BANANA BOF
Scope & Problem Description

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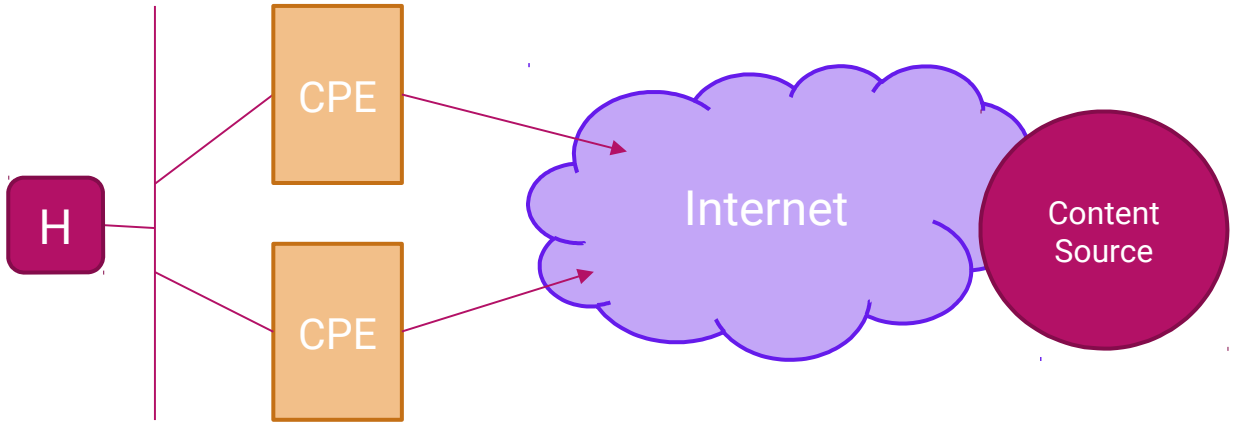
BANANA BOF Scope

- Bandwidth aggregation and failover solutions for multi-access networks where the end-nodes are not multi-access-aware
  - Higher bandwidth (through bandwidth aggregation)
  - Increased reliability (through failover)



BANANA BOF Scope

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  - Higher bandwidth (through bandwidth aggregation)
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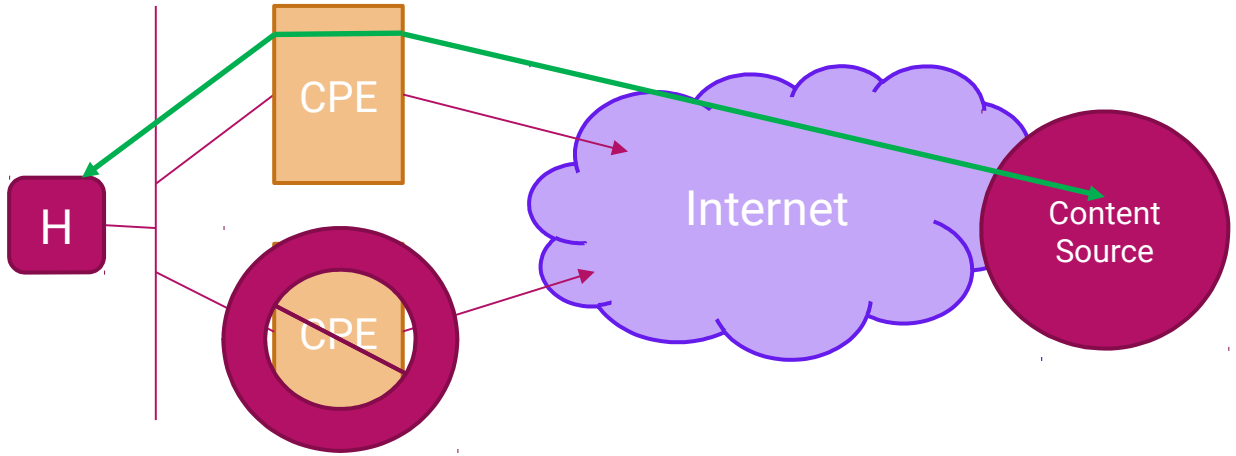
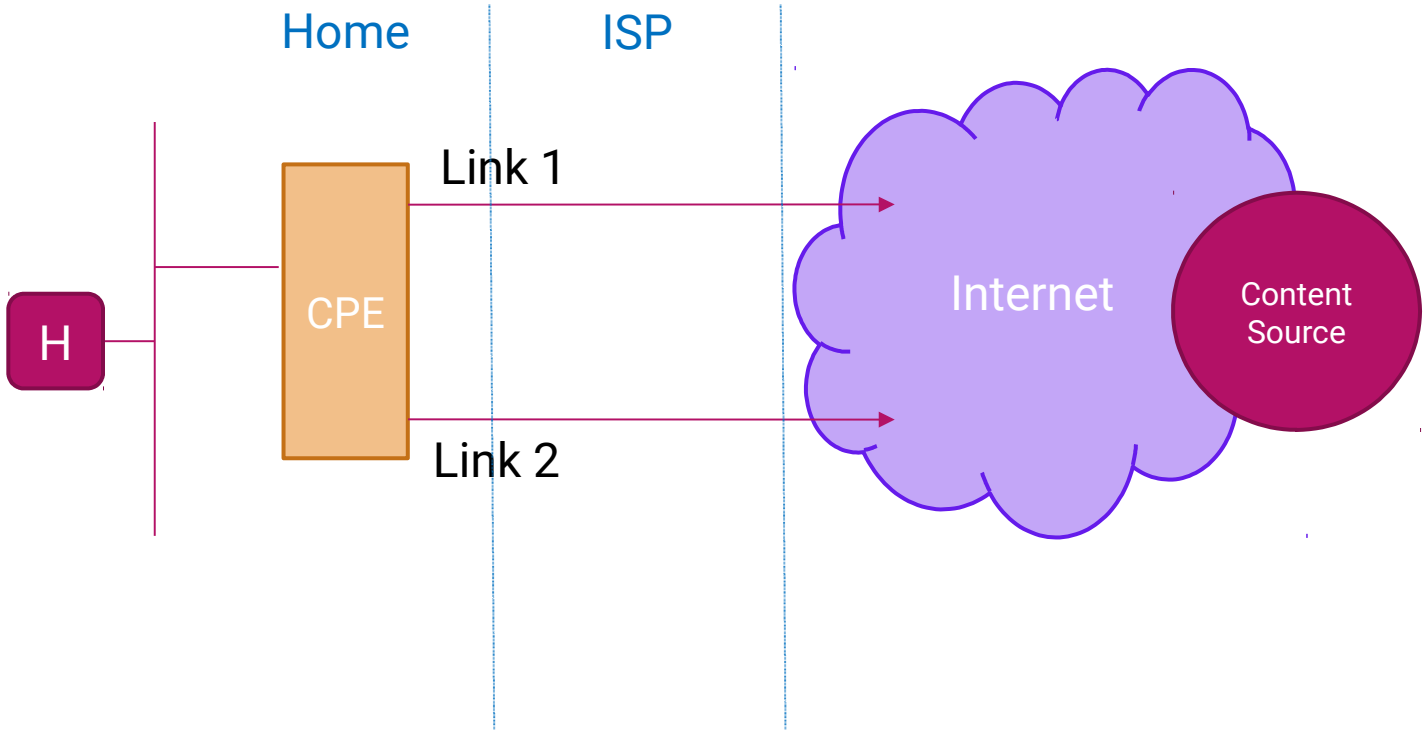
- Traffic is sent through default router or the path chosen by Source Address Selection
  - Flow is limited to bandwidth of chosen link
  - Other path is unused
  - Flow will not switch to other path if initial path becomes unavailable



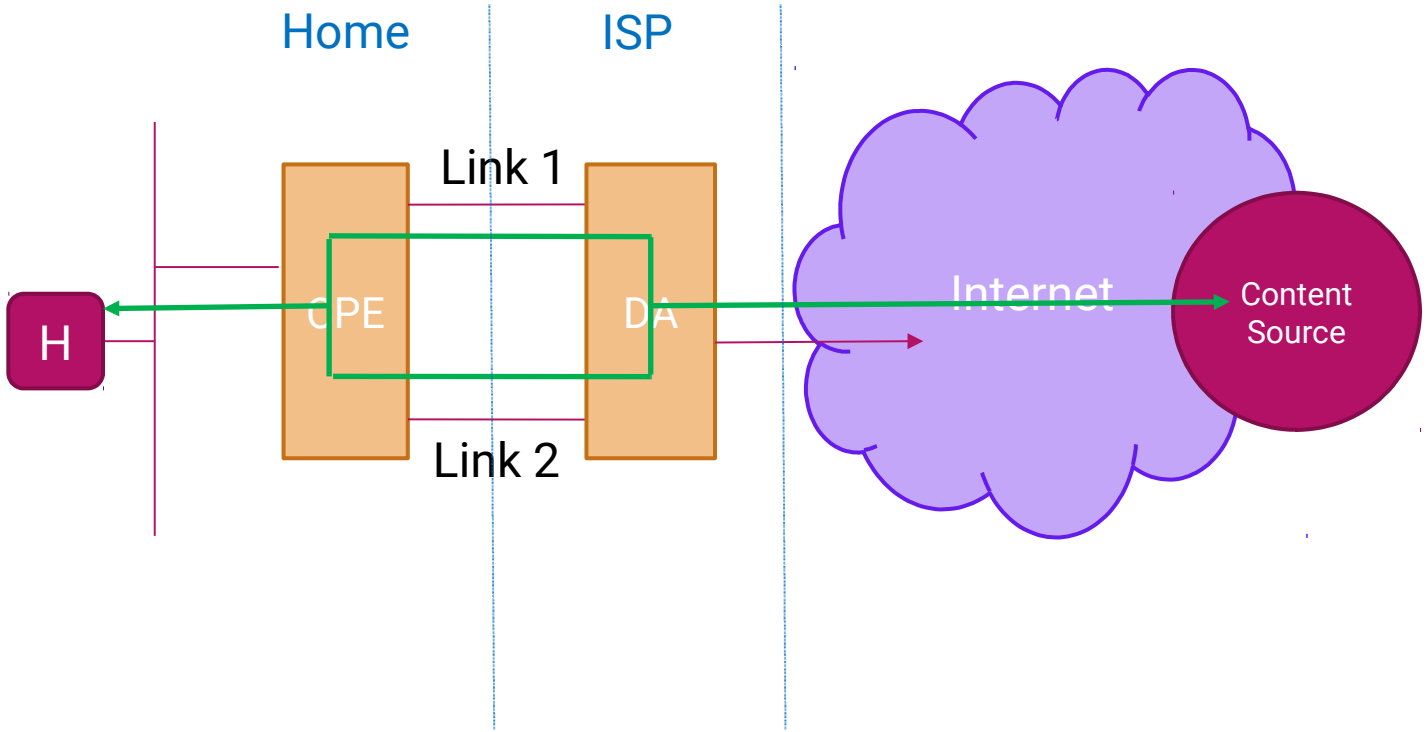
Three Solution Scenarios

- Single Operator
  - Multiple access networks provided by a single provider (e.g. DSL & LTE)
  - De-aggregation can occur within the provider network
- Aggregation Service
  - Multiple access networks from multiple providers (e.g. DSL & Cable)
  - All traffic from the home is routed/proxied through a de-aggregation service somewhere in the Internet, and then sent to the original destination
- Edge-to-Edge
  - Multiple access networks from single or multiple providers
  - Traffic is de-aggregated by multi-access-aware hardware at the remote edge

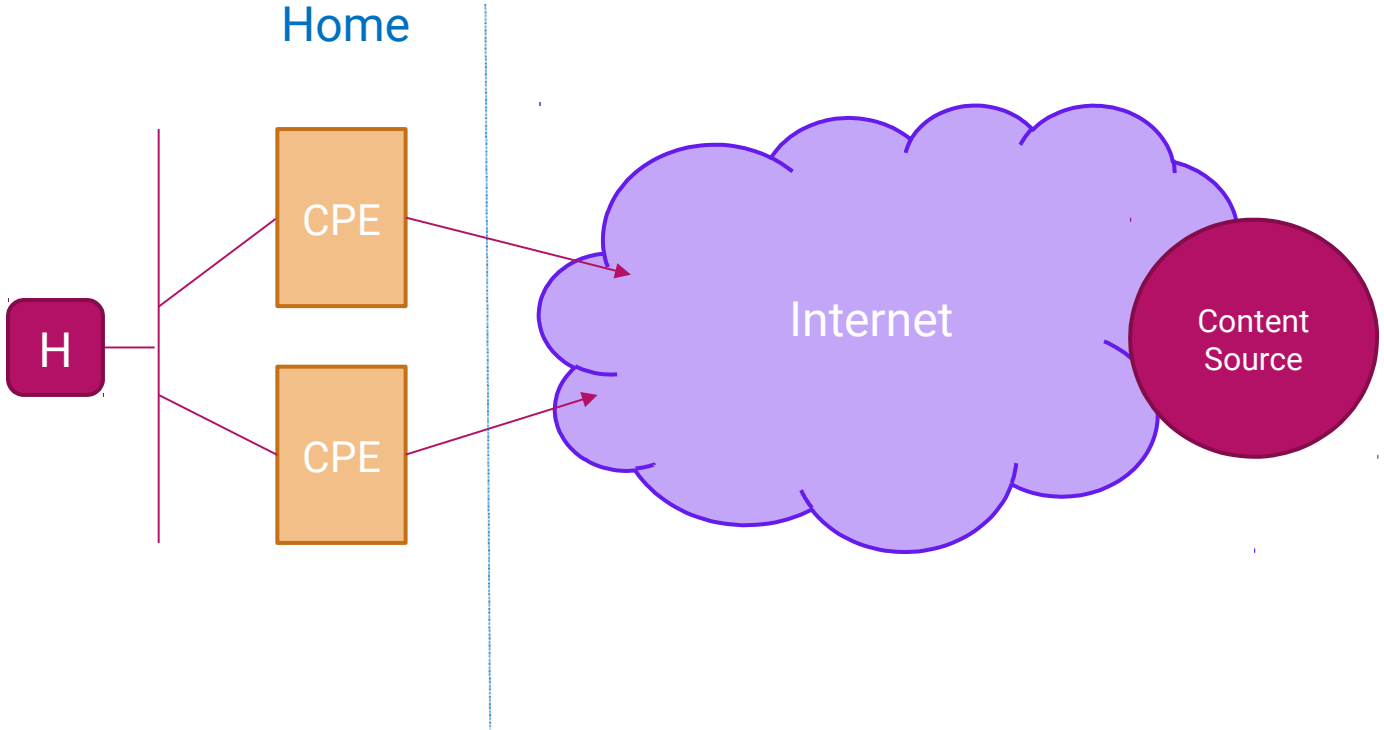
Single-Operator Scenario



Single-Operator Scenario



Aggregation Service Scenario



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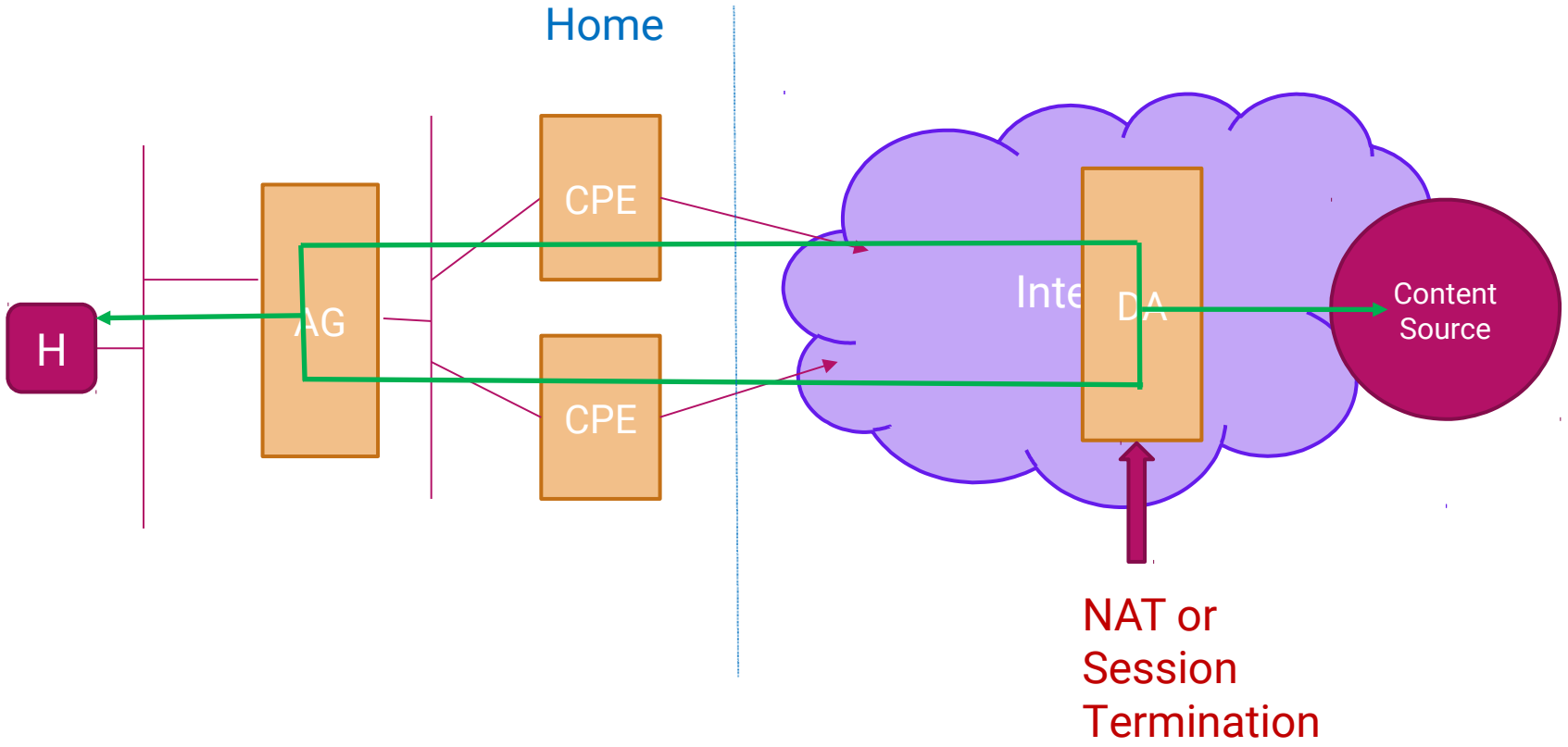
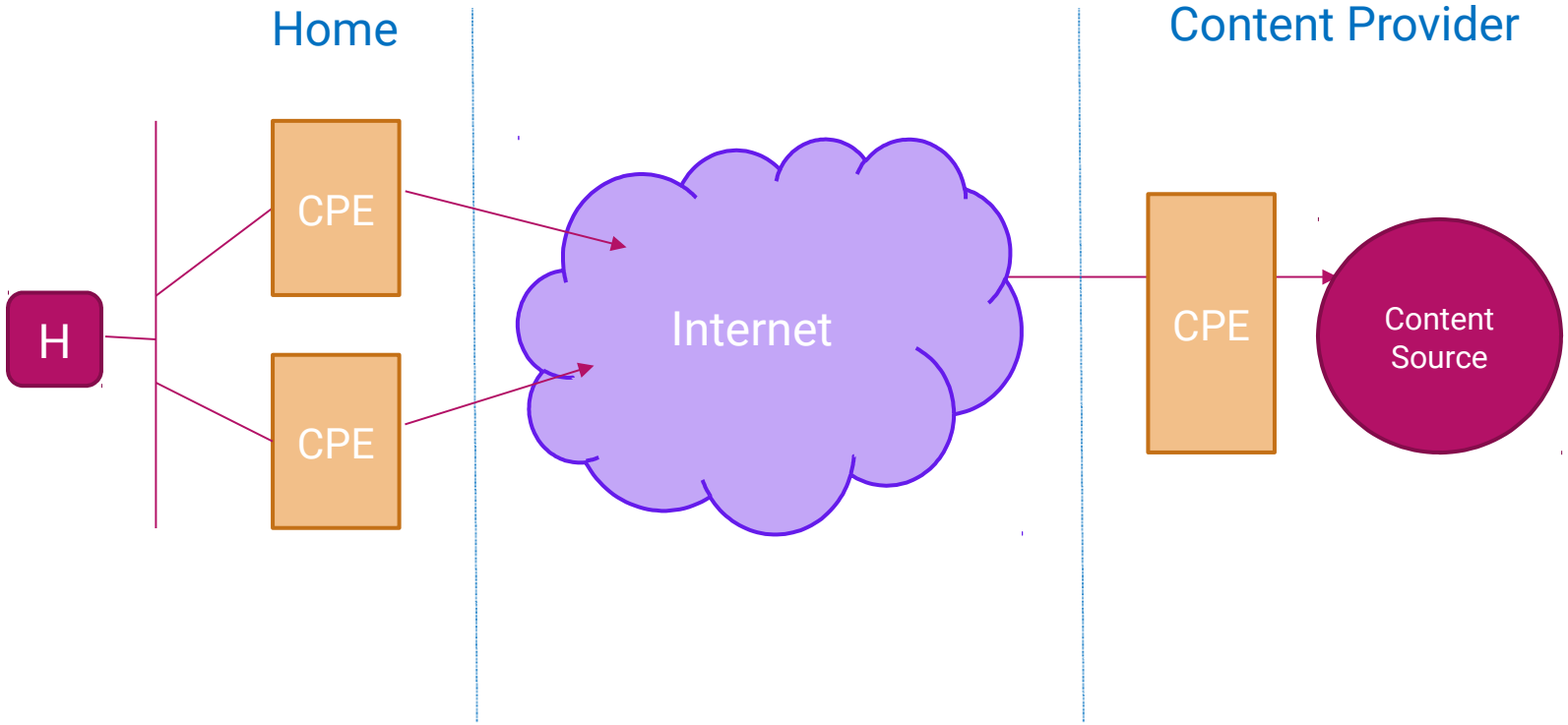


Edge-to-Edge Scenario



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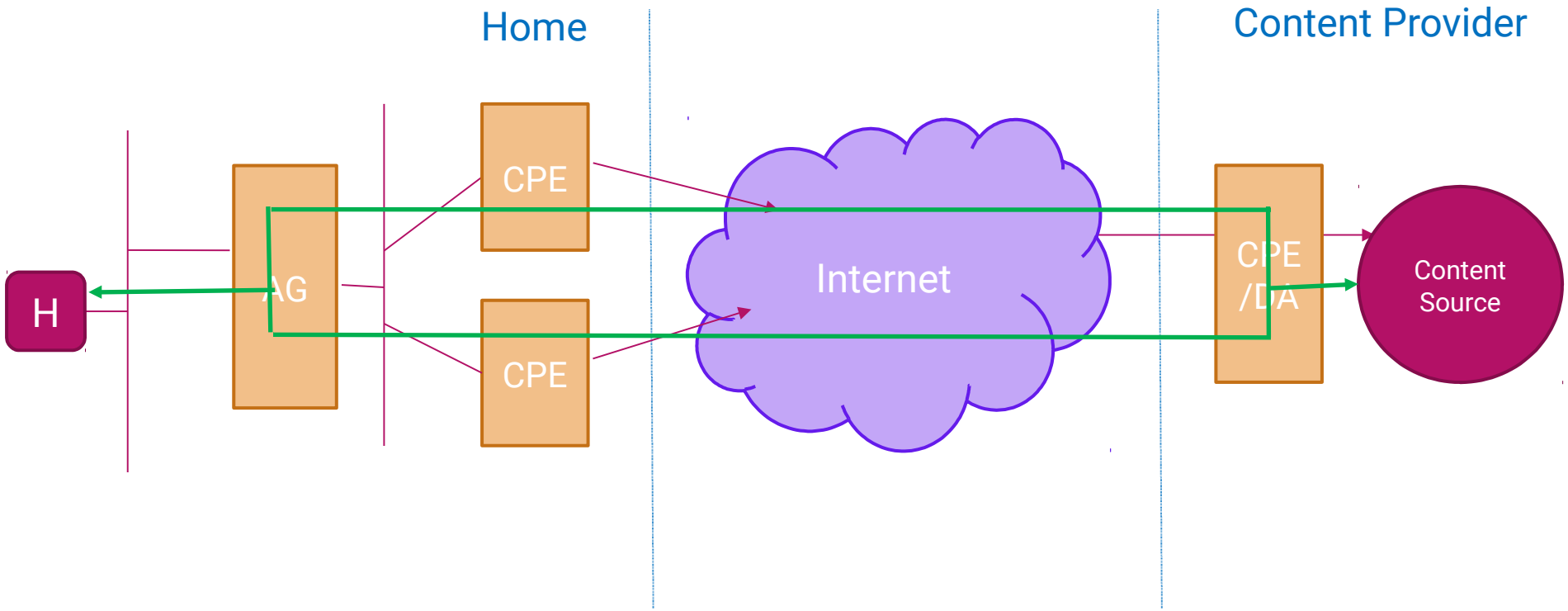

Solution Proposals

- GRE Tunnel Bonding
  - https://datatracker.ietf.org/doc/draft-zhang-gre-tunnel-bonding
  - Current draft assumes Single Operator scenario, could be easily adapted to Aggregation Service scenario
  - Traffic is shared on a per-packet basis and tunneled to the de-aggregation point in GRE Tunnels.
- MPTCP Proxy Solution(s)
  - https://datatracker.ietf.org/doc/draft-boucadair-mptcp-plain-mode/ , https://datatracker.ietf.org/doc/draft-peirens-mptcp-transparent/ & other work
  - Current work applies to Single Operator or Aggregation Service scenarios
  - Simple case is TCP-only, work is underway on support for UDP – multiple options being explored

Solution Proposals (2)

- Multipath Bonding at Layer 3
  - https://irtf.org/anrw/2016/anrw16-final21.pdf
  - Edge-to-edge solution, but incomplete (discovery, security)
  - Output of the Applied NW Research group of the IRTF
  - UDP-only solution, would need work to pair with a TCP solution like MPTCP Proxy
- MAG Multipath Binding Option
  - https://datatracker.ietf.org/doc/draft-ietf-dmm-mag-multihoming-02
  - Mobile IP-based solution, work being done in DMM WG
  - Scenario would depend on the topology of the MIP network

Solution Proposals (3)

- Bonding Solution for Hybrid Access
  - https://datatracker.ietf.org/doc/draft-muley-network-based-bonding-hybrid-access/
  - 3GPP-specific solution for Single-Operator scenario

High-Level Challenges

- Performance (only do aggregation if it increases app-level throughput, bottleneck discovery, flow control to avoid buffer bloat or congestion)
- Small number of flows (makes flow-based load sharing ineffective, do not want high-bandwidth flows constrained to a single link)
- Bypass requirement (some traffic is required by law, regulations or contracts to take a particular path)
- Tunnel issues: packet reordering, MTU issues, etc.
- Proxy issues: encrypted traffic, side-effects of session termination, etc.

High-Level Challenges (2)

- Provisioning/configuration/discovery (multi-access network details, de-aggregation point, credentials, etc.)
- Reverse routing (operator controlled? IP address translation? transport-layer session termination?)
- TCP-only vs. TCP/UDP – bulk of traffic is TCP now, but will that remain constant as QUIC is deployed more widely? what about UDP failover?
- Security! -- Must not become a vehicle for MITM attacks!
- Transition Strategy – how does this mechanism interact with end-to-end MPTCP? with end-nodes that are multi-access aware? etc.

Clarifying Questions?

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