Hybrid Access Networks and requirements on MPQUIC

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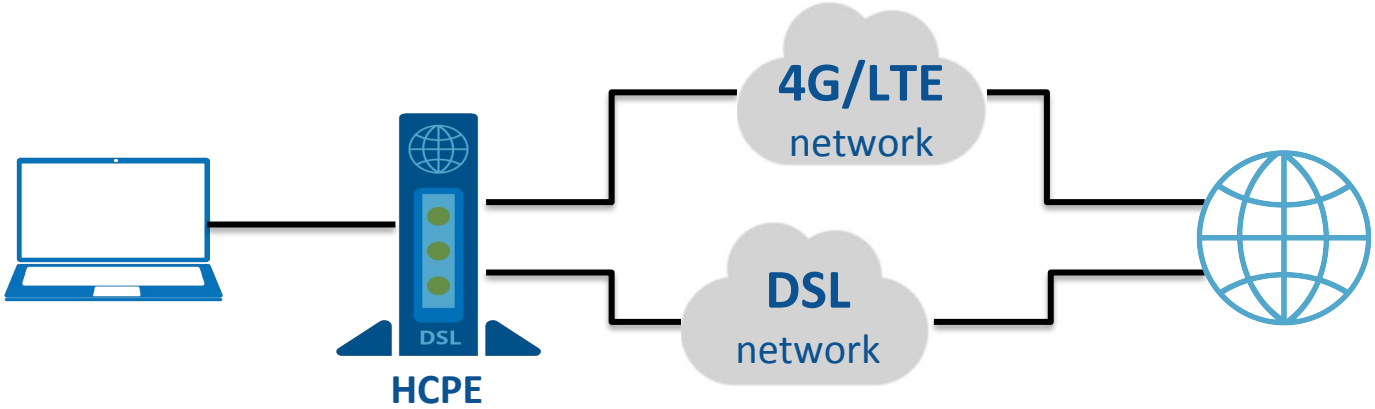
Hybrid CPEs



Many users of hybrid CPEs would like to use DSL **and** 4G
Unfortunately, most get DSL ***or*** 4G with 4G as a backup

- Per-flow/user load balancing is sometimes possible but with limitations

Agenda

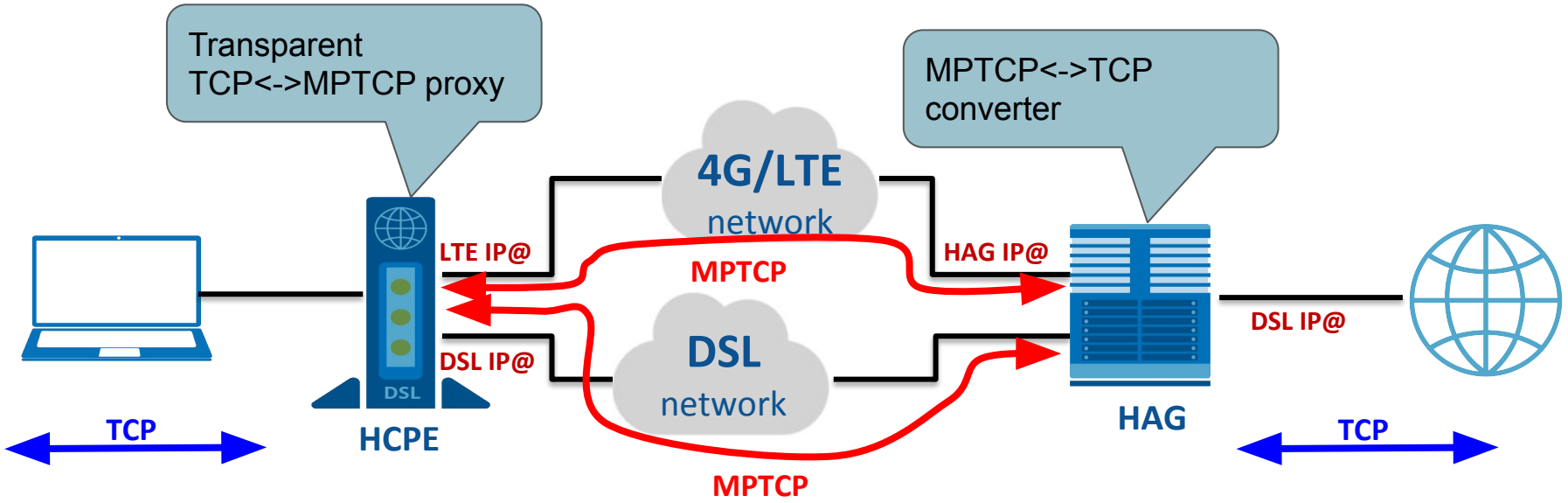
- **MPTCP-based Hybrid Access Networks**
- MPQUIC in Hybrid Access Networks

Hybrid Access Networks with MPTCP

Objective

- Solution enabling network operators to provide faster Internet access services in rural areas where fiber cannot economically be deployed by combining
  - A wired access network (typically xDSL)
  - A wireless access network (typically LTE)
- Specifications
  - BBF TR-348, BBF TR-378
  - MPTCP (RFC6824), 0-RTT TCP Convert Protocol (RFC8803)

Basics of MPTCP-based Hybrid Access Networks



Similar architecture and protocols used by ATSSS in 5G

Benefits of Multipath in Hybrid Access Networks

- MPTCP provides bandwidth aggregation which is key for low and medium-speed access networks
  - Congestion control automatically senses network capacity
- Network operators want to prioritise DSL over LTE
  - **Path manager** can delay the creation of LTE subflows if the customer DSL link is not fully used
  - **Packet scheduler** prefers to send data over DSL and only uses LTE when its congestion window is full over DSL

Agenda

- MPTCP-based Hybrid Access Networks
- **MPQUIC in Hybrid Access Networks**

What would be the benefits of MPQUIC ?

MPQUIC in Hybrid Access Networks

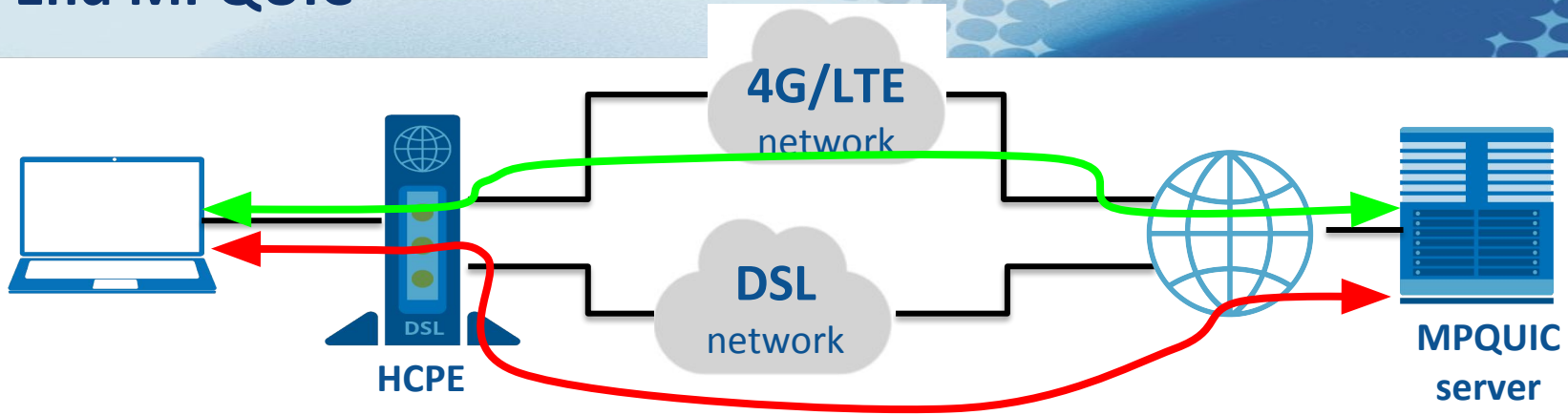
- MPQUIC could provide bandwidth aggregation for non-TCP flows using Datagram extension
- MPQUIC would enable an over-the-top solution to aggregate bandwidth from any combination of different access networks without risking middlebox interference
- MPQUIC would be easier to deploy on access routers since it would not require kernel changes

Requirements for MPQUIC in Hybrid Access Networks

To support this use case, MPQUIC would need to

- Be able to learn the availability of different paths/addresses (can change over time with mobile devices)
- Be able to start and stop using a path (i.e. path manager)
- Be able to simultaneously send packets over two or more paths to support bandwidth aggregation
- Be able to prefer some paths over others (i.e. packet scheduler)
- Be able to sense the performance (delay, bandwidth) of different paths (PING frames, congestion control, ...)

End-to-End MPQUIC



Host needs to be aware of the two paths

- HCPE advertises two IPv6 prefixes in LAN
  - Red prefix from DSL network
  - Green prefix from 4G network

`draft-ietf-rtgwg-enterprise-pa-multihoming-12`

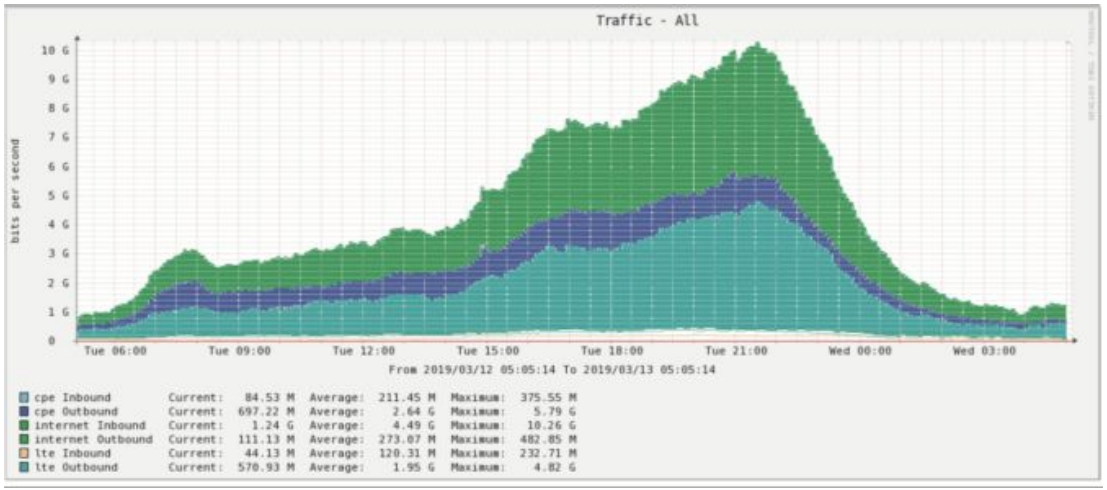
Beyond Hybrid Access Networks

- Hybrid Access Networks are one deployed use case that combines several low-speed networks, there are many other situations where multiple links should be combine
  - Smartphones using low bandwidth WiFi and xG
  - Vehicules (cars, trains, trucks, drones, …) using several wireless networks
  - Home and enterprise networks using different ISPs
  - Dual-stack hosts have different IPv4 and IPv6 paths !

Backup slide

Deployment experience

- MPTCP-based Hybrid Access Networks have been deployed in several countries serving more than 500k citizens
  - Usage of a live 10Gbps HAG



Source: https://www.tessares.net/increasing-broadband-reach-with-hybrid-access-networks-ieee-article-summary/