

# VIOLA: Current Results + Outlook

(Vertically Integrated Optical Testbed for Large Applications in DFN)

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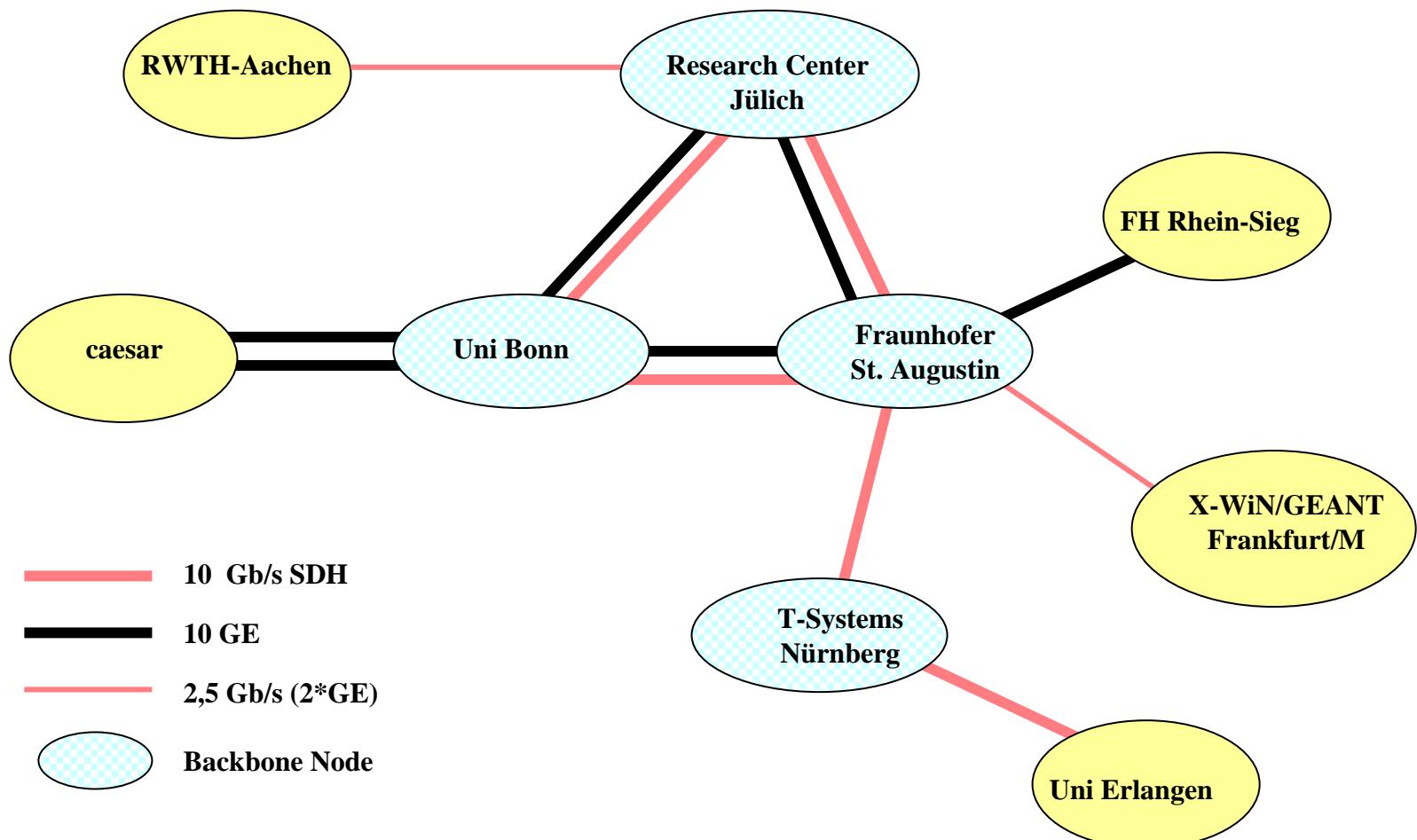
**ONT3, 7/8 th Sep. 2006**  
[www.viola-testbed.de](http://www.viola-testbed.de)

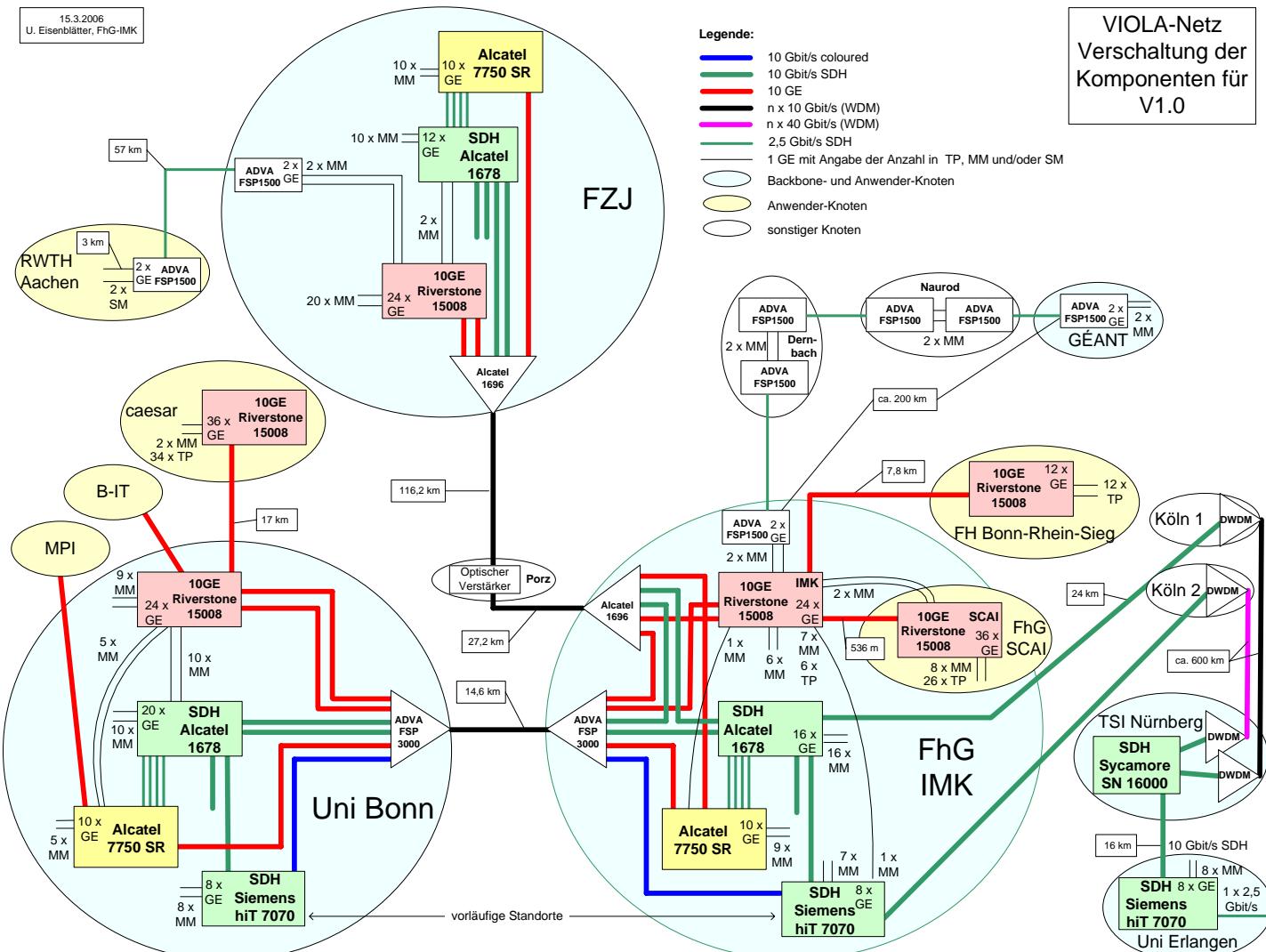
- Leader of consortium: DFN-Verein
- Members of consortium:
  - Alcatel SEL AG, T-Systems International GmbH,
  - Siemens AG, FZ Jülich,
  - FhG (IMK, SCAI), Universität Bonn,
  - Stiftung caesar, FH Bonn-Rhein-Sieg (U Appl. Sc.)
  - RWTH Aachen, GasLINE, Navtel, Uni Erlangen
- Associated partner:
- Term of Project: 3 Years
  - Start of VIOLA: June 2004
  - Funding: ca. 11 M€ from BMBF (Ministry of Research)
  - Total costs: ca. 20 M€

- Test & evaluation of networking technology
  - L2/L3 VPN Services based on MPLS
    - VLL, VPLS, H-VPLS;
    - L2 versus L3
    - Could be interesting for cooperations within a Service-Provider-Network
  - Next Generation SDH
    - Provision of efficient Ethernet Services based on SDH,
    - P2P-Ethernet-Services, especially within a Service-Provider-Network
  - GMPLS/ASON: Signalling mechanisms and interfaces (OIF);
    - E2E-Connections, BoD, Interdomain
    - International Cooperation
    - From Management to Signalling

- Integration of Applications, Middleware
  - Implement Middleware Environment (UNICORE, Grid, PC-Cluster);
  - Implement Middleware Tools:
    - Meta-Scheduling
    - Network Reservation
  - Integrate real users;

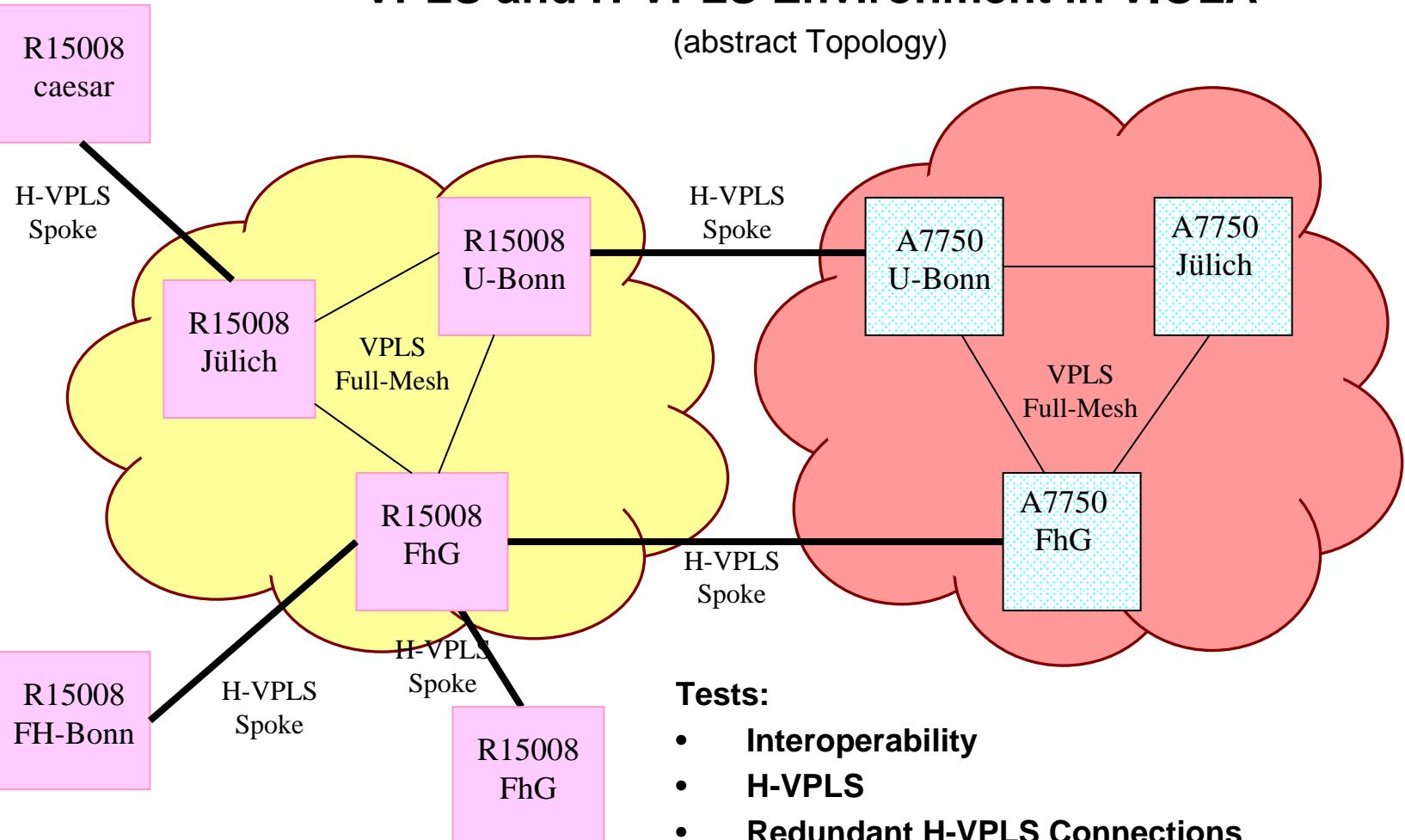
- Contribute to the Question: Which Elements will form future Hybrid-Networks (Packet, Circuit)
  - User need: still IP, but certain QoS-requirements => Circuits
  - „Hard“ Circuits (Lambda, SDH, ...) versus „Soft“ Circuits (MPLS VPN)?
  - Signalling (with complexity and costs) versus (cheap?) Management  
(Think on ATM!)
  - Technical platform: IP, SDH, WDM (L-Switching might be enough)
  - Operational aspects (simplicity, robustness, stability)





## VPLS and H-VPLS Environment in VIOLA

(abstract Topology)



### Tests:

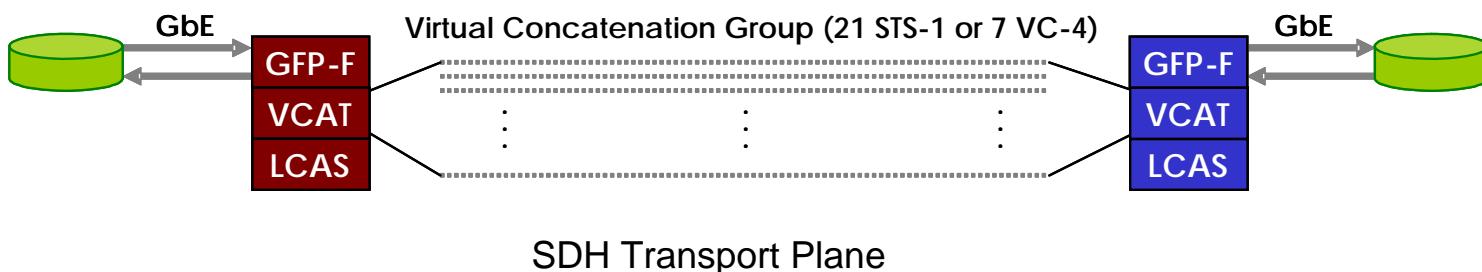
- **Interoperability**
- **H-VPLS**
- **Redundant H-VPLS Connections**

- Operation of L2-Subnetworks
  - VPLS, H-VPLS (Hierarchical Virtual Private LAN Service)
  - Based on Riverstone15008 and Alcatel-7750, connected via SDH-Equipment (Alcatel-CC 1678) or directly with 10GE-LAN-Phy
  - Test: Performance, Functionality
  
- Current L2-Results
  - VLL and VPLS, Basic Functionality, QoS OK
  - Interworking Ether Flow Control between L2/SDH-Switches: OK
  - QoS-Fkt. for b/w limitations (Shaping,Policing;Ingress,Egress): OK
  - H-VPLS: Problems, Alcatel/Riverstone not fully compatible
    - Redundant connections with Link Aggregation: ok
    - Link redundancy: not compatible (Stand-by modus versus NM)

- X-WiN
  - WDM-Backbone with up to 160 \* 10 Gb channels
  - Provides IP-BE and Lambda-Connectivity
- Cost Comparison L-VPN versus VPLS-VPN
  - 1 Gb L-Connectivity: 30.000 EU/Year  
(advance reservation, period of commitment)
  - 1 Gb VPLS-VPN: 38.000 EU/Year  
(assumptions of HW-upgrade (Cisco) and operat. costs)
  - Even worse for VPLS with higher B/W

## NG-SDH-Results

- Basic tests/interworking for GFP/VC between Alcatel-CC-1678, Siemens-CC-hiT7070 and ADVA-GE-MUX-1500: OK
- LCAS tests between Alcatel-CC-1678 and ADVA-GE-MUX-1500 and test equipment (Acterna, Anritsu):
  - Working, but ...not all features, difficult to handle



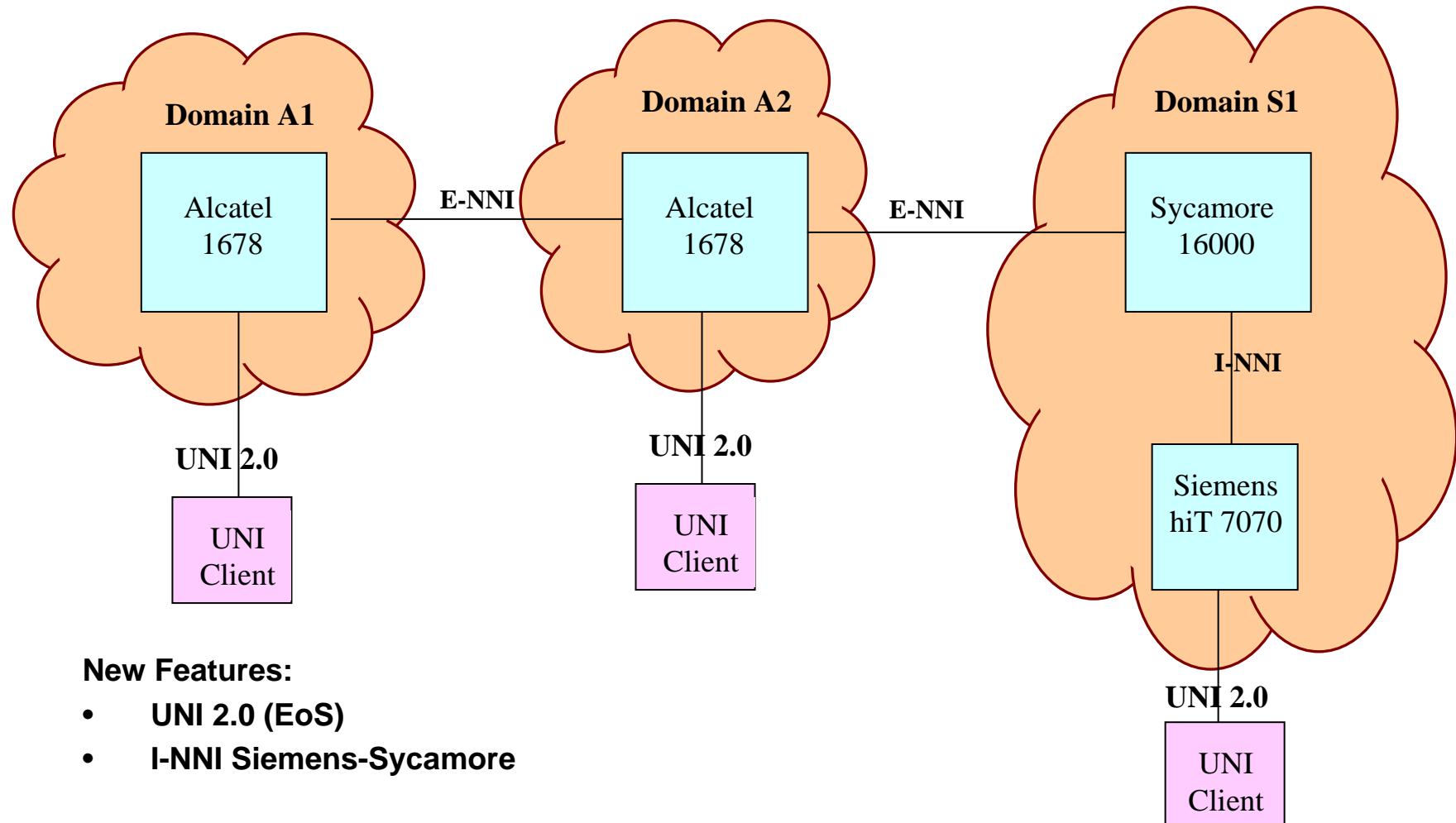
SDH Transport Plane

## Signalling-Results

- GMPLS with Soft-Perm-Conn at Alcatel-CC1678: In Operation
- E-NNI at Alcatel-CC1678 and Sycamore-CC SN16000: In Operation
- UNI 1.0,R2, network side at Alcatel-CC1678: In Operation
- UNI 1.0,R2, network side at Sycamore-CC-SN16000: In Operation
- UNI 1.0,R2, client side, Alcatel Proxy: In Operation
- Interworking tests of E-NNI between Alcatel-CC1678 and Sycamore-CC-SN16000: OK

## Since Spring 2006

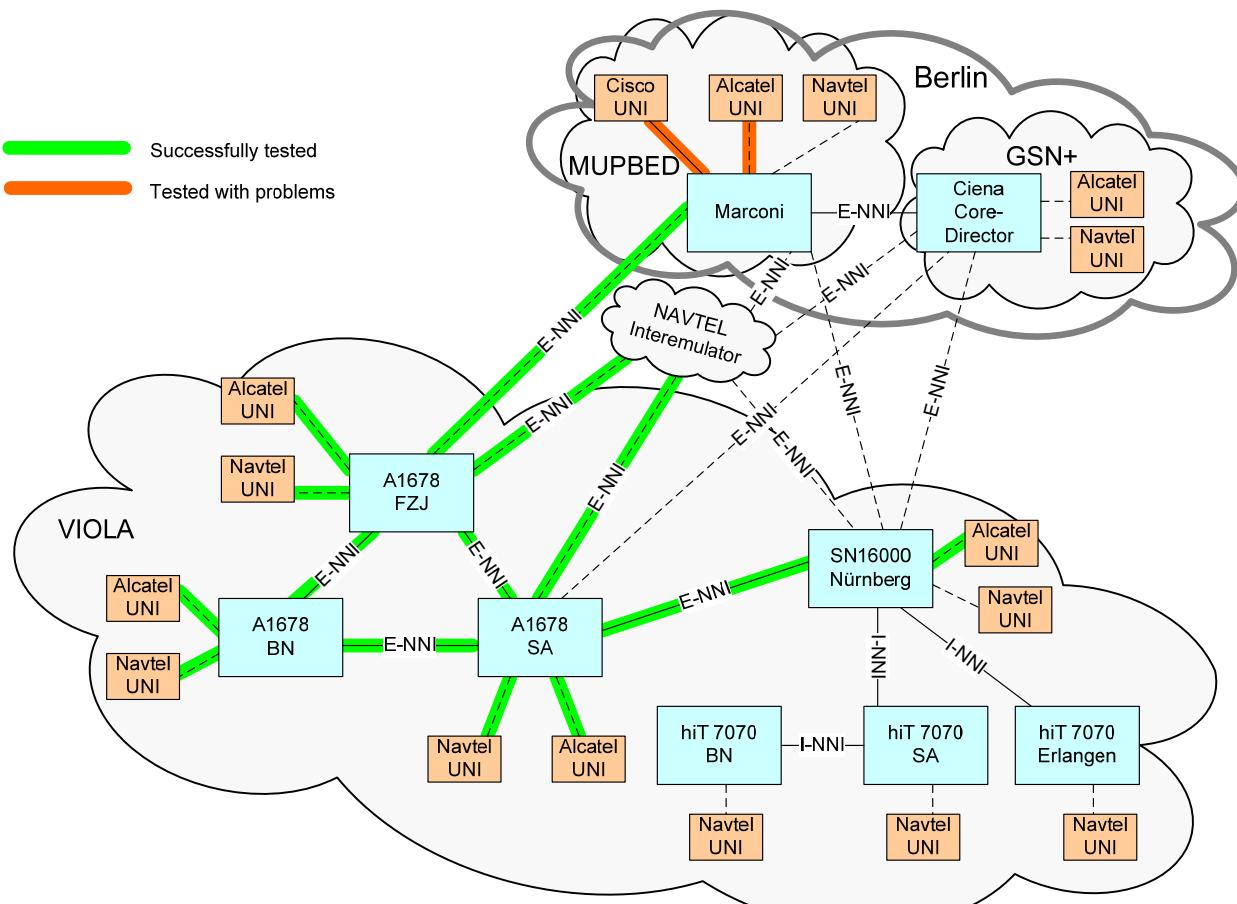
- I-NNI at Siemens-CC hiT 7070 and Sycamore-CC SN16000: In Operation
- UNI 2.0 (EoS), network side at Siemens-CC hiT 7070 and Sycamore-CC SN16000: In Operation
- UNI 2.0 (EoS), at Alcatel-CC1678 and Proxy (network+client) In Operation



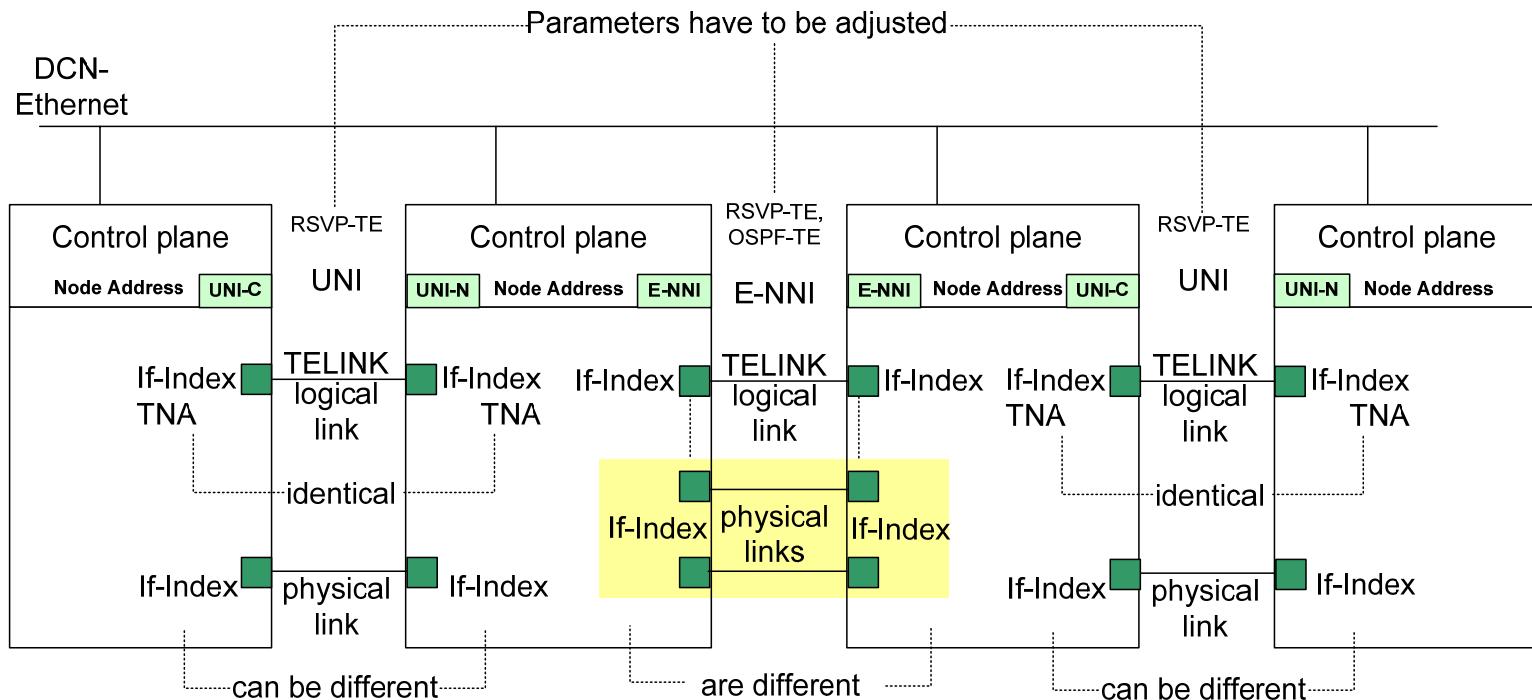
### New Features:

- **UNI 2.0 (EoS)**
- **I-NNI Siemens-Sycamore**

## Test Results – E-NNI and UNI 1.0 R2 Tests Overall Results



## *Test Results – Complex Protocol Configuration, Missing Inband Auto Configuration*



the remote If-Index has to be configured on both sides of a link

the remote Node Address has to be configured on both sides of a TELINK

## Implementation of a MetaScheduler (based on GGF)

- UNICORE Client sends request to MetaScheduler
- MetaScheduler negotiates earliest time to run this job with local schedulers
- MetaScheduler requests the reservation of the requested resources to the local Schedulers and to the Network Reservation System

## Implementation of a Network Reserv. System (ARGON)

- Web-Interface is used by the Meta-Scheduler and end users
- Access to Services based on MPLS (VPLS) and GMPLS (OIF)

**Initial versions of both tools are integrated in applications and are running in VIOLA**

## Within VIOLA (until April 2007)

- Ongoing tests within NG-SDH, H-VPLS and „Signalling Environment“ (in particular UNI 2.0)
- Upgrade of Equipment (e.g. 40 Gb-components, started in August 2006)
- Enhancement of initial version of MetaScheduler and ARGON (Network Reservation System)

## Project Proposal BODEGA (BoD for Grid-user)

- Decision End of September 06 (hopefully)
- Refinement of project description in QIV/06 (If Yes!)
- Start in April 07 ??

## BODEGA Goals:

- Middleware: Enhancement of network reservation system ARGON (plus MetaScheduling)
- Network: OIF- and GMPLS-Signalling
  - Ongoing with Routers and SDH-equipment
  - New: Integration of Lambda-Switches/ROADM
- L-Switches/ROADM:
  - Realistic environment in many NRENs (much more than SDH-service)
  - Realistic operational alternative/complement: Signalling/NM

## BODEGA Goals:

- German part of an European BoD-Service
- Cooperation with EU-projects (e.g. ARGON)
  - GN2-JRA3 and
  - PHOSPHORUS (Starting in September 2006)
- Special Issues
  - Interdomain/transeuropean
  - Hybrid Management for E2E-connection
    - partly with NM and
    - partly with Signalling

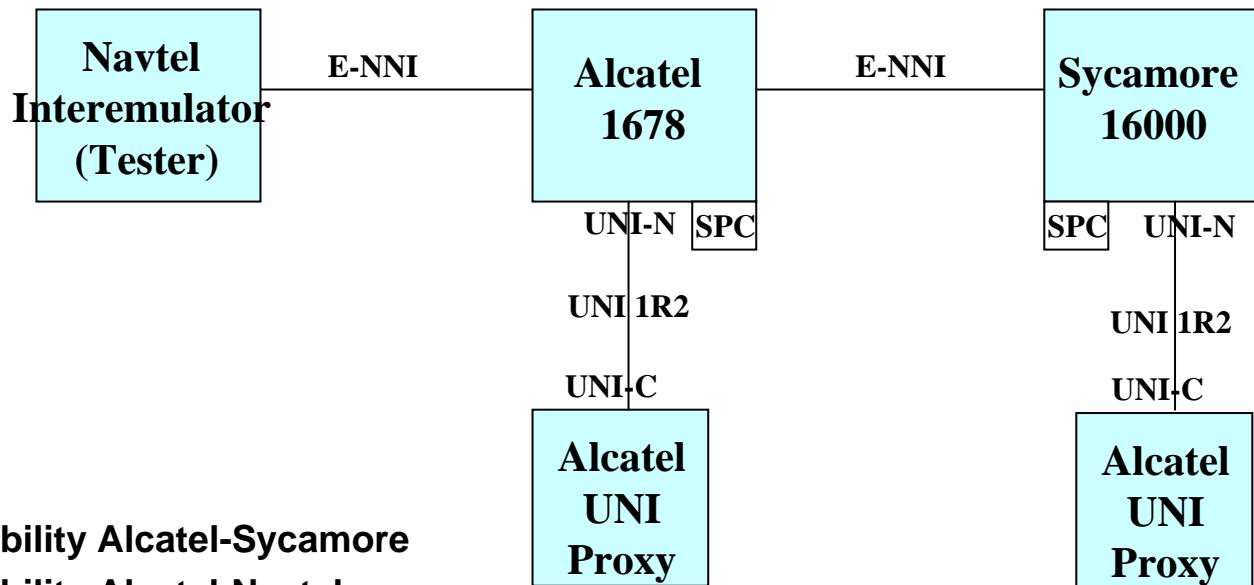


# Material



## Appendix: Materials

## E-NNI and UNI-1R2 : Alcatel- Sycamore



### Tests:

- Interoperability Alcatel-Sycamore
- Interoperability Alcatel-Navtel
- UNI 1R2 - Proxy, Set Up
- Successful, BUT ... Some features,  
difficult to handle

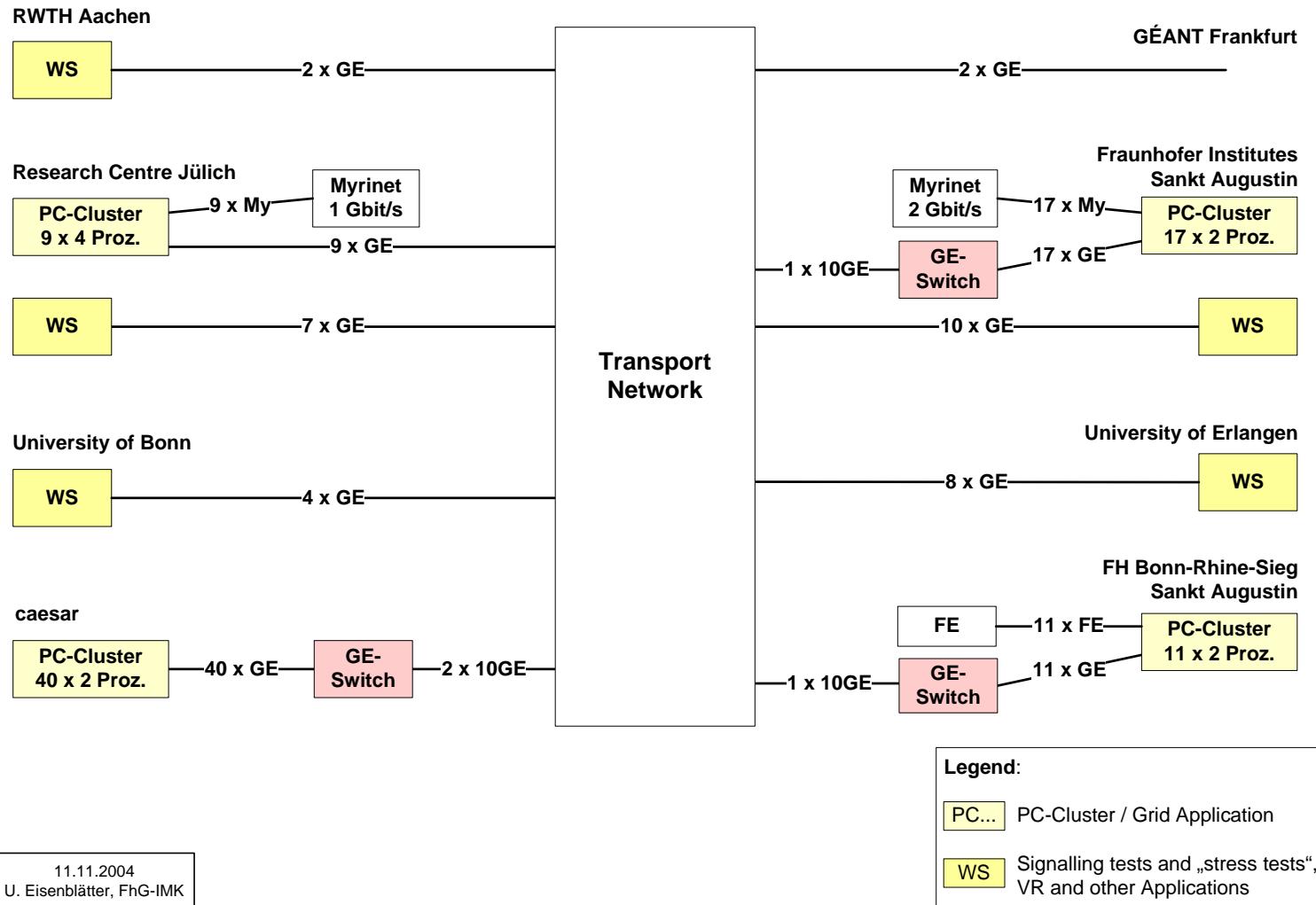
## Interworking in optical transport networks

- GMPLS for IP-based control plane (IETF)
- ASON / ASTN (Automatic Switched Optical/Transport Network, ITU)
- OIF (Opt. Internetworking Forum): Interfaces based on GMPLS+ASON
- UNI for user controlled signaling
  - UNI 1R2: Signalling for SDH-Connections
  - UNI 2.0: Signalling for Ether-Connections over SDH
- E-NNI: Interdomain-Interface
- I-NNI: Intradomain-Interface
- OIF-Interfaces include GMPLS-Components like RSVP-TE, OSPF-TE, ...
- Further issues: Peer-/ Overlay-/ Augmented-Model

- Provision of Ethernet-Service over SDH with bandwidth adjustment (NG SDH: GFP, LCAS, VC).
  - GFP-F: Generic Framing Procedure, Framed Mode (ITU-T G.7042), method to transport data packets (e.g. Ethernet) over SDH
  - Virtual Concatenation (VC) instead of Continuous Concatenation (CC): VC4-Container may use different ways in the transport network
  - LCAS: Link Capacity Adjustment Scheme (ITU-T G.7041): dynamical bandwidth adjustment for SDH-links, variable number of VC4-container within a VC-group during operation

- Definition of Commercial Services (e.g. T-Systems)
- Technical Platform and Services in X-WiN
- International Connectivity (NREN), Interdomain Connectivity
  - => Signalling is required, but still to fix
- Architecture: Peer/ Overlay/ Augmented - Model

# Access of Applications to the Transport Network

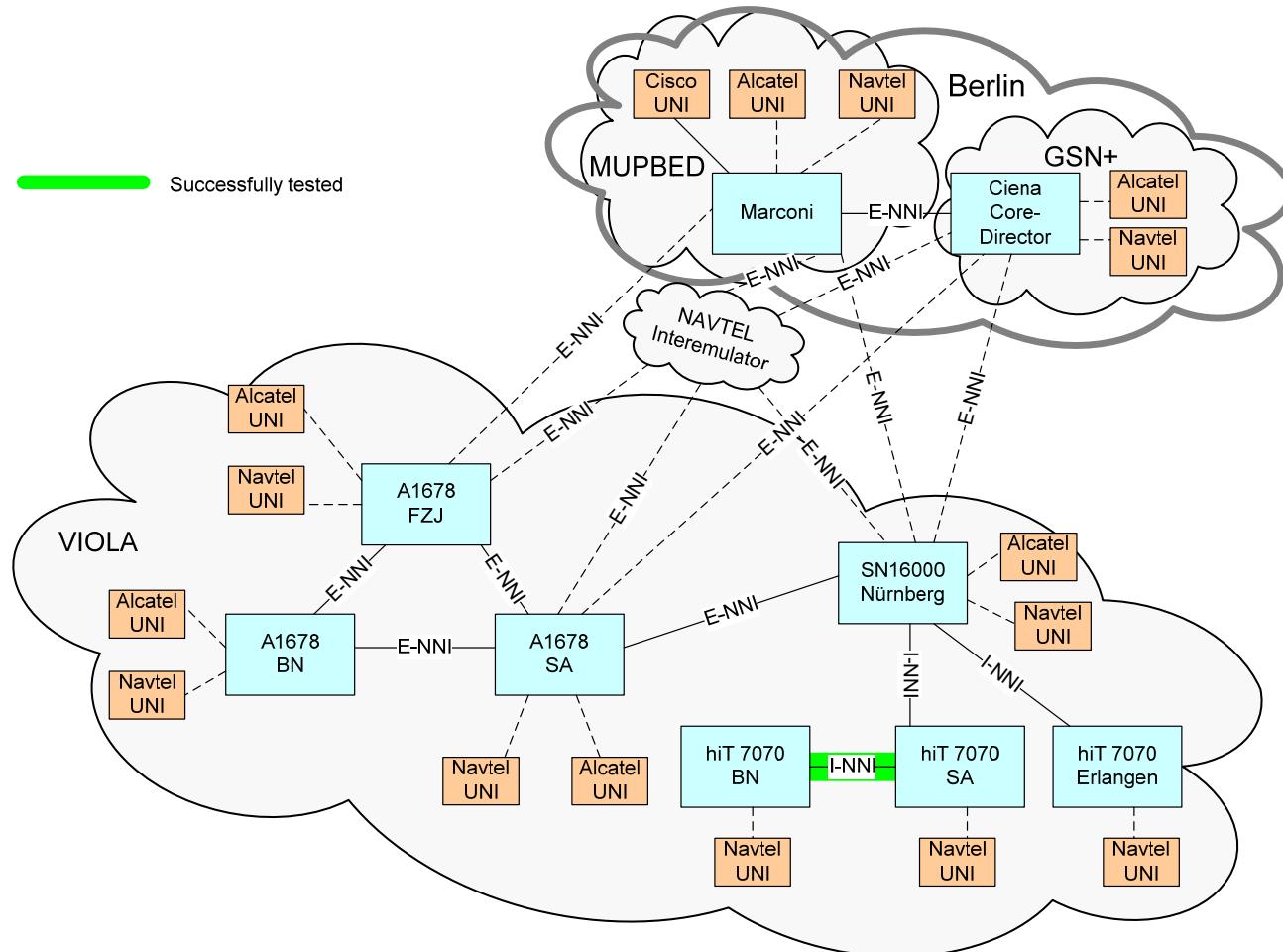


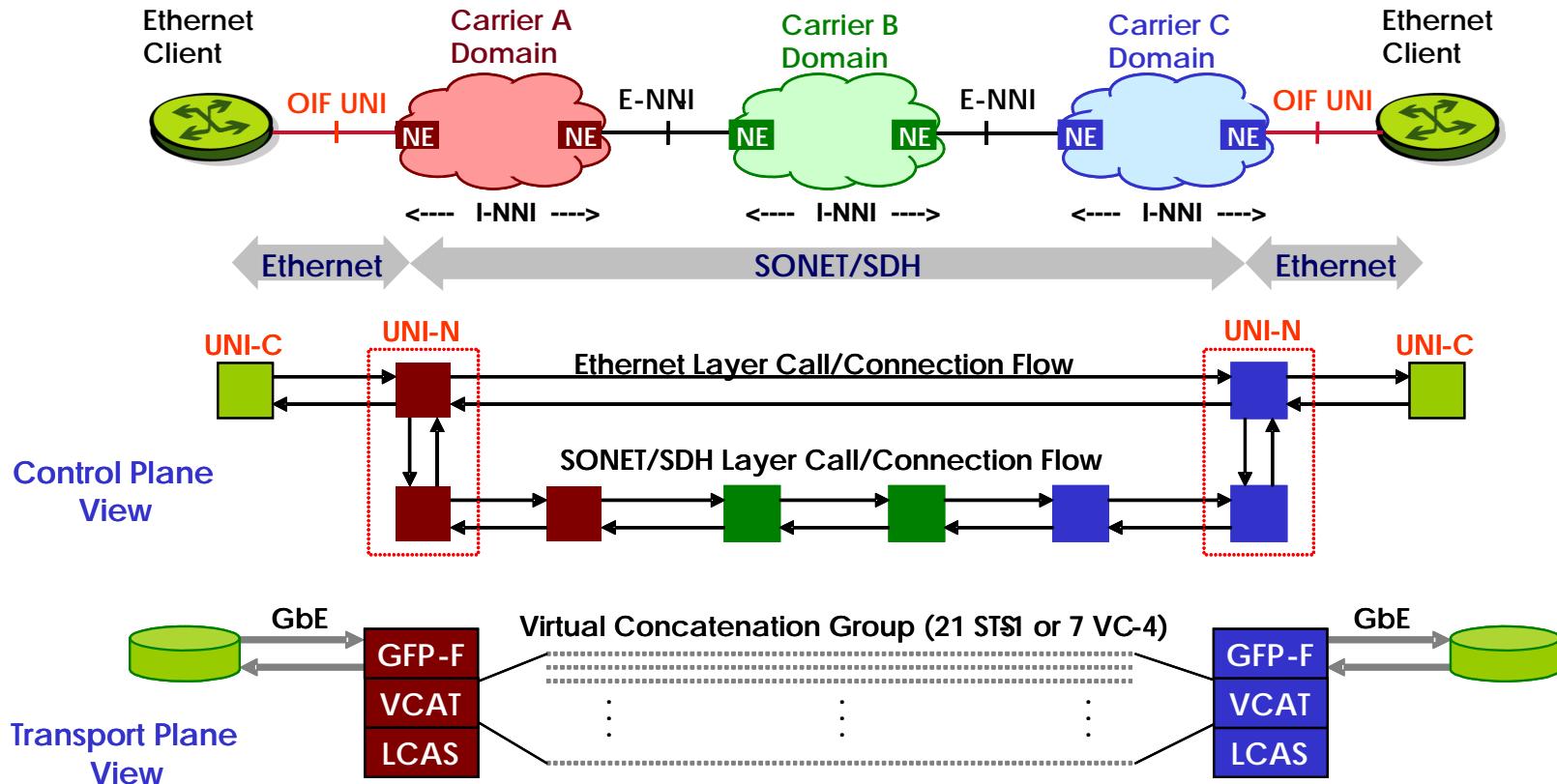
## Equipment to provide VPN (VPLS)

- **Alcatel 7750 SR (Router)**
  - Interfaces: up to 10 Gbps-SDH, GE and 10GE,
  - L2-Service: VPLS (H-VPLS)
- **Riverstone 15008 (GE-Switch)**
  - Interfaces: GE and 10GE,
  - L2-Service: VPLS (H-VPLS)

- **Alcatel 1678 (SDH-Cross-Connect)**
  - Interfaces: up to 10 Gbps-SDH (STM-64) and GE, with GFP
  - Signalling: OIF/UNI-N 1.0 R2 and E-NNI
- **Siemens SURPASS hiT 7070 (SDH Cross-Connect)**
  - Interfaces: up to 10 Gbps SDH (STM-64) and GE, with GFP
  - Signalling: I-NNI, Cross-connect capacity: 160 Gbit/s
- **Siemens/Sycamore Networks SN16000 (SDH Cross-Connect)**
  - Interfaces: up to 10 Gbps SDH (STM-64),
  - Signaling: E-NNI, I-NNI, OIF/UNI 1.0 R2, Cross-connect capacity: 2.5 Tbit/s
- **Alcatel 1696 (WDM-System)**
  - Interfaces: 10 Gbps SDH (STM-64) and 10 GE
- **Siemens/ADVA FSP 1500 (GE Multiplexer)**
  - Interfaces: GE (multiplexed to 2.5 Gbps SDH (STM-16) via GFP)
- **Siemens/ADVA FSP 3000 (Metro-WDM-System)**
  - Interfaces: 10 Gbps SDH (STM-64) and 10 GE

## ***Test Results – E-NNI and UNI 2.0 Tests Overall Results***





- **Diversity of Equipment and Connectivity offers:**
  - Different SDH-domains
  - Different VPLS-domains
  - In triangel in parallel with up to 10 Gbps:
    - SDH-connectivity and
    - L2-Ethernet-connectivity
  - User access with  $n * GE$
  - e2e-connectivity via L2-service or via L2/SDH-service