WHITEPAPER

Reclaim Bandwidth and Drive DOCSIS Upgrades with ABR Delivery to the Edge

Learn how using new ABR receiver technology is helping operators move necessary network overhauls forward

About the Authors

Sharen Sandhu
VP Product

With over 15 years of product management experience, Sharen Sandhu is VP of Product at WISI America, where she leads product strategy and marketing. Sharen has played a key role in launching new solutions designed to effectively process video at the edge, while ensuring carrier-grade quality, operational efficiency, and a world-class user experience.

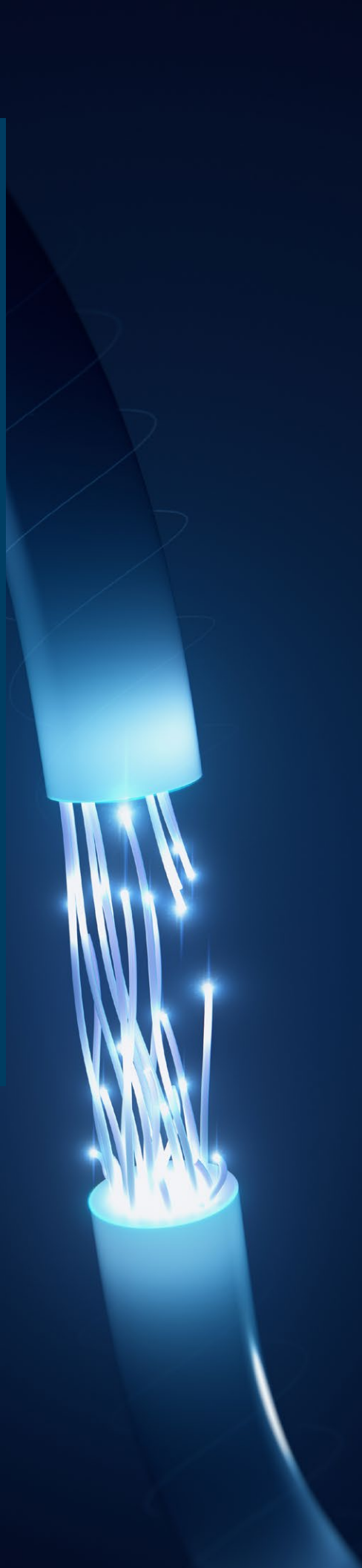
Sharen began her career in software development, before turning her focus to product management. She holds a B.Sc. degree in Mathematics and Computer Science from the University of British Columbia, and a M.Sc. degree in Design and Digital Media from the University of Edinburgh.

Rosalinda Thorleifson
Marketing Manager

With extensive marketing experience and a strong foundation in sales, Rosalinda Thorleifson drives campaigns and product launches that align with customer needs and market demands. She has been instrumental in building WISI's brand presence and successfully rolling out key product launches across North America.

Rosalinda holds a B.A. in Communications and Media Studies from Simon Fraser University.

TABLE OF CONTENTS



Glossary

ABR (Adaptive Bitrate) Streaming: A video streaming technology that dynamically adjusts video quality by selecting an alternative video profile based on available bandwidth and device capabilities to ensure a smooth viewing experience.

ABR (Adaptive Bitrate) Reception: Also called ABR Receive, this involves receiving an MPEG-DASH or HLS video profile over the Internet and converting it into an MPEG Transport Stream for distribution over IPTV, QAM, or analog networks. Unlike traditional ABR streaming, which dynamically adjusts video quality based on network conditions, ABR Reception devices are typically deployed in fixed-bandwidth environments and do not support this adaptive capability.

DRM (Digital Rights Management): Technology used to control how digital content is used and distributed, with the primary goal being to prevent unauthorized reproduction and distribution and to enforce content usage rights specified by the provider.

Encryption: The process of scrambling the content so that only authorized users and devices can access it, often used in DRM systems.

Edge Deployment: A deployment model where the video format is converted closer to end devices, typically at edge sites or regional distribution points. Edge sites typically include hospitality locations like hotels, stadiums, apartments, and hospitals.

High-Split Capabilities: Expands upstream bandwidth in DOCSIS networks by shifting the frequency split, enabling faster upload speeds and better performance for modern applications.

IP (Internet Protocol): In the context of content delivery, the method of digitally converting and transmitting video as data packets over managed or unmanaged networks.

IPTV (Internet Protocol Television): Tightly managed delivery of video content using Internet Protocol (IP) networks. Widely deployed in subscriber-based telecommunications networks to deliver live channels and video-on-demand through broadband connections instead of traditional cable or satellite.

OTT (Over-The-Top): A streaming service delivered directly to viewers via a high-speed Internet connection, bypassing traditional broadcast, cable, or satellite TV platforms. These services typically use Adaptive Bitrate (ABR) technologies and include models such as Subscription Video on Demand (SVOD), Advertising Video on Demand (AVOD), and Free Ad-Supported Streaming TV (FAST).

Pay-TV: Any type of paid video service, including cable, satellite, IPTV, and OTT.

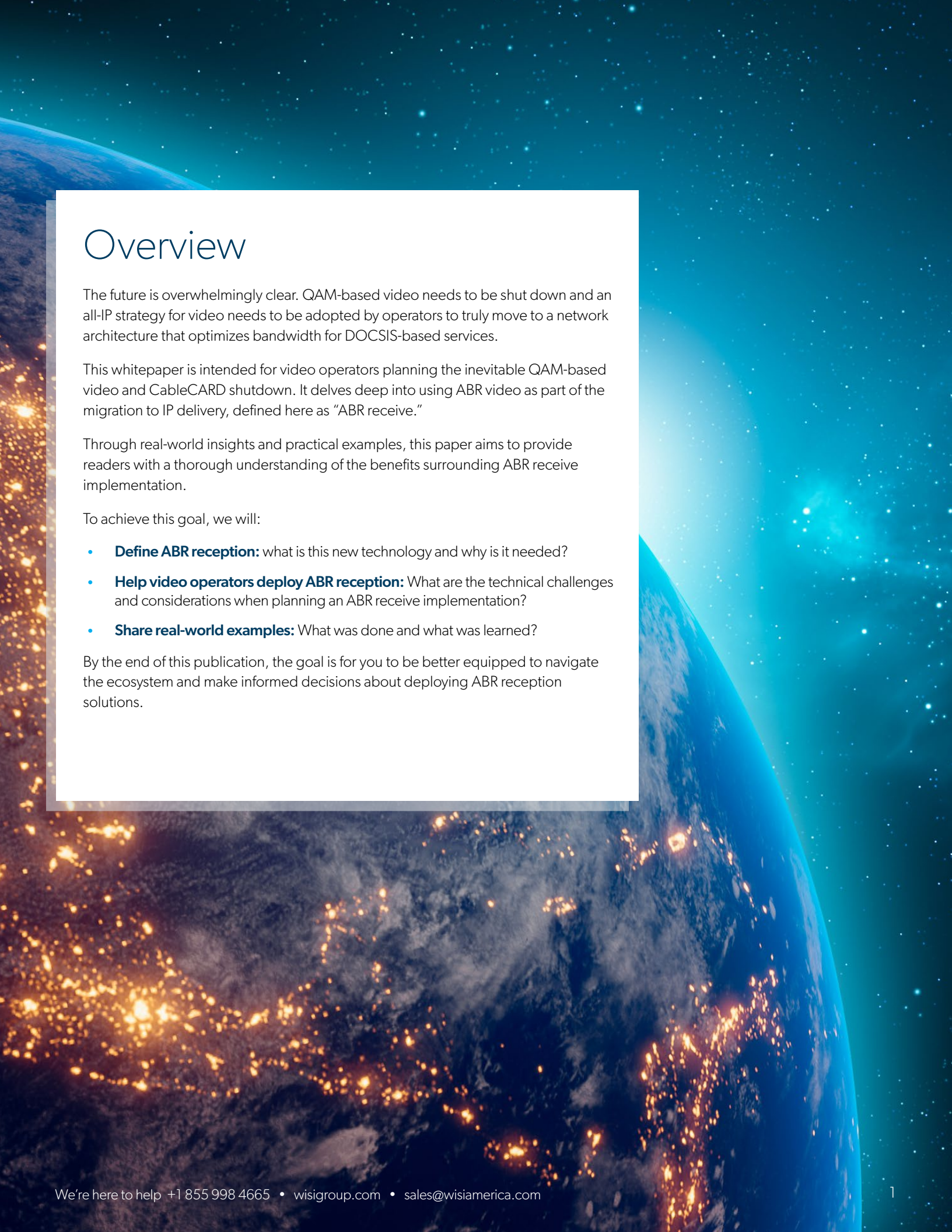
QAM (Quadrature Amplitude Modulation): QAM is an RF modulation scheme used to transmit digital signals over coaxial cable. In this paper, QAM applies in two ways:

1. Video QAMs between headend and edge sites – Operators use QAM to distribute digital video across their network, typically from a centralized headend to edge locations for further processing or conversion.
2. QAM delivery within a property – Once at the site, QAM is used to modulate digital video onto an RF carrier for delivery to end devices, such as set-top boxes and TVs, over coaxial cable.

Both applications rely on QAM modulation, but the first focuses on transport within an operator's network, while the second ensures signal delivery to viewers within a property.

Transcoding: Converting video streams for distribution over target video networks, typically changing the codec and bitrate to match network infrastructure and device capabilities.

Trusted Execution Environment (TEE): A secure area of a processor that executes code while ensuring content is protected.



Overview

The future is overwhelmingly clear. QAM-based video needs to be shut down and an all-IP strategy for video needs to be adopted by operators to truly move to a network architecture that optimizes bandwidth for DOCSIS-based services.

This whitepaper is intended for video operators planning the inevitable QAM-based video and CableCARD shutdown. It delves deep into using ABR video as part of the migration to IP delivery, defined here as "ABR receive."

Through real-world insights and practical examples, this paper aims to provide readers with a thorough understanding of the benefits surrounding ABR receive implementation.

To achieve this goal, we will:

- **Define ABR reception:** what is this new technology and why is it needed?
- **Help video operators deploy ABR reception:** What are the technical challenges and considerations when planning an ABR receive implementation?
- **Share real-world examples:** What was done and what was learned?

By the end of this publication, the goal is for you to be better equipped to navigate the ecosystem and make informed decisions about deploying ABR reception solutions.

I. Introduction to ABR Receive

Why is ABR receive needed?

ABR reception, also called ABR Receive or ABR to QAM/IP, is a game-changer for video delivery to hospitality customers.

By deploying ABR Receive solutions, operators achieve several key benefits:

1. Reclaimed bandwidth for DOCSIS-based upgrades by migrating to an all-IP video delivery
2. Reduced risk by removing the need for video QAM delivery between headend and edge sites
3. Maintain existing infrastructure and CPE devices due to flexible output options
4. Opportunity to expand services and deliver video to more modernized locations
5. Simplified workflows by repurposing the same video streams for both residential and hospitality customers

Reclaim Bandwidth

Operators such as Mediacom, and Cox Communications[1] are moving to all-IP video services as part of their DOCSIS 4.0 transition and are open about the benefits: increased DOCSIS bandwidth for high-speed Internet services, simplified networks with the consolidation to IP, reduced headend complexity, and the elimination of legacy CableCARD.

To further simplify and optimize video delivery networks, the use of ABR streams should be considered along with this transition to IP. While planning DOCSIS upgrades and a migration to IP video delivery, why not also repurpose ABR streams used for residential networks for other customer segments? More specifically, when it comes to edge sites, such as hospitality and business accounts, operators could use ABR-based video segments to deliver Pay-TV services to these locations.

Using ABR video not only assists with migrating to an all-IP video network for bandwidth reclamation, but it can also lead to a more flexible way to support the edge.

Stop Delivering Video to Edge Sites Using QAM

Operators that continue to use QAM to deliver video services between the headend and edge sites face several challenges:

- **High-risk legacy equipment:** Many operators still rely on end-of-support and end-of-life legacy equipment like CableCARD gateway devices at hospitality sites. These are QAM to QAM or QAM to analog units that receive video QAMs, bulk decrypt using CableCARD technology, and then output QAM or analog at the edge location. CableCARD is now considered an obsolete cable-TV standard, and maintaining CableCARD equipment in the field is high risk. Should one of these gateway devices fail in the field, it might not be possible to replace it, risking a complete outage at that site.
- **Stalled network upgrades:** Using video QAM delivery is holding back operators from migrating to new architectures and upgraded DOCSIS networks. The only way to achieve high-split capabilities is for operators to let go of legacy video QAM spectrums and migrate to all-IP.
- **Missed revenue opportunity:** Using video QAMs to deliver content to the edge uses large amounts of bandwidth, which also leads to lost revenue. An operator transitioning from traditional QAMs to using IP or ABR to deliver content to hospitality sites will greatly reduce bandwidth usage. The reclaimed spectrum can be used for selling additional data services, increases revenue, and is a more profitable source of revenue than video.

To reduce risk and overcome these challenges, operators are recommended to move towards IP delivery between headend and edge sites. It is important to note, however, that edge sites may maintain QAM delivery within the property. Charter chief financial officer Jessica Fischer said, "QAM video is going to be with us for a long time."[2] To support existing infrastructure within the building, Operators need to continue offering QAM solutions to business customers for the unforeseeable future. When network migrations to IP delivery are complete, legacy CableCARD products at the property site can be replaced with IP to QAM or ABR to QAM solutions that can ingest IP/ABR streams and deliver QAM outputs.

---

[1] *https://www.nexttv.com/news/qam-dont-spirit-mediacom-follows-wow-in-moving-linear-video-off-its-cable-network*

[2] *https://www.nexttv.com/news/charters-jessica-fischer-xumo-stream-box-wont-replace-the-traditional-world-box-set-top-anytime-soon*

Add Flexibility at the Edge

Freeing up valuable spectrum is the primary driver when deploying ABR receive applications, and having a variety of deployment options at the edge is an attractive side effect.

With ABR video delivery to hospitality locations, operators can:

- Use existing edge site infrastructure and maintain current customer-premise equipment (CPE)
- Upgrade property sites to receive newer formats
- Serve new, modernized ABR-ready property sites

Many hospitality customers, constrained by tight budgets, cannot practically upgrade in-room equipment. As a result, maintaining current infrastructure is often the only feasible option. However, it's important to note that with ABR delivery to the location, future upgrades are streamlined. The hospitality property is already receiving modernized streams, so it can easily upgrade CPE devices when budgets and operational plans allow it.

Additionally, ABR delivery to the edge can achieve new revenue streams. Having Pay-TV services delivered as ABR streams opens the door to serving new, previously unattainable hospitality locations with more modern networks and CPE devices.

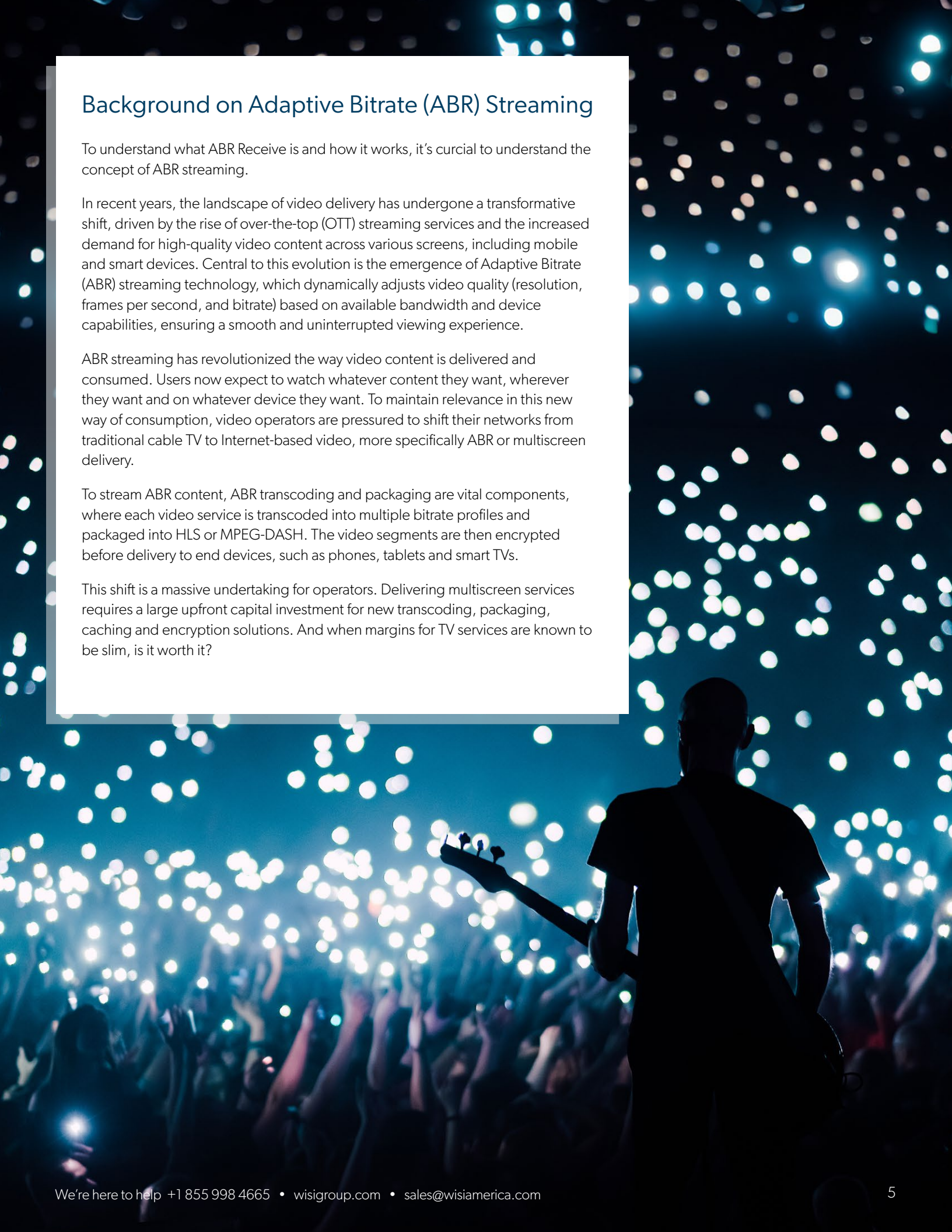
ABR reception truly tackles the full spectrum—with ABR video, operators ensure that current customers are continually supported and existing services are maintained, but they can also unlock new business and generate new revenue streams.

Eliminate Duplication of Efforts

Without ABR receivers, video operators who have migrated to use multiscreen delivery for residential customers are forced to process content twice:

1. **Once for residential networks:** Video streams ingested into the central headend are transcoded into ABR profiles and packaged into HLS and MPEG-DASH for delivery to multiscreen devices at residential sites.
2. **Again for business customers:** The same video streams are also processed, often transcoded to MPEG-2, and delivered as MPEG transport stream to feed hospitality and business locations that use linear QAM and analog.

Going through two different workflows to feed different types of subscriber networks is costly, wasteful and can be an operational nightmare for headend resources. Video content is flowing from the headend to various networks multiple times in multiple formats, which consumes a considerable amount of bandwidth. In this modern world, bandwidth is high-value real estate and is more profitable for operators when used for data and broadband services. Operators want to use as little bandwidth as possible when delivering Pay-TV services, particularly to hospitality locations where margins for video services are typically low.



Background on Adaptive Bitrate (ABR) Streaming

To understand what ABR Receive is and how it works, it's curcial to understand the concept of ABR streaming.

In recent years, the landscape of video delivery has undergone a transformative shift, driven by the rise of over-the-top (OTT) streaming services and the increased demand for high-quality video content across various screens, including mobile and smart devices. Central to this evolution is the emergence of Adaptive Bitrate (ABR) streaming technology, which dynamically adjusts video quality (resolution, frames per second, and bitrate) based on available bandwidth and device capabilities, ensuring a smooth and uninterrupted viewing experience.

ABR streaming has revolutionized the way video content is delivered and consumed. Users now expect to watch whatever content they want, wherever they want and on whatever device they want. To maintain relevance in this new way of consumption, video operators are pressured to shift their networks from traditional cable TV to Internet-based video, more specifically ABR or multiscreen delivery.

To stream ABR content, ABR transcoding and packaging are vital components, where each video service is transcoded into multiple bitrate profiles and packaged into HLS or MPEG-DASH. The video segments are then encrypted before delivery to end devices, such as phones, tablets and smart TVs.

This shift is a massive undertaking for operators. Delivering multiscreen services requires a large upfront capital investment for new transcoding, packaging, caching and encryption solutions. And when margins for TV services are known to be slim, is it worth it?

Operators find themselves at a critical crossroads with two primary options:

- Launch a new multiscreen Pay-TV service that can be viewed on smart devices alongside OTT streaming services to maintain as much of their current customer base as possible. This can be done by managing all the required video processing equipment on-premise, in the operator's headend, or by partnering with a 3rd party hosted platform that delivers Pay-TV content in ABR format.
- Stop offering a Pay-TV service altogether. There are operators choosing this path. Some are recommending that subscribers purchase a streaming solution with linear TV content, such as Sling TV, YouTube TV or Hulu, to continue watching news and sports.[3]

For operators that are maintaining their TV services, most want to ensure that the latest and greatest video technologies are offered to residential consumers first and foremost. Residential customers can be fickle and will easily switch services to another operator or even cut the cord completely if they're not happy with the quality, cost or performance of their Pay-TV service. Additionally, it's typically not a challenge for residential customers to consume content delivered in ABR or multiscreen formats. It's common for residential customers to have broadband and WiFi enabled in their homes. These customers tend to own smart TVs or have streaming devices such as Apple TVs, Amazon Fire Sticks, or modern set-top boxes that support HLS or MPEG-DASH streams.

This is not often the case at hospitality locations such as hotels, hospitals, nursing homes, etc., where coaxial cable is part of the building infrastructure. At these sites, the in-room devices support linear TV as QAM or analog-based signals. Migrating to ABR delivery requires upgrading or replacing the TVs and/or set-top boxes in all the rooms, which can be a very costly and operationally disruptive process.

This is why ABR reception is needed.

---

[3]https://www.streamtvinsider.com/video/mybundle-ceo-hundreds-cable-operators-drop-traditional-pay-tv-coming-years

Enter ABR Receiver

So, what exactly is ABR Receive or an ABR Receiver?

An ABR receiver is a device that receives adaptive bitrate (ABR) streams, usually HLS or MPEG-DASH, and converts them into a format compatible with traditional linear cable TV, typically IPTV, QAM, or analog, to serve hospitality locations.

ABR Receiver can be used primarily in two ways:

- Operators can deliver ABR streams directly to edge sites over IP networks, including the Internet. At the property, an ABR receiver converts ABR streams to transport streams and then outputs IP, QAM or analog to support existing devices.
- Operators can convert ABR streams to IP multicast at a central site and deliver multicast video streams to edge sites. At the edge site, the IP video streams are delievered as is or are converted to QAM or analog to support existing in-room devices.

An ABR Receiver is the optimal solution to allow operators to deliver modernized ABR content to residential subscribers, while also allowing business customers to maintain existing infrastructure.

WISI Promotion

Deploy ABR Receive with WISI

WISI is proud to offer the first-to-market Professional ABR Receiver. Re-purpose ABR video streams from multiscreen deployments and convert them to IP transport stream for IPTV services or to QAM or analog for hospitality networks. The ABR Receiver allows video operators to connect multiscreen Pay-TV offerings to the edge and maintain existing infrastructure at hospitality sites.

Benefits include:

- Eliminate duplication in the headend – use the same ABR streams for business accounts that continue to serve linear workflows
- Continue to provide secure end-to-end content protection with ABR bulk decryption capabilities
- Launch a trusted video platform, deploy with TiVo Managed IPTV Service, Innovative Systems, Minerva Networks and Cryptoguard video services.
- Provide synchronized screens from ABR sources in venues like sports bars and stadiums

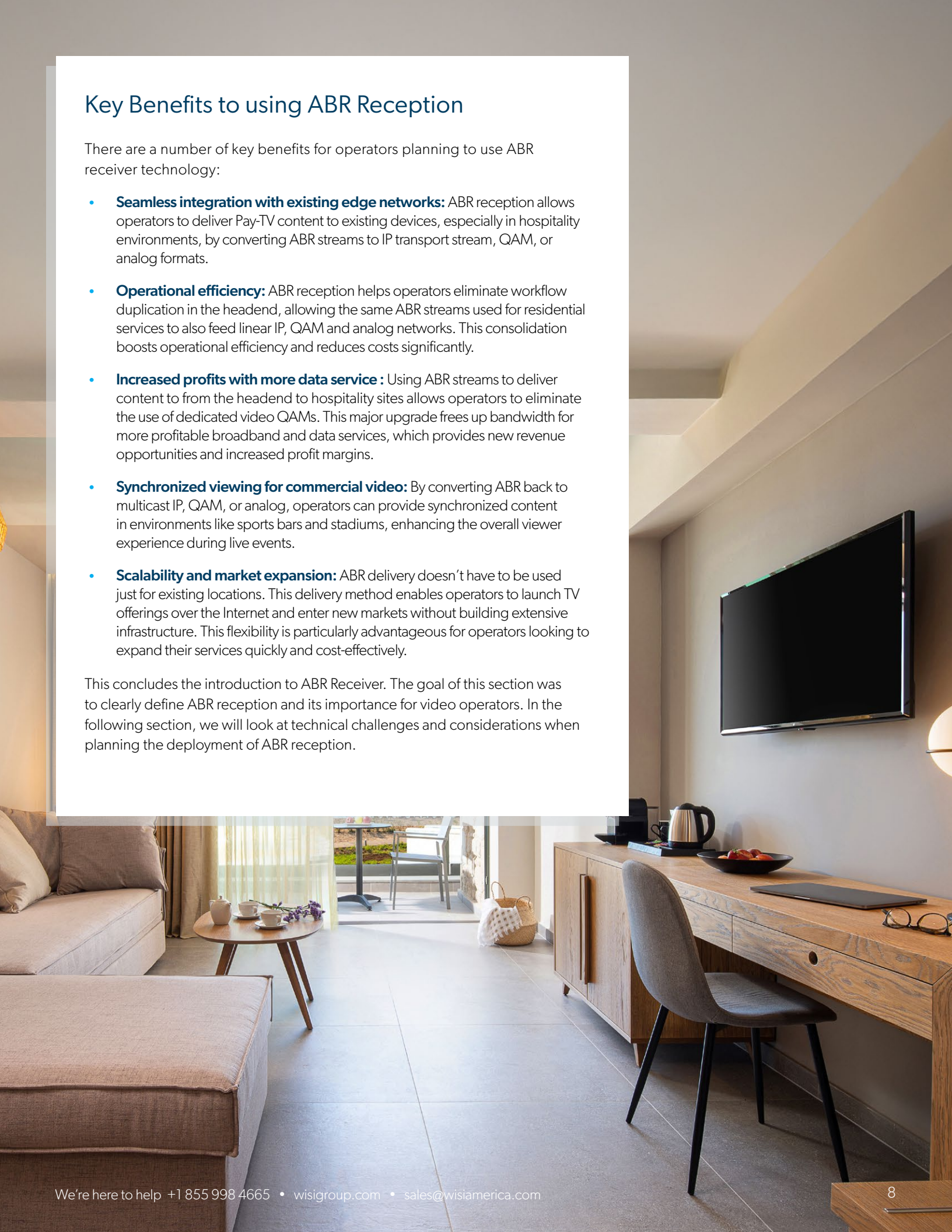
View the Solutions Page

Key Benefits to using ABR Reception

There are a number of key benefits for operators planning to use ABR receiver technology:

- **Seamless integration with existing edge networks:** ABR reception allows operators to deliver Pay-TV content to existing devices, especially in hospitality environments, by converting ABR streams to IP transport stream, QAM, or analog formats.
- **Operational efficiency:** ABR reception helps operators eliminate workflow duplication in the headend, allowing the same ABR streams used for residential services to also feed linear IP, QAM and analog networks. This consolidation boosts operational efficiency and reduces costs significantly.
- **Increased profits with more data service :** Using ABR streams to deliver content to from the headend to hospitality sites allows operators to eliminate the use of dedicated video QAMs. This major upgrade frees up bandwidth for more profitable broadband and data services, which provides new revenue opportunities and increased profit margins.
- **Synchronized viewing for commercial video:** By converting ABR back to multicast IP, QAM, or analog, operators can provide synchronized content in environments like sports bars and stadiums, enhancing the overall viewer experience during live events.
- **Scalability and market expansion:** ABR delivery doesn't have to be used just for existing locations. This delivery method enables operators to launch TV offerings over the Internet and enter new markets without building extensive infrastructure. This flexibility is particularly advantageous for operators looking to expand their services quickly and cost-effectively.

This concludes the introduction to ABR Receiver. The goal of this section was to clearly define ABR reception and its importance for video operators. In the following section, we will look at technical challenges and considerations when planning the deployment of ABR reception.



II. Technical Considerations

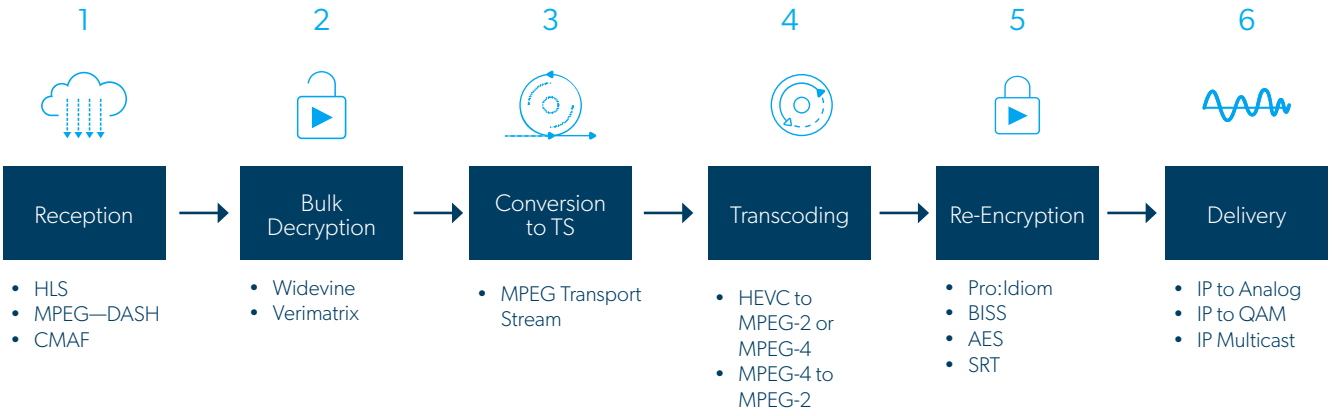
In this section, we delve into the technical challenges and considerations when planning the deployment of ABR Receiver. The purpose of this section is to help operators make informed decisions when faced with various options available for ABR receive solutions.

The key areas explored are:

- **ABR receive workflow:** A high-level introduction to the technical stages within the ABR receive application.
- **Deployment options:** An examination of the various methods employed to deliver ABR content efficiently, including centralized and edge deployment models.
- **ABR protocols:** A detailed overview of the communication protocols that facilitate seamless content delivery, including CMAF, HLS, and DASH, along with their respective advantages and implementation considerations.
- **Content security:** A discussion on the encryption techniques and Digital Rights Management (DRM) providers, such as Widevine, Verimatrix, and Fairplay, used to ensure content security and compliance with industry standards.
- **Management and monitoring:** Insights into the tools and best practices for managing and monitoring ABR Receiver systems to maintain optimal performance and security.

ABR Receive Workflow

There are six key stages within the ABR receive workflow:



WISI Promotion

Using an Innovative Systems Solution?

WISI has an exciting new partnership with Innovative Systems. This collaboration integrates Innovative Systems' technology with WISI's ABR Receiver, and helps operators streamline operations, reduce headend equipment, and ensure a seamless entertainment experience for business accounts.

This new integration enables operators, who utilize Innovative Systems' middleware and packaging solutions, to efficiently serve IP multicast or QAM sites.

View the Solutions Page

Not all stages are required, as the workflow depends on the requirements of each edge site.

Here is an overview of each stage:

1. Reception

ABR audio and video streams are received as HLS, MPEG-DASH, or CMAF segments from content delivery networks (CDNs) or directly from hosted or content providers. The ABR Receiver selects specific ABR profiles for the audio and video streams and downloads them segment by segment.

2. Bulk Decryption

Encryption protocols used for ABR streams cannot be reused for linear TV delivery. Therefore, the ABR streams must be bulk decrypted when received and can then be re-encrypted into a format used at the hospitality location. For example, one common application is for Widevine to be bulk decrypted from ingested MPEG-DASH streams, and then before the IP or QAM streams are output from the ABR Receiver, they are re-encrypted with Pro: Idiom, a common encryption standard for hospitality TVs.

3. Convert to Transport Stream

The video and audio segments are converted to MPEG Transport Stream, a specific digital format used for TV signal delivery. The video streams are typically MPEG-4 but could also be HEVC, and the audio streams are typically AAC. At this stage, the streams are digital IP and each video service is a Single Program Transport Stream or SPTS.

4. Transcoding (Optional)

Video streams may be transcoded to a format suitable for distribution, such as converting MPEG-4 or HEVC to MPEG-2 for end devices that only support MPEG-2.

Audio may also be transcoded from AAC to Dolby AC-3 or MPEG-Audio, if AAC is not supported by the location-specific TVs or Customer Premise Equipment (CPEs).

5. Re-Encryption (Optional)

Ensuring end-to-end encryption is paramount to protect the content all the way to the end device. Linear content for cable TV systems uses encryption protocols different from ABR streams. This means that operators usually must re-encrypt the video content into a format used for IP or QAM delivery. Encryption is not required at sites using analog signals.

6. QAM/Analog Delivery

For operators not using IP format delivery, the transport streams are modulated onto RF carriers using QAM or analog.

For QAM networks, the streams may be multiplexed into Multiple Program Transport Streams (MPTS) so that each QAM delivers several services.

Deployment Options

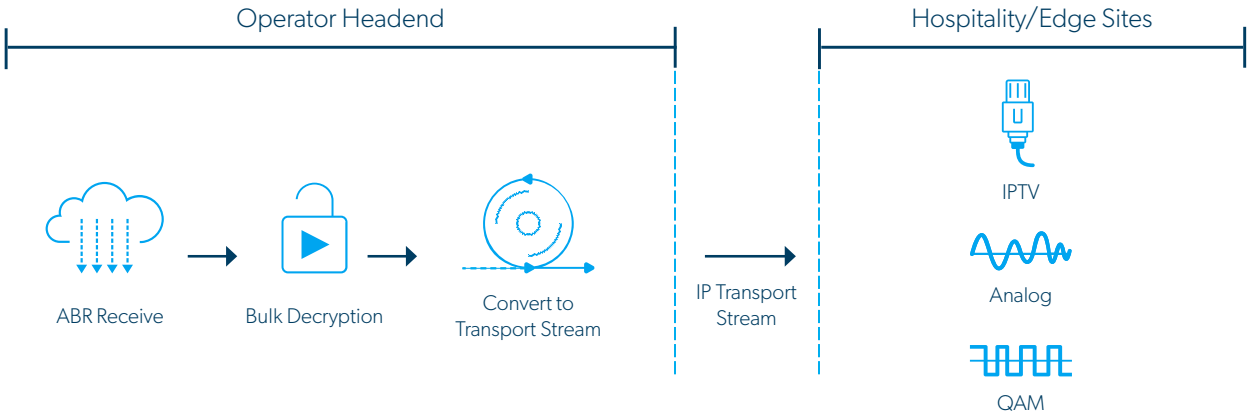
An operator can deploy ABR reception in two primary ways: centralized or at the edge. Both methods have advantages and key considerations that are important to take into account when planning an ABR reception project. One method might work well for one operator but not another, as network topologies, priorities, content line-ups, and budgets differ.

Centralized Deployment

In a centralized deployment model, ABR conversion occurs at one or more central locations, typically the operator's headend sites.

At the central location, video services are typically received as ABR streams from a hosted provider. Hosted providers deliver video content as multiple bitrate profiles to various video operators, who in turn deliver the content to their subscribers.

An ABR receiver located at a central location converts the ABR streams to IP transport stream for delivery to edge sites, including hospitality and business accounts. At each of the edge sites, video streams received as IP transport stream can then be processed according to site-specific requirements. The content can remain as IP for IPTV deployments or can be converted to RF signals using IP to QAM or IP to analog. Content protection between the headend and edge properties is possible with a wide range of standard, IP-based encryption protocols such as Pro:Idiom, BISS, AES, or SRT (Secure Reliable Transport). Bulk decryption of the IP streams might be required at each edge site unless in-room devices are able to decrypt the selected protocol.

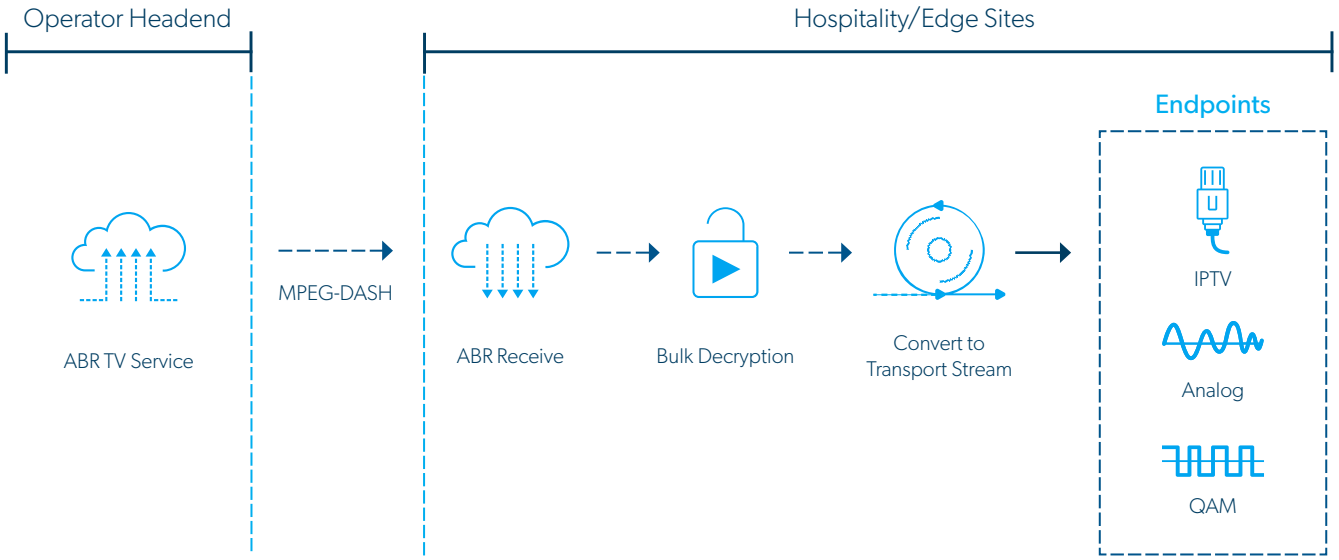


Key advantages:

- ✓ **Flexibility at the edge:** Edge sites can deploy IP to QAM or IP to analog units, which are standard video solutions offered by various vendors. If the edge site supports IPTV services, no additional processing is required.
- ✓ **Capitalize on existing assets:** Edge sites might have existing equipment that can be repurposed to receive IP streams and output QAM or analog. In this case, capital expenditure is reduced as only the central ABR receive units need to be added.

Edge Deployment:

In an edge deployment model, ABR conversion takes place closer to the end devices, typically at edge sites or regional distribution points. ABR streams are received and converted into linear formats near the network edge before being distributed to local subscribers.



Key advantages:

- ✓ **Standardize at the edge:** Equipment deployed at hospitality sites can more easily be standardized on a single vendor solution with an edge deployment model. The solution selected by the vendor should have output options to allow for IP, analog or QAM delivery.
- ✓ **Centralized management and monitoring:** If using a single vendor solution at the edge, it's more likely that a centralized management and monitoring solution can be implemented using APIs. This allows for bulk provisioning, firmware updates or license upgrades from a central location.
- ✓ **Reduced processing units:** Taking ABR streams all the way to the edge requires less video processing equipment compared to a centralized model. With a centralized ABR receive deployment, streams are converted to transport stream at the headend, or at central locations, and then formatted to QAM or analog at the edge. With an edge deployment, the ABR streams can be converted straight to QAM or analog at the property site. There is one less processing step which can reduce the overall number of units to manage.

Transcoding to MPEG-2

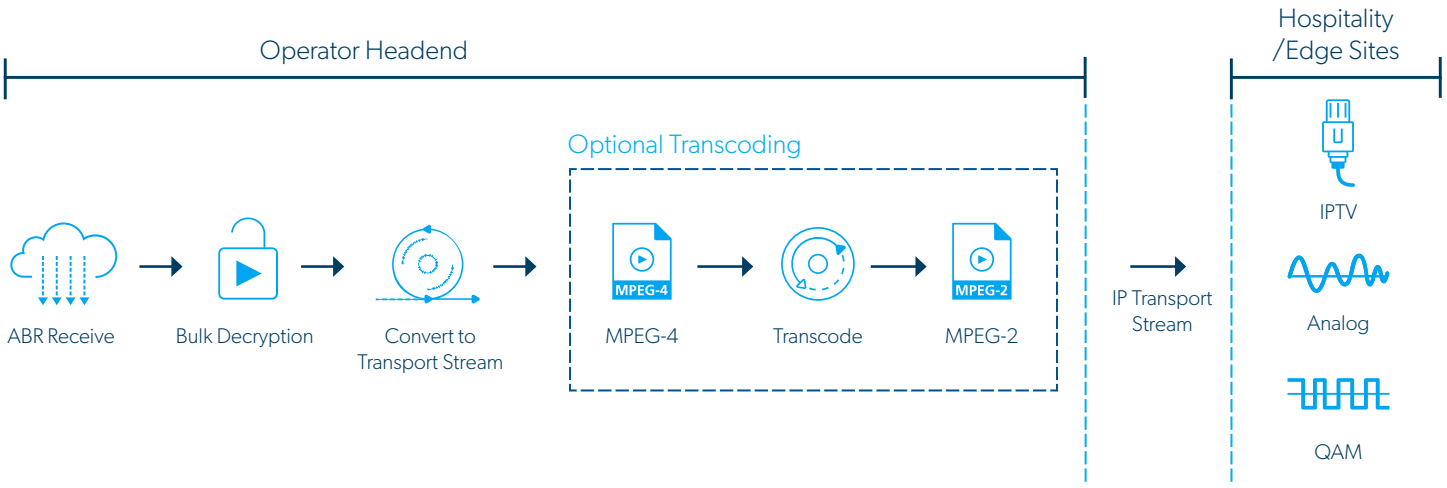
Many hospitality locations, such as hotels, nursing homes, hospitals and motels, still require MPEG-2 video services as their end devices are not MPEG-4 or HEVC compatible. Operators are often not even sure how many of their business customers require MPEG-2 and don't know how to find out. This isn't only an issue with legacy equipment. New hospitality TVs continue to be deployed in North America that only support MPEG-2 video when using coaxial cable.

When migrating from video QAM delivery to IP delivery, either as transport stream or ABR streams, a big consideration is how to continue serving MPEG-2 locations.

Here are some of those key advantages and considerations when planning how to serve MPEG-2 sites:

Transcode Centrally

Operators that choose to transcode centrally will receive ABR at a central headend and transcode to MPEG-2 at that location before delivering IP transport stream to edge sites.



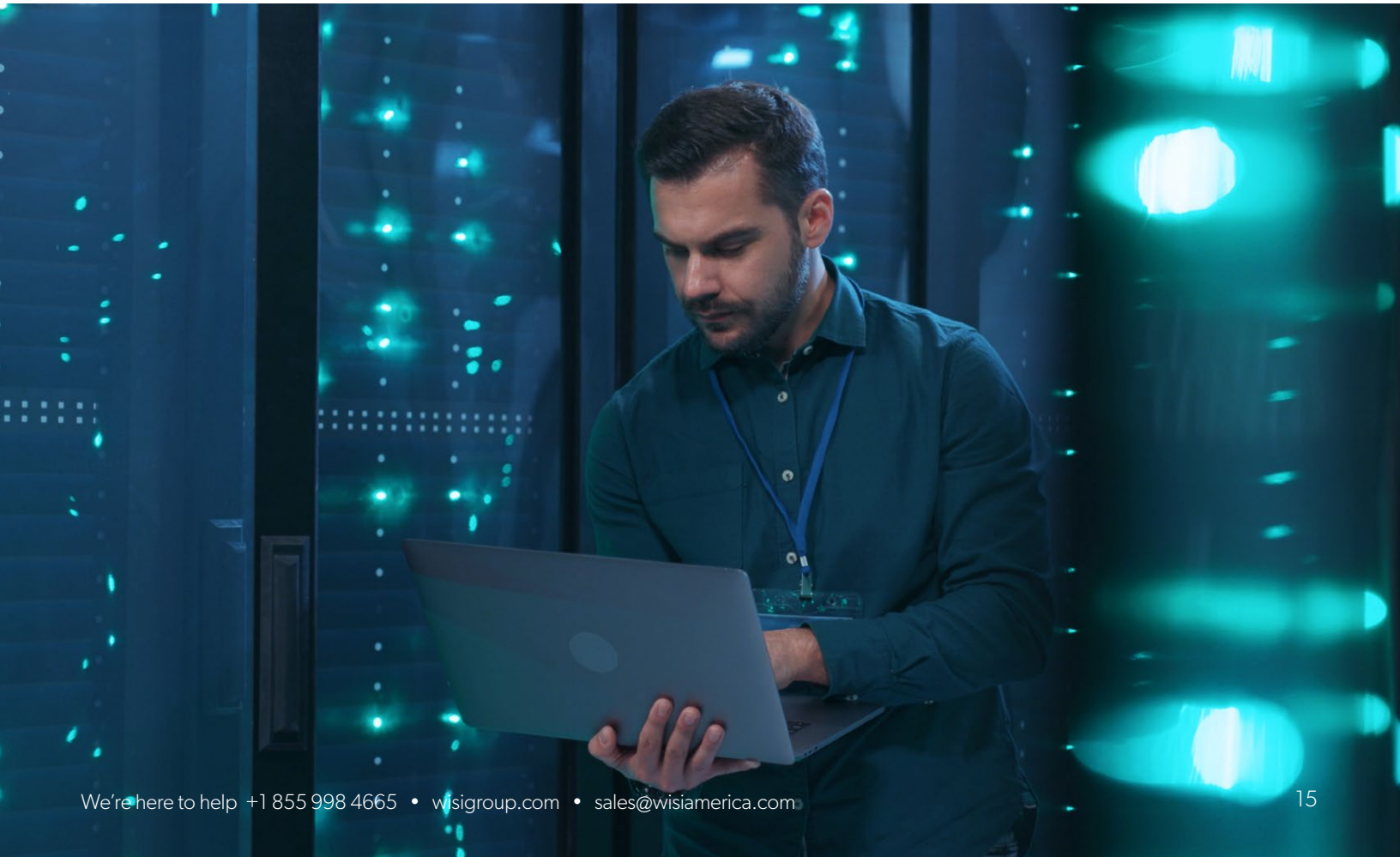
Key advantages:

✓ **Minimize equipment to manage:** Transcode to MPEG-2 at the same central locations where ABR receive units are deployed. Transcoding once at a central location is more efficient and requires less equipment than transcoding at edge properties. For further efficiency, is it possible to receive ABR and transcode in the same unit?

Considerations

- **Increased bandwidth:** Edge sites will typically require either MPEG-4 or MPEG-2, depending on CPE devices installed. Operators transcoding centrally might have to deliver both MPEG-4 and MPEG-2 to the edge
- **Difficult to track usage:** Delivering both MPEG-2 and MPEG-4 outputs from the headend makes it difficult to monitor which streams are being used. As hospitality sites gradually upgrade, operators may lack visibility into when MPEG-2 usage drops to minimal levels. At that point, the cost of maintaining MPEG-2 streams could outweigh the revenue generated from remaining MPEG-2 sites.

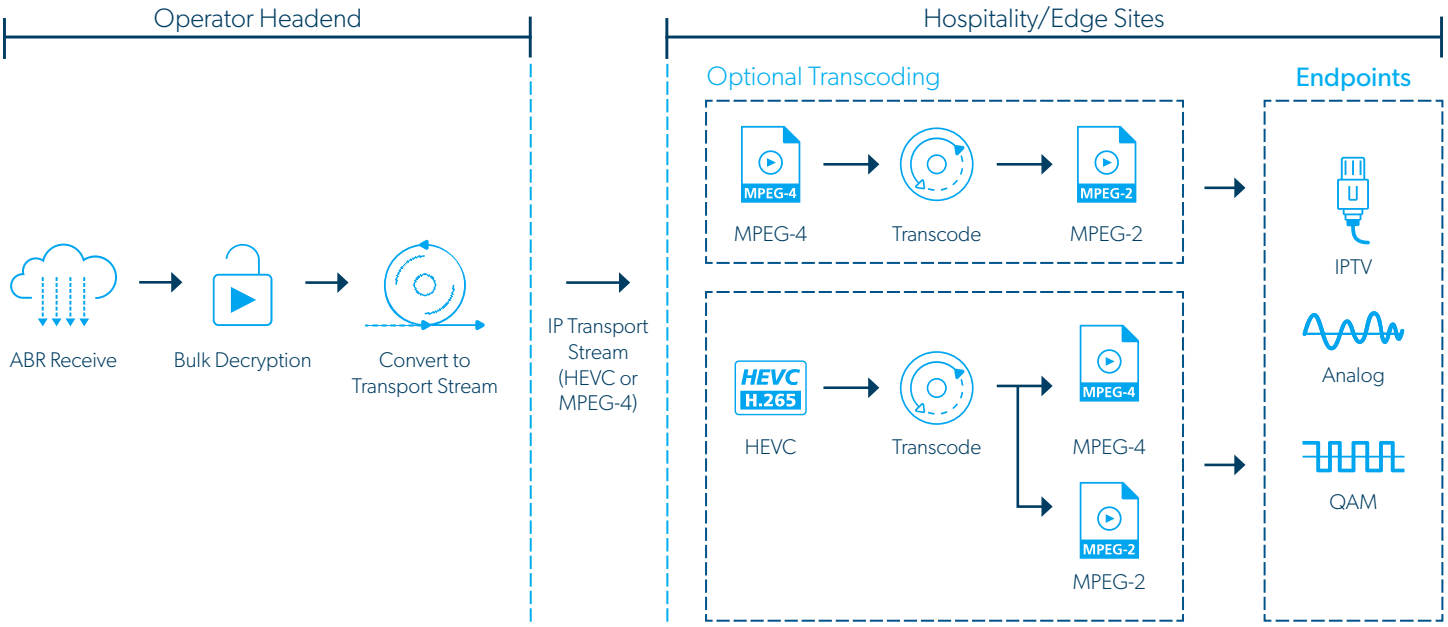
When receiving ABR at the edge, transcoding centrally is not applicable. MPEG-DASH and HLS streams are delivered using the MPEG-4 and HEVC codecs. It is not possible to transcode to MPEG-2 centrally and deliver the MPEG-2 codec as an ABR stream. Therefore, when considering ABR reception deployments at the edge, the operator must also understand the potential cost of transcoding at the edge.



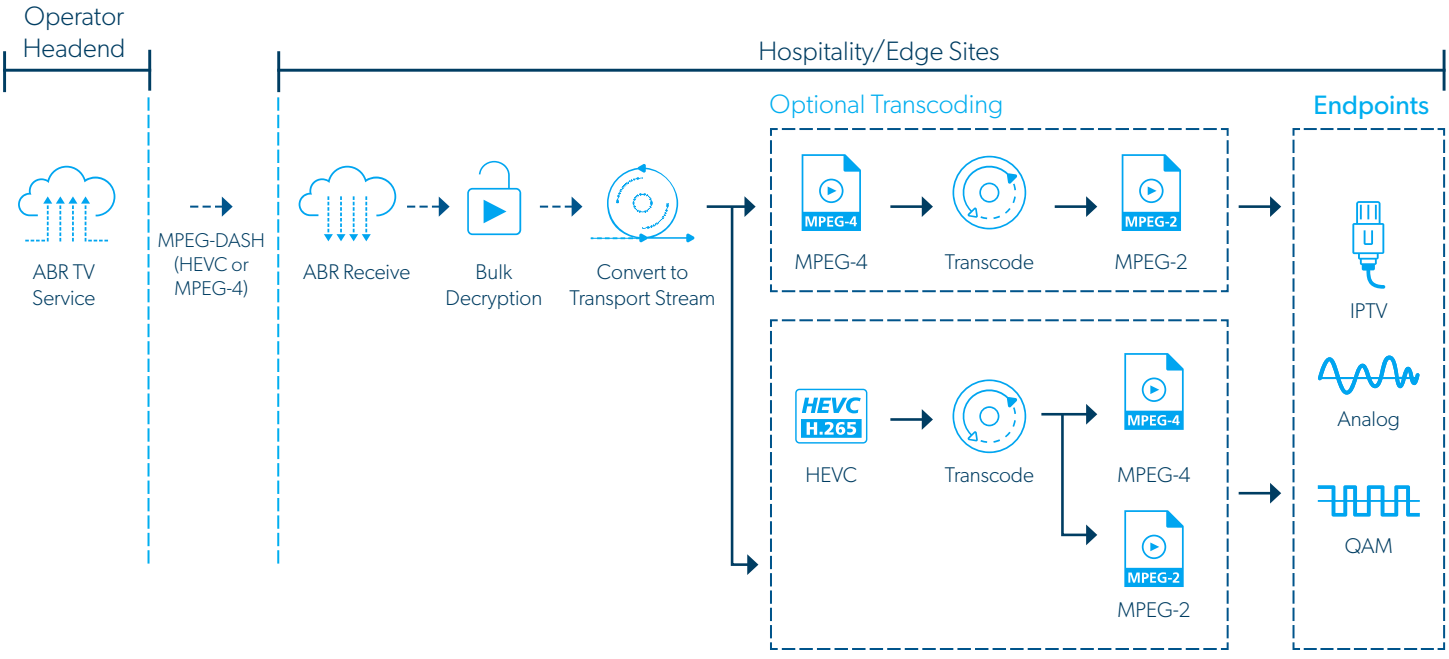
Transcode at the Edge

Transcoding at the edge can be architected in two different ways:

1. Operators can receive the ABR streams centrally in HEVC or MPEG-4 and deliver IP transport stream in the same codec to the edge. At the edge side, the HEVC or MPEG-4 streams can be transcoded to MPEG-2 and delivered using QAM, if necessary.



2. Operators can receive ABR streams at the edge site, and perform all processing in one location: ABR to transport stream conversion, bulk decryption, transcode to MPEG-2, and QAM modulation.



Key advantages:

- ✓ **Bandwidth efficiency:** When transcoding at the edge, IP and ABR streams between the headend and edge locations can always use the HEVC or MPEG-4 codec. Streams only need to be delivered in one format to all edge locations which is an optimized and cost-effective use of the available bandwidth.
- ✓ **Only transcode when needed:** Operators only need to supply transcoders at sites where required. As these sites upgrade to using HEVC or MPEG-4 compatible devices over time, fewer transcoders will be required. Transcoding at the edge can help operators track which sites need specific codecs. Additionally, operators can understand how this number changes over time.

Considerations

- **Cost of transcoding:** Transcoding video is a costly process and can potentially add rack units of equipment at the edge site. If an operator decides to transcode at the edge, the additional cost needs to be understood. Does this cost get passed to the business account, or will it be the operator's expense?

Optimizing Transcoding Costs

Transcoding can be a costly process, no matter what deployment option is being considered. An operator will likely be familiar with transcoding costs used for residential content delivery, but this might not accurately represent the cost of transcoding at the edge.

Content quality requirements for residential customers are not necessarily the same as those for business accounts. Residential customers pay individually for their TV services and have high expectations about how that content will be delivered. These viewers often want support for large screens, expect high-quality outputs for premium content such as fast-action sports, and are able to support Internet-based ABR services.

TV content delivered to business accounts is typically distributed across multiple devices in individual rooms, viewed by temporary residents. The expectations from these viewers are different. There should be a sufficient line-up of content, delivered at a good enough quality to enjoy.

With this difference in mind, operators can optimize the cost of transcoding by adjusting the video profiles delivered to hospitality locations. The resolution, bitrate and framerate of the services can sometimes be reduced relative to residential delivery requirements and still produce satisfactory quality levels for hospitality TV. If needed, higher-quality profiles can still be considered for higher-value content.

Reducing the resolutions, bitrates and/or framerates of streams can increase the number of streams that can be transcoded per rack unit. For ABR streams received from a hosted provider, using the top profile with the highest resolution might be the more costly one to transcode. The top profile may be selected for high-value content only, while the 2nd or 3rd profile could be used for all other content. Mixing profiles in this way is a recommended approach to manage the cost of transcoding.

Transcoding Takeaways

There is no easy answer or one-size-fits-all approach when it comes to transcoding for hospitality sites. It is important for operators to consider transcoding early in the project.

There are key questions and items to investigate as an ABR receiver project is being planned and budgeted:

1. How many MPEG-2 sites are supported today?
2. How many MPEG-2 sites will be supported in the future?
3. What is the bandwidth cost of delivering content as both MPEG-4 and MPEG-2? Alternatively, what is the cost of MPEG-2 transcoders at the edge?
4. What are the optimal resolution, bitrate and frame rate for the edge sites?
5. How many video streams are delivered today to MPEG-2 sites? Could the channel lineup be reduced to optimize costs?

Looking at these questions will help start the process of planning the deployment strategy for the ABR receiver. It might even initiate discussions or surveys for existing edge sites to discover what is supported today and if there are planned upgrades.

The main takeaway here is to be prepared for transcoding costs and start the analysis early to understand the potential impact.

ABR Protocols

In this section, we will explore the common streaming protocols used in ABR video delivery. The goal of this section is to help operators understand the differences between the protocols and why one might be preferred when considering ABR reception.

The most common ABR protocols used in video streaming are:

- **HLS (HTTP Live Streaming):** Developed by Apple, HLS segments both live and Video on Demand (VOD) content for delivery over HTTP. Segments are delivered and stored as either MPEG-TS or fragmented MP4 media files and are typically encrypted using Apple's proprietary FairPlay technology, although Verimatrix, Widevine and Marlin are also supported. Streaming content in HLS is popular due to its compatibility with iOS devices and web browsers. For an ABR receiver application, HLS can be complex due to the multiple HLS versions in use, various interpretations of the HLS standard, and the proprietary FairPlay encryption which is only supported on Apple devices.
- **MPEG-DASH (Dynamic Adaptive Streaming over HTTP):** MPEG-DASH or DASH, standardized by MPEG, is the only HTTP-based streaming solution that is an international standard making it well suited for an ABR receive application. MPEG-DASH streams are often encrypted using Google Widevine technology, a commonly used DRM system included in most major web browsers.
- **CMAF (Common Media Application Format):** CMAF iis a unified streaming format that merges the strengths of HLS and MPEG-DASH while overcoming their limitations. It's a presentation container format that can be used for the delivery of both HLS and MPEG-DASH and is used to simplify the delivery of ABR streams. Because CMAF encapsulates MPEG-DASH, it also incorporates all the benefits discussed in the previous section and is, therefore, another optimal choice for delivery to an ABR receiver.

MPEG-DASH has been increasingly adopted by major streaming platforms and service providers, ensuring a consistent and reliable streaming experience for users worldwide.

There are other protocols, such as Microsoft Smooth Streaming (MSS), Adobe Systems HTTP Dynamic Streaming (HDS). This paper focuses on the protocols that are most commonly used for ABR Receiver application.

Why MPEG-DASH?

MPEG-DASH is the recommended protocol for ABR receive due to its international standardization and widespread adoption.

With its standardization and widespread industry support, MPEG-DASH has been increasingly adopted by major streaming platforms and service providers, ensuring a consistent and reliable streaming experience for users worldwide. Due to standardization, MPEG-DASH works universally across products from various vendors. This ensures an efficient and streamlined process when integrating an ABR receiver with streams from 3rd party packaging solutions.

By leveraging DASH as the primary streaming protocol for ABR receive applications, operators can achieve a more universal content delivery ecosystem. Choosing MPEG-DASH will ensure flexibility for operators due to the focus on standardization of the protocol. If any part of the ABR receive workflow needs to be upgraded, replaced, or expanded in the future, there will be more compatible options from a variety of vendors. Operators will benefit from choice, rather than be trapped with a single source.

WISI Promotion

Do You Utilize TiVo Video Services?

WISI is excited to unveil a groundbreaking feature for TiVo Managed IPTV Service users. The newly launched capability integrates WISI's ABR (adaptive bitrate) Receiver easily with TiVo, transforming premium video delivery for operators that serve hospitality and edge sites. This enhancement is designed to streamline operations, reduce headend equipment, and ensure a seamless entertainment experience for business accounts.

Bridge the gap between multiscreen ABR video delivery and legacy QAM networks. Use ABR streams for both residential and business subscribers.

View the Solutions Page

Content Security

This section provides an overview of how encryption and Digital Rights Management (DRM) are used in the ABR receiver workflow.

DRM overview

Digital Rights Management (DRM) is a technology used to control how digital content, such as music, video, and software, is used and distributed. The main goal of DRM is to prevent unauthorized reproduction and distribution of digital media and enforce the content usage rights specified by the content provider.

Here's how DRM typically works:

- **Encryption and decryption:** Content is encrypted at the source and only authorized devices with the correct decryption keys can access and decrypt the content after it's been received. This means that even if someone copies the file, they cannot use or view it without the proper decryption key.
- **Rights Management:** DRM systems manage rights associated with the content. These rights define what a user can do with the content. For example, rights might specify that a video can only be watched five times or a music file can only be played on specific devices.
- **Authentication:** Users and devices often need to authenticate with a DRM server to prove they are eligible to access the content. This authentication process can check if a user has a valid subscription, has made a purchase, or meets other criteria set by the content provider.

DRM and ABR Receiver

When integrating ABR reception workflows, operators must ensure compatibility with the existing DRM/encryption system already in place. Since DRM selection is typically determined during the deployment of residential ABR services or provided as a standard by the hosted provider, it must be supported by the ABR receive solution under consideration. This alignment is critical for seamless integration.

There are two primary encryption platforms used for ABR reception deployments:

- **Widevine:** Widevine is the most widely deployed provider of content security solutions for IP video operators worldwide. It is included in most major web browsers and is often used to encrypt MPEG-DASH streams.
- **Verimatrix:** Well-known in the Pay TV industry to cable, satellite, and OTT service providers, Verimatrix is already deployed by many video operators to securely deliver linear and ABR video services. Its multi-DRM system is compatible with PlayReady, Widevine, and FairPlay, and it offers its own proprietary DRM technology.

Other encryption providers include FairPlay and PlayReady. At the time of writing, Widevine and Verimatrix were the only encryption types used for an ABR receiver application.

Operators must evaluate DRM providers based on factors such as security requirements, cost models, and device compatibility.

The remainder of this section focuses on considerations when moving forward with Widevine technology.

Deployment with Widevine

Widevine DRM is a strong choice for an ABR receiver application for its widespread adoption, robust security features and cost efficiency. Widevine provides three distinct security levels, which are outlined below. It is important to recognize that the hardware and device-type plays a large role in determining what kind of security level is applied.

Security Levels

Widevine offers three security levels designed to cater to different requirements of content protection.

The security level used is dependent on the presence and use of a Trusted Execution Environment (TEE) on the device. A TEE is a secure area of a receiver or client device that executes code while ensuring data loaded inside is protected.

Here is an overview of Widevine's security levels:

- **Level 1 (L1):** Widevine's highest level of security. L1 utilizes the TEE for all operations, including video rendering, content decoding, and hardware-level decryption. It is designed to prevent media from being easily screenshot and re-distributed. Many laptops and smartphone devices do not support L1 security. Typically, L1 is supported by certain smart TV brands and Android apps.
- **Level 2 (L2):** Combines hardware and software-based security features for enhanced content protection. Video processing, including content decoding and rendering, can occur outside the TEE, while media decryption occurs within the TEE. L2 is not intended for mobile device applications.
- **Level 3 (L3):** This type of encryption relies on software-based mechanisms for broader device compatibility and does not require a TEE. Web browsers such as Chrome and Firefox use L3.

Widevine L3 is a viable security level for bulk decryption solutions that are owned and managed by video operators. Solutions, such as ABR receivers, use secure networks and are not accessible by end consumers.

Encryption Modes

There are options when implementing encryption methods, and it's important to understand how each one impacts performance. The Common Encryption Scheme (CENC) used by most DRM platforms specifies standard encryption and key mapping methods, including the common format for encryption-related metadata. However, the details of rights mapping, key acquisition, storage, and other rules are left up to the DRM system.

The standard includes four modes for common encryption:

- CENC – AES CTR with full sample encryption (commonly used)
- CENS – AES CTR with subsample pattern encryption (not commonly used)
- CBC1 – AES CBC with full sample encryption (not commonly used)
- CBCS – AES CBC with subsample pattern encryption (commonly used)

The two most common and relevant modes in a streaming workflow are CENC and CBCS.

What do these modes mean?

Let's start with some definitions to explain the above modes:

- **Advanced Encryption Standard (AES):** One of the more popular symmetric key cryptography algorithms used in software and hardware for both government and commercial use.
- **Counter (CTR) mode:** An encryption algorithm. A popular AES block cipher mode in which every step can be done in parallel.
- **Cipher Block Chaining (CBC) mode:** An encryption algorithm where a cipher block is produced by encrypting an output of the previous cipher block and present plaintext block. In this mode, parallel encryption is not possible, as every step requires the previous cipher.

The following table shows which encryption modes are supported by the common protocol and DRM combinations:

	CENC	CBC1	CENS	CBCS
Protocols				
HLS (with or without CMAF)	✗	✗	✗	✓
MPEG-DASH (with CMAF)	✓	✗	✗	✓
MPEG-DASH (without CMAF)	✓	✗	✗	✗
DRM				
Fairplay	✗	✗	✗	✗
Widevine	✓	✗	✗	✓
PlayReady v1.0 to v3.3	✓	✗	✗	✗
PlayReady v4.0	✓	✗	✗	✓

When implementing DRM solutions, operators must consider the impact of encryption on system performance and resource utilization. CBCS, which does pattern encryption, requires less processing power than CENC, which does full encryption. Using CBCS mode, therefore, can significantly increase the performance of the ABR receiver system. CBCS is also the most widely used, as it's the lower common denominator between DRM platforms, as HLS and FairPlay only support this mode.

In summary, operators must evaluate the trade-offs between encryption modes, such as device compatibility, security requirements and target cost per stream. Widevine with CBCS, MPEG-DASH and CMAF is a strong way forward to ensure optimized performance for ABR reception.

DRM Takeaways

Widevine DRM is advantageous for operators seeking cost savings and efficient deployment:

- **Cost-effective:** Widevine DRM integration remains royalty-free, minimizing upfront costs for operators compared to other DRM solutions that may require licensing fees. It's important to note that Widevine key server access is generally managed via a key server proxy. Depending on who is managing access, the operator might be charged for authentication and use of the proxy.
- **Robust security:** Widevine DRM is a globally recognized platform and is widely deployed. Widevine offers robust security measures, including strong encryption and authentication mechanisms, safeguarding content against piracy and unauthorized access.
- **Performance optimization:** Widevine DRM with CBCS encryption, combined with MPEG-DASH and CMAF, is the recommended combination to achieve optimal performance and efficiency throughout the application workflow.

By leveraging Widevine DRM, operators can establish a secure, cost-effective, and scalable DRM solution for ABR reception workflows, meeting both content protection requirements and operational efficiencies.

Monitoring and Management

Robust monitoring and efficient management are essential components of any video workflow, to ensure smooth operation, effective troubleshooting, and enhanced control over content delivery. ABR receive is no exception.

An ABR receiver, especially if deployed at an edge location away from headend engineering teams, needs to be reliable and easily accessible.

The following list provides some recommended approaches to the monitoring and management of an ABR receiver.

- **Monitoring tools:** Built-in monitoring tools within the ABR receiver are a strong approach. Monitoring and analytics integrated into the product provide real-time insights into system performance, network health, and content delivery metrics. For example, WISI's video platforms include tools for tracking stream health, bitrate, packet loss, enabling operators to proactively address issues and maintain optimal video quality. If the selected ABR receiver lacks built-in tools, operators should consider third-party monitoring platforms, though this approach adds cost to the project.
- **APIs for configuration and control:** Centralized management through APIs allows seamless integration with existing provisioning and reporting systems. Operators can automate configuration tasks, control system behaviour, and orchestrate workflows efficiently. This capability enables bulk updates across edge sites without manual intervention, avoiding costly and time-consuming truck rolls.

By centralizing monitoring and management through integrated tools and APIs, operators can ensure efficient operation, proactive troubleshooting, and seamless integration of ABR reception workflows with existing infrastructure.

III. Customer Case Study

Optimizing Bandwidth and Streamlining Content Delivery

WISI is working with a Tier 1 video operator to deploy ABR reception within their video network to replace legacy QAM to QAM units at hospitality sites. This case study examines the deployment process, challenges encountered, and solutions implemented.

Deployment Overview:

- **Objective:** Migrate the network from using video QAMs to using all-IP video delivery. Replace legacy QAM to QAM equipment at hospitality sites. Centralized network management.
- **Key drivers:**
  - Remove end-of-life CableCARD decryption products
  - Optimize the use of spectrum by using QAMs for DOCSIS instead of video delivery

Current challenges:

- **Outage Risk at Customer Sites:** The operator relied on legacy equipment that was past end-of-support and end-of-life, creating a constant risk of service outages. Any failure could disrupt production streams at customer sites, making it urgent to replace the outdated gear.
- **Bandwidth Constraints:** Delivering video QAMs from headend sites to hospitality locations consumed significant bandwidth. This limited the operator's ability to upgrade networks or expand data services, putting growth plans on hold.

Solution:

The operator is deploying ABR receivers at hospitality sites to replace QAM to QAM units. Specific features defined with this solution include:

- **Modular, power-efficient platform:** The product deployed is the WISI Tangram Video Platform; a 1RU modular system, globally deployed and renowned for high-density hospitality applications. The ABR receive functionality is available using GT5100 software running on GT2000 hardware. The GT2000 is a universal edge module, capable of changing applications with a software license. Capacity is still available in the platform to add additional features such as Pro:Idiom encryption, local channel insertion, and analog modulation.
- **MPEG-DASH and Widevine:** Optimized combination of streaming protocol and DRM system to maximize performance per 1RU unit. A single GT2000 module receives MPEG-DASH streams, bulk decrypts Widevine and outputs transport stream video as either IP or QAM.
- **Electronic Program Guide (EPG):** Gracenote channel guide integration with an EPG feature ensures guide updates while enhancing user experience.
- **Centralized management via API tools:** Enable centralized provisioning, monitoring, and troubleshooting, with API tools for comprehensive control and flexibility.

Results:

- **Minimal disruption for existing customers:** The operator's hospitality customers have no need to upgrade in-room devices. ABR streams received at the property are converted back to transport stream as IP, QAM, or analog; the output format is tailored to meet the specific requirements of each site.
- **Operational efficiency:** Streamlined workflows and API-driven configurations enhance operational efficiency, reducing manual intervention and minimizing downtime.
- **Standardized deployment:** The same product can be deployed at any location, as it offers IP or QAM output options, allowing the operator to standardize on one solution.

IV. Additional Features

Any video delivery workflow is more than simply ingesting sources and outputting streams. Operators implement other elements and features to enhance the overall viewing experience. Some of these items will work differently in an ABR-segmented workflow compared to a linear video network.

The purpose of this section is not to define the implementation of these additional features in an ABR reception workflow, but to make operators aware of these items and to ensure that they are not missed in the planning process:

- **Emergency Alert System (EAS):** Operators must review where emergency alerts are injected into programming for hospitality TV. If this is done at the edge site, currently in the QAM-to-QAM units, operators will need to ensure EAS can still be supported in the replacement units.
- **Simultaneous substitution:** Canadian operators must abide by simultaneous substitution rules defined by the CRTC. For Canadian operators deploying ABR reception, where does the substitution take place for ABR workflows and are there changes to consider for hospitality sites?
- **Ad insertion:** Operators might target or localize delivered ads through Dynamic Ad Insertion (DAI) tools to further monetize their video delivery service. What are the ad insertion systems used today, and will they continue to work with ABR receivers deployed centrally or at the edge?
- **Electronic Program Guide (EPG):** What kind of program guide, if any, is supplied to edge sites? Do hospitality customers provide static channel lists, scrolling program guides or interactive program guides to their end users?
- **Re-encryption:** What encryption protocol is supported by the hospitality TVs installed? Common protocols used at hotels are Samsung LYNK and Pro:Idiom. It's important for operators to ensure that encryption requirements at the edge are maintained with any new product deployed on-site.

IV. Future Considerations

As the landscape of video streaming continues to evolve, operators must anticipate future trends and technologies to stay ahead of the curve.

Here are a few considerations to think about with regard to ABR receive workflows:

- **Migration to HEVC:** Currently, MPEG–4 is the standard codec used for ABR delivery. However, HEVC is advancing along the adoption curve and is already being used in the broadcast TV industry to deliver 4K/UHD video and/or to enhance high-value sports content. For delivery to hospitality sites, using HEVC can save an operator up to 40% bandwidth compared to MPEG-4, with no discernible loss in quality. This is a significant amount of further spectrum savings that can be used for other services. What is the impact of using HEVC on ABR receiver workflows? One option could be to deploy edge transcoding at hospitality locations to convert HEVC streams to MPEG-4 or MPEG-2, depending on site-specific requirements.
- **Low-latency streaming:** Real-time applications such as live sports and gaming demand low-latency streaming solutions to minimize the delay between content capture and viewer playback. Like streaming codecs, HTTP-based protocols are always evolving, and newer options will inevitably be developed to improve the quality and/or latency of the video. Operators should keep an eye on newer protocols as they are made available and evaluate which ABR reception solutions have adopted them.
- **AI and machine learning:** AI and machine learning technologies are increasingly being utilized to optimize content delivery, personalize recommendations, and improve viewer engagement. Future ABR reception solutions may incorporate AI-driven algorithms for content transcoding, quality assessment, or audience analytics, enabling operators to deliver tailored viewing experiences and maximized audience engagement.
- **5G and edge computing:** The rollout of 5G networks and the proliferation of edge infrastructure are poised to transform video streaming by enabling high-speed, low-latency content delivery at the network edge. How will this affect how ABR streams are delivered or received at edge locations?

By anticipating future trends and technologies, such as codec support and evolving standards, operators can position themselves for success in the dynamic and competitive landscape of video streaming, ensuring continued innovation and growth in ABR Reception workflows.

V. Conclusion

Any ABR reception implementation requires a range of technical decisions. Throughout this whitepaper, we have explored ABR receive deployment considerations in detail to help operators optimize video delivery networks and expand their reach.

To conclude this paper, this section summarizes key recommendations for operators planning an upgrade to an all-IP-video network and why an ABR receiver should be a serious consideration as part of this plan.

Recommendations for Operators

- ✓ **What is best for your customer:** Hospitality customers often do not prioritize their TV service, as it is typically a required amenity rather than a profitable offering. These customers will be reluctant to replace or upgrade every device in each room, and they will also oppose rewiring buildings due to the associated costs and disruptions. Consider a solution that utilizes the existing infrastructure and CPE devices while minimizing the need for extensive upgrades or rewiring.
- ✓ **Evaluate delivery methods:** Assess whether a centralized or edge deployment model aligns best with the network requirements. Centralized deployment simplifies control and management from a single location, while edge deployment ensures product standardization and localized adaptability at hospitality sites.
- ✓ **Optimize end device compatibility:** Audit site-specific output requirements (IPTV, QAM or analog) and codec support (HEVC, MPEG-4, MPEG-2). It is important to have a clear picture of how many sites require RF modulation and/or transcoding to support end devices.
- ✓ **Implement a secure encryption and DRM solution:** Evaluate encryption strategies, DRM options, and authentication methods to maintain high security levels while optimizing performance per unit and cost per stream.
- ✓ **Adopt comprehensive monitoring and management tools:** Deploy monitoring and management tools to proactively oversee system performance, troubleshoot issues, and optimize content delivery across all deployment sites. Centralized control facilitates seamless integration with existing provisioning and billing systems, enabling efficient updates without manual interventions.
- ✓ **Stay informed about emerging technologies:** Keep up with evolving standards and technologies, such as low-latency streaming, AI, machine learning, 5G, and edge computing. Embracing these innovations can drive competitiveness, unlock new revenue streams, and ensure continued growth and innovation in ABR streaming.

By utilizing ABR reception, operators can confidently navigate the complexities of video delivery and ensure seamless experiences for viewers.

Our team is available for project discussions and product demos.

Contact sales@wisiamerica.com to learn more.

WISI America
112-19055 Airport Way
Pitt Meadows, BC, Canada, V3Y 2B4
Phone: +1 855 998 4665