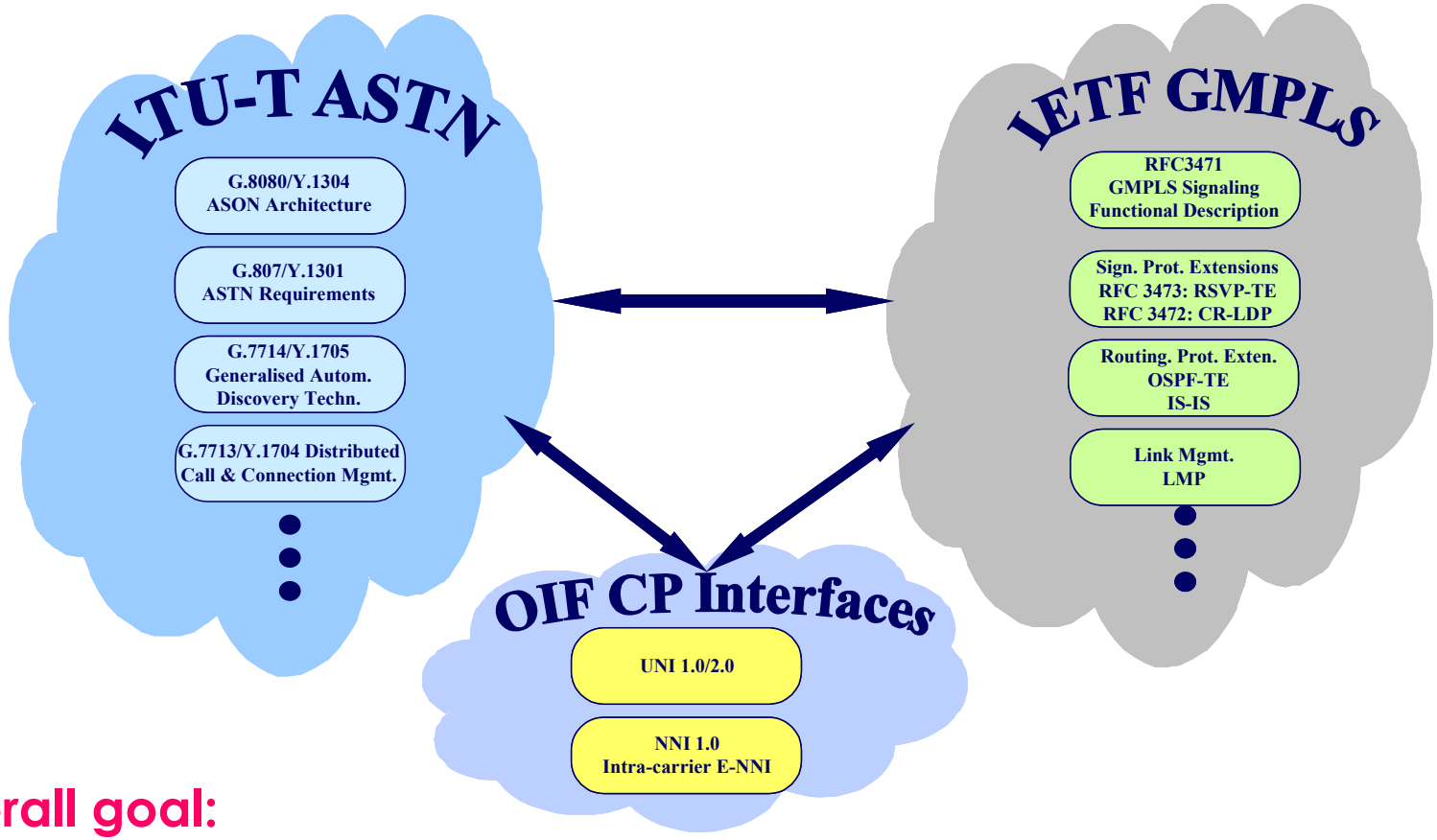


OCC: Optical Connection Controller
CCI: Connection Control Interface
NMI: Network Management Interface
NMS: Network Management System

I-NNI: Internal Network-Network Interface
E-NNI: External Network-Network Interface
UNI: User Network Interface

ASON/GMPLS Standards Bodies & Forums

Organisations Involved in Specifying fast Configurable TN



Overall goal:

Complete <u>one</u> interoperable, harmonized set of ASON/GMPLS standards and specification to foster the deployment of control plane enabled networks

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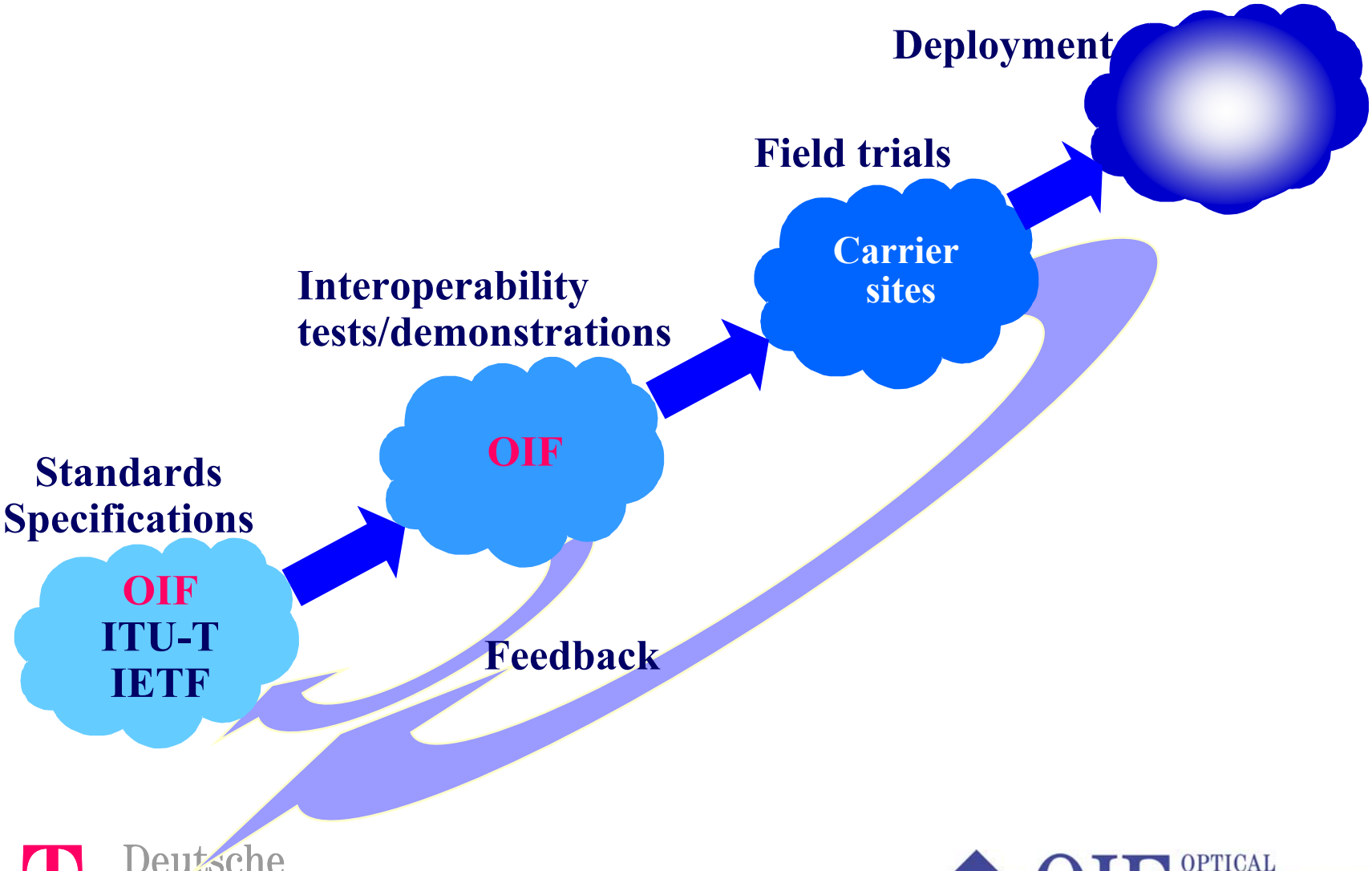
Control Plane Evolution Path

From Standards to Deployment



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Interoperability areas

Most efficient data over SDH transport:

Ethernet-over-SDH/SONET adaptation, based on ITU-T Rec.:

- **G.7041: Generic framing procedure (GFP)**
- **G.707: Network Node Interface for SDH; virtual concatenation (VCAT)**
- **G.7042: Link capacity adjustment scheme (LCAS)**

Fast connection provisioning, initiated by clients:

Switched connections setup by using UNI 1.0 R2 based on OIF IA:

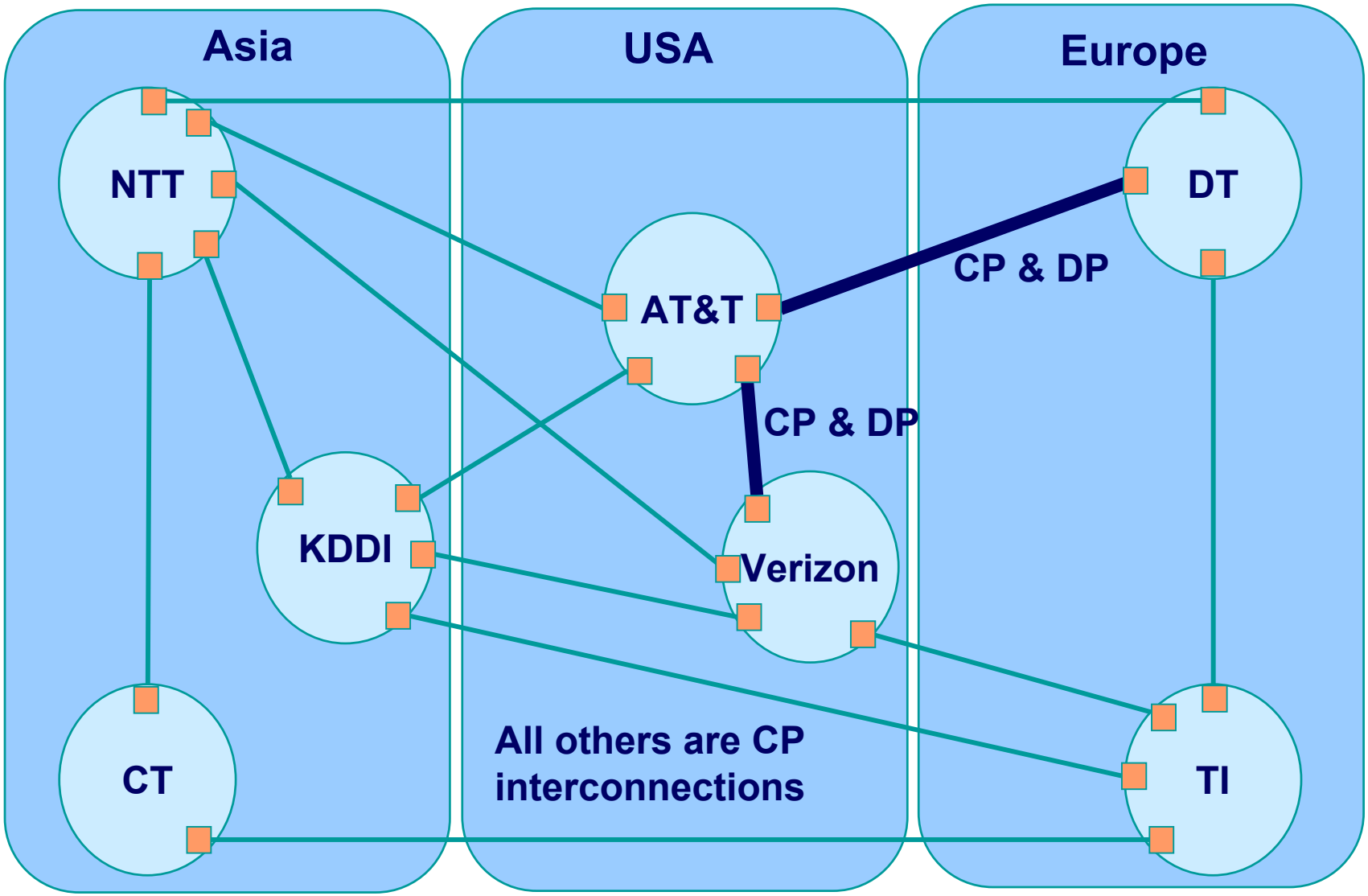
- **2003.248.05: UNI 1.0 signaling specification, R2**
- **2003.249.09: RSVP extensions for UNI 1.0 signalling, R2**

Fast multi-domain connection provisioning:

Soft permanent and switched connection setup over multiple network domains by using E-NNI signalling and routing, based on:

- **2003.179.08/IA: OIF intra-carrier E-NNI signalling specification**
- **2003.259.02/Draft: Specification for intra-carrier E-NNI routing using OSPF**

Topology of the OIF Worldwide Test Bed



CP: Control plane
DP: Data plane

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Participants

Carriers

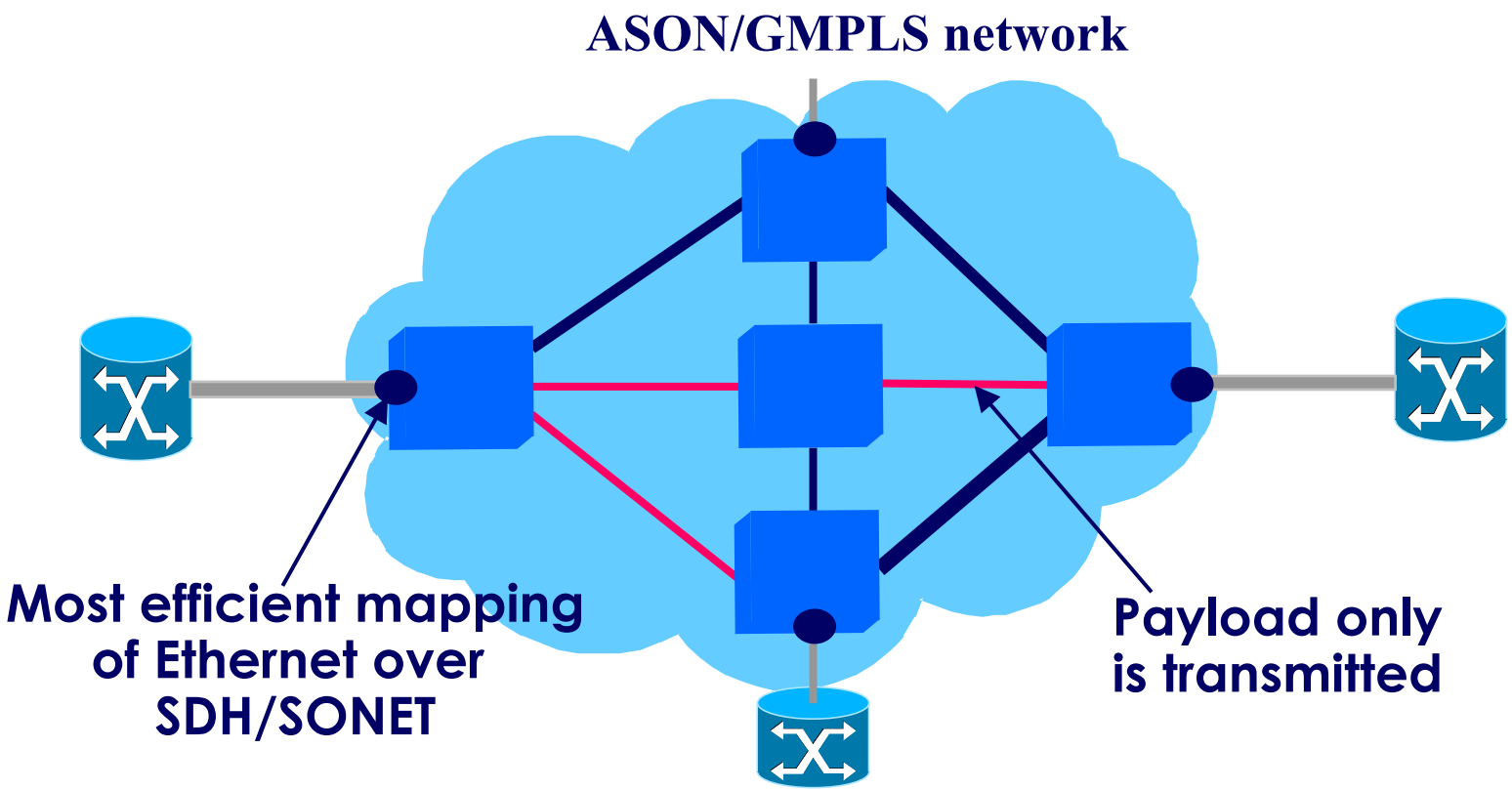
- **North America:** AT&T, Verizon
- **Asia:** China Telecom, KDDI, NTT
- **Europe:** Telecom Italia, Deutsche Telekom

Vendors

- **Transport network elements:**
  - **Alcatel, ADVA, CIENA, Cisco, Fujitsu, Lucent, Marconi, NEC, Nortel, Siemens, Sycamore, Tellabs, Turin Networks, Mahi Networks**
- **Client network elements:**
  - **Avici, Cisco, Tellabs**

Reference Network for Ethernet over SDH/SONET Adaptation Interoperability Tests

Based on ITU-T Standards



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Tests for Ethernet Adaptation: GFP-F, VCAT, LCAS

#	Test cases
1	Partial bandwidth (B), FE over STS-1/VC-3
2	Full B, FE over STS-1-2v/VC-3-2v
3	Full B, GE over STS-1-21v/VC-3-21v
4	Partial B, GE over STS-1-3v/VC-3-3v
5	Partial B, FE over STS-1-Xv/VC-3-Xv, LCAS
6	Partial B, GE over STS-1-Xv/VC-3-Xv, LCAS
7	Full B, FE over STS-3c/VC-4
8	Full B, GE over STS-3c-7v/VC-4-7v
9	Partial B, GE over STS-3c-1v/VC-4-1v
10	Partial B, GE over STS-3c-Xv/VC-4-Xv, LCAS

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Tests for Ethernet Adaptation over SDH/SONET

Participating carrier labs:

- **North America:** AT&T, Verizon
- **Europe:** Telecom Italia, Deutsche Telekom

Local tests: Were carried out first, covering mostly a subset of the test list

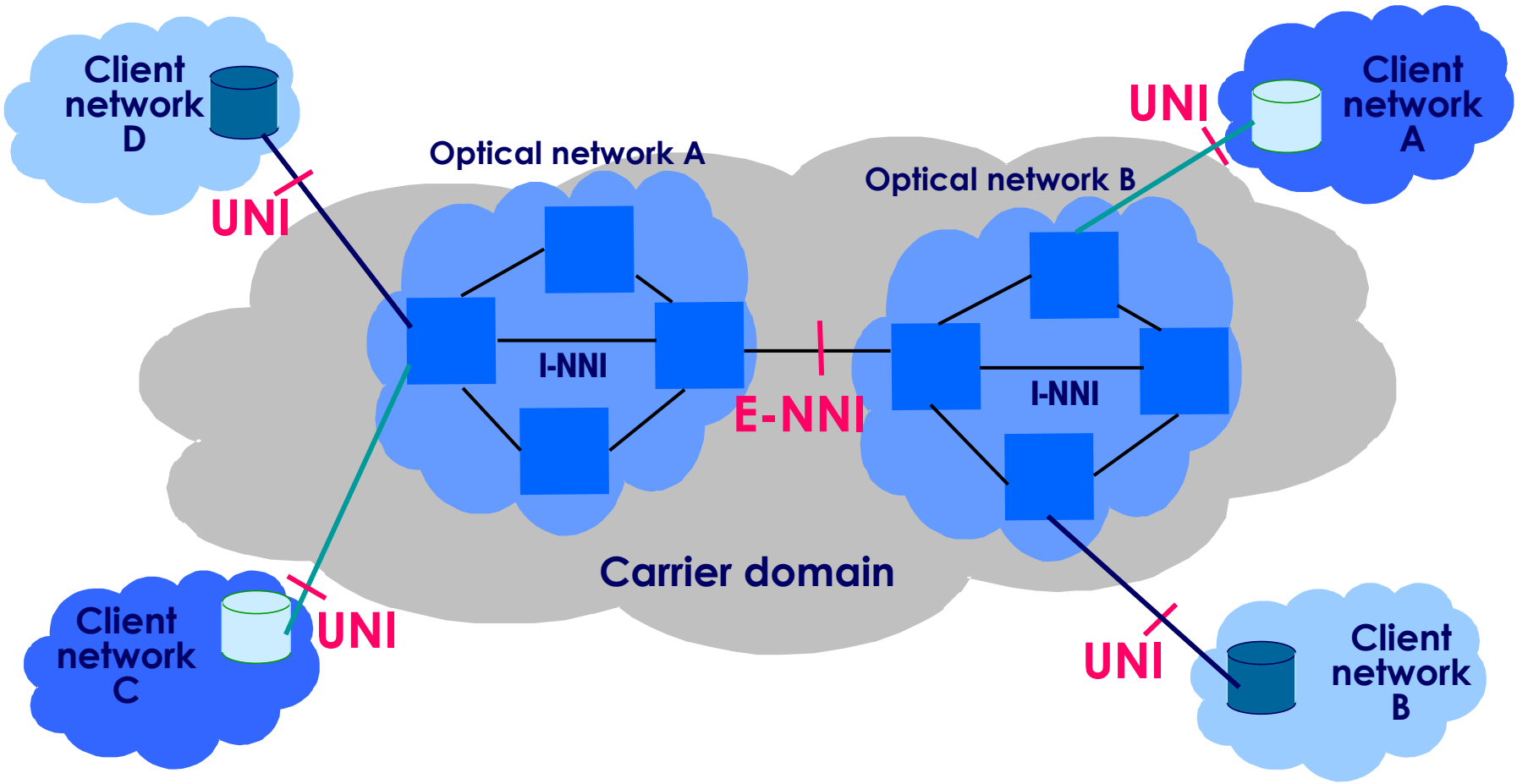
- **Example: Within DT tests 8. – 10. were carried out, based on GE interfaces and VC-4 switching granularity**

Global tests: Were carried out between the labs of Verizon, AT&T and Deutsche Telekom

All participants passed these world wide interoperability tests, show clearly that actual, standard compliant implementations are really interoperable, even on global scale

Reference Network for Control Plane Interfaces (UNI, E-NNI) Interoperability Tests

Based on OIF Implementation Agreements



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Tests for Control Plane Interfaces: UNI, E-NNI

#	Test case	UNI-C	UNI-N	E-NNI
1	Basic routing functionality	-	-	X
2	Routing functionality for virtual links	-	-	X
3	Connection initiated by UNI	X	X	-
4	Dual-domain connection initiated by EMS	-	-	X
5	Dual-domain connection initiated by UNI	X	X	X
6	Multi-domain connection initiated by UNI	X	X	X

Example of Local Tests Network

Deutsche Telekom Lab in Berlin

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Interop Test Partners at DT's Lab in Berlin

Vendor	Network function
Ciena	UNI(N) 1.0R2, E-NNI, GFP-F
Tellabs	UNI(N) 1.0R2, E-NNI, GFP-F
Marconi	UNI(N) 1.0R2, E-NNI, GFP-F
Cisco	UNI(C) 1.0R2
Alcatel	GFP-F
Lucent	GFP-F
ADVA	GFP-F

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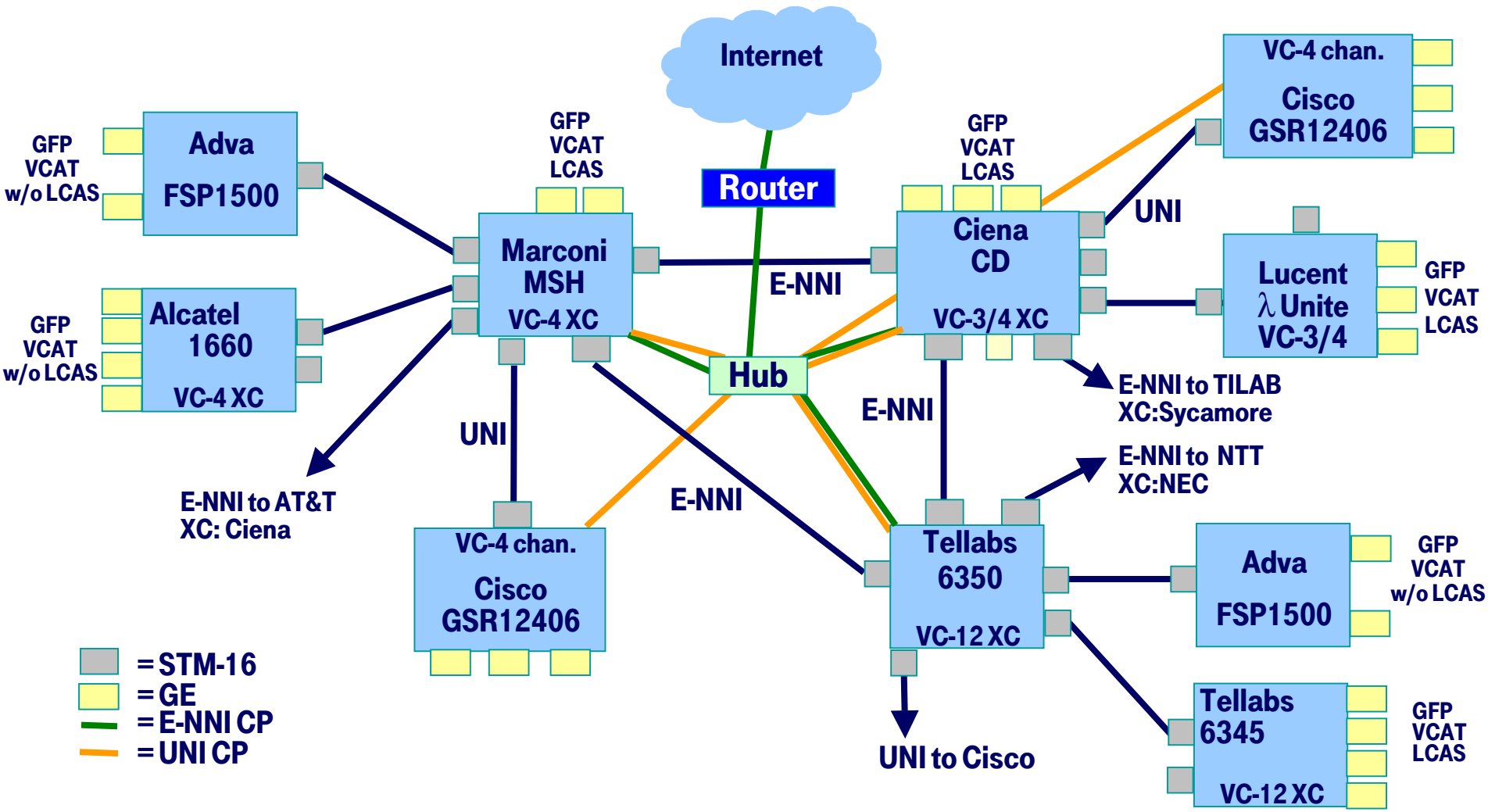
Detailed Network Topology in DT's Lab in Berlin



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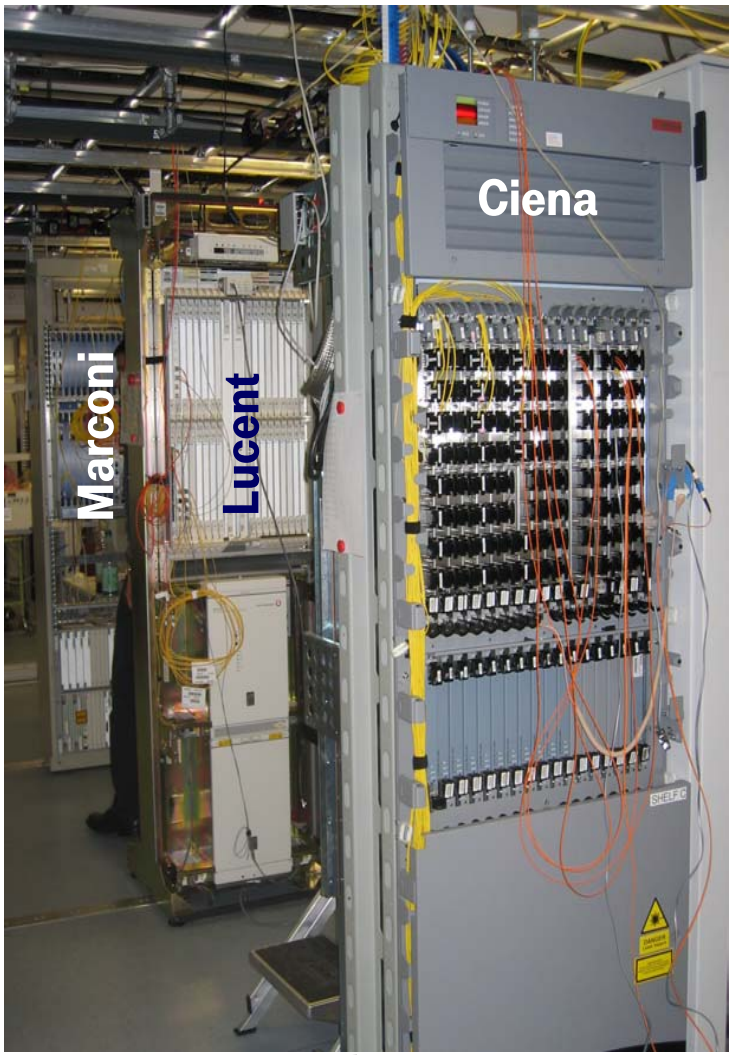
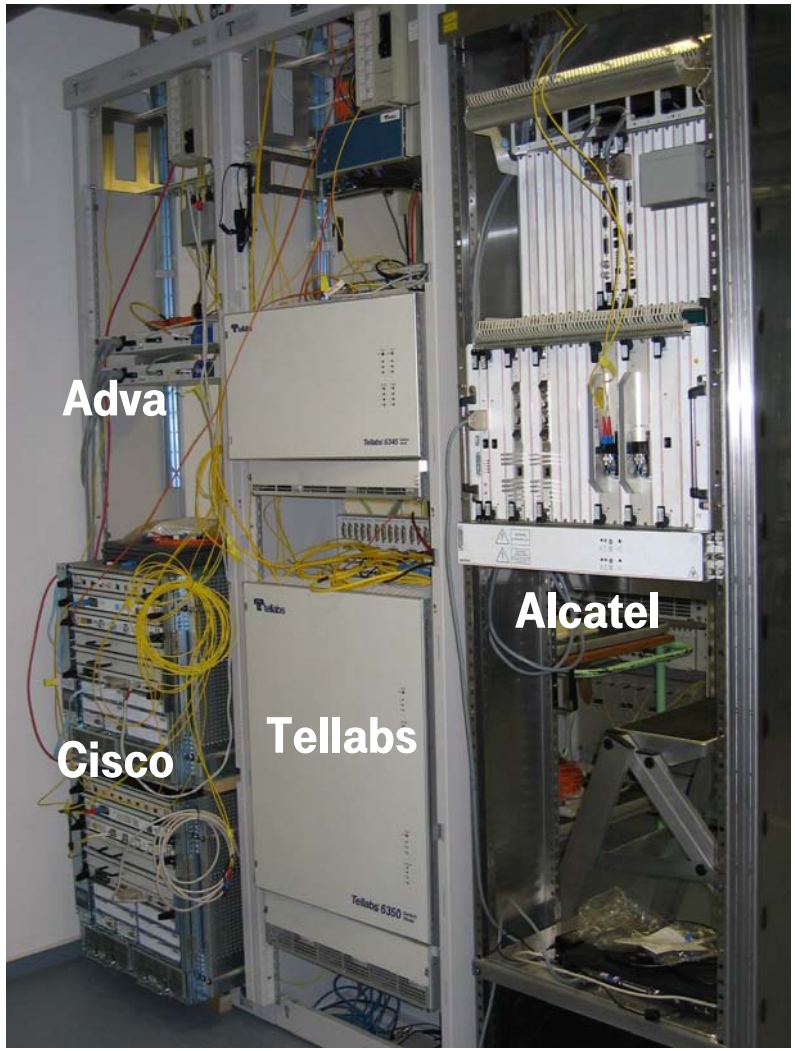
Berlin Atrium Lab View





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OIF WORLD INTEROPERABILITY DEMO

SUPERCOMM 2004 Chicago

http://www.oiforum.com/public/supercomm_2004.html

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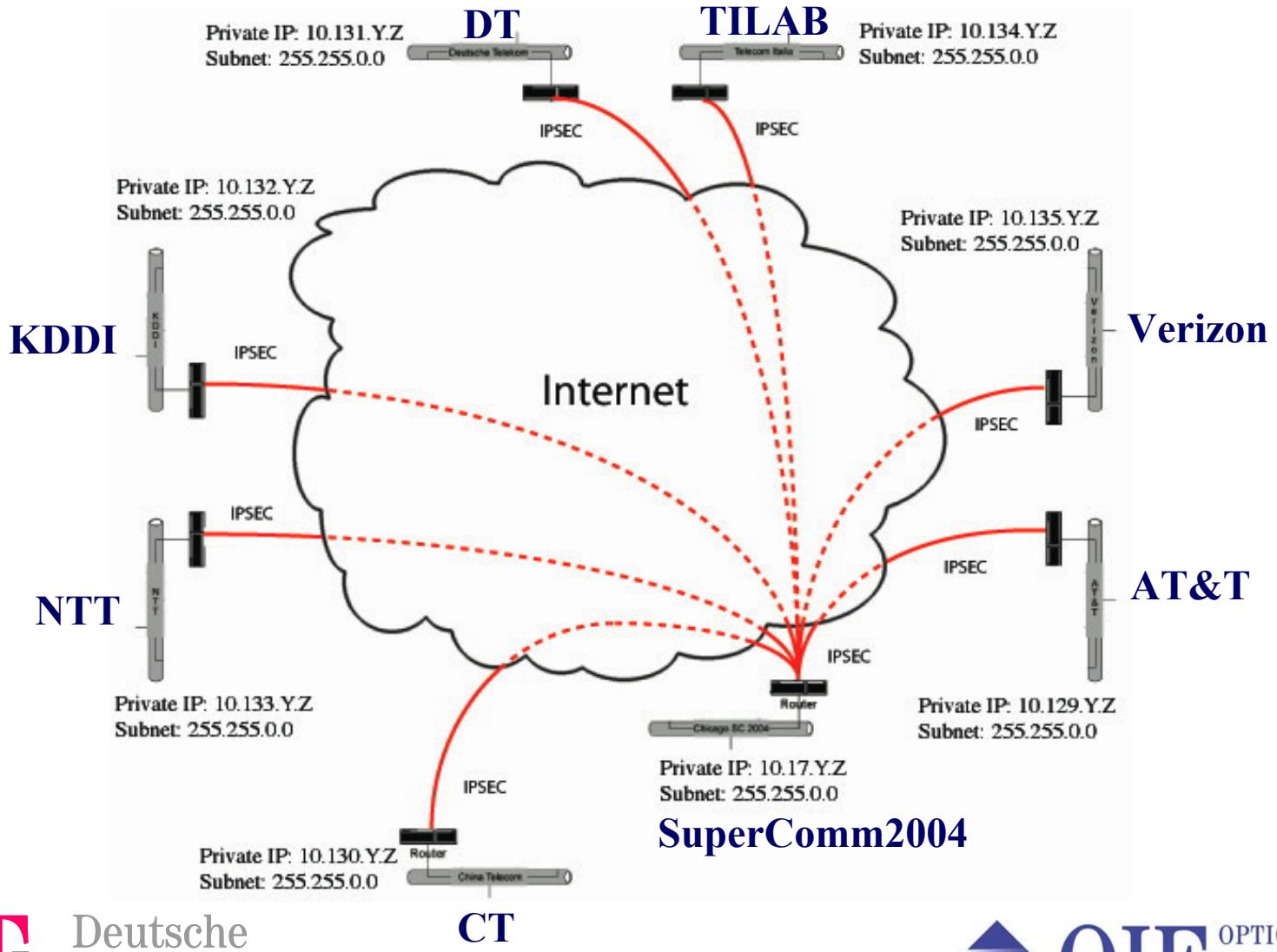
OIF SuperComm Booth Interconnections

Signaling Network for Test Network Topology Display



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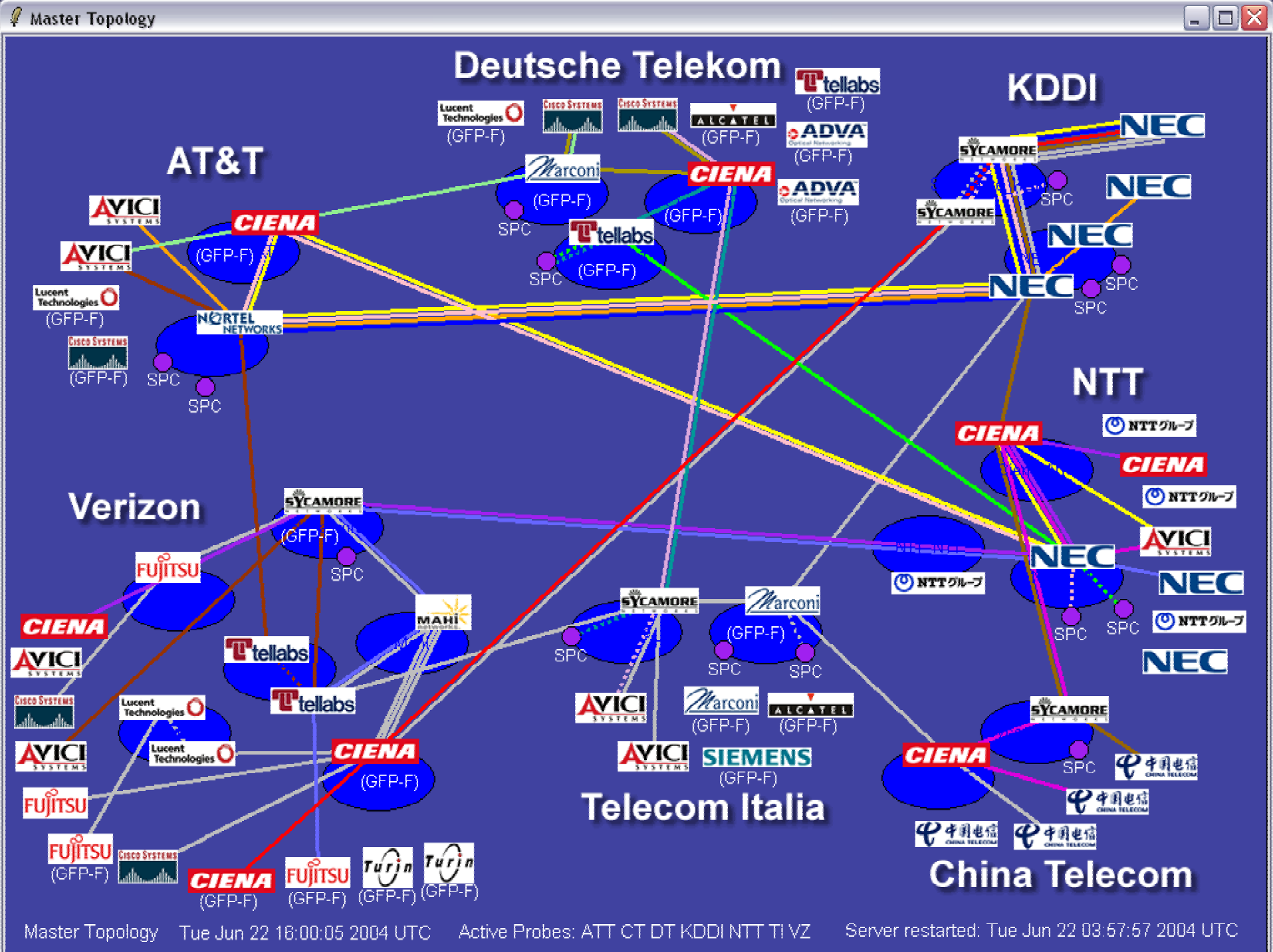
Master Topology
Deutsche Telekom
AT&T
KDDI
NTT
Verizon
Telecom Italia
China Telecom
Lucent Technologies (GFP-F)
Cisco Systems (GFP-F)
Cisco Systems (GFP-F)
ALCATEL (GFP-F)
tellabs (GFP-F)
ADVA (GFP-F)
Marconi (GFP-F)
CIENA (GFP-F)
ADVA (GFP-F)
SPC
tellabs (GFP-F)
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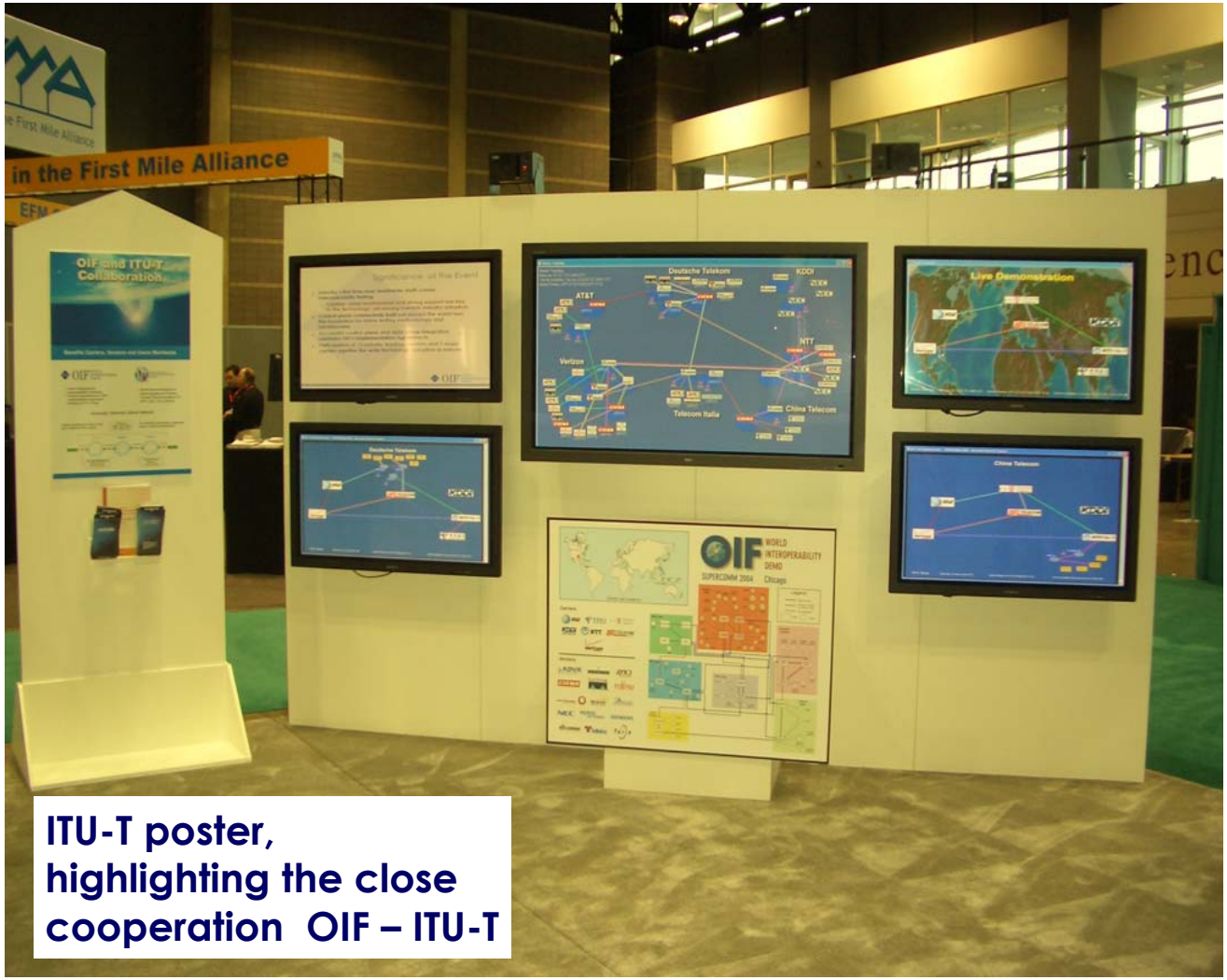
AVICI SYSTEMS
AVICI SYSTEMS
CIENA (GFP-F)
Lucent Technologies (GFP-F)
NORTEL NETWORKS
Cisco Systems (GFP-F)
SPC
SPC
SYCAMORE
NEC
SYCAMORE
SPC
NEC
NEC
NEC
SPC
SPC
NTTグループ
CIENA
CIENA
NTTグループ
AVICI SYSTEMS
NEC
NEC
NTTグループ
NTTグループ
SPC
SPC
NEC
SYCAMORE (GFP-F)
SPC
FUJITSU
MAHI
CIENA
AVICI SYSTEMS
tellabs
tellabs
Cisco Systems
Lucent Technologies
Lucent Technologies
AVICI SYSTEMS
CIENA (GFP-F)
FUJITSU
FUJITSU (GFP-F)
Cisco Systems
CIENA (GFP-F)
FUJITSU (GFP-F)
Turin (GFP-F)
Turin (GFP-F)
SYCAMORE
SPC
Marconi (GFP-F)
SPC
SPC
AVICI SYSTEMS
Marconi (GFP-F)
ALCATEL (GFP-F)
AVICI SYSTEMS
SIEMENS (GFP-F)
CIENA
SYCAMORE
SPC
中国电信
中国电信
中国电信
中国电信
Master Topology Tue Jun 22 16:00:05 2004 UTC Active Probes: ATT CT DT KDDI NTT TI VZ Server restarted: Tue Jun 22 03:57:57 2004 UTC

OIF SuperComm Booth
Test Network Topology Displays



ITU-T poster, highlighting the close cooperation OIF – ITU-T

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Summary

- **All participants successfully carried out these world wide interoperability tests!!!**
- **This joint effort of vendors and carriers, covering activity areas of the ITU-T, IETF and OIF, manifest globally the strong request for an interoperable, harmonized set of ASON/GMPLS standards and specifications.**

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Acknowledgements

These results are based on a joint effort of all OIF interoperability test partners, vendors and carriers, support teams, colleagues and the OIF staff

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