Path Layer UDP Substrate (PLUS)

Technical Considerations

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segue

- (this slide is a placeholder for a clean segue from Ted’s and Natasha’s talks, if necessary)

PARENTAL

ADVISORY

EXPLICIT

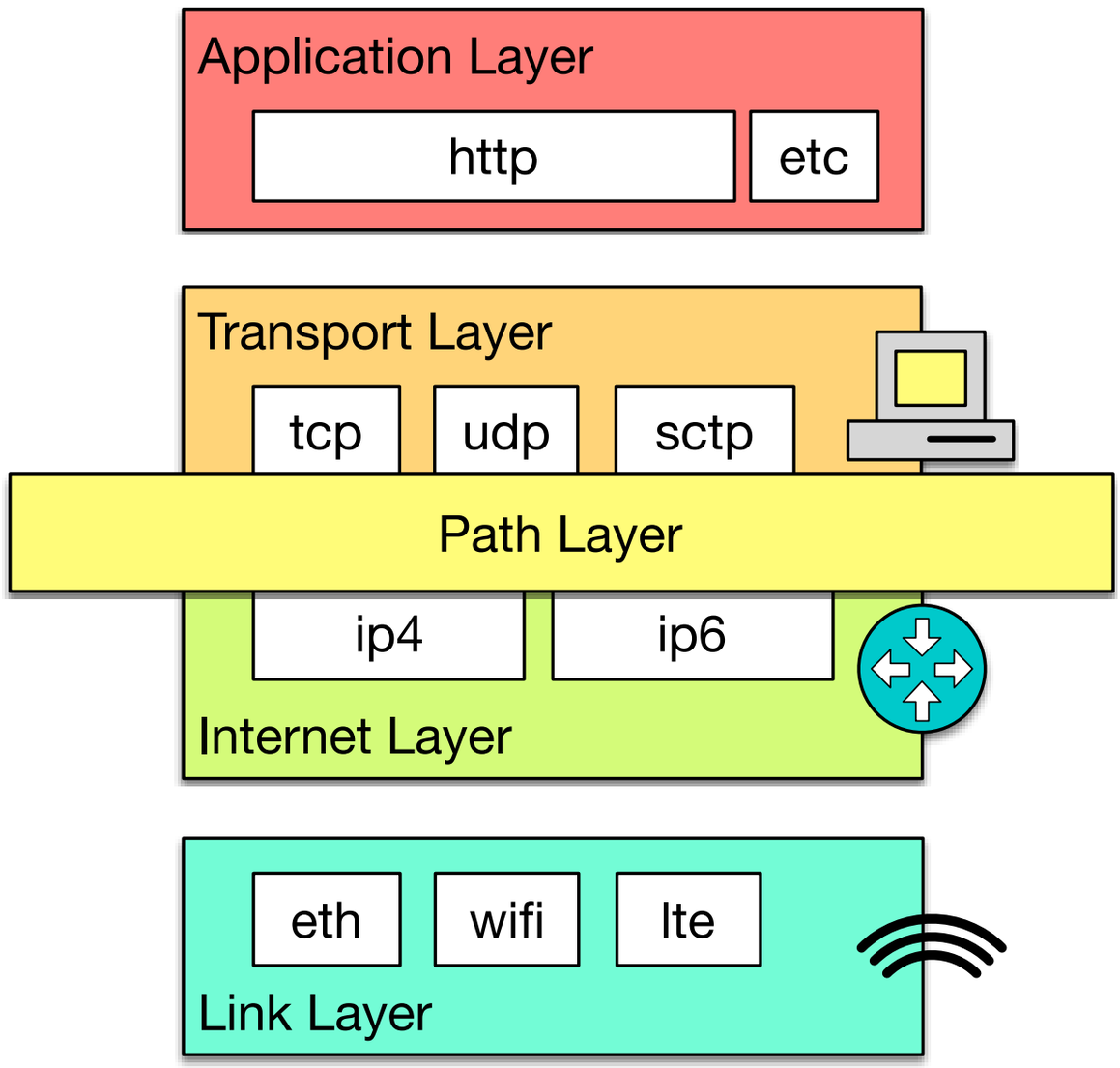
COOPERATION

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.
- We present making this cooperation explicit, and handing control over it to the endpoints, as a way to reduce tension in the end-to-end tussle.
- We declare that everything devices on path don’t need to see (including transport headers) should be encrypted to prevent future unauthorized “implicit cooperation”.

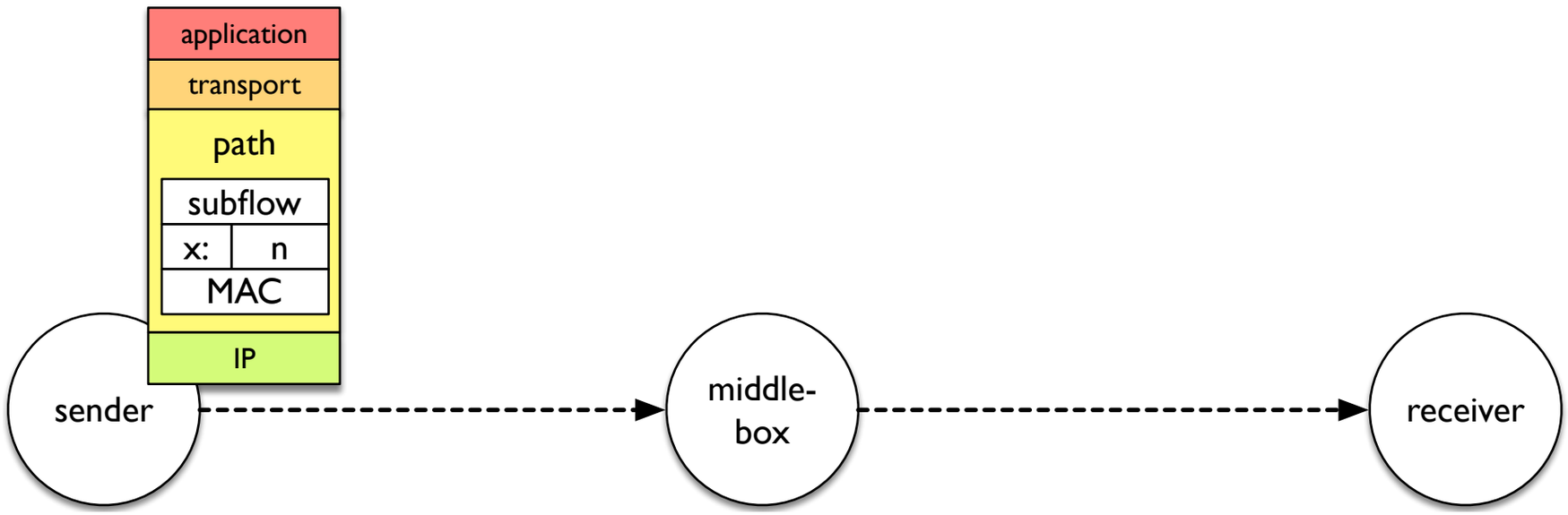
Introducing the Path Layer

- Network: hop-by-hop, no data-plane state.
- Transport: end-to-end, stateful.
- Hidden layer in between where all the state in the network lives.
- PLUS makes this explicit.

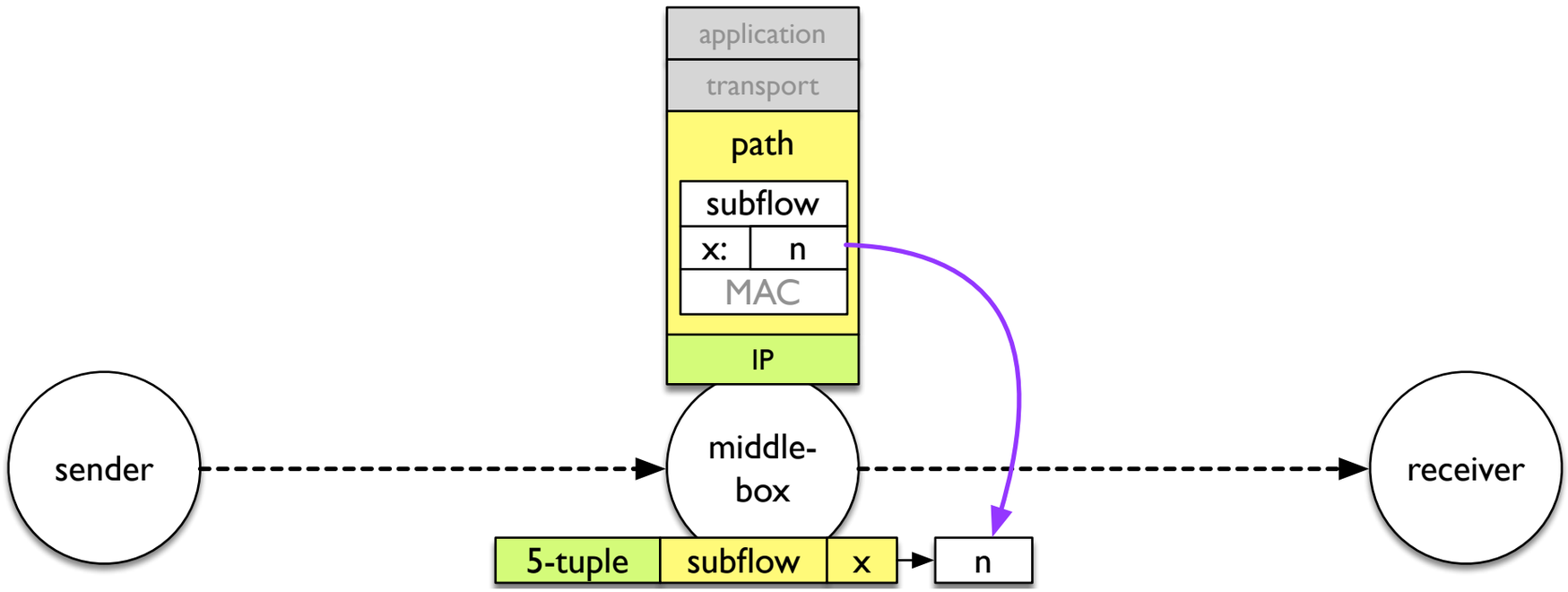


Mechanisms

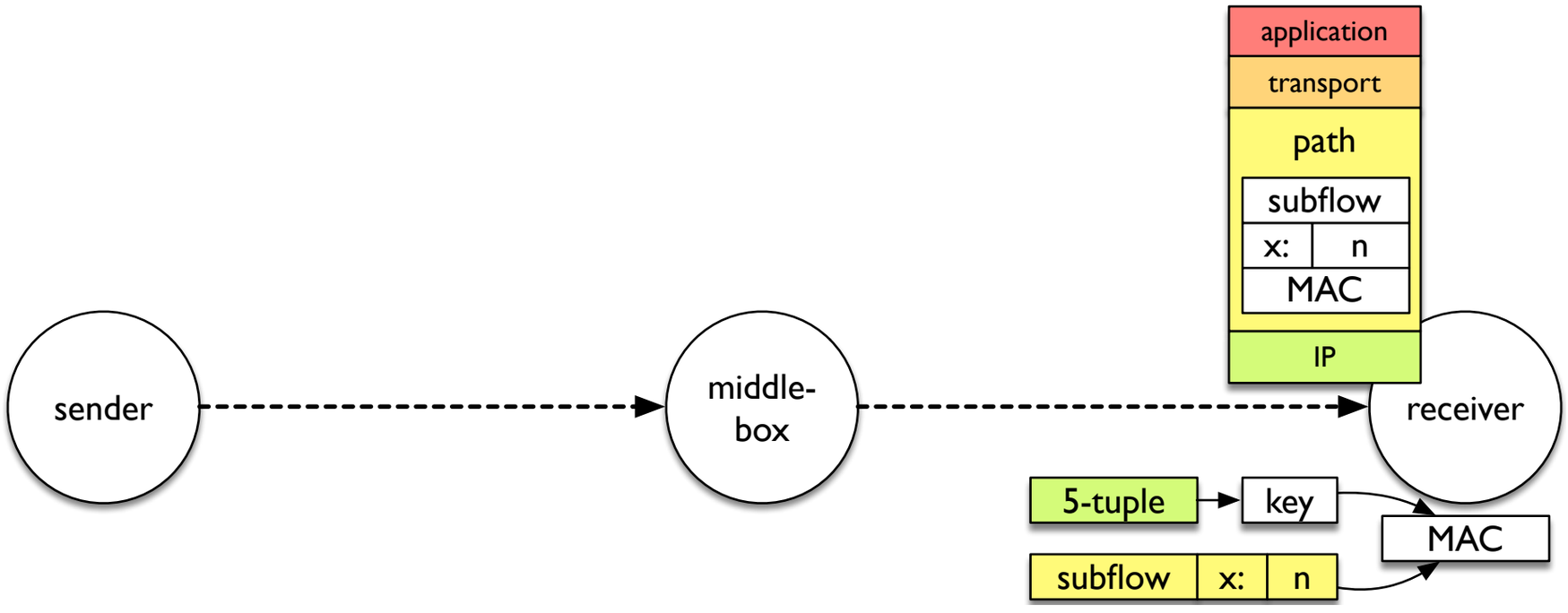
Endpoint to Path (sender-side)



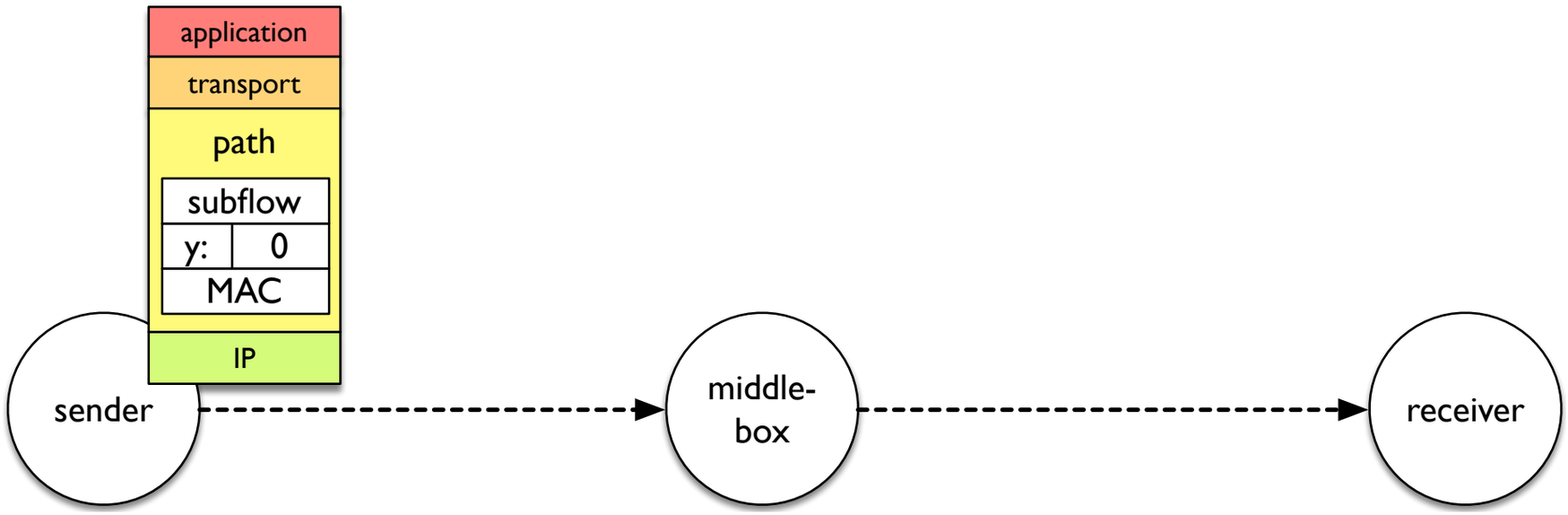
Endpoint to Path (on-path)



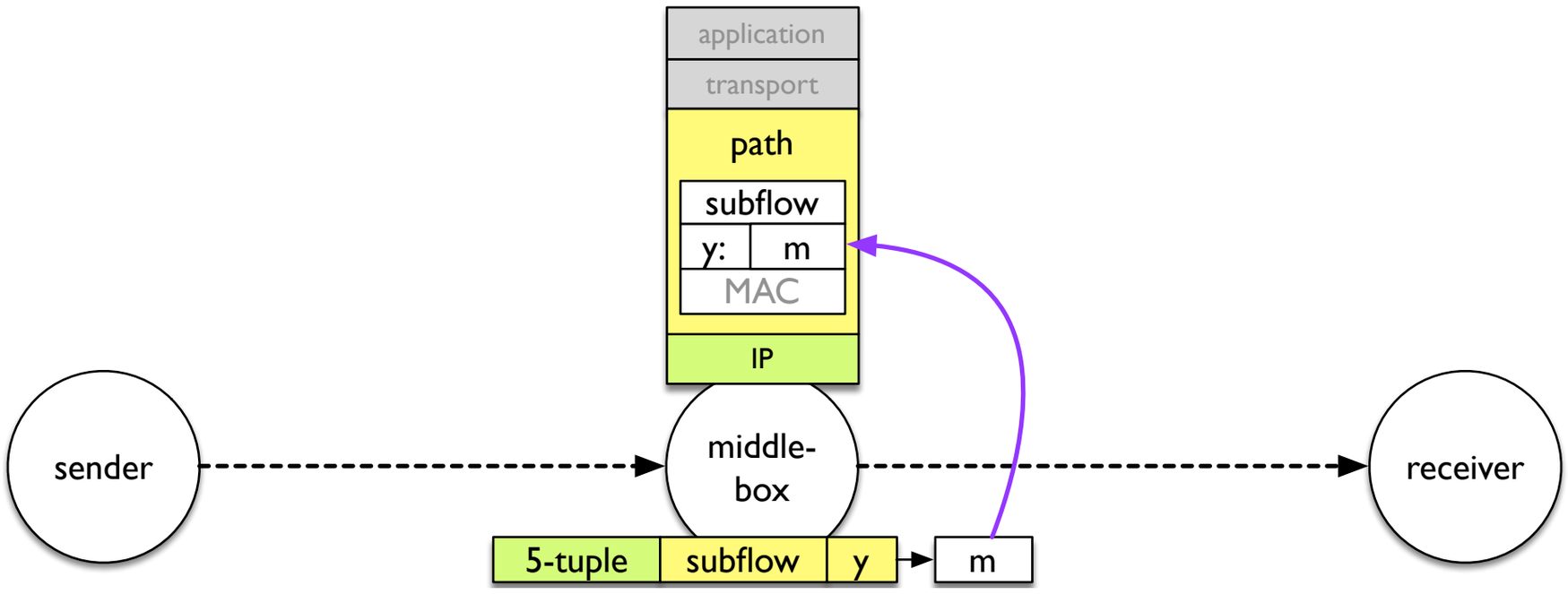
Endpoint to Path (receiver-side)



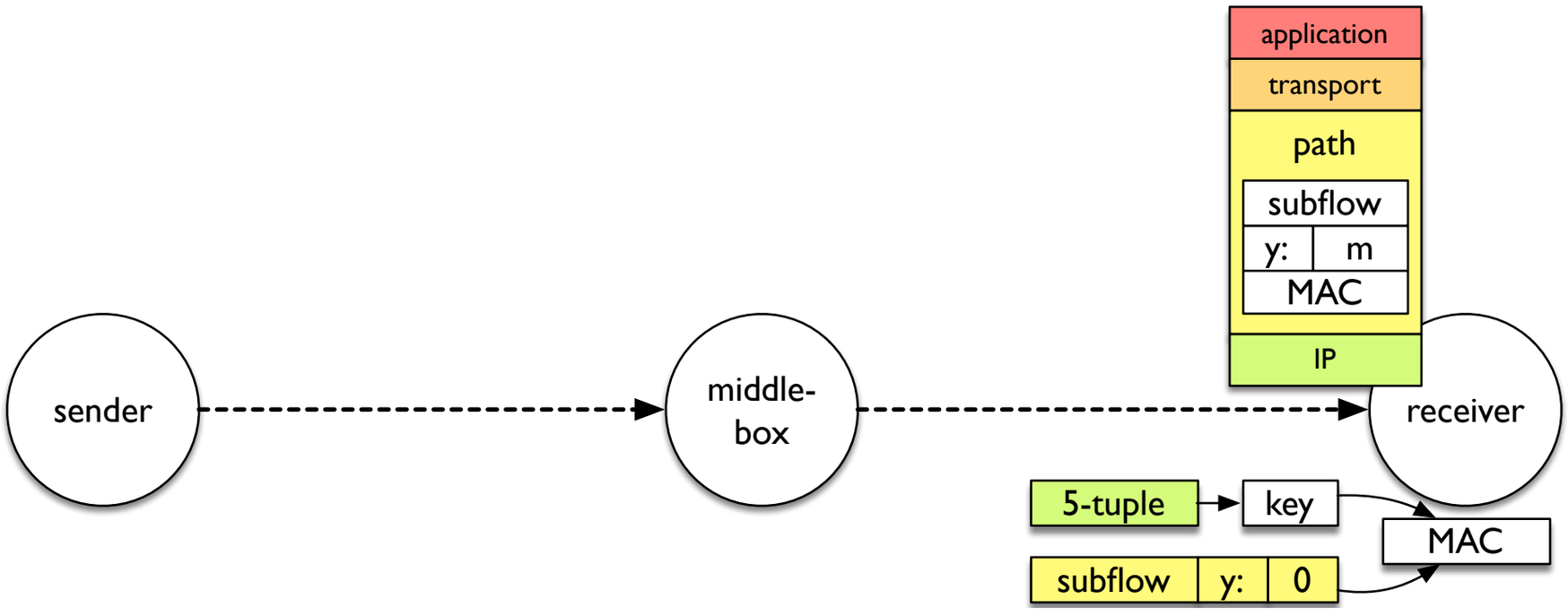
Path to Receiver (sender-side)



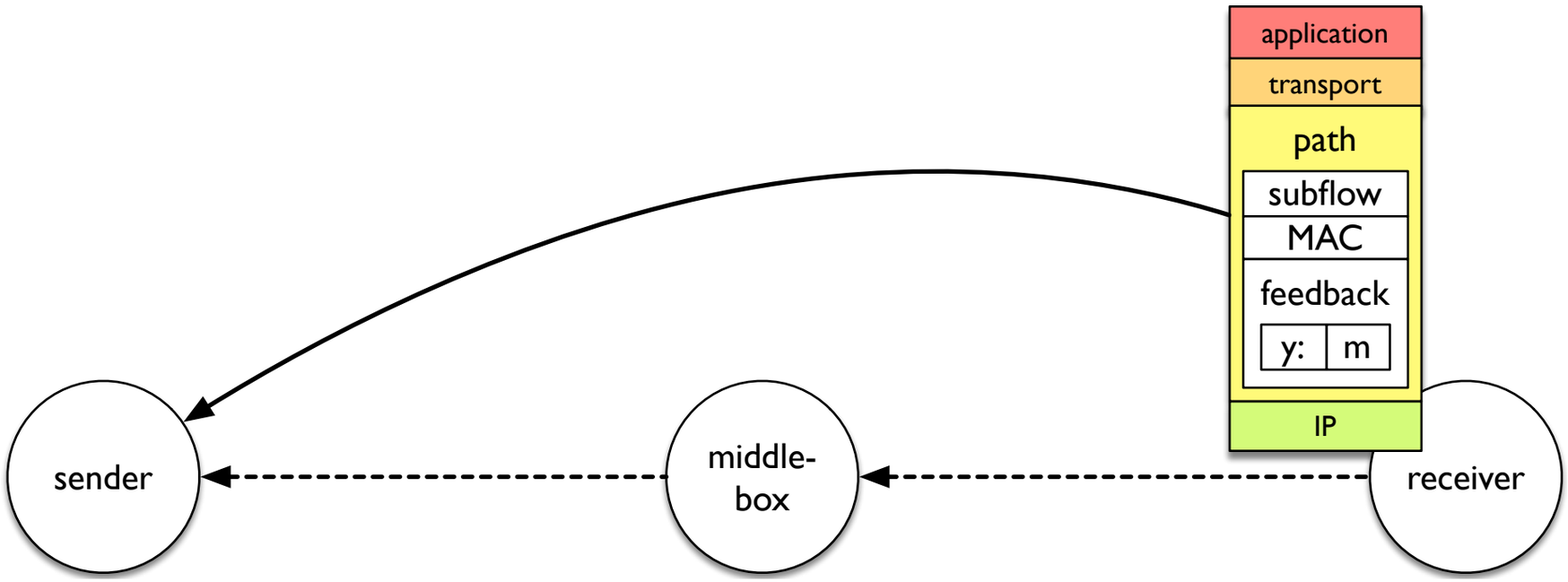
Path to Receiver (on-path)



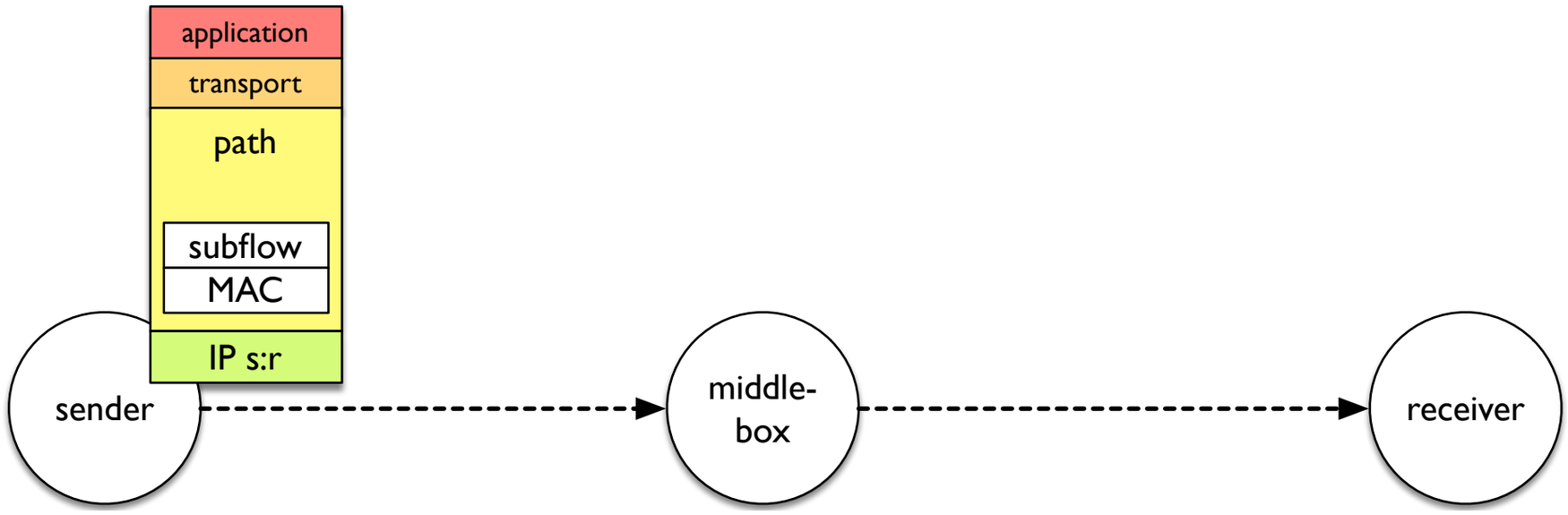
Path to Receiver (receiver-side)



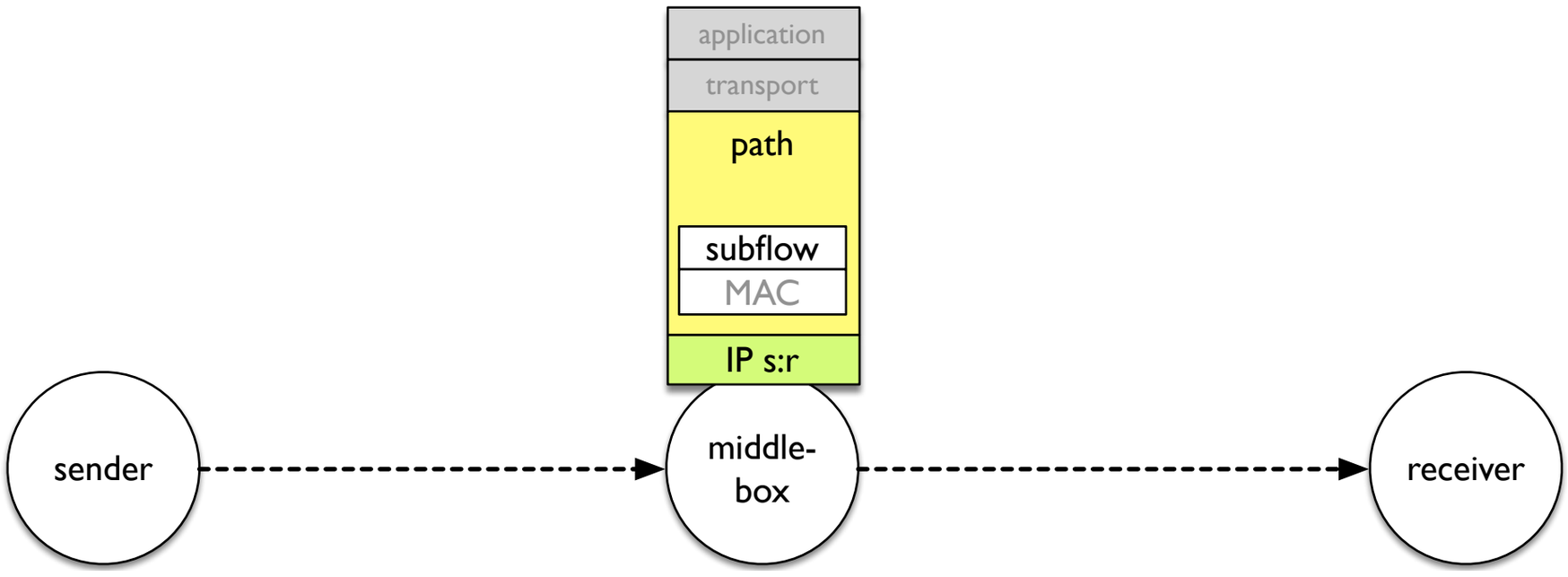
Receiver Feedback



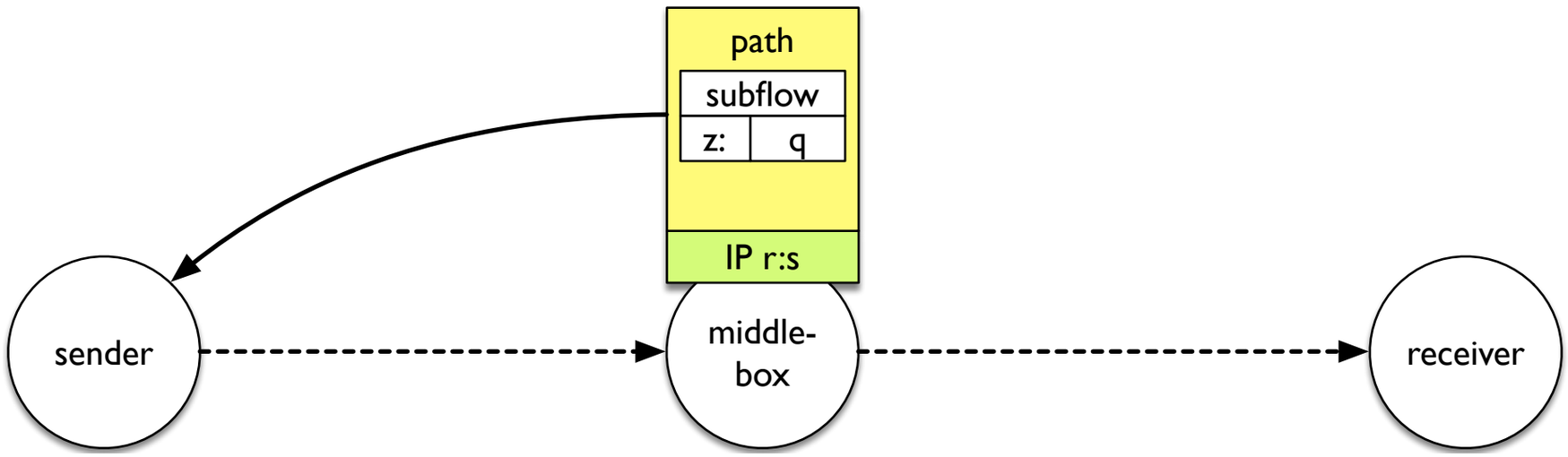
Path Direct to Sender (sender-side)



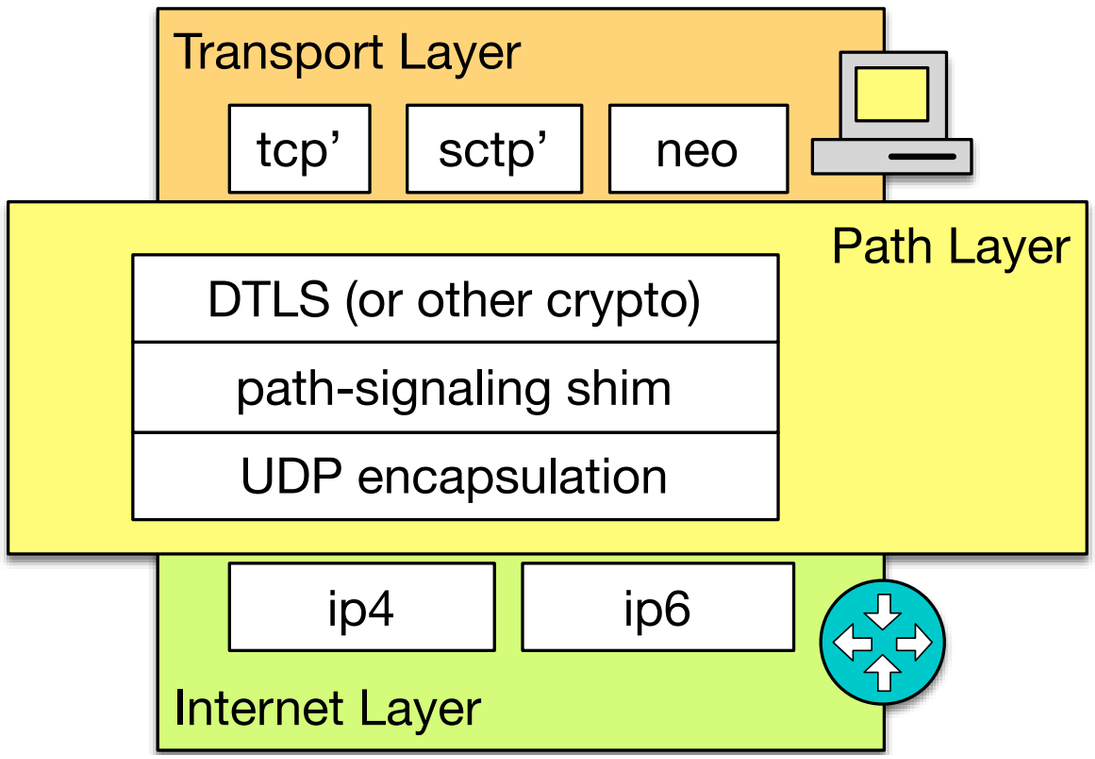
Path Direct to Sender (on-path)



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

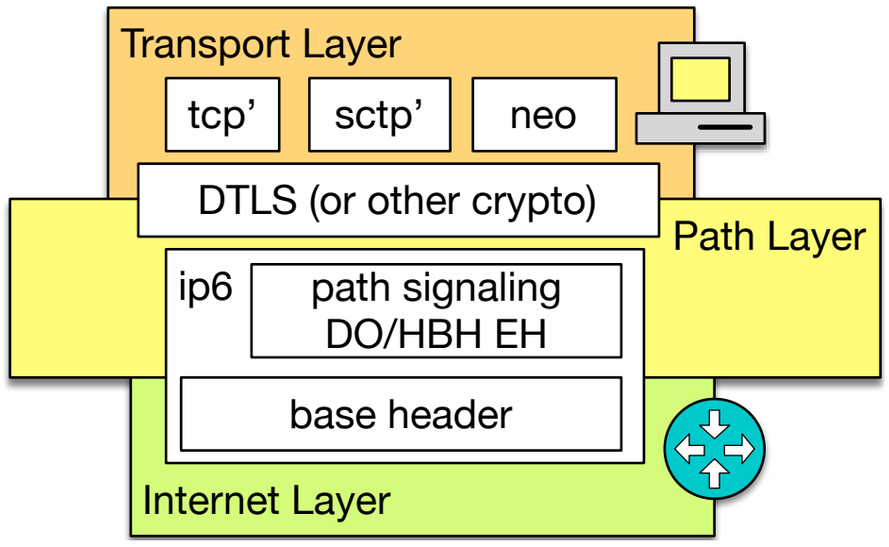
meanwhile, on the spud@ietf.org list…

Is this a user tracking and network neutrality violation machine?

- Will it be possible for a middlebox to insert user identifiers in the server-bound stream of a client-server protocol?
  - **No**, unless the client specifically requests it.
    - (Note: possible without PLUS, 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: brings **transparency** to this behavior.

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: deployable hack
    - HBH to communicate with path: cleaner, but deployment issues
- Defined EH already supported in most socket APIs
  - may meet “userspace implementability” req’t.
- More impaired in the Internet than UDP



Can we make transport innovation work without cooperation?

- **draft-herbert-transports-over-udp**
  - Standardize *x* over DTLS over UDP stack.
  - Fix transport innovation problem with crypto.
    - Breaks all middleboxes except NATs
      - This is a feature.

- True: sometimes, cooperation is useless.
  - Equivalent to PLUS when neither endpoint decides to expose anything to the path.

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 at all?
  - No advantage over a UDP-based shim layer.
  - Needs kernel support: no userspace implementation.
  - No fast-path recognition or packet/property association.

and in conclusion…

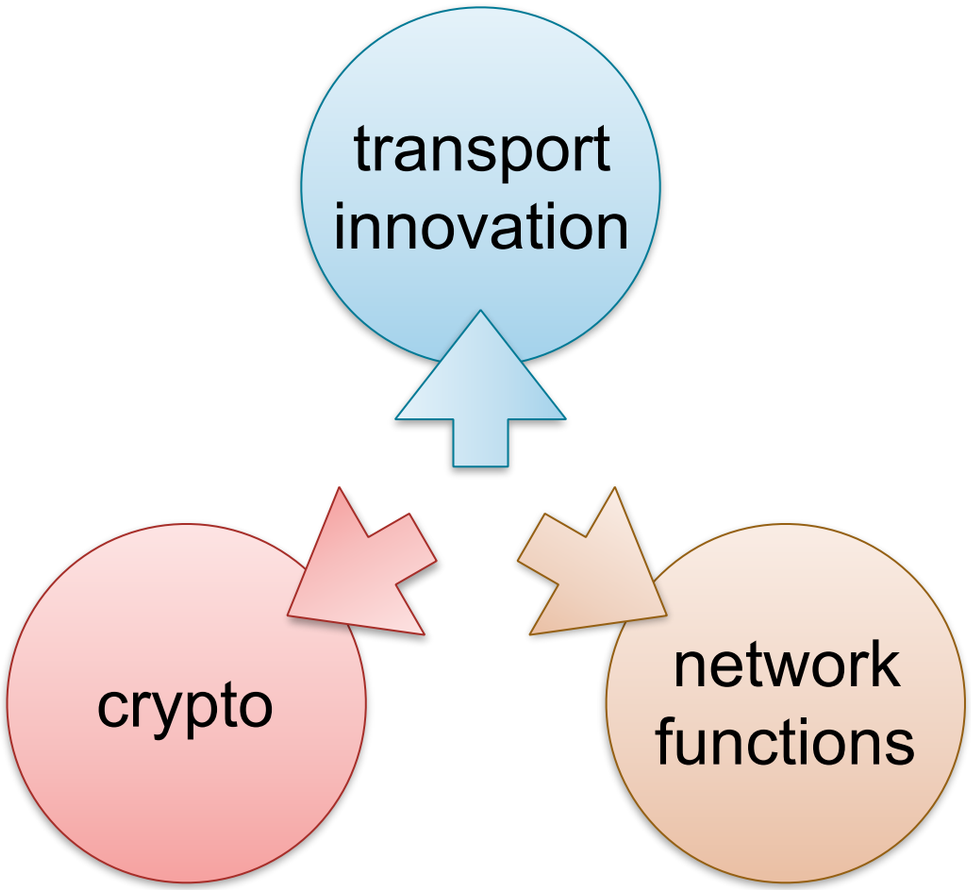
Things we need

- 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

junkyard slides

A three-way tussle

- Transport innovation impossible due to middleboxes
- Crypto to enable innovation breaks in-network functionality
- Some in-network functionality useful, necessary



Question:
(in this talk)

- If we believe…
  - the set of requirements we think we have…
    (draft-trammell-spuq-req as starting point,
    for elaboration in a future WG)
    - describe constraints on a solution we think…
    - addresses the problems we want to solve…
      (see Ted's and Natasha's talks,
      use draft-kuehlewind-spud-use-cases as starting point,
      for elaboration in a future WG)
- … then can we show that a technical approach exists to implement these requiremenrs?