Overlay Routing Problem Statement

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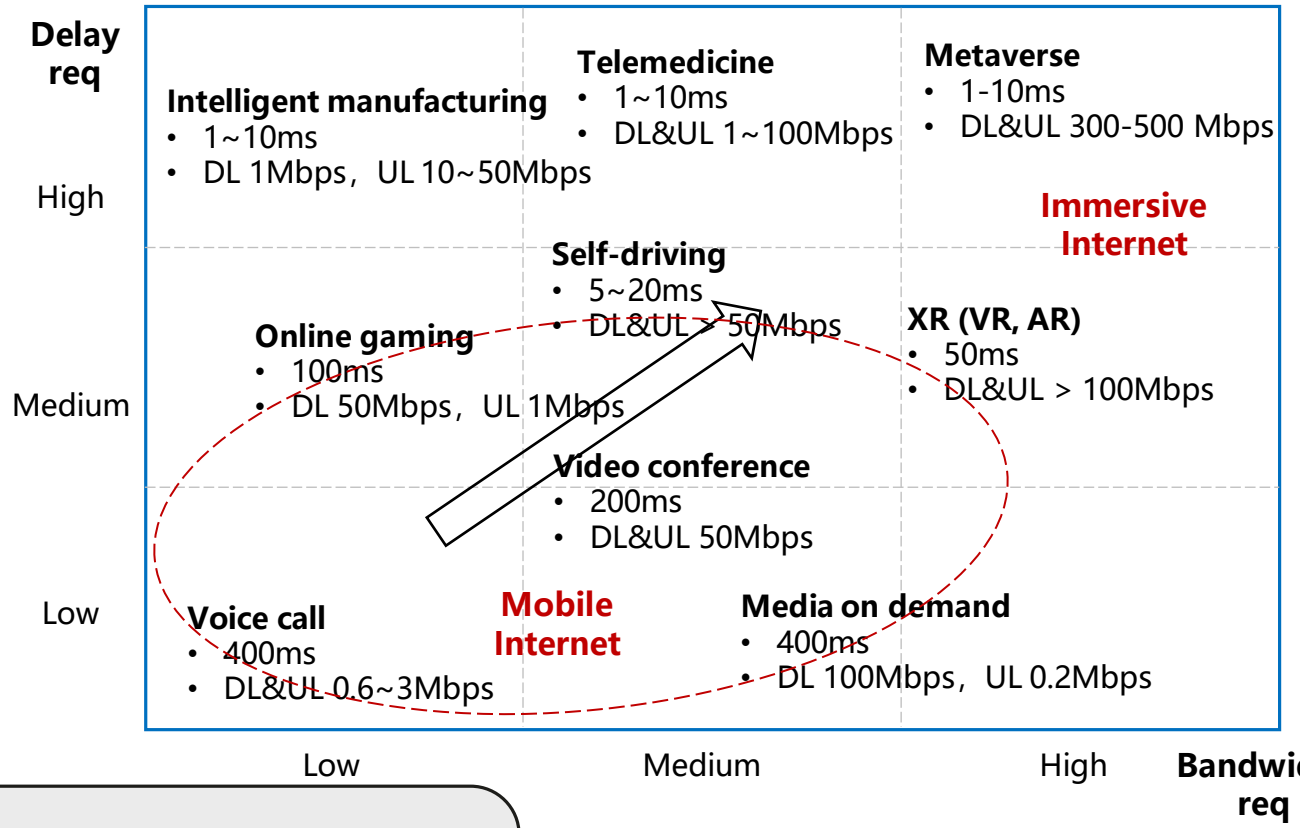
Internet is Entering a New Era, Requiring Significantly Higher Communication Quality

- A new era of Internet: more interactive, immersive and real-time
  - RTC: 2,900% growth since COVID-19 pandemic
  - VR: 48.7% annual growth rate over 2021-2026
- Much higher, more strict and deterministic quality requirement
  - E.g., low latency, high throughput

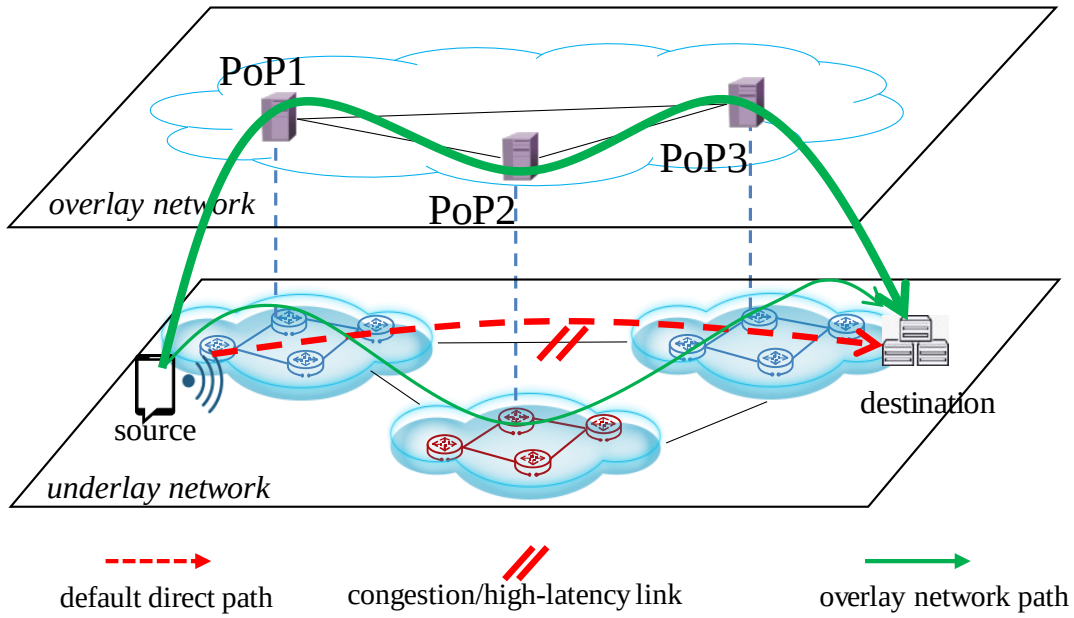


Technique gap in wide-area and public (cross-domain) networks

- Traditional Internet: best-effort delivery, BGP, no performance guarantee
- Recent advance (e.g., 5G, SD-WAN): single domain, not end-to-end solution

Overlay Networking: Provide Better Path Selection in Internet

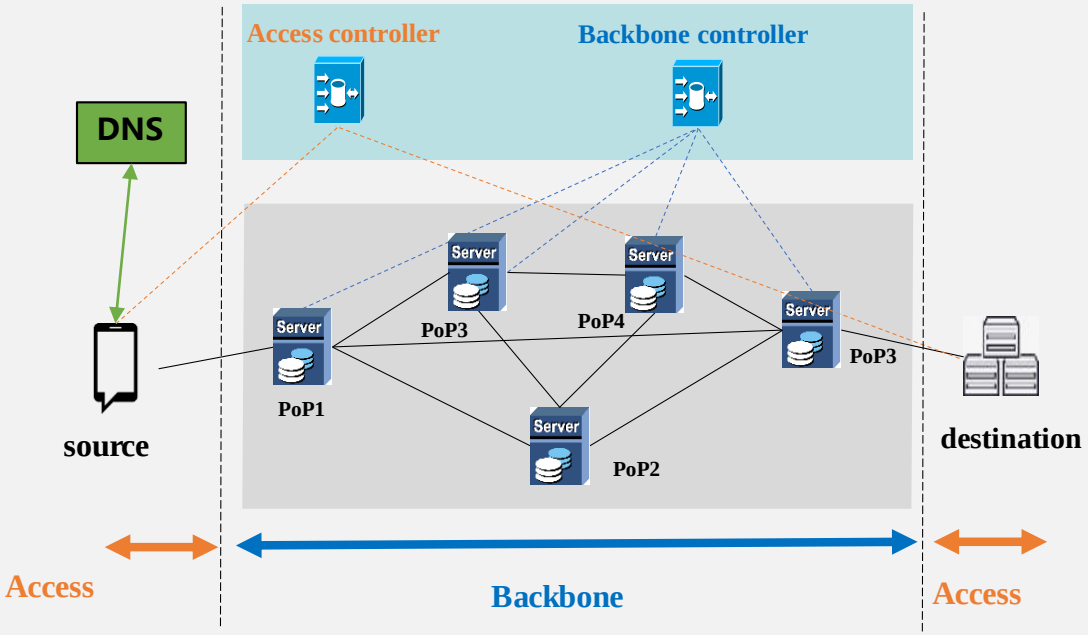
- OTT (over-the-top) service providers uses private infrastructure to provide better network performance
  - Multiple PoPs (Point of Presence) are deployed worldwide to relay traffic
  - Overlaying private circuits and the public Internet
  - Endpoints use overlay forwarding paths instead of default direct paths (e.g., for shorter distances or bypassing congestion points)



Overlay Routing Problems

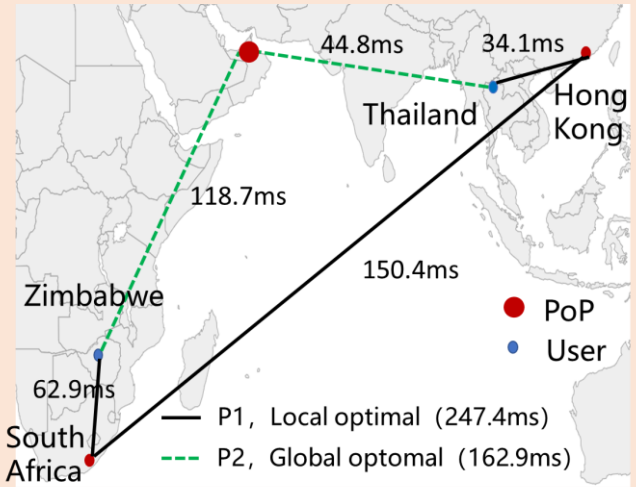
End-to-end routing is divided into two segments:

- **Access segment: nearby access**
  - Obtain access controller address by DNS
  - Assign access points (ingress and egress) based on geographic location or latency
- **Backbone segment: backbone optimal path**
  - Configures the optimal path in the backbone



Problem 1: Local optimal is not global optimal

$$Opt|_{E2E} \neq Opt|_{access} + Opt|_{backbone}$$



Problem 2: Complex signaling

- DNS request for des address
- DNS request for access controller
- Access point request
- …

Problem 3: Path unawareness at endpoints

- Zero information about the path or path properties (e.g., latency, jitter, bandwidth…)

[1] Erik Nygren, Ramesh K Sitaraman, and Jennifer Sun. The Akamai network: a platform for high-performance internet applications. ACM SIGOPS Operating Systems Review, 2010

[2] Ramesh K Sitaraman, Mangesh Kasbekar, Woody Lichtenstein, and Manish Jain. Overlay networks: An akamai perspective. Advanced Content Delivery, Streaming, and Cloud Services, 2014

[3] AWS Global Accelerator. https://aws.amazon.com/global-accelerator

Potential Extensions

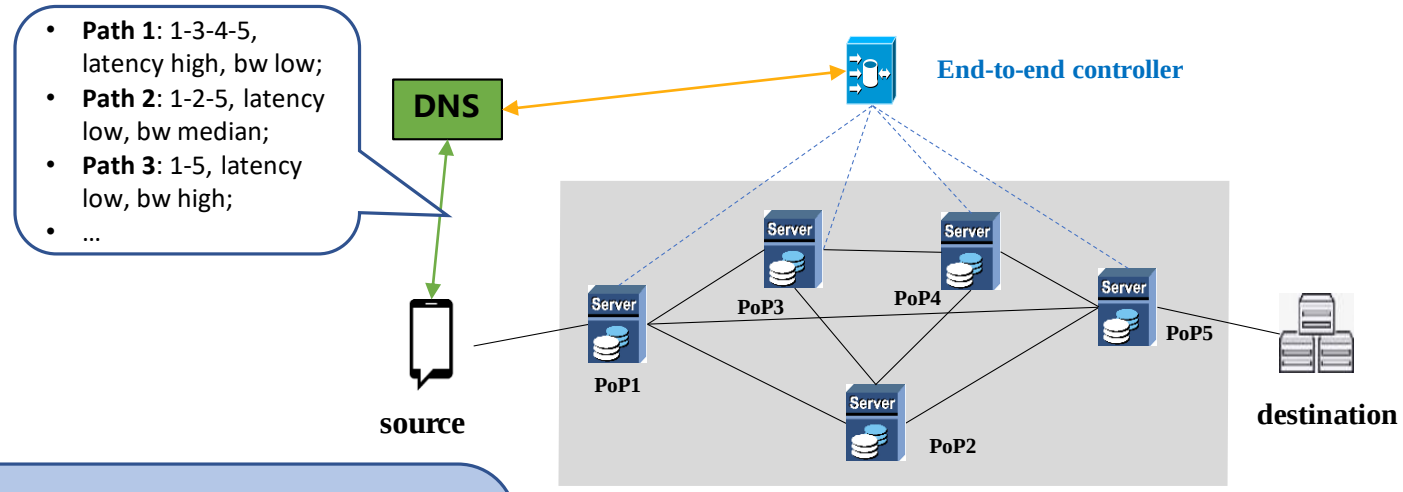
Extension 1: End-to-end joint path computation

- Compute entire overlay paths, include both access and backbone segments

Extension 2: Configure endpoint path via DNS

- Controller as a root DNS server
- Return both destination address and candidate path set with path properties
- Extension Mechanisms for DNS (EDNS) [RFC2671]
- New OPTION-CODE pseudo Resource Record (OPT RR)

New standard



Extension 3: Endpoint determine the final path

New standard

- Select path from DNS response
- Source routing starting at endpoint

Relation to PANRG, and moving forward

- In the charter: "…aims to support research in *bringing path awareness to transport and application layer protocols,* and to bring research in this space to the attention of the Internet engineering and protocol design community"

- Moving forward:
  - Any interest in documenting the PS first of all?

Q & A

Comments?

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