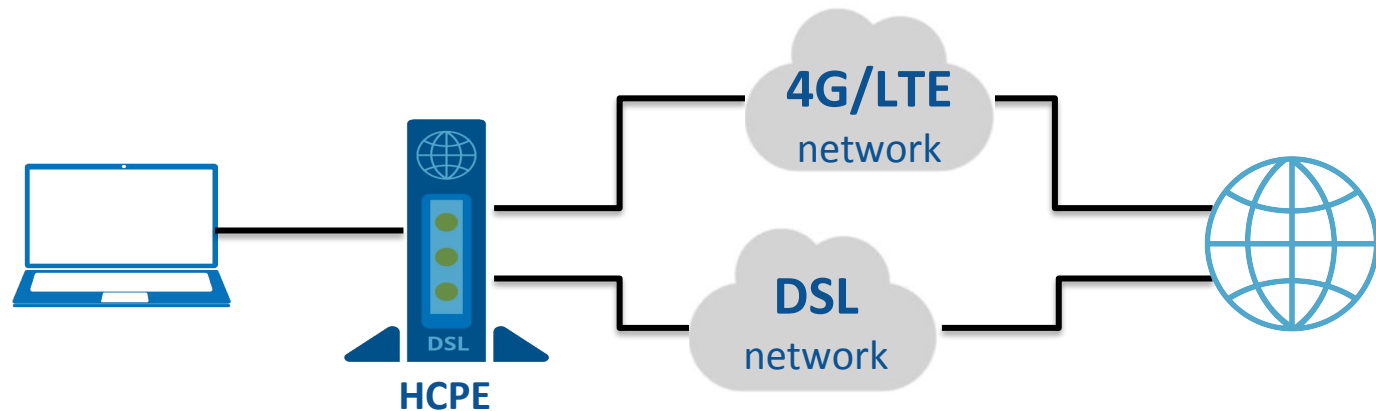


# Hybrid Access Networks and requirements on MPQUIC

QUIC interim meeting, Oct. 2020

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# Hybrid CPEs



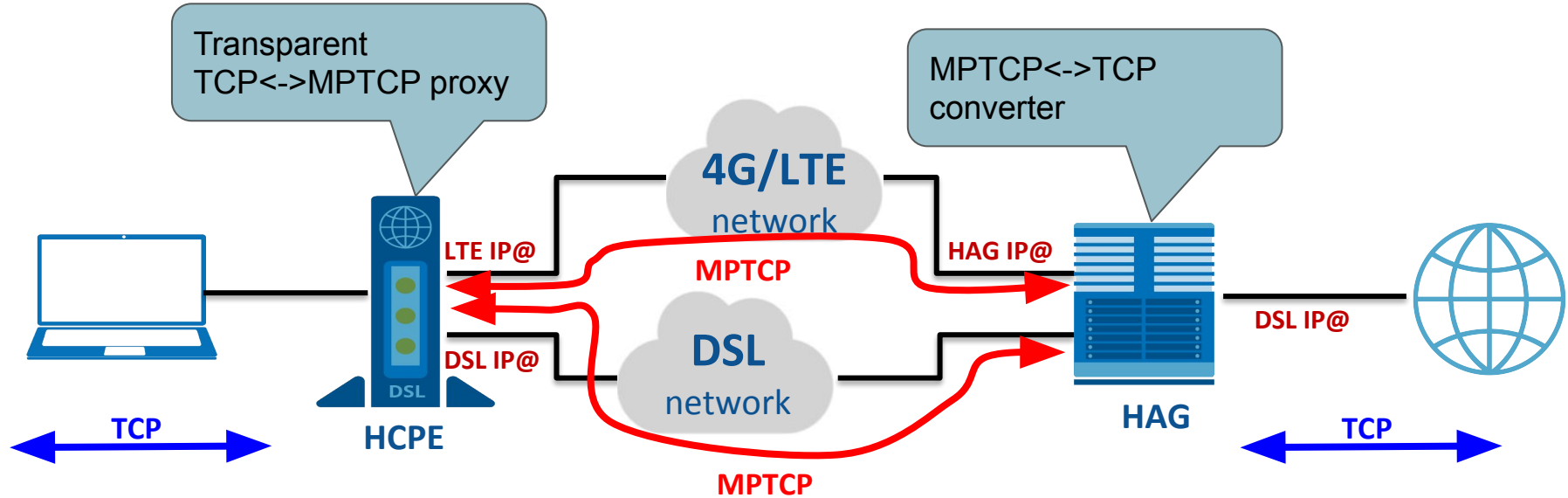
Many users of hybrid CPEs would like to use DSL **and** 4G  
Unfortunately, most get DSL **or** 4G with 4G as a backup

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

## Objective

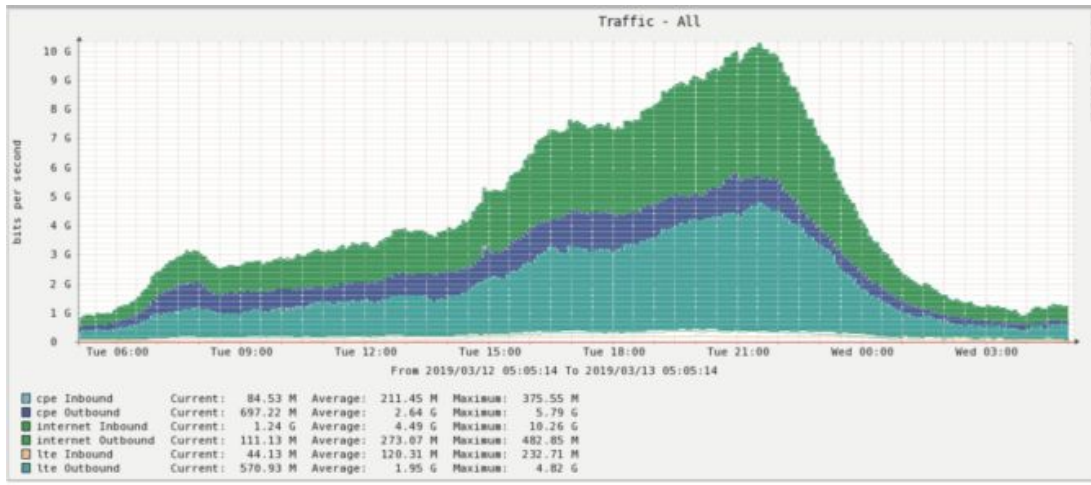
- Solution enabling network operators to provide faster Internet access services in rural areas where fiber cannot economically be deployed by combining
  - A wired access network (typically xDSL)
  - A wireless access network (typically LTE)
- Specifications
  - BBF TR-348, BBF TR-378
  - MPTCP (RFC6824),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

# Basics of MPTCP-based Hybrid Access Networks



# 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/>

# 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

# 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
  - Single path QUIC should already do this since today's hosts have both IPv6 and IPv4 addresses
- 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, ...)



# 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 !