

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

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# Problem Statement

- With live audiences exploding (10s of millions) combined with increasing bitrates (4K/8K/AR), are we at an inflection point?
  - Will we ever?
  - If yes to either, what should we do?
- 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

# 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

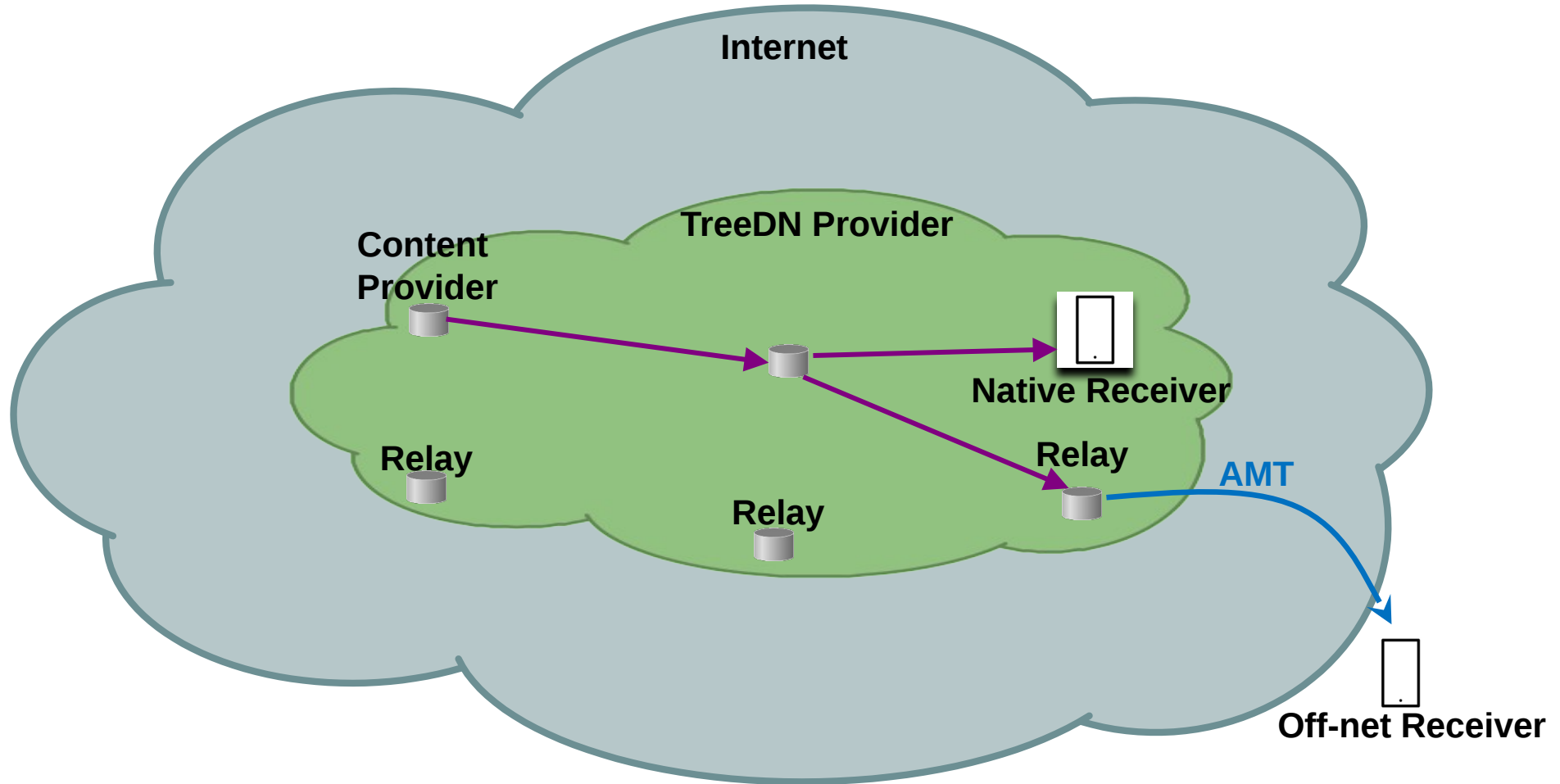
- No multicast audience because no multicast content, and vice versa

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

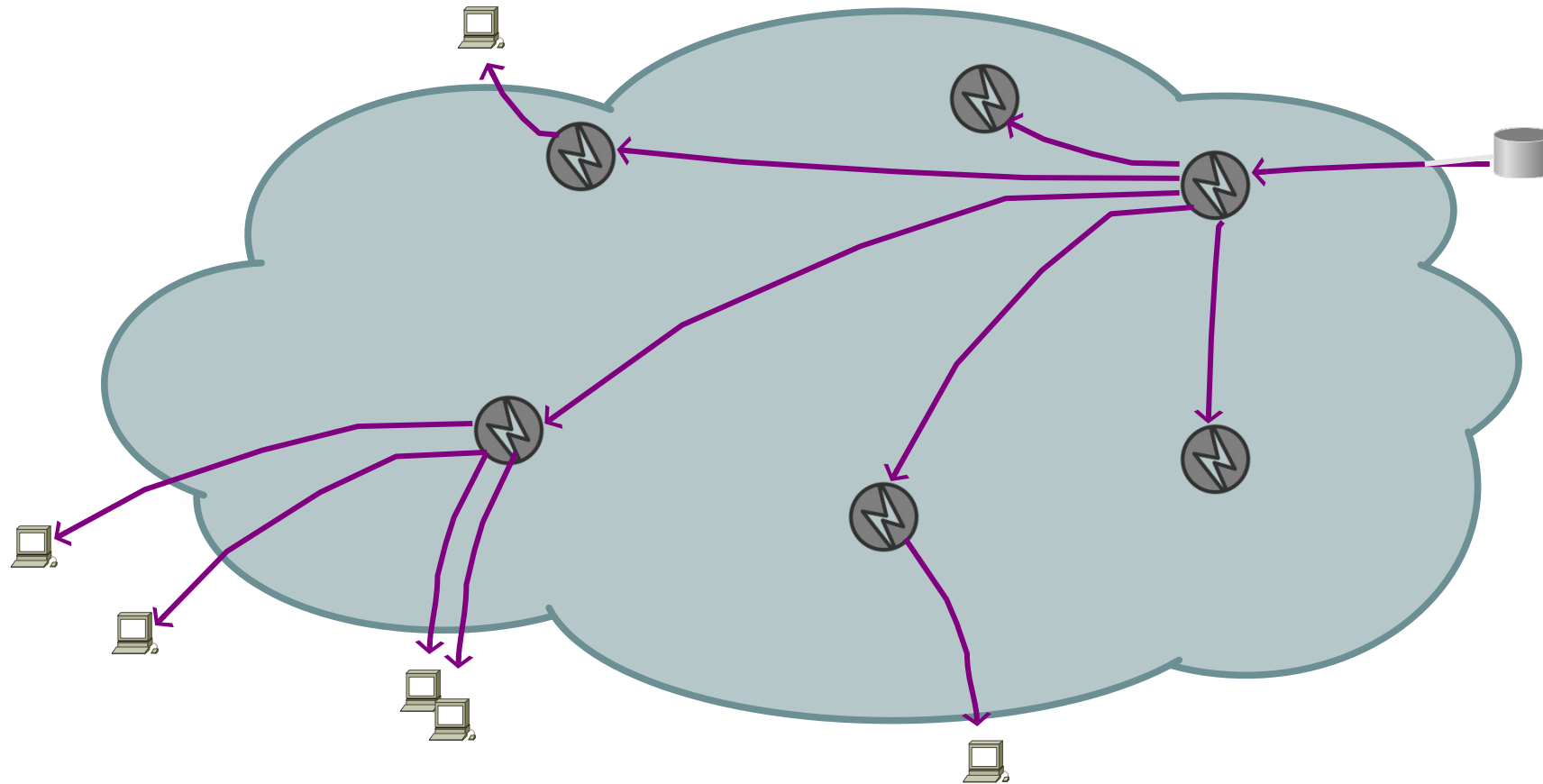
# TreeDN: Tree-based CDNs

- 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
  - 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
- 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= SSM + AMT

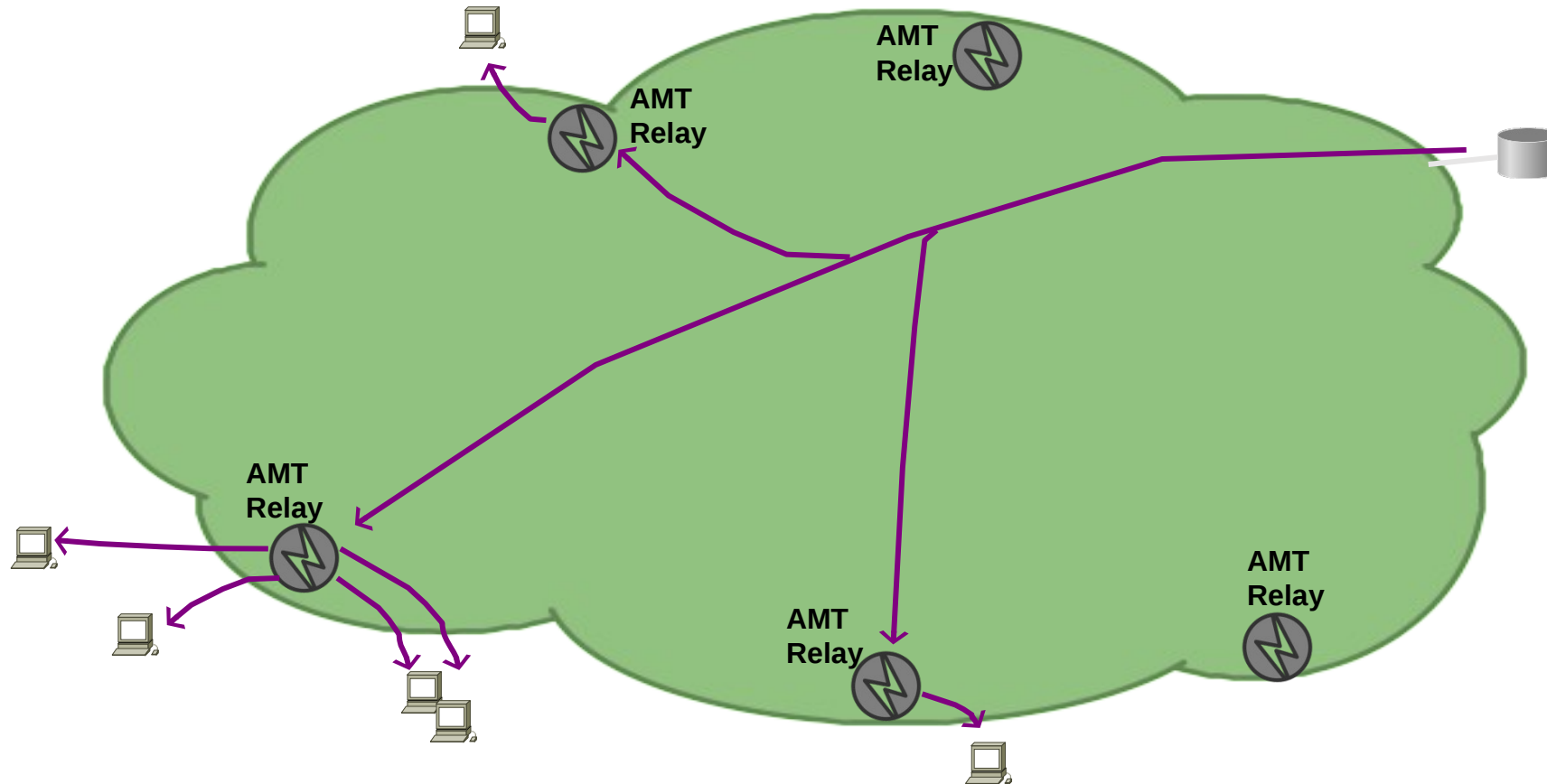


# CDN's without Multicast



# 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
  - Scales to makes new content viable (eg, AR livestreaming to mass audiences)
- 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
- 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)

# 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
  
- Next steps: WG Adoption?
  - MOPS or MBONED?