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CASP – Cross-Application Signaling Protocol

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August 27, 2002

Overview

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- Protocol properties
- Message delivery
- Transport protocol usage
- Message forwarding
- Message format
- Next-hop discovery
  - Scout protocol
- Mobility and route changes
- Protocol heritage

What is CASP?

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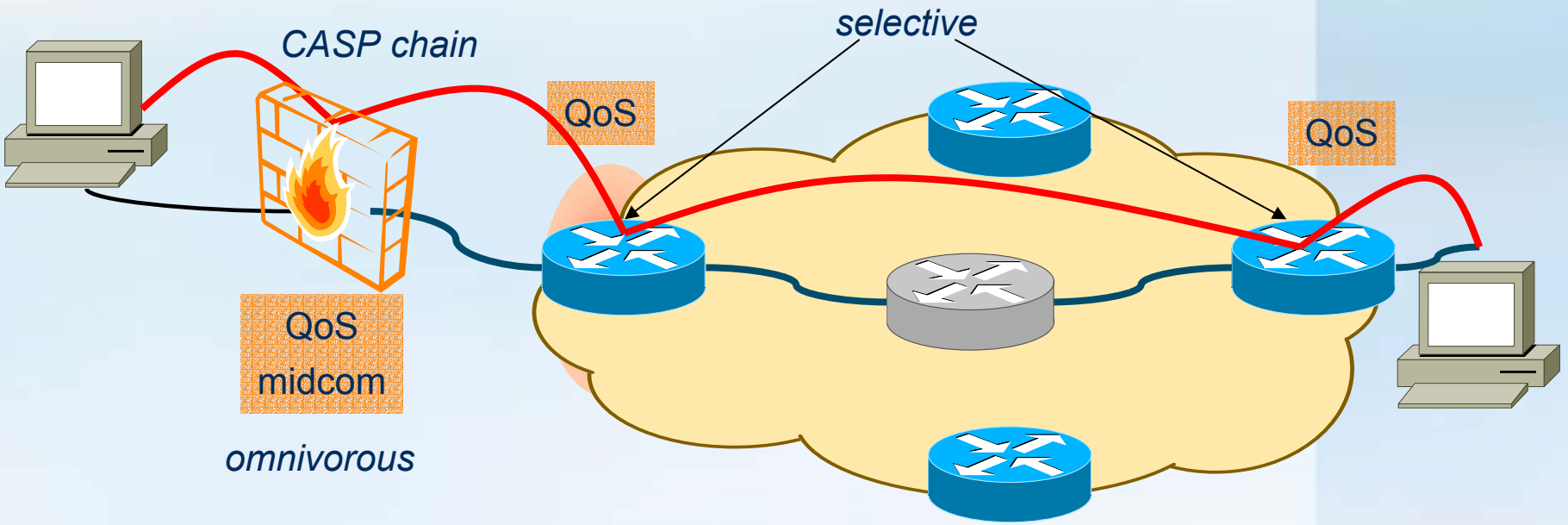
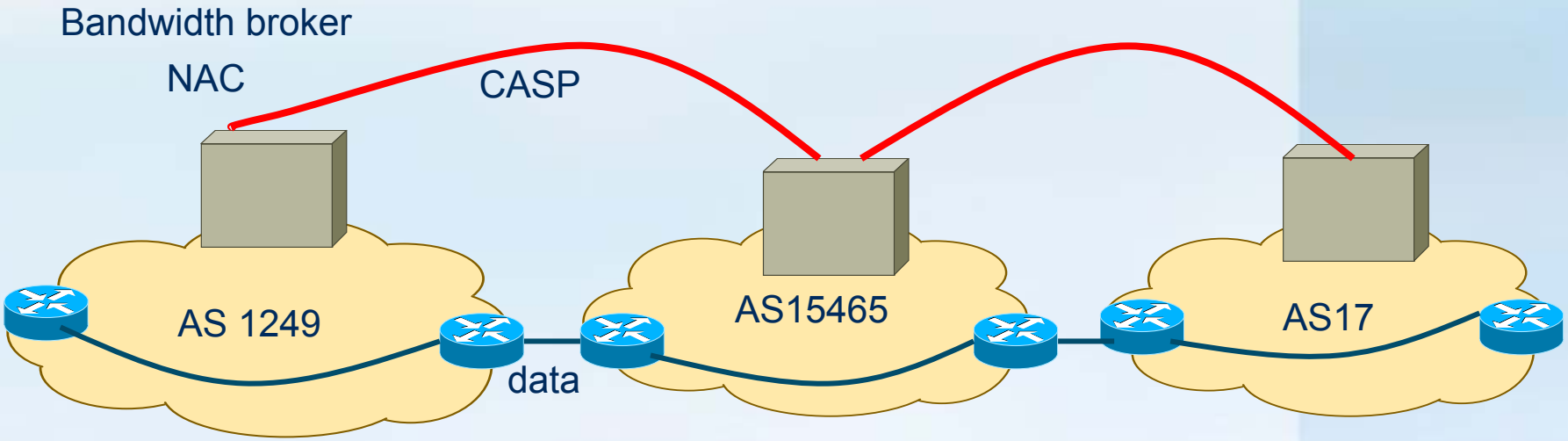
- Generic *signaling service*
  - establishes state along path of data
  - one sender, typically one receiver
    - can be multiple receivers → multicast
  - *can* be used for QoS per-flow or per-class reservation
  - but not restricted to that
- avoid restricting users of protocol (and religious arguments):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

CASP network model – on-path



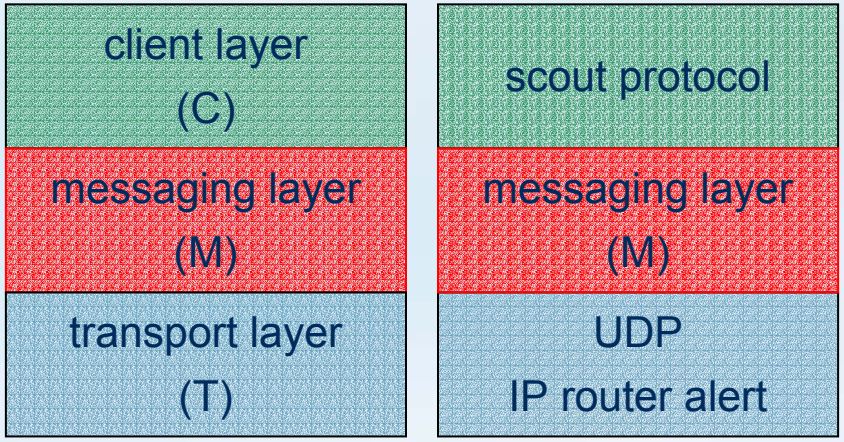
- CASP nodes form CASP chain
- not every node processes all client protocols:
  - non-CASP node: regular router
  - omnivorous: processes all CASP messages
  - selective: bypassed by CASP messages with unknown client protocols

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

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 transport protocol usage

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- *Most* signaling messages are small and infrequent
- but:
  - not all applications → e.g., mobile code for active networks
  - digital signatures
  - re-"dialing" when resources are busy
- Need:
  - reliability → to avoid long setup delays
  - flow control → avoid overloading signaling server
  - congestion control → avoid overloading network
  - fragmentation of long signaling messages
  - in-sequence delivery → avoid race conditions
  - transport-layer security → integrity, privacy
- This defines standard reliable transport protocols:
  - TCP
  - SCTP
- Avoid re-inventing wheel → see SIP experience

CASP transport protocol usage

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- One transport connection → many M- & C-layer sessions
- may use multiple TCP/SCTP ports
- can use TLS for transport-layer security
  - compared to IPsec, well-exercised key establishment
  - not quite clear what the principal is
- re-use of transport →
  - no overhead of TCP and SCTP session establishment
  - avoid TLS session setup
  - better timer estimates
  - SCTP avoids HOL blocking

Message forwarding

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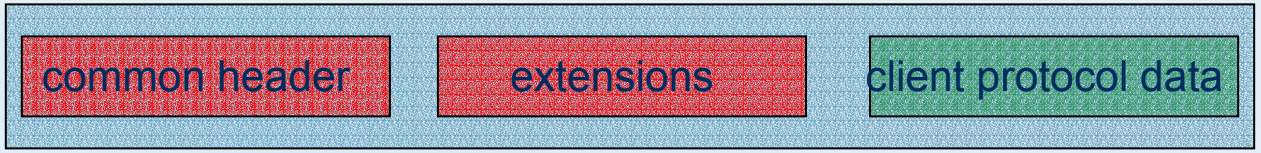
- Route stateless or state-full:
  - stateless: record route and retrace
  - state-full: based on next-hop information in CASP node
- Destination:
  - address → look at destination address
  - address + record → record route
  - route → based on recorded route
  - state forward → based on next-hop state
  - state backward → based on previous-hop state
- State:
  - no-op → leave state as is
  - ADD → add message (and maybe client) state
  - DEL → delete message state

Message format



- No M-layer distinction between requests and responses
  - just routed in different directions
  - client protocol may define requests and responses
- Common header defines:
  - destination flag
  - state flag
  - session identifier
  - traffic selector: identify traffic "covered" by this session
  - message sequence number
  - response sequence number
  - message cookie → avoid IP address impersonation
  - origin address → may not be data source or sink
  - destination address or scope

Message format, cont'd

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- Limit session lifetime
- Avoid loops → hop counter
- Mobility:
  - dead branch removal flag
  - branch identifier
- Record route: gathers up addresses of CASP nodes visited
- Route: addresses that CASP message should visit

Capability negotiation

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- CASP has named capabilities
  - including client protocols
- Three mechanisms:
  - discovery: count capabilities along a path
    - "10 out of 15 can do QoS"
  - record: record capabilities for each node
  - require: for scout message, only stop once node supports all capabilities (or-of-and)
- avoid protocol versioning

Next-hop discovery

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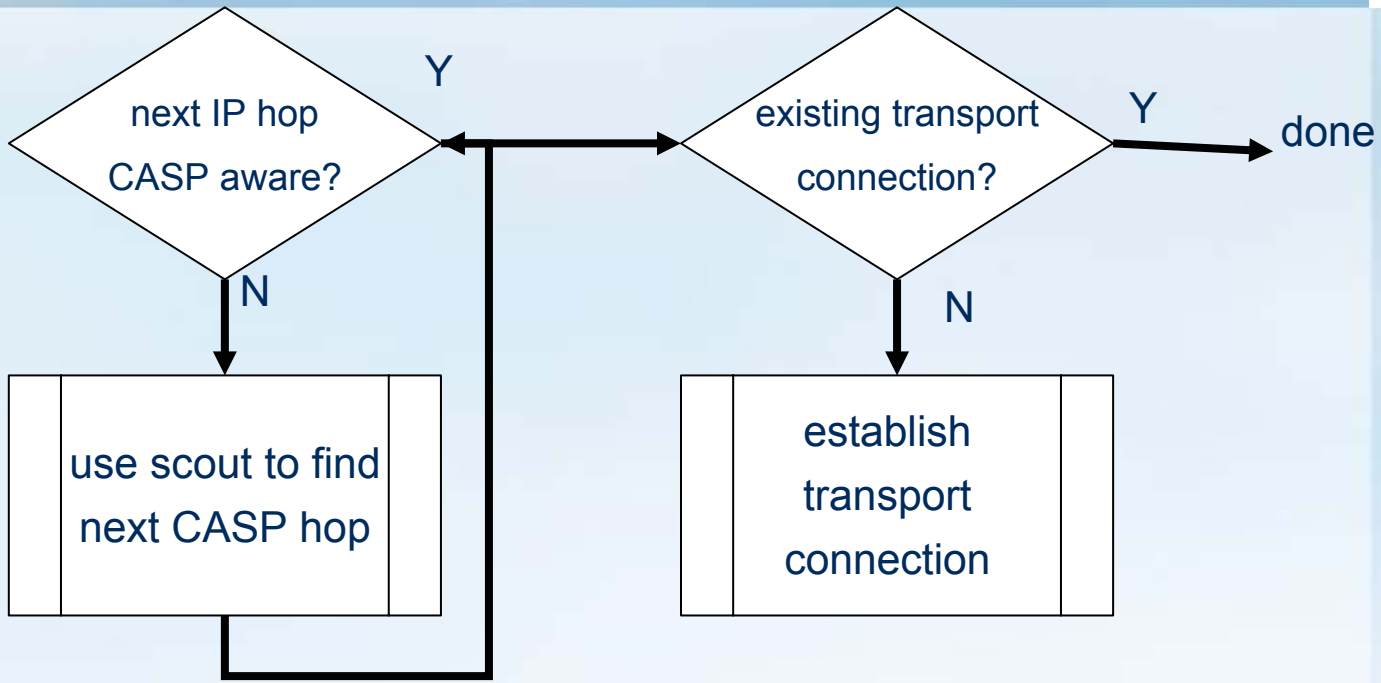
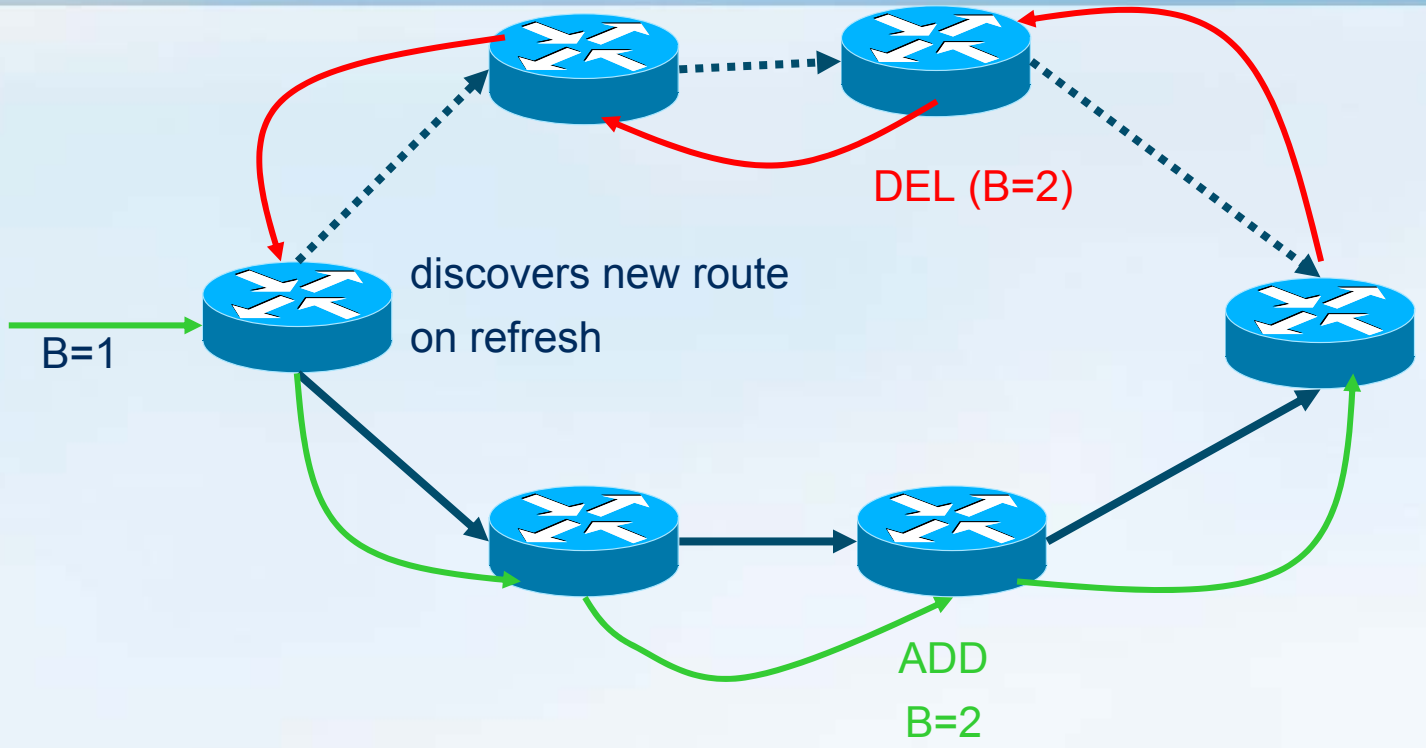
- Next-in-path service
  - enhanced routing protocols → distribute information about node capabilities in OSPF
  - routing protocol with probing
  - service discovery, e.g., SLP
  - first hop, e.g., router advertisements
  - DHCP
  - **scout protocol**
- Next AS service
  - touch down once per autonomous system (AS)
  - new DNS name space: `ASN.as.arpa`, e.g., 17.as.arpa
  - use new DNS NAPTR and SRV for lookup
    - similar to SIP approach

Next-hop discovery



- scout messages are special CASP messages
- limited < MTU size
- addressed to session destination
- UDP with router alert option → get looked at by each router
- reflected when matching CASP node found

Mobility and route changes



- avoids session identification by end point addresses
- avoid use of traffic selector as session identifier
- remove dead branch

The weight of CASP

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- CASP state = transport state + CASP M-state + client state
- M-state = two sockets
- transport state = O(100) bytes → 10,000 users consume 1 MB

Conclusion

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- CASP = unified infrastructure for data-affiliated sessions
- avoid making assumptions except that sessions wants to "visit" data nodes or networks
- not *just* mobility, but also mobility
- protocol framework in place
  - but need to work out packet formats

CASP properties

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- 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
- extensible
  - data format
  - negotiation

CASP properties, cont'd.

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- Topology hiding
  - not recommended, but possible
- Light weight
  - implementation complexity
  - security associations (re-use)
  - may not need kernel implementation

