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Service Oriented Network Framework Enabling Global QoS and Network Virtualization

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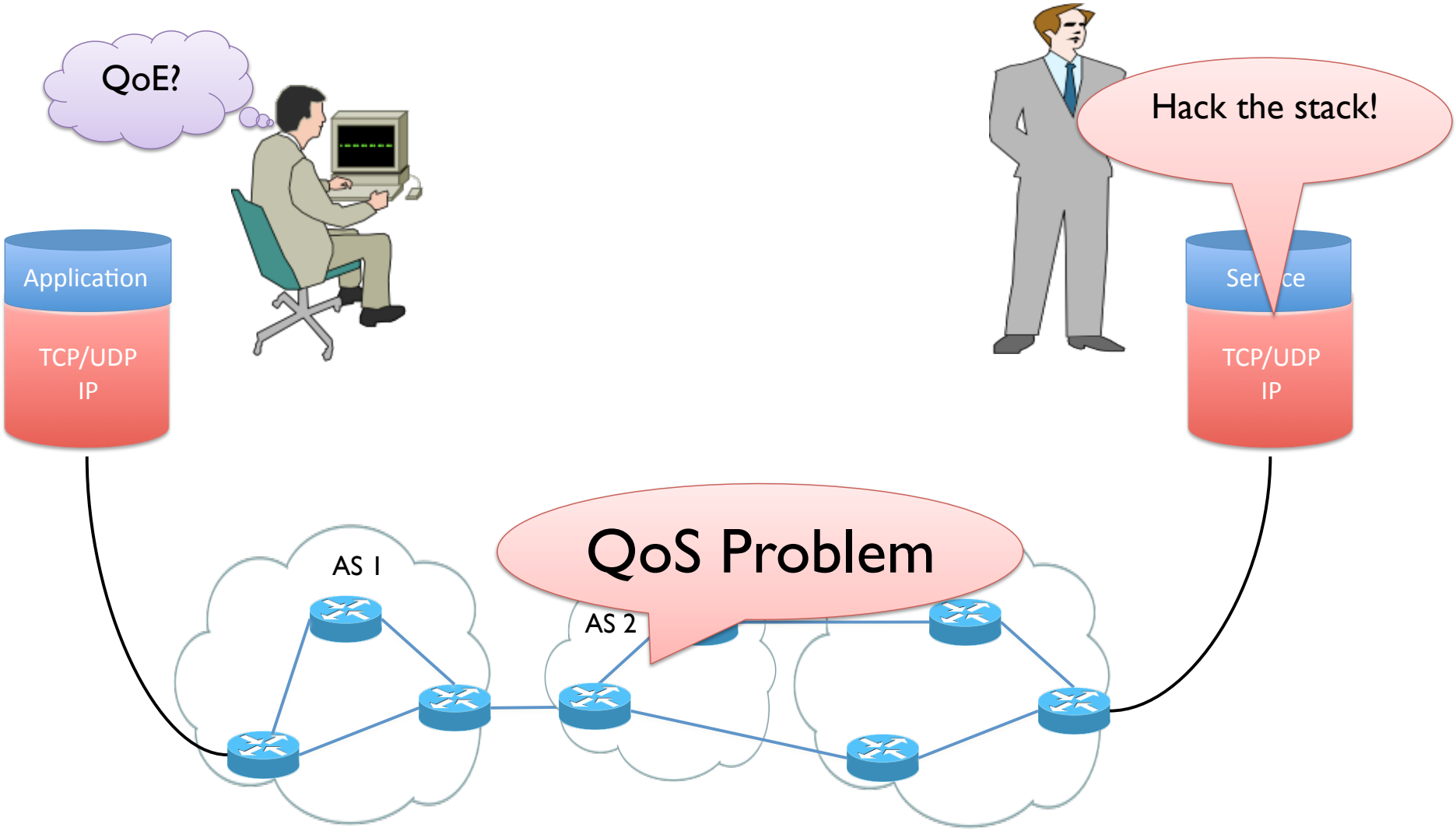
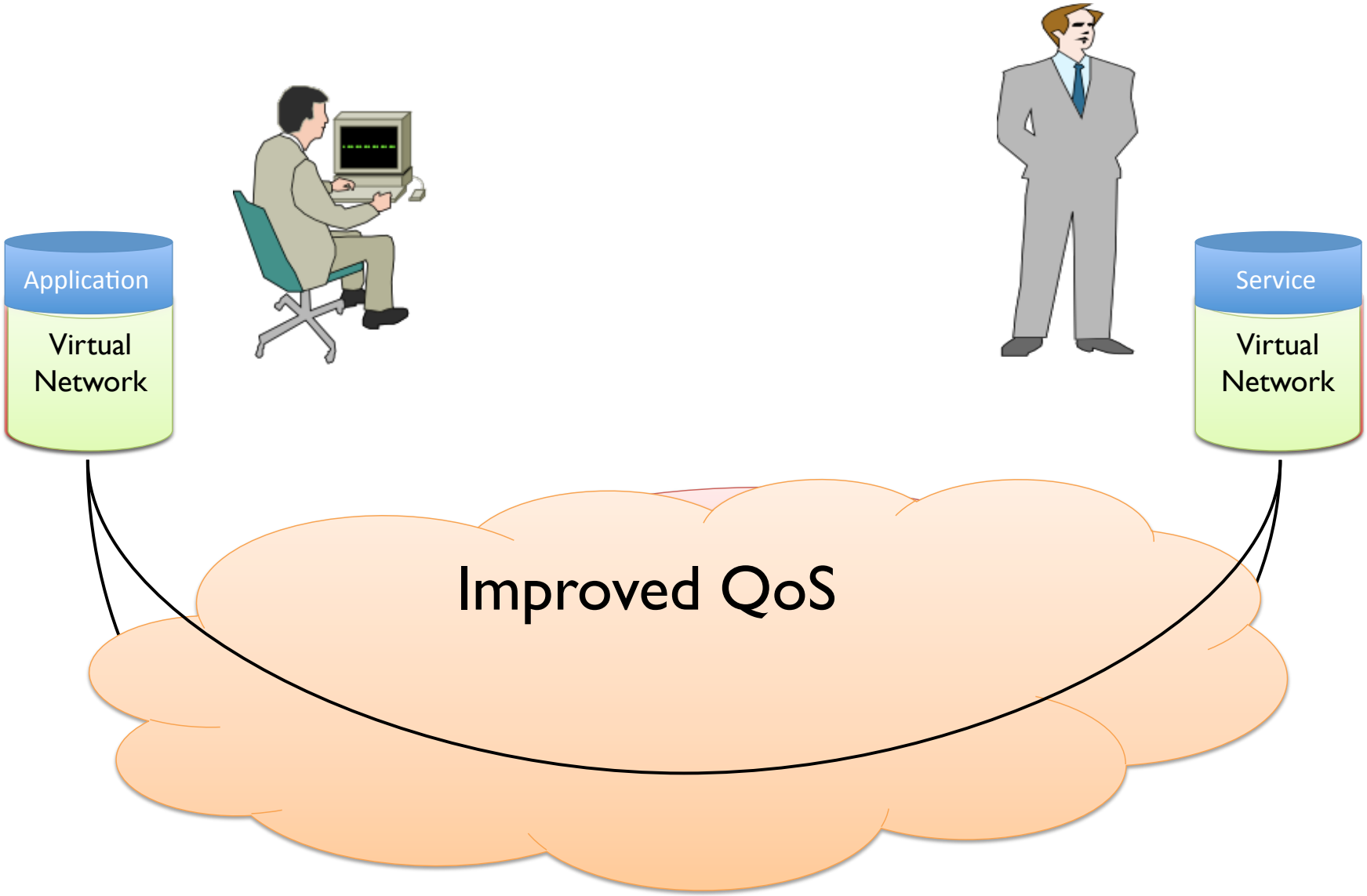
Agenda

- Motivation
- Abstract Network Interfaces / API
- Predicting QoS
- Prove QoS / Measurement Infrastructure
- Conclusion and Outlook

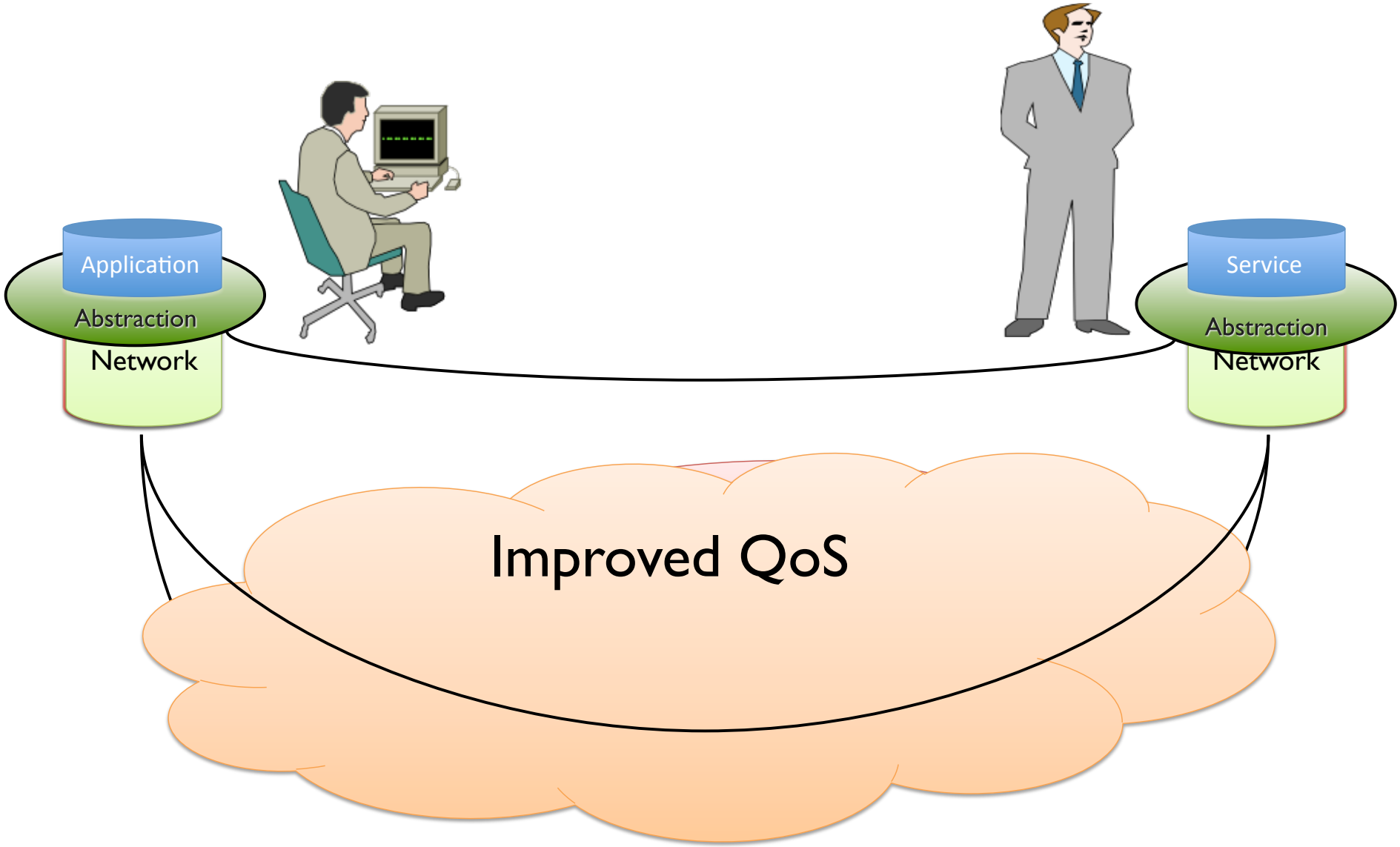
Motivation


QoE?
Application
TCP/UDP
IP
Hack the stack!
Service
TCP/UDP
IP
QoS Problem
AS 1
AS 2

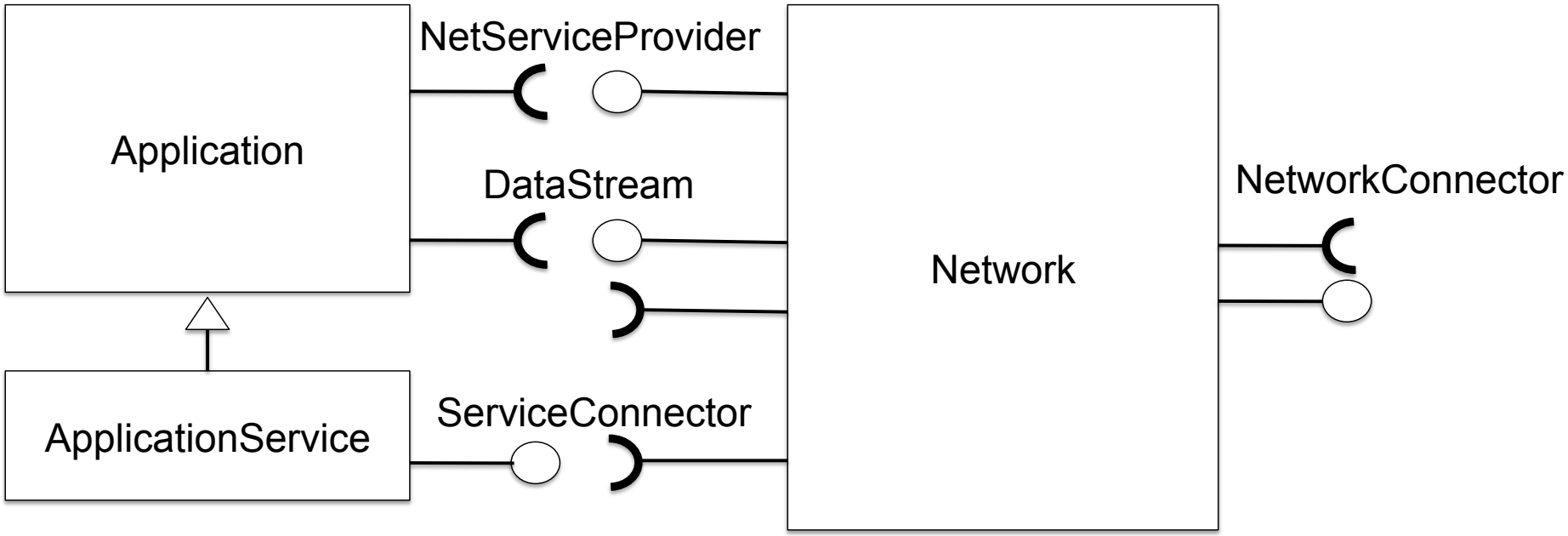
Motivation


Application
Virtual Network
Service
Virtual Network
Improved QoS

Motivation


Application
Abstraction
Network
Service
Abstraction
Network
Improved QoS

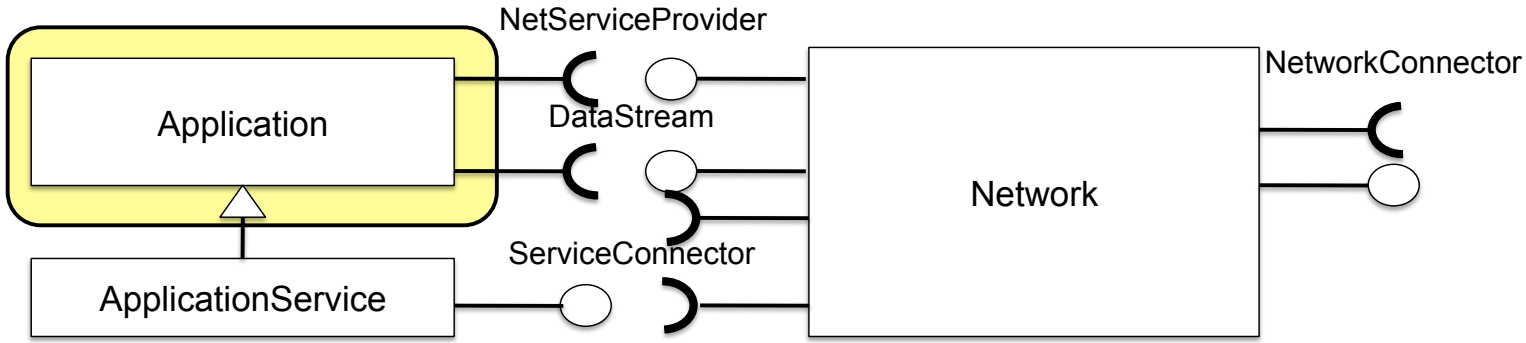
Architecture Overview



Application Interfaces

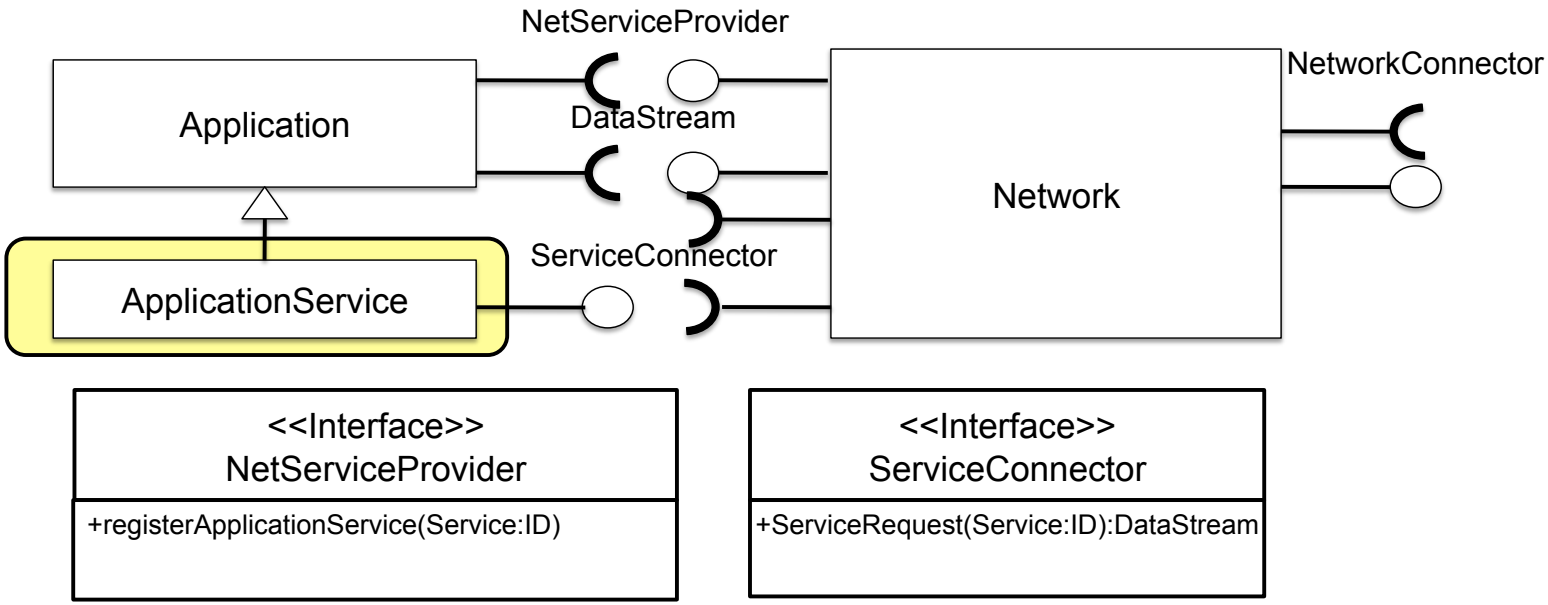
<<Interface>>
NetServiceProvider

+requestNetService(Delay: int,Jitter:int,Loss:real,Bandwidth:int, reliability:boolean,Dst: ID): list of service descriptions
+requestNetService(Delay: string,Jitter:string,Loss:string,Bandwidth:int,reliability:boolean, Dst:ID): list of service descr.
+getPredefinedServices(): list of service description
+requestServiceChain(Service: ID): list of ServiceIDs
+initiateServiceChain(ServiceChain: list of ServiceIDs):boolean if service chain establishment was successfull



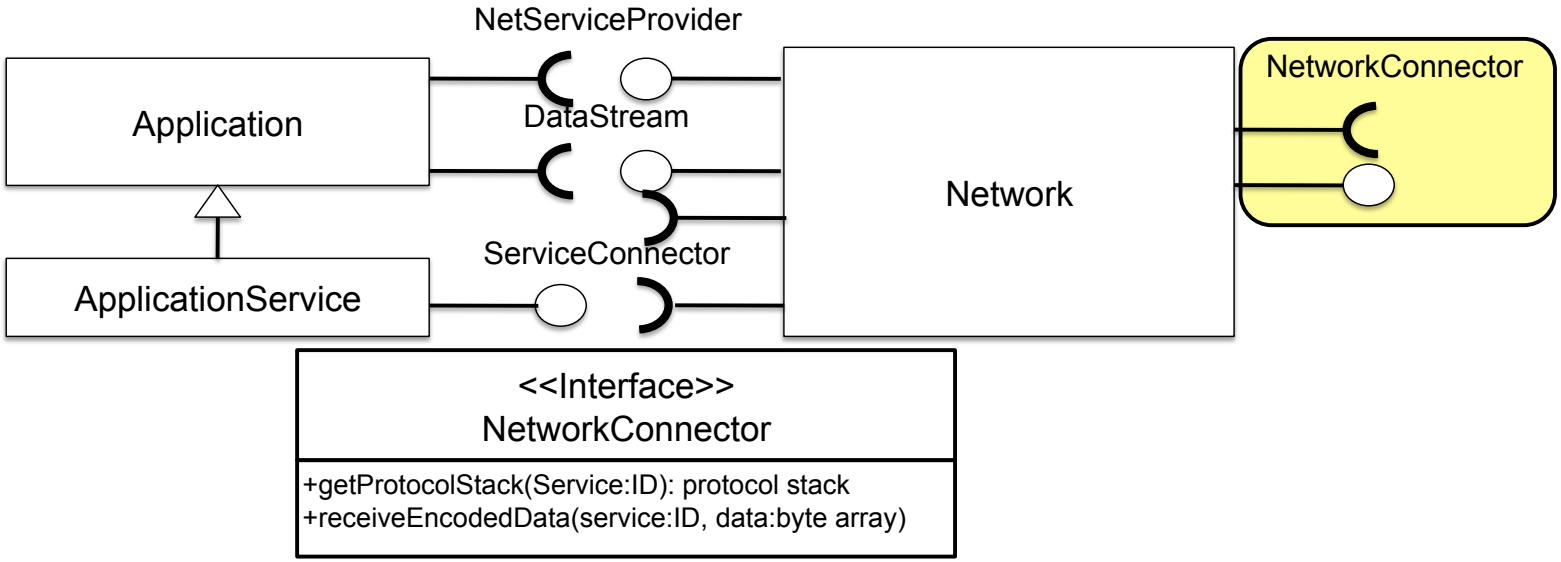
- Request Network Service
  - Specify QoS or predefined service
- Store a network service chain for future use

Application Service Interfaces



- Register an application service
  - Spread the information of the existance
  - Register point for request acceptance
- Hand over service requests

Network Connector



- Hand over on application layer
  - is time consuming
  - needs bridging device or agreed protocol
- Time and hardware cost money
- Direct data transfer between two network using the same protocol stack

QoS and Pricing

- Bandwidth

$$\mathrm{Min}(C_i, C_j)$$

- Delay

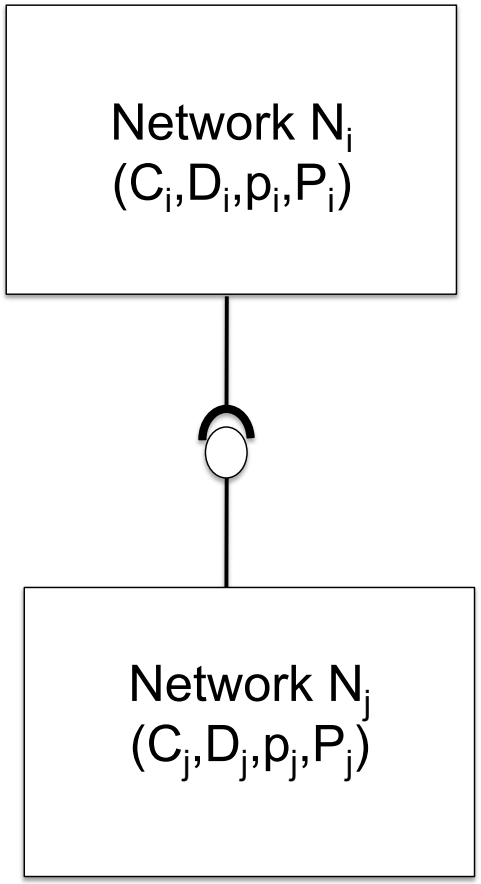
$$\mathrm{Sum}(D_i, D_j) + c$$

- Loss

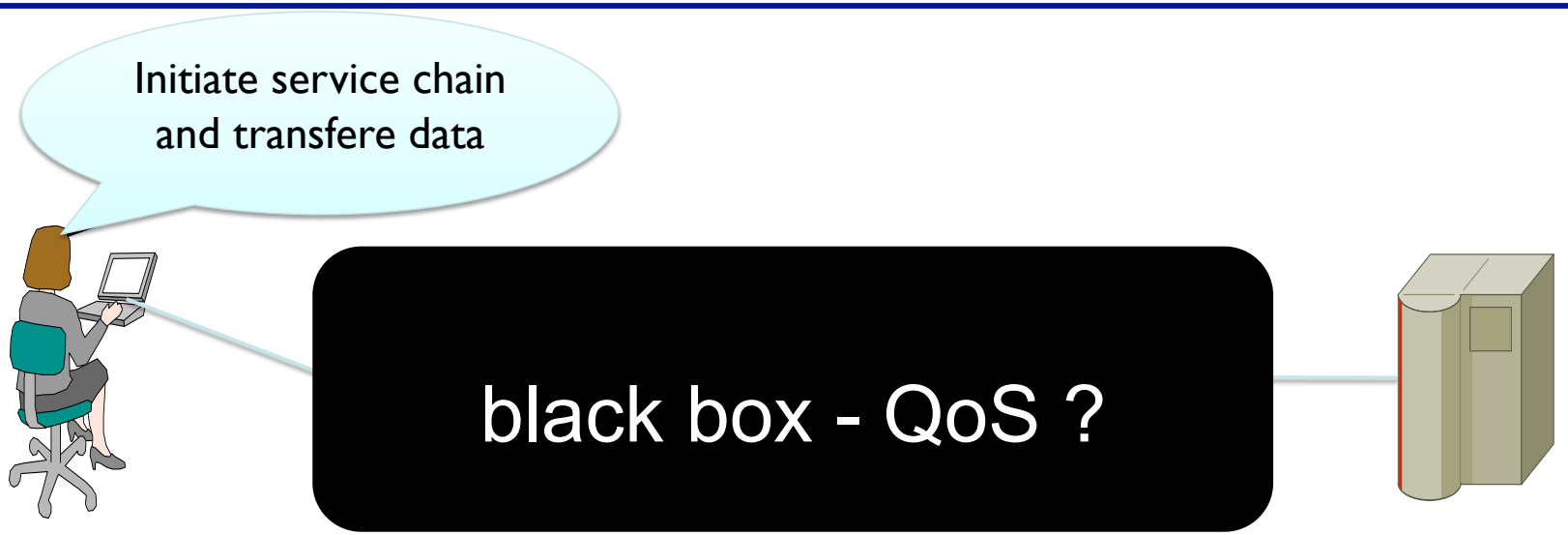
$$p_i + (1 - p_i)\, p_j$$

- Pricing

$$\mathrm{Sum}(P_i, P_j)$$



Example Network



Measurement Infrastructure

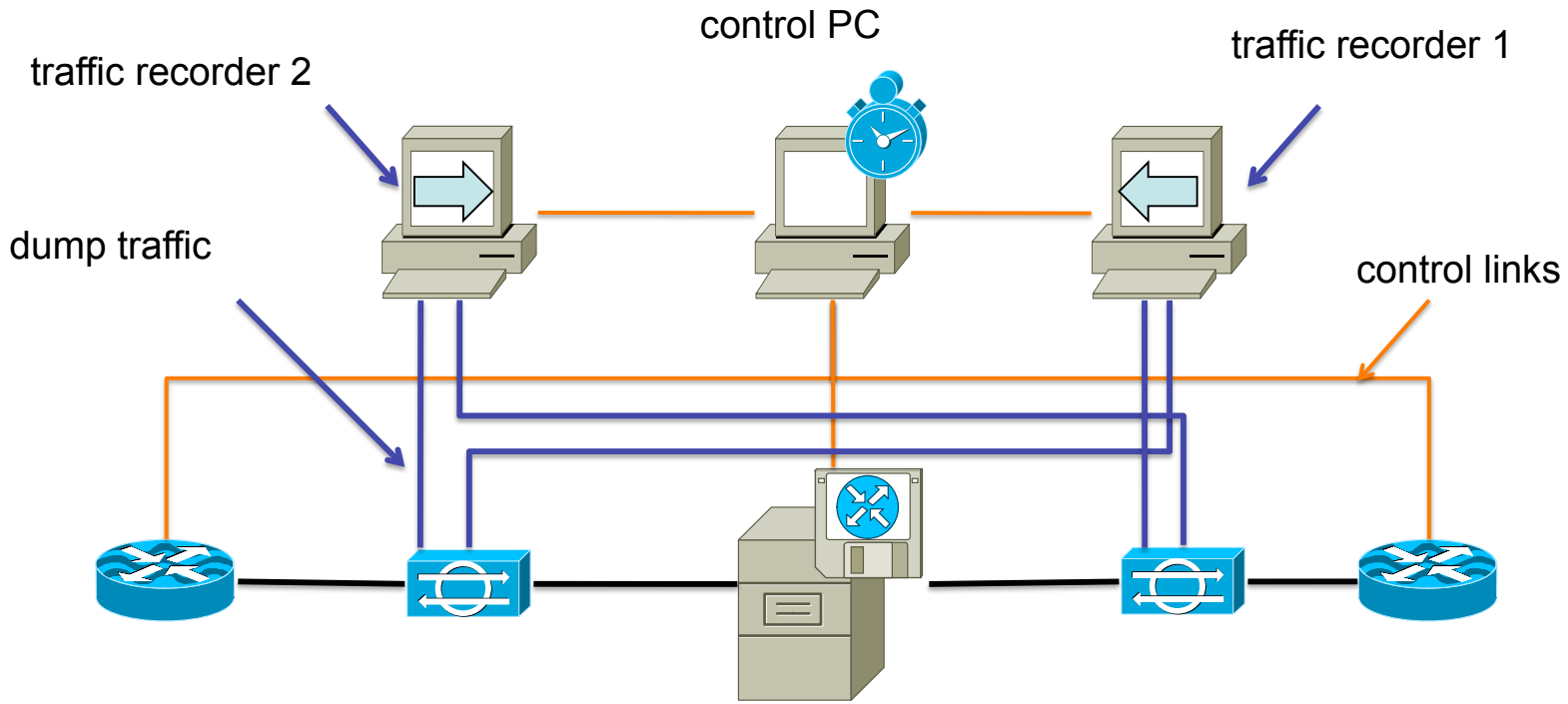
- Network management of virtual networks will be challenging
- Hardware sharing, unreliable peers, etc. add new sources of errors
- Exact monitoring is crucial (for enabling QoS)
- Combine active and passive measurements

- Passive measurements
  - don‘t interfere with the system
  - easily provide values for available bandwidth, loss
  - face problems in inter-AS space

Active Measurement

- Trigger on request ➔ provide direct feedback
- End-to-end measure
- Emulate traffic characteristics
- Should bypass the incoming queue / application queue of the target device
- Measure one way delays
- Evaluation of Cisco IP SLA (RTR)
  - Available on many systems
  - Easy to integrate (SNMP)

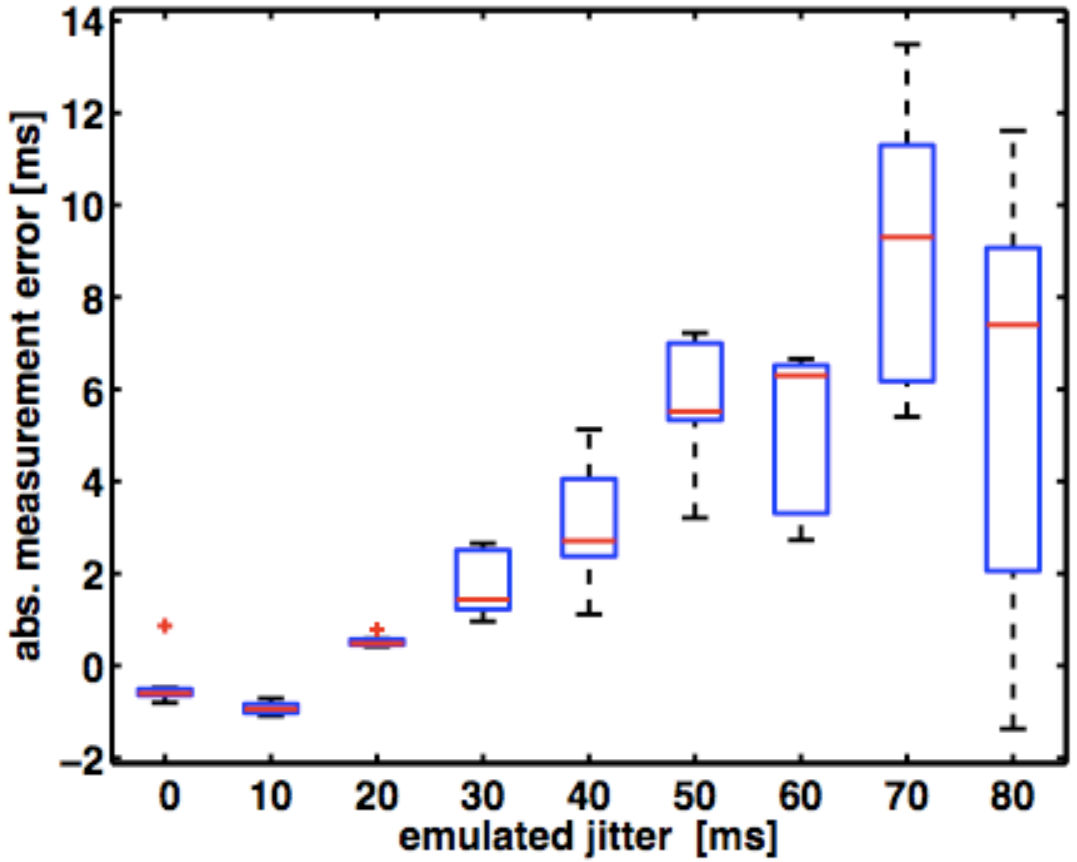
Testbed Setup



- Emulate different network conditions
- Measure one way delays
- Provide synchronous time & automation

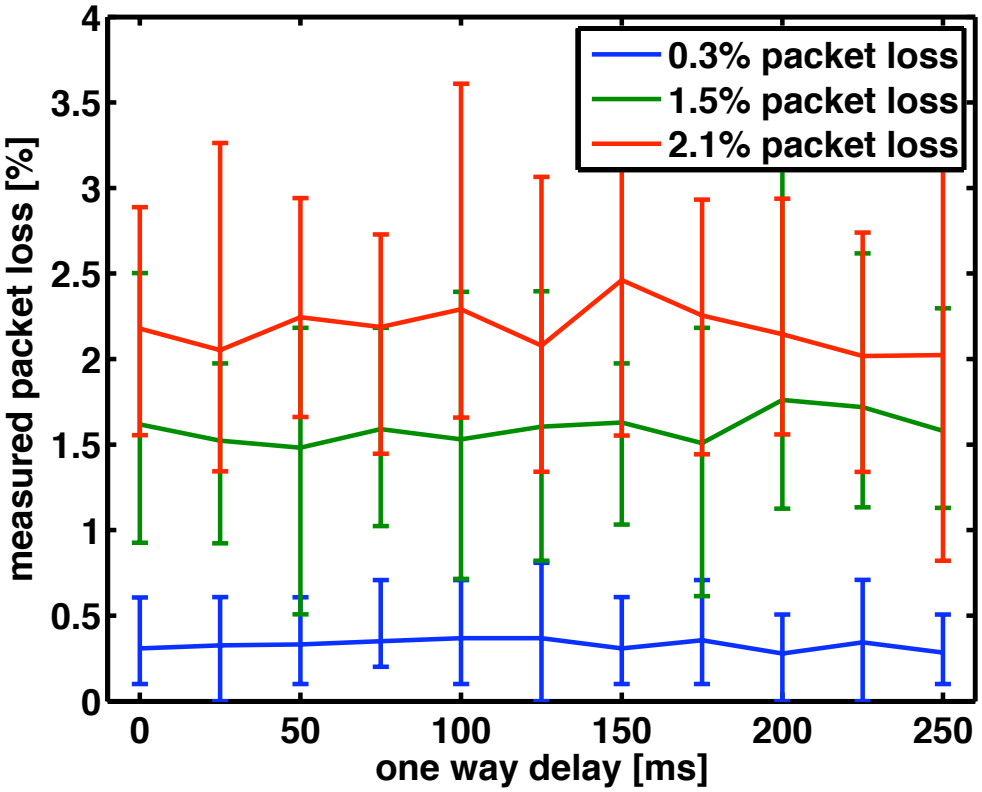
➔ IP SLA provides good one way delay measurements 0 ms ≤ ε ≤ 6 ms

Results: Jitter



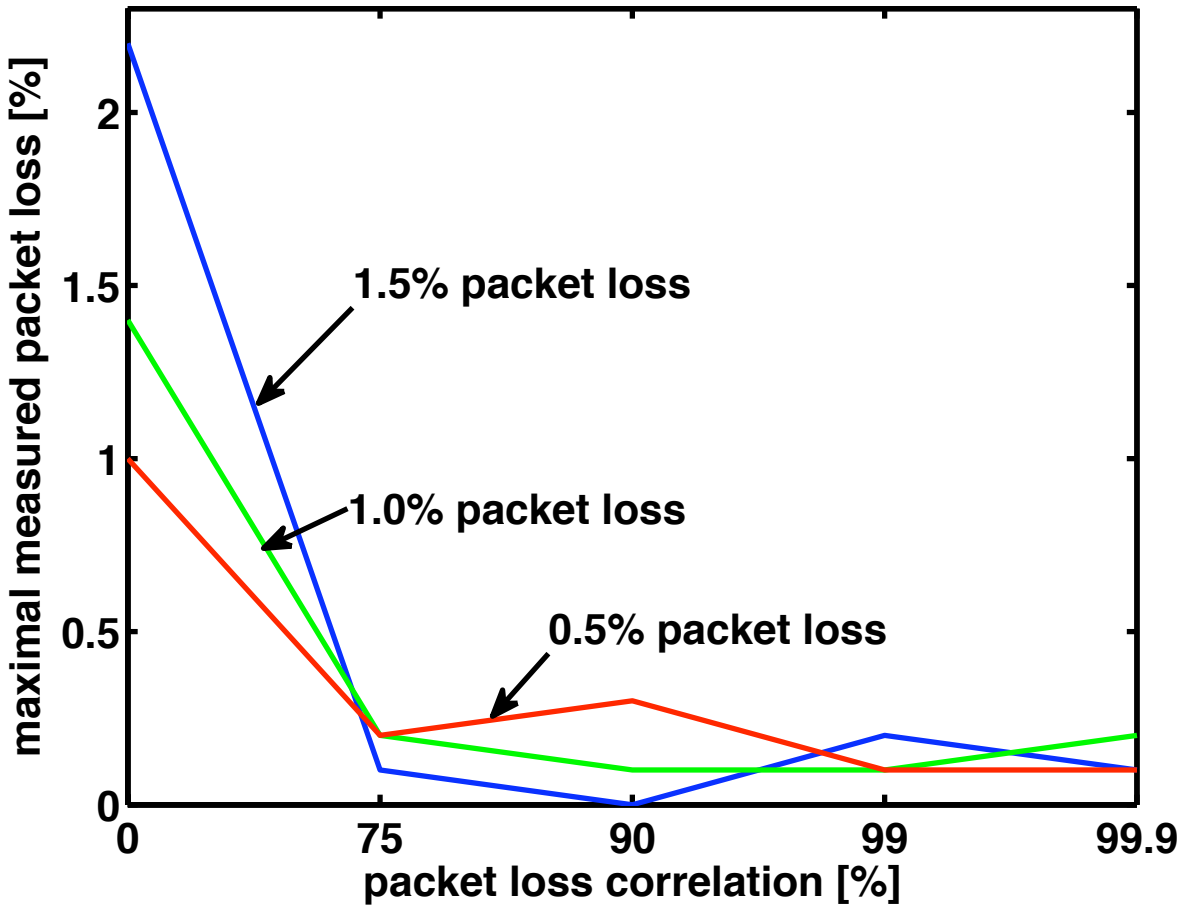
- Low Jitter values are often underestimated
- Jitter values reveal increasing error at higher jitter values

Results: Loss



- Loss values are correct, but only for the test packets
- Single measurement results can only detect packet loss

Results: Loss (bulk)



- Bulk loss is very hard to detect
- The measurement values do not characterize the packet loss in the network

Conclusion & Outlook

- Conclusion
  - Service Oriented Network Framework
  - Enable global QoS
  - Measurement infrastructure to verify QoS in the virtual network
- Outlook
  - Implementation for G-Lab
  - Speed test for application level data hand over
  - Compare QoS calculation and measurements