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