The Underlay Abstraction in the Spontaneous Virtual Networks (SpoVNet) Architecture

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Future Internet

- Internet has evolved from 4-node network to ubiquitous, global communication network
  → But … is it flexible enough for the future?

- Patchwork design and deployment problems
  - “Half” layers: IPsec, MPLS (2.5); TLS (3.5) …
  - TCP adaptations to wireless, mobile etc.
  - Multicast, MobileIP → Deployment?

- 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
SpoVNet in a Nutshell

- Extensible set of services implemented by overlays
  - Spontaneous and flexible per application
  - No infrastructure support required
  - Self-organizing, scalable and robust

- What is different to other Overlay-based approaches?
  - Framework provides generic (transport-)mechanisms for convenient realization of overlay-based services and innovative applications
  - Optimization and adaptivity using Cross-Layer Information
SpoVNet Architecture

**Goals: Provide a framework that**

1) allows comfortable creation of application supporting (overlay-)services in *heterogeneous* networks

2) assures that these services can be *incrementally replaced* by evolving *underlay* services

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**Application**

**Service abstraction**

SpoVNet services

**Underlay abstraction**

SpoVNet base

**Underlay**

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New Service

Facilitates comfortable creation of new services

Allows to replace SpoVNet services with underlay services
SpoVNet Underlay Abstraction

- Provides **generic transport mechanisms** hiding **mobility, multi-homing and heterogeneity**
Application Example

Implementation of a P2P VoIP service
- May include mobile devices and heterogeneous networks (WLAN, ad-hoc, …)
- Underlays may (partially) provide quality-of-service support

Requirements
- Identification and localization of VoIP host
- Establish connection in heterogeneous environments
- Keep up connectivity at all time with suitable QoS

→ Can be implemented on top of the SpoVNet underlay abstraction
VoIP Connection Establishment

- **Base Overlay**
  - Provides identifier-based addressing

- **Base Communication**
  - Connections driven by requirements
  - Selects a appropriate L4 protocol
  - Provides persistent end-to-end connectivity, even when
    - nodes are multi-homed
    - relaying is necessary between different L3 protocols
    - mobility causes locator changes
  - Maps quality-of-service requirements

- Maps (SIP-)address to a set of locators
- QoS: max-delay=80ms; Security: confidential; Reliability: none;
- Use DTLS/UDP (Unreliable/Secure)
- Use underlay mechanism (e.g., NSIS) to signal QoS or use cross-layer information for “best-effort” QoS
Further Features of the Underlay Abstraction

- **Base Communication**
  - Sending one-shot (datagram) messages

- **Base Overlay**
  - Creating a SpoVNet instance
    - Initiator fixes properties (ID, cryptographic functions, authentication policy)
  - Joining a SpoVNet instance
    - Requires **authorization** and **integration** into Base Overlay
  - **Authentication Mechanisms**
    - Cryptographic node identifiers
    - No spoofing of identifiers possible
  - **Authorization Mechanisms**
    - Centralized: Initiator decides on authorization
    - Decentralized: Initiator may authorize other nodes to perform authorization
Conclusion & Future Work

○ SpoVNet …
  • … enables flexible, adaptive, and spontaneous provisioning of application-oriented and network-oriented services

○ SpoVNet Underlay Abstraction
  • Supports easy creation of overlay-based services
  • Generic transport mechanisms to deal with underlay characteristics (mobility, multihoming, heterogeneity, …)
  • Identifier-based addressing scheme
  • Transparent selection of transport- and network-layer protocols to provide persistent transport links

○ Current work
  • Evaluation by simulation models
  • Prototype implementation