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CASP – A Lightweight QoS Signaling Protocol

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Lightweight QoS Signalling for Mobile Multimedia Scenarios (LQS)

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- **Overall project theme:**
  „Design of a *technology independent Lightweight QoS Signalling protocol for access networks*“

- Joint Project with members of Siemens (CT, ICN and ICM) together with Prof. Henning Schulzrinne, Columbia University

- In parallel to the joint activity in IETF WG NSIS (Next Steps In Signalling) with members from Siemens (RMR, CT, ICM), NEC, TU Berlin, Univ. of Ulm

LQS: Why are existing solutions insufficient?

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- inter-domain signaling
- out-of-path signaling
- signaling other than end-to-end
- bi-directional signaling
- mobility support
- multicast support usually not needed
- interworking with policy, security, TE, ...

Siemens Requirements for LQS (I)

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M – Per-flow signaling

M – Mobility support

M – Conformance to NSIS requirements / framework

=> evaluation of usability of RSVP or a descendant
=> protocol extendible to the rest of the network

M – Signaling between End System and Access Network

(M – Mandatory, O – Optional / to be discussed)

Siemens Requirements for LQS (II)

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M - Support of Signaling Proxies

M - Signaling in the Access Network only

M – Heterogeneous Access Networks

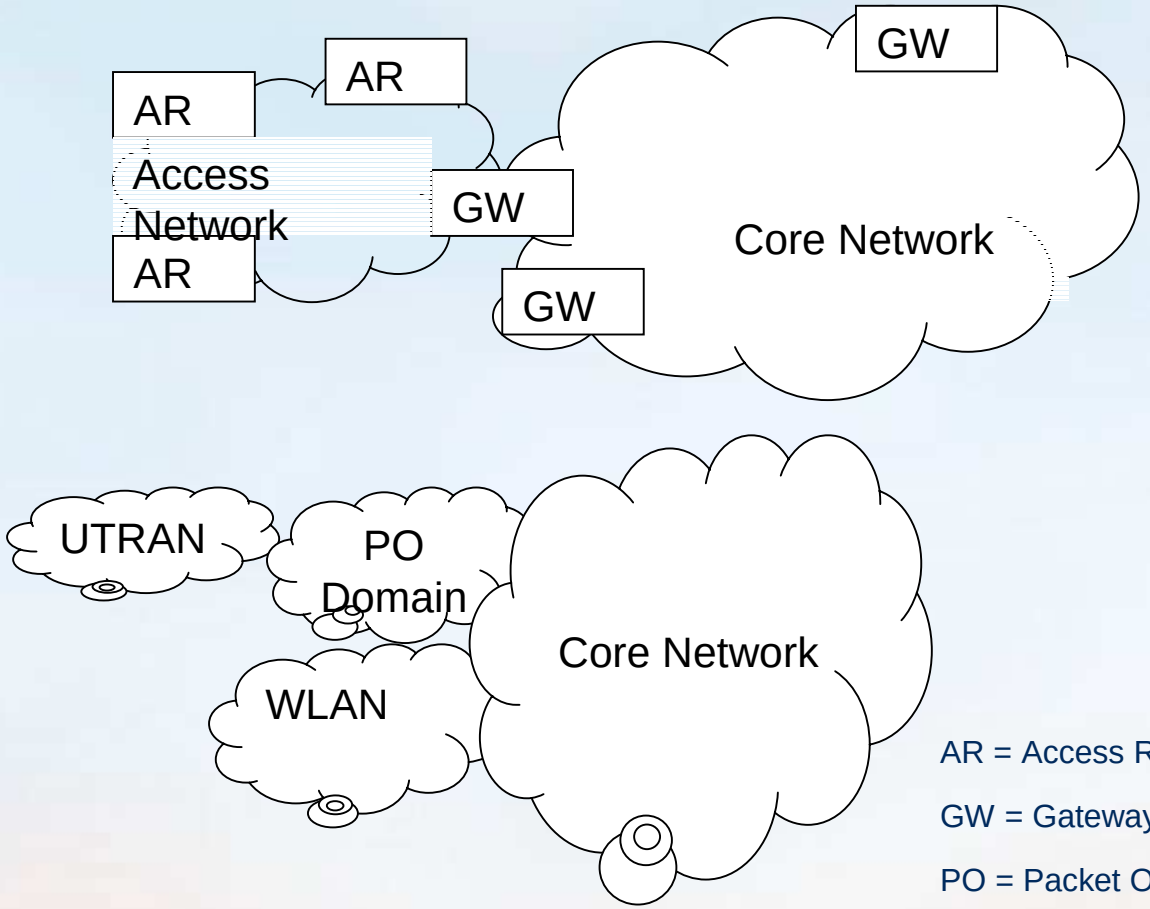
M - Independence of mobility protocols

O – Interface to other layers (e.g. support of adaptive applications, interworking with link-layer QoS)

O - Signaling across IPv4/IPv6 boundaries

(M – Mandatory, O – Optional / to be discussed)

What is an Access Network?



AR = Access Router

GW = Gateway

PO = Packet Orieted

UTRAN = UMTS Radio Access Network

Core Network

- Aggregated traffic
- No mobility

Access network

- Access to end systems
- Per-flow QoS signaling
- Traffic aggregation possible
- Mobility

LQS: Where to use?

- QoS Signalling
- Configuration of middleboxes
- Topology discovery
- Measurement data collection
- MPLS label distribution
- …..

LQS: Why now?

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- **Signalling solution needed:**
  - In 3GPP for inter-domain signaling
  - Between bandwidth-brokers
  - In conjunction with mobility
- **IETF NSIS (Next Steps In Signaling) WG chartered in Nov. 2001**
  - Generates wide interest
    - most active participants - mobility community (Siemens, NEC, Ericsson, Nokia, Alcatel)
    - closely followed and supported by „RSVP inventors“

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CASP – Cross-Application Signaling Protocol

What is CASP?

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- **Generic *signaling service***
  - establishes state along path of data
  - one sender, typically one receiver
    - can be multiple receivers → multicast
  - *can* be used for QoS per-flow or per-class reservation
  - but not restricted to that
- **Avoid restricting users of protocol:**
  - sender vs. receiver orientation
  - more or less closely tied to data path
    - router-by-router
    - network (AS) path

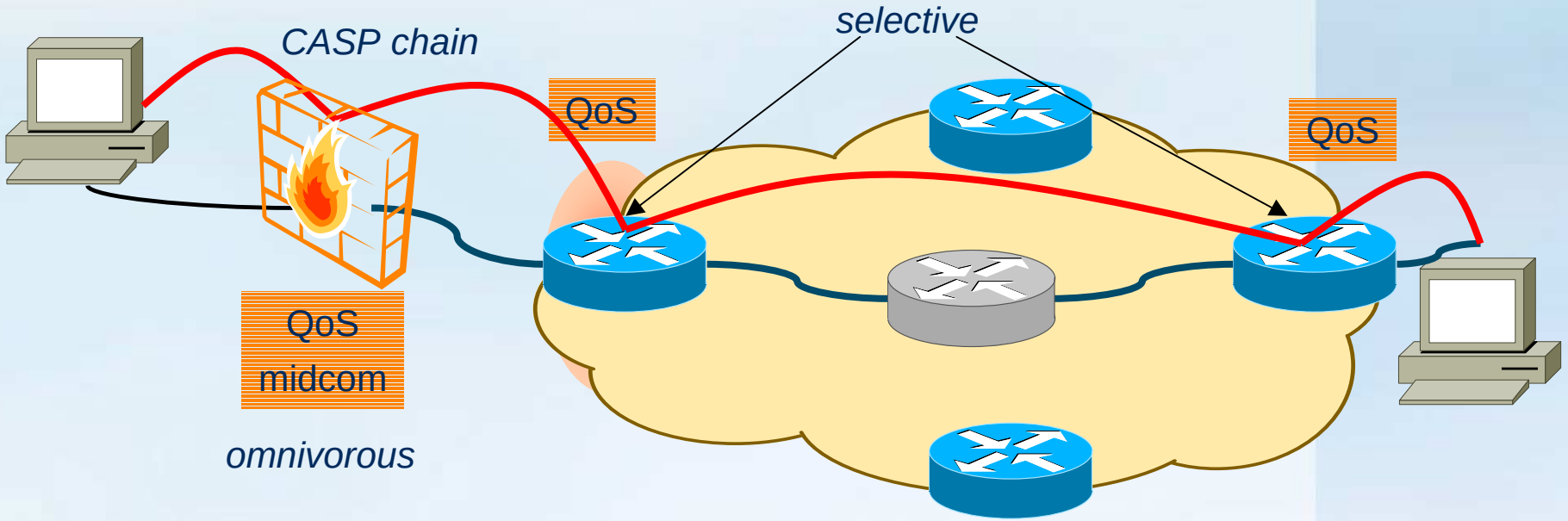
CASP Properties

- **Layered**
  - M(essaging) - layer
  - C(lient) - layer
- **Network friendly**
  - congestion-controlled
  - re-use of state across applications
- **Transport neutral**
  - any reliable protocol
  - initially, TCP and SCTP
- **Policy neutral**
  - no particular AAA policy or protocol
  - interaction with COPS, DIAMETER needs work
- **Soft state**
  - per-node time-out
  - explicit removal

CASP Properties

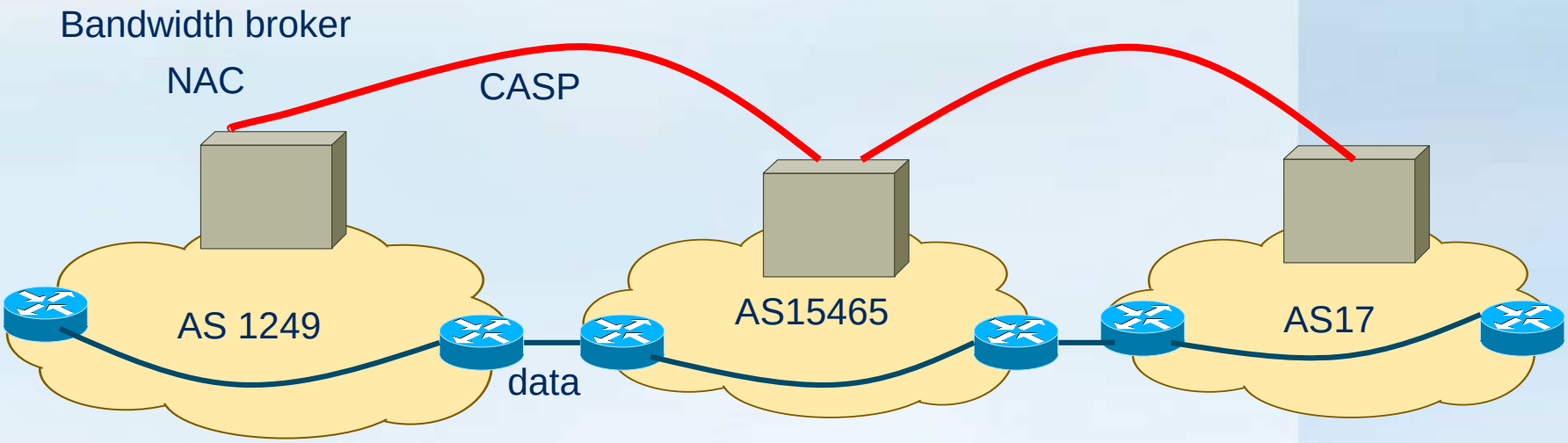
- **Extensible**
  - data format
  - feature negotiation
- **Security protection**
  - first peer, intra and inter domain
- **Topology hiding**
  - hide addresses of visited nodes
- **Light-weight**
  - message forwarding overhead
  - implementation complexity
- **Mobility transparent**

CASP Network Model – On-Path



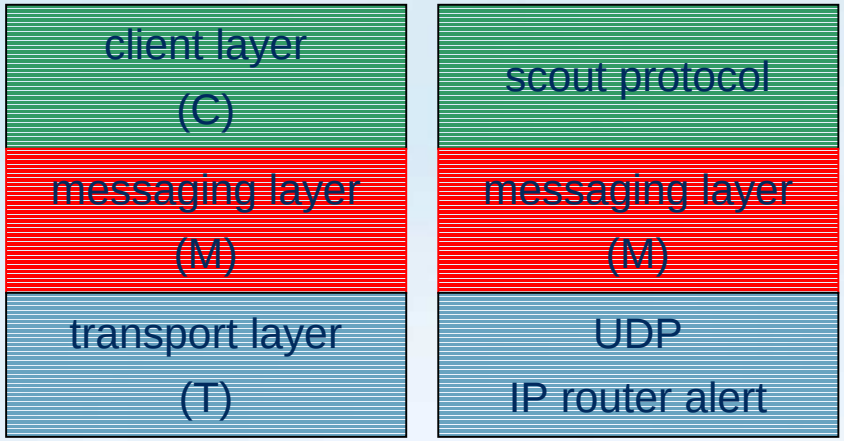
- **CASP nodes form CASP chain**
- **Not every node processes all client protocols:**
  - non-CASP node: regular router
  - omnivorous: processes all CASP messages
  - selective: bypassed by CASP messages with unknown client protocols

CASP Network Model – Out-of-Path



- Also route network-by-network
- Can combine router-by-router with out-of-path messaging

CASP Protocol Structure



- **Client layer does the real work:**
  - reserve resources
  - open firewall ports
  - …
- **Messaging layer:**
  - establishes and tears down state
  - negotiates features and capabilities
- **Transport layer:**
  - reliable transport
    e.g. TCP, SCTP

CASP Messages

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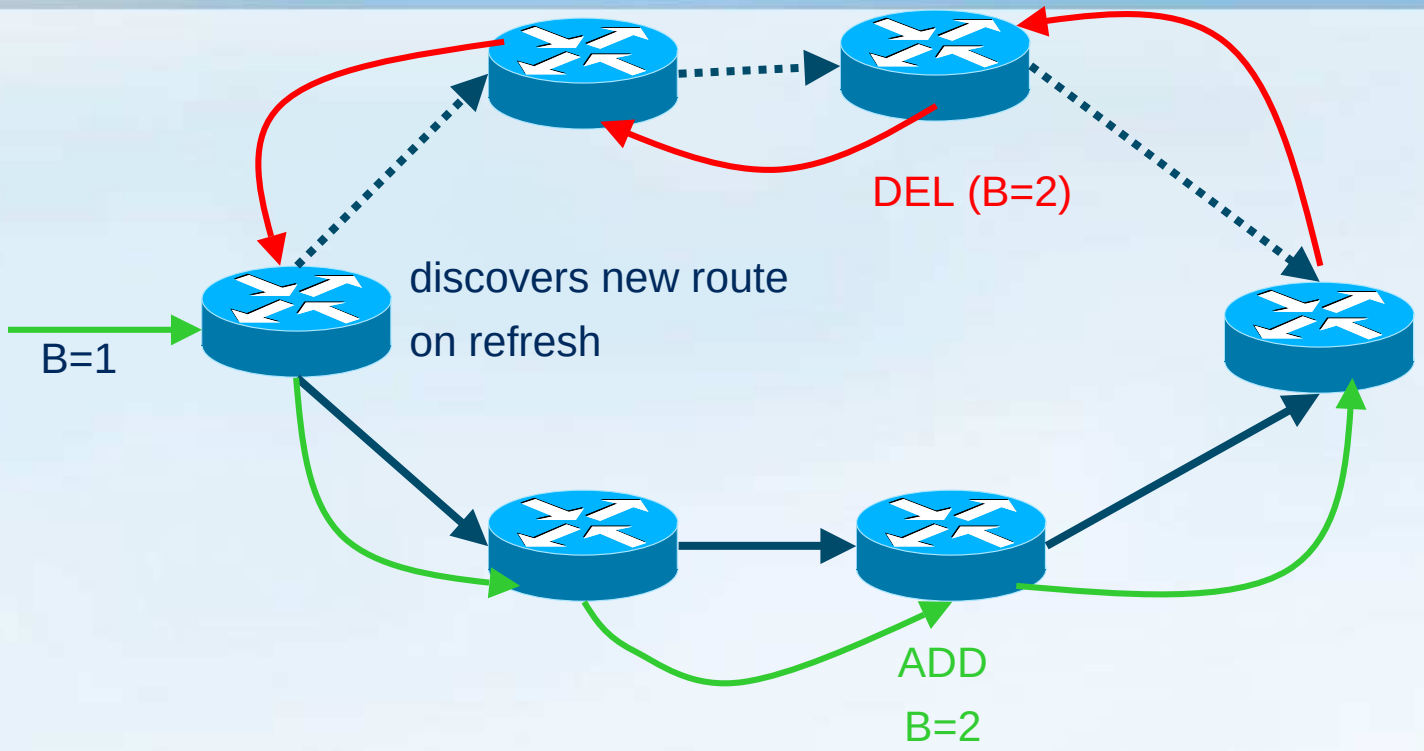
- **Regular CASP messages**
  - establish or tear down state
  - carry client protocol
- **Scout messages**
  - discover next hop
- **Hop-by-hop reliability**
- **Generated by any node along the chain**

CASP: Mobility and Route Changes



- **Avoids session identification by end point addresses**
- **Avoid use of traffic selector as session identifier**
- **Remove dead branch**

CASP Security

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- **Security for the M(essaging) layer**
  - IPSec
  - TLS (possibly with EAP on top of it)
  - many different key exchange protocols supported (IKE, KINK, SOI, etc.)
- **Security for the C(lient) layer**
  - based on the security of the M-layer
  - CMS used to selectively wrap objects and to provide protection for them

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CASP QoS Client Protocol

CASP QoS Client Protocol Feature Overview

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- Direction Neutral
- Bidirectional Reservation
- Reservation Range
- Partial Reservation
- Advance Reservation
- Resource Query
- Reserve / Commit Mechanism
- Local Information

CASP QoS Client Protocol Features

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- **Direction Neutral**
  - sender-oriented and receiver-oriented reservations
- **Message reduction**
- **Support for adaptive application**

- **Bidirectional Reservation**
  - single reservation for symmetric routes
  - support of asymmetric reservation
- **Message reduction**
- **Enhanced resource utilization**

CASP QoS Client Protocol Features

- **Reservation Range**
  - specification of upper and lower resource threshold
- **Message reduction**
- **Support for adaptive application**

- **Partial Reservation**
  - application may accept „blackholes“ for some time
- **Enhanced resource utilization**

- **Advance Reservation**
  - resource reservation at any time in future
- **Potential feature for conference applications**

CASP QoS Client Protocol Operation

- **Resource Query / Response**
  - query resources before requesting them
- ✦ **Avoid unnecessary resource allocation**

- **Reserve / Commit Resources**
  - reserve assigns resources
  - commit allocates resources for exclusive use
  - receiver / Sender oriented reservation
  - priority object for reservation priority
- ✦ **Efficient resource usage**

- **Local information**
  - authentication, DSCP, accounting
- ✦ **Minimize information overhead**

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CASP – Future Work

Plans and Ideas

CASP – Future work

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- **Implementation**
  - Message layer (in-band, hop-by-hop)
    - likely, Linux or FreeBSD
  - Discovery mechanisms
    - routing-based (OSPF)
    - scout protocol
  - QoS client
  - out-of-band messaging
    - "bandwidth broker" or NAC model
  - integrate with traffic control

- **Enhancements**
  - investigate tunnels

CASP future work

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- **Performance analysis**
  - message handling
  - TCP and TLS set-up overhead
  - maximum number of simultaneous connections
- **Specify additional client protocols**
  - NAT and firewall control ("midcom")
  - MPLS or lightpath setup?
  - denial-of-service traffic filter?
  - router QoS management → gather performance statistics
- **Interaction with AAA**
  - authentication, authorization and accounting
  - something other than COPS?
- **IETF**
  - submit Internet Draft to IETF NSIS working group
  - pursue standardization