MPT Network Layer Multipath Library

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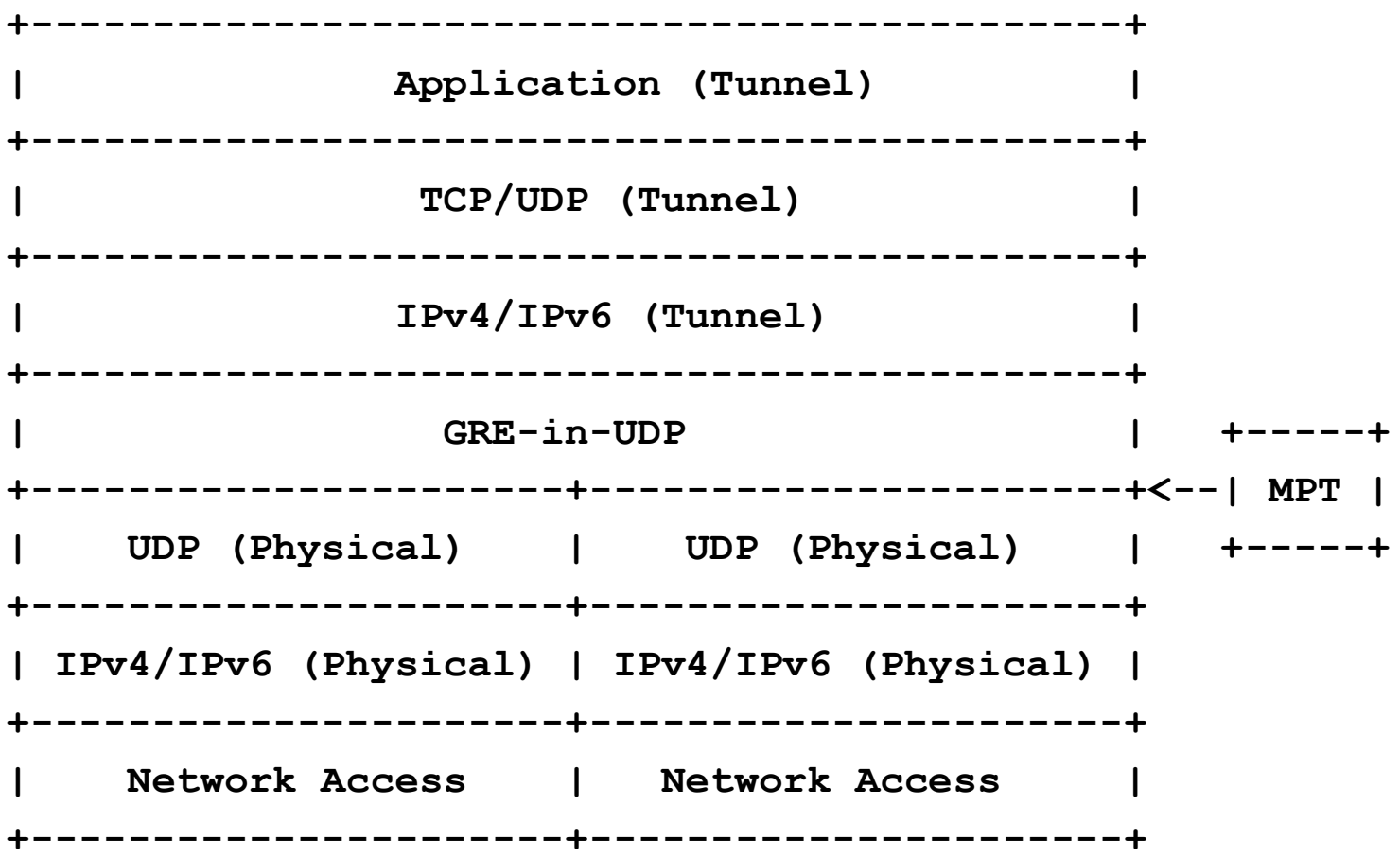
What is MPT?

- MPT
  - is a network layer multipath solution
  - provides a tunnel over multiple paths using the GRE-in-UDP encapsulation [RFC 8086]
  - is different from both MPTCP [RFC 6824] and Huawei's GRE Tunnel Bonding Protocol [RFC 8157].
- Benefits of MPT
  - Path throughput capacity aggregation
  - Resilience to network failures
  - Better suits to real-time traffic than MPTCP

MTP can also be used

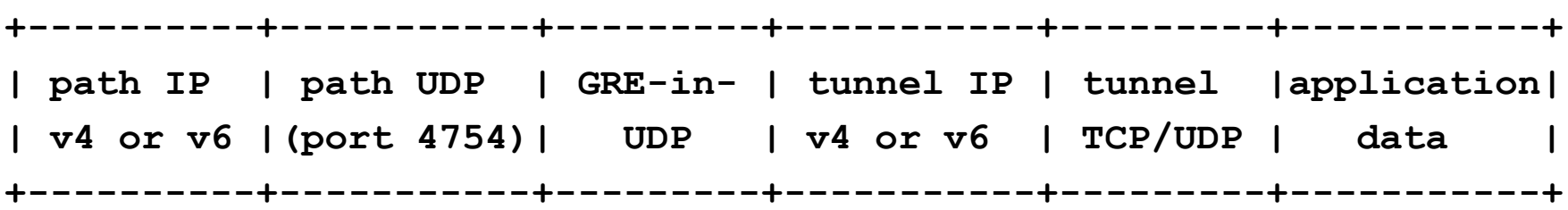
- As a router,
  - routing the packets among several networks between the tunnel endpoints, thus establishing a multipath site-to-site connection.
- As an IPv6 transition technology
  - The version of tunnel IP and the version of path IP are independent from each other, therefore MPT can also be used for IPv6 transition purposes.

MPT in the Networking Stack



MPT Concept

- MPT implements a tunnel over several paths
- The tunnel traffic packets are mapped to one of the paths using
  - per packet based mapping (implemented)
  - flow-based mapping (planned)
  - combined mapping (planned)
- MPT data packet encapsulation



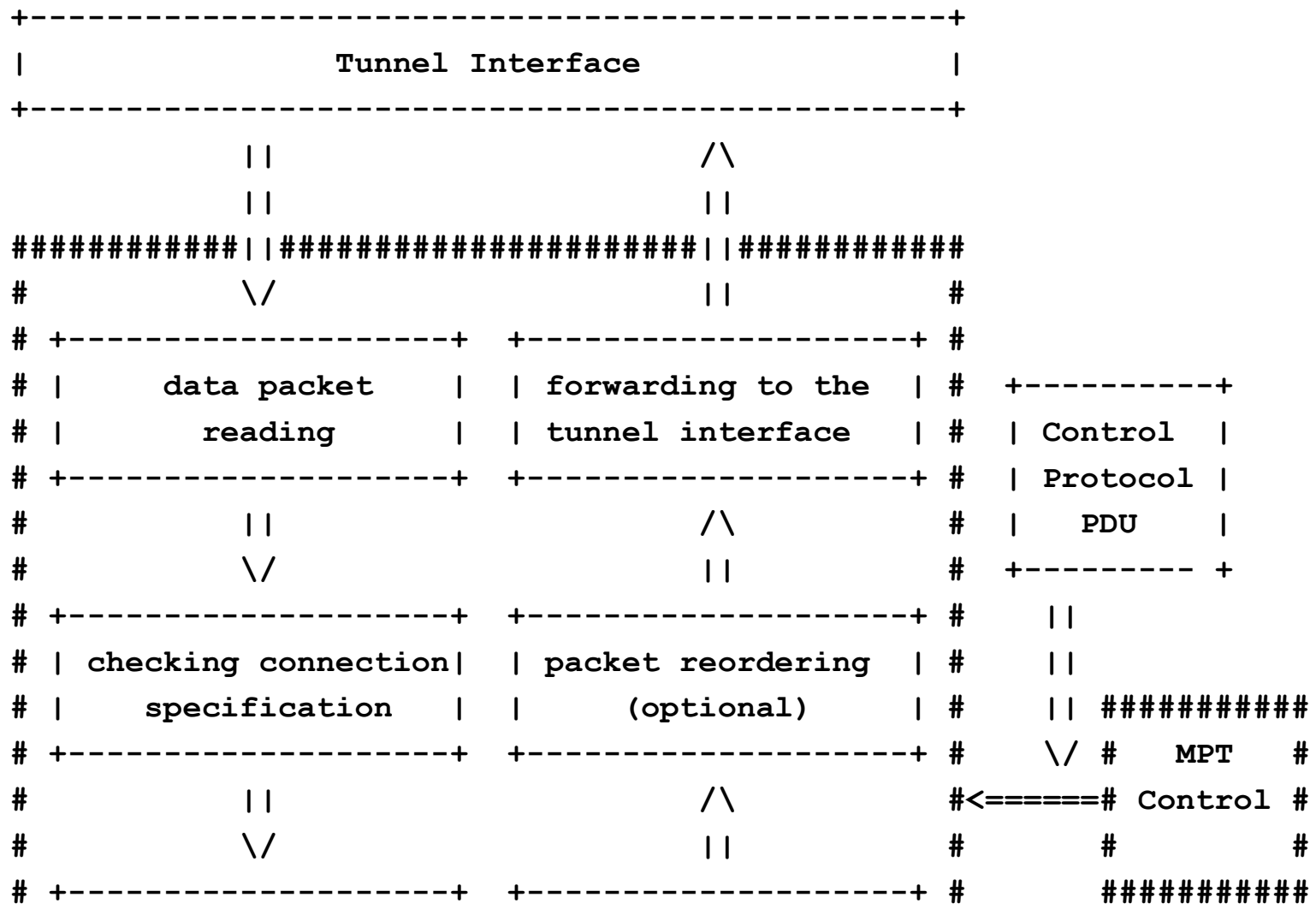
Connection specification

- A connection defines a communication session between two tunnel endpoints
- A connection may contain several paths
- All the parameters of the connection are stored in a “connection specification”, containing e.g.:
  - name, permissions, tunnel IP version, etc.
  - number of paths, their definitions, their weights, etc.

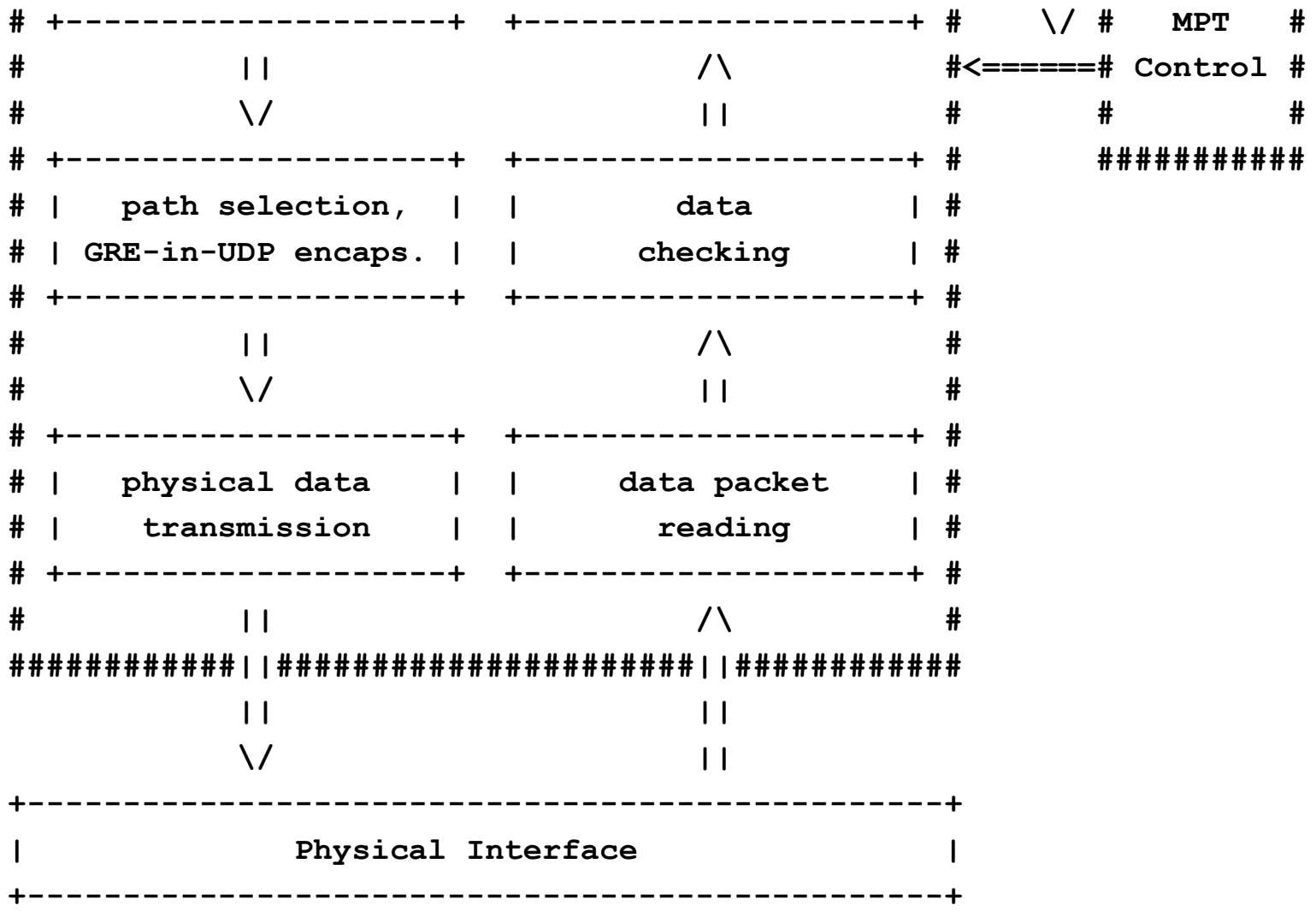
Control plane overview

- When the MPT servers are started they establish connections automatically (using configuration files)
- Connections may also be later established or teared down dynamically
- Paths may be added to / deleted from the connections
- There is an optional keep-alive mechanism for paths

Data Plane Overview – 1/2



Data Plane Overview – 2/2



Per packet based mapping

- A mapping decision is made for every packet
- The paths have their own weights
- The number of bytes sent to a path is proportional to the weight of the path
  - The draft contains
    - precise algorithm description
    - sample implementation (C code)

Flow-based mapping

- Flows are identified by the usual 5-tuple
- All the packets of a given flow are handled the same way
  - Rationale: provide different QoS for different classes of traffic e.g. VoIP, http, bit-torrent, etc.
    - See samples for possible scenarios in the draft
  - No implementation yet.

Packet reordering

- Different paths may have different delays
- The order of the tunnel packets may change
- Order-right delivery (optional)
  - Based on GRE sequence numbers
  - Done by the receiver, using reordering buffer
  - Controlled by parameters
    - reorder window (size of reordering buffer)
    - maximum buffer delay
  - Working well, parameter selection is still researched

MPT Results

- MPT has one working implementation [1]
- It was tested as a solution for:
  - path throughput capacity aggregation [2]
  - fast connection recovery [3]
  - elimination of the stalling events on YouTube video playback [4]

[1] B. Almási, G. Lencse, Sz. Szilágyi, “Investigating the multipath extension of the GRE in UDP technology”, *Computer Communications*, vol. 103, no. 1, pp. 29–38, May 1, 2017, DOI: 10.1016/j.comcom.2017.02.002

[2] Á. Kovács, “Comparing the aggregation capability of the MPT communications library and multipath TCP”, in: *Proc. CogInfoCom 2016*, Wroclaw, Poland, 2016, pp. 157–162, DOI: 10.1109/CogInfoCom.2016.7804542

[3] F. Fejes, R. Katona, and L. Püsök, “Multipath strategies and solutions in multihomed mobile environments”, in: *Proc. CogInfoCom 2016*, Wroclaw, Poland, 2016, pp. 79–84, DOI: 10.1109/CogInfoCom.2016.7804529

[4] F. Fejes, S. Rácz, and G. Szabó, “Application agnostic QoE triggered multipath switching for Android devices”, in: *Proc. IEEE ICC 2017*, Paris, France, May 21-25, 2017, pp. 1585–1591.

Thank you for listening!

- The Internet Draft is available:

  https://tools.ietf.org/html/draft-lencse-tsvwg-mpt-00
- All comments are welcome!
  - On site to Marius Georgescu
  - In e-mail to Gábor Lencse: gabor-l@is.naist.jp