COMPLETING THE ULTRA HD JIGSAW

THE ADDRESSABLE MARKET FOR UHD
HOW PAY TV WILL DIFFERENTIATE
WHY CONTENT PROTECTION IS NOW ON THE RADAR
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Gauging the market for UHD
55% of consumers want to buy a UHD or 4K television. 55-inch is the magic figure for screen size. 5% penetration is when Pay TV will launch.

Streaming 4K and true UHD
4K streaming will remain relevant even after broadcast services arrive. Poor 4K might dent consumer enthusiasm. Pay TV is still guarded about expectations.

How Pay TV can differentiate with UHD
4K and UHD are different animals. Pay TV can excel by dedicating more bandwidth to make UHD something more than just better pictures.

Getting the ecosystem ready for UHD
Satellite modulation will improve, but overall we must rely more on compression improvements to make UHD economic. Encoding improvements will be less generational.

Setting a new benchmark for content security
The MovieLabs Specification for Enhanced Content Protection sets a new benchmark for protecting premium content. Designed for 4K/UHD, it reflects changing security philosophies.
Distributing video content for multi-screen consumption has always been a challenge in terms of adequately protecting content while enhancing the total user experience (UX).

The introduction of the ultra high definition (UHD) video formats presents its own unique revenue security challenges. The traditional requirements remain: the consumption of content will need to be fairly and consistently managed and the content owner adequately compensated.

However, the recent MovieLabs’ Specifications for Next Generation Video and Enhanced Content Protection1 present a number of additional imperatives for properly protecting higher value services that include UHD content. The Requirements promote particular ways of authenticating and verifying each device, and revoking the device when necessary. The combination of a secure system-on-a-Chip (SoC) with an embedded immutable identity and cryptographic subsystem mechanisms is also particularly attractive.

**The Rise of the Watermark**

But perhaps the most significant addition to the range of expected security mechanisms is the application of forensic watermarking. This requirement represents a shift in thinking, given that watermarking technologies have not been widely deployed in the past except for premium value applications.

Forensic watermarking’s popularity, however, is rapidly increasing as threats to operator revenue continually evolve and the industry learns from the characteristics of the new challenges. With many operators recognizing that content redistribution is a real and growing revenue threat, a watermark offers a valuable tool for identifying not only the demographics of redistribution attacks, but also any possible security perimeter weaknesses. For example, if the studio notices a trend in misappropriated content from a certain type of device, they can work together with the OEM to fix the potential flaw.

**Benefits of a Forensic Watermark**

The main benefit of watermarking is its ability to track a piece of content’s origins, and where it is consumed. Furthermore, if the content is used beyond the licensed use case, such as illegally uploaded to the Internet, detecting the forensic mark in the video can identify the source of the content such as the distributor, the type of user device, and eventually the end-user who abused his or her legal rights. Multiple marks can be embedded in the video.

In comparison to other digital media such as audio, digitally distributed movies can be protected particularly well by forensic watermarking. Digital video is a composition of many individual images and corresponding audio information, with a much larger amount of data than any other common media file and with more scope to robustly embed information.

With advanced methods that make use of the density of information to insert watermarking payloads, video watermarks can be vastly more effective in all respects when compared to audio or textual information. The latest commercial watermarking technologies are robust against attempts of removal, such as re-encoding or even targeted filtering attacks.

It is also important to note that the data contained within the watermark is meaningless to anyone other than the operator who already has a legitimate need to link it to service delivery related data. Subscribers’ personal details are protected and kept anonymous to everyone but the content owner.

**Importance of Watermarking for UHD**

Watermarking is particularly well suited to provide revenue security for UHD content. If a would-be pirate is aware of a watermark’s existence, its presence may deter the content theft from occurring in the first place. However, should the piracy still occur, the watermark provides valuable data as to where – and by whom – the content was last consumed. The watermark cannot be extracted and travels with the content as it is being illegally consumed, providing valuable data regarding any weak links in the content protection chain.

As such, it is expected that watermarking will play an increasingly important role in a multi-layer security system to protect the most valuable content Hollywood has to offer in the near future.

References:

Ultra HD (UHD) is the leading contender to be the next big thing in TV. At the very least it promises unsurpassed viewing quality and at its best it will be a compelling new television experience that feels more immersive than 3DTV. Although higher resolution viewing is being initiated by 4K online services offering four times the resolution of HDTV, Pay TV operators will be able to differentiate with the same resolutions but higher frame rates and improved colour depth, exploiting their bandwidth advantage to deliver true UHD.

Introducing 4K but especially UHD requires upgrades across the content-to-consumer delivery chain, with storage, encoding and decoding among the obvious pressure points. The difference between 4K streaming and full UHD are explored later in this report. However, one key consideration that has been largely ignored until now is content security but this is now under the spotlight since MovieLabs, the technology development initiative of the six major motion picture studios, issued guideline specifications for the treatment of 4K/UHD content.

These specifications are being viewed as the most important content security initiative yet for 4K/UHD, but also a new benchmark for the protection of all high-value content, with a high emphasis on the individualization of security and better opportunities to fix breaches and shut down piracy once it has begun.

Their publication reflects the fact that services are now arriving in the market, albeit downloaded or streamed. These early 4K broadband offers will provide competition for the Pay TV industry but also whet the public appetite for higher resolution content.
To buy a new UHD or 4K television within two years

Analytics is for 7.3 million UHD televisions strategy analytics found that TV brands likely to sell for less than 55% of people said they are likely with 50-inch models from the major brands. The firm as a critical factor in uptake, expected to fall significantly in 2014, and then 15.7m in 2015, 28.2m in 2016 and 44.3m in 2017. This would take the total of UHD televisions installed in homes to over 90 million by 2017. UHD TV prices, viewed by the firm as a critical factor in uptake, along with content availability, are expected to fall significantly in 2014, with 50-inch models from the major TV brands likely to sell for less than $2,000 later in the year.

The analyst firm also issued some important statistics recently about consumer propensity to buy a new UHD or 4K television set. Based on around 6,000 interviews across the U.S., UK, Germany, France and Italy (carried out late December) 55% of people said they are likely to buy a new UHD or 4K television set within the next 2 years. The proportion who said ‘Very Likely’ in the U.S. was 19%; across the European markets the proportion of ‘Very Likely’ consumers averaged 14.5%. The question asked respondents to assume significantly improved pictures and that pricing was acceptable to them.

When gauging the addressable market for UHD television services, a key question is whether you can enjoy the benefits of the new format on mid-sized televisions rather than 80+ inch monsters. The majority opinion is that below 55 inches the benefits are limited but above that UHD will deliver a noticeably better experience than HDTV.

There is already a trend towards larger televisions. “55 inches has emerged in Q4 2013 as the most important screen size in terms of unit sales,” a spokesman at Futuresource, the UK consulting firm notes. “This size strikes a nice balance between price and screen size. We anticipate that 84+ inch televisions will remain prohibitively expensive and though the benefits of UHD are more significant in the large screen sizes, depending on your viewing distance, the 55-inch screen size gets a discernable improvement.”

Futuresource says consumers go into a store with a budget in mind and come out with the largest screen size they can get for their money. Vassilis Seferidis, Director of European Business Development at Samsung, sees a desire for bigger screens even before the content is available to fill them with UHD pictures. “When you start to 55 inches you start to reach the limits of HD. Then you have to go to UHD or higher resolutions if you want the same level of experience,” he argues.

Futuresource issued figures at International CES 2014 suggesting that UHD sets will account for 5% of the televisions sold this year. According to Seferidis, when we reach the point where 5% of all the televisions installed in homes (rather than 5% of new sales) are UHD-capable, the major Pay TV operators will start launching their UHD services. He points out that 5% compatible screen penetration was the trigger point at which platform operators and channels launched their HD services last decade. Samsung is working on the basis of a viable starter mass-market for Ultra HD (with 5% set penetration) in 2017 in Europe.

**Gauging the Market for UHD**

The latest (and provisional) forecast from the research firm Strategy Analytics is for 7.3 million UHD television sets to ship globally in 2014 and then 15.7m in 2015, 28.2m in 2016 and 44.3m in 2017. This would take the total of UHD televisions installed in homes to over 90 million. UHD TV prices, viewed by the firm as a critical factor in uptake, along with content availability, are expected to fall significantly in 2014, with 50-inch models from the major TV brands likely to sell for less than $2,000 later in the year.

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**Completing the Ultra HD Jigsaw**

David Watkins, Strategy Analytics

**Streaming 4K and True UHD**

Video Unlimited, the movie download service from Sony, already offers a catalogue of 140 titles in 4K, while Netflix announced deals with Smart TV manufacturers for 4K streaming this year and Comcast will make 4K streamed content available via a Samsung Smart TV Xfinity app during 2014. As anticipated, streaming will provide the first sight of ultra high resolution content, if not true UHD, in consumer homes.

Jan Trow, Senior Director Emerging Technology & Strategy at Harmonic, a leading encoding and storage vendor, thinks streaming will be a major delivery channel for this new format. “It will play an instrumental role in the introduction of 4K/Ultra HD services. Once it is established, I believe this viewing habit will be difficult to shift and streaming will be here to stay.”

According to David Watkins, Director, Connected Home Devices at Strategy Analytics, “It is highly likely that, initially, premium streaming services along with Blu-ray will be the main conduit for 4K content to address the demanding, high-end and early adopting market segment. Once 4K capable sets penetrate the mass-market in a meaningful way, broadcast will step up to the plate, although we do not see this happening until 2016 at the earliest.”

Jan Trow says the market for linear UHD will be held back if screen manufacturers put sales figures ahead of a quality experience, especially with the public already in a guarded mood after the 3D ride. This concern is echoed by Watkins, who warns that Chinese set manufacturers are mainly focused on pixel count, with little consideration about compression, colour depth and frame rate, all of which are critical, he says, when displaying high quality native 4K content.

“The is why Chinese vendors have been able to sell very low cost UHD television sets, like sub $1,000, into their domestic market. As these vendors make a push into other markets there is some concern that sub-standard implementation of UHD technology will cause a backlash amongst consumers.”

There have been some notable experiments with UHD, mainly involving sports, like the screening of a Bayern Munich vs Dortmund Bundesliga football game by Sky Deutschland. But there is definitely no sense of urgency from Pay TV operators yet.

Among the obvious candidates...
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**VERIMATRIX**

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**SWISSCOM THINKS UHD MAKES SENSE FOR CONSUMERS WITH TV SIZES OF 55-INCHES AND ABOVE**

Although services can be delivered with H.264 encoding, most people believe that the new H.265 (HEVC) compression standard is needed to make UHD economic at any scale. Using this new codec today, bit rates range from 9Mbps for 4K VOD movies at 24fps (frames per second) to 25Mbps for true UHD, depending on the kind of content you are compressing.

Boris Felts, VP Product at Envivio, whose company runs an early access programme for HEVC compression and has been conducting trials with service providers, says early trials have used 20-30Mbps in HEVC for live content. He gives 25Mbps as a guide average figure. This is for UHD with 3840×2160 resolution, 50/60 frames per second and 10 bit colour depth.

Trow says that at 50/60p frame rates you need 15Mbps to deliver an improvement over HDTV for typical linear TV content but 20Mbps for premium sports. If you want to adopt 100/120p frame rates then bit rates are nearer 25Mbps.

This wide range of bit rates presents an opportunity for Pay TV operators to differentiate themselves. Keith Wymbs, Chief Marketing Officer at Elemental Technologies, one of the companies leading the charge for HEVC-based encoding of 4K/UHD content, notes that Pay TV operators have shown before how they are willing to dedicate the bandwidth needed to ensure a favourable consumer reaction and encourage uptake for new services. "Satellite operators have been particularly adept at using this strategy," he notes.

"At the high end of the range, we could see some services for Pay TV operators dedicating as much as 30Mbps for live UHD sports content. At the low end, we can see IP-streamed UHD movies in the low teens bit rate," he adds.

Wymbs thinks the bandwidth advantage for broadcast networks over streaming services will be nullified over time. Maybe that is the point when the Pay TV industry takes another step forward. Harmonic’s Trow would like to see efforts to get broadcast TV to match the quality already attained by 4K cinema, including for colour rendition. He hopes for a common approach for the different screens, given that much of the UHD material has 4K origins, though he worries it will not happen.

But he does think the ‘creatives’ will have their day with this technology, pointing to "wide camera angles, slick zooms and panoramic stadium shots that will give so much more sense of occasion to a viewer, with their field of vision well and truly filled for premium sports events."

Peter Fregelius at Swisscom thinks UHD could be a way to differentiate compared to OTT players. "Even with HEVC the required bandwidth is relatively big and it could also be costly for an OTT service," he explains.

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**HOW PAY TV CAN DIFFERENTIATE WITH UHD**

to pioneer a next-generation format, DIRECTV believes 4K will have broad appeal once there is a convergence of reasonably priced 4K televisions and more 4K content. The U.S. satellite operator says it will be ready if and when the consumer demand materializes. BSkyB says it is confident that there is a place for this format, although it is quite conservative in its estimates about when it will take off. "It will start with VOD content and consumer produced UHD content. It will take a long time, at least five years, before we will have broadcasting of UHD," Fregelius suggests.

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**GETTING THE ECOSYSTEM READY FOR UHD**

The arrival of the DVB-S2X specification promises 20-50% efficiency gains in modulation for satellite but there is no work on a terrestrial equivalent, and certainly no expectation of a DVB-T3. Compared to HDTV, the UHD roll-out is more reliant on compression efficiencies than a combination of compression and modulation gains.

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**WE COULD SEE SOME SERVICES FOR PAY TV OPERATORS DEDICATING AS MUCH AS 30MBPS FOR LIVE UHD SPORTS CONTENT**

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The good news is that improvements in compression should reach market faster than they did with SD and HD before. As Keith Wymbs explains: “We are now operating in an environment where there are no longer generations of encoders. Our software-based solutions enable constant improvement in algorithms for customers with a seamless upgrade. Our H.265/HEVC compression has improved by more than 25% in the past year alone and all through software refinement. “

Decode silicon will be ready soon. Taking Broadcom as an example from among the leading SoC manufacturers, the company announced a range of HEVC/H.265 decode chipsets designed to support UHD roll out last September. Significantly, the company used International CES 2014 to announce SoCs for entry level satellite STBs that will use HEVC to deliver more HDTV, suggesting there is more than one market requirement to generate scale for the new codec.

There are important implications for storage and workflow as the industry adopts UHD, too, and with so much else to think about, one issue that has been overlooked until now is content protection. But that is about to change thanks to the MovieLabs Specification for Enhanced Content Protection – Version 1.0. While each member of MovieLabs can decide the extent to which they use the specifications or require others to adhere to them, expert commentators think they are an important intervention in the evolution of 4K/UHD services and will thought of as the ‘state-of-the-art’ for content protection generally. He thinks 4K and UHD provide the perfect opportunity to encourage advanced technologies into the market. “MovieLabs wants to use 4K as a catalyst to drive advances in security generally,” he declares.

Peter Fregelius at Swisscom says the specification has implications across the delivery chain. “There are implications from the encoder to the watermarking server down to the set-top box, which must support HDMI 2.0 and HDCP 2.2 and maybe client watermarking technologies. These are all new technologies that must be implemented if studios make the requirements that are stated in their MovieLabs specification,” he explains.

Boris Felts, Envivio MovieLabs can decide the extent to which they use the specifications or require others to adhere to them, expert commentators think they are an important intervention in the evolution of 4K/UHD services and will have implications for the delivery of high value content generally. Andre Roy, Head of Security Practice at Farncombe, a leading content security consultancy that also audits content protection technologies, says the MovieLabs specification represents the best industry attempt today to specify content security requirements for the distribution of 4K/UHD content.”

Peter Fregelius at Swisscom

The MovieLabs specifications address revocation and renewal (including active monitoring for security breaches), response to security breaches, hack containment, the establishment of secure media pipelines and trusted computing environments, outputs and link protection, among other things. The document calls for renewable software-based security, secure device authentication and the need to individualize the security process, from per-asset playback policies through to watermarking.

Steve Christian, VP Marketing at Verimatrix, whose content security solutions are widely used across IPTV and multiscreen TV deployments, views the document as an effort to advance what is currently

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Verimatrix, shares the view that the MovieLabs specifications mark a new approach to content protection. He says they emphasize a shift towards server-side security management rather than client-side management, and also towards what he calls a ‘moat and castle wall’ approach where there are multiple layers of protection.

The specs call for the ability to authenticate devices at the time that consumption happens. "It leans on two-way networks and security is then based on a two-way communication between the headend and device," Peterka explains. He thinks the attitude to revocation is also important. "The studios have realized that content security solutions can be broken, so they want an environment where they can revoke a solution and get it fixed and re-instated."

The MovieLabs specifications gather together some best-in-class technologies that are already deployed or specified elsewhere, including side-channel attack resistance, secure execution environments and hardware root of trust. Others are not widely used. Roy gives individualization of the security solution, security monitoring, forensic watermarking, and a workable revocation and renewal capability as examples.

Verimatrix says its VCAS content security solution has these boxes ticked. Peterka points out that the studios are not defining the actual technologies that have to be used but providing broad requirements in the hope that the industry will deliver the solutions to meet them.

"This is a very different approach to what we saw with Blu-ray, when there was a prescriptive requirement for AACS, which failed over time, leaving the studios putting their best HD content into a ‘broke’ content protection environment. "With the new approach, if one of the technologies fails, they can stop re-releasing content onto that technology," he points out.

THE ROAD AHEAD
Content security is finally part of the UHD ecosystem debate, just in time for early streaming 4K services. According to Futuresource, 2014 will be the year of broadband-delivered 4K from the likes of Netflix, then in 2015 we could see a 4K Blu-ray standard. The company expects satellite operators to lead the Pay TV charge from 2016 with commercial channel roll outs.

David Watkins at Strategy Analytics says economies of scale will ensure that UHD will filter down into smaller television screens until it is the industry baseline resolution for these displays, although this may take a decade or more.

"There is of course the small matter of whether consumers will actually buy UHD," he points out. "But as long as consumers continue to care about picture quality, and there are no signs of this changing, and assuming TV vendors and retailers go about marketing UHD the right way, we see no reason why, given the right price, a consumer would not go for a higher specification product."

THE MOVIELABS SPECS REPRESENT A CHANGE IN PHILOSOPHY AND A NEW BENCHMARK WHEN PROTECTING PREMIUM CONTENT

Steve Christian, Verimatrix •

for content watermarking and the requirement for monitoring represent a change in philosophy when it comes to protecting premium content. "These are a reflection of the increasing risk posed by content redistribution over IP networks and the importance of being able to reliably identify and shut down sources of pirated and re-distributed content," he explains.

Roy explains that the most stringent content protection requirements today are aimed at protecting the integrity of the display device (whether that is a set-top box or an application on a tablet), the cryptographic keys and the operations that support content encryption, plus the video path. "The next generation of premium content, like UHD/4K, also requires that pirated content is discoverable and traceable to its source, hence the requirements for watermarking and monitoring. It requires that 'hack once, hack all' scenarios that assist in the proliferation of piracy are avoided, hence the requirement for individualization."

Verimatrix, CTO at

Petr Peterka, CTO at

Verimatrix

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