Key Technical Challenges for Multicast-Assisted ABR Video Delivery Systems

Mile High Video 2019

Jeff Van Dyke
Senior Director, Technology

Akamai
Experience the Edge

Agenda

- Drivers for Multicast-Assisted ABR
- High Level Network Flows
- Challenges
- Usage and Experience
- Summary
- References

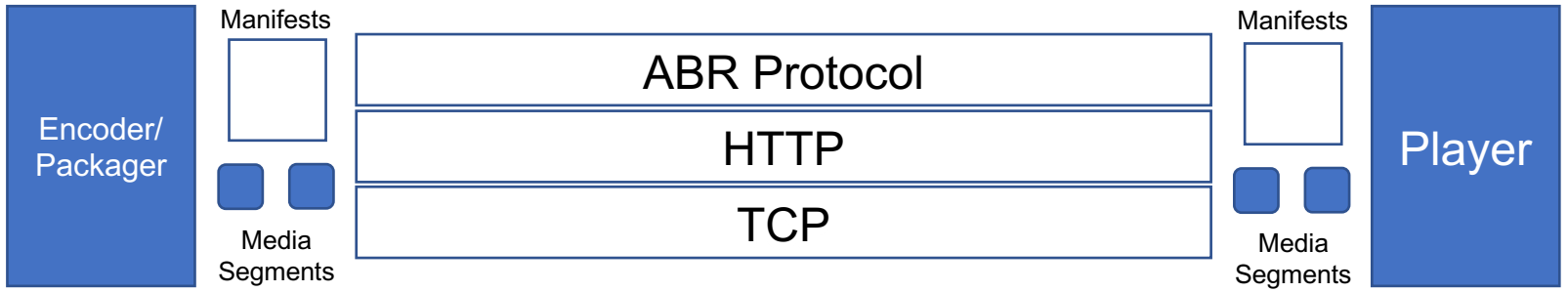
Drivers

Drivers for Multicast-Assisted ABR

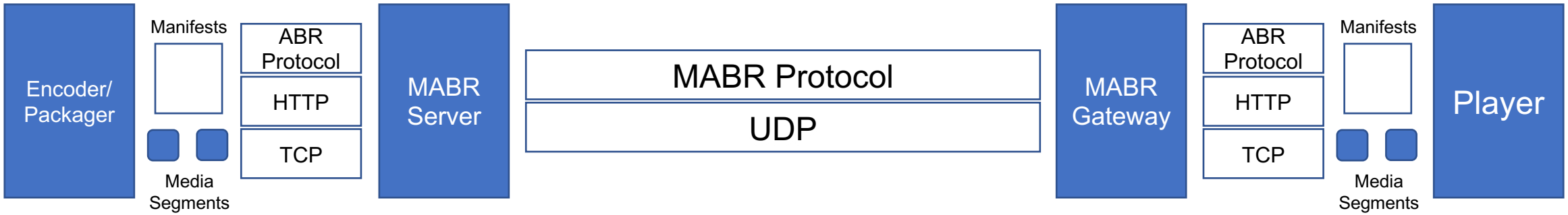
- Dramatic growth in video consumption
  - > 80% year over year growth in concurrent viewers for major live sporting events
  - Tame peak to average variance
    - Reduce capex and opex investment in cache and network capacity
  - Improve viewer quality of experience during peak events
- Network evolution
  - Fully utilize broadcast media capabilities in modern access network architectures (xPON, DOCSIS 3.x, 4G and 5G eMBMS)
- Move to all IP video delivery
  - Consistent OTT content workflow based on standard ABR delivery

High Level Network Flows

Unicast ABR Transport (simplified)

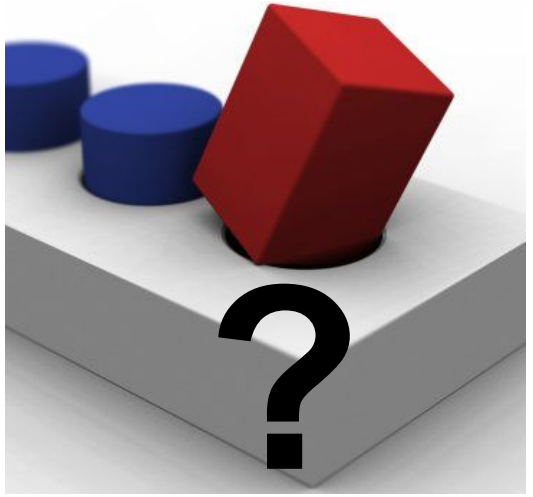


Multicast-Assisted ABR Transport (simplified)



Note: The above focuses on segment delivery. The MABR gateway commonly retrieves manifests directly from the packager/CDN.

Unicast ABR and MABR Comparison



Unicast ABR

- TCP transport
  - Session oriented
  - Flow/congestion control
  - Reliable delivery
- HTTPS/TLS provides privacy and data integrity
- ABR protocol enables switching between bitrate versions

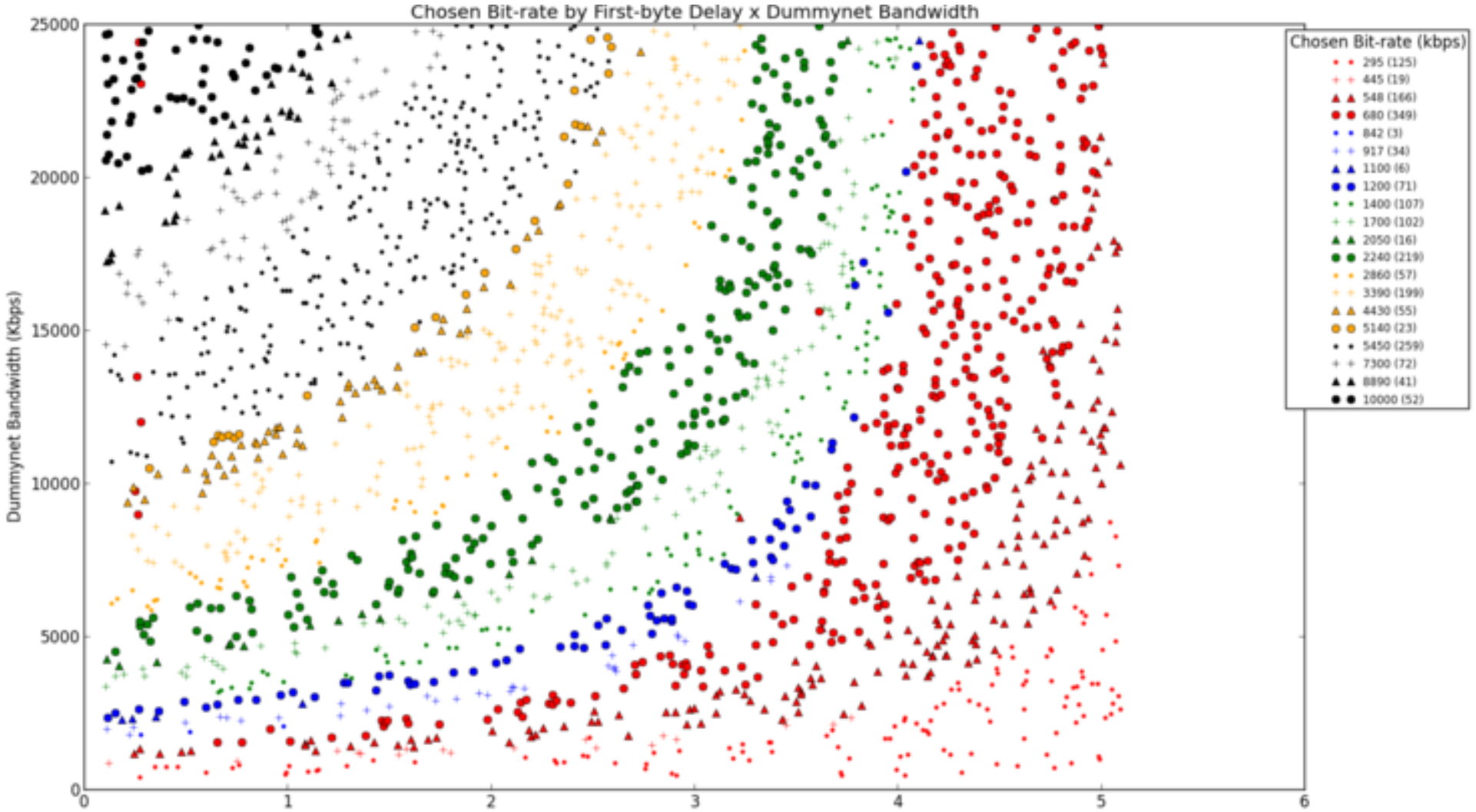
MABR

- UDP transport
  - No per user session
  - No flow/congestion control
  - No reliable delivery
- MABR protocol provides reliable delivery through FEC and unicast repair methods
- Data integrity must be provided by MABR protocol
- Switching may create inefficiencies if all bitrate versions are not available via MABR

Challenges

Managing Player Bitrate Switching

- The player selects ABR bitrates based on estimates of available bandwidth.
  - System must “hint” appropriately to player to lock onto a bitrate delivered over MABR.
- MABR Gateway component primarily responsible for pacing delivery to the player.
- MABR Server may also employ techniques to smooth delivery of segments to the MABR Gateway.



Player Bitrate Selection Example

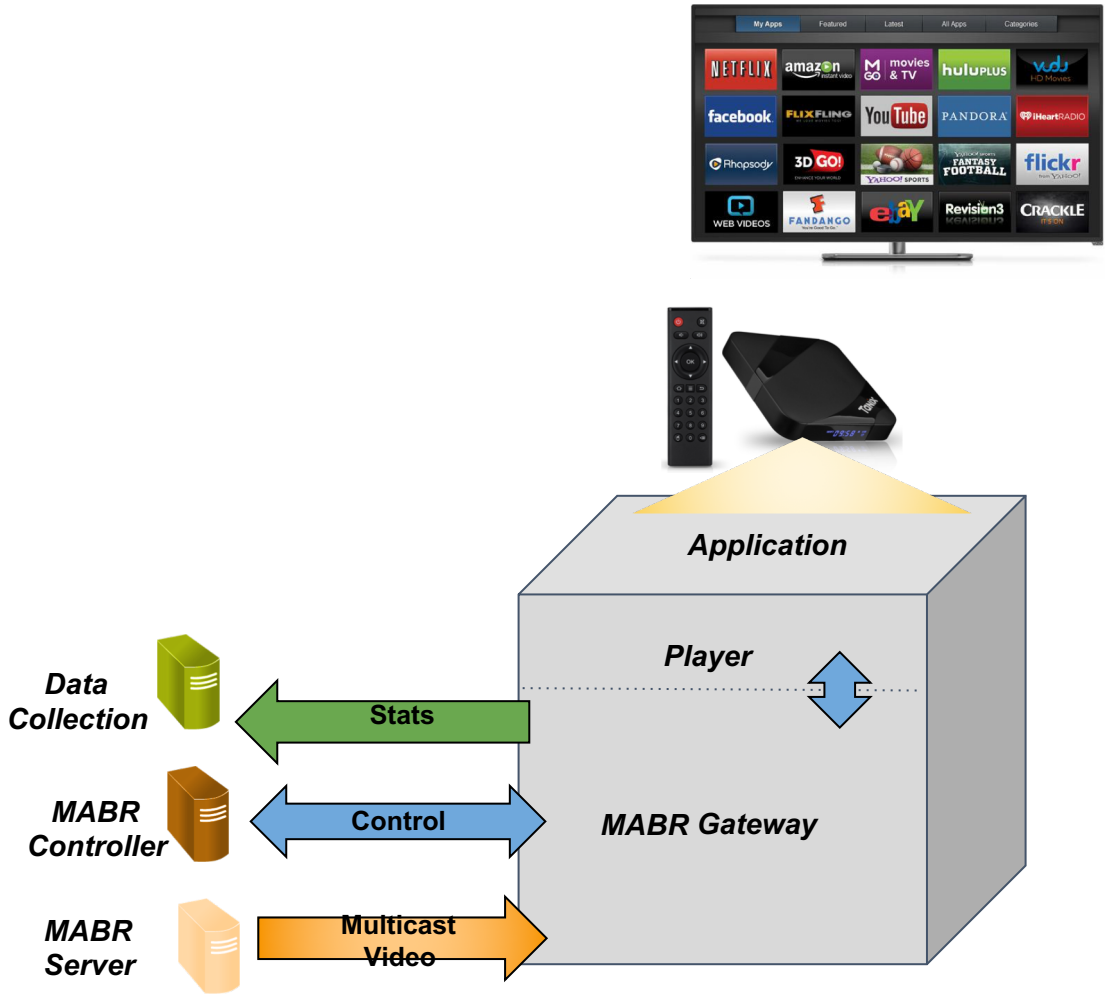
Consistent HTTP Experience

- The MABR protocol must transport media segments and their associated metadata
- The MABR Gateway reconstructs the segments and HTTP headers for consumption by the player
- Some systems may arbitrarily truncate HTTP headers to fit pre-defined payload sizes
  - Potential for interoperability issues, particularly with third-party content

Visibility

- The system must collect data to determine efficiency, performance, quality and content popularity
- For example:
  - Unicast vs. multicast consumption
  - Segments requiring repair
  - Channel and bitrate being consumed
  - Multicast (S, G) information
  - Minimal client identifying information for problem correlation and diagnosis
- Data collection and processing infrastructure must scale with the number of MABR gateways

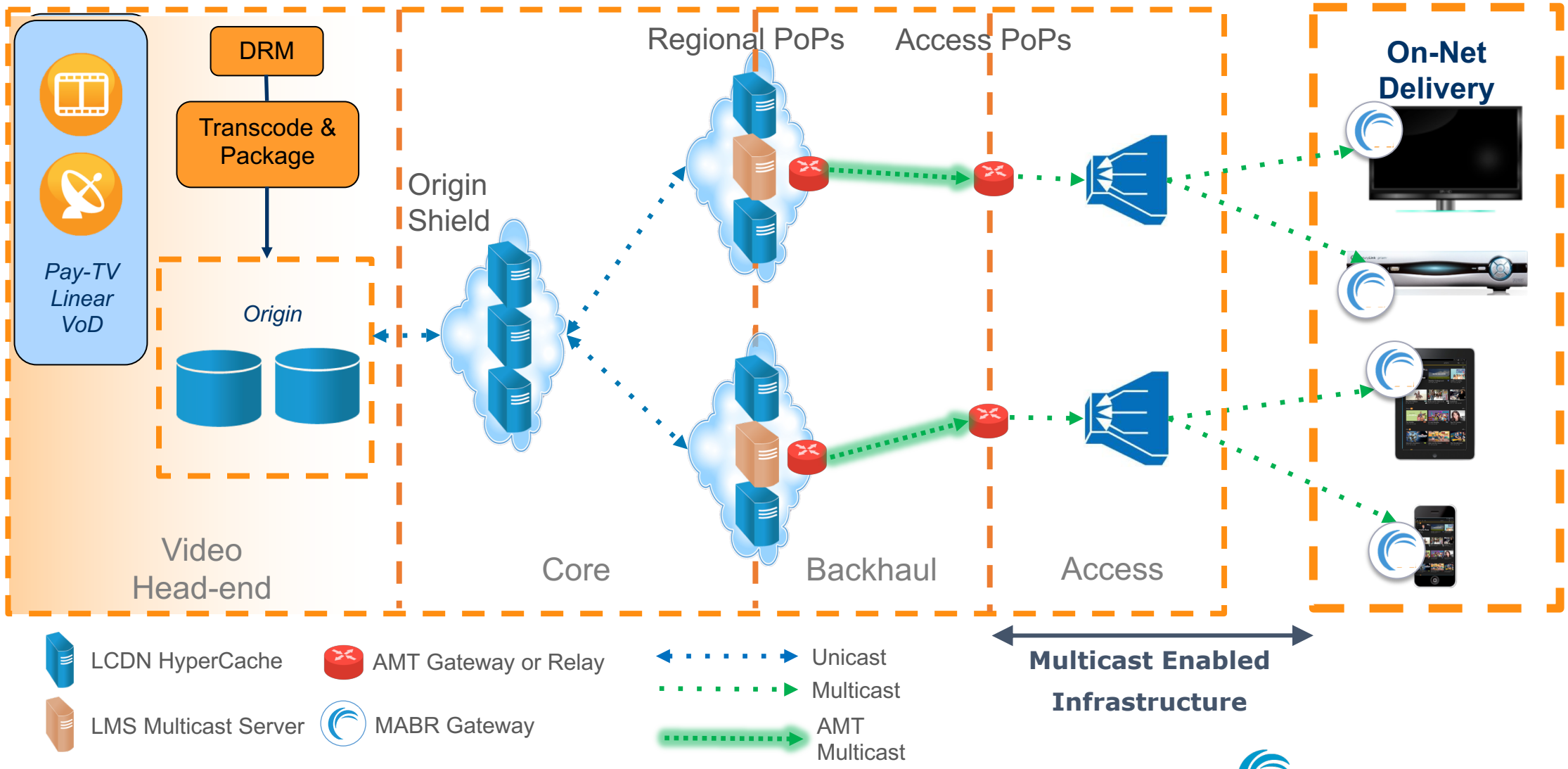
MABR Gateway Integration



Traversing Network Segments that are not Multicast Capable

- Legacy multicast networks required end to end multicast support and often special QoS configuration
- MABR is more flexible; multicast support is only required downstream from the Multicast Server
  - Commonly, the Multicast Server is deployed at the edge of the access network
  - But, what if we want to deploy the Multicast Server higher in the network?
- Multicast tunneling protocols (e.g. Automatic Multicast Tunneling (AMT)) provide a solution

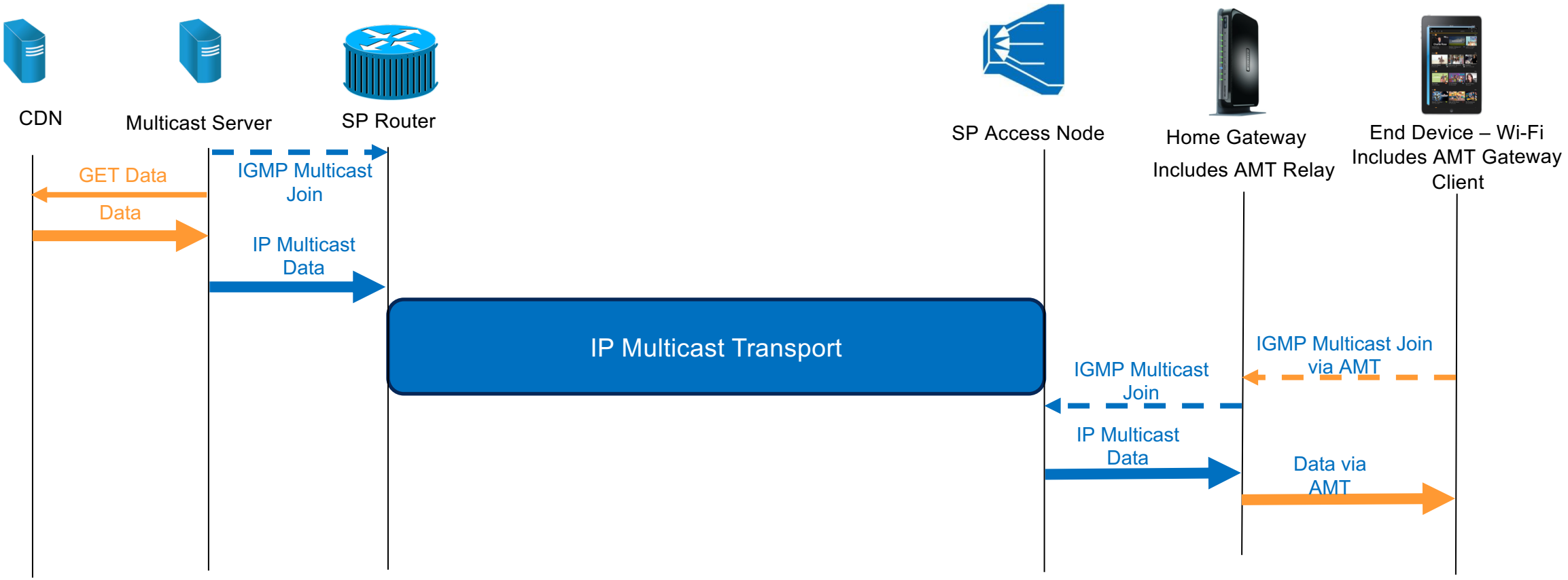
Network Application of AMT



Multicast over Wi-Fi

- MABR Gateway commonly integrated into set-top box (STB) or home gateway
  - Primarily targeted at first screen, but can serve other devices in the home as a shared HTTP cache
    - Requires sufficient hardware resources on the STB/gateway, increasing cost
    - Initial integration and updates can be complex and time consuming
    - Not suitable for delivery of content not owned by the carrier (e.g. true OTT)
- Alternative approach is to enable MABR Gateway to be integrated into the viewing device
  - Utilize app store installation and update model
  - MABR protocol processing off-loaded to the device
  - But, multicast over Wi-Fi is unreliable
- Again, multicast tunneling protocols provide a solution

AMT Relay in CPE

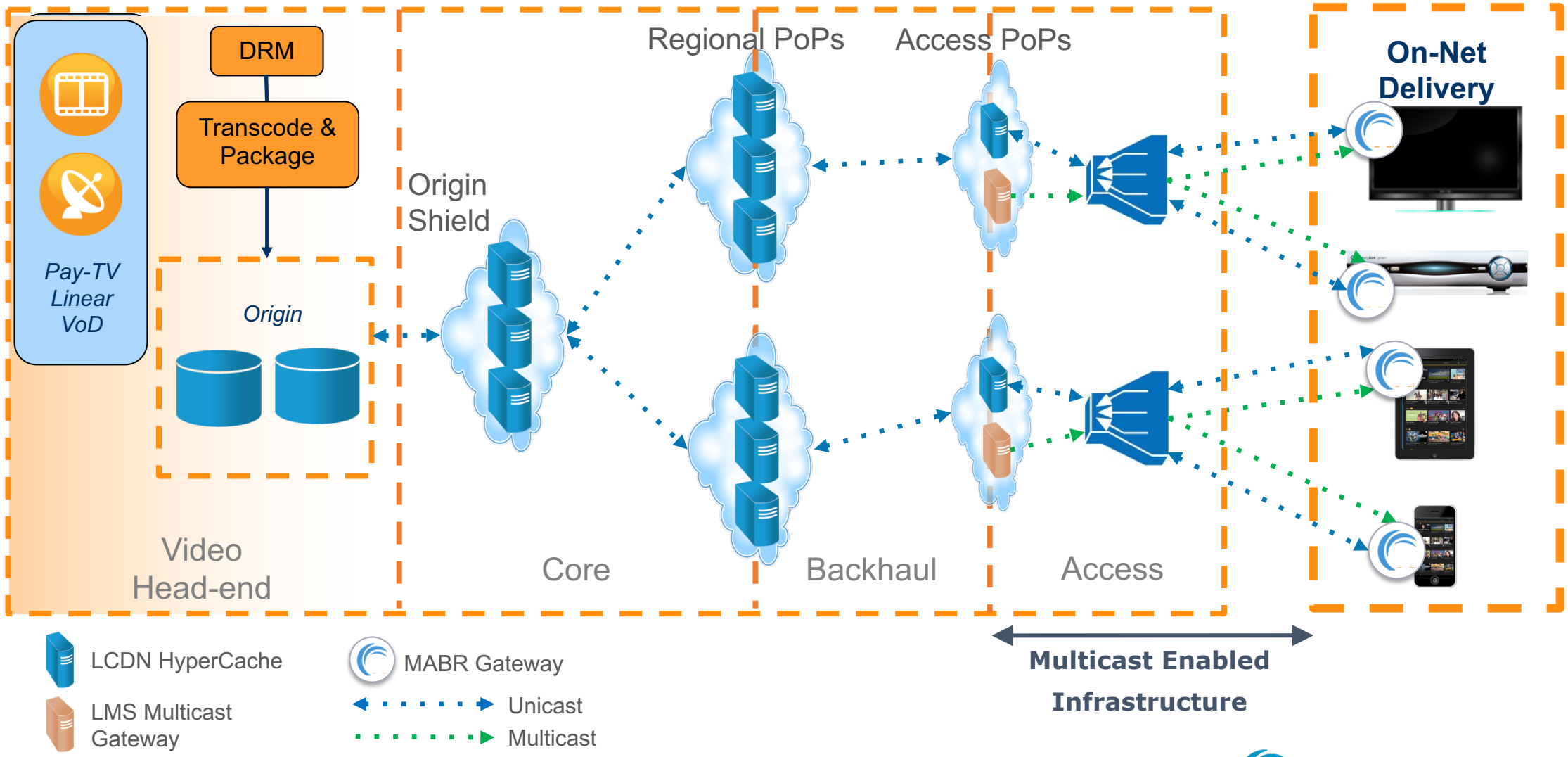


Usage and Experience

Usage and Experience

- Primary application is replacement of legacy multicast or pure unicast delivery for IP TV services.
- Handwave latency results are comparable to legacy multicast services.
  - Further improvements possible with ultra-low latency CMAF

Multicast-Assisted ABR Deployment Example



Akamai Experience the Edge

Summary

Summary

- Multiple factors are driving the need for broadcast efficiencies
- A consistent ABR content workflow across live and VoD services is very attractive
- MABR is challenging
  - But these challenges can and must be addressed to provide scalable and high quality video services now and in the future


Akamai
Experience the Edge

References

- RFC7450 Automatic Multicast Tunneling
- Akamai authored works
  - DNS Reverse IP AMT Discovery (IETF Draft – Standards Track)
  - Asymmetric Manifest Based Integrity (IETF Draft - Experimental)

