



## **HEVC Advance: Video for the Mobile, Connected, Ultra-High-Def 21<sup>st</sup> Century**

Video demand today is best described as “no excuses”. Consumers want the best possible quality picture, they want to watch it whenever and wherever they choose, they want it delivered seamlessly to screens ranging from the largest monitors to their smallest smart phones, they want it to arrive on demand with no lag, stutter, digitization or any other defect, and they want it at a price point less than today’s pricing.

Legacy digital video technologies (codecs) are simply inadequate for the job, as everyone’s daily experience readily verifies. And even where those legacy technologies *appear* to be adequate to the task, it is only because everyone in the value chain from the content creators, to the content distributors, to the device makers are taking dramatic measures to make the consumer experience *appear* seamless. That approach is admirable, but it’s fundamentally a kluge, like patching up a rocket with duct tape.

HEVC is the only technology that can give consumers what they want, while also providing huge benefits to content creators, distributors, and device makers, benefits that will allow them to abandon their expensive kluges, provide the anywhere anytime high quality video their customers demand, and at the same time reduce both their own costs as well as the costs – and prices - faced by their customers.

The key to HEVC’s ability to deliver these benefits to every segment of the value and distribution chains is the dramatic reduction in bandwidth achieved by the vastly-improved compression of the HEVC codec. Compared to even the most recent legacy codec (AVC), HEVC delivers today’s HD video at up to double the compression ratio – half the bit

rate – while delivering the same level of video quality. Even more importantly for newly-emerging Ultra High Definition/4K video, HEVC is the only video codec today that is capable of efficiently streaming Ultra HD video for consumers.

A comparison of the significant bandwidth savings offered by HEVC as shown in a web presentation by the Society of Motion Picture and Television Engineers in March of this year highlights these two points:<sup>1</sup>

*Table 1: HEVC Potential – Direct-to-Home; For Similar Picture Quality*

Definition	MPEG-2 Video	AVC	HEVC
SD	3-5 Mbps	1.8-3 Mbps	1-1.8 Mbps
HD	10-18 Mbps	5-9 Mbps	2.5-4.5 Mbps
4K UHD TV (2160p60 10b)	n/a	n/a	8–15 Mbps 15–25 Mbps

A good illustration of the benefits of HEVC is the dramatic way in which video consumption is changing at an ever-increasing pace with the growing popularity of video delivered using Internet-Protocol, or IP video. Commonly referred to as “video streaming”, “Over the Top” video, or simply “OTT”, IP video is distributed to consumers over the same facilities the consumers use for any other internet-related activity, both hard wired (such as fiber, cable, or DSL) and wireless.

Streaming video already has enabled the emergence of scores of new content providers – such as Hulu, Vudu and Apple TV – while allowing others – from Netflix to the networks (such as HBO Go and CBS All Access) – to revolutionize their business models by providing streaming content directly to consumers. Streaming video’s rapid rise in

<sup>1</sup> Available at <https://www.smpte.org/sites/default/files/section-files/HEVC%20tutorial%20C.pdf>.

popularity with consumers was captured in a snapshot provided earlier this year in a Cisco report on IP Traffic in which it was predicted that IP traffic would triple from 2014 to 2019, with IP Video representing 80% of Global IP Traffic by 2019.

**Consumer Internet Traffic, 2014–2019**

This category encompasses any IP traffic that crosses the Internet and is not confined to a single service provider’s network. Internet video streaming and downloads are beginning to take a larger share of bandwidth and will grow to more than 80 percent of all consumer Internet traffic by 2019 (Table 10).

Consumer Internet Traffic, 2014–2019							
	2014	2015	2016	2017	2018	2019	CAGR 2014–2019
<b>By Network (PB per Month)</b>							
Fixed	31,545	37,908	46,511	58,115	72,933	91,048	24%
Mobile	2,050	3,430	5,599	8,906	13,587	20,544	59%
<b>By Subsegment (PB per Month)</b>							
Internet video	21,624	27,466	36,456	49,068	66,179	89,319	33%
Web, email, and data	5,853	7,694	9,476	11,707	14,002	16,092	22%
File sharing	6,090	6,146	6,130	6,168	6,231	6,038	0%
Online gaming	27	33	48	78	109	143	40%
<b>Total (PB per Month) Consumer</b>							
Internet traffic	33,595	41,338	52,110	67,021	86,520	111,592	27%

Source: Cisco VNI, 2015

But despite their newly-won disruptive freedom, streaming video providers face the same restraints physics imposes on everyone else: the highest quality video such as UHD means higher bit rates, which directly translates into the need for more bandwidth for distribution, which in turn directly translates into higher total bandwidth costs for both video providers and consumers.

This is where HEVC comes to the rescue: by increasing compression by up to 50% over the legacy AVC code, HEVC-encoded video content can cut in *half* the bandwidth needed for streaming and take up *half* the storage capacity, thereby cutting both streaming

and storage charges in *half*. So at a given resolution the video will use as little as half the resources, or for a given amount of resources you can stream or store up to double the amount of video.

UHD video will use more bandwidth as Table 1 above demonstrates. But far from facing a massive increase in bandwidth costs, streaming video providers will only need to use – and pay for – effectively the same bandwidth to provide 4K/UHD that they use today to deliver lower quality HD Video. And content providers that continue to provide only HD video to their customers can achieve up to 50% savings in bandwidth demand – and therefore in cost – by using HEVC Video.

The same bit-rate reductions offered by HEVC that lead to significant savings in bandwidth and related costs for video content *distribution* also lead to significant savings in the amount and cost of video content *storage*. Whether streaming providers purchase or self-provide storage for their video content, storage accounts for another large chunk of streaming providers' overall cost. Reducing their storage need by up to 50% or more will create significant savings for streaming providers on storage, both immediately while their video is mostly HD, and in the future as they migrate to mostly UHD.

As shown in the following pay-per-view example using industry averages, switching to HEVC will lower content providers' costs as compared to even a relatively efficient legacy codec such as AVC, and allow content providers to provide a UHD stream that delivers a better quality user experience, and does it more cost effectively.

## Mid-Tier Streaming Service Provider for Single Movie (Title-by-Title)

### Based on Use of AVC v HEVC

AVC				
	Low GB Transport Cost		High GB Transport Cost	
	HD 1080p	UHD (1)	HD 1080p	UHD
<b>Revenue</b>				
Single movie (title-by-title)	<b>\$4.00</b>	n/a	<b>\$4.00</b>	n/a
<b>Cost</b>				
GB per 2 hour movie	6.0	n/a	6.0	n/a
Cost per GB	\$0.008	n/a	\$0.015	n/a
Streaming cost per movie	<b>\$0.048</b>	n/a	<b>\$0.090</b>	n/a
AVC royalty fee (2)	<b>\$0.020</b>	n/a	<b>\$0.020</b>	n/a
<b>Total Cost per movie</b>	<b>\$0.068</b>		<b>\$0.110</b>	

HEVC				
	Low GB Transport Cost		High GB Transport Cost	
	HD 1080p	UHD	HD 1080p	UHD
<b>Revenue</b>				
<b>Single movie (title-by-title)</b>	<b>\$4.00</b>	<b>\$5.00</b>	<b>\$4.00</b>	<b>\$5.00</b>
<b>Cost</b>				
GB per 2 hour movie	3.0	7.0	3.0	7.0
Cost per GB	\$0.008	\$0.008	\$0.015	\$0.015
Streaming cost per movie	<b>\$0.024</b>	<b>\$0.056</b>	<b>\$0.045</b>	<b>\$0.105</b>
HEVC royalty fee (2)	<b>\$0.020</b>	<b>\$0.025</b>	<b>\$0.020</b>	<b>\$0.025</b>
<b>Total Cost per movie</b>	<b>\$0.044</b>	<b>\$0.081</b>	<b>\$0.065</b>	<b>\$0.130</b>

Comparative Gross Profits Using AVC v HEVC				
	Low GB Transport Cost		High GB Transport Cost	
	HD 1080p	UHD	HD 1080p	UHD
<b>Gross profit using AVC after costs of CDN and AVC royalty</b>	<b>3.932</b>		<b>3.890</b>	
<b>Gross profit using HEVC after costs of CDN and HEVC royalty</b>	<b>3.956</b>	<b>4.919</b>	<b>3.935</b>	<b>4.870</b>
<b>Other Cost savings in storage, etc.(estimated)</b>	<b>0.006</b>		<b>0.012</b>	
<b>Gross profit using HEVC plus other cost savings</b>	<b>3.962</b>		<b>3.947</b>	

**Notes:**

- (1) Streaming UHD through H.264 is not feasible
- (2) Assumes AVC MPEG LA Royalty.

Another part of the equation that has been missing from the discussion is the *consumer*. Yes, the consumer, the whole reason this entire industry of content providers and device manufactures and others exists and thrives. The simple fact is that consumers will benefit greatly from HEVC, both from the enhanced viewing experience and also from the *direct* savings on the bandwidth charges they pay, because of the fact that HEVC video uses as little as half the bandwidth of the last-generation H.264/AVC legacy codec. For example, the average consumer that views video on her smartphone uses approximately 3GB of data (equates to approximately 3 hours of HD video) per month and pays \$30-\$45 or more. Some consumers use and pay far more. As shown in the chart below, based on Verizon wireless' recently announced new data plan<sup>2</sup>:

#### Consumer Mobile Video - HD Resolution - Verizon Wireless Example

	Medium	Large	X-Large	High
Data in each data plan (in GB)	3	6	12	20
Price (cost to consumer) for each data plan (in \$)	45	60	80	120
Average cost per GB in each data plan (in \$)	15.00	10.00	6.67	6.00
GB per hour of video/streaming in AVC coding	1.00	1.00	1.00	1.00
GB per hour of video/streaming in HEVC coding	0.50	0.50	0.50	0.50
Hours of HD video under data plan in AVC coding (	3	6	12	20
Hours of HD video under data plan in HEVC coding	6	12	24	40
<b>Additional Streaming Hours with HEVC</b>	<b>3</b>	<b>6</b>	<b>12</b>	<b>20</b>
<b>Or</b>				
<b>Incremental Cost Savings (in \$)</b>	<b>15</b>	<b>20</b>	<b>20</b>	<b>40</b>

<sup>2</sup> <http://www.verizonwireless.com>

If HEVC were widely adopted, that consumer could either watch another 3 hours of video content for the same cost *OR* could choose a lower tier, less expensive, data plan and depending on the service provider save ~\$10 dollars (or more) per month! *Yes, \$10 per month – for every smart phone user – for every month – with HEVC!* Over the average 2 year life of a smartphone *that's \$240 dollars of either saving or additional video viewing.* And yes, while pricing is in flux and savings might be somewhat higher or lower than the example – one thing is irrefutable – with HEVC there will be very meaningful savings and/or a lot more hours of viewing for the same cost to the consumer.

So when pundits and others say that content providers shouldn't adopt HEVC or device manufacturers shouldn't include HEVC in their smart phones, you have to ask yourself, "How can anyone be so short-sighted?" Or maybe the issue is not short-sightedness, but on whom their sight is focused. If it is focused on the *consumers* there is no question that HEVC is the right move.<sup>3</sup> And if content providers deprive their customers of the bandwidth savings available with HEVC, we suggest consumers should, and will, find alternative content providers that have their interests more in mind.

Another issue that has been raised is the dire predictions that this "greedy" HEVC Advance royalty rate will stifle adoption of HEVC on devices. But let's look at the facts.

The HEVC Advance royalty in the U.S. for a HEVC Main profile decoder and/or encoder ("player") for a mobile device such as a phone or tablet or lap-top computer is \$.50, and the royalty for the more advance Main 10 profile is only \$.80. For a typical premium smartphone or mobile product with a price tag of about \$700, that's a royalty rate of .0007% to .001%! Even for a smartphone half that price, the royalty for Main profile

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<sup>3</sup> And as shown earlier there is effectively no case where switching to HEVC is more expensive for a content provider.

(the most likely use) is .00035%! And such a player provided with the smartphone may be used to decode HEVC video from any licensed HEVC video provider.

Are the phone/mobile product suppliers really going to deprive their customers of the tremendous benefits and direct cost savings of HEVC, let alone deprive the consumer ecosystem – which is struggling with capacity limitations – all because of a royalty of .0007% to .001%? A royalty which will take an average smartphone consumer approximately 3 days of typical usage to recover in costs savings? If they do, we would again suggest consumers find another supplier with their interests more in mind.

Another big part of the equation that has been missing is the strong consumer preference for the highest quality video and the fact that consumers are willing to pay a *premium* to receive it, a fact that the content providers have long known and factored into their pricing plans. For example, a Netflix subscription charges a \$3 premium (\$12 vs \$9) per month for the opportunity to watch in UHD. M-GO charges a \$2 to \$5 premium for a UHD title compared to an HD title. As shown above, the additional cost to provide that UHD video programming using HEVC, including the HEVC Advance royalty, is but a tiny fraction of the additional revenue enjoyed by the content provider. For example, in the case of Netflix, assuming Netflix streamed 20% of its content in UHD to its subscribers, the HEVC Advance royalty rate per subscriber would be 1.2 cents!

Compared to the benefits received across the value chain not only in improved video quality but also in real savings, the licensing rates of HEVC Advance are both fair and reasonable for all potential licensees. As anyone interested in HEVC already knows, there has been a lot of noise by, or on behalf of, streaming video providers about the HEVC Advance royalty rates. But comparing the benefits the streaming video providers and their

customers will get from HEVC to the licensing rates of HEVC Advance shows just how fair and reasonable HEVC Advance's rates are.

First, for content providers the rate structure is perfectly – and purposely – aligned with the various streaming video business models. The license provides for a royalty of 0.5% of “attributable” revenues, explaining that “attributable” revenues are confined to only that portion of the streaming service provider’s revenues that are associated with transmitting HEVC video. And the license does not in any way affect a streaming video provider’s choice of business model: by specifying that the 0.5% is assessed against any attributable revenue received by the streaming service provider “regardless of source or business model,” the license equally accommodates all business models ranging from those that directly charge end users in some fashion, to those that do not directly charge end users at all, instead achieving revenues from a related source, such as advertising. And to be clear, royalties are due only on *commercial* HEVC video transmitted by a *commercial* entity to an end-user who is receiving revenue or other consideration for such HEVC video transmission. Consumers sending or receiving non-commercial HEVC video from another consumer, such as a video clip of a family outing or a FaceTime or Skype conversation, are not impacted, as no royalties are due to HEVC Advance on such consumer video.

Second, recognizing the bandwidth savings of HEVC, and the resulting savings to the streaming service provider in reducing its costs for related resources – from content storage costs to bandwidth-related distribution costs – the royalty rate is only a portion of the savings and benefits the streaming video provider and other industry participants achieve by using the licensors’ inventions.

As anyone interested in HEVC also knows, much of the pushback by, and on behalf of, streaming video providers appears to be premised on the notion that the only fair and reasonable rate for such video providers is “free”, or if there is a royalty it should be paid by someone else ignoring the fact that content providers are a primary beneficiary of HEVC.

It must be said that “free” is a strange price for a commercial entity to insist is the only reasonable price. The streaming providers use many different resources in their businesses, and they face a cost for each. No matter how tough they are as negotiators, it is unlikely that their position in dealing with their suppliers of storage media or distribution services, or their providers of electricity, or for that matter their employees, is to insist that goods or services should be provided for free. They uniformly recognize that the way our economy works, they must pay for the resources they acquire from others in order to provide their services.

Uniformly, that is, except when it comes to their use of other peoples’ inventions. As noted earlier, HEVC is an industry standard that was developed over the course of more than 10 years through the cooperation of dozens of industry participants. Each of the participating companies made large investments and took significant risks in both dollars and opportunity costs over many years to invent the technologies that are incorporated into the HEVC standard. They also invested large sums of money in the development of the standard itself, both in soft costs for the time their employees spent in meetings and working on issue between meetings, and in hard costs for travel, hotels, and all the other expenses of such large efforts such long periods of time. The patented inventions that resulted from those investments in innovation and in establishing the standard are just as real “resources” being used by streaming video providers and others implementing HEVC

in their services and products as storage media, electricity, or employees. Like any other resources, using them comes at the price of paying for them.

One significant advantage of HEVC Advance is that it has already attracted – and will continue to attract – as licensors many of the companies that played significant roles in developing the HEVC standard. As a result the HEVC Advance license will provide coverage for many of the inventions at the very core of the HEVC standard. Similarly, and for the same reasons, HEVC Advance will offer hundreds of essential patents from day one, a number that will grow several fold as these same HEVC pioneers, and the others who join them as licensors, continue to receive additional patents from their pending applications.

Thus, HEVC Advance is, and will be, the best single source for patent coverage that is both broad and deep, offering those implementing HEVC the inventions and technical resources they need to build the best products and services, as well as the legal protection they want for those products and services.