

Quality-of-Service Signaling for Virtual Networks

Roland Bless and Martin Röhrich
Institute of Telematics
Karlsruhe Institute of Technology (KIT)

SPONSORED BY THE



Federal Ministry
of Education
and Research

Motivation

- ▶ **Network Virtualization** promising abstraction technique
 - Optimize utilization of network resources
 - Design and deploy novel network architectures and protocols

- ▶ **Virtual Nodes** interconnected via **Virtual Links**
 - Mostly configured statically
 - Mostly no **Quality-of-Service (QoS)** guarantees
 - Limited to specific administrative domain

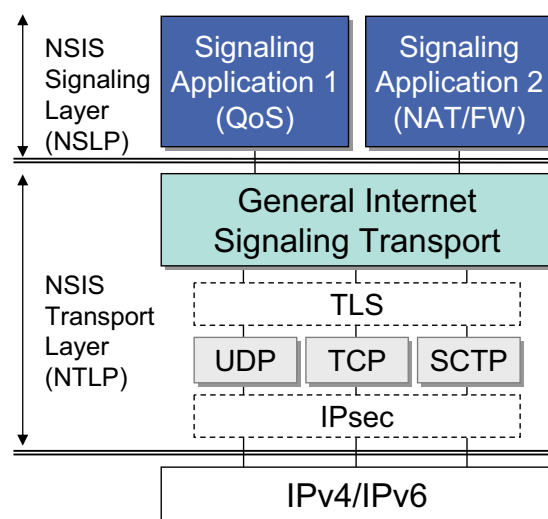
- ▶ **Signaling necessary** to dynamically setup virtual links on demand
 - Combine signaling for QoS guarantees with virtual link setup

Setup Virtual Links on Demand

- ▶ Creation of **virtual links with QoS guarantees** between virtual nodes
 - Virtual nodes possibly part of different infrastructure provider domains
 - Setup of virtual nodes via management interface
- ▶ Assumptions
 - Underlying **IP-based substrate**
 - **Signaling control entity** operates independently from virtual machines
- ▶ Use the **Next Steps in Signaling Framework** as signaling solution

Next Steps in Signaling Framework

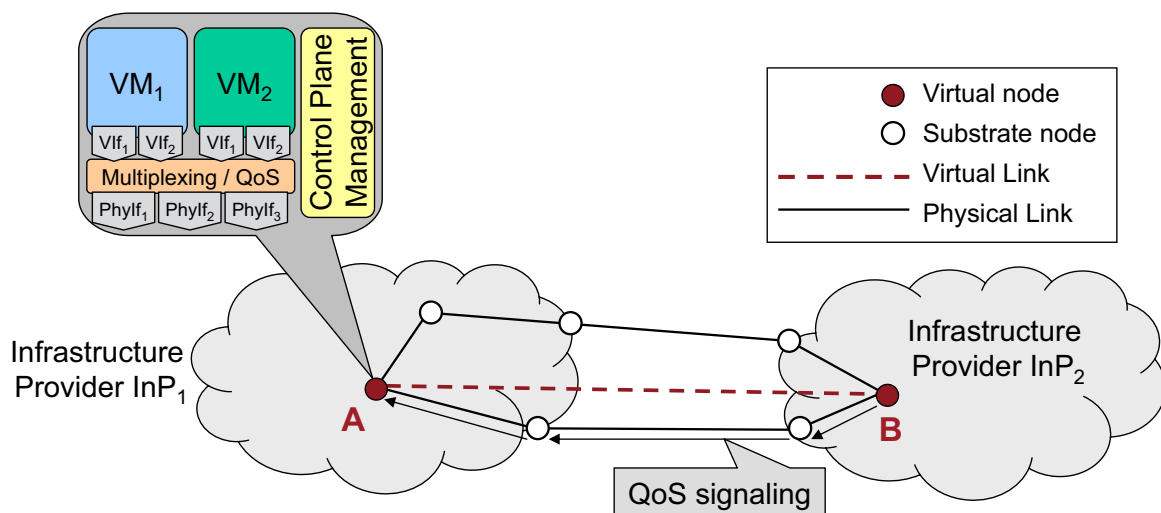
- ▶ IP-based signaling framework
- ▶ Two-layered approach
- ▶ **Quality-of-Service NSIS Signaling Layer Protocol (QoS NSLP)**
 - QoS resource reservations along data path
- ▶ **General Internet Signaling Transport Protocol (GIST)**
 - Routing and transport of signaling messages
 - Interception realized by Router Alert Option
- ▶ Don't create entirely new NSLP
 - Extend QoS NSLP with dedicated **VLSP object**



Path-coupled Signaling

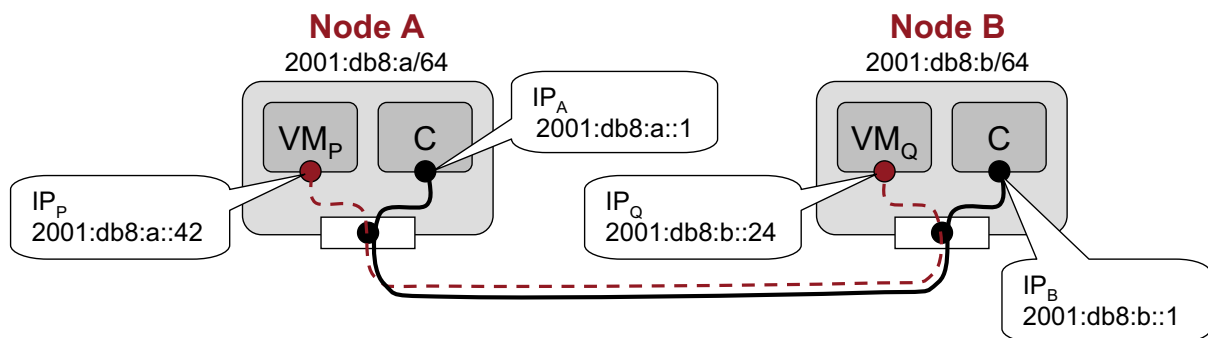
- ▶ **Path-coupled signaling** advantageous for QoS resource reservations
 - Install state in nodes belonging to substrate path
 - Assures that working substrate path exists
 - Works for any tunneled solution
 - Tunneling includes encapsulation overhead
- ▶ IPv6 as substrate protocol
 - 64 bit available for addressing hosts within a subnet
 - Each VM can get its own IP address directly in the substrate

Path-coupled Signaling for Virtual Networks – Challenges I



- ▶ Differentiation between physical node and virtual node
 - Management of NSIS control path only accessible via entity within physical node
 - Direct addressing of virtual node desired

- ▶ Establishment of a virtual link between VM_P and VM_Q
 - Span path between IP_P and IP_Q



- ▶ How to assure that node B intercepts signaling messages on behalf of VM_Q ?
- ▶ How can signaling messages for IP_B be processed by signaling control entity in node B?

Path-coupled Signaling – Possible Solutions I

- ▶ **Explicit Signaling Target Message Routing Method**
 - Do not rely on path-coupled MRM
 - Send signaling messages to directly addressed entity
 - Signaling from A directly to IP_B
 - No state installation on nodes along data path
- ▶ **Packet classifier**
 - Signaling messages in “outer flow” ($A (IP_A) \rightarrow B (IP_B)$)
 - Installation of state for “inner flow” ($IP_P \rightarrow IP_Q$)
 - Using packet classifier
 - May not be strictly path-coupled
 - Different routing for substrate and packet classifiers possible

Path-coupled Signaling – Possible Solutions II

- ▶ **Router Alert Option code point**
 - Use special code points similar to reservation aggregates
 - Router alert option must be supported by intermediate nodes

- ▶ **GIST header flag extension**
 - Introduce new GIST header flag
 - Use some sort of “deep packet inspection”
 - Allows for interception of NSIS control entity on behalf of VM
 - NSIS control entity must be aware of flag
 - Intermediate nodes may ignore this flag

Summary

- ▶ Combine Quality-of-Service signaling with signaling for virtual link setup

- ▶ Path-coupled signaling especially advantageous for QoS resource reservations

- ▶ Problems arise for path-coupled signaling if no tunneling is used
 - Possible solutions outlined

- ▶ Implementation and evaluation of solutions in progress

Thank you for your attention

Questions?

Virtual Link Setup

- ▶ Two variants: intra-domain and inter-domain
- ▶ **Intra-domain**
 - Basically an extension of constraint-based routing for traffic engineering?
- ▶ **Inter-domain**
 - Standardization is required to enable interoperability
 - Current prototype uses an additional object for **QoS NSLP signaling**
 - Path-coupled signaling for QoS reservation combined with virtual link setup

