MIGRATING TO IP VIDEO OVER DOCSIS

THE CHALLENGES, REQUIREMENTS, AND TECHNOLOGIES AT THE FOREFRONT OF CHANGE

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INTRODUCTION

For many service providers, IP video is on the near horizon. But this evolution is not going to happen overnight. Instead, there will likely be a gradual changeover from legacy to IP video, and both delivery types will need to coexist throughout this transition. This creates new challenges for service providers as they contend with limited spectrum resources, the costs of legacy CPE replacement and the phase-in of next-generation features that subscribers demand.

In this whitepaper we explore the migration to IP video, examining the challenges that service providers face, the requirement for a phased spectrum evolution plan and the innovative new technologies that can help smooth this transition. While we focus primarily on HFC-based service providers evolving to IP video over DOCSIS, many of the concepts presented can be applied industry-wide.

TODAY'S SUBSCRIBERS' EXPECT A LOT FROM TOMORROW'S TELEVISION

When it comes to IP video evolution, consumers today expect a continuation of everything they love about the traditional television experience. Today's video lineups often include hundreds of channels, providing almost unlimited choice for subscribers. And when they interact with this content using an electronic program guide (EPG), the response is virtually instantaneous. Service providers have also done well improving the quality of their traditional video services – evolving their offerings from analog to digital and from standard definition to HD while developing the aggregated EPG, search and recommendation capabilities that are the key differentiators for multichannel video program distributors (MVPDs). And today's subscribers expect the improvements to continue, with the coming transition to 4K Ultra HD and the crisp, immersive video programming it brings.

Subscribers are also excited by many of the rich new capabilities that are already available on their favorite Internet streaming services. While the software that runs on today's television set-top boxes sees an upgrade every 18-24 months, interfaces in the streaming world are being updated as frequently as every week. In addition, streaming service providers are targeting content recommendations and advertising to the individual user based on data about their demographics and viewing preferences. And in the streaming world, the experience isn't confined to the living room during prime time. Video is available everywhere, all the time.

As traditional video providers set forth on a migration path to IP video delivery, they must continue to offer the familiar features that their subscribers have grown to love, and the innovative new Internet capabilities they are beginning to crave. These include broad content lineups, responsive navigation, ever-improving video quality, innovative interfaces, extensive personalization and ubiquitous access to their favorite content. But evolving the legacy video delivery infrastructure to meet these requirements in an all-IP world is not so simple.

To make the transition seamless and economically feasible, service providers must chart a course of network evolution that leverages innovative tools and techniques to maximize their existing CPE investments, and makes efficient use of today's finite spectrum resources.

THE SERVICE DELIVERY REALITIES EFFECTING THE IP VIDEO TRANSITION

In order to develop a successful migration path to IP video, service providers must first consider today's realities of video and broadband delivery: there are countless QAM-based set-top boxes deployed in the field - the numbers are still growing - and replacing them all in favor of their IP counterpart is an extremely expensive proposition. Therefore, it is most likely that legacy QAM video and IP video will need to coexist on service provider networks for quite some time. Doing so requires the spectrum allocated to video traffic to be divided between the legacy and IP services, limiting the available bandwidth that can be allocated to each. This is known as the simulcast tax.

Further complicating the situation is the steadily rising demand for broadband throughput. Top-tier residential broadband service rates continue to increase at a 50% annualized growth rate in accordance with Nielsen's Law[1]. Whether this is driven by the increase in streaming video traffic or an escalation of advertised service rates by an increasingly competitive market, many service providers are scaling their broadband capabilities to keep pace with this trend and placing increased requirements on the limited access network spectrum.

DEVELOPING A ROADMAP FOR SUCCESS

In order to meet the expectations that users have for next-generation television while keeping pace with bandwidth demands and considering the simulcast tax, service providers must plan and execute a strategy for success. This means constructing a spectrum transition plan that

accounts for every MHz of space in this finite resource. It also means deploying advanced technologies in each stage of the IP video migration to deliver the best service experience using the least amount of network bandwidth. Finally, by using advanced data collection and analytics, service providers can make well informed decisions that can reduce spectrum requirements significantly during the IP video transition.

Creating a Comprehensive Plan for Spectrum Evolution

Each service provider is well served by developing a spectrum evolution plan that is customized for its subscriber base, the current state of its network and its own service service goals. However, most effective strategies will have one thing in common: the close synchronization between the introduction of next-generation capabilities and the phase-out of legacy services. Figure 1 illustrates a phased approach to spectrum evolution designed to help one service provider maximize efficiency while driving toward the goal of a fully converged IP service environment. It also factors in an upgrade to 1.2 GHz capabilities as part of the service provider's planned infrastructure replacement cycle.

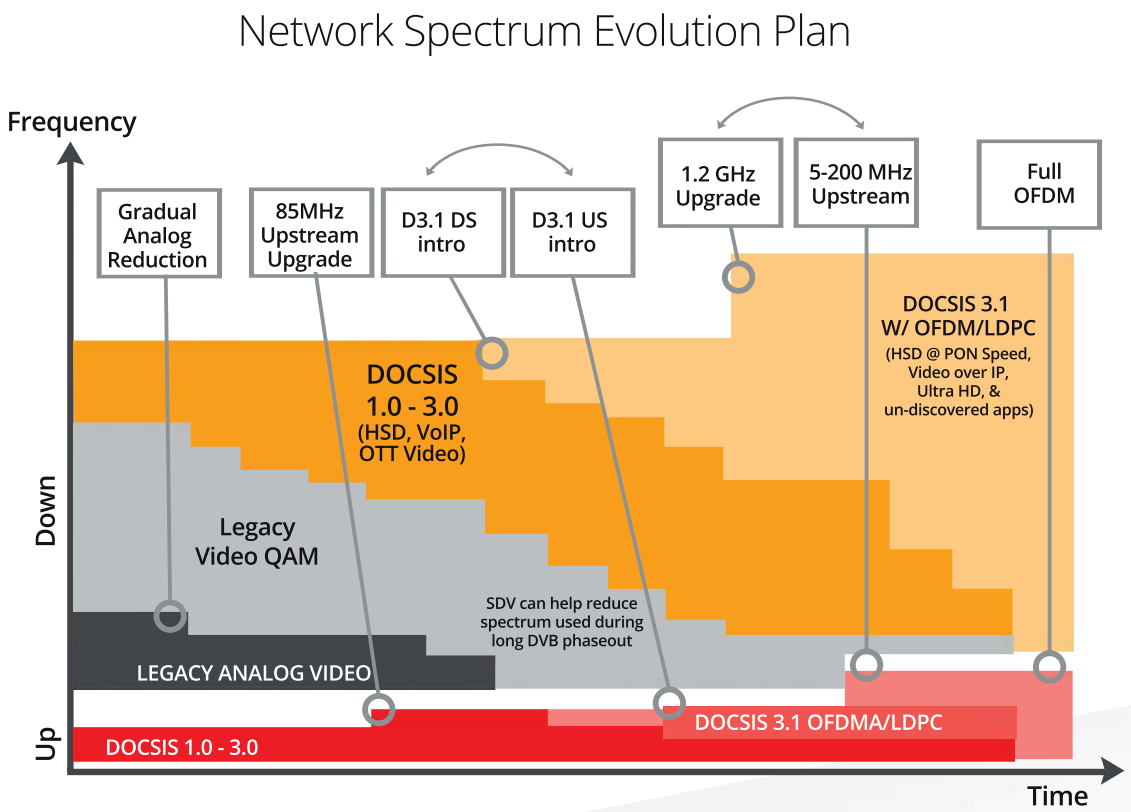

Figure 1: An example spectrum evolution plan for a DOCSIS-based service provider network

Harnessing New Technologies for IP Video Success

To help service providers cope with finite spectrum resources throughout the IP video transition, several new and existing technologies can be utilized. These include advanced broadband specifications, new compression algorithms, innovative video delivery techniques, streaming capabilities from the multiscreen world and a hybrid multicast/unicast model.

DOCSIS 3.1

For HFC-based service providers, DOCSIS 3.1 promises a much more efficient utilization of spectrum than today's DOCSIS 3.0 systems. Using the same amount of spectrum, service providers can transition from delivering eight bits per hertz to 10, 12 or even more. This added bandwidth capacity is critical, not only to meeting increasing broadband requirements, but for enabling IP video delivery over DOCSIS as well.

Advanced Compression Technology

New compression technologies such as HEVC can help deliver today's HD video with up to a 50% bit rate savings[2]. This level of efficiency can help service providers reduce the spectrum requirements for their existing service lineups, or even expand the number of channels they offer. HEVC can also be used to improve the video quality of today's existing lineups, allowing service providers to add new 4K channels with more pixels, color, contrast and motion detail to bolster the subscriber experience.

Switched Digital Video

Switched digital video (SDV) provides a strategic tool to help service providers scale back the amount of spectrum they allocate to legacy QAM channels, without reducing the number of channels available to subscribers. By sending less-frequently watched channels over the network only when a viewer requests them, service providers can achieve a significant bandwidth savings for their legacy broadcasting capabilities.

ABR/VBR

Advanced bit rate (ABR) and variable bit rate (VBR) technologies, which have grown increasingly popular in multiscreen IP video delivery, can also enable service providers to deploy high-quality IP video offerings over today's HFC networks. ABR/VBR technologies allow service providers to achieve significant benefits by aggregating tens or even hundreds of channels together over an IP pipe, and unlocking new bandwidth savings through statistical multiplexing. This can help maintain a high-quality video stream over fully utilized IP networks, minimizing

pixilation, freezing and audio cut-outs even in the face of network congestion. ABR/VBR can also help service providers unify IP video to set-tops with their multiscreen offerings, leveraging the same transcoding resources for both while delivering video efficiently to multiple screen types.

Multicast Assist and Fast Channel Change

Similar to SDV in the legacy domain, a multicast/unicast model allows service providers to minimize the spectrum requirements for IP video while offering an extensive channel lineup. However, many service providers have been concerned about the speed of channel change in this model. With multicast assist, service providers can offer fast channel change capabilities to most subscribers.

By multicasting the most popular channels in the IP video system and unicasting lesser watched channels, service providers can minimize the spectrum requirements for IPTV. And by adding a multicast assist capability, unicast streams can be converted to multicast whenever they are requested in a given network segment. While the first subscriber to tune in to a channel being unicast might experience some delay, any additional subscribers to tune in to that same channel will experience fast channel change. By deploying multicast assist, ARRIS estimates that service providers can improve their network utilization for IP video by up to 50%.

Multicast Assist: How it Works

When an initial unicast request is made by a set-top box, a signal is sent to the multicast server to begin multicasting that channel within its network segment. All home gateways in that segment are then alerted that a new multicast stream is available. For subsequent households tuning in to the multicast stream, the home gateway acts as a multicast to unicast proxy and delivers the channel to the set-top boxes within that home. The result: for all of the follow-on subscribers who tune in to that channel, channel change is virtually instantaneous. ARRIS has tested this capability with its E6000 CER CCAP system, and has documented its capacity to perform more than 300 transactions per second.

Employing Advanced Data Collection and Analysis

While an effective spectrum transition plan and advanced technologies can help ease the migration to IP Video over DOCSIS, the most powerful tool a service provider can deploy might just be the ability to collect and analyze data. By instrumenting their systems across the video delivery environment, service providers can begin to collect actionable information that can help them identify where to allocate their precious spectrum resources. As an example, a recent ARRIS data collection and analysis exercise resulted in several pieces of data that have

the potential to help service providers improve the efficiency of video delivery during the IP video migration.

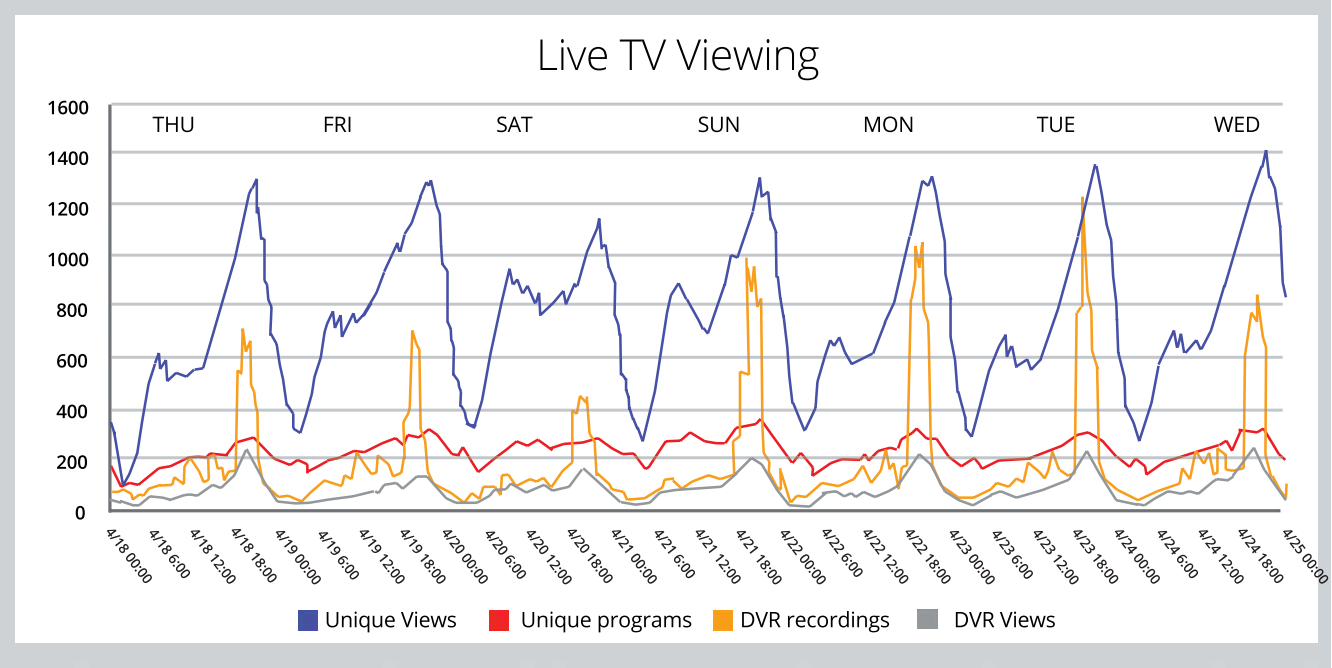

Figure 2: ARRIS data for viewing patterns as measured across 2,386 set-top boxes

Based on information collected and analyzed by ARRIS, as shown in Figure 2, linear TV still dominates during peak viewing times. More than 80% of viewers were found to be watching live TV between 7 PM and 9 PM. By knowing which channels are most popular at a given time based on real user data, service providers can best decide which channels to multicast, and when. ARRIS estimates that a highly-accurate multicast/unicast model can enable a bandwidth savings for service providers of up to 75% during peak times. The ARRIS analysis is summarized in Table 1.

# Tuners	Unicast Downstream Channels	Multicast Downstream Channels
125	10	6
250	17	8
500	35	10

Table 1: Comparing the unicast and multicast channel requirements for video delivery to multiple tuners

A recent ARRIS paper[3] explores the many possibilities that Big Data presents when applied to television delivery. These include new methods for optimizing systems, enhancing subscriber experiences and improving the performance and value of content. Many of these concepts are critical to consider as we create the IP video delivery systems of tomorrow.

CONCLUSION

As our industry continues to evolve to a fully IP-based video delivery model, there are many challenges to overcome. But with a full suite of modern technologies and years of experience at our fingertips, we are well positioned to make this evolution economical and seamless for service providers. This is best achieved by developing a comprehensive spectrum evolution plan and deploying advanced new technologies such as DOCSIS 3.1, HEVC, ABR/VBR and multicast assist.

But beyond the technical aspects of this transition are the real drivers for this change: the subscribers who are craving to communicate and connect with content in new ways. As we build a bridge to the service delivery environment of tomorrow, we can benefit significantly by putting end customers first and ensuring we are constantly improving their experiences along the way. From Gigabit broadband speeds to ultra-high definition video, we must continue to bring subscribers what's next, even though the next phase of network evolution is just beginning.

RELATED READING

To learn more about the strategies that are guiding the evolution to DOCSIS 3.1, please read the ARRIS white paper:
"Managing the Evolution to DOCSIS 3.1: Operational Considerations for a Smooth Transition."

MEET OUR EXPERT: Cornel Ciocirlan

Meet Cornel Ciocirlan, Chief Technologist, EMEA at ARRIS. For 18 years, Cornel has brought his vision, confidence and expertise to work, helping service providers across Europe, the Middle East and Africa evolve their networks to deliver the service experiences of tomorrow. He's pioneered new technologies that are bringing users and the cloud closer together, making the multiscreen world a reality and helping pave the way to an all IP world. Cornel has studied Mathematics & Computer Science at Bucharest University in Romania.

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