G-Lab:
Concept, use cases and federation

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www.german-lab.de

NETWORK OF EXCELLENCE

G-Lab: Concept, use cases and federation

1. **Testbeds and use cases: a challenge liaison**
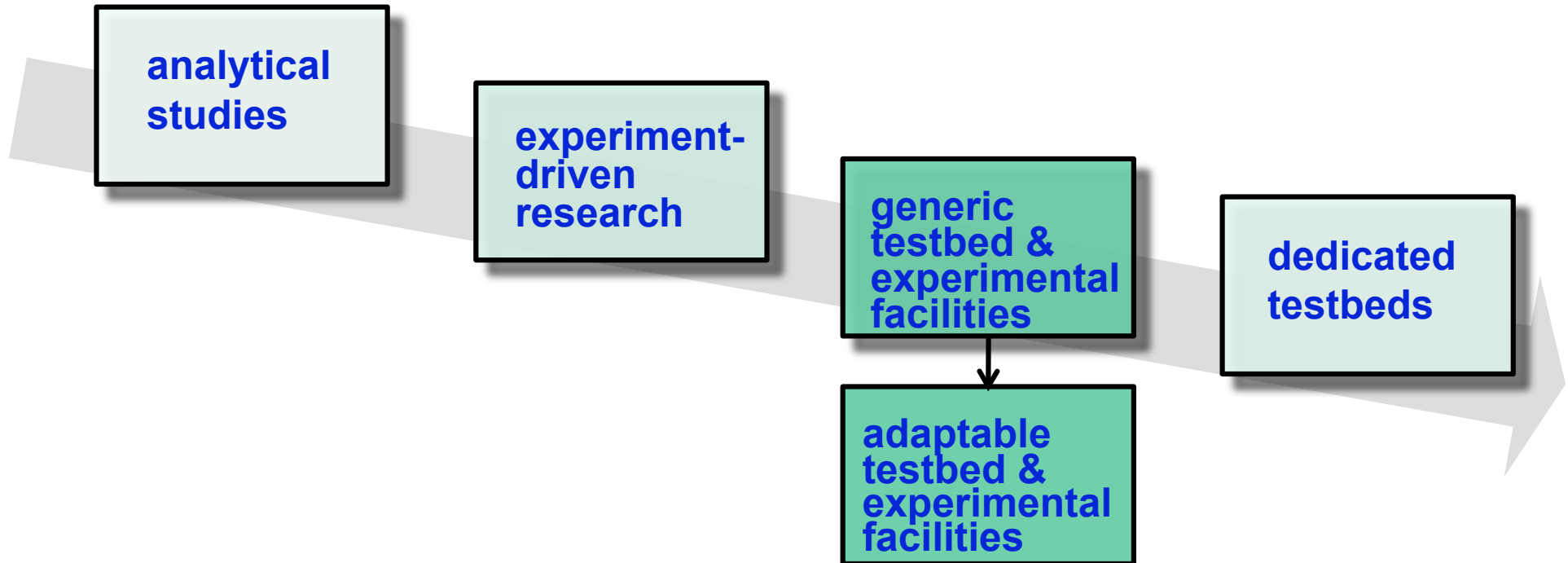   - Generic Testbeds and Experimental Facilities

2. **The G-Lab approach**
   - Concept, consortium and funding path
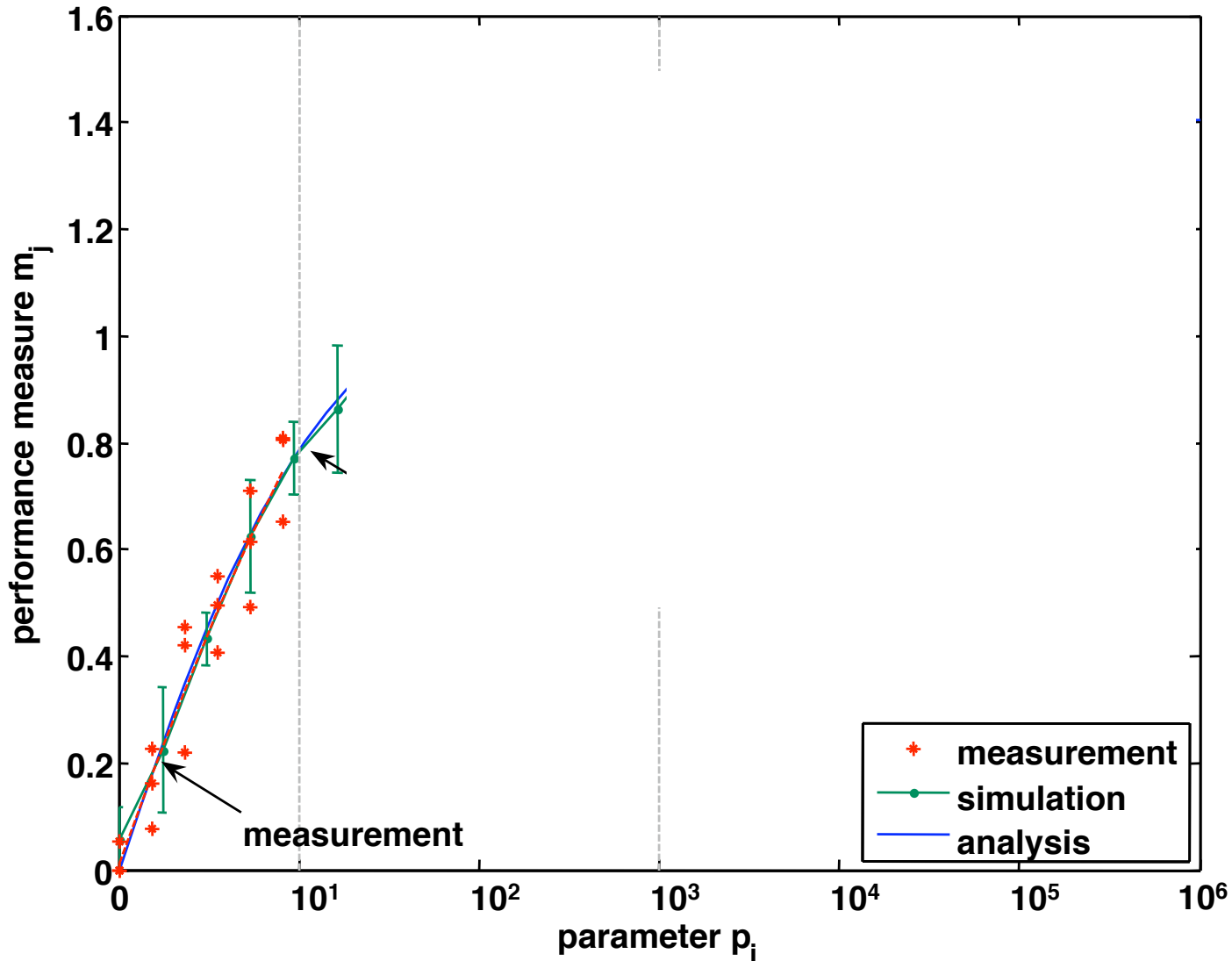   - G-Lab Phase 1

3. **Initial Use Cases and federation need**
   - Prerequisites for test cases
   - Layering and positioning of experiments
   - Examples of use cases
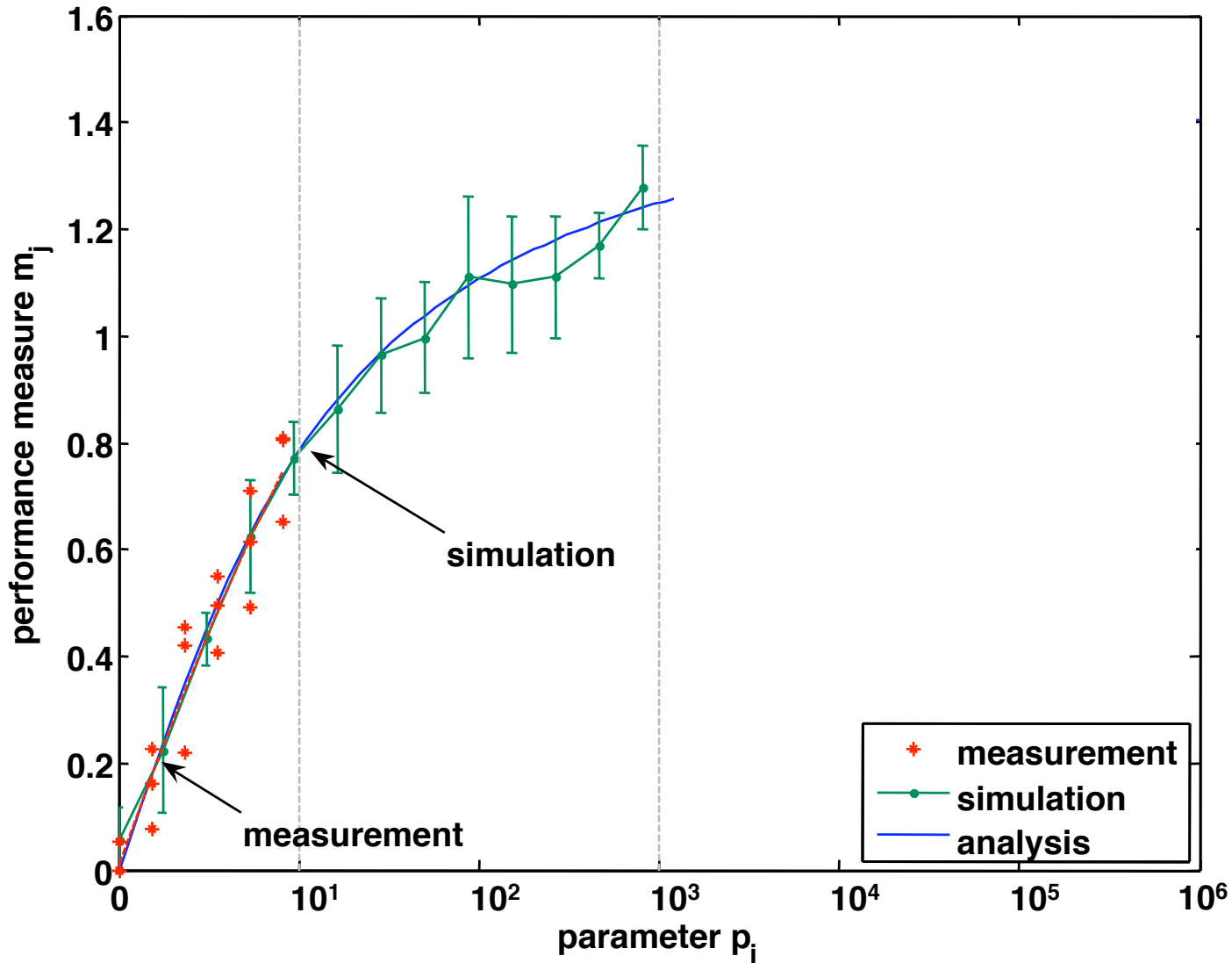   - Some thoughts on federation

4. **Challenges**

Testbeds and experimental facilities

analytical studies

experiment-driven research

generic testbed & experimental facilities

adaptable testbed & experimental facilities

dedicated testbeds

Measurement, Simulation, Analysis

Measurement, Simulation, Analysis

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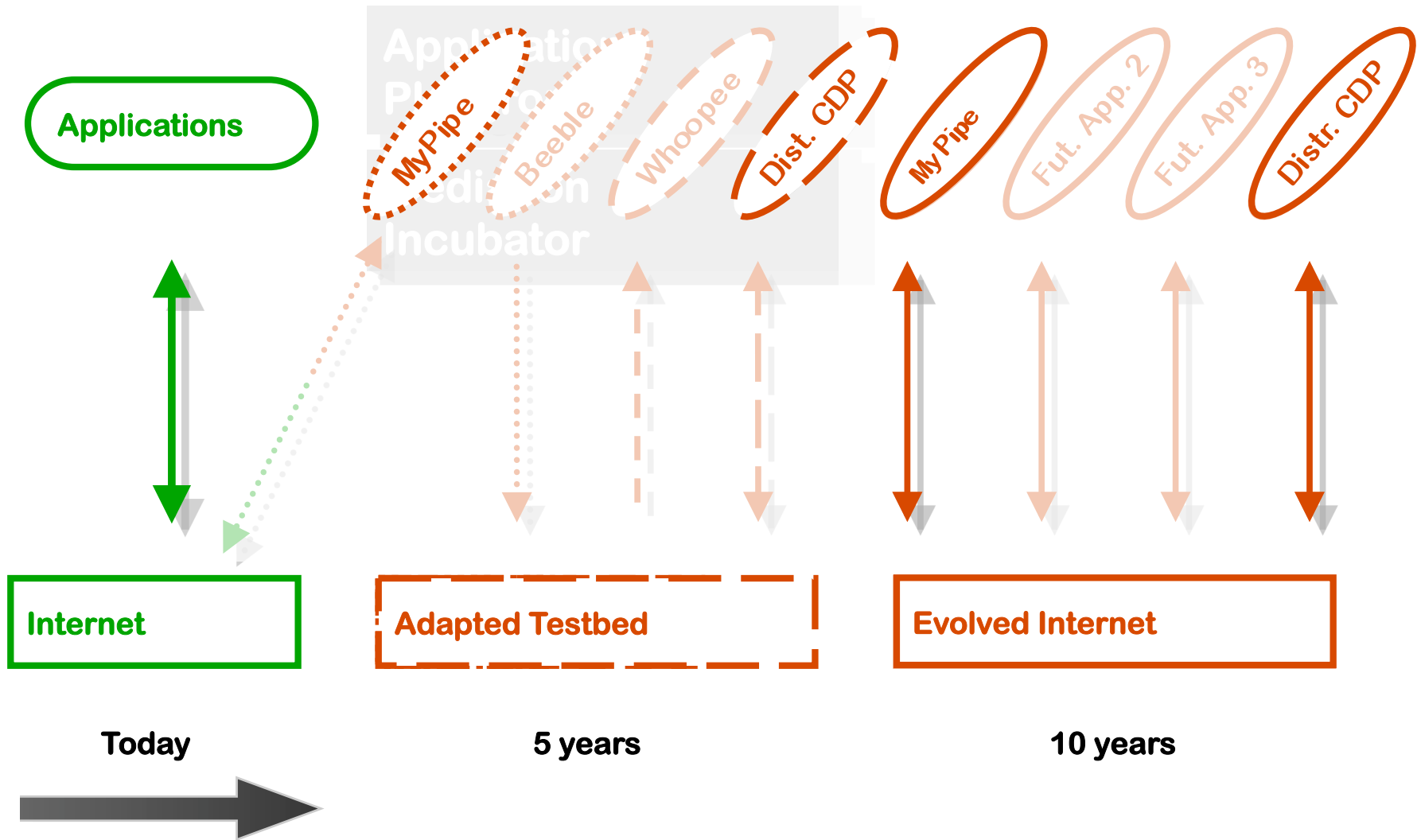   - Some thoughts on federation

4. **Challenges**

Experimental facility and its adaptation

Applications

Internet

MyPipe Beeble Whoopee Dist. CDP

Adapted Testbed

MyPipe Fut. App. 2 Fut. App. 3 Distr. CDP

Evolved Internet

Today   **5 years**   **10 years**

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG
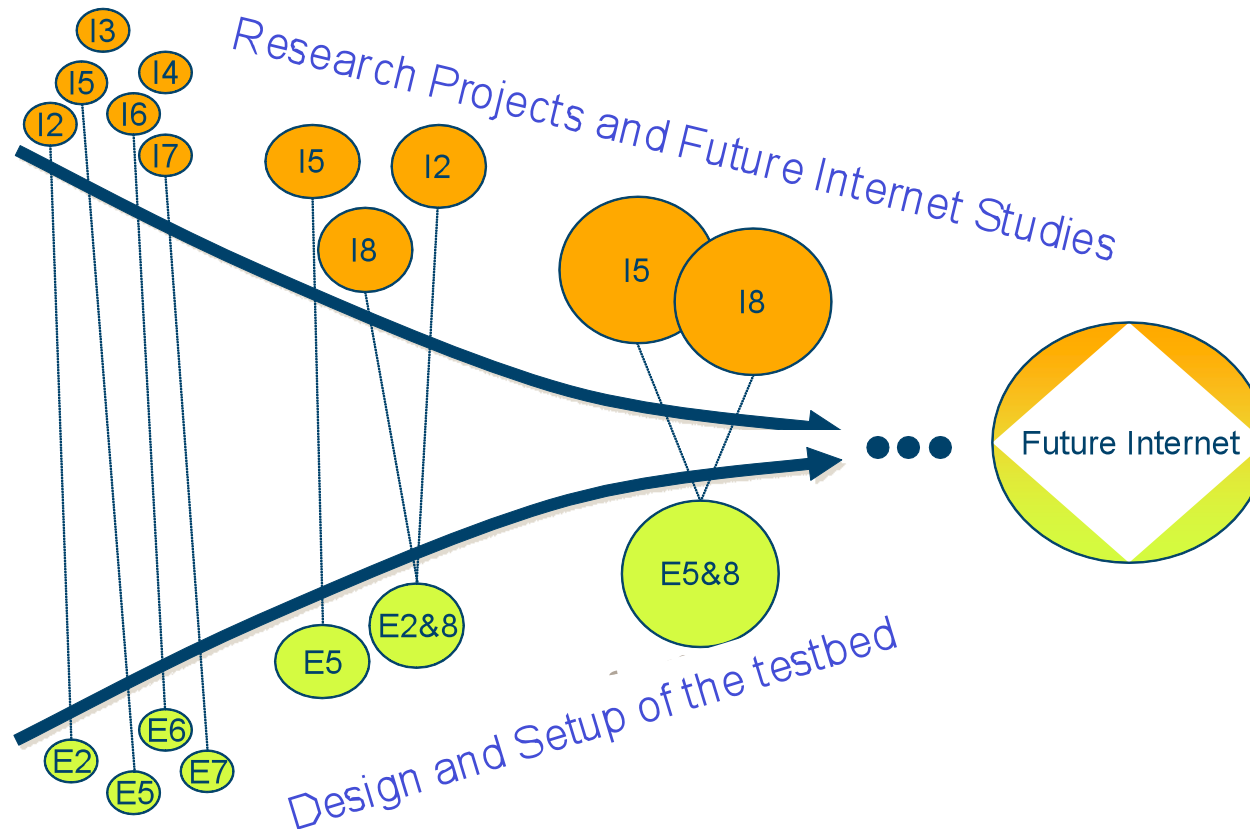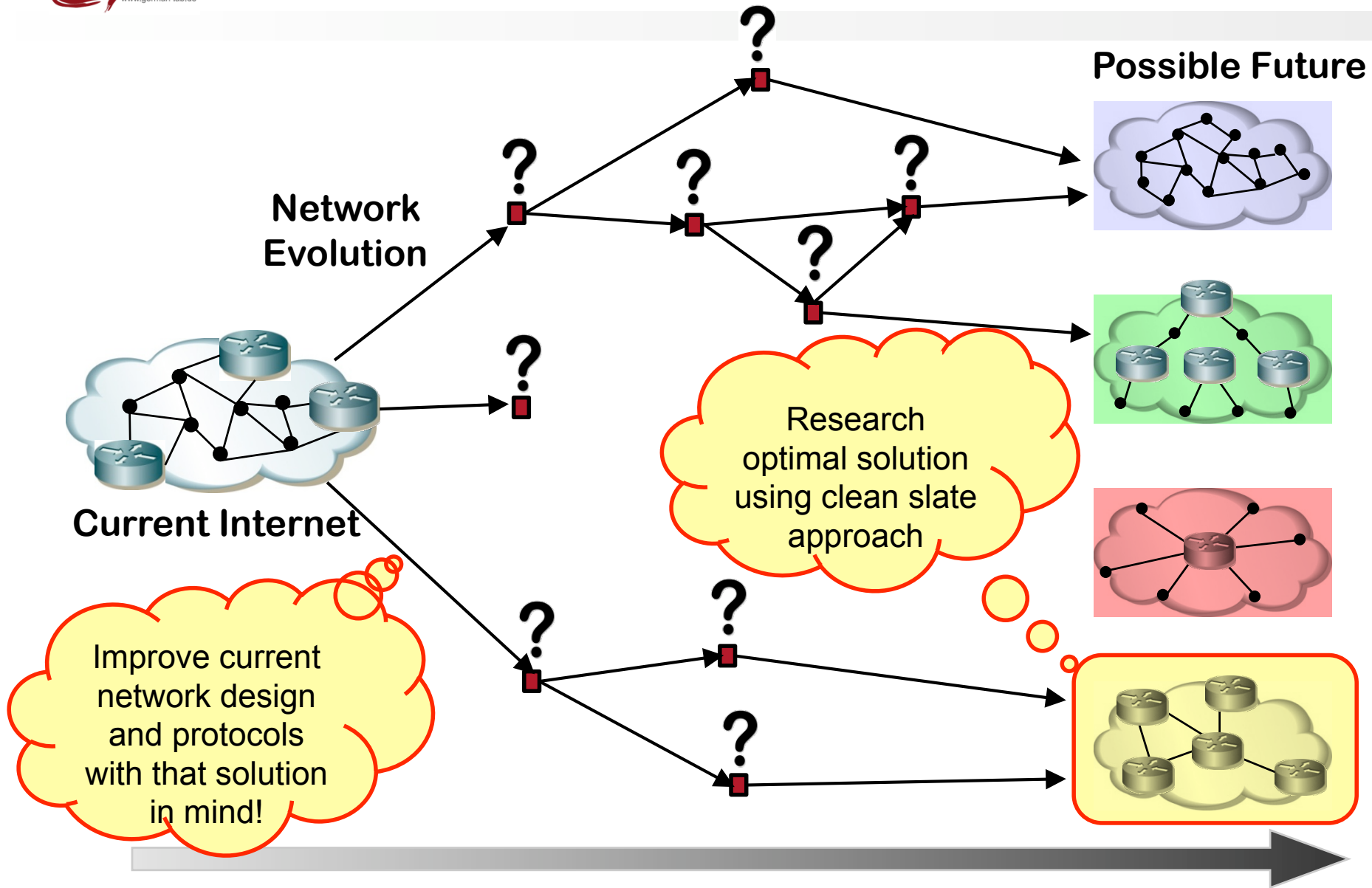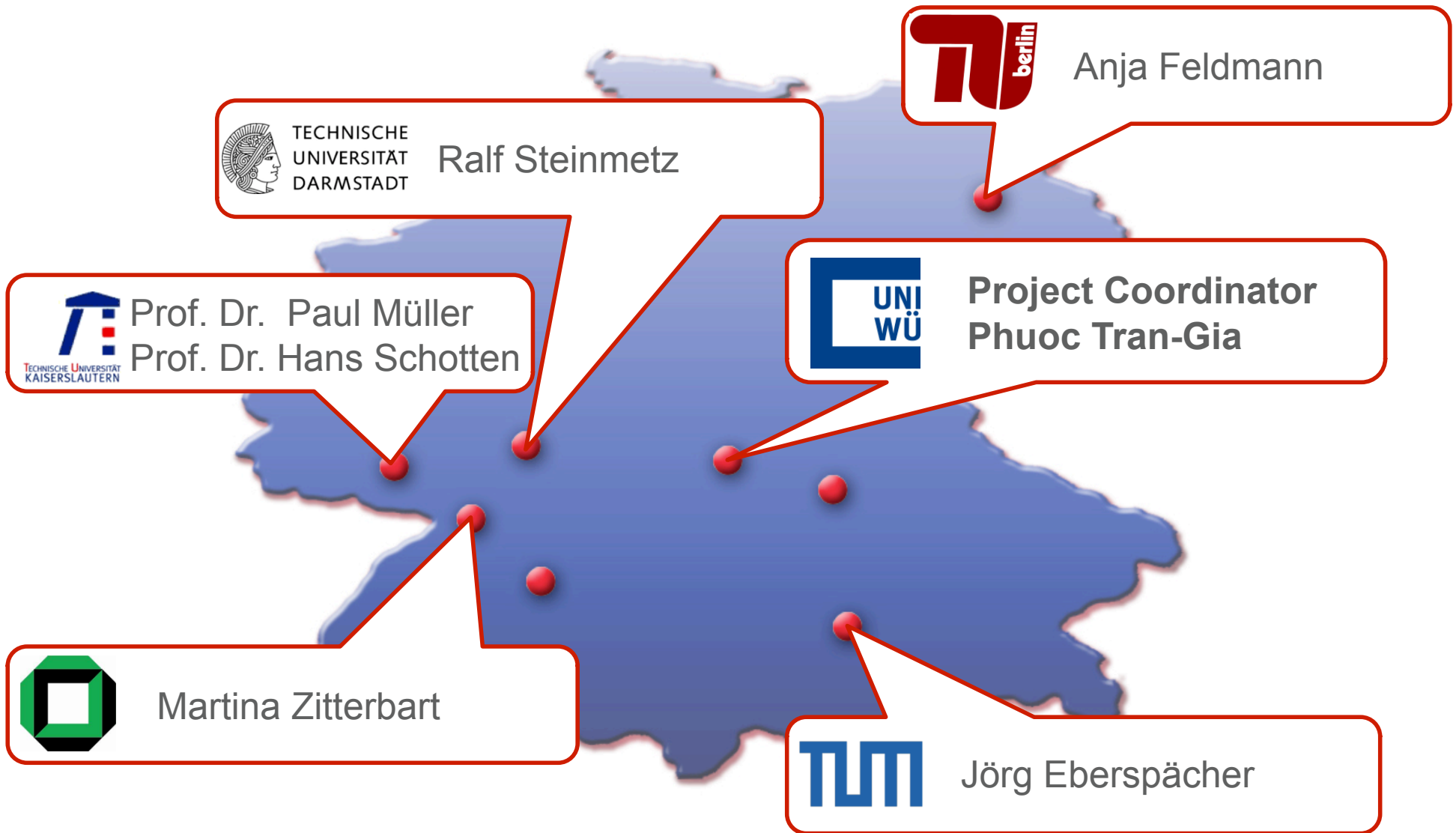
G-Lab project objective and pathway

▶ Provide an experimental platform for studies on mechanisms, protocols and applications towards Future Internet

G-Lab view: Pathway(s) towards Future Network(s)
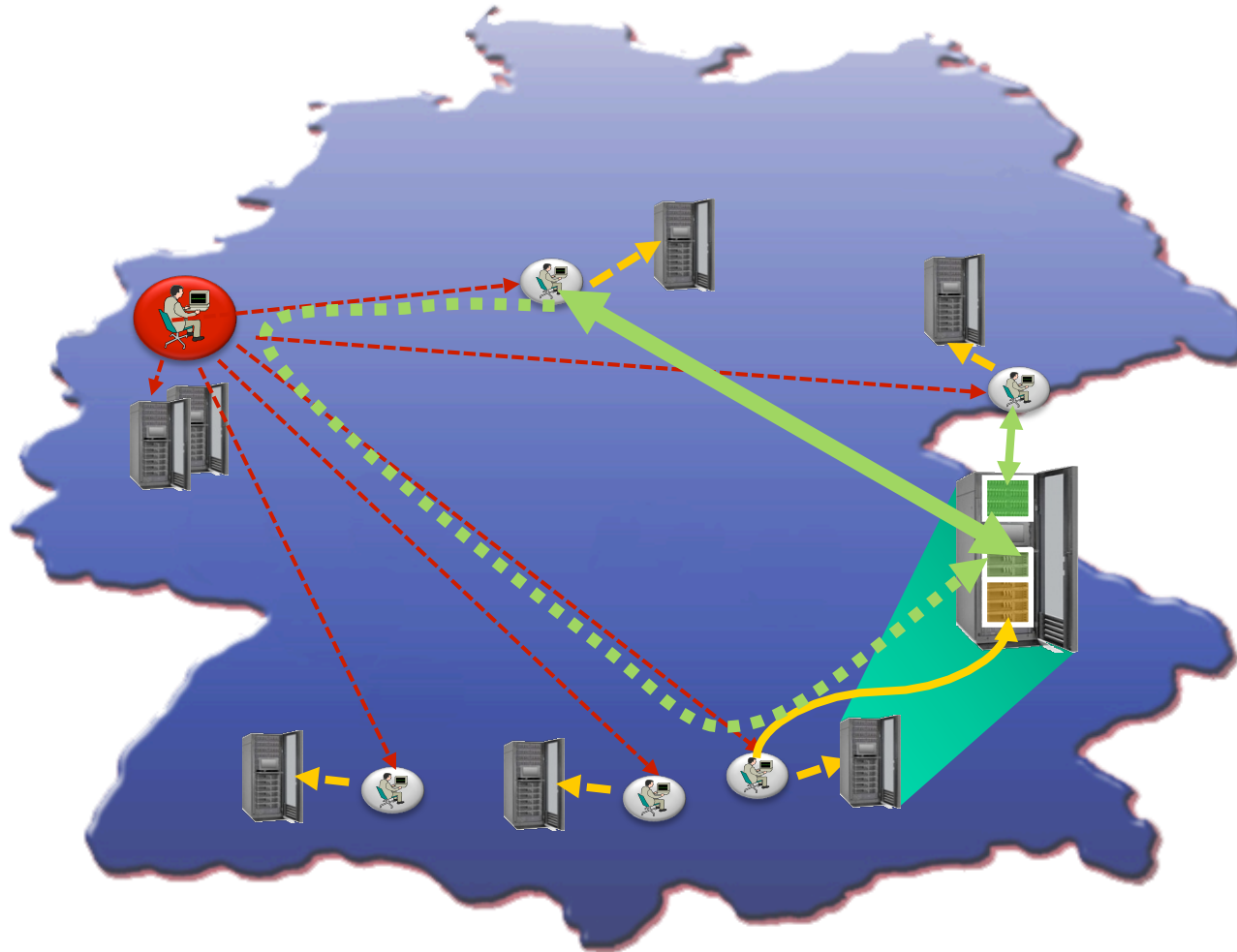

Possible Future

Network Evolution

Current Internet

Research optimal solution using clean slate approach

Improve current network design and protocols with that solution in mind!

Timeline

Prof. Phuoc Tran-Gia

G-Lab University Project Partner

Anja Feldmann

Ralf Steinmetz

**Project Coordinator
Phuoc Tran-Gia**

Prof. Dr. Paul Müller
Prof. Dr. Hans Schotten

Martina Zitterbart

Jörg Eberspächer

G-Lab Phase1 Experimental Facility

- ▶ Homogeneous hardware

- ▶ Minimum of 25 nodes per side

- ▶ Central with 59 nodes (in Kaiserslautern)

- ▶ G-Lab Phase 1: around 200 nodes

G-Lab approach and project plan

▶ Building the experimental platform **together** with test cases

▶ G-Lab project plan

- total budget: ~ 11 mio€

- Phase 1 (6 partners)
  - building the experimental platform/testbed (start with Planetlab software), approximately 200 nodes
  - studies of NGN mechanisms and algorithms, explore their testability on G-Lab testbed
  - eventually modify the experimental platform

- Phase 2 (~10 projects)
  - second round of projects (call for proposal early 2009)
  - expand the experimental platform
  - Phase 2 project should have links with Phase 1 studies and/or testable on G-Lab

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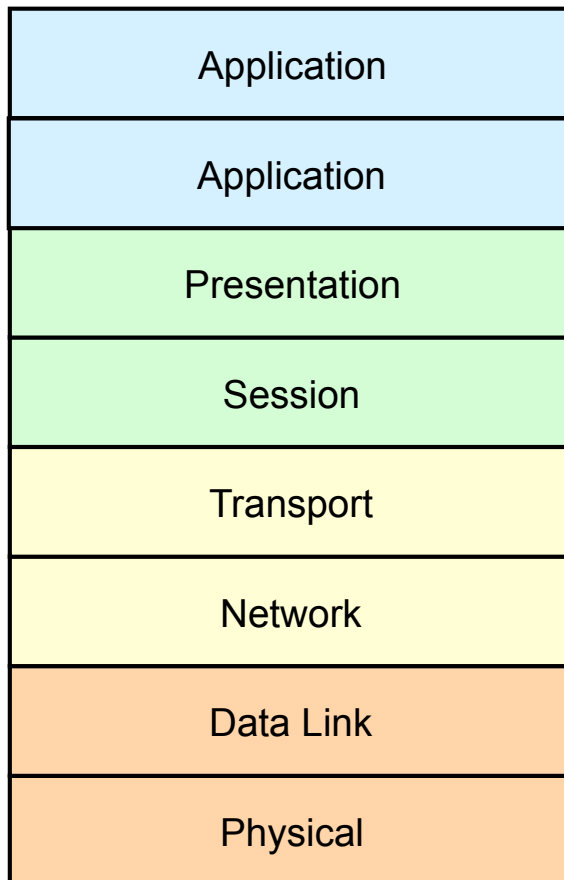   - Prerequisites for test cases
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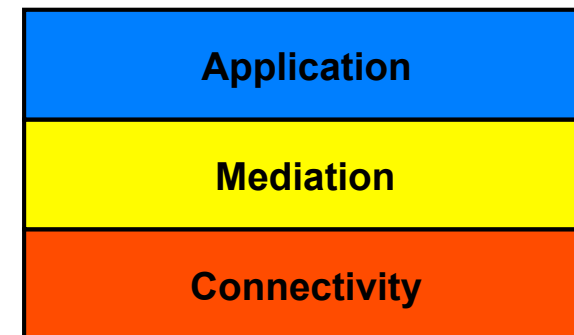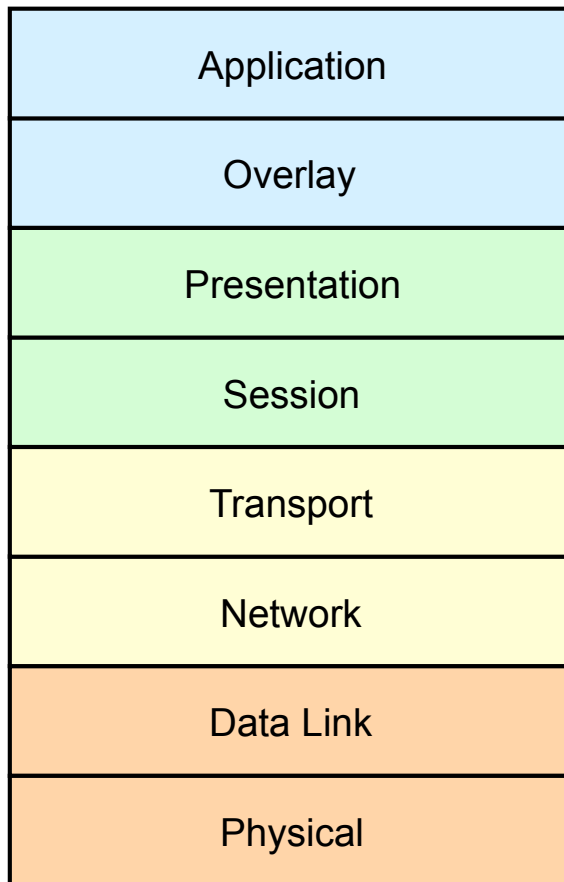   - Some thoughts on federation

4. **Challenges**

which architecture
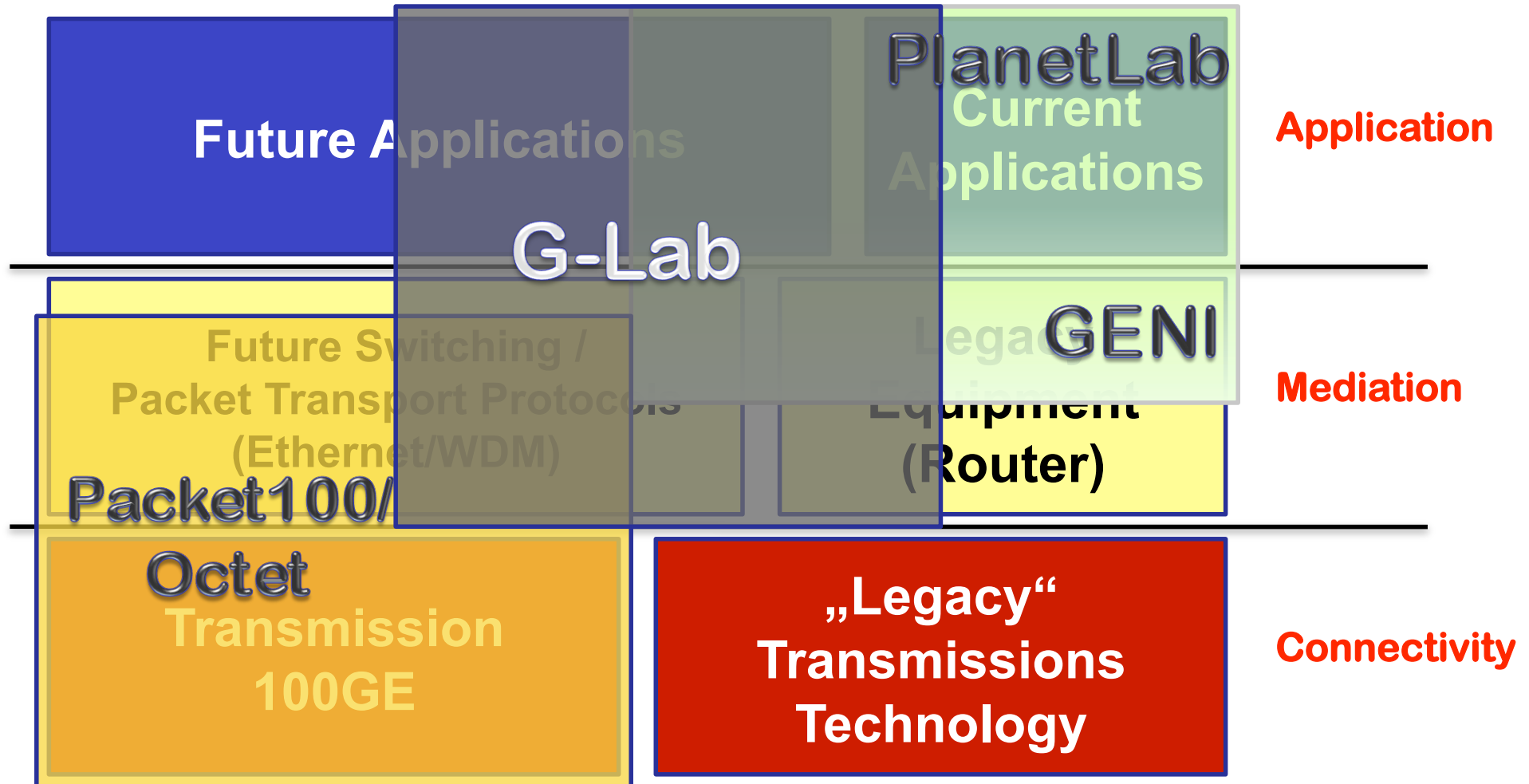# & what and where to test

Thinning the protocol architecture

| Application |
| Application |
| Presentation |
| Session |
| Transport |
| Network |
| Data Link |
| Physical |

Thinning the protocol architecture

Application
Overlay
Presentation
Session
Transport
Network
Data Link
Physical

Application
Mediation
Connectivity

Coordination of future testbeds

Application

Mediation

Connectivity

Future Applications

PlanetLab

Current Applications

G-Lab

Future Switching / Packet Transport Protocols (Ethernet/WDM)

GENI

Legacy Equipment (Router)

Packet100/

Octet Transmission 100GE

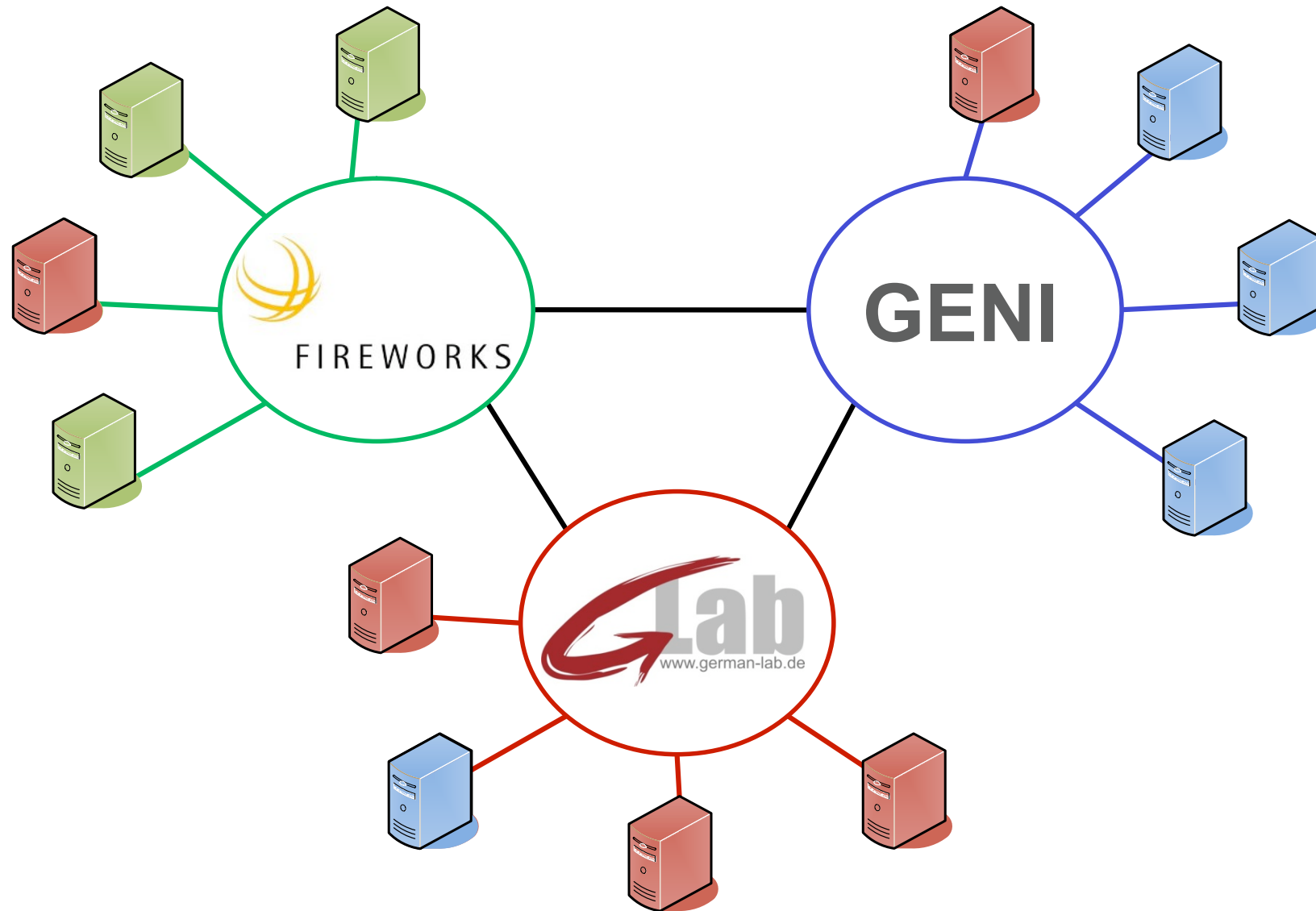„Legacy" Transmissions Technology

Potential use cases in G-Lab

▶ QoE Control for P2P-based Video Streaming
- proof-of-concept of QoE-aware feedback control
- evaluation of time dynamics of system reaction
- federated testbed helpful to allow tests on scalability and impact of delay on control loop

▶ Test of a Future Internet routing proposal
- emulation of routing proposal, e.g. GLI
- proof-of-concept, (small-scale) scalability and performance tests

▶ Locality of P2P traffic
- test of a FP7 project: SmoothIT
- reduction of costs due to P2P traffic in inter-domain environments
- implementation of architecture and protocol concept to exchange information between overlay and underlay
- worldwide federated testbed helpful to include various ISPs

Potential use cases in G-Lab

▶ Path computation element (PCE) in MPLS
  - functional and performance tests
  - scalability consideration
  - federated testbed needed

▶ Service-oriented grid system with applications
  - P2P-SIP
  - SpoVNet

▶ Definition and ad hoc roll-out of virtual networks
  - Scalability tests
  - Network management and monitoring issues

▶ Performance evaluation of DHT-based mapping service for future Internet

▶ Security concepts for decentralized systems
  - Prototypic integration of local anomaly detection and distributed collaboration of detection instances

Some thoughts about federation

▶ Needs for federation
  - federation is a need, not final aim
  - most functional and performance tests will be done locally
  - federation is crucial to test (medium-scale) scalability
  - federated testbeds important to test global system behavior

▶ Federation in G-Lab
  - start with Planetlab-like federation
  - inspect current use cases towards need to federate
  - some potential use cases need global federation
  - start negotiating with Akari/Japan, Onelab/EU, Geni/US

▶ Promoting federation
  - G-Lab phase 1: promote federation as important feature
  - Embed FP7 use cases (e.g. SmoothIT) having federated tests
  - G-Lab phase 2: inject federation as feature in Phase2 call for proposals

The International Federation of G-Lab
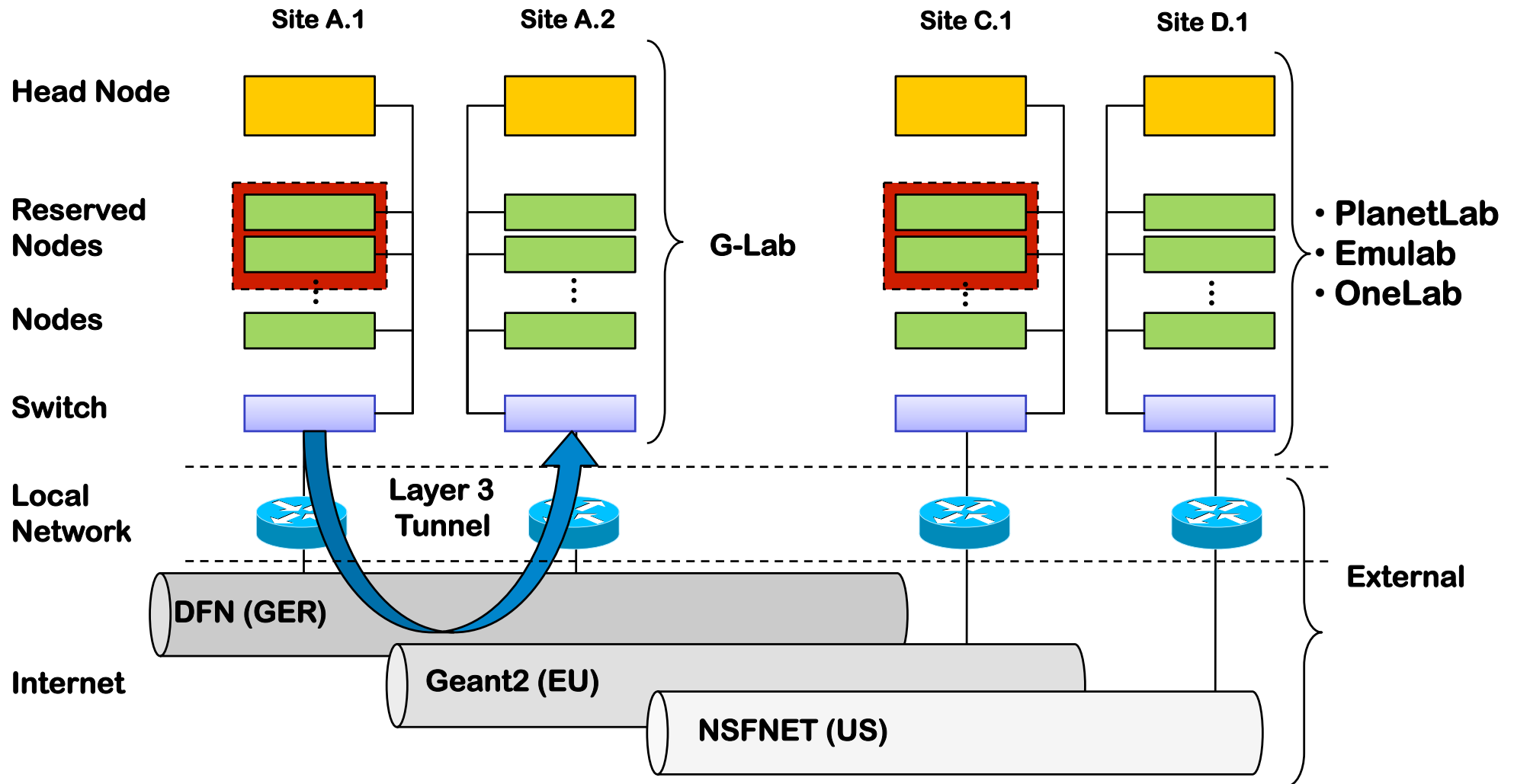
▶ Federation through different physical networks all over the world

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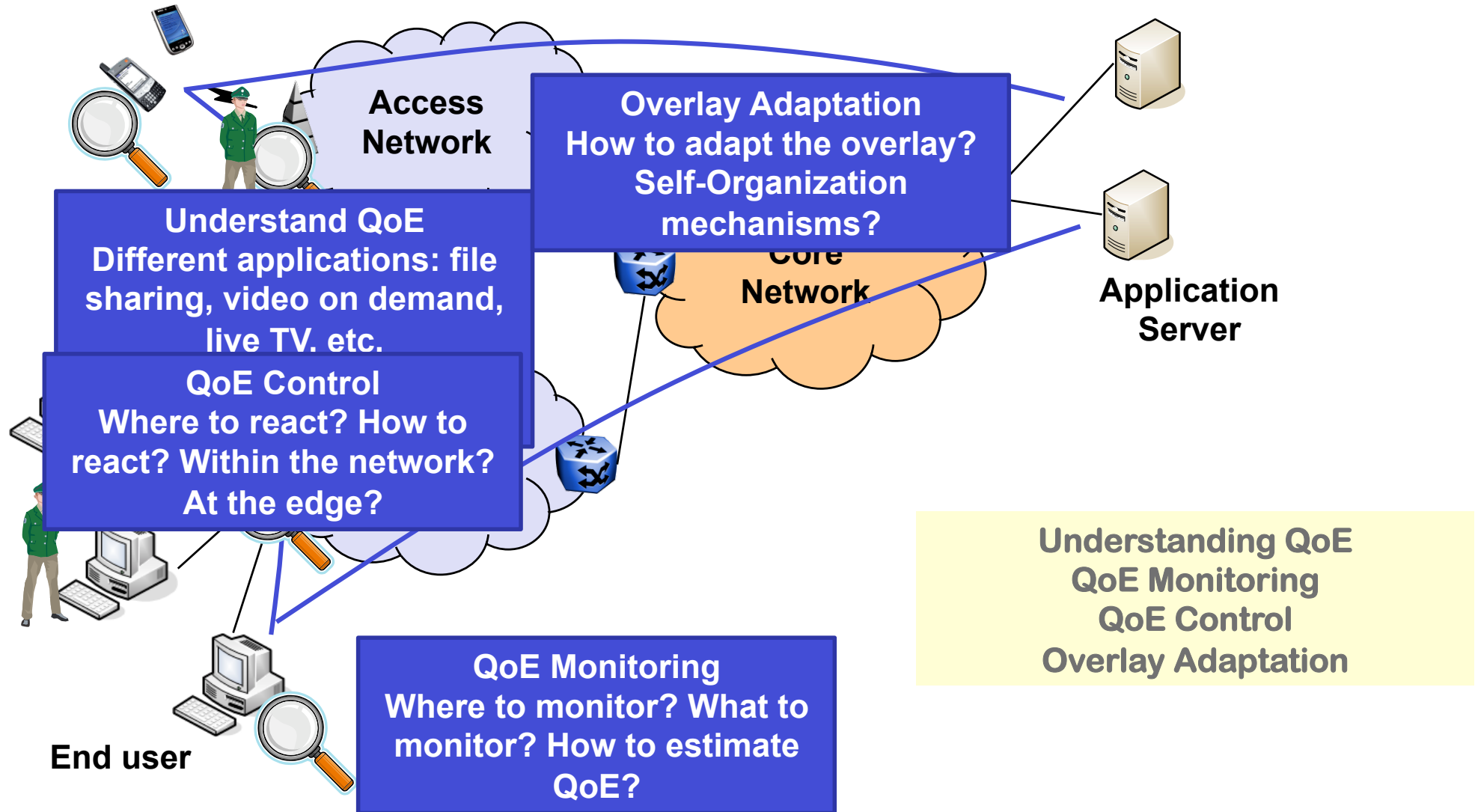   - G-Lab Phase 1

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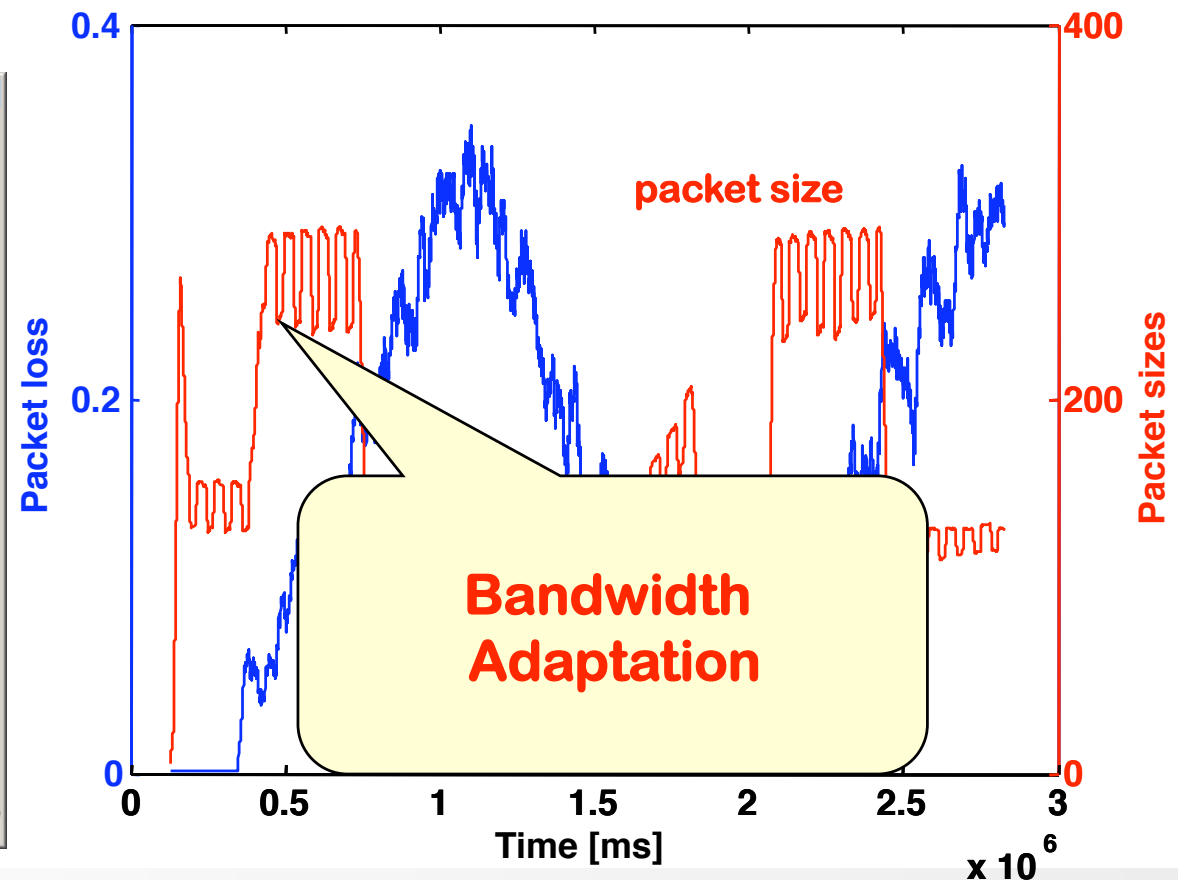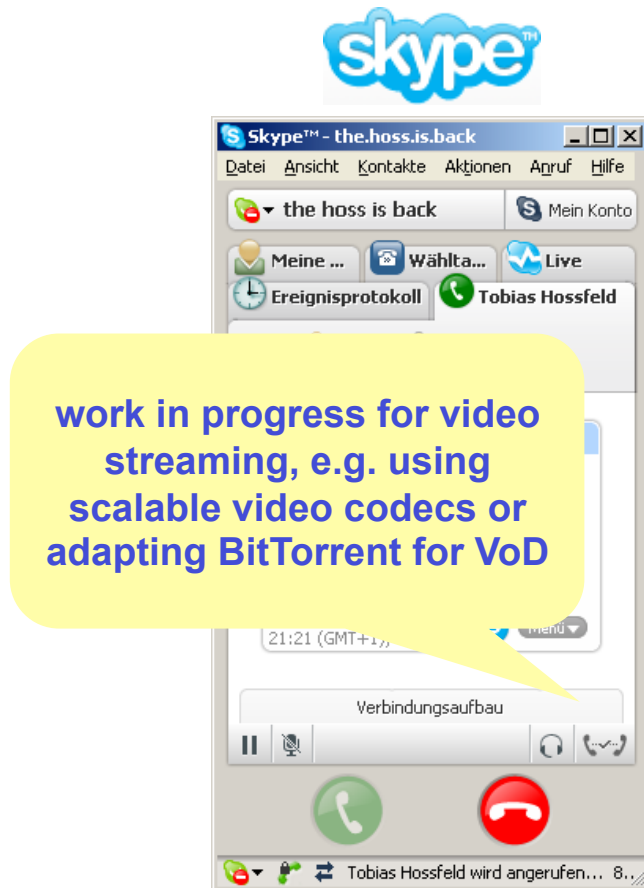   - Some thoughts on federation

4. **Challenges**

Thank you !

Example:
Video-on-Demand Streaming

Scientific Questions

Access Network

Core Network

Application Server

End user

Overlay Adaptation
How to adapt the overlay?
Self-Organization mechanisms?

Understand QoE
Different applications: file sharing, video on demand, live TV. etc.

QoE Control
Where to react? How to react? Within the network? At the edge?

QoE Monitoring
Where to monitor? What to monitor? How to estimate QoE?

Understanding QoE
QoE Monitoring
QoE Control
Overlay Adaptation

- ▶ Proof-of-concept of QoE-aware feedback control
- ▶ Evaluation of time dynamics of system's reaction

Prof. Phuoc Tran-Gia

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Potential use cases in G-Lab

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Example:
Locality of P2P traffic
(FP7-SmoothIT)

SmoothIT FP7 Project

Project Coordinator

Prof. Burkhard Stiller

University of Zurich

Email: stiller@ifi.uzh.ch

*Project website: http://www.smoothit.org*

Duration: *Jan 2008 – Dec 2010*
**Total Cost:** *4.4mio€*
EC Contribution: *3.0mio€*

Contract Number: INFSO-ICT-216259

Partners:

▶ *University of Zurich (CH)*

▶ *Technische Universität Darmstadt (DE)*

▶ *DoCoMo Communications Laboratories Europe GmbH (DE)*

▶ *Athens University of Economics and Business (GR)*

▶ *Julius-Maximilians Universität Würzburg (DE)*

▶ *AGH University of Science and Technology (PL)*

▶ *PrimeTel Limited (CY)*

▶ *INTRACOM S.A. Telecom Solutions (GR)*
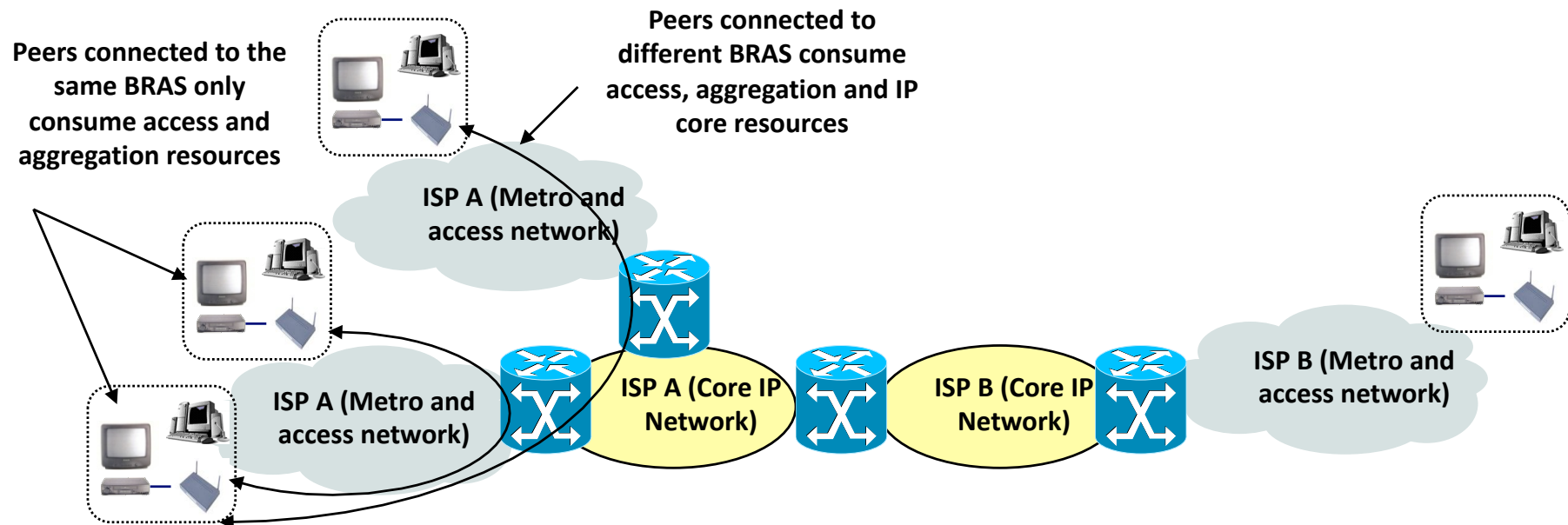
▶ *Telefónica Investigación y Desarrollo (ES)*
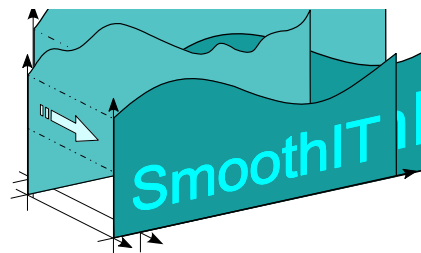
SmoothIT Goal
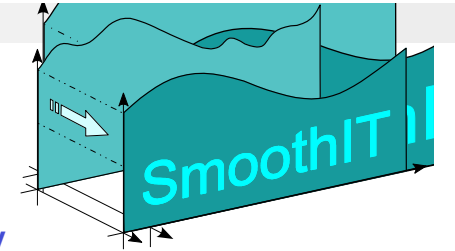
▶ Current situation in P2P applications and traffic
- significant and increasing amount of P2P traffic
- suboptimal peer selection due to information asymmetry
  – Underlay *topology*, incl. *routing metrics & values*, unknown to overlay
  – Overlay *requirements,* incl. traffic characteristics, unknown to underlay

▶ Consequence
- Non-optimized overlay traffic in the underlay
  – Higher costs in (a) underlay
  – Lower QoS in (b) overlay and for (c) application providers
- Conventional traffic management techniques not suitable

▶ Goal of the SmoothIT project
- Bridge overlay with underlay
- Apply Economic Traffic Management (ETM)
- Optimize traffic and achieve win-win-win situation for all parties

SmoothIT Example: Locality of P2P Traffic

▶ As higher the percentage of "multidomain" traffic as higher the network resources consumption and total costs

▶ Internal P2P traffic does not consume interconnection bandwidth

▶ Traffic locality may reduce both network investments and transit costs

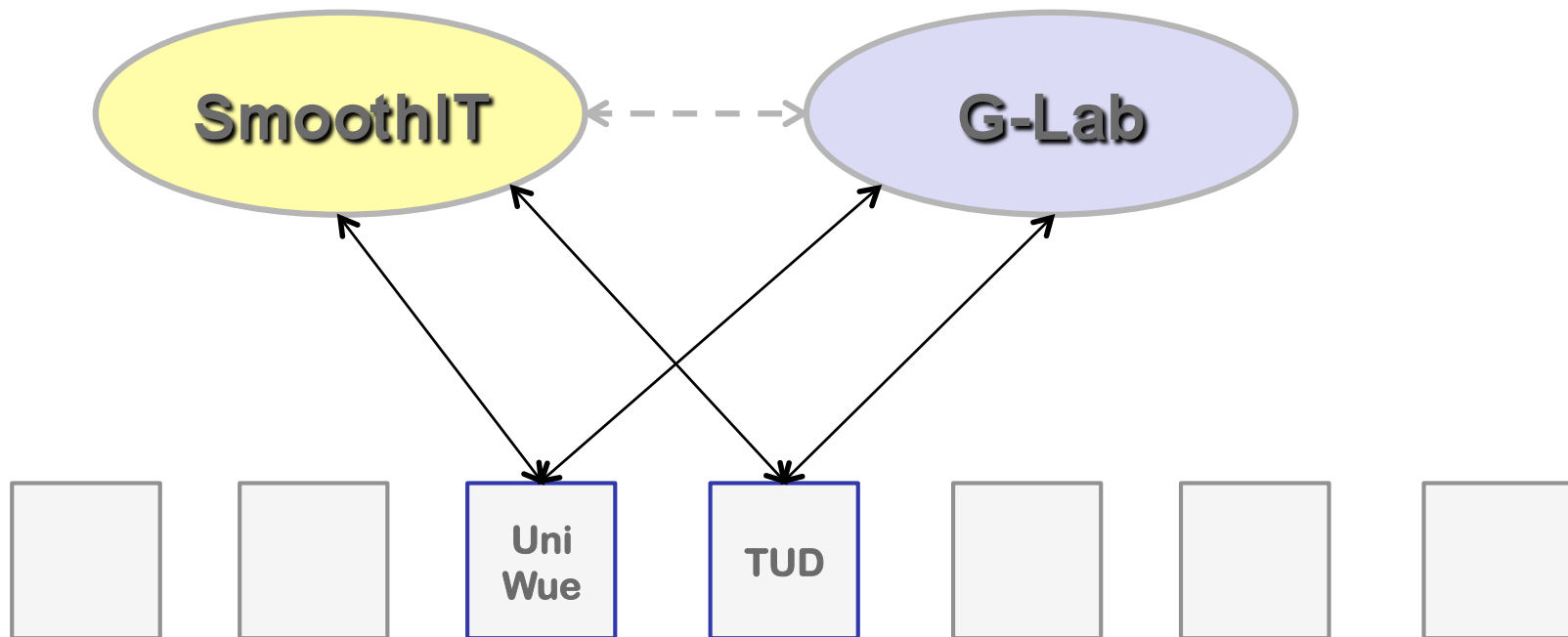▶ How to promote traffic locality? Economic Traffic Management

Peers connected to the same BRAS only consume access and aggregation resources

Peers connected to different BRAS consume access, aggregation and IP core resources

ISP A (Metro and access network)

ISP A (Metro and access network)

ISP A (Core IP Network)

ISP B (Core IP Network)

ISP B (Metro and access network)

Testing SmoothIT in G-Lab

▶ Advantages of federation
- larger number of nodes
- heterogeneous resulting testbed
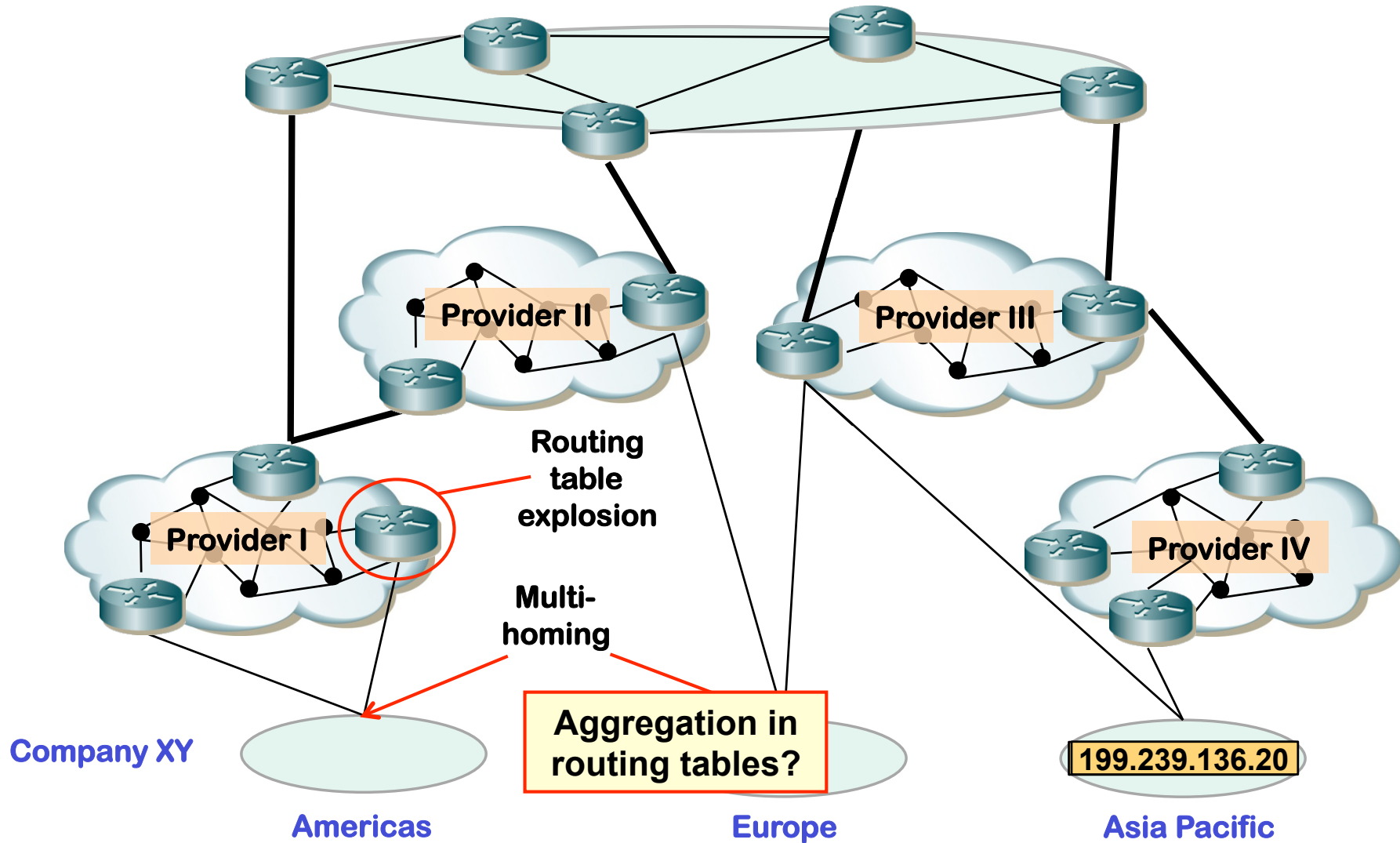- realistic, spatial distribution

▶ Features of SmoothIT tested in G-Lab
- Underlay-Overlay information exchange in SmoothIT architecture
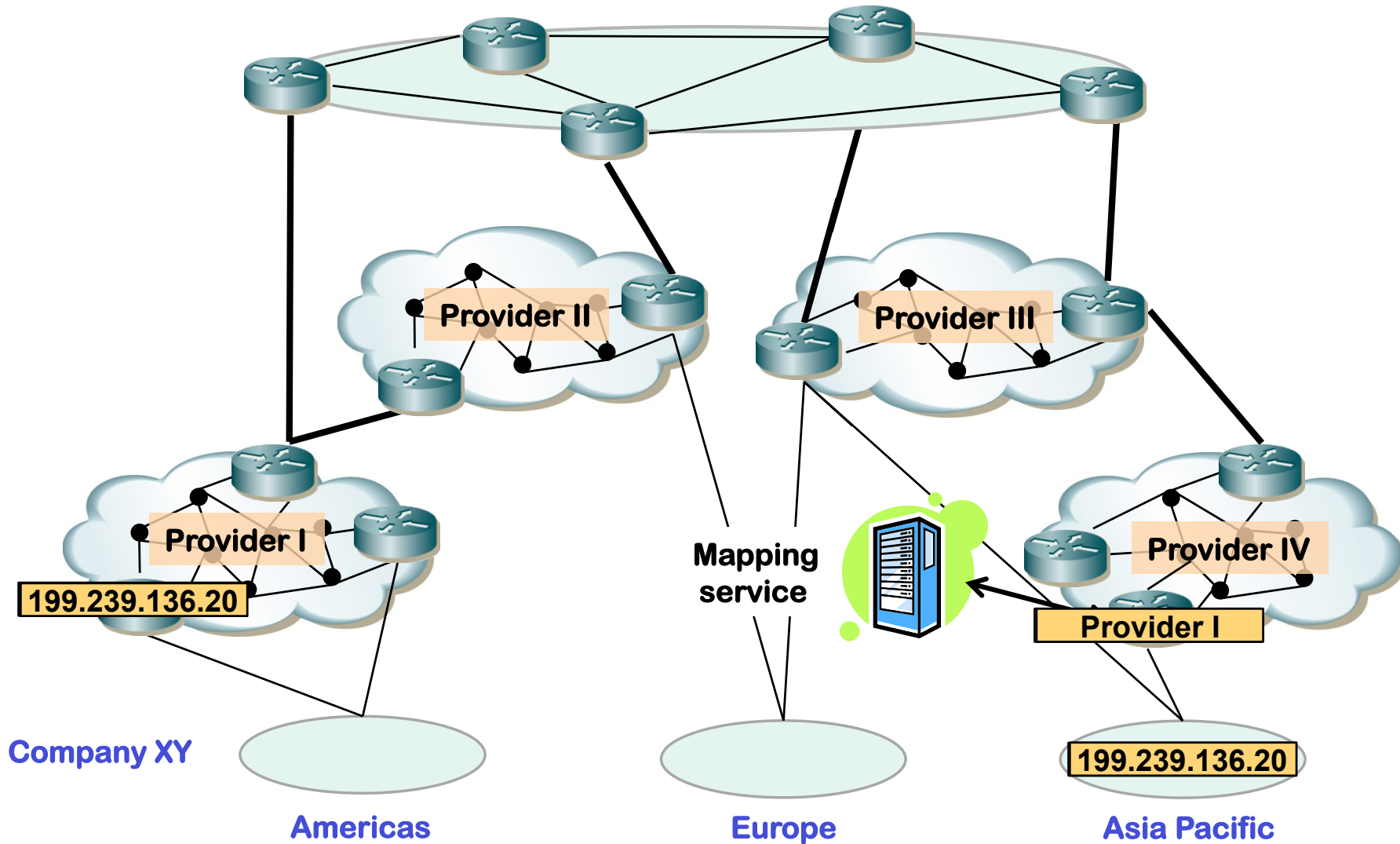- how P2P traffic can be kept local

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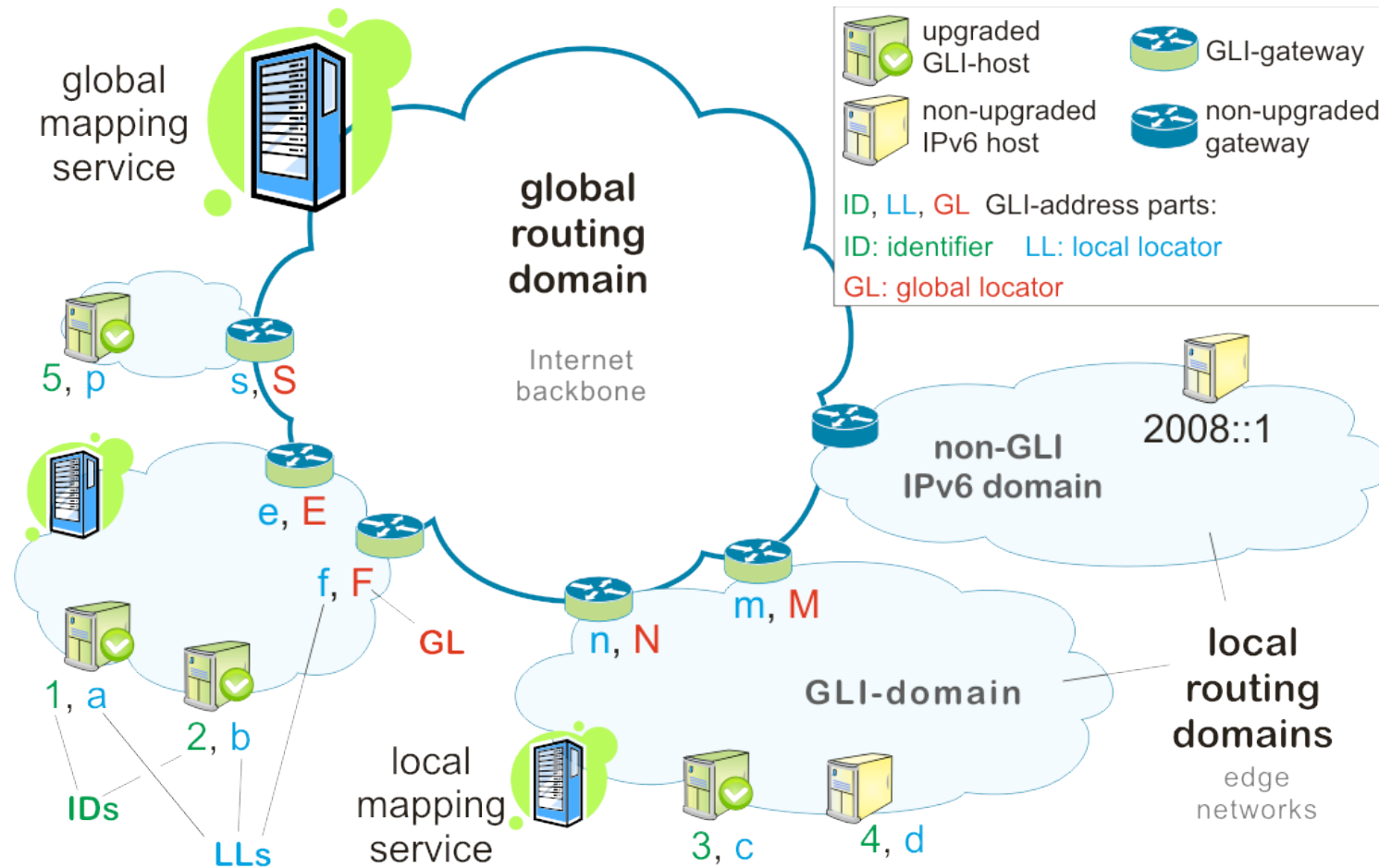# Example:
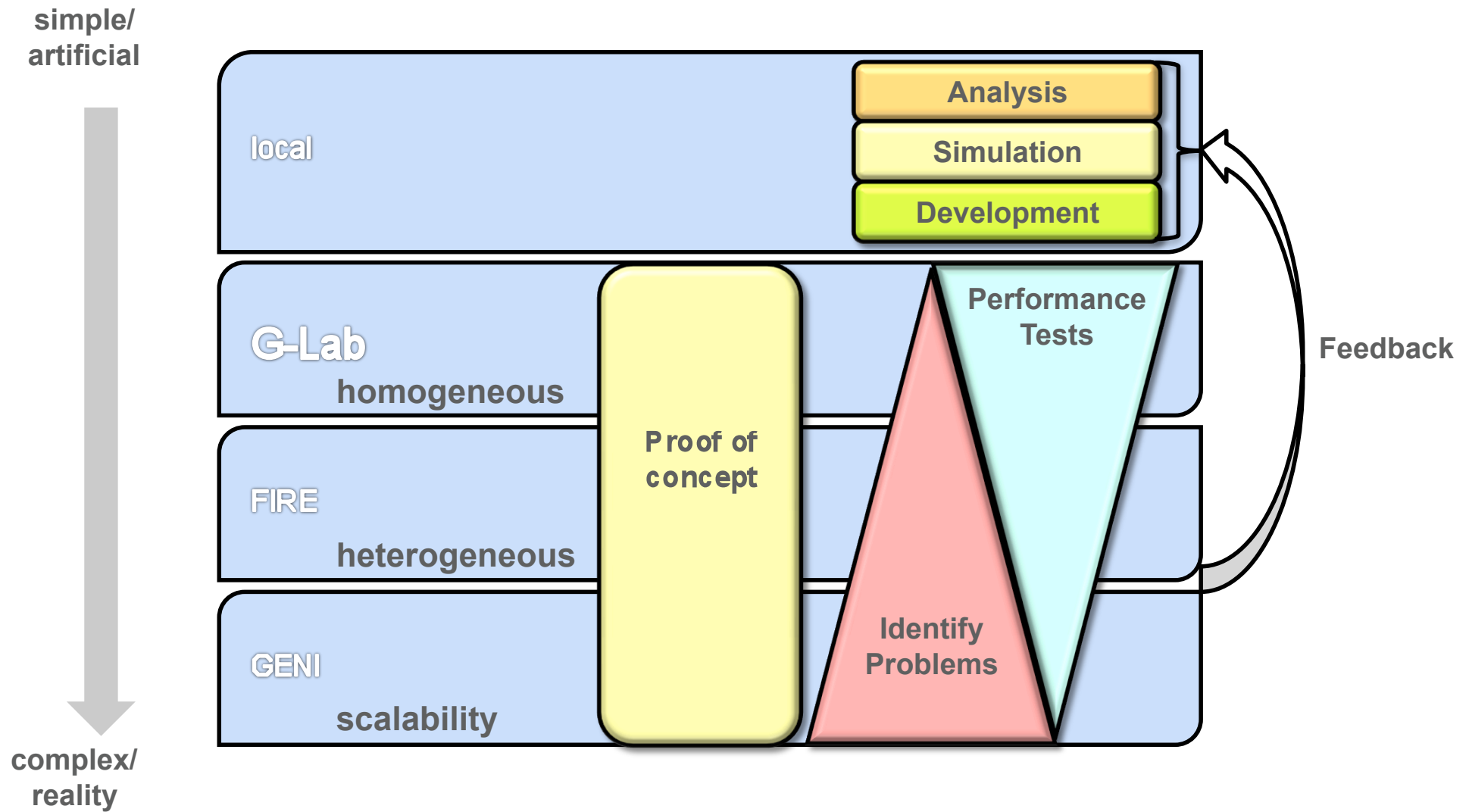# Next-Generation Routing

Current Internet Routing

Routing table explosion
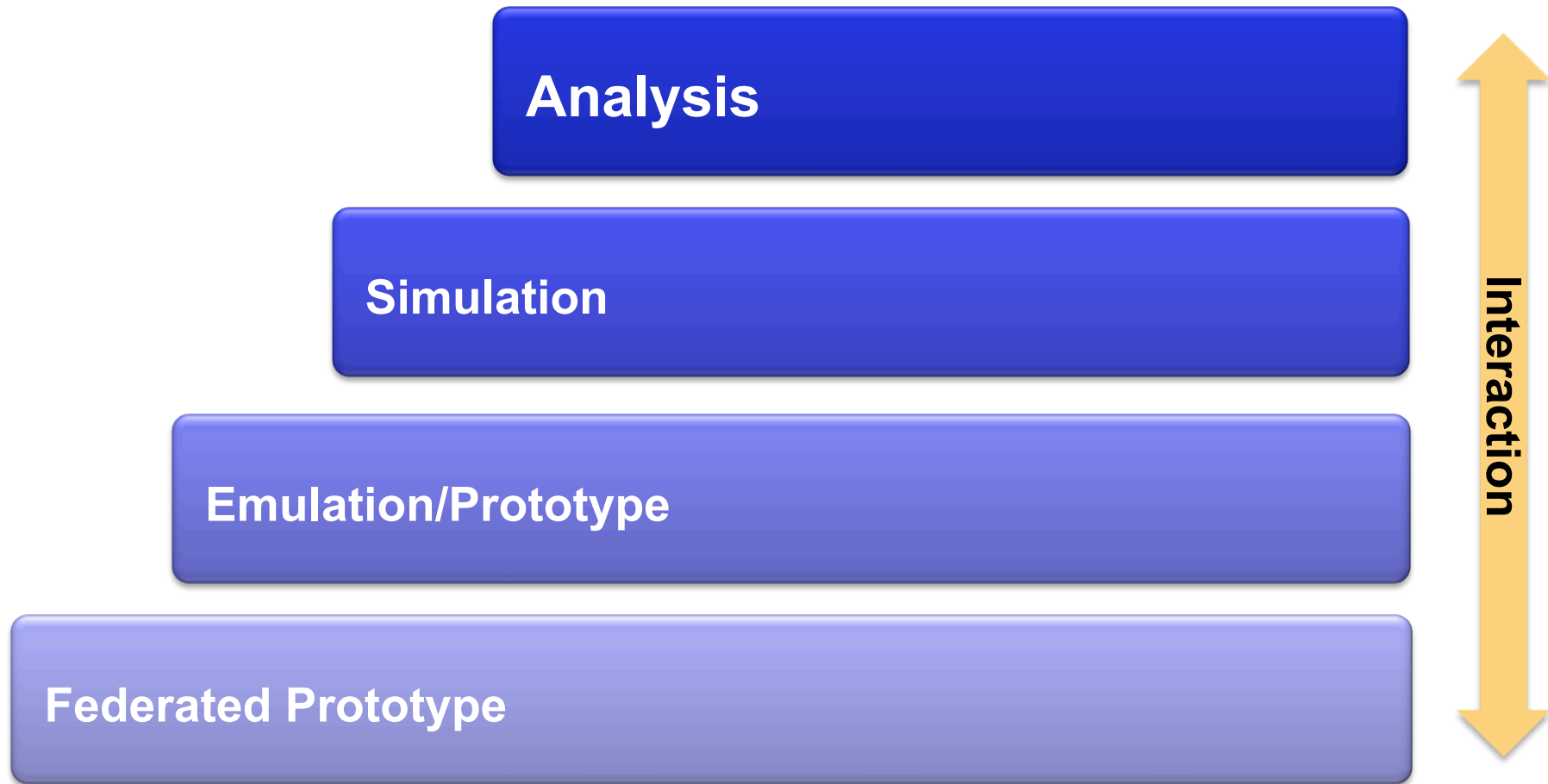
Multi-homing

Aggregation in routing tables?

Company XY

Provider I

Provider II

Provider III

Provider IV

199.239.136.20

Americas

Europe

Asia Pacific

Provider II

Provider III

Provider I

199.239.136.20

Mapping service

Provider IV

Provider I

199.239.136.20

Company XY

Americas

Europe

Asia Pacific

BACKUP

Analysis
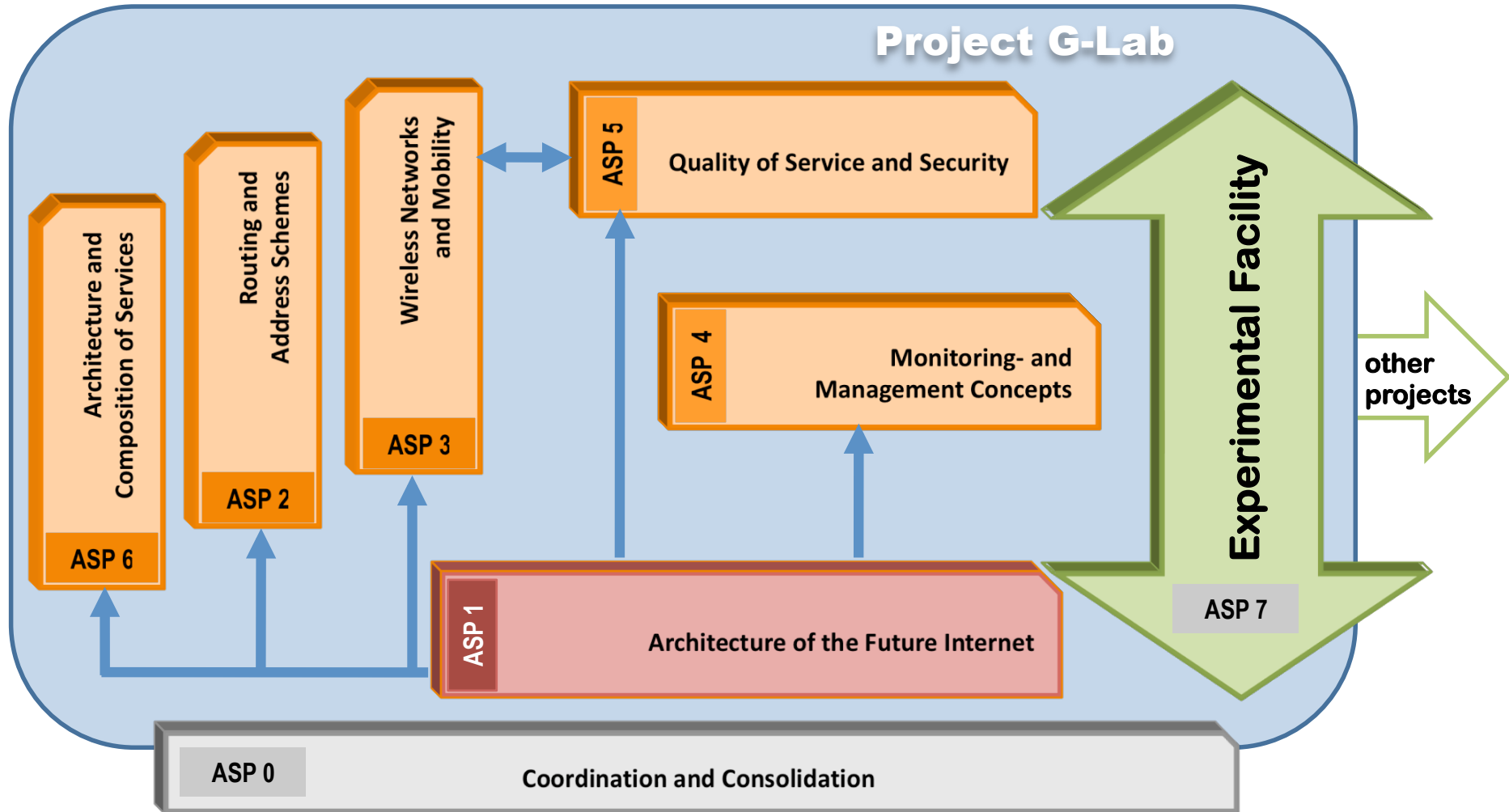
Simulation

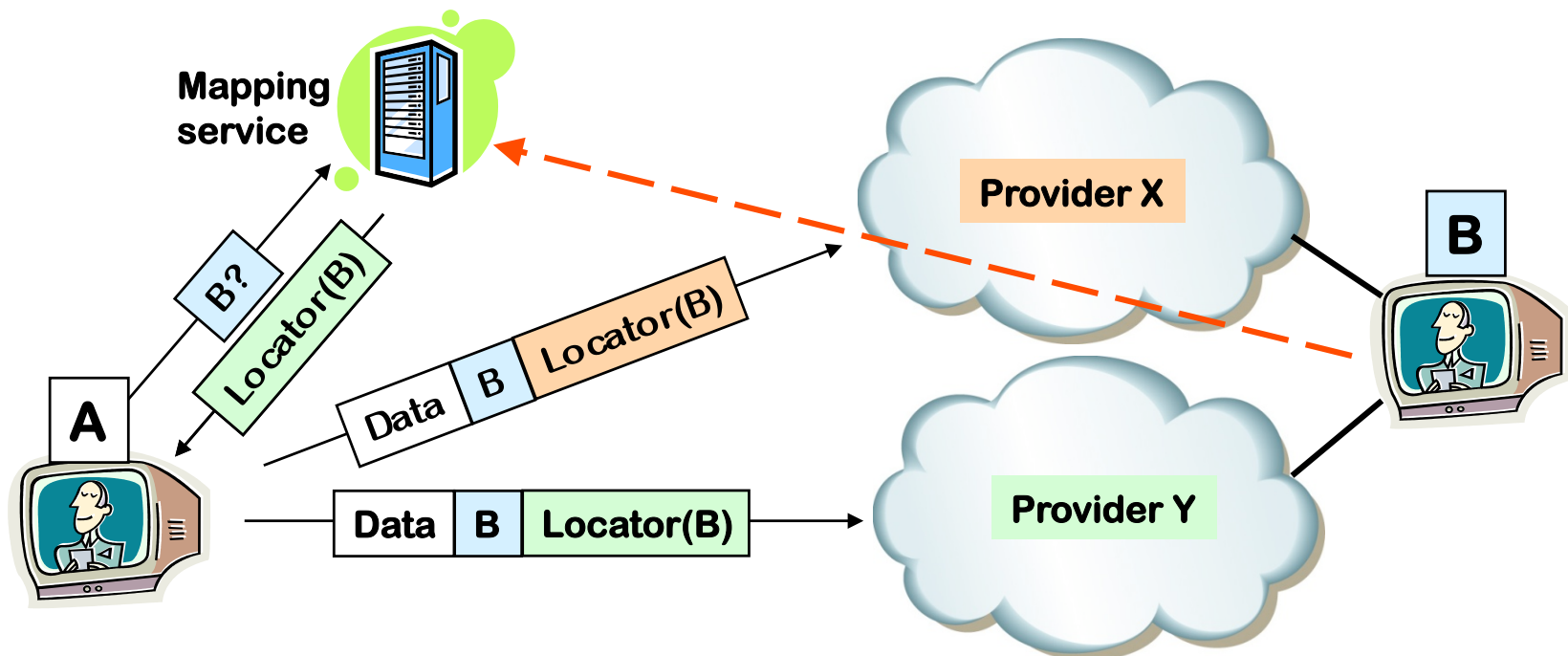**Emulation/Prototype**

Federated Prototype

Interaction

Example: Locator / Identifier Split

▶ Separation of IP addresses
  ▪ Identifier
  ▪ Locator
▶ Mapping function
  ▪ Identifier → locator

▶ Objective
  ▪ Limit growth of routing tables
▶ Open issues
  ▪ Mapping system
  ▪ Exact implementation of Loc/ID

Future is not to be predicted, but to be created

(Samsung)

GENI/FIND