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G-Lab

The German Initiative to an Experimentally Driven Future Internet Design

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Overview

- The G-LAB Initiative
  - Objectives
  - G-LAB Structure
  - Overview of Projects
- Experimental Facility
  - Federated Experimental Approach
  - Experimental Sites
  - Flexibility in Equipment & Boot Images
- Two Project Examples
  - Future Internet Routing: FIR@Würzburg/Berlin/Munich
  - Future Multicast Services: H∀Mcast@Hamburg

G-LAB Objectives

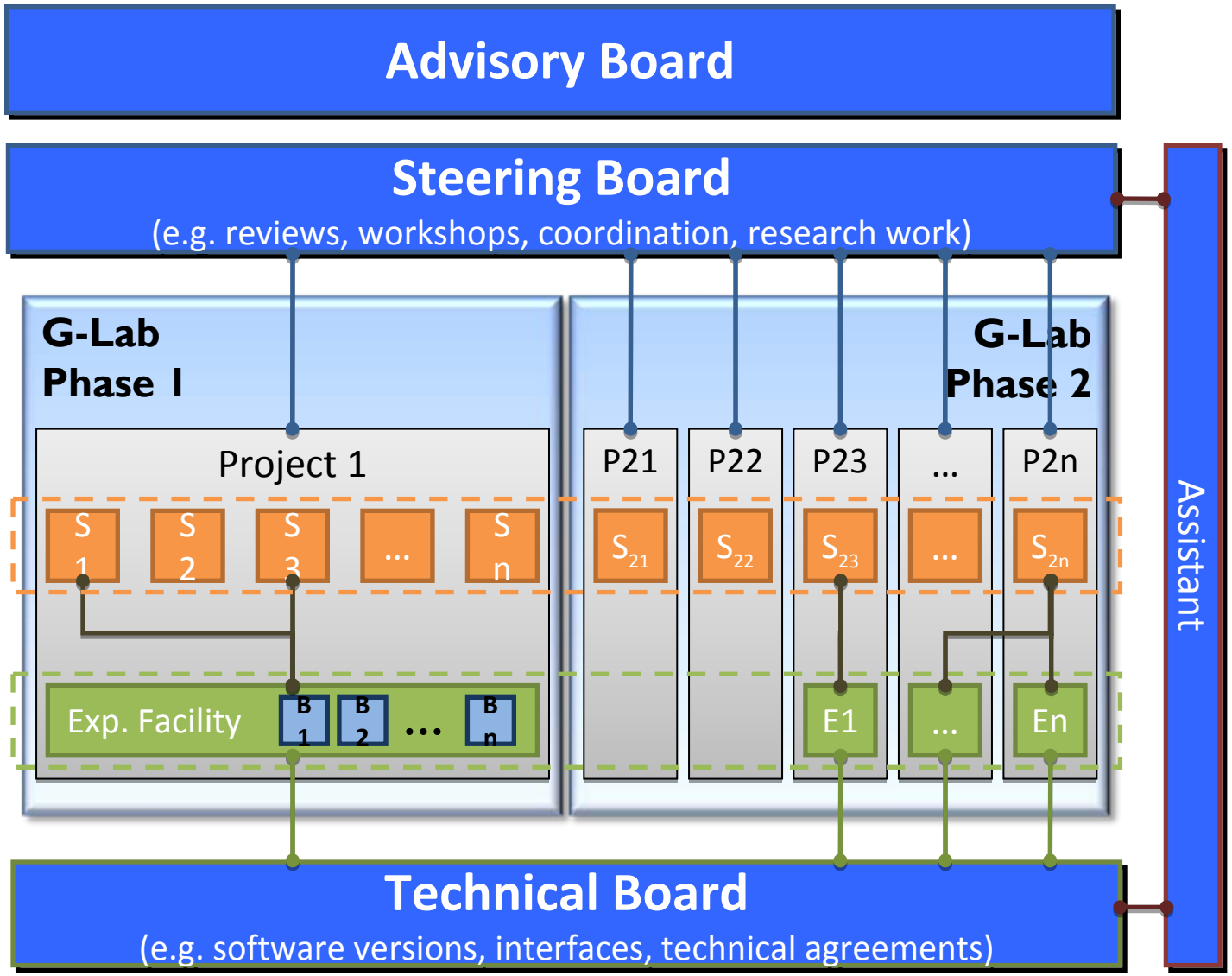
- Provide an Environment for Network Research that Stimulates
  - Discussions and exchange for groups from academia and industry
  - Open, flexible experimental facilities
  - Funding of new ideas

- Foster Heterogeneous Approaches and Contributions
  - Topics range from core technologies to distributed computing services
  - Include concurrent and competitive work
  - Grant room for the development of new prospects
  - Focus on experimentally driven work and exploration
  - Common denominator: Good communication research

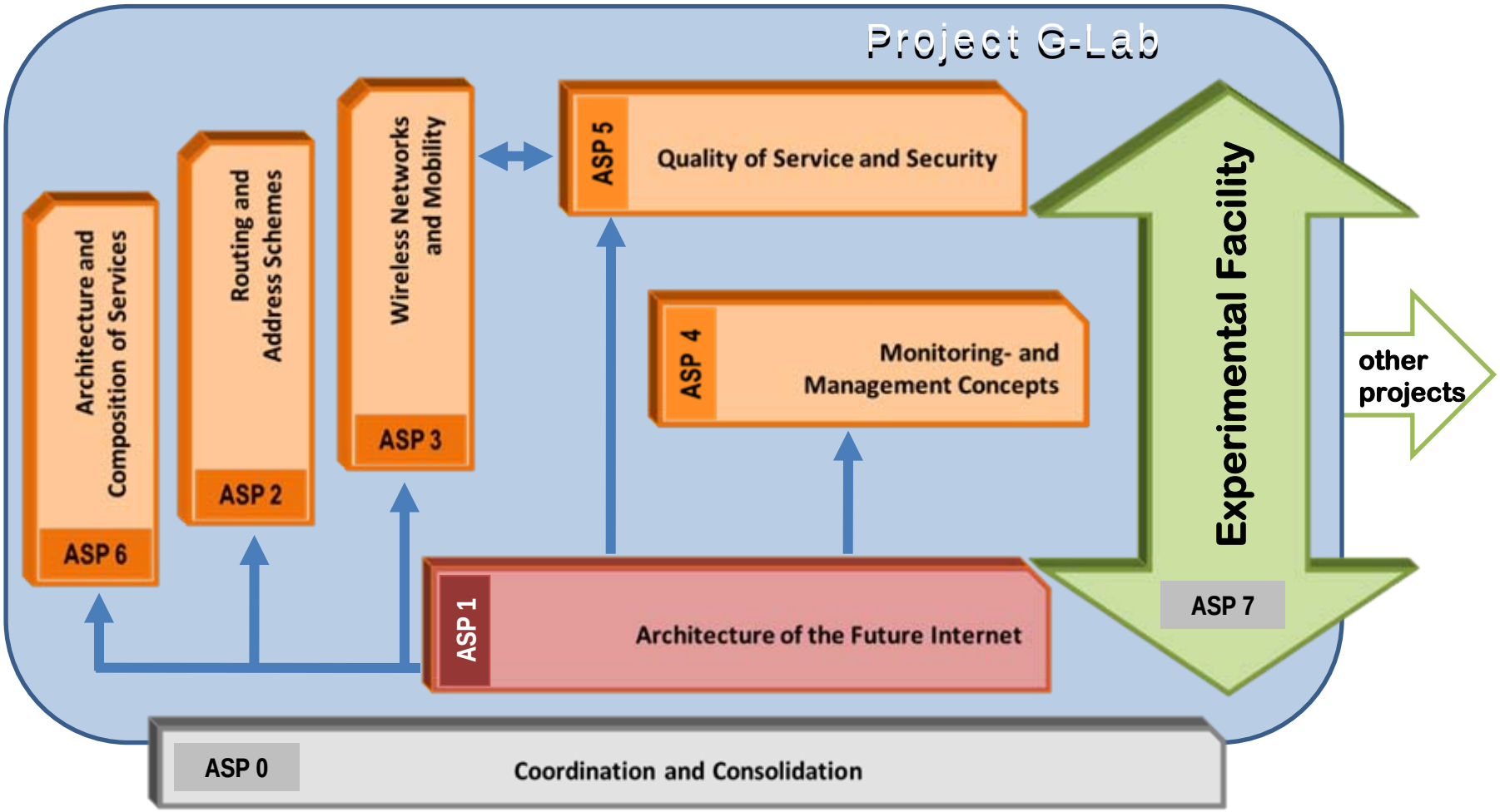
"No special initiatives from top down are needed at all"

Jon Crowcroft (Future Internet Enervation)

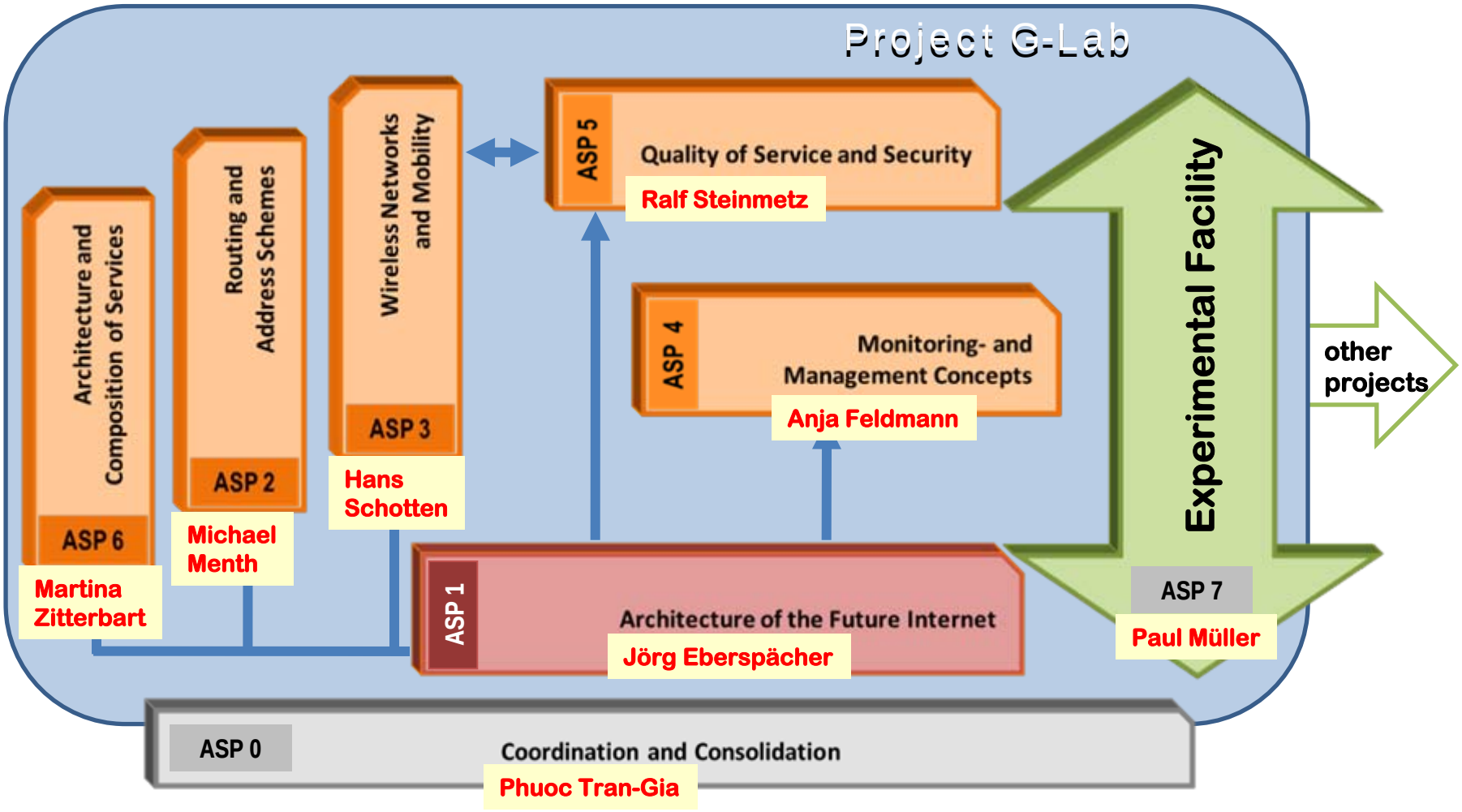
G-Lab Structure



G-Lab Phase 1 Project Structure



G-Lab Phase 1 Project Structure



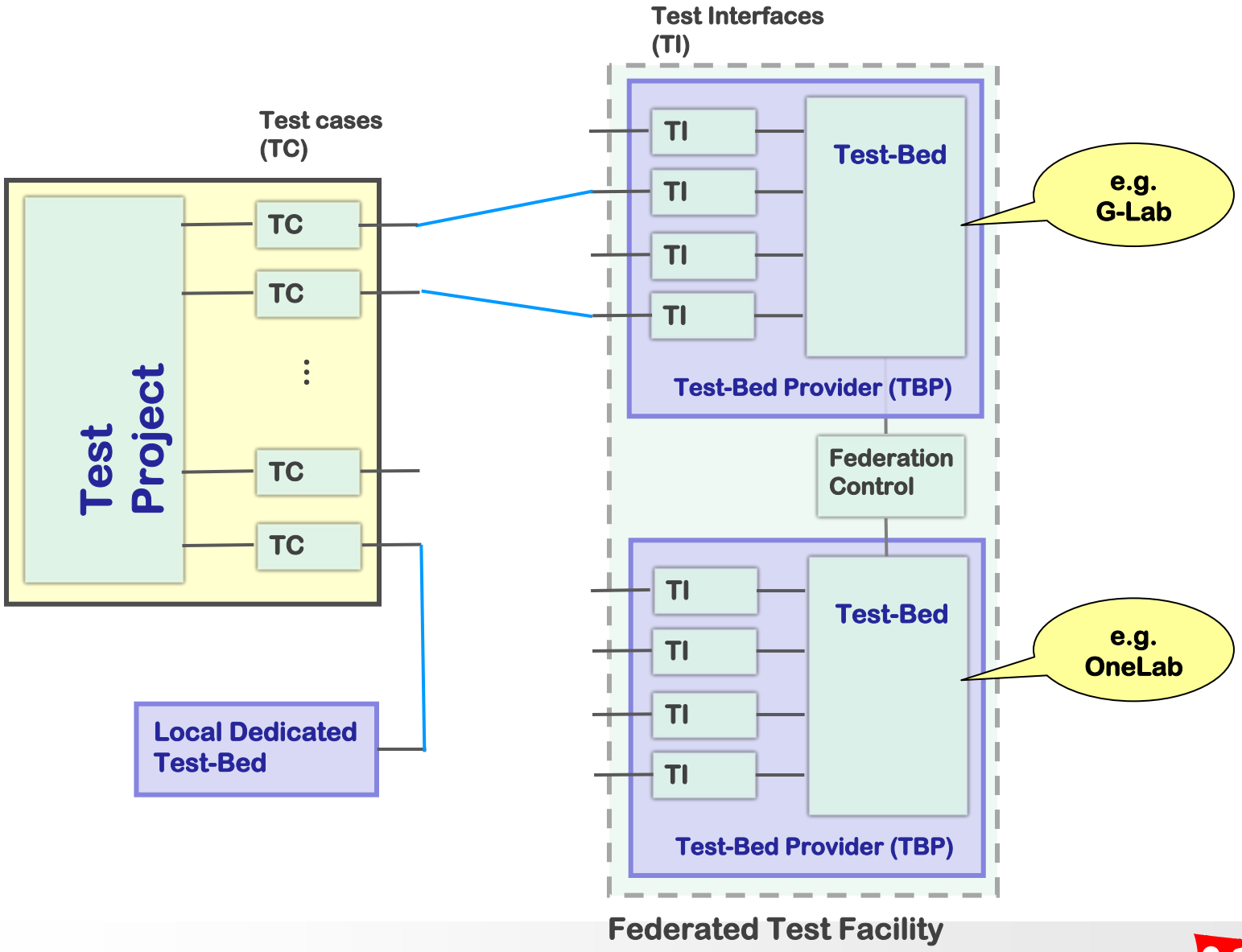
G-Lab Phase 2: Projects

- **CICS (Convergence of Internet and Cellular Systems)**
  - Develop architectures and protocols to support mobility and quality of service
- **COMCON (Control and Management of Coexisting Networks)**
  - Use of virtualization to support the introduction of new services and new transport networks
  - Provider and operator-grade management and control of coexisting networks (by network virtualization)
- **Deep (Deepening G-Lab for Cross-Layer Composition)**
  - Explore innovative composition-approaches for cooperation between network and services with the focus on security in the future internet.
- **FoG (Forwarding on Gates)**
  - Enable dynamic function injection in a network
  - Bridging connection oriented and connectionless

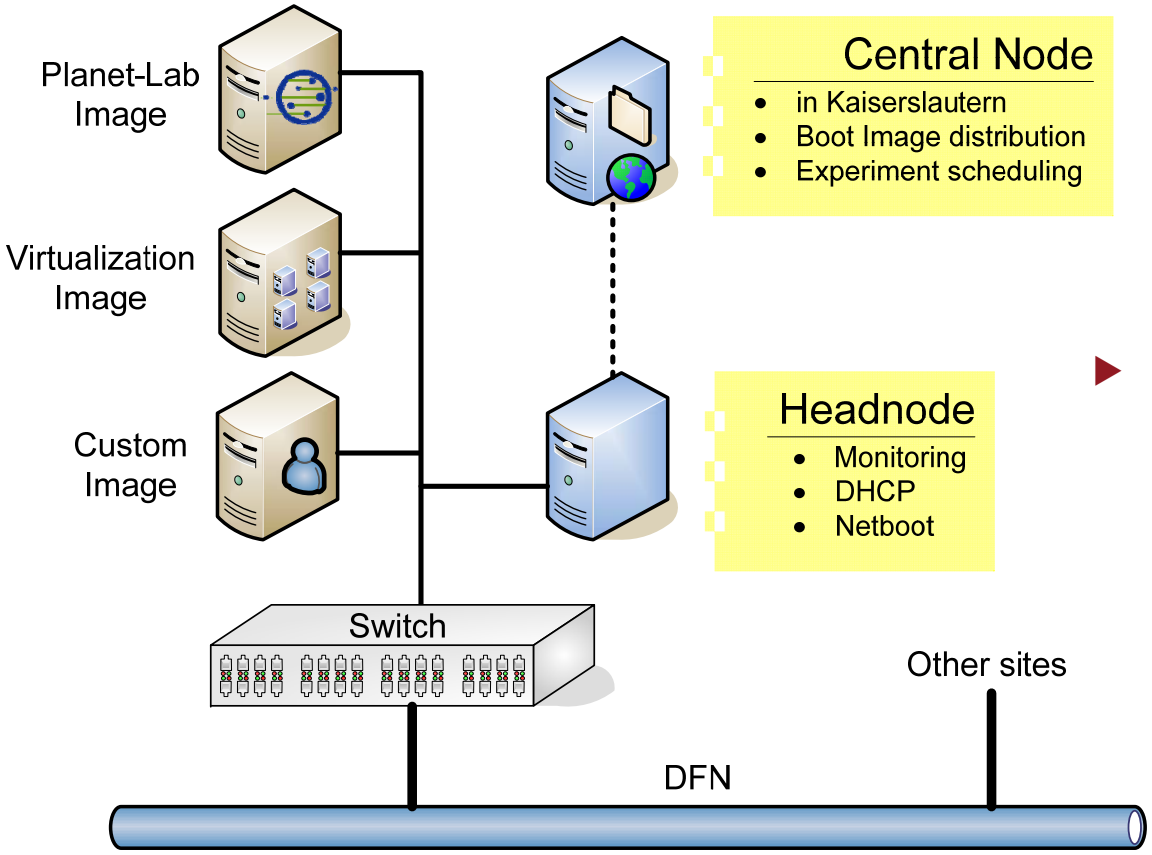
G-Lab Phase 2: More Projects

- **Ener-G (Energy Efficiency in G-Lab)**
  - Exploration of energy-efficient operation
  - Energy-aware virtualization and consolidation of communication
- **HAMcast (Hybrid Adaptive Mobile Multicast)**
  - Universal multicast service middleware
  - Decouple the processes of application development and infrastructure deployment
- **NETCOMP (Network-Computing for the Service Internet of the Future)**
  - Create technology to extend network agnostic grid and cloud computing to real-time multimedia communication:
- **Real-World G-Lab**
  - Provisioning of a base for Internet of Things (IoT) research through integration of Wireless Sensor and Mesh Networks
- **VirtuRAMA**
  - Concurrent virtual networks
  - Live migration of virtual routers

Test cases and federation of Experimental Facilities



G-Lab Experimental Site Structure

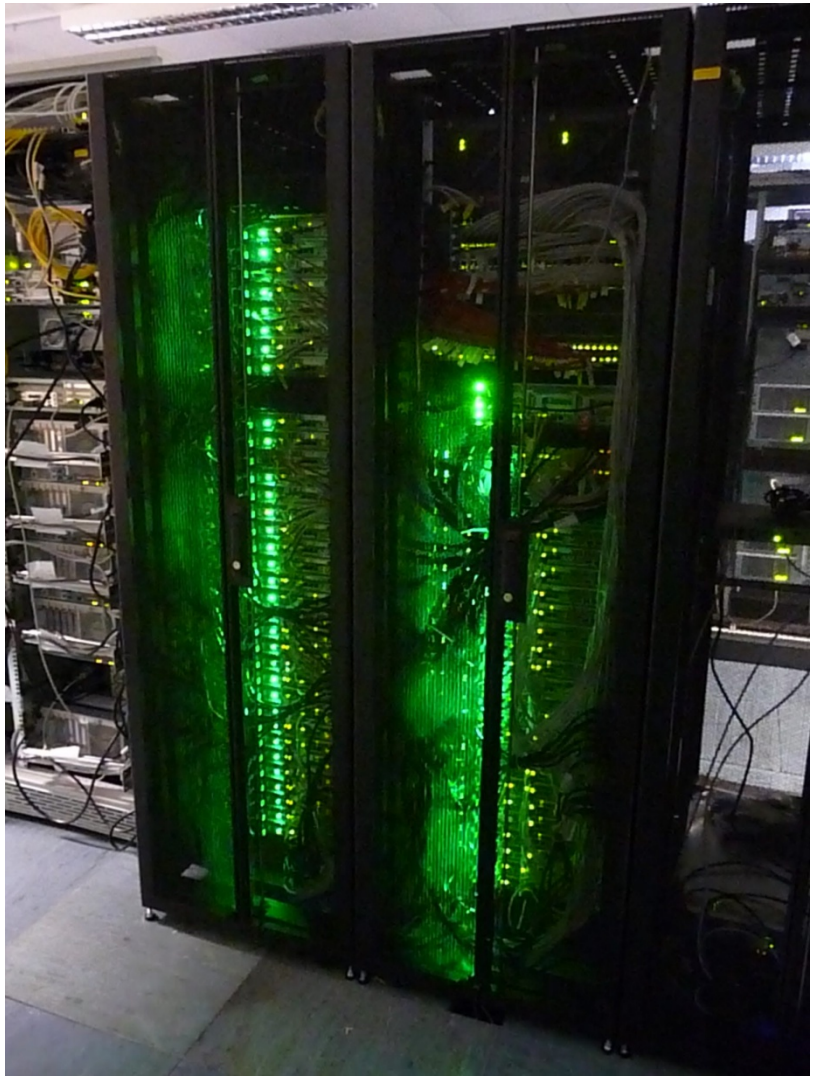


- Central Node
  - Resource management
    - Experiment scheduling
    - Resource provisioning
  - Boot Image management
    - Distributes Images
    - Assigns Images to nodes
- Each site has a Headnode
  - Manages local nodes
    - DHCP
    - Netboot
    - Monitoring
    - ILOM access
  - Executes orders from Central node
    - Local overrides possible

Hardware Equipment

- Normal Node
  - 2x Intel L5420 Quad Core 2,5 GHz
  - 16 GB Ram
  - 4x Gbit-LAN
  - 4x 146 GB disk
  - ILOM Management Interface (separate LAN)
- Network Node
  - 4 extra Gbit-Lan
- Headnode
  - 2x Intel E5450 Quad Core 3,0 GHz
  - 12x 146 GB disk
- 174 Nodes in total

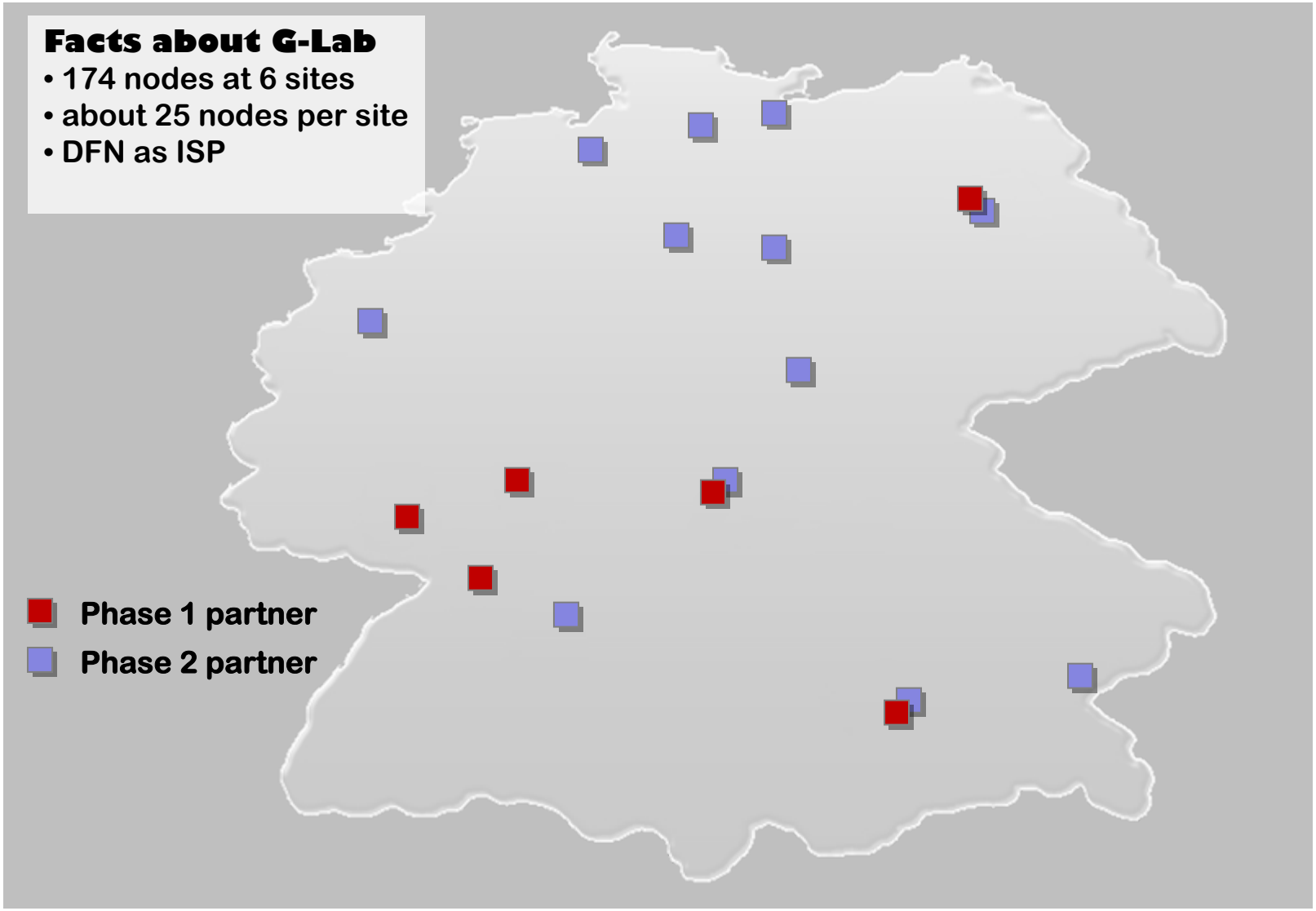
  (1392 cores total)
- Extensions under Way
  - Mesh Networks
  - Nodes at Dedicated Places (IXPs)



Experimental Flexibility

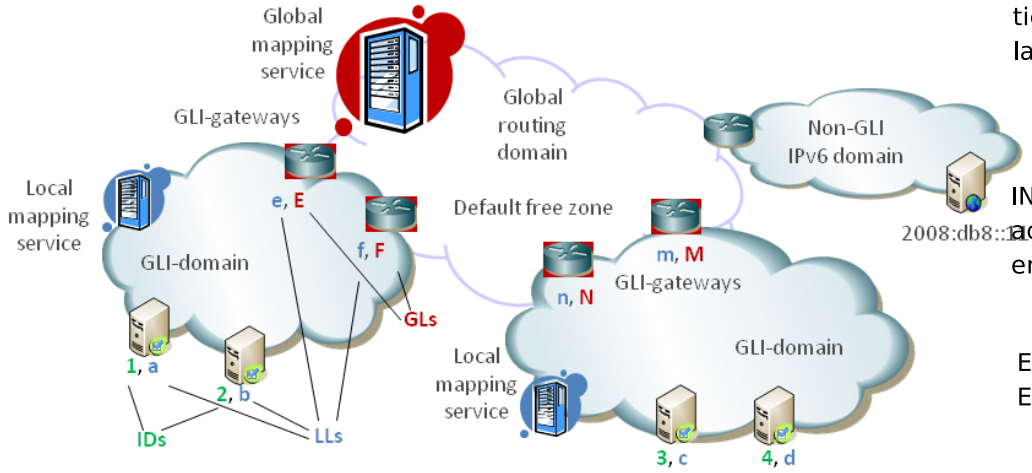
- Experimental Facility is part of research experiments
  - Facility can be modified to fit the experiments needs
  - Researchers can run experiments that might break the facility
    - Experimental facility instead of a testbed
- Research is not limited by
  - Current software setup
  - Current hardware setup
  - Restrictive policies
- Experimental Facility is evolving
  - Cooperative approach
    - „When you need it, build it“
    - Core team helps
  - Cooperation with other facilities (e.g. Planet-Lab, GENI)
  - Federation

Partner Locations



Proposals for FIR Architectures

- Evolutionary approaches
  - LISP (Cisco)
    - Already operational pilot networks http://www.lisp4.net/
    - Gateways for map&encaps
    - Routing on identifiers in edge networks
  - Uni WÜ: GLI-Split
    - Loc+ID coded in IPv6 address
    - Multiple benefits
    - Demo EuroView 2009

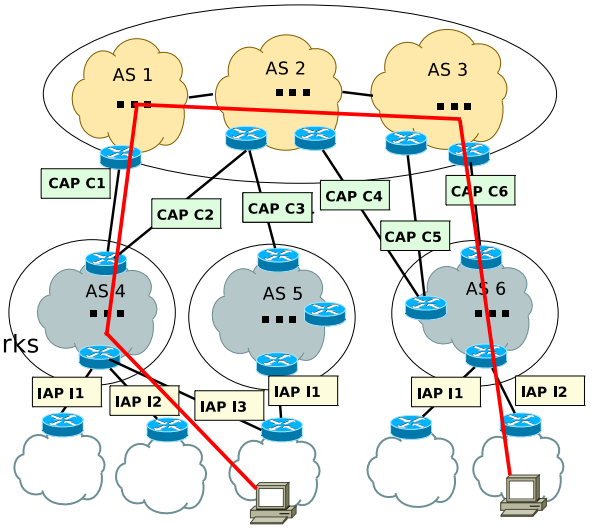


- Clean-slate approaches
  - TU Berlin: „HAIR: Hierarchical Architecture for Internet Routing”
    - Hosts compose complete addresses instead of gateways
    - Demo EuroView 2009
  - TU Munich: A Novel DHT-Based Network Architecture for the Next Generation Internet

CORE:
tier-1 ASs
large Providers

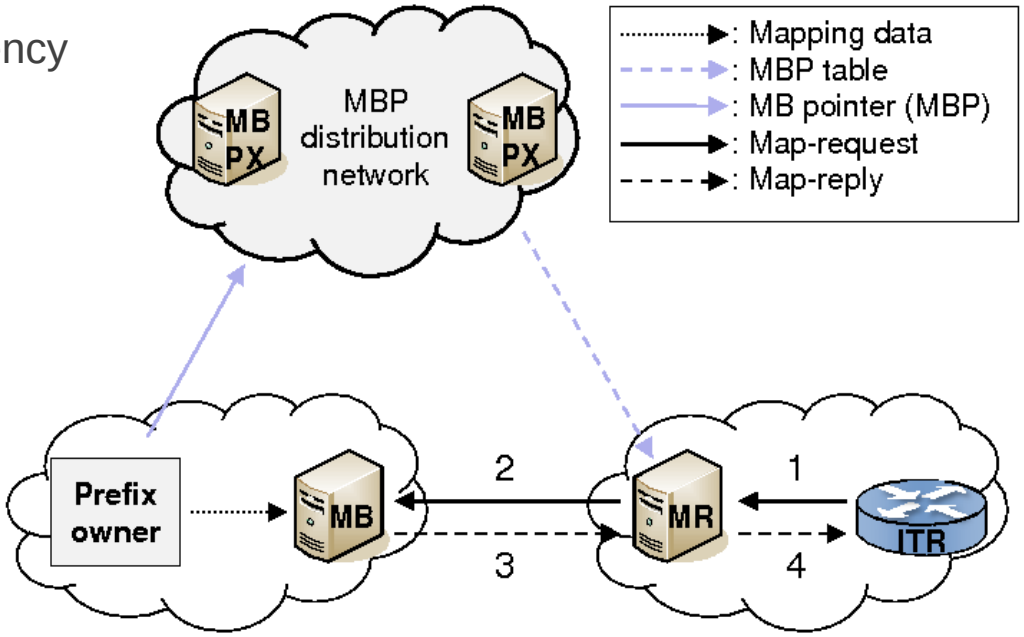
INTs:
access provider
enterprise networks

EDGEs:
Ethernet



Proposals for Mapping Systems

- Requirements
  - Scalability
  - Security & resilience
  - High performance & low latency
  - Packet forwarding

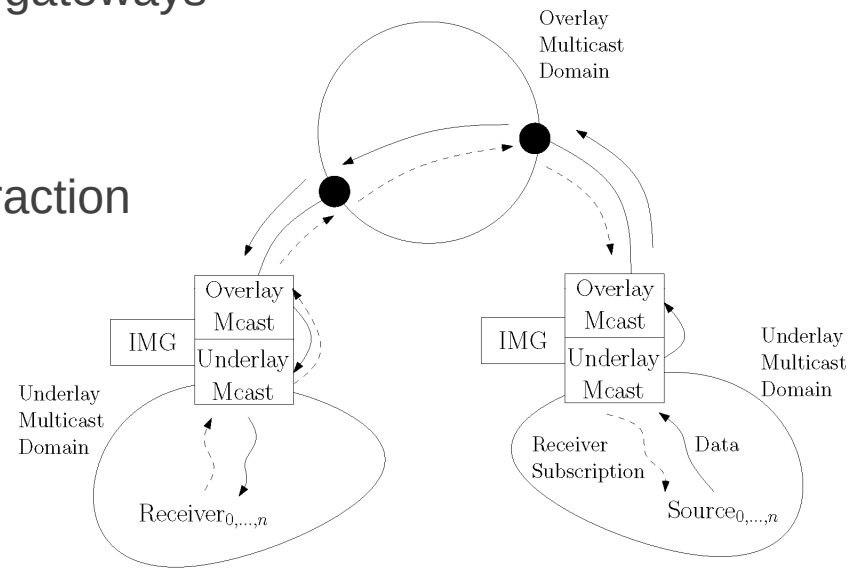


- FIRMS (UniWü)
  - Map-base (MB)
  - MB pointer (MBP)
  - Map-resolver (MR)
  - Ingress tunnel router (ITR)
  - Demo EuroView 2009
  - Protoype (ongoing)
- HiiMap (TUM)
  - Global mapping system: ID-to-regional-prefix
  - Regional mapping systems: ID-to-Loc
  - Prototype (ongoing)

H∀Mcast – Hybrid Adaptive Mobile Multicast

- Evolutionary widening of the architecture heading at a Multiservice Internet
  - Abstraction of the Socket API
  - Increased, heterogeneous network functions at end systems
  - Optional gateways (explicit and implicit)

- Hybrid, open architecture
  - Multilayered, including intelligent gateways
- Mobility-transparent Routing
  - At network and application layer
- Optimization on overlays by ISP interaction
  - Focus on Peering Points
- Secure member authentication in group applications



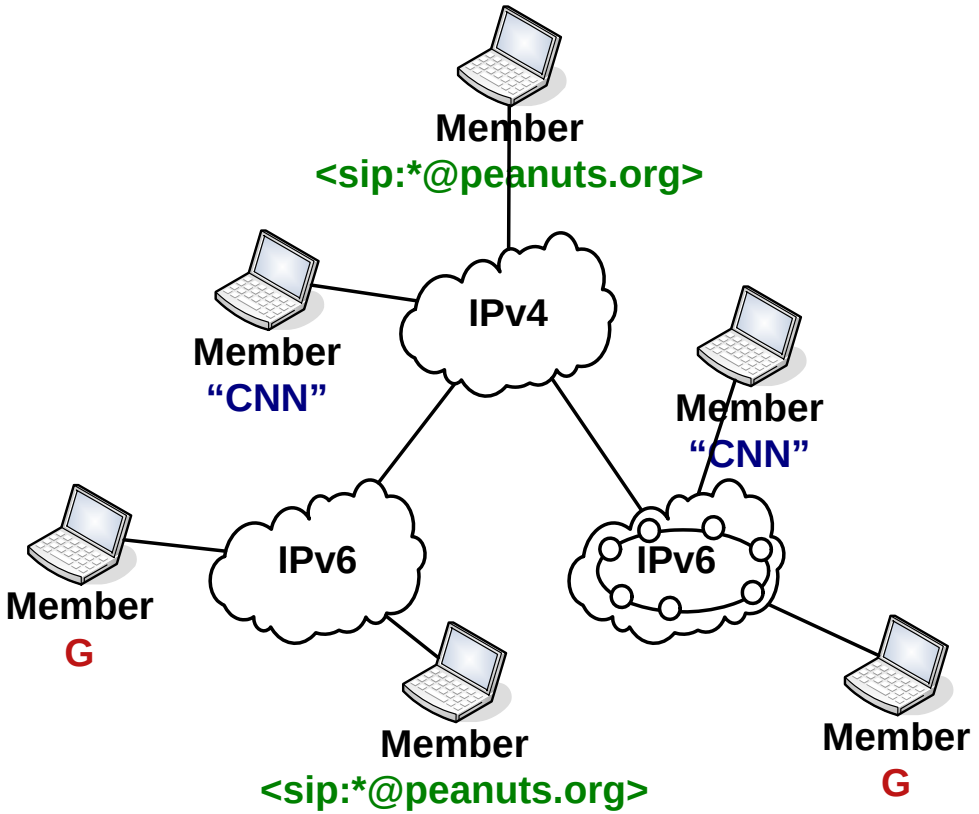
Naming and Addressing

"Multicast addresses are a set of distributed application names"

John Day (Patterns in Network Architecture)

Just use any application name?

- Problem of mapping to network technologies:
- Domains may run same technology but remain isolated
- Domains may run distinct technologies but host members of the same group
- Proposal: Use abstract, namespace-aware data type - URIs for late binding + new API



Thanks!

1st IEEE Workshop on Pervasive Group Communication (IEEE PerGroup)

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held in conjunction with IEEE GLOBECOM 2010
and co-sponsored by IEEE HCCTC sub-committee
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http://pergroup.realmv6.org