Path Layer UDP Substrate (PLUS)

Technical Considerations

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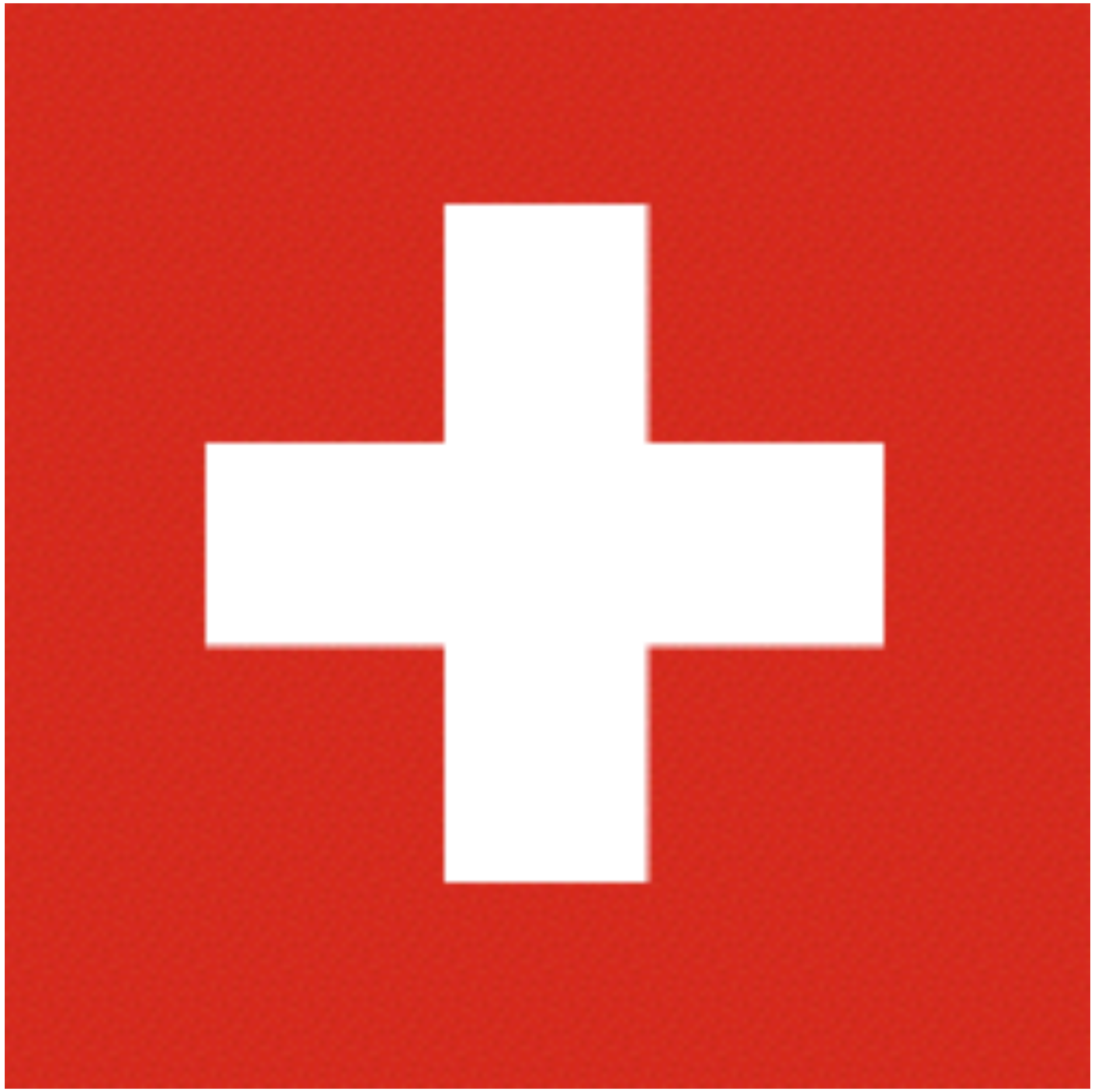
PLUS BoF — IETF 96 Berlin — 21 July 2016



PARENTAL

ADVISORY

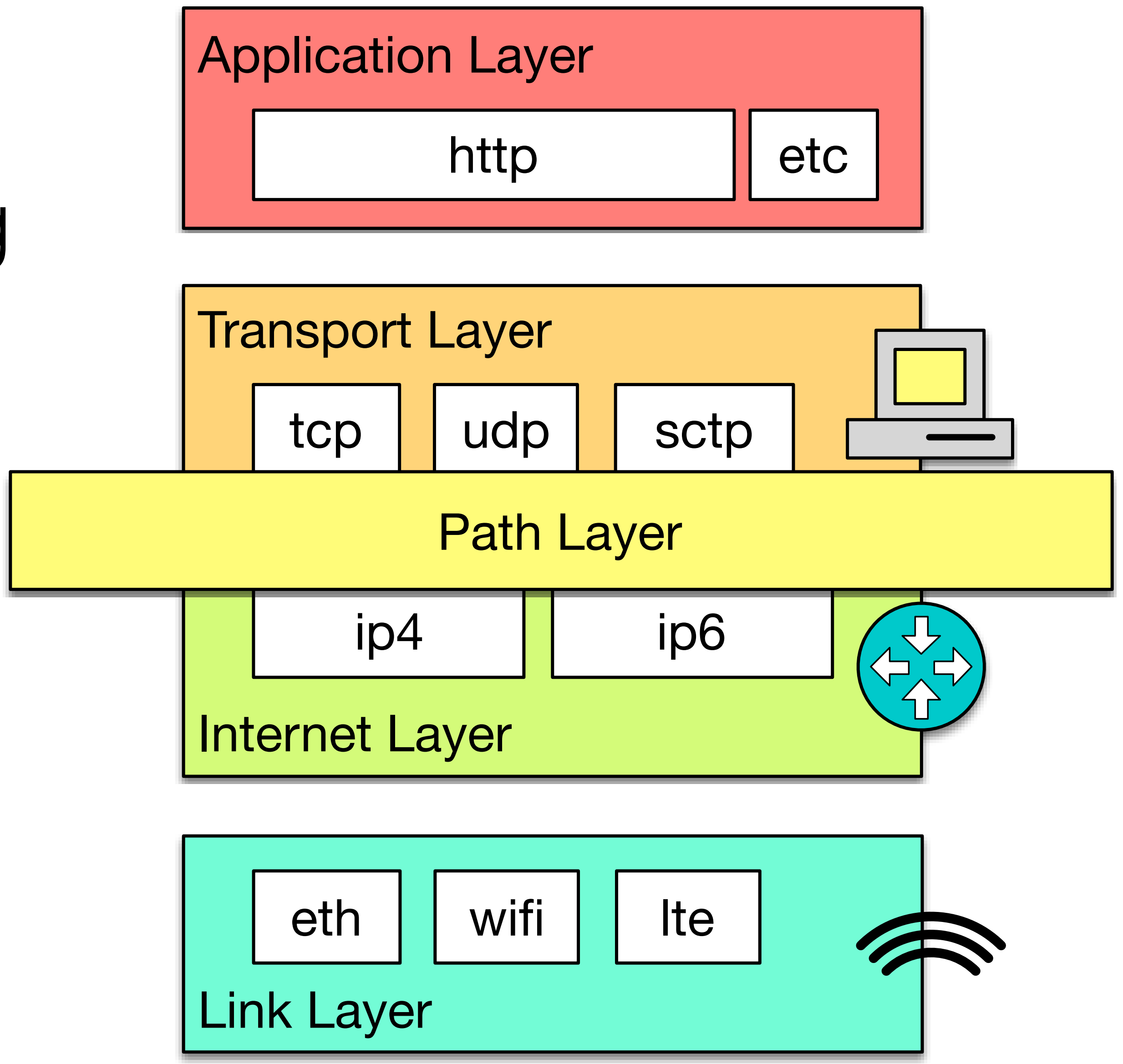
EXPLICIT COOPERATION

Explicit Cooperation

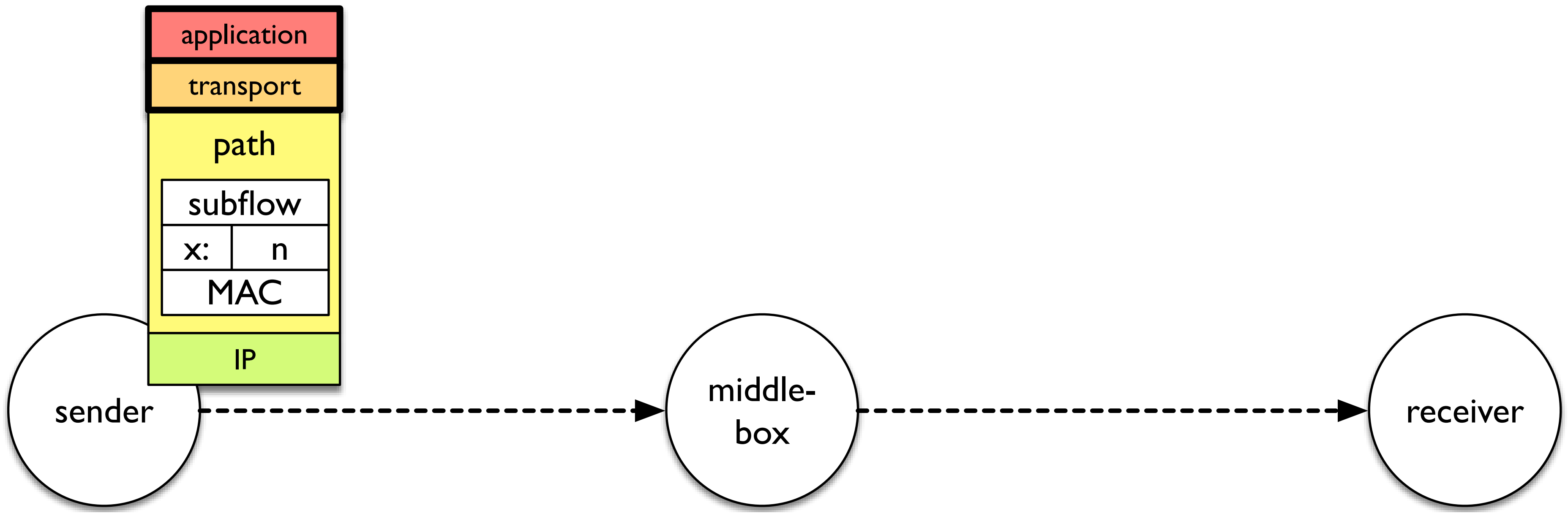
- “Implicit cooperation” between endpoints and middleboxes **already widespread in the Internet**,
  - where “cooperation” may be the wrong term: some hacks and workarounds are quite hostile.
- **Explicit cooperation** under **endpoint control** may be a way to reduce tension in this tussle
  - Declarative, advisory signaling with no trust required between endpoint and path.
- **Encrypt everything devices on path don’t need to see** (including transport headers), to prevent future “implicit cooperation” without sender authorization.

Three and a half mechanisms to make the path layer explicit

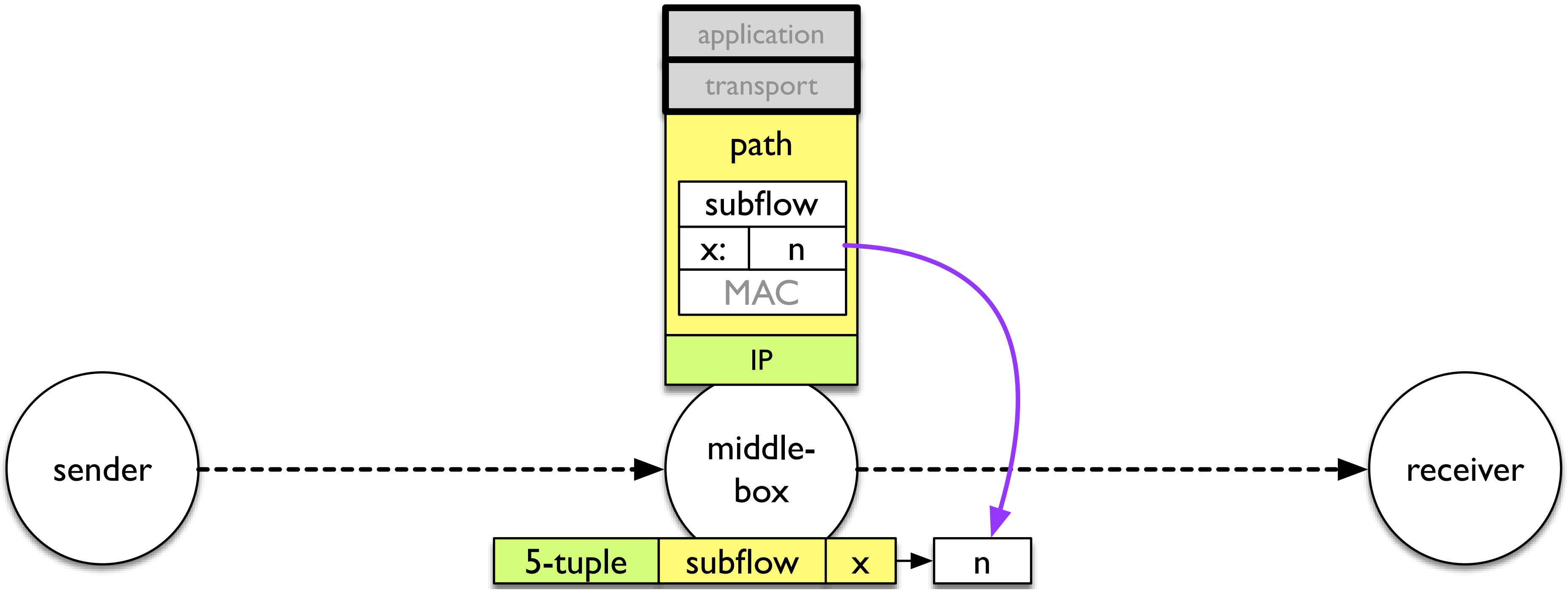
- Sender – Path Signaling
- Path – Receiver Signaling
  - with encrypted feedback to sender
- Direct Path – Sender Signaling
  - information about dropped packets



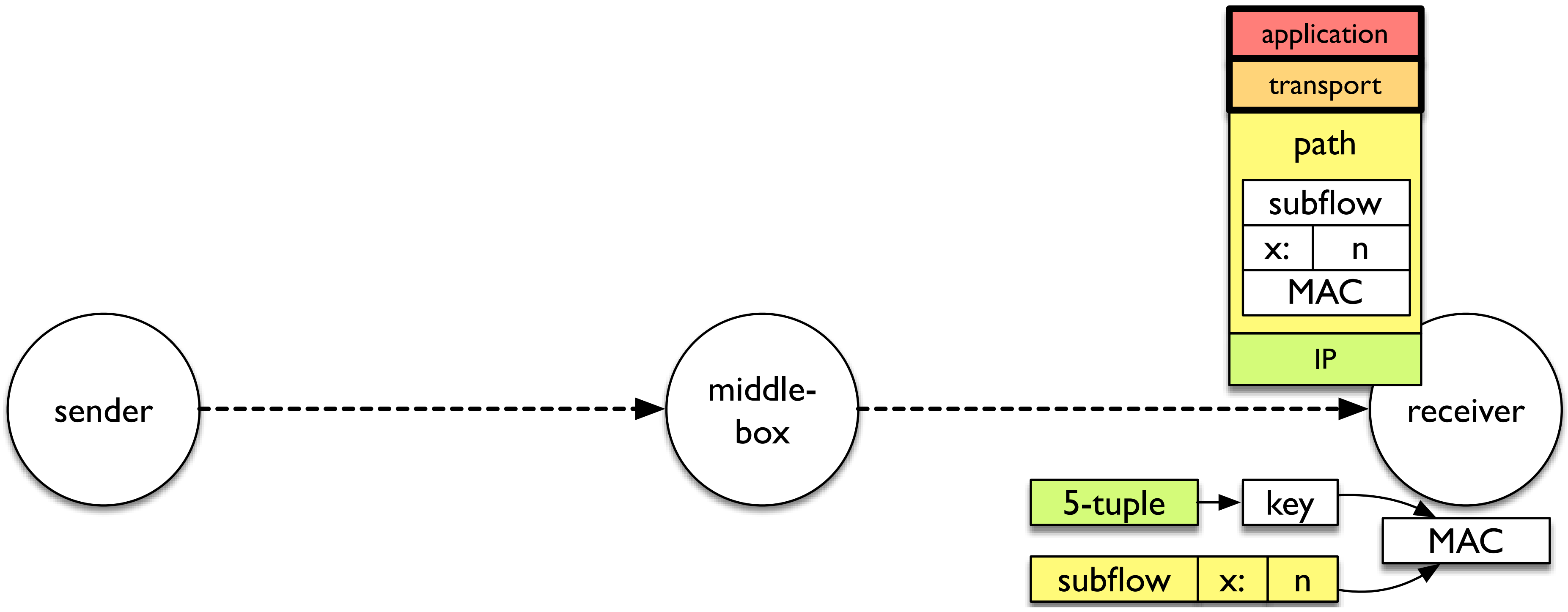
Sender to Path (sender-side)



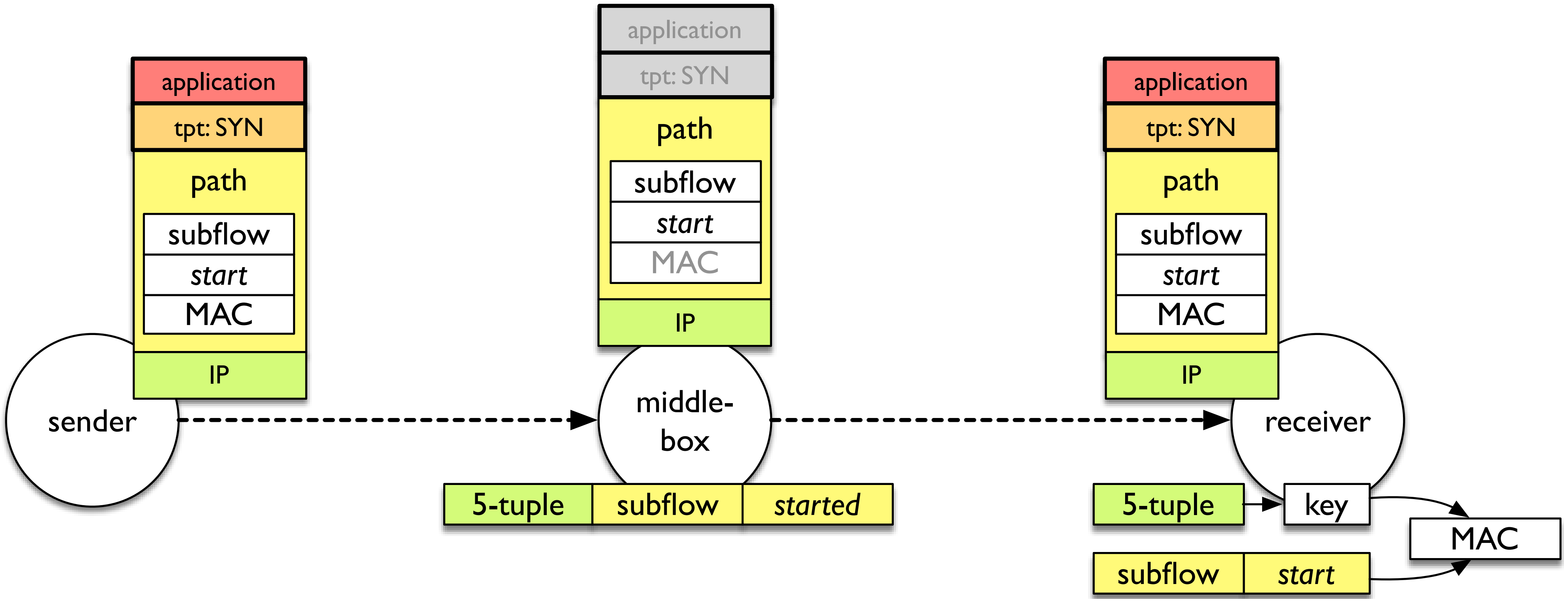
Sender to Path (on-path)



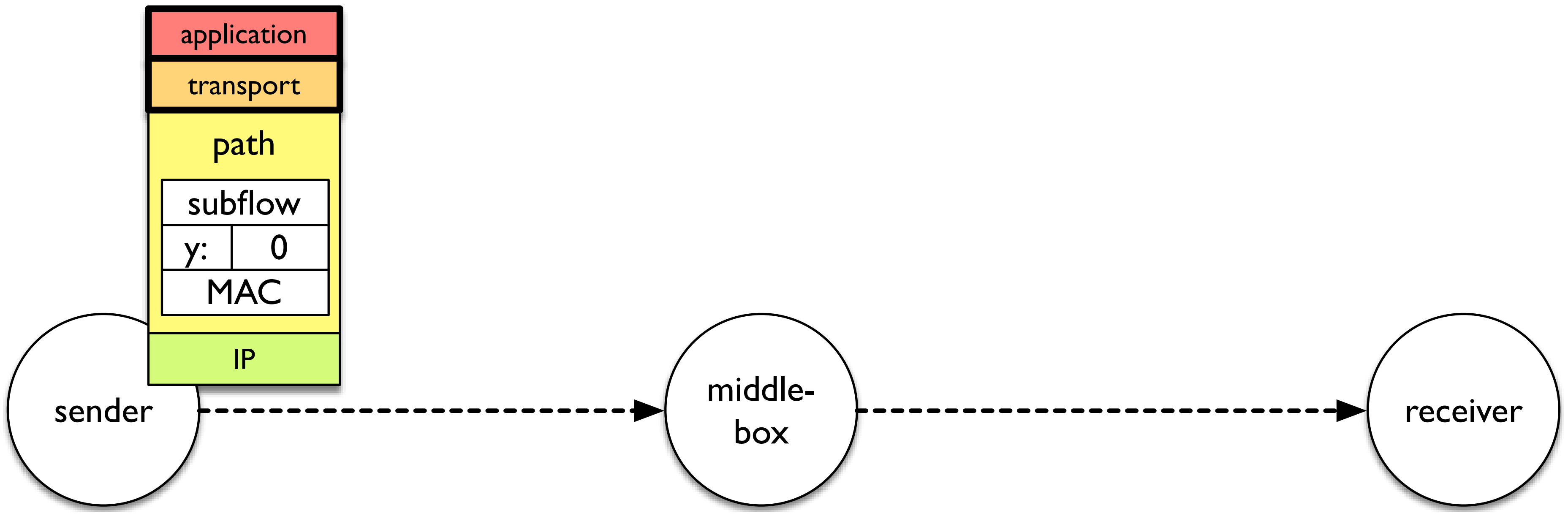
Sender to Path (receiver-side)



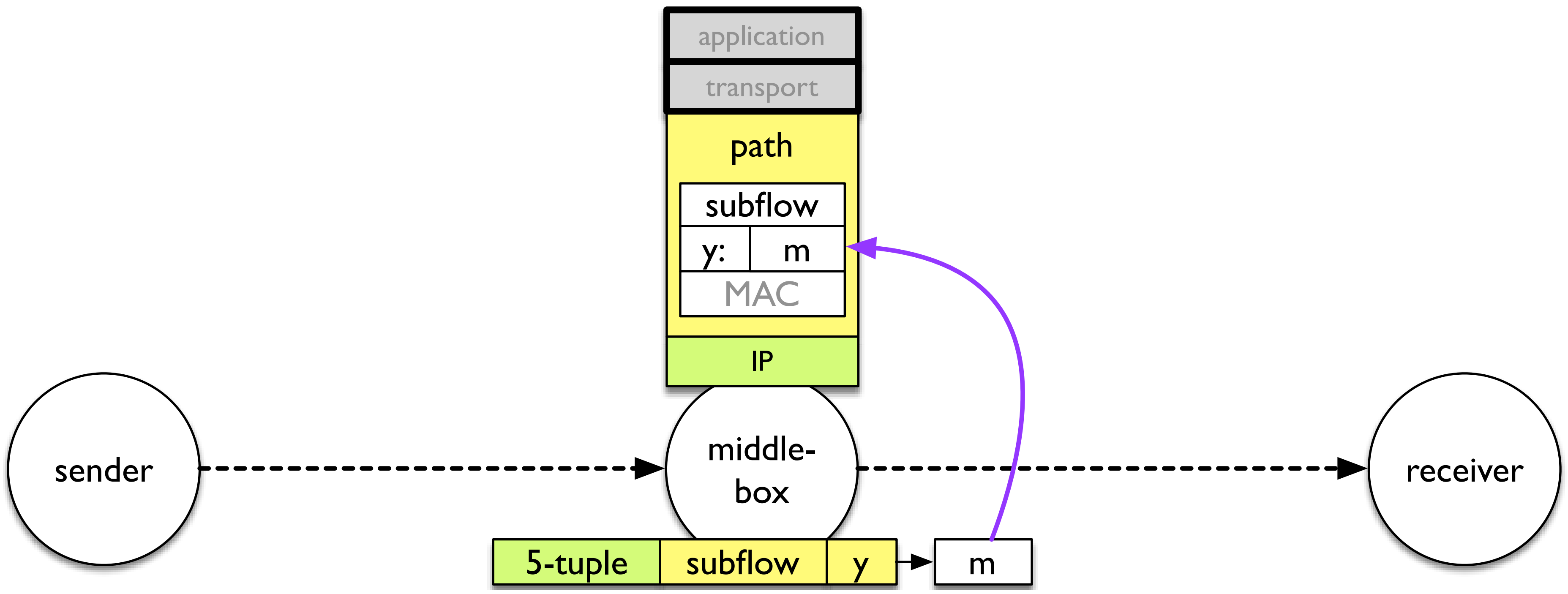
Sender to Path
Transport State Signaling



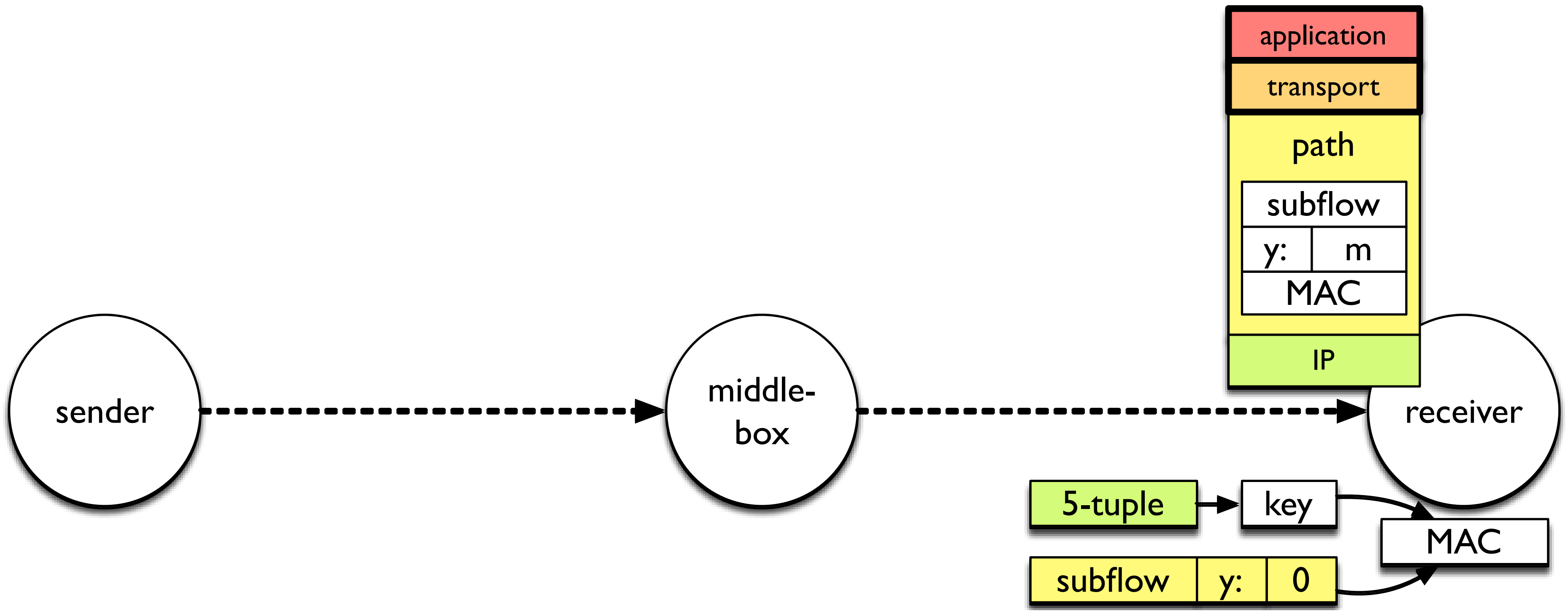
Path to Receiver (sender-side)



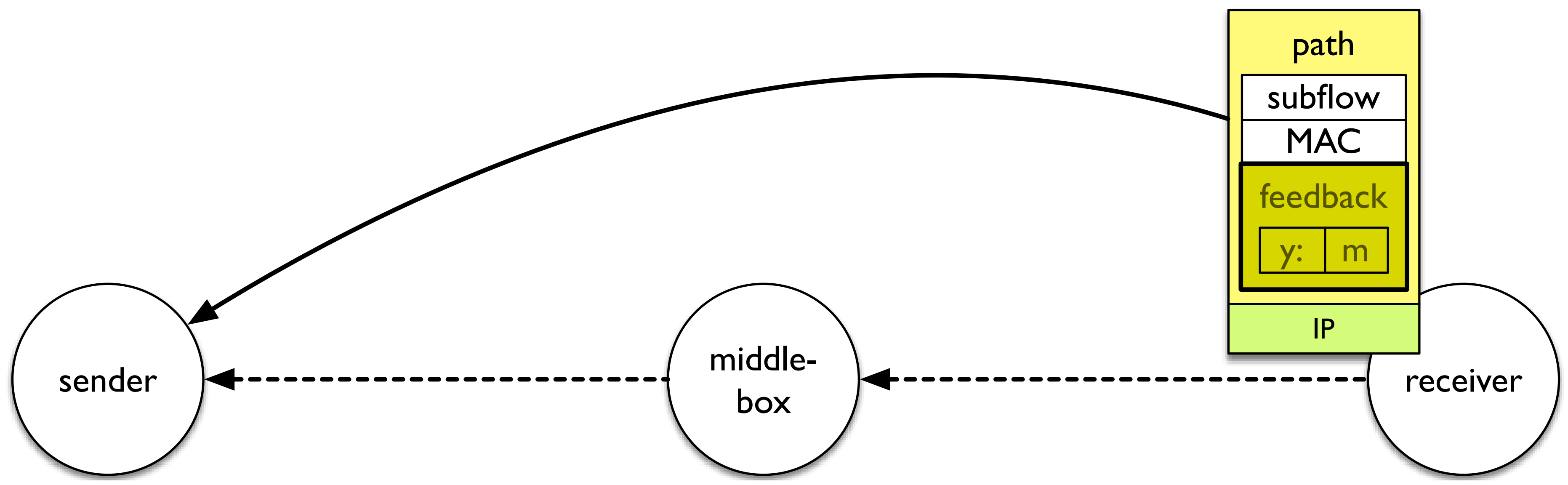
Path to Receiver (on-path)



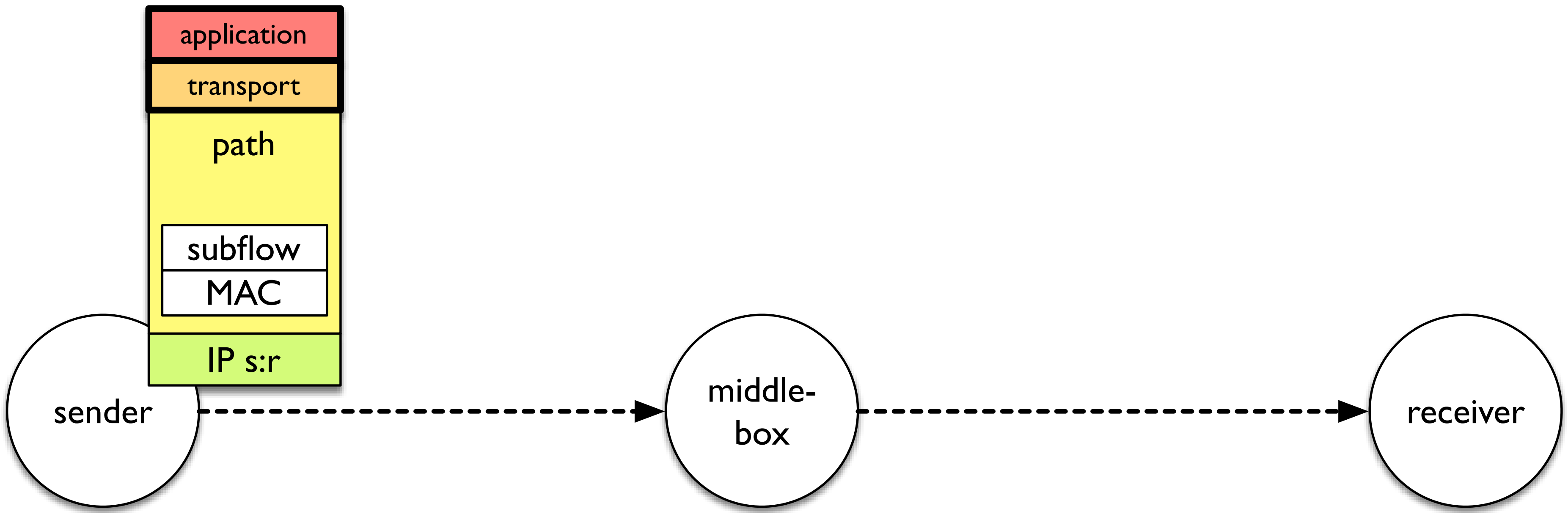
Path to Receiver (receiver-side)



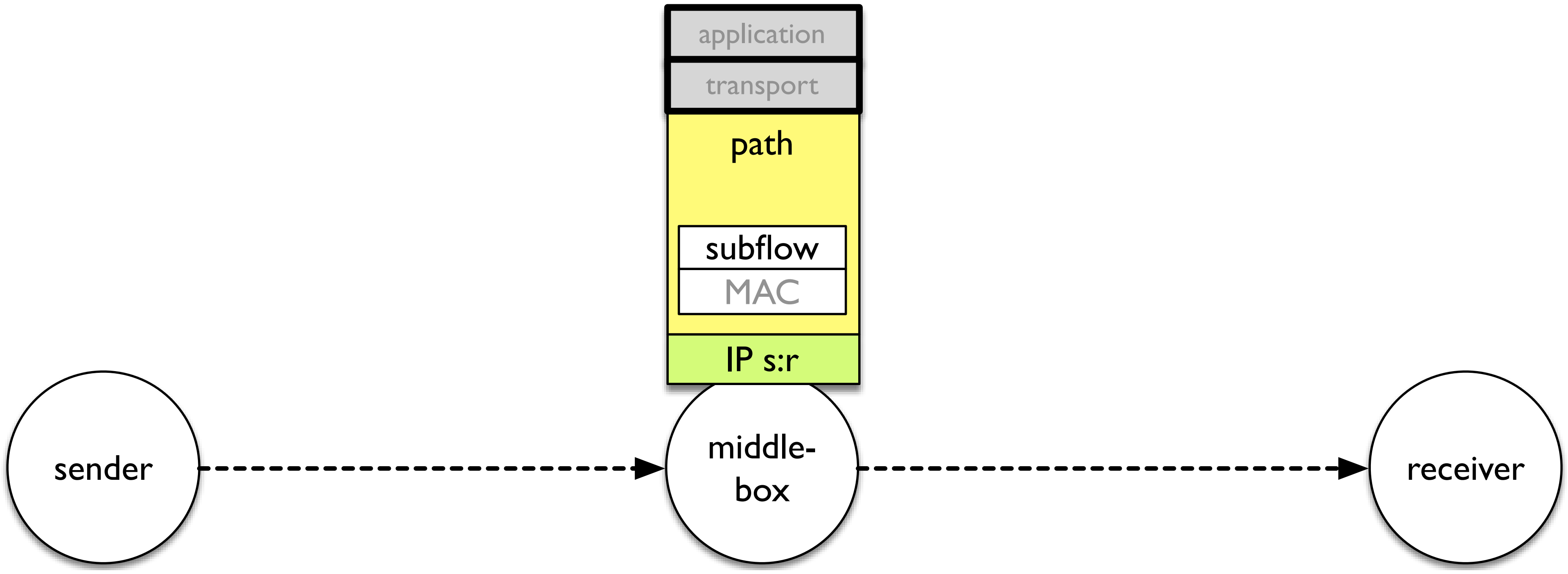
Receiver Feedback



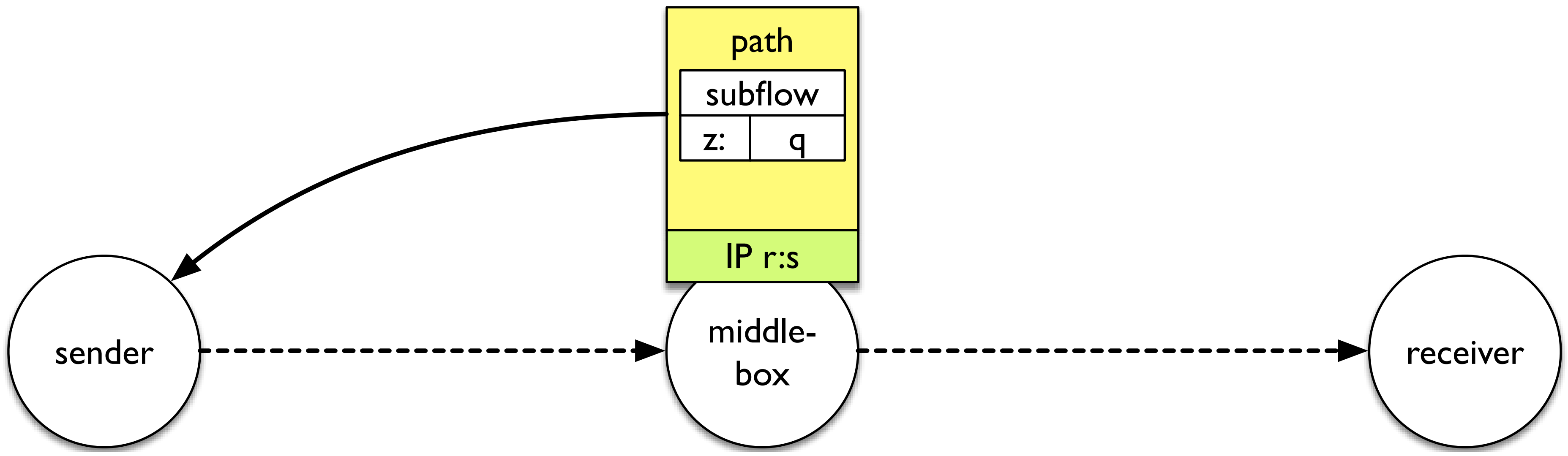
Path Direct to Sender (sender-side)



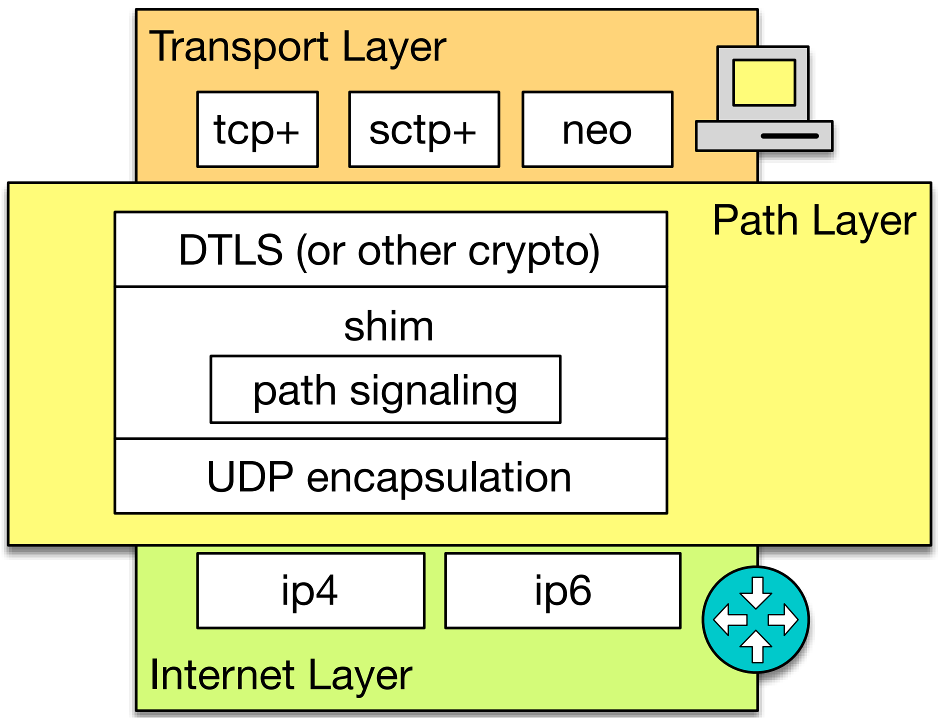
Path Direct to Sender (on-path)



Path Direct to Sender (feedback)



Anatomy of the Path Layer



- UDP encapsulation
  - userspace implementation
  - ports for NAT
  - ~95% deployable today
- encoding for signaling mechanisms
- crypto to protect transport headers and above

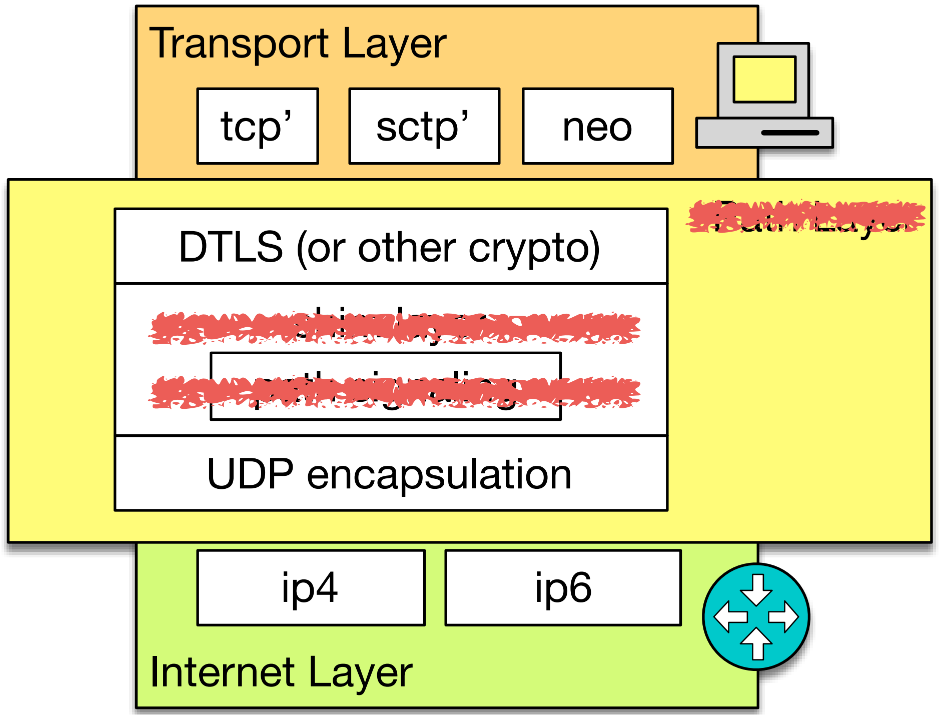
meanwhile, on the spud@ietf.org list…

Is this a user tracking and network neutrality violation machine?

- Will it be possible for a middlebox to use PLUS to insert user identifiers in the server-bound stream of a client-server protocol?
  - **No**, unless the client specifically requests it.
  - (Note: possible without PLUS, out of band, today)
- Will it be possible to use PLUS to require a client to insert a particular kind of metadata into a stream?
  - Bad news: yes; no technical solution exists here.
  - (Worse news: also many ways to do this without PLUS)
  - Good news: PLUS brings **transparency** to this behavior.

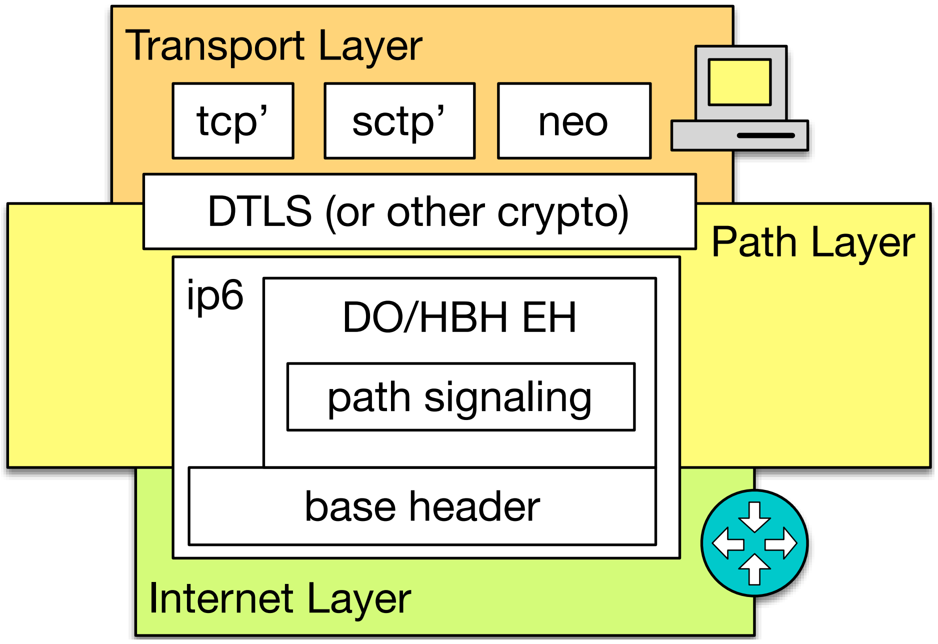
Can we make transport innovation work without explicit cooperation?

- **draft-herbert-transports-over-udp**
  - *x* over DTLS over UDP.
  - Make transport innovation possible with crypto.
  - Breaks middleboxes.
    - This is a feature.
- Equivalent to PLUS when neither endpoint decides to expose anything to the path.



Can we use IPv6 extension headers?

- IPv6 extension headers can be used to implement PLUS mechanisms
  - Ignore IPv4 in future deployments
  - DO to expose to path: hack, but more deployable
  - HBH for exchange with path: cleaner, but less deployable
- DO/HBH already supported in most socket APIs
- But: more impaired than UDP

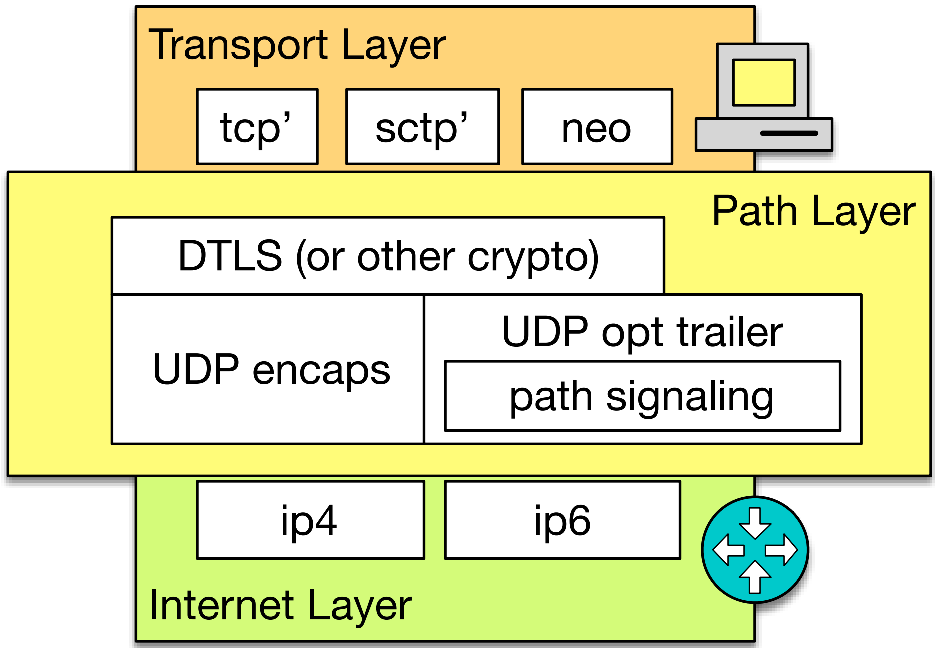


	web	MX	NS
DO	**89.5%**	88.5%	79.7%
HBH	**61.0%**	54.5%	45.9%

1-p(loss), 8-byte DO/HBH
to Alexa top 1M domains, 8.2014-6.2015
(draft-ietf-v6ops-ipv6-ehs-in-real-world-02)

Can we use UDP Options?

- **draft-touch-tsvwg-udp-options**
    - add option space to UDP in a "gap" between the UDP and IP lengths of a packet.
    - Allows optional data to be added to existing UDP applications in a backward compatible manner.
- Proposal: use this option space for PLUS
    - Are these the same problem?
    - Must be in-kernel: no userspace implementation.



Do we need
to choose now?

and in conclusion…

Things we need

- A mechanism for making widespread cooperation between endpoints and middleboxes explicit
- Endpoint control over explicit cooperation
- A clear boundary between what the path can see and what it cannot, enforced by encryption
- A design for this facility that deploys on the endpoints from day zero
- All this without requiring a trust relationship between the endpoints and middleboxes