

TreeDN: Tree-based CDNs for Live Streaming to Mass Audiences (draft-ietf-mops-treedn)

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Problem Statement

- With live audiences exploding combined with increasing bitrates (4K/8K/AR), are we at an inflection point?
 - NFL Thurs Night FB on Amazon Prime (10-15M streaming viewers)
 - NFL Sunday Ticket on YouTubeTV
 - 2023 Cricket IPL Final- 32M concurrent streams
- Live Streaming is not the same as On-Demand Streaming
 - Expectations for low latency means shorter playout buffers
 - < 10s to match traditional broadcast TV, much less for micro-betting
 - Join rates are vastly different
 - Smooth/predictable for on-demand, ~ step function for live events

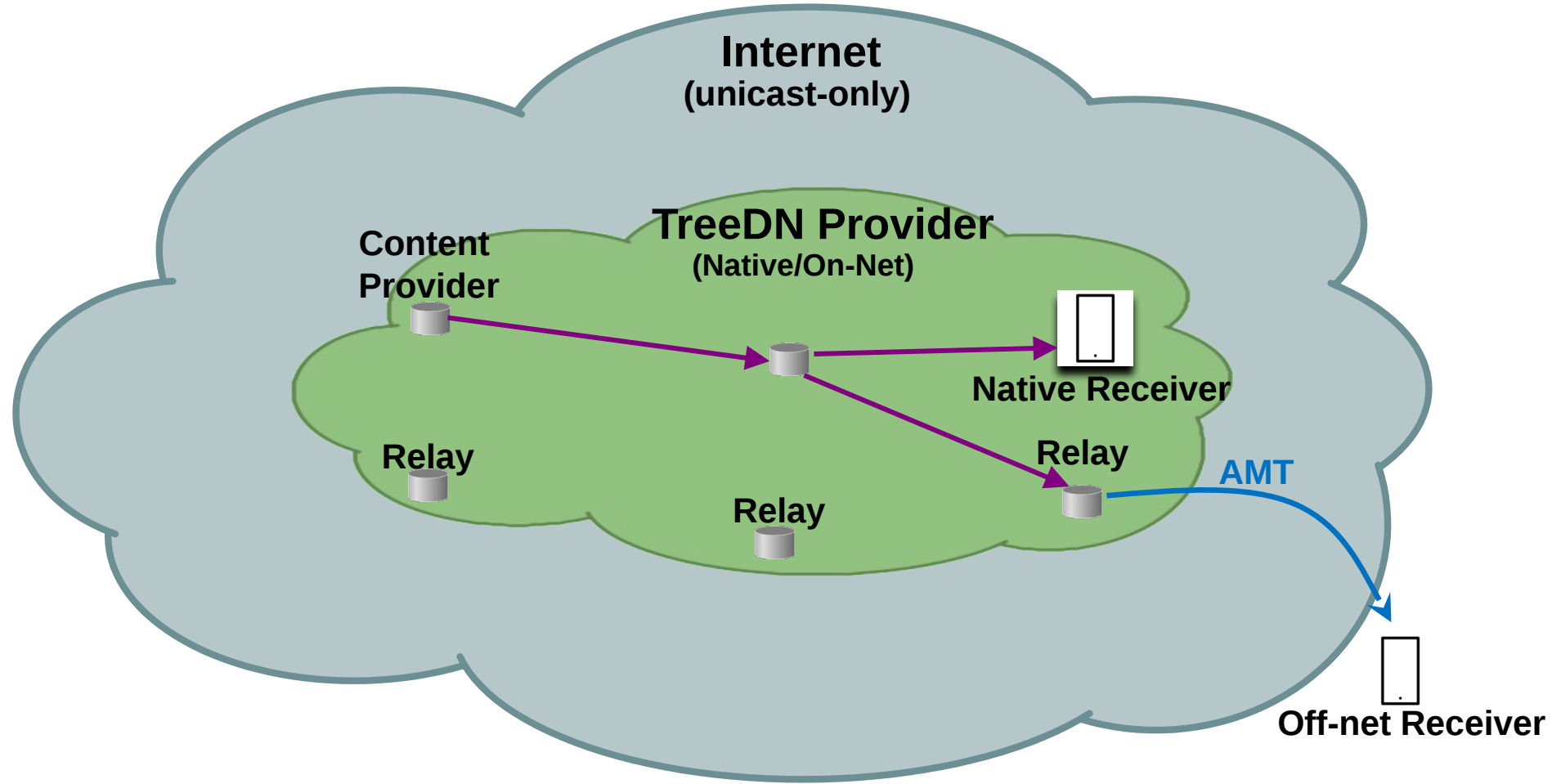
TreeDN: Tree-based CDNs

- Leverages native and overlay concepts to deliver service to end users even when parts of the network don't support multicast
 - Native (On-Net): SSM
 - Overlay: AMT (RFC7450)
- Incremental Deployment
 - Multicast-enabled parts of network enjoy benefits, unicast-only parts are tunneled over
 - Most importantly, end users receive the service (eg, no dependency on last mile provider)

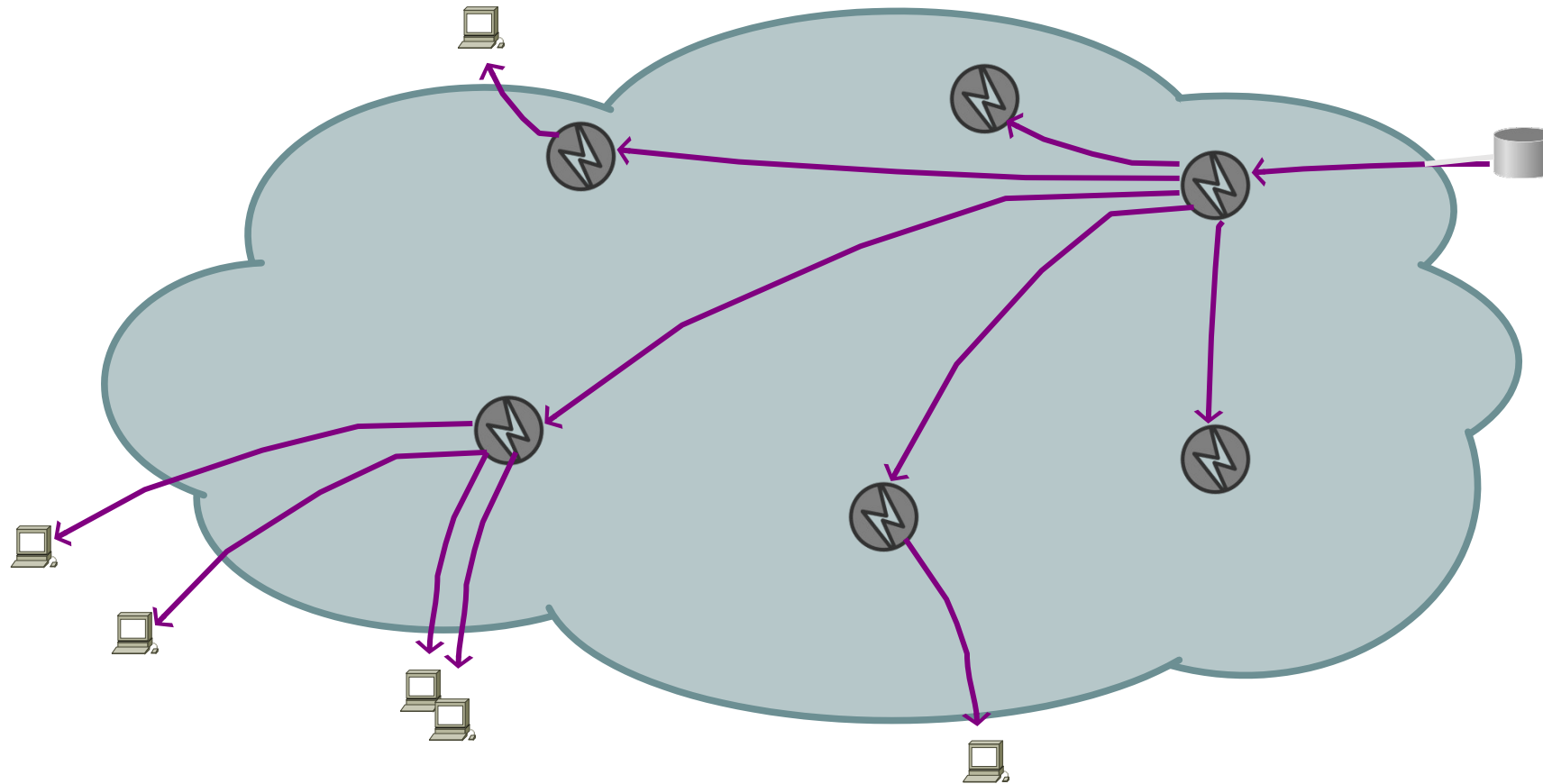
TreeDN Components

- Native (On-Net): SSM
 - SSM vastly simplifies multicast deployment, solves the "It's too complex" problem
 - Usually PIM-SSM, but could also use mLDP, GTM, BGP-MVPN, BIER, SR-P2MP
- Overlay: AMT (RFC7450)
 - Dynamically-built tunnels in host/app "hop over" unicast-only parts of network
 - Simplifies "last mile"- can avoid wifi and other in-home issues
 - Solves the "All or Nothing" and "Chicken & Egg" problems
 - Could also use LISP or any other overlay networking technologies

TreeDN= SSM + AMT

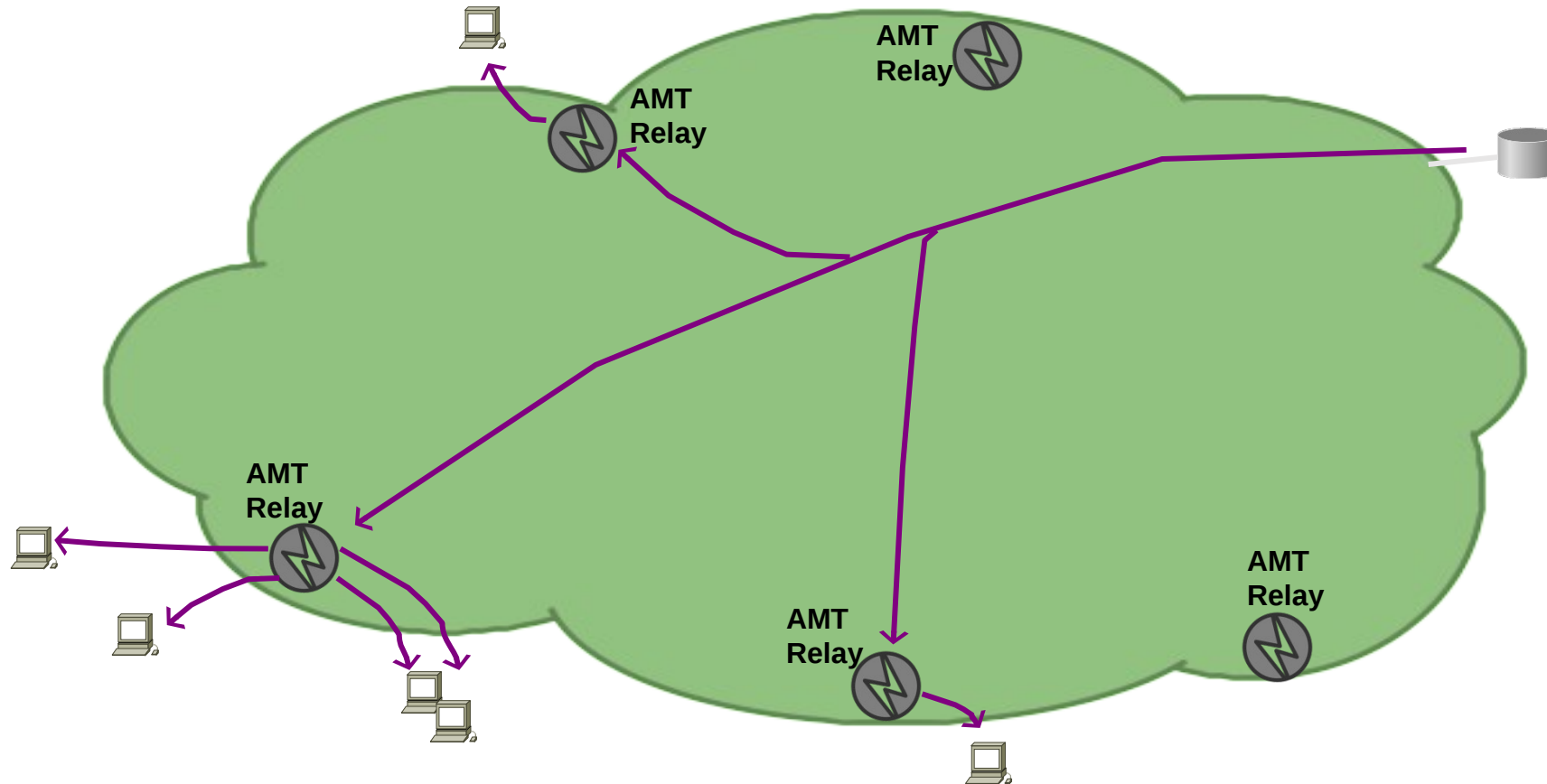


CDN's without Multicast



CDN's with Multicast: TreeDNs

- Replication point closer to receivers, only to relays with nearby receivers
 - If deployed on existing network infra (CDN-on-a-Chip): \$0 capex... and maybe \$0 opex, too



TreeDN Benefits

- More efficient network utilization
 - Delivers existing live streaming content at an order of magnitude lower cost
 - Scales to makes new content viable (eg, AR livestreaming to mass audiences, microbetting)
 - Sustainability/Green Networking
- Allows SPs to offer new Replication-as-a-Service (RaaS)
 - At potentially zero additional cost to deliver service (if existing infra support AMT)
 - Open, standards-based architecture with widely available protocols
 - Far less coordination between CP and CDN
 - No need for data storage, protection, key management- CDN just forwards packet
- Addresses fundamental problems with network replication on Internet
 - Incremental deployment, overlay networking, mcast over WIFI
- Democratizes and decentralizes content sourcing
 - Is it healthy for the Internet (and society) that a small handful of companies control nearly all content distribution?

Use Cases/Applicability

- Any multi-destination content
 - Live streaming (audio/video/AR/telemetry)
 - Large File SW Updates (eg, OS updates)

Updates from -01 to -02 Draft

- Added diagram

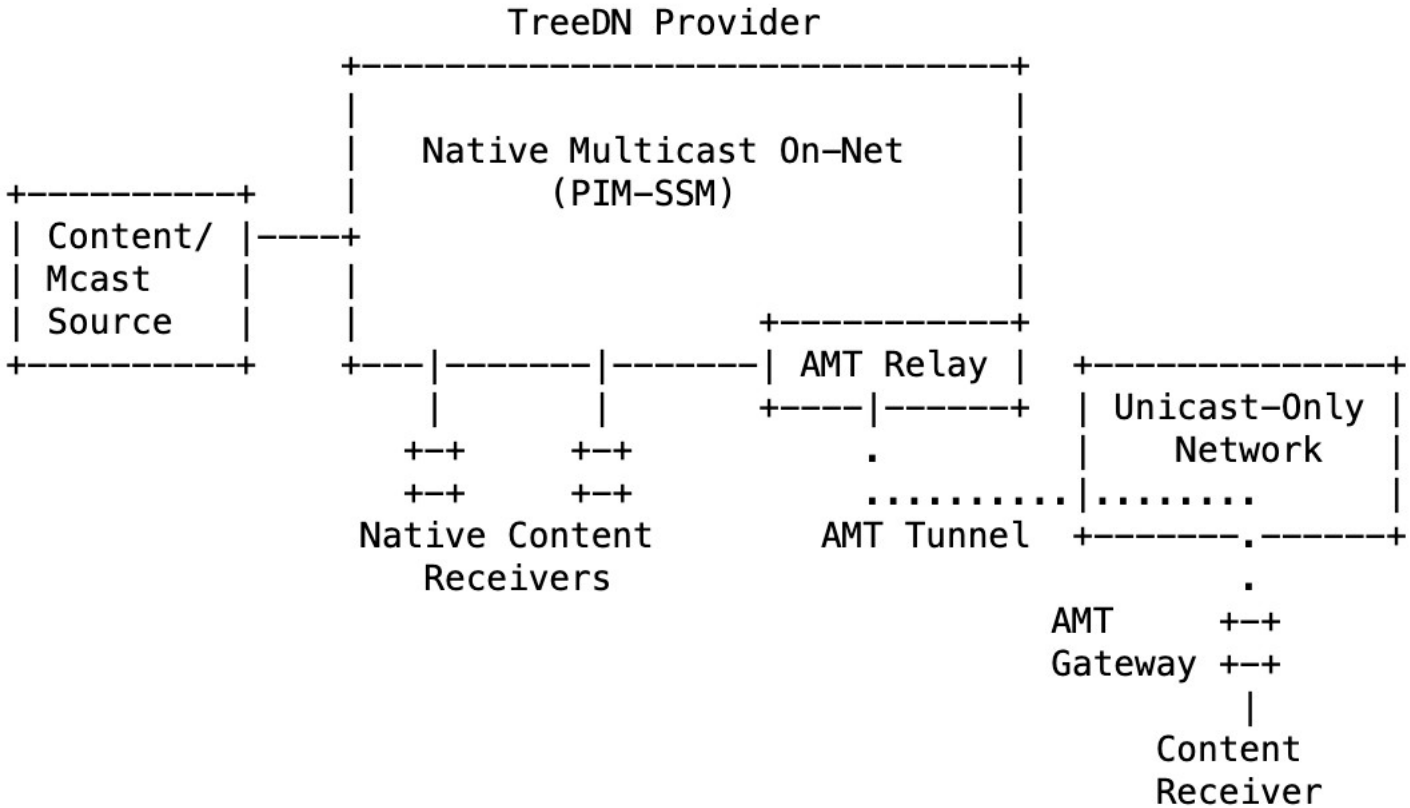


Figure 1: TreeDN Provider Example

Updates from -01 to -02 Draft

- Added section on Transport Layer diffs between TreeDN and traditional unicast-based CDNs (Sect 7)
 - Pointers to existing work
 - Reliability (FEC)
 - ABR- see DVB-MABR, RFC8085
 - Authorization/Encryption- see DVB-MABR, Group Key Management using IKEv2, mcast QUIC
- Renamed Intro -> Problem Statement

Next Steps

- Seeking more reviews
- What's else?

Reference Slides

Network-Based Replication

- Multicast has been fairly successful in some places
 - Financials, Video Distr, VPN SPs, some enterprises
- Internet Multicast- not so much...
 - So what went wrong?

The Problems with Internet Multicast

1. “All or Nothing” Problem

- Every L3 hop (router/fw) between source and destination must be multicast-enabled

2. “It’s Too Complex” Problem

- Perceived benefit not worth the cost of deploying and operating

3. “Chicken and Egg” Problem

- No multicast audience because no multicast content, and vice versa

- Good News: Network Replication technologies are now available to address these problems

Summary: Crossing Supply/Demand Curves for Live Streaming on the Internet

- Demand: exploding livestream audience sizes + increasing bitrates (4K/8K/AR)
- Supply: network-based replication is easier and more available than ever
- TreeDN describes a CDN model optimized to address the increasing strain of live streaming on the network, and enables new types of content delivery