An Architecture for Supporting Future Internet Applications

Sebastian Mies
Institute of Telematics, University of Karlsruhe (TH), Germany

The SpoVNet Consortium: University of Karlsruhe (ITM), University of Mannheim (PI4), University of Stuttgart (IPVS, IKR), University of Tübingen (RI)

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Future Internet

- Internet has evolved from 4-node network to ubiquituous, global communication network
- However: Patchwork design and deployment problems
  - "half" layers: IPsec, MPLS (2.5); TLS (3.5) …
  - TCP adaptations to wireless, mobile etc.
  - Multicast, MobileIP → Deployment?

  → But … is it flexible enough for the future?
- How to improve flexibility?

  → Calls for new architectures !?
  - Clean slate … time horizon of 10 years and more?
  - Overlay-based architecture … the way SpoVNet goes!

Spontaneous Virtual Networks Objectives

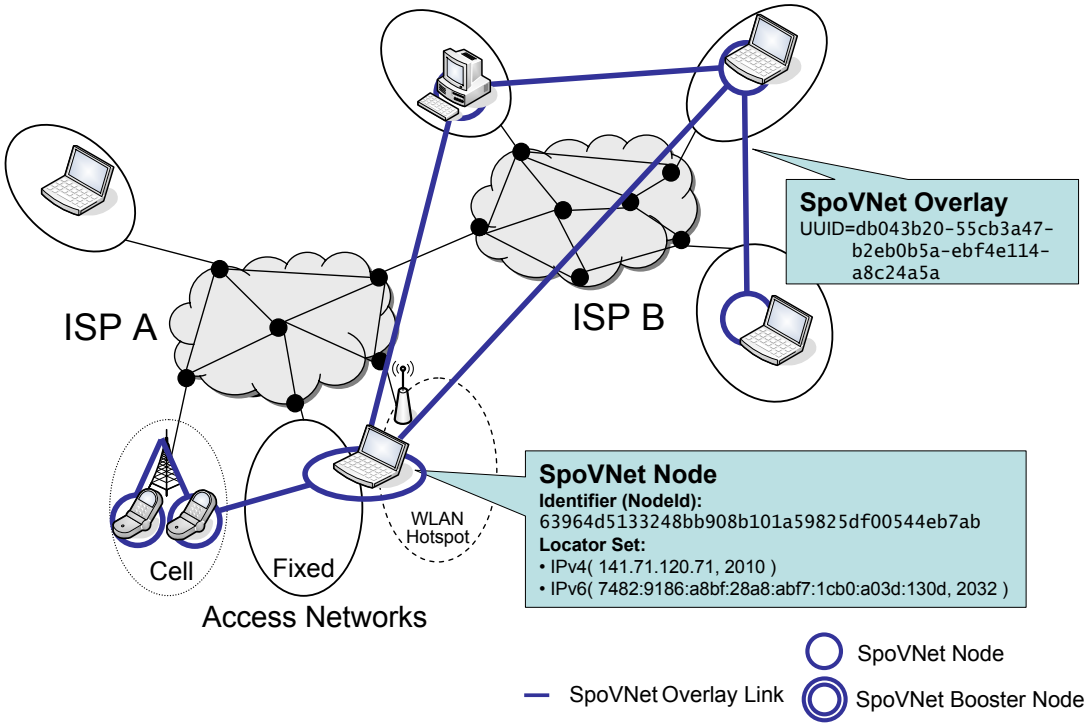
1) Provide communication services flexibly, adaptively and spontaneously on top of heterogeneous networks

2) Enable seamless transition from current to future networks

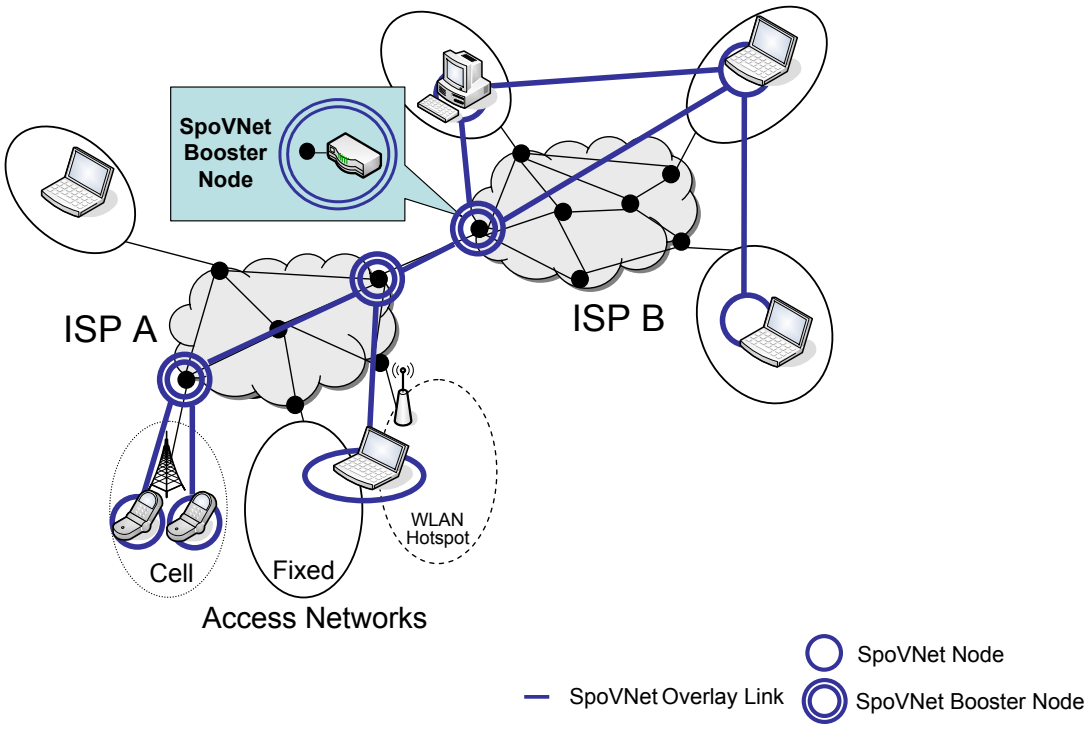
Objective 1: Communication Services

- Extensible set of services implemented by overlays
  - Spontaneous and flexible per application
  - No infrastructure support required
  - Self-organizing, scalable and robust
- Overlays designed to be underlay-aware
  - Adaptive due to cross-layer information, e.g.
    - Handover events, congestion status …
  - Handling of heterogeneous networks

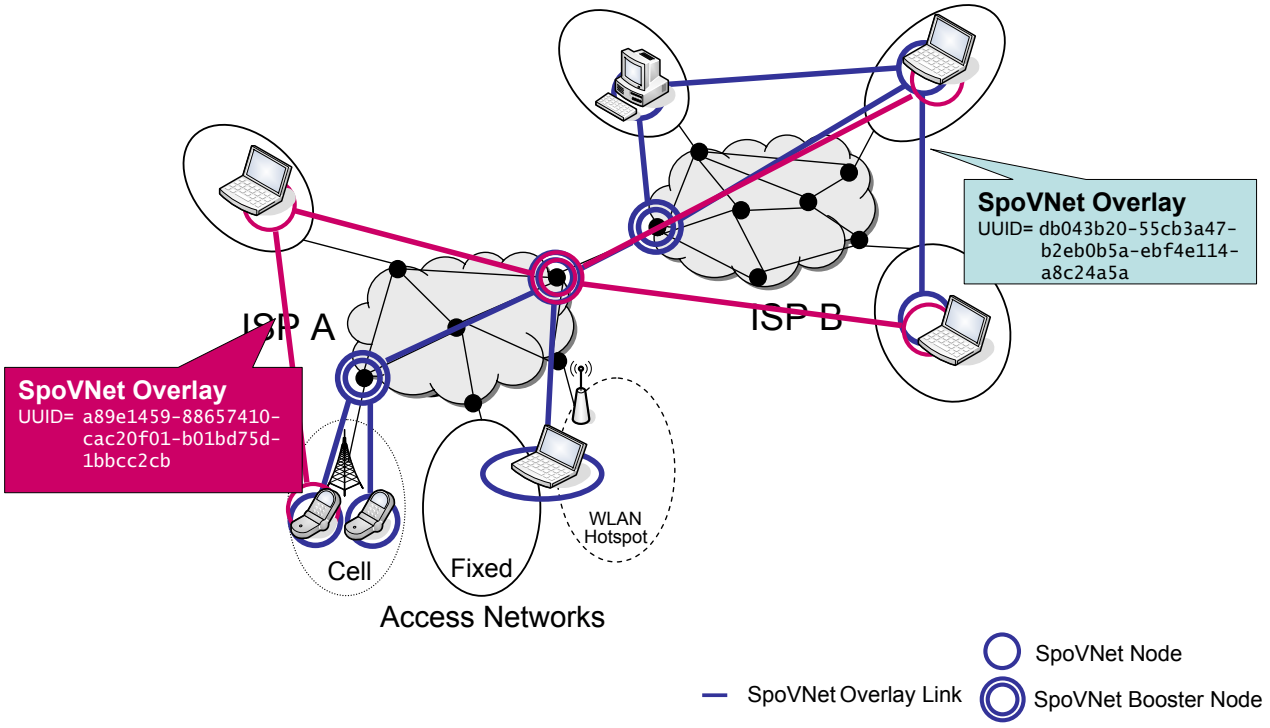
SpoVNet Overlay



SpoVNet Overlay with Booster Nodes



Multiple SpoVNet Overlays



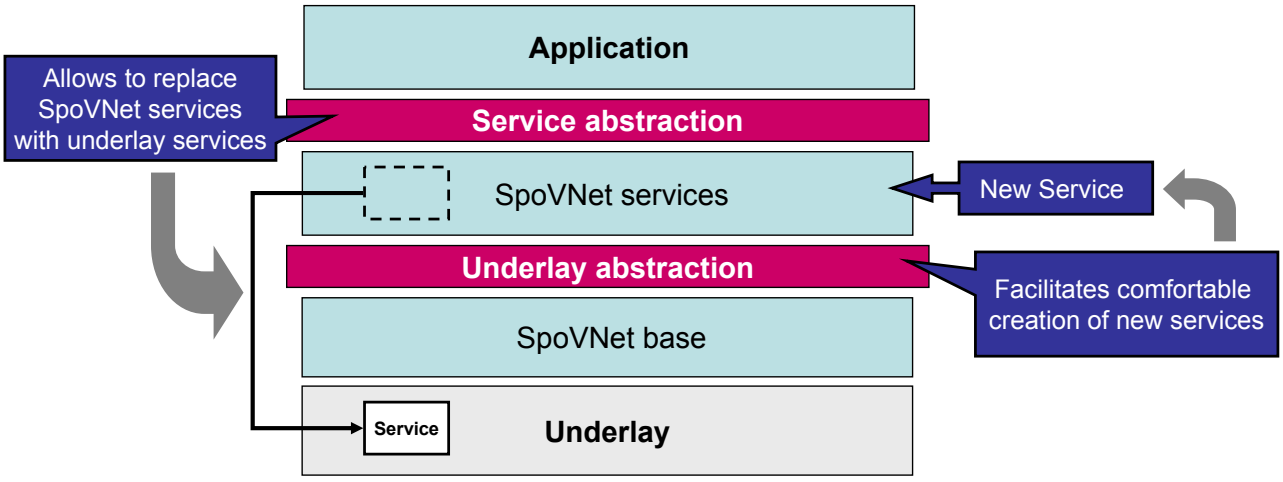
Objective 2: Seamless Transition to Future Networks

- Provide a framework that

  1) Allows comfortable creation of application supporting services in heterogeneous networks
  2) Assures that these services can be incrementally replaced by evolving underlay services

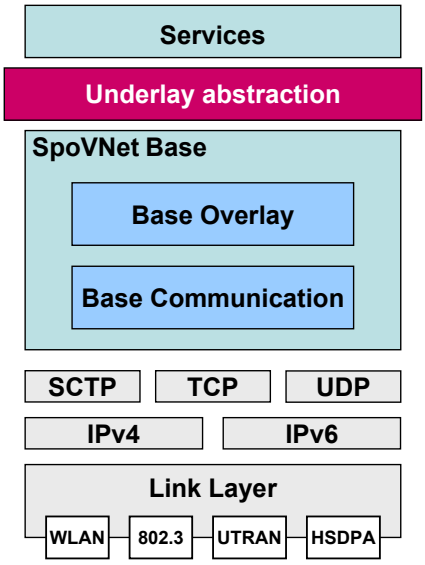
→ **Two-tier abstraction architecture**

Two-Tier Abstraction



Underlay Abstraction

- Provides abstract transport connectivity hiding mobility, multi-homing and heterogeneity

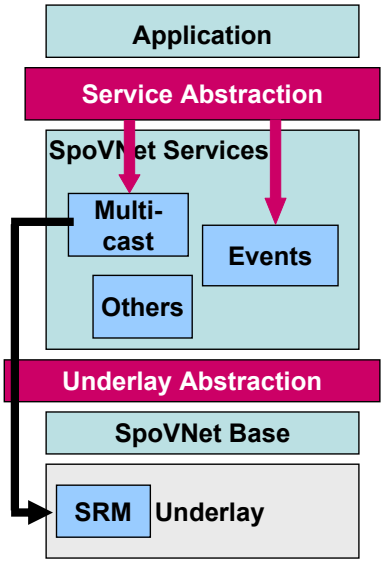


Example:

1. Service requests a connection, e.g. `CreateConnection( NodeId, QoSReq, SecurityReq )`
2. Base Overlay resolves *NodeId* to locator set
   - Handles multi-homing
3. Base Communication provides direct transport connectivity
   - Selects appropriate protocols and network access
   - Handles heterogeneity
4. Persistent connection handle is returned to service
   - Locator set may change
   - Handles mobility

Service Abstraction

- SpoVNet services supply well-defined interfaces to the application



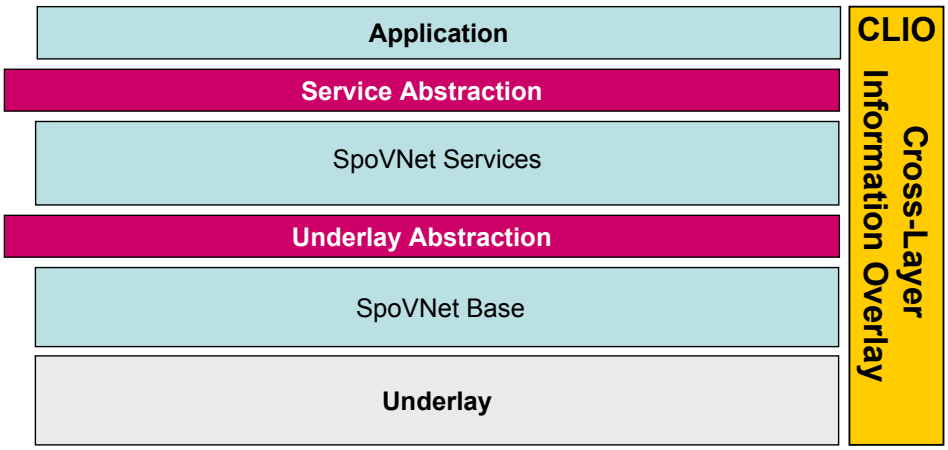
- Applications may utilize none, one or more SpoVNet services, for example

  a virtual world online game may use
  - the multicast service for data dissemination, e.g. `createGroup( MultiSource, QoSReq, SecReq )`

  and
  - the event service for in-game event notification, e.g. `subscribe( Id, EventClass, QoSReq, Listener )`

- Take advantage of incrementally evolving underlying network services
  - e.g. use source-routed multicast to enhance SpoVNet multicast service

Cross-Layer Abstraction



- The Cross-Layer Information Overlay (CLIO) provides abstract cross-layer information

  →Services and applications can now adapt autonomously to changing network conditions

… also supported by SpoVNet

- Quality-of-Service
  - Meet constraints with help from CLIO or use underlay support
    - Overlay optimization based on cross-layer information
    - Monitoring of QoS parameter values
- Security
  - Base overlay provides basic security building blocks
  - Advanced security features provided by specific services
- Robustness
  - Achieved, e.g. by supported redundancy in the overlay graph

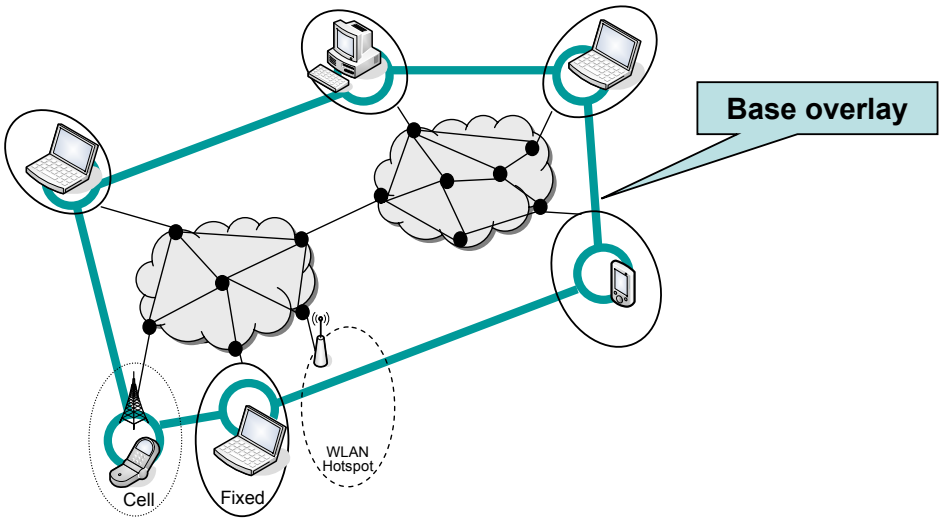
- Brief overview of the SpoVNet architecture
- Application of SpoVNet

Virtual World Online Game

- During the game, players may
  - move between access networks
  - build sub-groups
- Some communication requirements
  - Basic connectivity between players
  - Dissemination of events to players nearby
  - Intra-game group chat communication

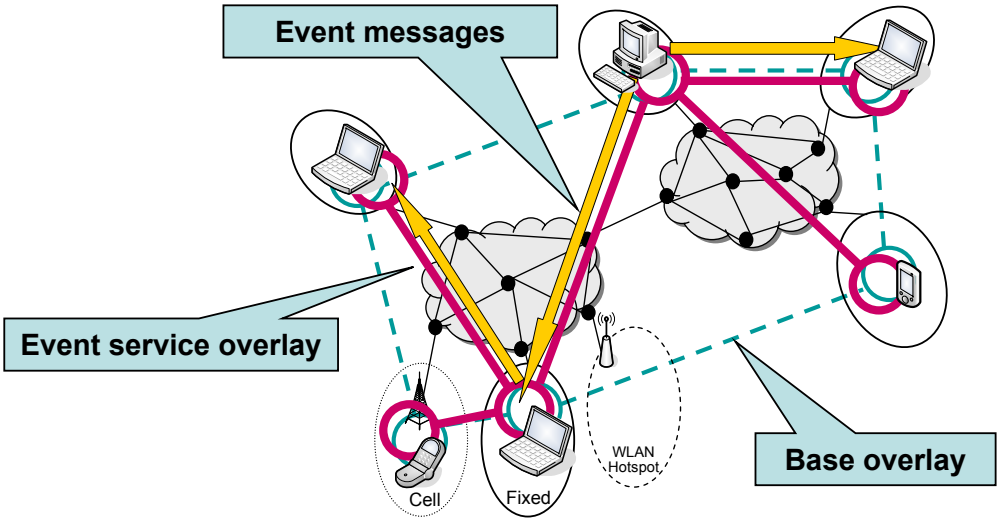
Virtual World Online Game

- Basic connectivity between all players
  - SpoVNet base overlay connects all nodes
  - Each player can join or leave this overlay



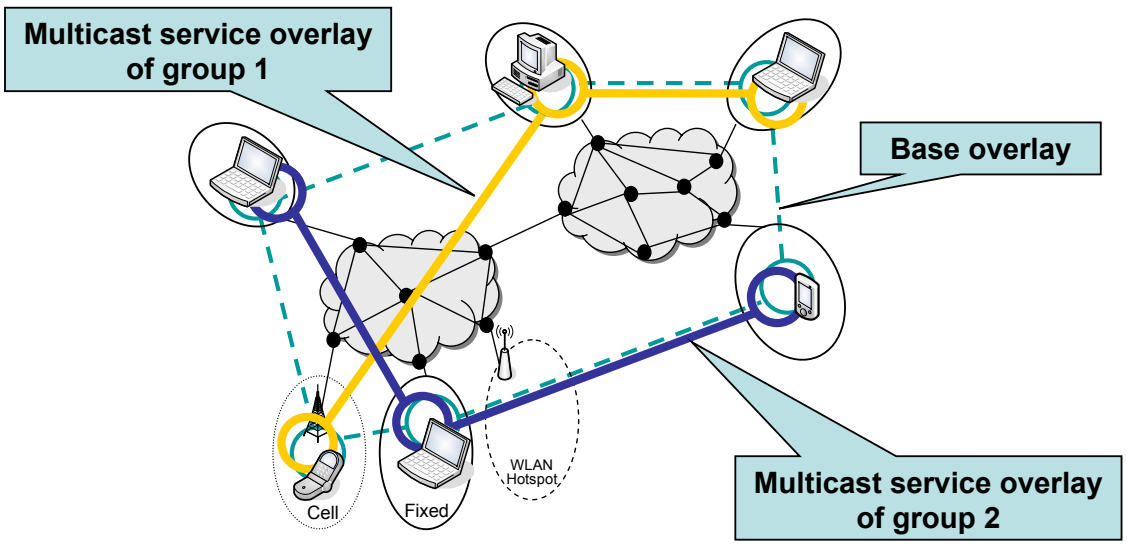
Virtual World Online Game

- Players must be informed about events inside the game
  - SpoVNet event service overlay to disseminate events



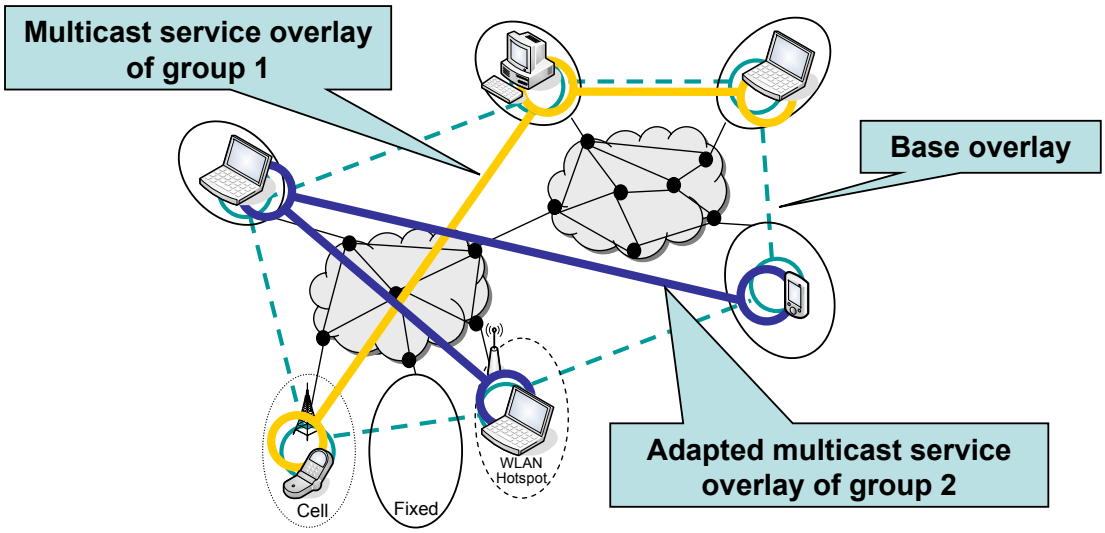
Virtual World Online Game

- Players want to chat with each other
  - SpoVNet multicast service is used to exchange chat messages



Virtual World Online Game

- Players may move between access networks
  - Service overlays need to adapt



Summary

- The SpoVNet objectives are to
  - provide adaptive, spontaneous communication services over heterogeneous networks
  - enable seamless transition from current to future networks

→SpoVNet fosters future services today and runs out of the box

- The SpoVNet project
  - supplies an architectural framework for flexible service provisioning by overlays
  - features fundamental research on enhanced services

Thanks! Questions?

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