MULTICAST AS A MANDATORY STEPPING STONE FOR AN IP VIDEO SERVICE TO THE BIG SCREEN

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Abstract

With the availability of new technology, namely home gateways with 16 or more DS tuners and CCAP platforms, the transition to a managed IP video service is now becoming feasible and cost-effective. The biggest challenge remaining is the bandwidth; especially with the continual growth of high-speed data service leading to constant contention among the services for the limited spectrum resources available.

This paper provides a window into the viewing habits in 2013. We show that linear content is still the number one service with the number of peak time viewers at over 75%. We compare the efficiencies of switched multicast, and unicast (native for ABR delivery) approaches. Furthermore, to give indication of the transition period to a full IP service, we further present the significant benefits of multicast even at small groups of subscribers.

We conclude by introducing a Multicast assisted ABR architecture that offers the benefits of multicast as well as building upon a single infrastructure to enable an IP video service to all devices in and outside the home.

THE TRANSITION TO A MANAGED IP VIDEO SERVICE

An IP Video service is nothing new in the cable space. Over the past few years operators have been offering VOD and linear services to mainly secondary screens. IP Video is yet to be used as the vessel for the primary video service. The motivation to expand IP Video to the big screen is clear – first and foremost it enables CPE cost reduction, eliminating components such as the cable card, and QAM tuners. Transition to IP video also opens the path to leveraging consumer electronics like consoles and Smart TVs without relying on a STB. An additional driver is the opportunity for significant OpEx and CapEx saving by maintaining a single architecture for video service to all devices. A baseline IP Video delivery architecture is depicted in Figure 1.With this architecture, linear channels are transcoded to multiple profiles, segmented, encrypted and pushed to the Origin server. From the Origin server, the segments are distributed via a CDN and made available over HTTP to ABR clients residing on STBs, Smart TVs, consoles, mobile devices, or browsers, where the latter may consume the linear service inside or outside the home, depending on content rights. The ABR client registers with the DRM application server and accesses it to get the keys to decrypt the content.

With the availability of new technology, namely home gateways with 16 or more downstream tuners as well as CCAP platforms, the transition to IP is now becoming feasible and cost-effective. The biggest challenge remaining is the bandwidth. DOCSIS 3.1 is still several years ahead, and so is HEVC. Cost of massive node splits is still significant and proactively replacing all legacy STBs with IP STBs, needed to reclaim the spectrum of QAM Video, is many years away from being an economical solution. Moreover, high-speed data service keeps growing rapidly and is competing with IP video for the limited spectrum resources available.

TRENDS IN CONSUMPTION OF A MANAGED VIDEO SERVICE

We believe today's viewership trends must also apply to IP Video service as the subscriber should be agnostic to the actual delivery scheme. Other trends that may have an impact on viewership, such as nDVR and new, more user friendly UI are not limited to IP Video. Examples are the Cablevision QAM-based nDVR service and the new Xfinity UI launched on the X1 QAM STB.

Looking at viewership information, it is very clear that live linear (consuming linear channels in real-time) service to the STB is still the predominant service by far. Next is DVR viewership also with significant viewership. Finally, VOD, as well as multiscreen, trail with few percentiles or less of the eyeballs.

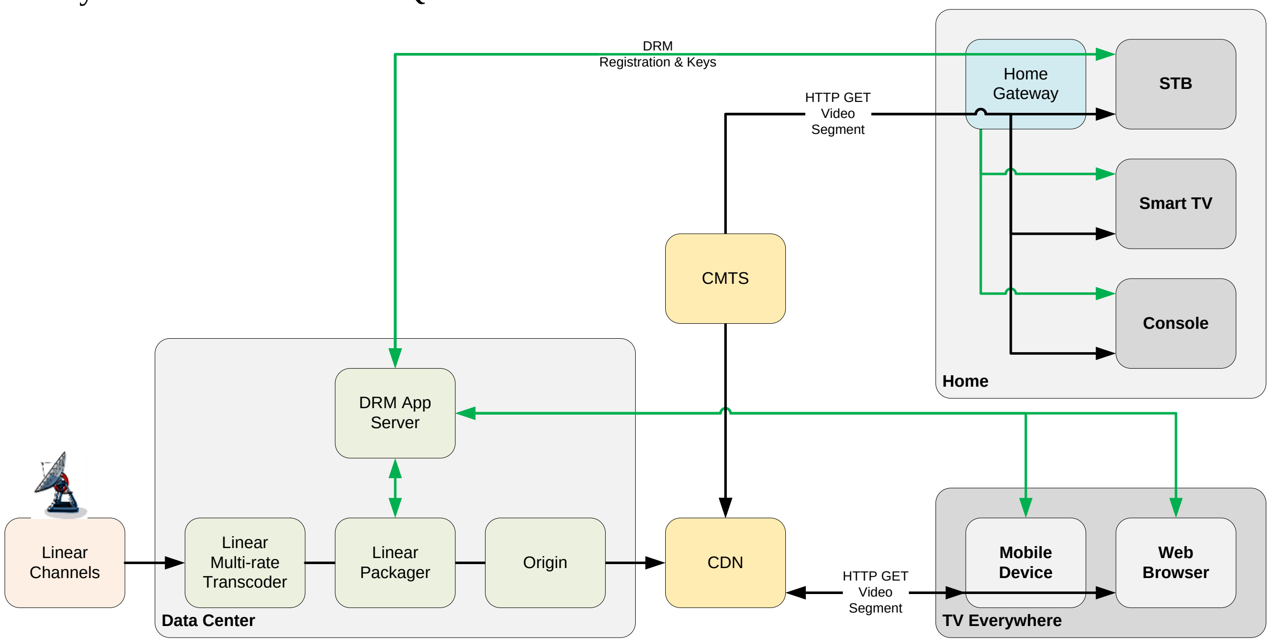

Figure 1 - Baseline IP Video Delivery Architecture

Case Study – Linear vs. DVR trends

Figure 2, Live TV Viewing, provides insight into the two dominant video services in the home, linear and DVR, over a period of a week. The data was collected from 1032 households with a total of 2,386 STBs. Data includes number of viewers (STBs tuned to linear content), number of channels, number of DVR recording sessions, and number of DVR playback sessions.

Multiple key insights become obvious from looking at the data:

1. At peak time (~6-8 PM) almost 60% of the STBs (1.4 STBs / Household) are consuming linear channels.
2. Number of STBs consuming linear channels changes dramatically throughout the day (300-1400), but is very similar between days at a particular time of day.
3. As expected, number of linear channels watched is dramatically lower, at ~300 channels at peak.
4. Number of DVR recording sessions is also very high, at peak time with over 1000 concurrent sessions (the gateway system used to collect this data can support up to six concurrent sessions).
5. DVR recording peaks are correlated with the linear peak with limited recording happening at off-peak hours.
6. Number of concurrent DVR play back sessions is significantly lower than the number of recording sessions and accounts to 9% of the STBs.
7. People are recording much more than they are actually watching

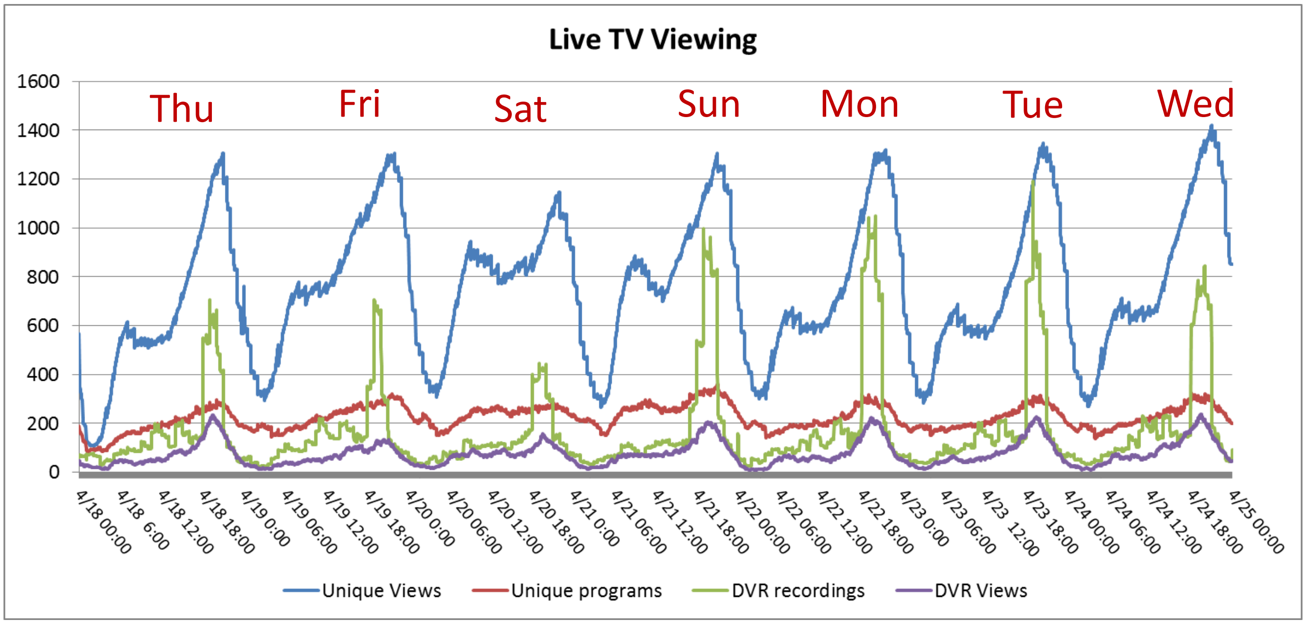

Figure 2 - Live TV Viewing trends

With all these said, the three key takeaways are:

1. Linear is still the king. No other service comes close.
2. The potential advantages of multicast are evident from comparing the unique linear views to the number of unique linear channels (~75% saving).
3. With DVR recording being a dominant factor, a unicast IP video service that doesn't include nDVR is not realistic. This becomes clear from comparing the number of unique linear views plus the number of DVR recording sessions to the number of unique linear channels (~85% saving).

Case Study – Bandwidth Requirements

At the end of the day the benefit of Multicast is to be proven at typical service group sizes. We have thus focused on three typical size, 125, 250, and 500 tuners. These model groups are equivalent to about 35, 70, and 140 subscribers per service group. The motivation was to explore the benefit in a small scale deployment as well as to see the benefit as the linear IP video service ramps up.

We have looked at a viewership data collected over a period of a month from a group of ~27,000 tuners (~20,000 STBs). The lineup consisted of 69 HD and 266 SD channels. We further assumed 6 Mbps for HD and 2 for SD (H.264).

Figure 3 compares the peak number of viewers to the peak number of channels, like the one done in Figure 2, only for smaller service groups. Note that a viewer can be either a STB tuned to a linear channel or a DVR recording a linear channel. For each service group, two data points are included, one representing the highest number of viewers, the seconds representing the largest number of linear channels over the one month period.

In all cases, during peak time, on average 50% of the tuners are tuned to linear channels, with a maximum of 61-67% depending on the service group size. In the 125 tuner service groups, less than 50 channels (40 on average) are watched at peak, less than 90 (average of 63) for the 250 tuner service groups, and less than 120 (average of 40) for the 500 tuner service groups.

Looking at this data and the graph, one can argue that the saving at the 125 tuners SGs will be marginal with an average worst case of 63 viewers and average worst case of 40 channels. This information is misleading as HD and SD channels are not weighted proportional to their respective bitrate. In order to clearly see the value of multicast a true bandwidth comparison is due. This comparison is illustrated at Figure 4, Multicast vs. Unicast Bandwidth requirement.

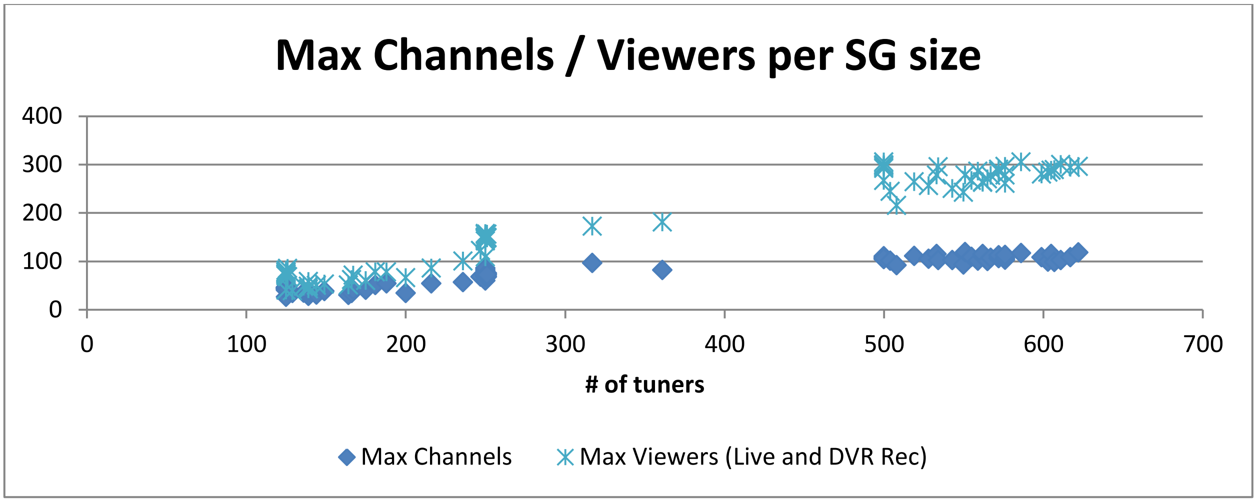

Figure 3 - Max Viewers vs. Max Channels

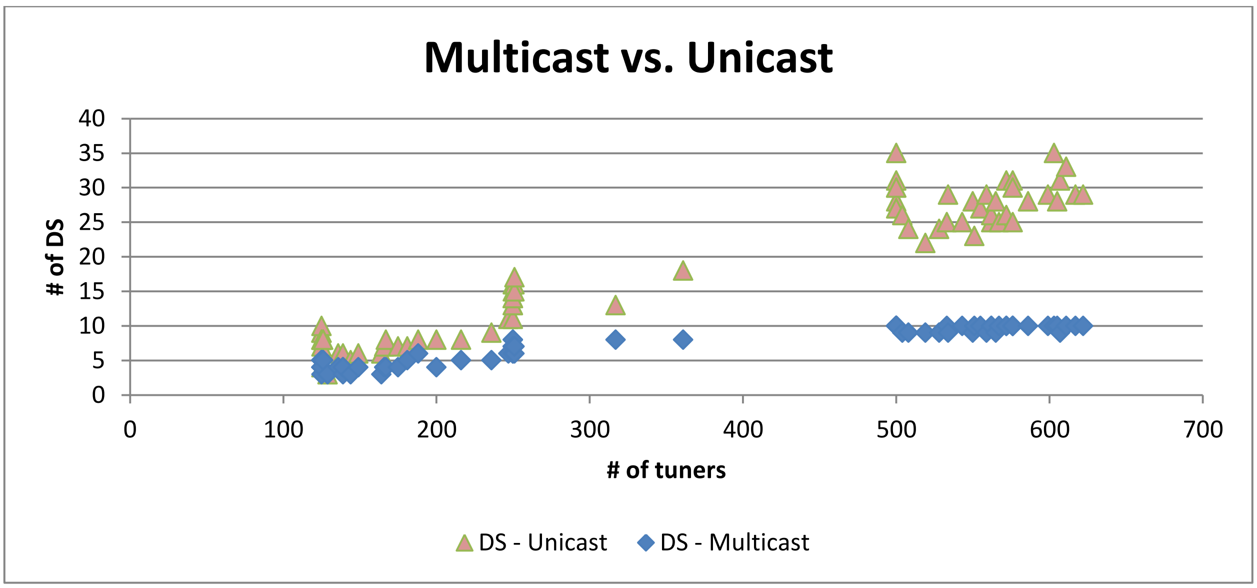

Figure 4 - Multicast vs. Unicast Bandwidth Requirements

For each service group, two data points are included, one representing the highest number of downstream DOCSIS channels needed for a multicast implementation, the second representing the highest number of downstream DOCSIS channels needed for a unicast service. The following table summarizes the worst case per SG size (125, 250 and 500 tuners). As the spectrum allocation across all service groups is the same, the worst case represents actual capacity planning.

# Tuners	Unicast (Max DS)	Multicast (Max DS)
125	10	5
250	17	8
500	35	10

Figure 5 - Linear IP Video Capacity Planning

It is clear that 50% saving on capacity can be achieved even at small service groups of 125 tuners (or ~35 subscribers). The saving grows with the service group size reaching over 70% at 500 tuners (140 subs). Moreover, this data indicates that a basic Linear IP Video service is feasible with a minimal spectrum of 5 to 10 DOCSIS downstream channels. It should be emphasized that actual capacity requirement are highly dependent on the HD take rate. In the case of the data analyzed here the number of SD channels at peak time was roughly 2.5 the number of HD channels. Moreover, other aspects of the solution, like unicast traffic for enabling fast channel change, and targeted ad insertion may dramatically increase the bandwidth requirements, if not addressed effectively.

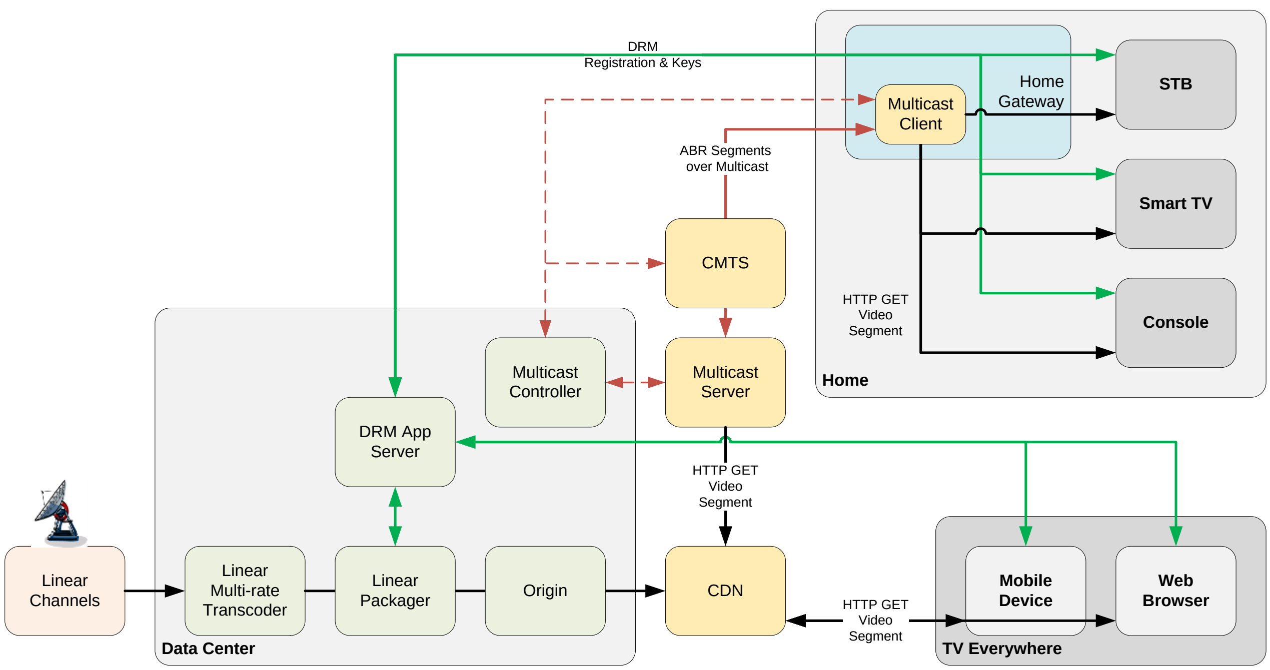

Figure 6 - Multicast Assisted ABR architecture

A MULTICAST ASSISTED ABR ARCHITECTURE

The architecture outlined in Figure 6 achieves both the goal of a unified architecture to reach all devices in and outside the home and the goal of minimizing the bandwidth requirements for a linear IP video service. Three new components are added to the baseline architecture: a Multicast Server, a Multicast Client, and a Multicast Controller. The role of the Multicast Server is to pull new Linear segments as they are made available in the CDN and deliver them over multicast. The Multicast Client serves two roles. It serves as a cache for segments arriving over multicast as well as a transparent proxy for requests coming from the ABR clients. When an ABR client requests a segment, the Multicast Client will intercept the request, check if it can be fulfilled from the cache, and if not, pass it to the CDN. A request for a linear channel segment not already cached in the ABR client can trigger an IGMP join request to the appropriate multicast in order to start filling the cache. As such, in a typical situation, the first few requests for segments will be fulfilled via unicast whereas all following requests would be met by the cache being filled by the multicast. Finally, the Multicast Controller serves multiple roles:

1. Collect viewership reporting from the Multicast Clients
2. Control the lineup being offered via multicast
3. Control the (proactive) caching on the Multicast Clients
4. Control the delivery and caching of ads in the Multicast Client.

Note that the some of the roles of the Multicast Controller are directly aimed at optimizing the Multicast assisted ABR service, and ensuring high efficiency compared to a pure unicast service.

SUMMARY

We have shown that to date linear service is still the predominant method used by subscribers to access MSO video content by far. As such, to offer a linear IP video service, operators should be implementing a Multicast architecture thus saving over 50% of the bandwidth compared to a pure unicast solution. We concluded by introducing a Multicast assisted ABR solution leveraging a common architecture for delivering video to all IP devices.