From display manufacturers, let's turn to a group that's actually involved with 4K content: so-called "Over The Top" (OTT) video providers, like Netflix, Amazon, Hulu, You Tube, etc. OTT companies are in the business of acquiring video content, which they then make available over the Internet, either freely or to paid subscribers (according to their business model). Netflix has also led an OTT movement into content creation, with original series like "House of Cards".

Netflix, in particular, has been active in promoting UHD, even pledging to create all its new original content to the 4K standard. More, it has raised its own 4K ante, by producing the 3rd season of House of Cards in an upscale "6K" format (6144 x 3160 pixels). This is not a trivial investment. Not only are 6K cameras expensive, but post-production editing costs also go up considerably with higher resolutions. In addition, the resulting source files are huge—the 6K master copy for a 55-minute House of Cards episode is said to be a whopping 5.5 TB.

Still, in the overall budget for a high-profile TV series—relative to salaries, location costs, marketing, etc.—the added production costs for 4K and higher formats are doubtlessly a relatively minor line item. And, in an era when a TB of storage can be had for less than $30, even the cost of storing a TB for every 10 minutes of video is trivial.

The real nub of the crises created by new UHD resolution standards is not the cost of producing, editing, or storing UHD video, but rather the challenge of being able to actually deliver UHD programs, like House of Cards, in a true 4K format. And, here, Netflix is on solid ground, because (like other OTT companies) they don't deliver video.

It may be helpful to keep this point in mind the next time you hear or read glowing comments about the imminent advent of UHD video from Netflix or other OTT providers. Certainly, they are ready to acquire and store UHD content. They are even able to produce their own original programs in UHD formats. But their responsibility for UHD ends there.

Of course, OTT companies must provide video. Netflix does this either via mail, in a stored media format (DVD, Blu-Ray, Ultra Blu-Ray), or by streaming it over the Internet[6]. But OTT providers are not responsible for anything to do with either of these delivery ecosystems.

Thus, the Blu-ray Disc Association has a long list of contributors to the Blu-ray standard, but this list does not include Netflix. In other words, since companies interested in stored media have developed Ultra Blu-ray for 4K content, Netflix is happy to rent these disks. But, if no stored disk format is developed for 8K UHD resolutions, well, that's simply not Netflix's call.

Much the same can be said of Internet delivery. True, Netflix is easily the largest consumer of Internet bandwidth and, together with fellow OTT traveler, You Tube (a distant second in bandwidth consumption), now accounts for over one-half of all Internet traffic during prime loading periods. But OTT companies (unlike Al Gore) do not claim any credit for creating the Internet, and (like Al Gore) they take no responsibility for either maintaining or upgrading it.

If the Internet bogs down and OTT streaming stops thereby, well, your OTT provider sincerely regrets the interruption in your service, and suggests you try again later. And, if that doesn't fix the problem, you are, of course, free to call your local Internet service provider to complain.

In the next part of this series, we will turn from the easy problem of queuing up orders of magnitude more data for delivery, to the hard problem of actually delivering orders of magnitude more data.

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[6]To make sure streaming content gets though to their customers, streaming companies take advantage of something known as Adaptive Bitrate Streaming (ABS). ABS leverages the fact that, unlike traditional broadcast technologies, where data flows only one way from transmitter to receiver, the Internet is bidirectional. An Internet provider can not only send data to a customer, they can receive data back. Two-way communication opens up a whole new realm of interactive possibilities, including ABS.

The bidirectional communication involved in ABS consists of sending data to a target address and, in real time, receiving back information about available bandwidth at the target destination. Thus, the usual protocol on receiving a video request is to begin sending a relatively low-bitrate stream to the target address. For this reason, when you first start up an on-demand video, the picture is often not very good.

As video delivery starts, however, the receiving device reports back to the sender on its available bandwidth. Based on that feedback, the sender then adjusts the bandwidth of the stream being sent to the target. Thus, if more bandwidth is available, the sender switches to a higher bitrate feed, as appropriate, and the softer, lower-bitrate picture originally sent suddenly improves. Or, if even the initial, lower bandwidth feed exceeds the available capacity, the feed starts at a still lower bitrate. Or, should available bandwidth be below the lowest usable level for the target display, a "try again later" message is sent.

A standard ABS ladder, with full HD as its top rung, might consist of 10 steps, ranging, say, from a high resolution of 1920 x 1080 at 5800Kbps to a low resolution of 320 x 240 at 235Kbps. Using this ladder, a client that fails to meet the high requirement of 5800Kbps might still get a (softer) full HD picture, at a lower bandwidth of 4300Kbps. If the client device fails even that bandwidth test, the picture will shift from "full HD" to 720p HD (1280 x 720) at 3000Kbps. A softer version of this format might be available at, say, 2350Kbps. Below 2350Kbps, the picture reduces again, to a 720 x 480 SD format, streamed at 1750Kbps. And so on, all the way down to the bottom rung of the ladder, the small screen 320 x 240 mobile format streamed at 235Kbps.

In short, you may have a "full HD" TV, but if all don't have at least 2350Kbps of streaming bandwidth available when you're watching House of Cards, you won't be seeing it in HD. And if you don't have at least 4300Kbps available, you will be seeing it in 720p HD rather than a full HD 1920 x 1080 format.

This sort of ABS ladder is the secret behind Netflix's cheerful promotion of 4K content. Yes, they will make House of Cards available in a 4K UHD format. Glad to do so, in fact. All it takes is adding more UHD rungs to the top of their ABS ladder. But they do not say you, in your particular circumstances, will receive House of Cards in 4K. In fact, they do not guarantee any streaming customer will ever receive the program in this format. In reality, the version customers receive depends entirely on the sort of receiver they have, and the fluctuating bandwidth available at that receiver while the program is playing.

Thus, if you have a UHD receiver hooked up to a pipe with (say) 18Mbps available, Netflix surely will be happy to send you House of Cards in a 4K 3840 x 2160 format. Of course, this will not be the "full 4K" version of the program (with 10-bit HDR color channels streamed at a rate of 60fps, which certainly would require far more bandwidth). But, at least, it will be 4K resolution. However, if no one in the country has 18Mbps available at, say, 9PM on a Sunday, then no one watching House of Cards at that time will get the UHD version of the program. Yes, many, perhaps all can still see the program. But it will be shown in a lower resolution, lower bitrate version, as determined by the particular circumstances of each customer.

To repeat, OTT providers just provide the content—in every format, up to and including UHD—but they are not responsible for which format actually gets delivered to you. That is determined by fluctuating circumstances, over which they have no control, across an Internet they never built.