



Cloudy future for CPE?

What role will set-top boxes (STBs), Home Gateways (HGs) and Smart TVs play in an increasingly cloud-based future? Is the STB bound to evolve into a HG to Smart Home /IoT services?

3 Screen

Solutions: We believe that STBs will continue to play an important role as the digital entertainment hub in the home. At the same time, we believe that devices like STBs and connected TVs have, by and large, already made the concept of the smart home a reality. Smart home networking is far away from being a plug-and-play proposition today, but major equipment vendors all have detailed smart home technology roadmaps. There will be further consolidation in the STB marketplace and ultimately only a few providers will support the market in the future. STBs and HGs will increasingly compete with Smart TVs, or small dongles, capable of performing the same functions. Cord-Cutting and the rise of OTT will make it attractive for users to ditch the STB, so adding IoT/HG functionality to the STB to shift it from being the media-hub to the 'smart home and media hub' is a chance

to keep the STB relevant and connected and not lose out to other devices. An STB will increasingly be considered a security device and safe gateway between the home and IoT clouds which manage and control all data-streams. Operators will realise the importance

of Service for Television. The Smart TV cannot be an alternative but will be a second option for customers who have a compatible device for the service. Smart Home offers new business opportunities for all operator to increase ARPU, reduce churn and win new customers.

From a passive device controlling access to a household's TV channels, the STB has evolved to become a key element in service providers' relationship with their subscribers. At the same time, the spread of broadband connectivity has made the role of home gateway devices increasingly significant. Factor in both the emergence of the cloud as a powerful resource and OTT TV apps on connected TVs, and the future of CPE in the home seems less clear. *Euromedia* spoke to a range of industry practitioners to define the role of managing and securing content distribution in the connected, multi-device Smart Home in an increasingly cloud-based environment.

AirTies: In an increasingly cloud-based future, STBs, HGs and Smart TVs will continue to connect to one another via whole-home Wi-Fi Mesh systems, which dynamically adjust to connect to the best available AP and frequency bands based on real-time network usage. More forward-thinking operators, like Sky Q in the UK or Wao in

Denmark, will use intelligent, in-home Wi-Fi Mesh software to turn their STBs into HGs to deliver quality service in every corner of the house, on the subscribers' screen of choice.

ABOX42: The Smart STB will always be the gateway device of a full service live TV provider like cable companies or telcos with IPTV. Using new Unicast IPTV Technologies like MPEG-DASH, live TV from the cloud can be played back on Smart STBs like our M30 series. We do not see a future without STBs for a full-service TV provider which needs to address every house and ensure the Quality

of Service for Television. The Smart TV cannot be an alternative but will be a second option for customers who have a compatible device for the service. Smart Home offers new business opportunities for all operator to increase ARPU, reduce churn and win new customers.

Amino Communications: There's no doubt the industry is moving decisively to IP/cloud multiscreen service delivery and CPE providers are already adapting their offerings to align with this trend. We are already providing routes for traditional broadcast operators to move to IP, offering both high performance hybrid platforms, pure IPTV/OTT devices and

now OTT devices where TV applications are serviced in the cloud.

Conax: The role played by STBs, HGs and Smart TVs varies significantly between the various markets and regions. Emerging markets are still highly focused on simple zappers to enable analogue to digital transition, while in more mature markets the fight is more around remaining the centre of attention amongst a growing selection of service providers. Some operators choose to fight this by introducing advanced HGs that controls access to content throughout the various screens in the home, while other operators choose to approach this through introducing Apps for Smart TVs or streaming devices such as the Apple TV. The philosophy between these approaches are very different and it is not clear which will be the winner in the longer term. The tendency we see in mature markets, that we believe will also come later in emerging markets, is that the STBs are becoming increasingly advanced. Offering access to hybrid services, in many cases including third party streaming services, seems to become a de facto standard. The goal for the operator is to remain in control of the device being used for the big screen, and avoid the consumer switching to other devices outside the operators control. This normally means providing a STB platform that enables use of Apps for simple introduction of new services. Home Gateway features are one of the areas covered by such STBs.

Eurofins: In an increasingly cloud-based future, while some operators may combine the STB and Home Gateway for service delivery, the STB is likely to remain the most cost-efficient means to deliver next-gen features and capabilities – effectively becoming a gateway for the smart home and

time to market, uniform functionality to full customer base, reduced cost, adaptability and lower cost of support. However, the higher security demands of new technologies like 4K UHD combined with the undeniable consumer shift towards viewing on unmanaged, connected devices, presents challenges here. New content protection requirements around premium content are upping the ante for delivery to unmanaged devices. Many of these requirements we've come to expect in managed devices, but they have also raised the bar for OTT services to unmanaged devices, meaning they must have similar security levels as the STB – which will likely evolve into a gateway for delivery of secure connectivity and consumer services to the smart home.

MoCA: STBs are evolving into gateways. Inclusive of functionality in the gateway will be management of IoT or home automation. The cloud subsuming more and more of the functionality of the gateway makes a lot of sense, and should result in a lower capex. ~~that there is still considerable demand for management and performance at the edge of the network that may be best delivered via in-home CPE. A combination of gateway and cloud-based functionality, however, will continue to evolve and jockey for supremacy. The final network incarnation – gateway or cloud – is still to be determined.~~

NAGRA: The STB or terminating device including TVs will be with us for the foreseeable future as service evolution has different life stages in both broadcast and broadband. It is thought that the HG may reappear as the server-under-the-stairs; i.e. a central home hub for the smarts of the future home including video consumption and audio services.

Netgem: There is a combination of two

SoftAtHome: STBs today offer video-based services while HGs offer all other services in the home. Different types of operator will have different box strategies with both types of device. As IoT is taking root in many markets, there is pressure to introduce more and more GW type of functionality in the home. So, operators with 2 boxes (STB & HG) will be investing more in the HG as it becomes the hub of the home. But broadcasters that have been promoting just a STB, might be cornered into a position of having to add HG type of features like IoT, Smart Speakers or an AI based assistant into their STBs.

Tivo: Even when functionality, such as recording, is moving to the cloud there is still a need for a device in the home that allows the user to interact with a service. The question of the STB evolving into a HG that interfaces with other devices in the smart home is still open for discussion. Some operators have been pushing toward providing services linked to the smart home. In this case, the STB is a natural place to locate some of this functionality.

Apps are increasingly used as a means of accessing content via Smart TVs. Will this trend eventually see the disappearance of the STB?

3 Screen Solutions: We do not believe apps will replace the STB. The technical and commercial advantages that an operator can realise with a STB are too significant. Rather, app-based TV is an intermediate step towards decentralised content-hubs in which the only visible sign of the app, if any, will be the player. Being in control of the 'canvas' and providing the user with intelligent recommendations and sophisticated search capability are areas where STBs will continue

“The STB remains remarkably resilient as a device considering the many epitaphs.”

IoT services. Across STBs, HGs and Smart TVs, moving automated testing capabilities into the cloud supports a more continuous delivery environment and offers a seamlessly integrated user experience, as it provides additional elasticity and scalability for test and measurement, and enables quick reaction to peaks in demand that often accompany new product or feature introductions. Ultimately, automated test suites must be flexible enough to work in both cloud-based and real-time environments where they are able to interface with customer devices for quality assurance.

Irdeto: In 2017, we are seeing trends from last year continue. Interest in Cloud DVR and networking services is increasing as consumer demand for OTT services grows and operators look to reduce investment in consumer premises equipment. The benefits of cloud services are well-known – namely,

trends. The first is that there is a need for intelligent cloud services to manage a more complex environment that takes content from different sources, for example on demand and live recordings. This is something that needs to happen, and Netgem has made significant investments in this area. The second trend is that there are more and more devices that require more local connectivity management. This is the glue between the equipment, such as the 'dumb' gateway and the STB that incorporates some basic Internet access. Given UK homes now have seven devices on average, that's a lot of pressure on relatively simple technologies. However, when we factor in connected printers, cameras, plugs and even light bulbs, that can really put a strain on the home gateway. We see a growing trend to deal with this – aggregating content in the cloud and presenting it in a simple way.

to hold their own.

ABOX42: There are two kinds of service operators. Pure OTT operators like VoD providers without a network and network operators with their own infrastructure. OTT services of course can be delivered as an app. If you are a network provider (e.g. IP, Telephony, TV) you want to use this as a competitive advantage and ensure the quality of services of the Live TV signal. So, the operator needs a solution which works with every TV set and in every customer home the service is sold to.

Airties: The STB remains remarkably resilient as a device considering the many epitaphs written over the last few years. We see continued strong demand from existing and new customers – and in wider industry terms there's even a move from major operators to larger higher performance

devices. There's no doubt that operators still want to own and define their own branded user experience and the STB plays a key role in its delivery. But we're also excited about the opportunities and possibilities for Android TV where the new 'operator tier' development programme is resolving previous areas of operator concern. New features allow operators to define their selection of apps to be installed and to have more control of the user experience.

Android TV is becoming a compelling proposition for some operators and we'll see growing traction for Android TV from operators.

Conax: In mature markets, we see operators starting to introduce their entire channel line-up through apps on either the Smart TV directly, or through streaming devices such as the Apple TV. In most cases, though, we see that the offering through these apps is currently simpler and of lesser quality than what is normally offered through the operator's own STB. While there are still significant security challenges with such an approach, we do see that this is a key strategic direction that is taken by several leading operators. The security challenges are related to how well the Smart TV or the streaming device is able to protect the content, and is based upon a lack of advanced security mechanisms that are typically present in modern STB chipsets. The industry is working on good security solutions for the Smart TVs, and we start to see the first adequate solutions emerging these days (a good example being the TVKey product from NAGRA). Until these security solutions become commonplace, we don't think we will see the most piracy exposed content offered directly to Smart TVs.

Irdeto: There's no doubt that consumer demand for OTT services is growing as viewing habits change towards unmanaged devices both inside and outside the home. However, while operators face the challenge of increasing efficiency while meeting ever-changing consumer needs, OTT will not diminish traditional pay-TV to the point where the STB will begin to disappear, at least

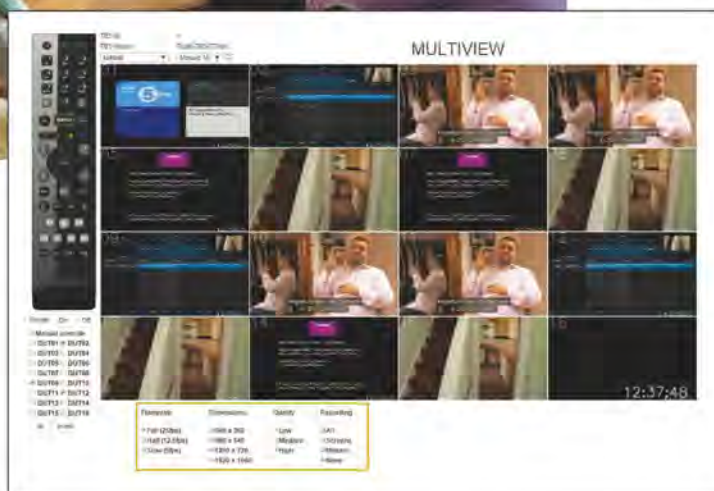


"Android TV is becoming a compelling proposition for some operators."

not in the short-term. The increasing demand for high value content – in particular sports - and early release and UHD movies, is where the STB remains the most secure and cost-effective delivery method to the mass market. This is due to the strict Movielabs security requirements for this high-value content and consumers' expectation for a high-quality, live TV experience, which are best met through the use of STBs. Without meeting these

appropriate. This means users can access the virtual STB on any device as demonstrated with the launch of Ooredoo Oman Mobile TV that preceded the launch of the Home TV service with an STB. We have already enabled this service and believe the trend will continue. Most of the investments we're making will rely on the virtual STB, so we're happy to see more devices connecting to a cloud environment. However, we don't

see physical STB disappearing completely because of the complexity of bringing content to a range of devices. While there is no standardisation specifically for this movement, the likes of HbbTV are an opportunity to effectively transform a dumb TV into a smart one. This means that,



requirements, operators will not be allowed to distribute the high value content which consumers demand and, therefore, we expect the STB to retain its importance for the next three to five years at least. In addition, open platforms such as Android TV are making it easy for STBs to offer both broadcast and OTT services as well as new apps easily and cost effectively.

This trend further increases the likelihood for the STB to maintain its dominance in the home.

Netgem: We believe there is a role to be played by a virtual STB architecture, and we've invested in this cloud software in instances where we're delivering a multiscreen experience outside the home. There is a growing need to have a virtual STB in the cloud to help users manage their profiles. We've pre-empted this move from an STB where everything is done locally, and transferred services to the cloud where

while the STB will likely reduce in size and importance, it won't disappear completely from the home.

SoftAtHome: We must differentiate means of accessing content from means of displaying it. Historically an STB was designed to deliver services without any dependency on TV set-makers roadmaps and to deliver these video-based services on all TVs, even the oldest. There is clearly a new tendency in the way content is being accessed from apps. However, at the same time, there have never been so many devices in people's homes as today (Apple TV, Roku, Fire TV, Amazon Echo, IoT devices, consoles ...) and the TV set itself is just one other device. Why is this? STBs are not disappearing but are evolving with much more competition in this segment. In the future, there probably won't be devices in the home called just STBs, but the operator-based video services dedicated STBs deliver today, will be available from devices offering multiple

services including video.

TiVo: Whilst there is a general trend towards apps, there are still advantages for the operator in providing an STB. First and foremost, an operator STB gives the operator the 'brand in the hand' as the consumer will be using their remote. Also, the nature of the consumer electronics industry means that TVs aren't necessarily updated once they are in the field, so the natural place for apps is actually on the operator STB. One thing is clear however in the 'apps world' – there is a need for a universal, integrated search function (like TiVo provides) to ensure consumers can find the content they want without needing to go in and out of each app separately.

Who controls the gateway to the home? Where does the responsibility for ensuring quality lie?

ABOX42: The gateway is operated and controlled by the company that provides the service, like in the past with the Cable Modem or the DSL Router. This way operator can ensure the end-to-end quality of the services.

AirTies: Service providers control the gateway to the home and are therefore responsible for ensuring customers have consistent, high-quality experiences. For some operators, Wi-Fi may account for more than half of all call-centre traffic. It's no longer sufficient to simply deliver the fastest speeds to the gateway. Consumers

must also be able to experience those speeds consistently through every room in the home, which requires a distributed Wi-Fi mesh solution.

Amino: The gateway remains pretty much under operator control. However, we have always worked with the wider ecosystem to provide monitoring and quality of service as it's such a key element in an operator's offering. However, as operators start to partner with third party content service providers to offer embedded services – with integrated Netflix as an example – providing a degree of feedback and even access to the home gateway CPE will help all parties deliver a better quality of service. Operators need to give a lot more weight to these quality issues as customers are in a much better position to switch out providers within the highly competitive landscape.

“Service providers largely control the gateway to the home, and it is therefore their responsibility to ensure quality of service.”

Conax: Traditionally this has been a clear responsibility of the pay-TV operators, providing both the broadcast service and the STBs used to access the service. With the emergence of more streaming services being accessed on devices outside the operator's control this responsibility becomes a lot more fragmented. An operator providing a streaming service will, in many cases, have no control over either the IP connectivity to the home, or the devices used to access the service. This is a concern both for the operators and for the consumers. MSOs providing both IP connectivity and TV service have a clear advantage here as they can control both the content delivery process and



the master device used to access the service on the big screen. By providing advanced hybrid STBs, optionally with Home Gateway capabilities, they can, to a large degree, take control of the quality of the service delivered to the home.

Eurofins: Service providers largely control the gateway to the home, and it is therefore their responsibility to ensure quality of service (QoS) at both the network

level and in the home. In today's highly fragmented multiscreen video market, QoS is quickly becoming a primary customer retention and engagement factor. It is therefore imperative that service providers maintain accountability for total quality assurance at the service level, which starts at the beginning stages of development when

the requirements and architecture are established. Operators must continuously expand their test suites to ensure service quality from the outset, rather than trying to solve problems once new services go live. This leads to a shared responsibility across network and CPE equipment vendors to achieve QoS at both the network level and in the home.

Irdeto: In a development from last year, home networking seems to be of less interest to operators. Instead the focus is very much on having comprehensive and dynamic

security capabilities to ensure the quality across multiple points and delivery through the cloud. With consumers' increasing expectations around OTT, it is crucial for operators to be able to reach consumers on any device, while securely delivering premium content and a great user experience. Operators who deploy IP connected STBs and gateways with a wide range of applications which they have never deployed before, need to protect these devices from Internet-based attacks.

MoCA: End users are getting smarter and their demands are becoming greater. They will take on some responsibility in terms of installation of home networking and automation devices but the operator's role as performance and reliability provider, as well as integrator and troubleshooter – if not actual CPE provider – remains critical. **NAGRA:** Management of the home and QoE

is still the responsibility of the pay-TV operator if they are supplying a customer with contracted services. However, if third-party services are not included but chosen by the customer then the provider of those services is responsible for their proper functionality.

Netgem: The ISPs always control the Internet gateway. This has included providing quality of service delivery for video where possible and beginning to develop managed gateway systems. Over time they will offer more features, such as security for smart home devices. While this can streamline service delivery, the average gateway to the home is currently quite basic. The reality of these growing demands on the gateway means they are reaching their limit in delivering high quality video services because they simply cannot cope with the bandwidth demands. Part of the problem is that services, like OTT providers, will often ignore what's happening in the home and operator network. There should be agreement between the content and service providers and operators to deliver a minimum service that users need. While there isn't necessarily going to be many more services or devices added to the gateway connection, there is a lot of work being done by content providers to better cache in the networks so it can be delivered across the system for users to access.

SoftAtHome: The HG is just the final termination point of a network, and ensures QoS delivery to connected devices. It is therefore natural for operators to deliver and control this gateway, as part of their

network. It also offers the ability to bring new features relating to local storage or IoT closer to the user. A NAS (Network Attached Storage) is a good example of such a feature, which can play a key role in several existing and emerging smart home services, giving users personal storage capability, which is secure and ensures privacy of their more sensitive data. SoftAtHome has developed such capabilities with its new solution called MediaCloud, this comprises an NAS managed easily by the operator to deliver new services at home. The Home Gateway can also deliver an IoT hub. **TiVo:** There are a couple of options for this that are coming to the fore. The traditional service providers and the new 'internet' players like Apple, Google and Amazon, could be responsible for regulating quality and leading the home into all-encompassing connectivity.

With cyber-attacks in the news, what are the security challenges of the Smart Home? It presents a bigger plane of attack, and the whole home system is only as strong as its weakest component. What are the challenges of ensuring content security and how are these overcome?

ABOX42: Security and privacy Issues are key to the success of an Operator Smart Home Solution. Most companies in the retail market are not used to high security standards and these products are sometimes in the news because of the low standards. Part of our operator gateway strategy is that we use the same high-end security which is already in operation in the pay TV market. Based on 3rd party robustness rules, our Smart Home gateway is very well protected against hacking or interception of private customer data. Security and privacy is always an issue with solutions based on retail products from many different vendors.

Amino: Content security is increasingly leveraging trusted execution environments that are built into chipsets to isolate content from applications. Looking ahead, security audits to ensure IoT devices work in a secure

environment are becoming increasingly important and we are beginning to see a separation of security processes from the CPU to further enhance protection from cyber-attacks. An outstanding issue is the lack of industry-wide best practice when it comes to securing devices both in terms of vulnerability testing and base line device security. It is likely that some of the larger IoT ecosystems

and money to generate a potential return. Consumers are aware of the threats, but the onus is very much on manufacturers to take on a lot of the security burden. Our recent global IoT security survey found that 78% of consumers are aware that any smart device connected to the Wi-Fi in their home has the potential to be targeted by a hacker, and 77% felt that the manufacturers have a level



of responsibility for keeping the device secure to prevent hacking. **NAGRA:** Every device connected to the home network represents a potential risk to the consumer; a risk that the device could leak private data to hackers, or that hackers could take over that device. No consumer wants their new Wi-Fi-enabled

will start to mandate 'baked-in' safeguards that meet a certain agreed threshold, but this has yet to happen.

Conax: As we have seen clearly in the last few months the hacker community is more than capable of launching sophisticated attacks addressed at both operators and content providers, as well as private users. A homogenous population of hybrid STBs is considered an ideal target for such attacks as they are effectively advanced computers that in many cases are less protected than a home PC. The security challenges to be overcome by a modern STB need to cater for attacks

aiming at getting access to the content itself as well as the ability to use the STBs to launch ransom attacks or even DDOS attacks on critical infrastructure or business. Operators need to protect their platforms and their subscribers from such attacks by ensuring they only introduce STBs that have been designed and evaluated to the highest security standards. Serious security vendors, such as Conax, have vast experience in supporting operators and STB vendors in how to build and maintain this high security.

Irdeto: The key security challenge of the Smart Home is that the increasing number of connected devices means a greater number of vulnerabilities for hackers to exploit. Cyberattacks operate on a business model and it is crucial that the Smart Home remains an unattractive or unviable target for the attackers. They will almost always target the least secure element first as this requires the least investment in terms of both time

security cameras actually enabling a robbery instead of preventing it. Or their connected refrigerator being hacked and spoiling all their food. Companies making these devices must ensure that the entire end-to-end security architecture behind them leverages concepts that are very similar to those in pay-TV security: namely hardware-based security in the device, secure authentication and communication with the server, and websites and apps that employ best practices for end-to-end encryption of all sensitive data.

Netgem: Security impacts all areas of the chain within the home, and consideration should be taken over where it sits. Given the number of devices now available, there is the potential for a leak that could present a backdoor to a breach that could lead to hackers accessing other, much more personal, information. There are two main parts to dealing with this challenge: protecting the main device that has a reasonable amount of information, such as the STB and other devices that come from different sources, sometimes not that secure. When it comes to security, we know operators are working hard to improve the local gateway but it will ultimately be down to the weakest link that's connected to it.

SoftAtHome: There is a need to develop security solutions to protect home networks as more and more vulnerable devices are installed within them. As key parts of this security will be at a network-level, operators delivering IoT services, especially Telcos, will be best positioned to implement this, often accompanied by specialist security vendors.

“Security and privacy Issues are key to the success of an Operator Smart Home Solution.”

Is CPE ready for UHD 4K-8K?

3 Screen Solutions: Everyone in our industry has begun to wake up to the many real underlying challenges of 4K. 4K is a completely different ball game from what we have today. Many people think that 4K is just a new higher resolution format, simply the next step after HD. Broad migration to 4K, however, is not just a question of increasing the specs of a STB. Widespread development of 4K requires a fundamental change to the entire ecosystem. Not only does content need to be altered to embrace the new Ultra HD standard, the smart TV, STB and nearly every aspect of the UI – and, importantly, how all these things interact – need to be re-engineered. 4K comes with higher demands on security. Content protection measures, like watermarking, are so far supported only by very few systems and STBs. No one has yet created a full 4K user interface, and that's because there are several major hurdles. Of course, any media player has to be able to cope with 4K, but you also need to change your streaming protocols, processes, DRM architecture, as well introduce new consumer hardware.

ABOX42: We offer both models for HD like M30 SmartSTB, and 4K with the new M35 SmartSTB. 8K is too far away right now to be in discussions with operators. There is still a cost difference between HD and 4K in the SmartSTB. If cost of the device is an issue in the business model, operators still choose HD STBs. With our SmartSTB Platform, the transition to 4K is pretty easy since all devices are software compatible and so the operator can just give out a new 4K STB once the customer subscribes to 4K service.

AirTies: As CPE transitions to UHD 4K-8K, there is a greater need to manage the bandwidth within the home, across multiple screens and streams. Outdated Wi-Fi systems have historically bottlenecked this process, and will only continue to exacerbate the issue as the industry moves to 4K-8K. Operators must embrace CPE with the latest Wi-Fi chipsets, home networking architecture, and software that intelligently routes data based on real-time conditions to ensure high-quality video delivery throughout the entire house.

Amino: To a certain extent, actual 4K UHD content delivery to the home has lagged behind CPE – with only limited pay-TV consumer availability – compared to the shipments of 4K TVs. We're already launching second-generation 4K devices with HDR and wide colour gamut to further improve user experience. Typically, these are lower power, higher performance, more compact devices that are ideally positioned for the wider consumer availability spanning OTT and live TV content that we'll start to see in 2018.

Conax: The industry is getting there, but there is still some way to go until the ecosystem is truly ready and consumer friendly. The abundance of partly incompatible standards related to UHD and HDR still means that there is a high risk that consumers buy UHD equipment that in the end cannot be used to fully access the



UHD service they want. The introduction of various certification logos to clearly mark CPE equipment as compliant is a major step in the right direction. Another important area for the industry is to ensure that the CPE equipment is capable of handling the security requirements imposed for access to high value content such as

UHD HDR and Early Release VoD.

Eurofins: CPE transition to UHD 4K-8K is inevitable. As operators make this transition, more nimble, automated and robust testing and quality assurance (QA) systems will become even more important. For example, as new services, devices and technologies enter consumer homes, a continuous testing system actively runs test scenarios on their

devices with full, 4K resolution to accurately depict the end-user experience. As the transition takes place, operators need to have systems and tools in place to replicate their customers' experiences to ensure they are receiving the quality improvements they expect.

Irdeto: Currently chipsets, security provisions and the MovieLabs requirements mean that the industry and the consumer are ready for 4K and HDR rollout on both STBs and mobile devices. We are seeing increasing numbers of 4K TVs and HDR-ready mobile phones shipping and uptake of UHD content is increasing. 8K is primarily for public showcase venues, such as hotel lobbies. It's unlikely to be used in the home, except perhaps in the future for game consoles or VR/360 viewing experiences where the pixels will

improve the quality of the image significantly. As the market demand for UHD content increases, however, it becomes even more important for operators to ensure adequate security levels to protect their investment.

MoCA: Yes. The question is rather: are there enough end users demanding 4K and 8K content? And are there content and use cases in these formats to drive adoption? Ultimate adoption of 4K is probably inevitable, but demand for 8K is more niche right now. I would not rule out 8K in the future, however; if consumers have the bandwidth, they will use it.

NAGRA: Yes, and has been for some time now.

Netgem: The increasing number of devices is straining the home gateway, and could become a weak spot in the chain. This is the case for both direct and Wi-Fi-based connections and could lead to latency issues. A resolution could lie in the STB, where it would act as the access point and Wi-Fi router exclusively for video services. By connecting to the STB, users can access some of the services on the box and watch them on their mobile devices in the home. This is a solution Netgem is already developing, and we plan to launch a service in partnership with ZTE in Mexico soon. In this instance, the Wi-Fi access point is handled by Netgem's intelligent middleware to deliver the best video experience. By having video capable devices focus on connecting to the STB, it frees up bandwidth on the router for other devices. It can also help in homes where Wi-Fi strength is an issue, by focusing devices on the appropriate router and expanding the wireless reach. Despite this, routers and STBs will still need to be upgraded to support 4K delivery, particularly as a lot of consumers are migrating to 4K and expecting their service providers to offer the service.

SoftAtHome: 4K has been commercially deployed by our clients over IP for almost two years, so unreservedly, yes CPE is ready for 4K. On the UHD side, Next Gen Audio in the form of Dolby Atmos has been deployed for 18 months already, and content is beginning to populate VoD catalogues. Despite there being several flavours of HDR available, CPE is already ready to handle all of them. Our clients have not yet asked us about 8K, but it is on its way with first availability in Japan. NHK, in preparation for the 2020 Tokyo Olympic Games, broadcast 7,000 hours of 2016 Rio Olympics Games in 8K (7680x4320) in Theatres. We envisage that by 2020, 8K deployment will start in Japan at least. One aspect of UHD that CPE is not quite ready for is High Frame Rate (beyond 100Hz). Demos and experimentation are impressive, but only a very few consumer-grade products are ready in 2017.

TiVo: CPE is ready for 4K, especially as many operators have already launched 4K CPE.

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