Middlebox Cooperation Protocol Technical Considerations

Brian Trammell, MAMI Plenary

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mami

measurement and architecture for a middleboxed internet

measurement | architecture | experimentation

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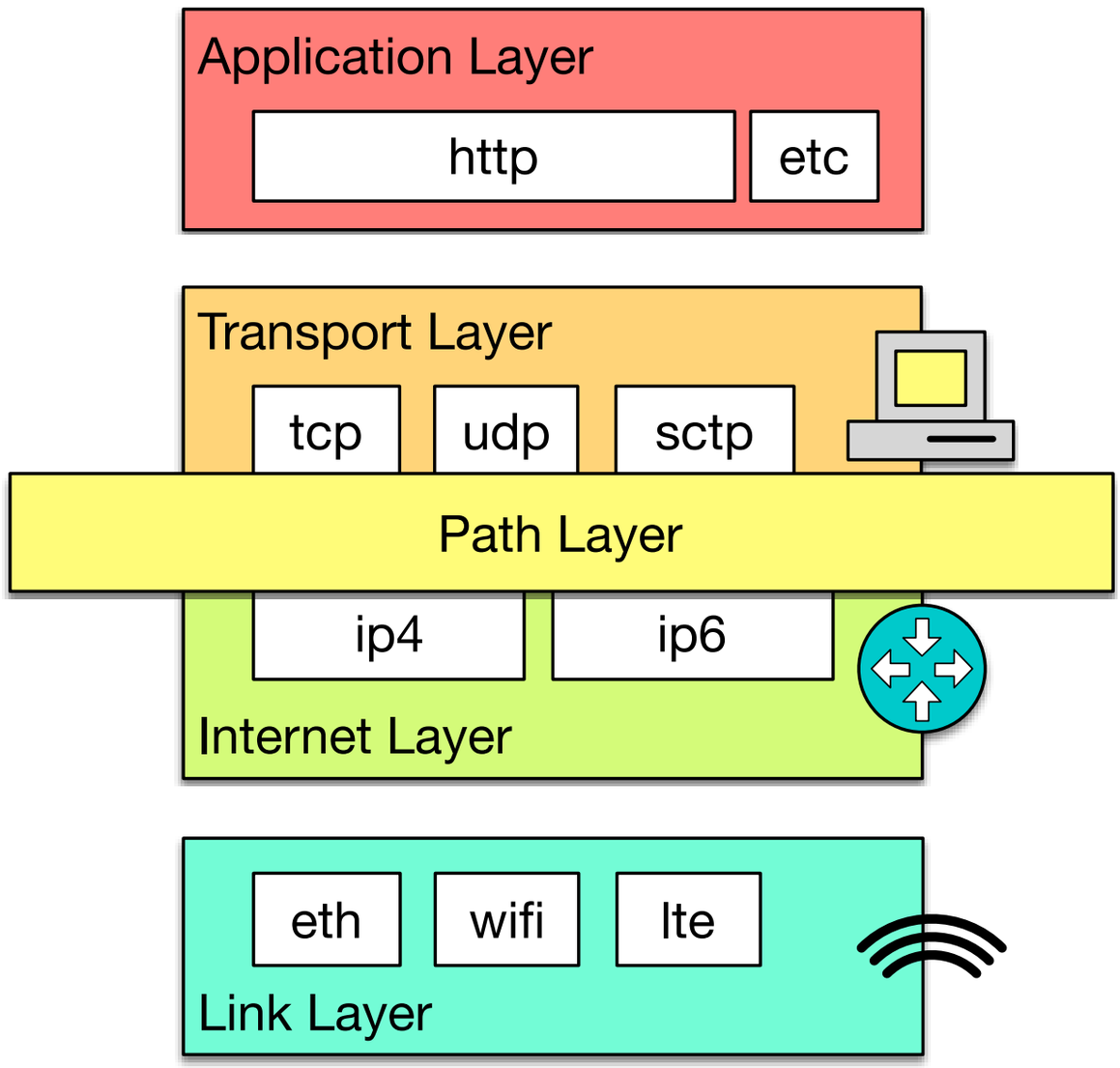
PARENTAL
ADVISORY
EXPLICIT COOPERATION

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 unauthorized “implicit cooperation”.

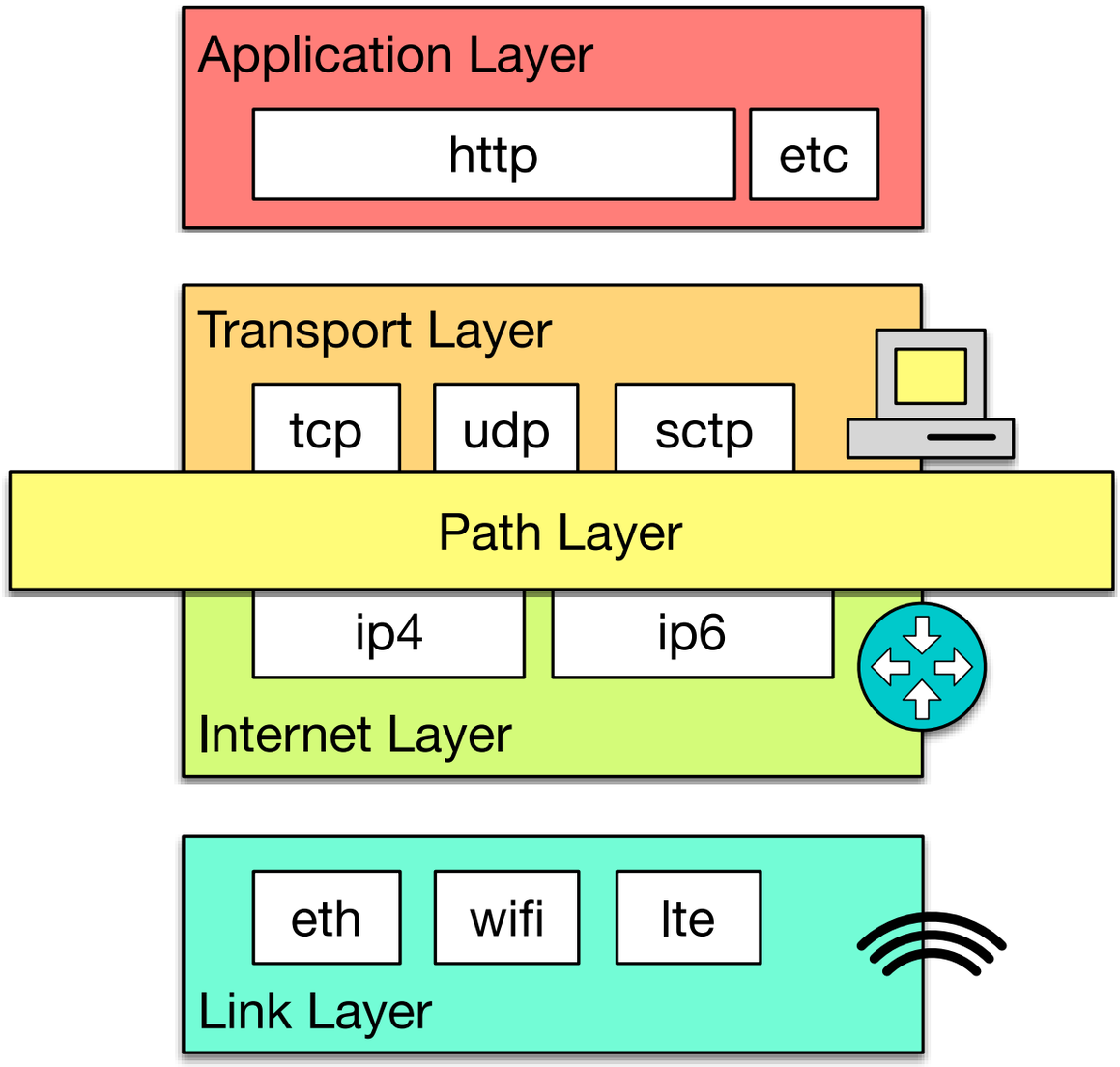
Introducing the Path Layer

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

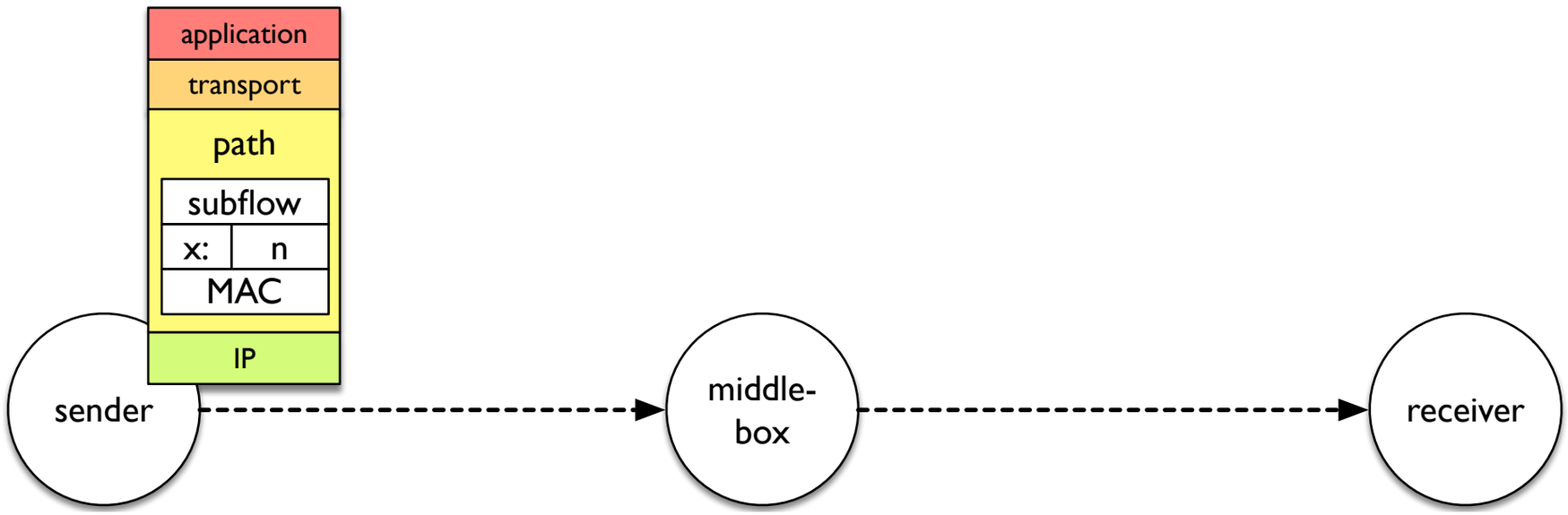


Three and a half mechanisms to make the path layer explicit

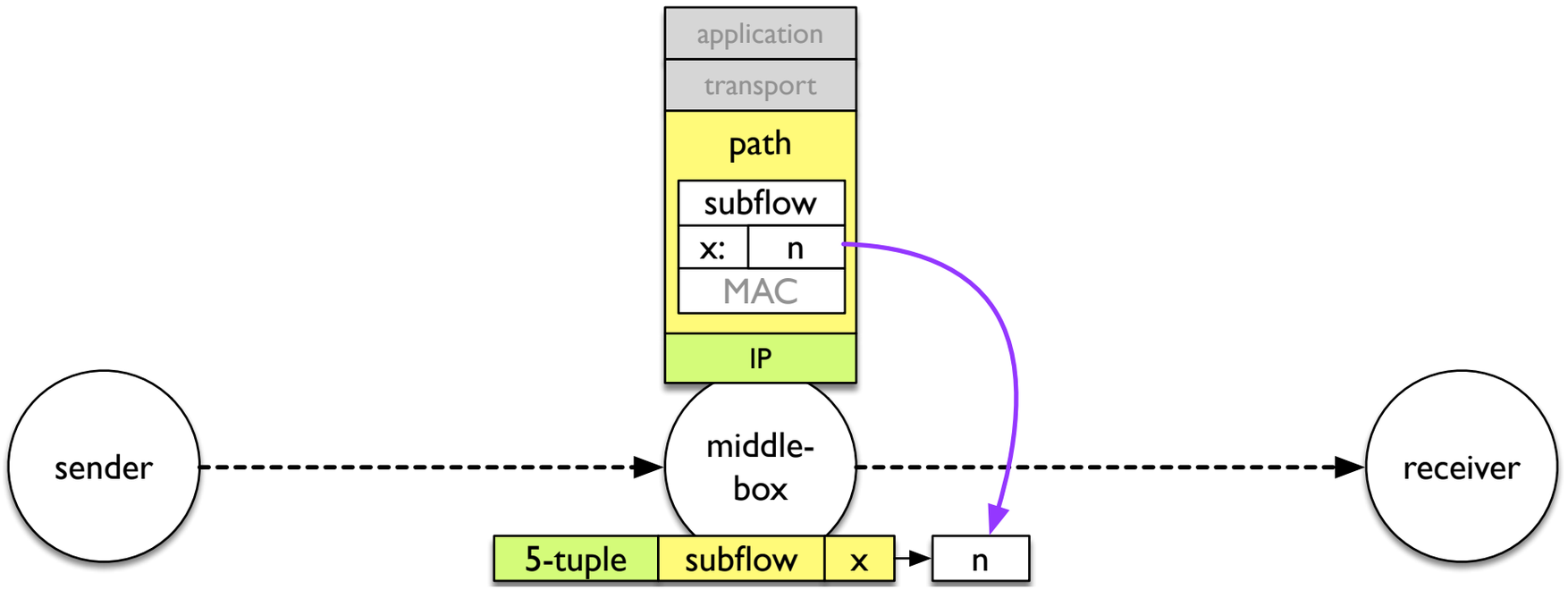
- Sender – Path Signaling
- Path – Receiver Signaling
  - with encrypted feedback to sender
- Direct Path – Sender Signaling



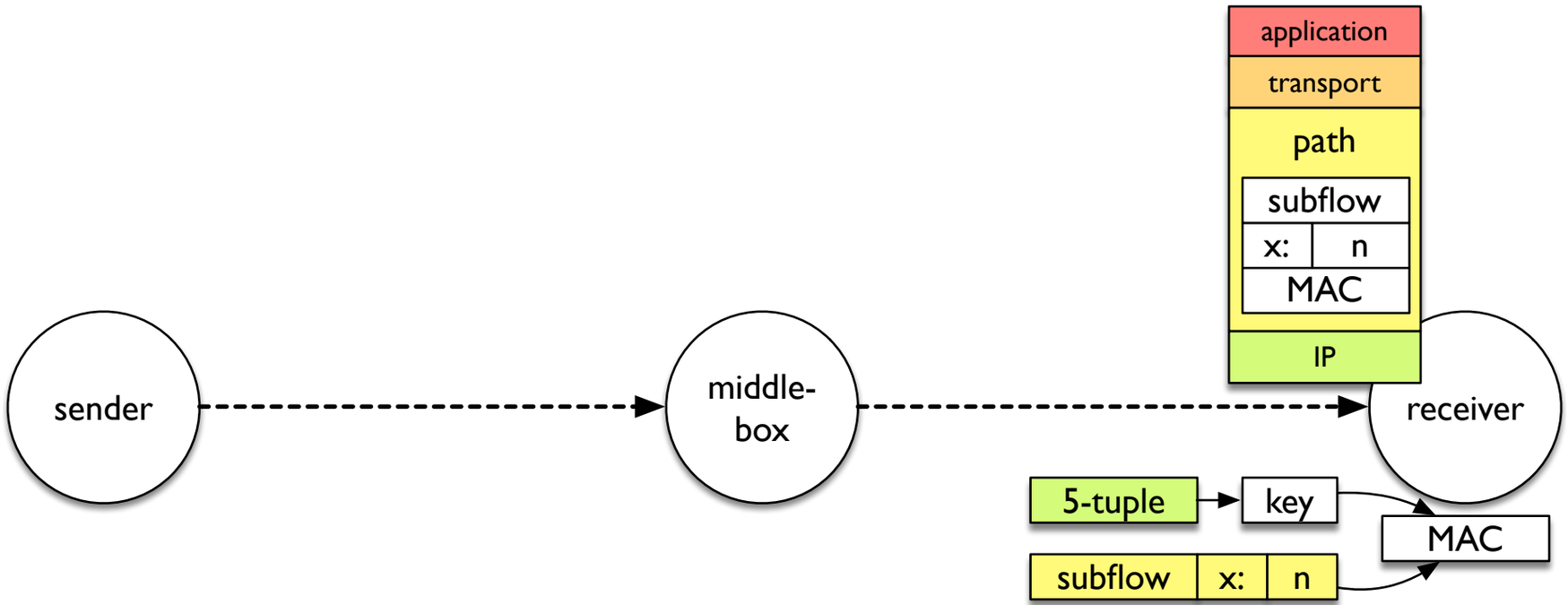
Sender to Path (sender-side)



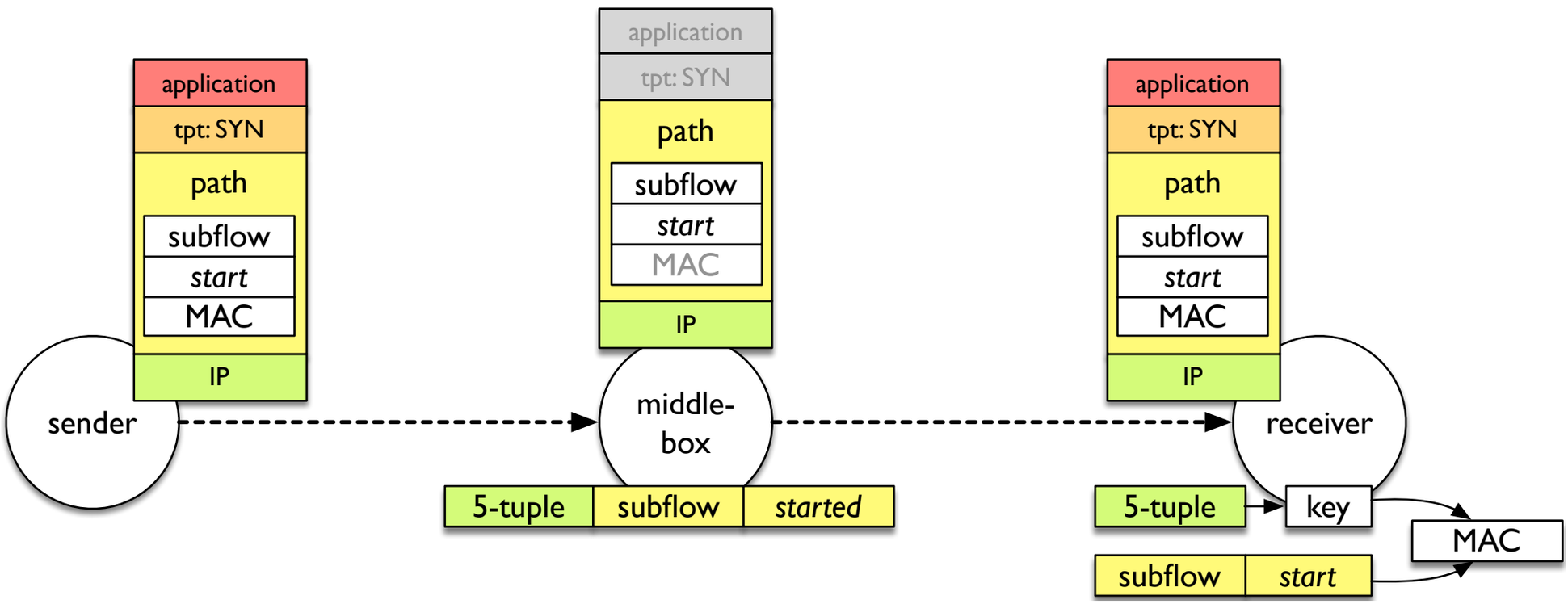
Sender to Path (on-path)



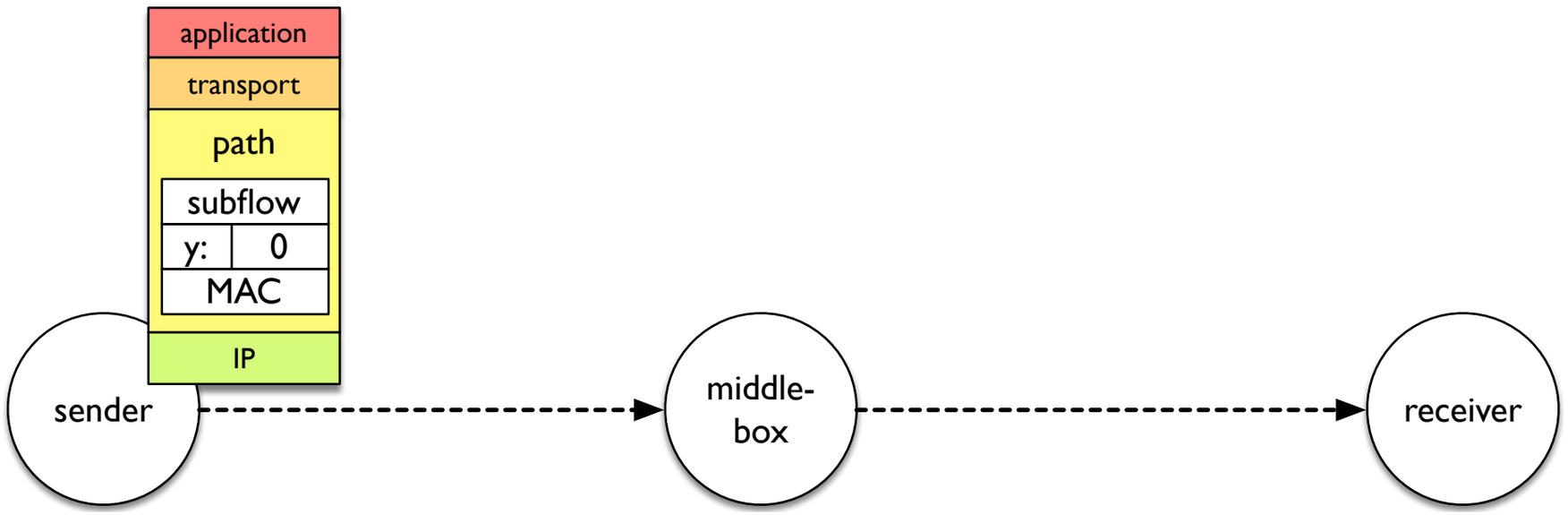
Sender to Path (receiver-side)



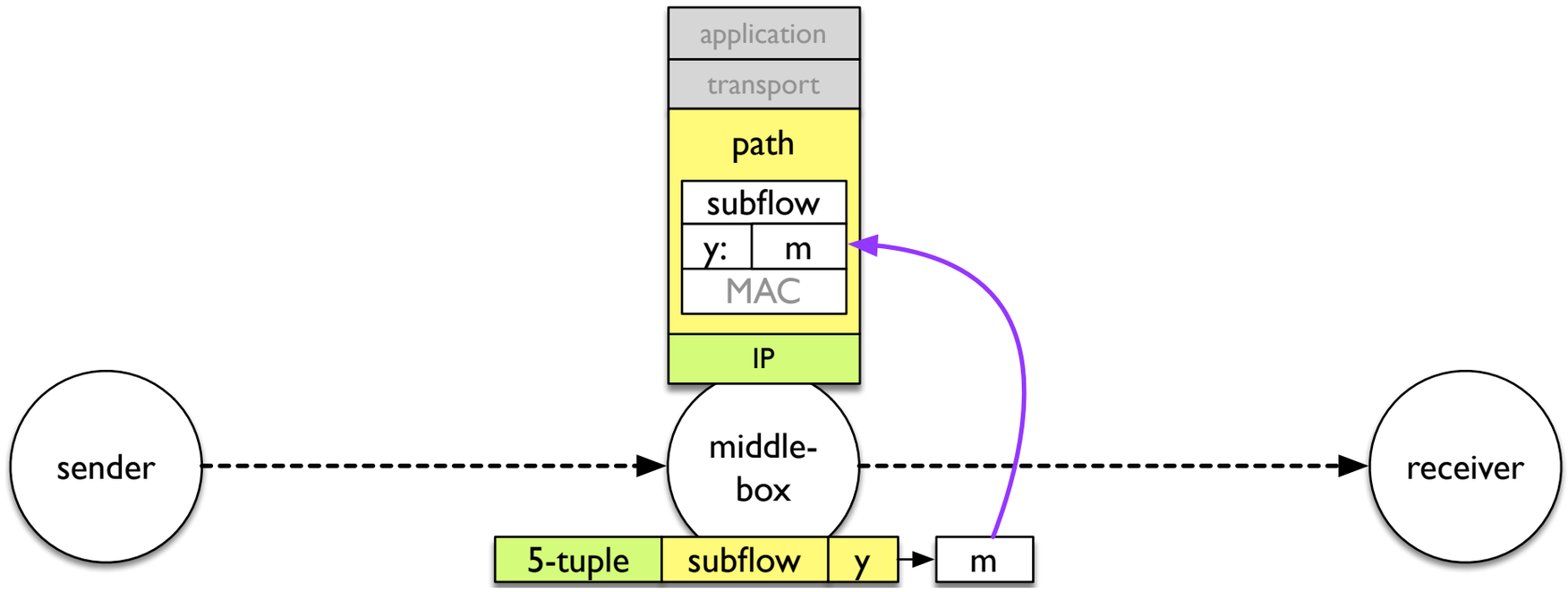
Sender to Path Transport State Signaling



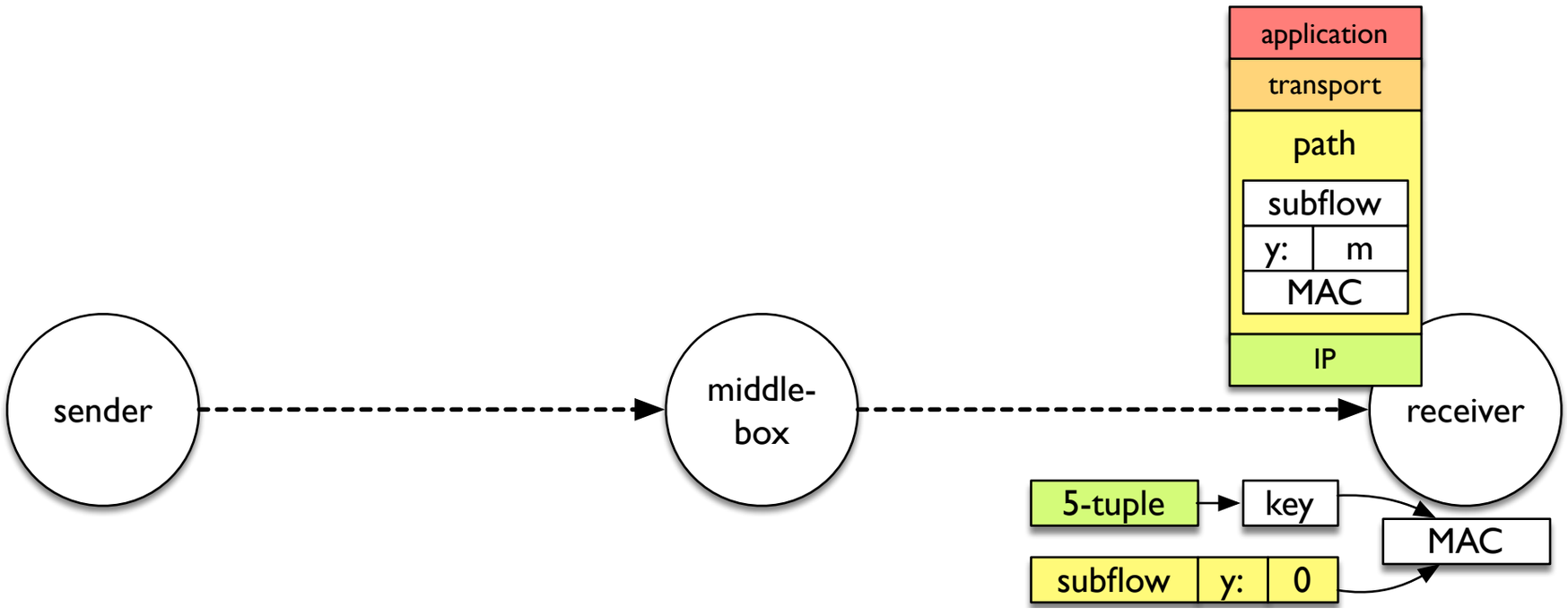
Path to Receiver (sender-side)



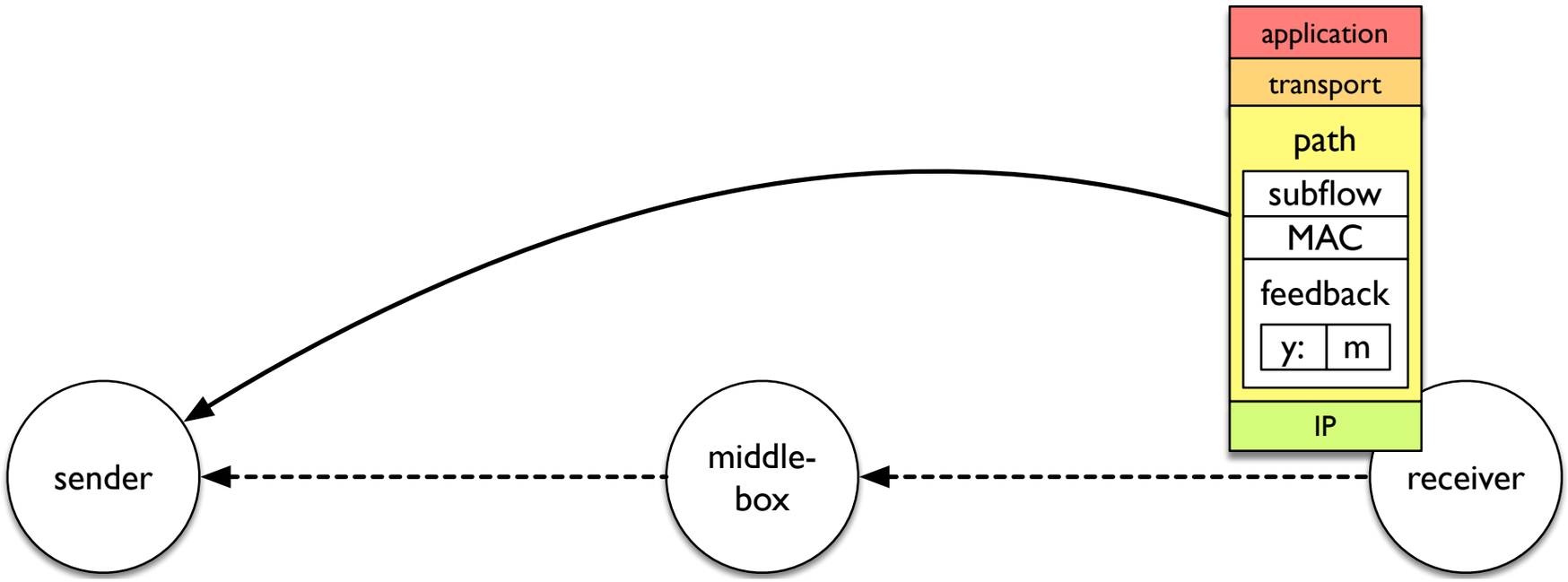
Path to Receiver (on-path)



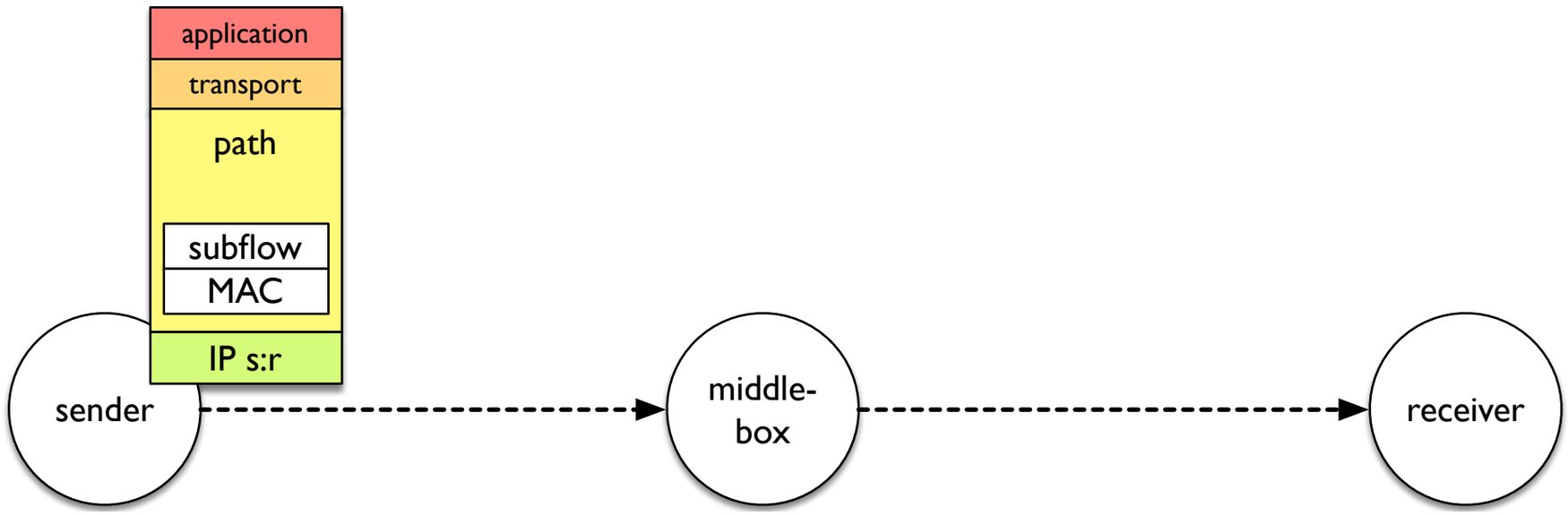
Path to Receiver (receiver-side)



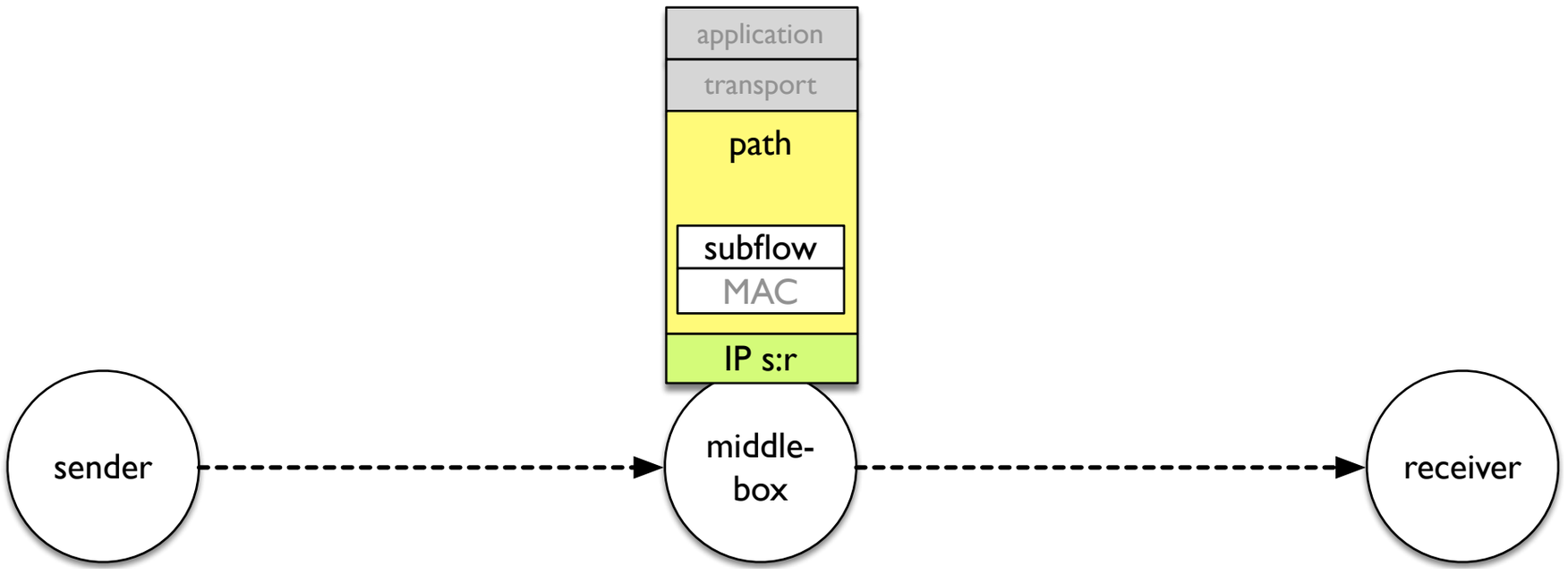
Receiver Feedback



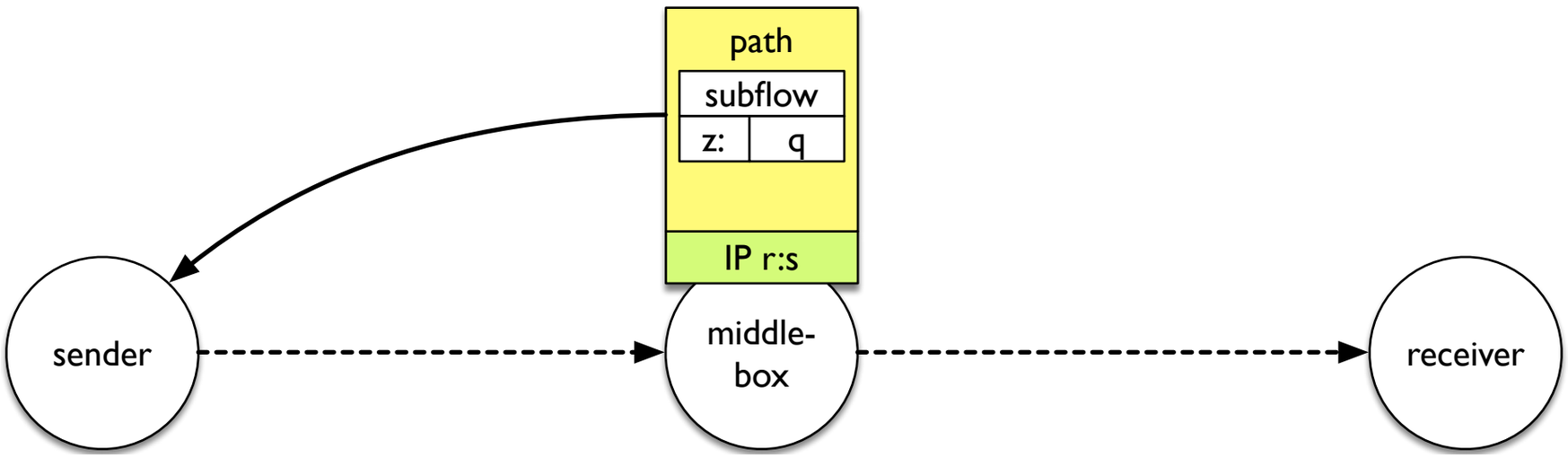
Path Direct to Sender (sender-side)



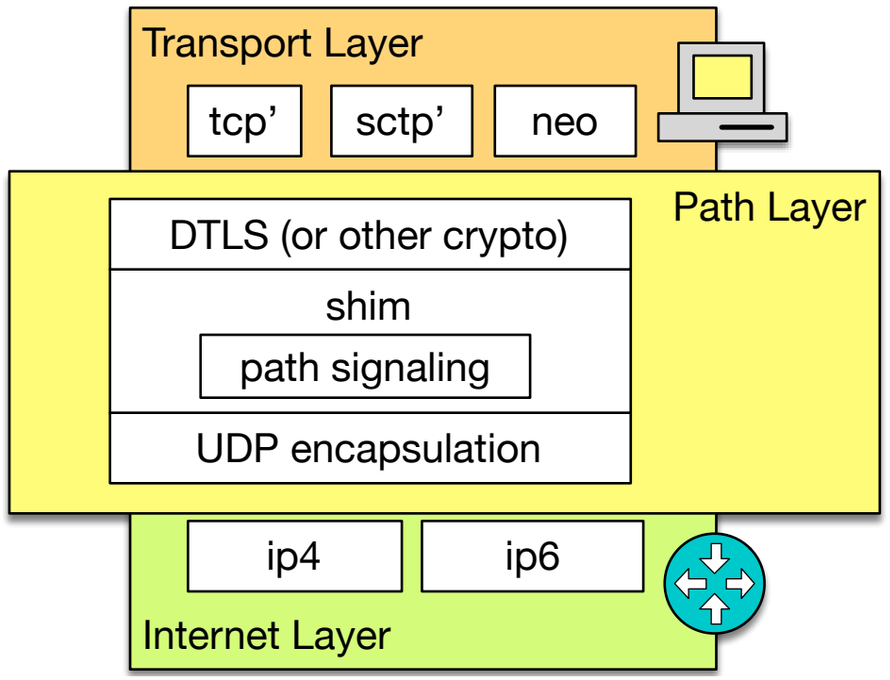
Path Direct to Sender (on-path)



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

Layering Security for Diverse Trust and Authentication Models

- “Core MCP” provides:
  - Signaling as above
  - Integrity protection of sender-provided data
  - Integrity protection of permission for path-provided data
  - Confidentiality and integrity for receiver-feedback data

- Sender-provided data can be encrypted for selected path elements.
- Path-provided data can be encrypted and MAC’d for sender/receiver
- Key negotiation, path element ID, and multiparty crypto protocols can run in-line over “core MCP”