An MPTCP Option for Network-Assisted MPTCP Deployments: Plain Transport Mode

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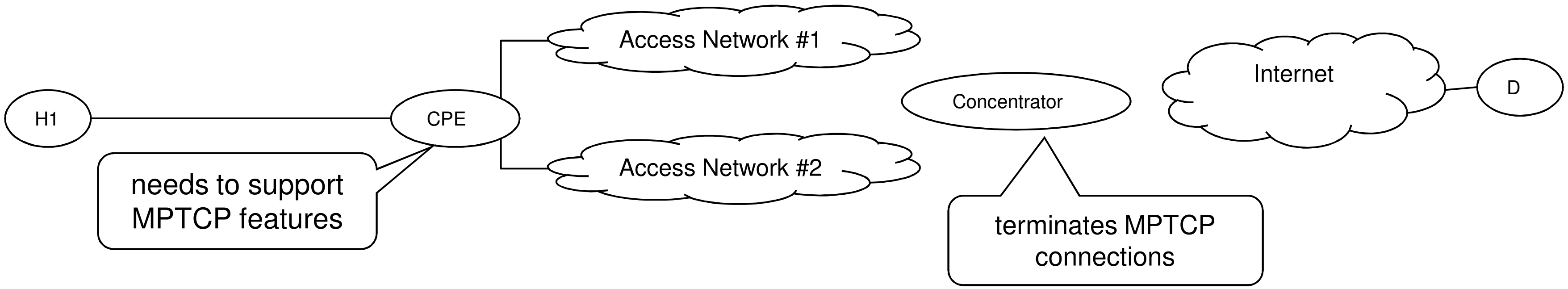
Outline

- Rationale
- The Plain Mode MPTCP Option
- Where to convey the option
- Handling UDP packets
- Some issues
- Next steps

Network-Assisted MPTCP: Rationale

- Given
  - The MPTCP penetration rate is close to null at the server side, and
  - Network Providers do not control customers' terminals
- A network-assisted model is attractive to offer bonding services



- **ASSUMPTION: All access networks are managed by the same Network Provider**

How many times did you hear: "*MPTCP is not my friend, because …*"?

- When you discuss with one of your favorite vendor(s)
- Each time you read a benchmark about bonding solutions
  - Excerpt from a document released in February 2016 by HGI (link)

Pro	Con
• Defined (IETF RFC 6824, IETF RFC 6356) • Implemented • Can be implemented end-to-end avoiding deployment of a new network element (HAG) • Works on a per application basis, so can perform dynamic, per application steering.	• Current implementations do not exploit MPTCP's full potential • Simple implementations may not provide significant advantages over regular TCP • Policies need to be created and tuned by the Operator. No standard to help. • Requires 2 IP addresses • Jitter and latency will be greater than that of the highest of the 2 paths • Only works for TCP

  - Some of the above comments are "odd", but the one about UDP is a valid one
- ***This document proposes an MPTCP extension so that connections can carry any kind of traffic (UDP, in particular) without requiring any encapsulation scheme***

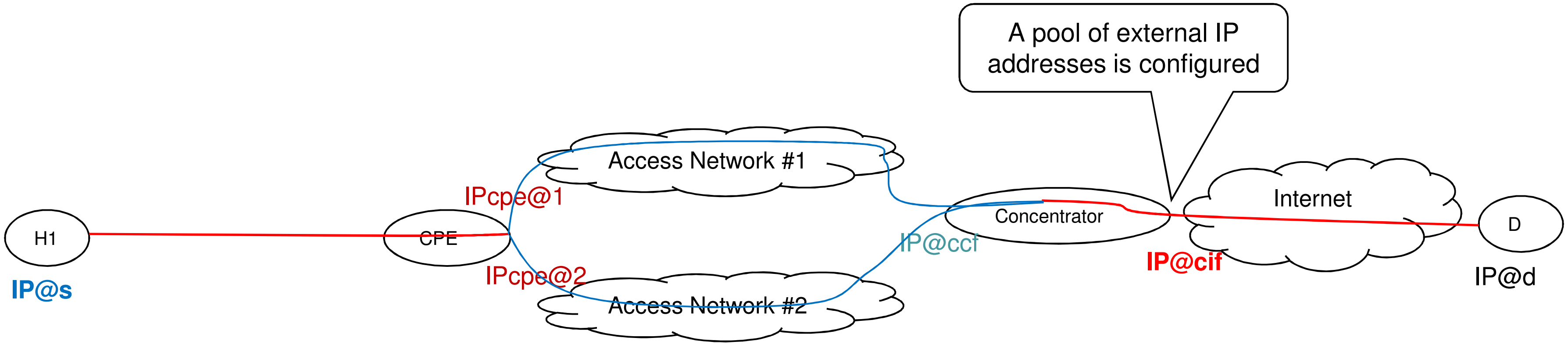
One Single Option, Multiple Uses

- The option is called: Plain Mode (PM)

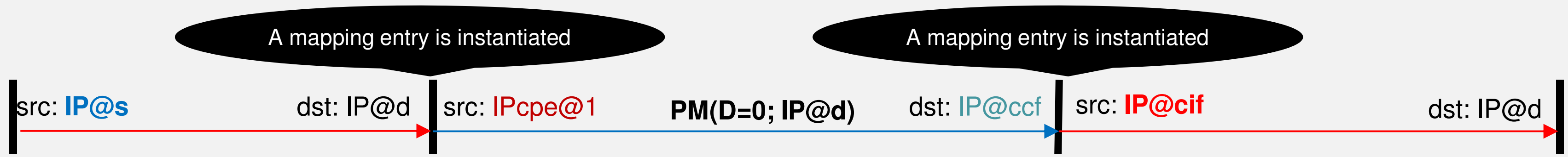
```
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
  +---------------+---------------+-------+-------+---------------+
  |     Kind      |    Length     |SubType|D|Flag |   Protocol    |
  +---------------+---------------+-------+-------+---------------+
  |          Address (IPv4 - 4 octets / IPv6 - 16 octets)         |
  +-------------------------------+-------------------------------+
  |   Port (2 octets, optional)   |
  +-------------------------------+
```

  - **D-bit (direction bit)**: indicates whether the enclosed IP address and/or port number are the original source (D-bit is set) or destination (D-bit is unset) IP address and/or port
  - **Protocol**: Indicates the protocol that is carried in the MPTCP connection, e.g., 6 (TCP), 17 (UDP)
  - **"Flag":** A set of reserved bits for future assignment as additional flag bits
  - **IPv4/IPv6 Address**: Includes a source or destination IPv4/v6 address
  - **Port**: May be used to carry a source or destination port number; valid for protocols that use a 16-bit port number

One Single Option, Multiple Uses

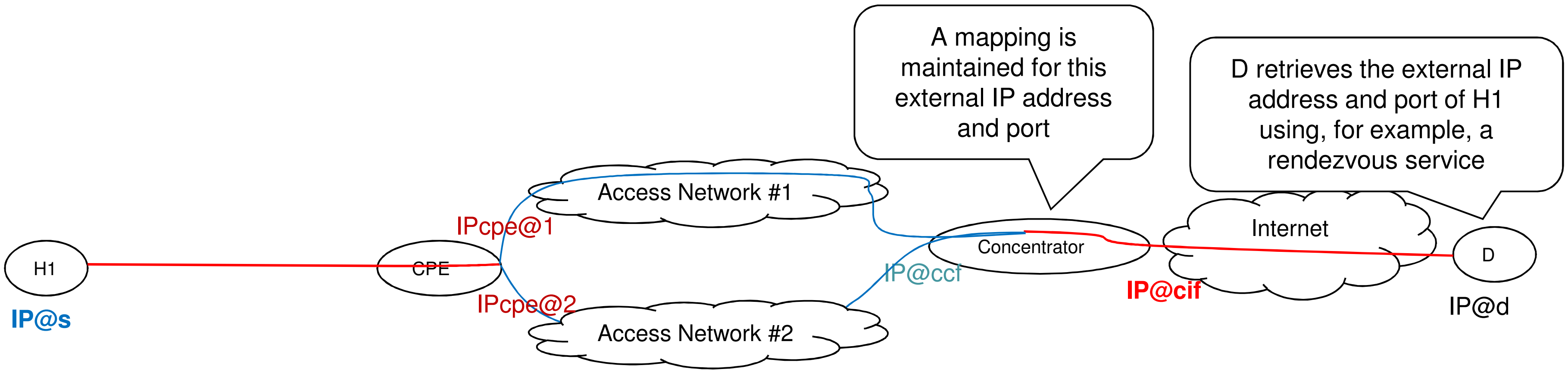


`Outgoing SYN/without source address preservation at the Concentrator`



ccf(concentrator customer-facing interface); cif(concentrator Internet-facing interface)

One Single Option, Multiple Uses



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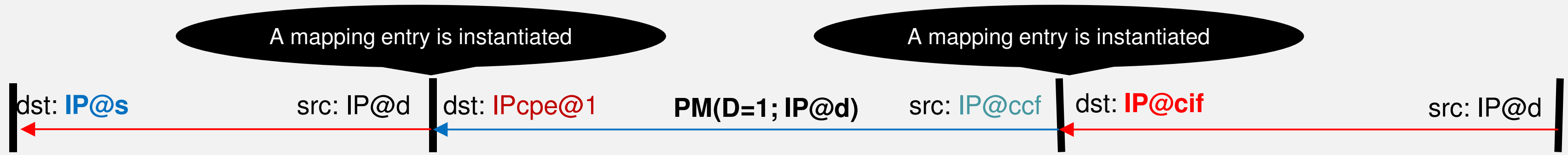

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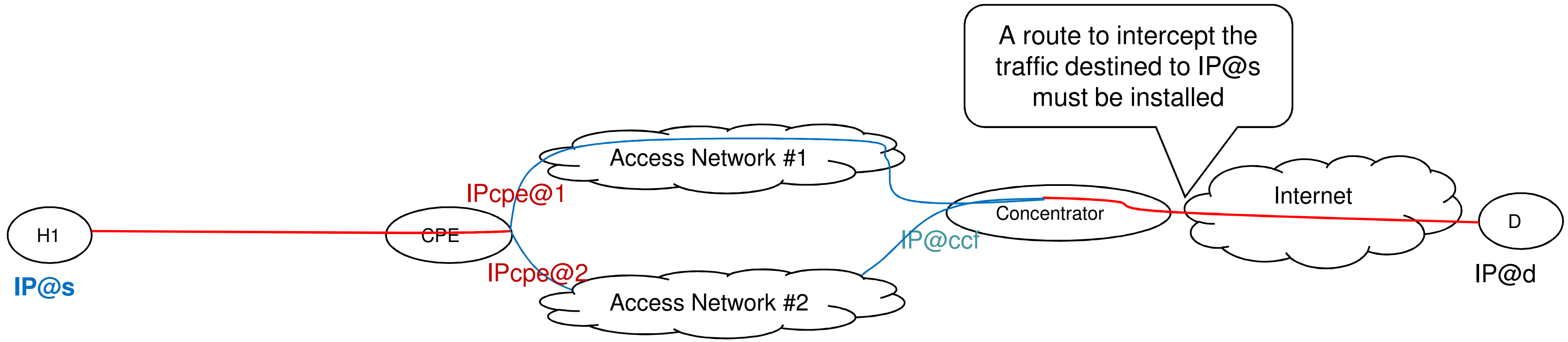

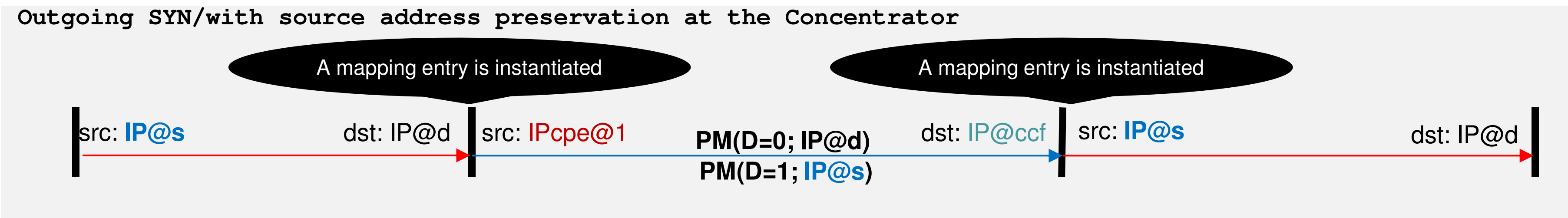

- Address preservation is required in IPv6 deployments, in particular
- Does not break applications with address referrals

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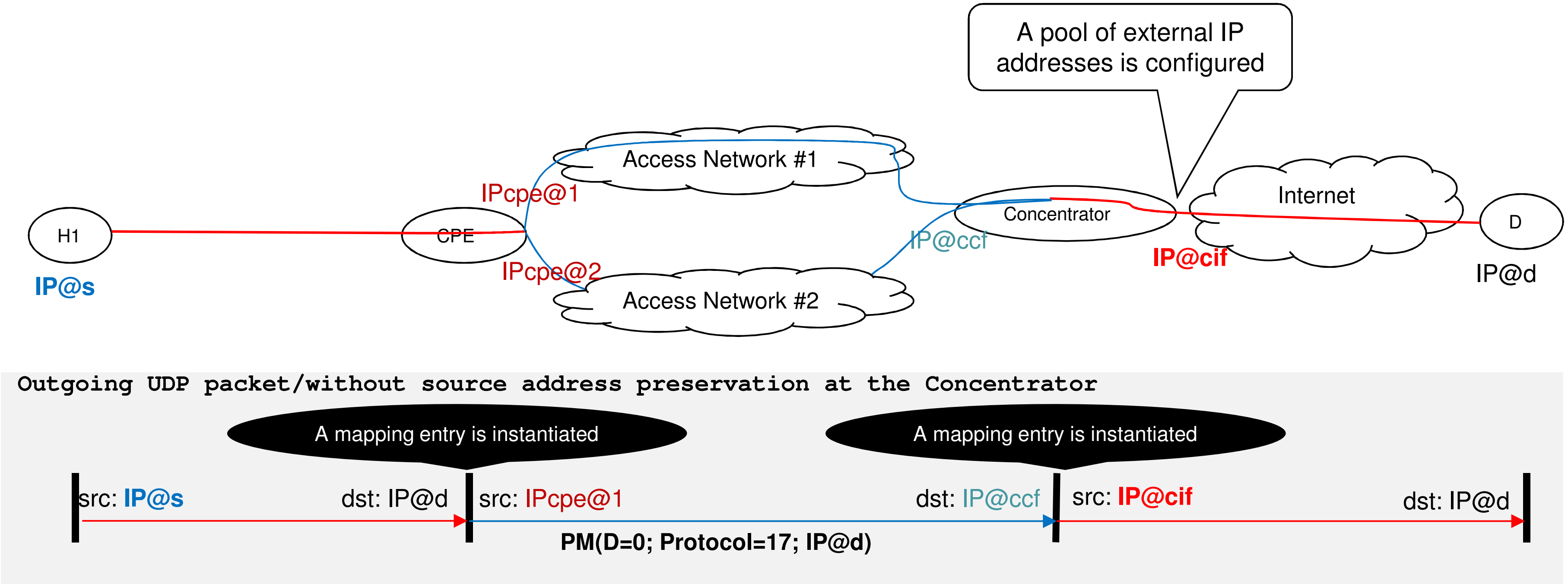

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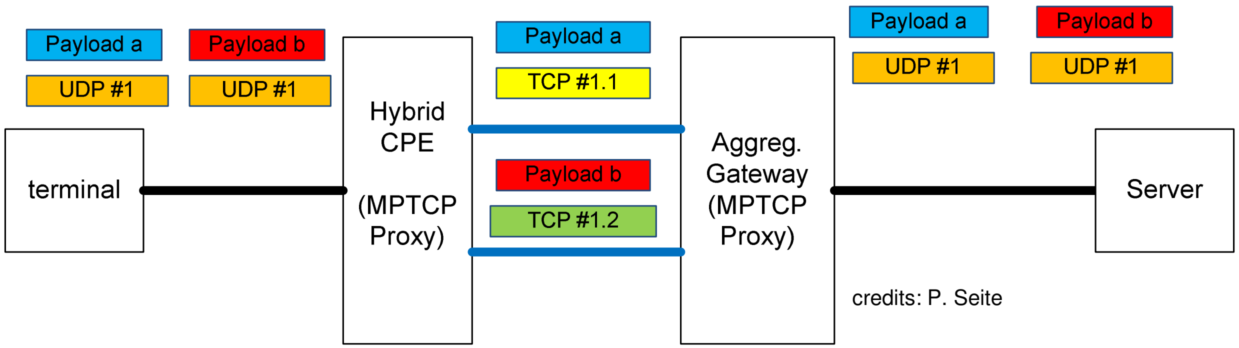
Where to Convey the PM Option?

- In SYN segments (RECOMMENDED)
  - The CPE and the Concentrator should maintain a state
  - The option should be included in this order:
    - Dedicated option space, if there is enough room left
    - In the SYN payload, otherwise
- It may be tempting to include the option in all segments (stateless)
  - ..but this design leads to an overhead
  - Some implementers reported that it is complex to integrate in an MPTCP stack

Carrying UDP Traffic



- Dedicated subflows are established to carry UDP traffic
  - These sub-flows can be established prior to the receipt of UDP packets (optimize 3WHS), or
  - Initialized upon receipt of an UDP datagram elected to the bonding service: SYN with data in payload (RECOMMENDED)
- UDP packets are "transformed" into TCP packets by the CPE/Concentrator and which carry the PM Option with the "Protocol" field set to 17
  - UDP header is swapped to a TCP header
- To avoid UDP fragmentation, it is RECOMMENDED to increase the MTU by at least 12 bytes the accommodate the overhead of the UDP/TCP header swapping
- Some TCP features may be disabled by the CPE or Concentrator such as reordering: *deployment-specific*

Carrying UDP Traffic: Some Open Issues

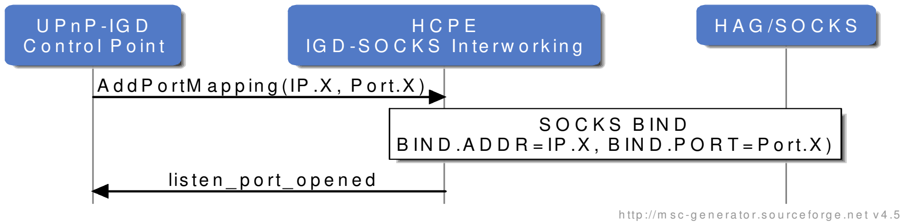
- *Issue#1: Include multiple payloads in the same MPTCP message or not?*
  - The current version assumes a simple mode with "1:1" header swapping
- *Issue#2: Do we need to indicate explicitly the payload boundaries?*
- *Issue#3: The behavior to follow if swapping UDP/TCP headers leads to fragmentation*
  - Not an issue if the MTU is well configured?
  - Declare these packets as not candidate for the bonding service?
  - Fragment the transformed packet and reassemble it before extracting the corresponding UDP packet?
  - Declare it out of scope of the specification?

Some Recommendations & Assumptions

- For IPv4 bonding services, the ***default behavior does not assume address preservation***
  - i.e., Only one instance of the PM option will be present
- The solution ***relies upon IETF BCPs and recommendations***, especially:
  - RFC4787, RFC5382, RFC6888, and draft-ietf-tsvwg-behave-requirements-update
  - CPE and Concentrator NAT capabilities are not altered
- Whether the CPE/Concentrator preserves ***DSCP marking or rewrites it is deployment-specific***
- The support of features such as ***MSS clamping is implementation-specific***

Incoming Connections

- In order to allow for incoming connections, means to instruct the concentrator about how to forward incoming traffic to the appropriate CPE are required
- ***Compatibility with UPnP IGD is RECOMMENDED***
  - SOCKS-based deployments will require an interworking function (which does not exist!)



credits: P. Seite

- ***Reuse existing code/protocols***, *e.g.*:
  - Port Control Protocol (RFC6887)
  - UPnP IGD/PCP Interworking Function (RFC 6970)

Recap

- No tunnel, no encapsulation
- No out-of-band signaling for each MPTCP subflow
- Carries any protocol (incl. UDP) for the benefit of massive MPTCP adoption
- Accommodates various deployment contexts
- Prototype implementations are underway

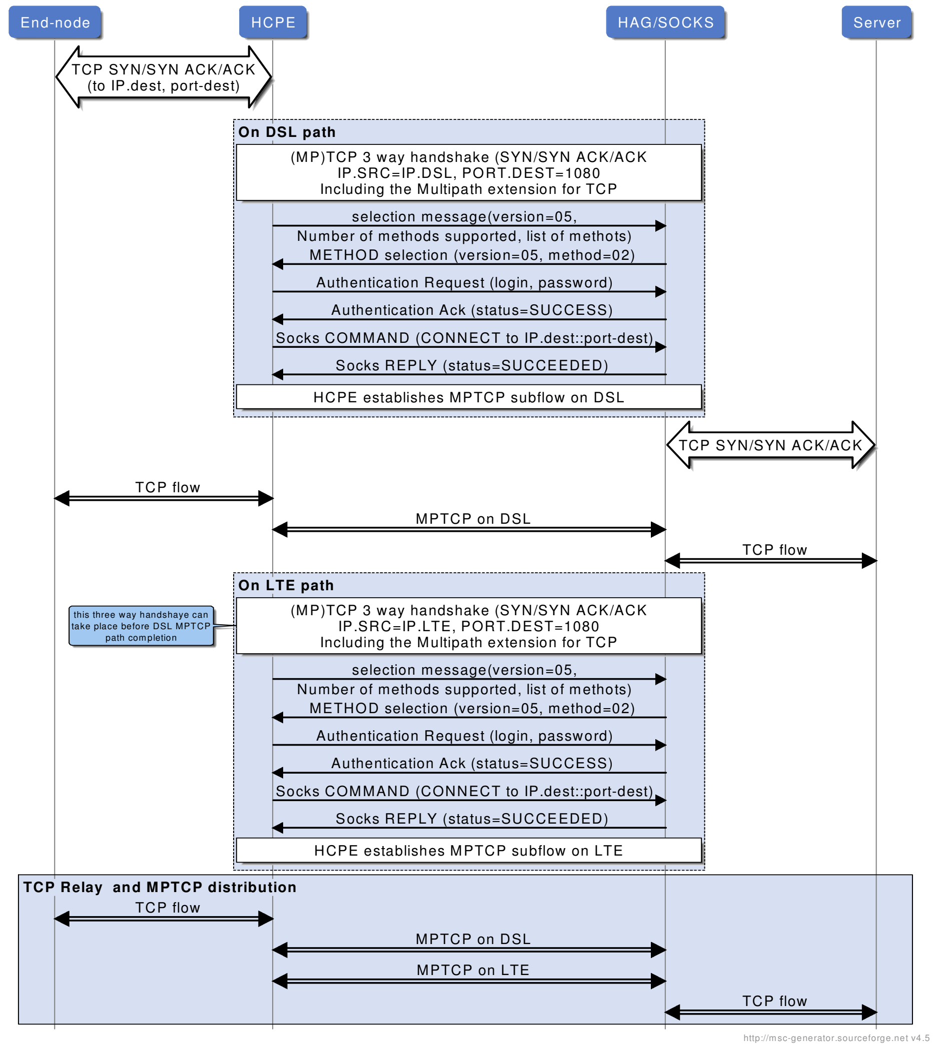
What's Next?

- Request mptcp WG adoption
- Comments and contributions are welcome

Appendix

Why not my favorite protocol: SOCKS, for example

- Too chatty
- UDP bonding is not natively supported
- Need for UPnP IGD-SOCKS interworking



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