Transparent Flow Mapping for NEAT

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In a nutshell

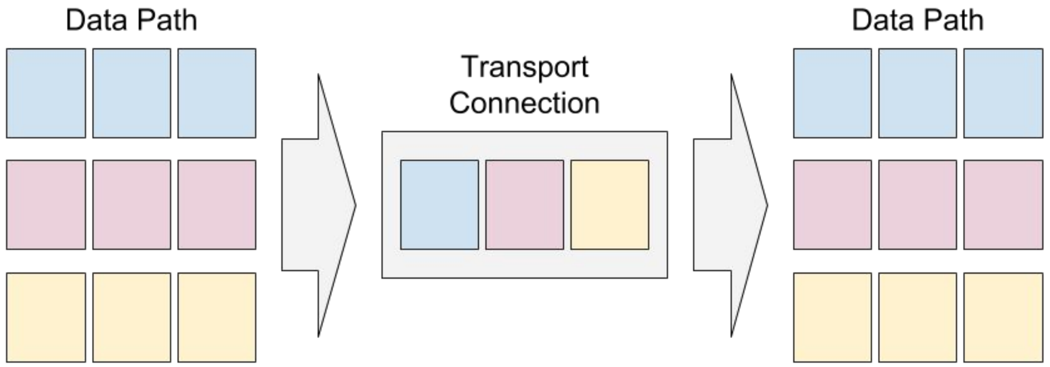
Automatic multiplexing + fallback

Transparent for the application

No additional coding effort

Multiplexing

- Bundling of several data paths to a single transport connection
- Key feature in widely used protocols
  - HTTP2 (TCP)
  - QUIC (UDP)
  - WebRTC Data Channel (SCTP)



Multiplexing - Pros and Cons

- Pros
  - Flow- and congestion-control mechanisms benefit from larger quantities of transferred data
  - Higher packet rates result in quicker loss detection
  - Shared congestion window is beneficial for new connections and connections with a low sending rate
  - Reduced amount of connections improves server capacities
- Cons
  - Additional coding effort
  - Fallback mechanism (optional)

NEAT Library

- Userland library for network communication
- Non-blocking and callback-based concept
- Unified API for all network protocols
- Supports (MP)TCP, UDP, SCTP (Kernel + Userland)
- Runs on Linux, FreeBSD, NetBSD and macOS
- Based on libuv
- www.neat-project.org

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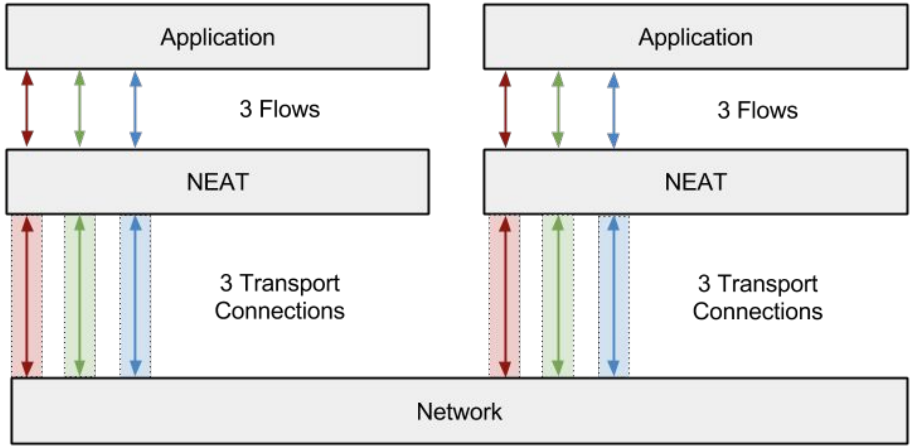
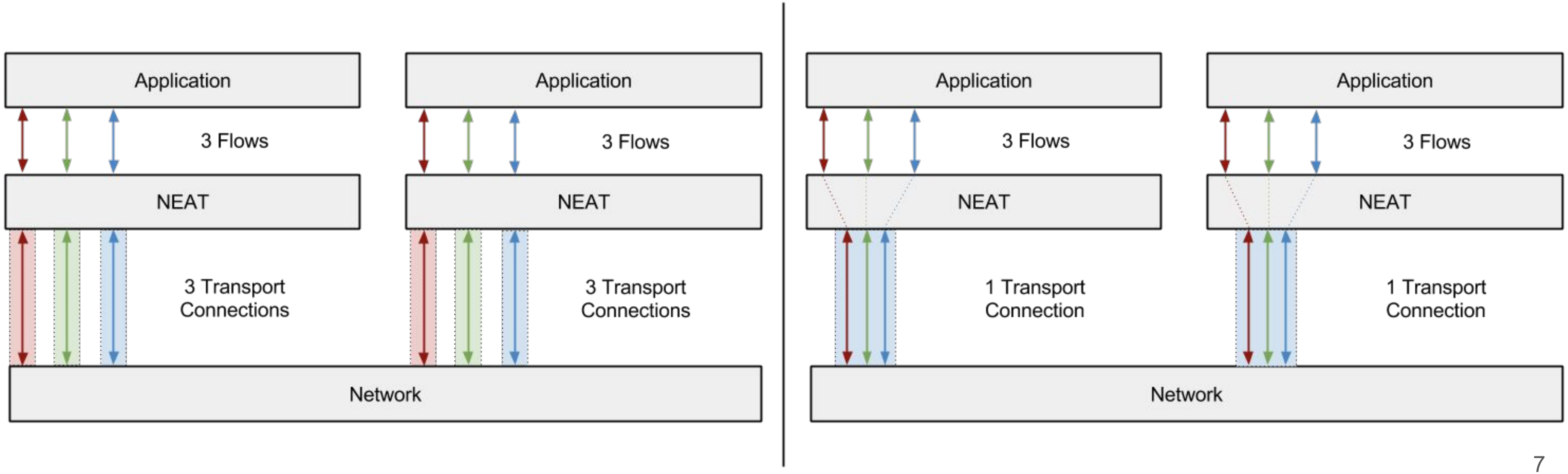
NEAT - Flow

- Bi-directional communication channel between two application endpoints
- Handles DNS resolution, buffer management, ...
- Can be grouped
- Unified API for all supported protocols
  - neat_open()
  - neat_write()
  - neat_read()
  - neat_close()
  - ...



Transparent Flow Mapping (TFM) - Concept

- Mapping multiple NEAT flows to a single transport connection while behaving like a 1:1 mapped flow



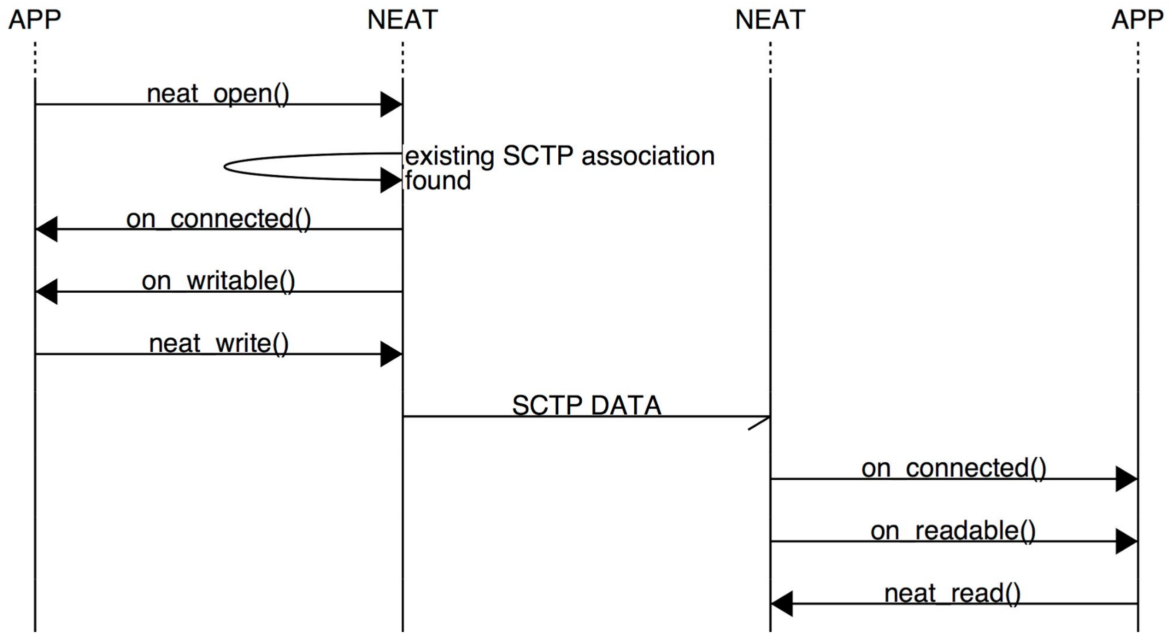
TFM - Requirements and Negotiation

- Both sides have to support
  - SCTP
  - SCTP - Stream Reconfiguration extension
  - SCTP - User Message Interleaving (IDATA) extension
- Support for TFM is negotiated via SCTP’s adaptation layer indication value
  - Carried via INIT / INIT-ACK chunk
  - TFM for NEAT specific value
  - If set by both sides → TFM support negotiated

TFM - Flow creation

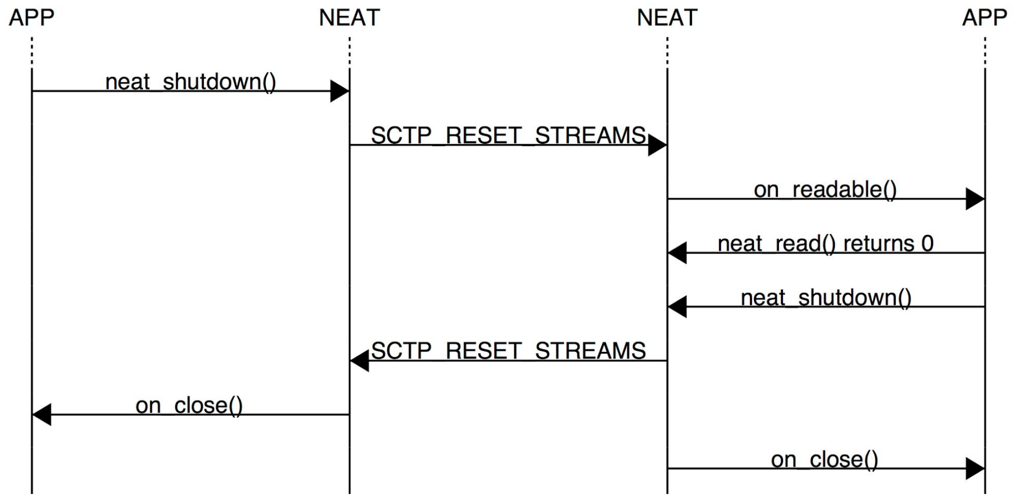
- Transparent mapping of a new flow requires an existing flow with
  - Same destination IP / DNS-Name
  - Same port number
  - SCTP connection
  - Unused SCTP stream
  - TFM support
- New flow is instantly mapped to existing transport connection
  - Zero RTT connection setup

TFM - Data Transmission



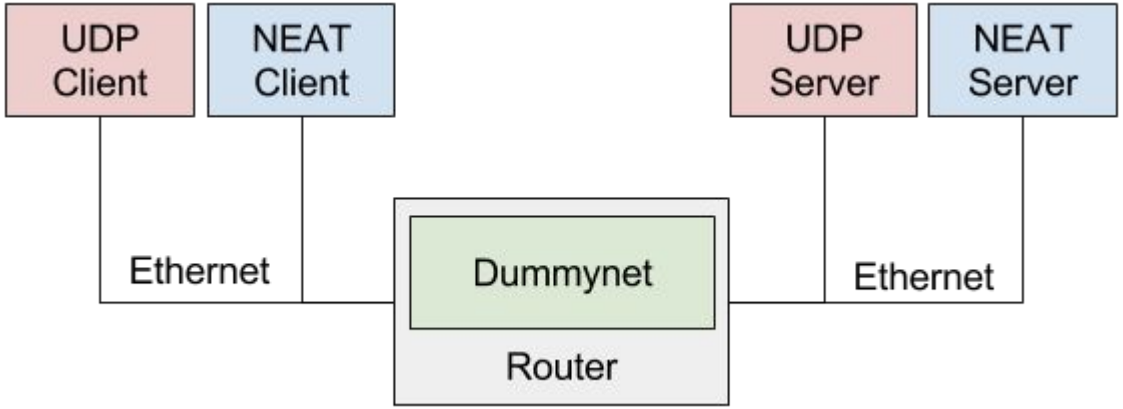
TFM - Flow Teardown

- Using SCTP's Stream Reset extension for closing procedure

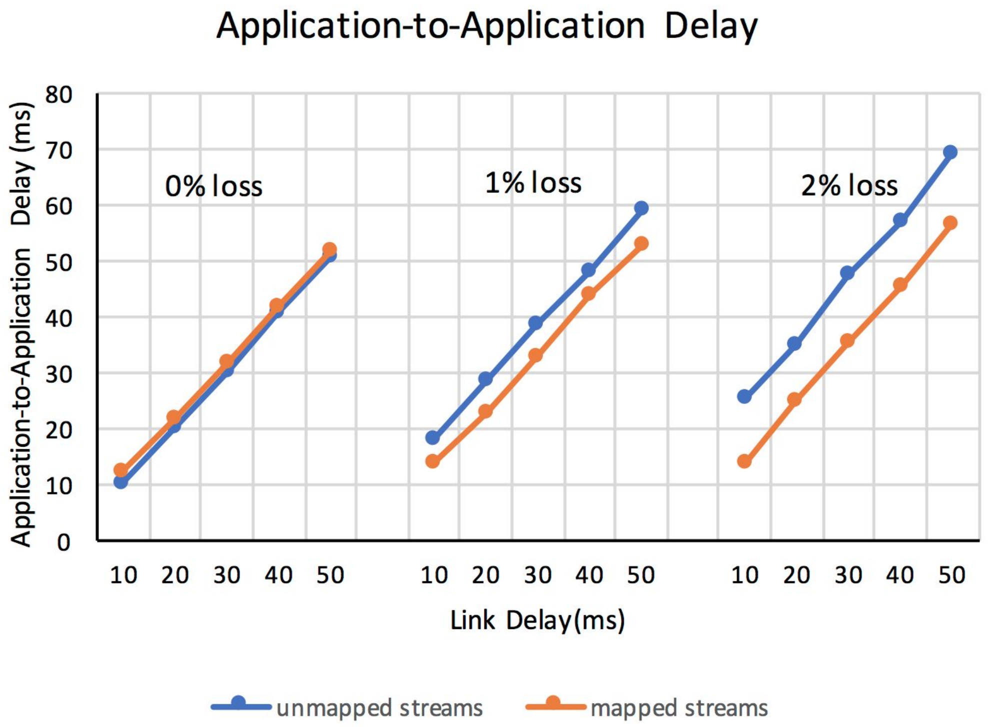


TFM - Measurement Scenario

- NEAT application using two flows, same target, low sending rate
- Comparing “1:1 mapping” vs “transparent flow mapping”
- Focus: Application-to-Application delay
- UDP background traffic



TFM - Measurement Results



TFM - Alternative Transport Protocols

- Our implementation uses SCTP with extensions
- Transparent approach allows usage of alternative protocols
  - Easy integration into Happy-Eyeballs mechanism
- Interesting Candidate: Google’s QUIC
  - Quick UDP Internet Connections
  - Multiplexing concept
  - Built-in encryption
  - Zero-RTT connection setup
  - Not standardized (yet)

Conclusion and Outlook

- Multiplexing without additional effort for the developer
- Automatic negotiation and integrated fallback solution
- Beneficial for multiple flows with a low sending rate
  - Faster loss detection
  - Congestion-Window reusage
  - Less server load
- Approach allows seamless integration of alternative protocols like QUIC

Questions? :)