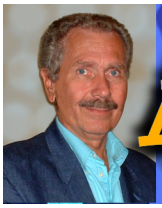

4K & U Executive TV HDTV Report nordahl.tv SM
4K & UHDTV Technologies & Economics of the Next TV Transition

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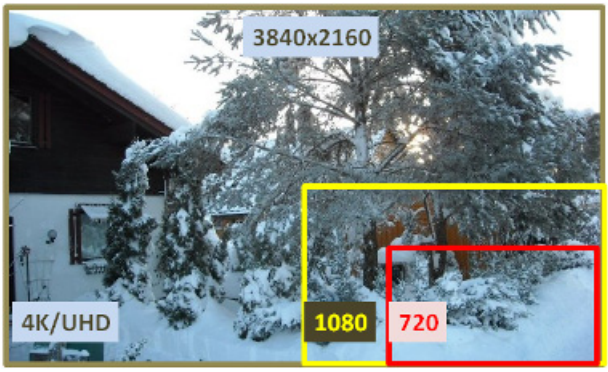
Attention all 720p60 TV Stations: Start STREAMING 1080p60 . . . be ready for 4K/UHD!

The 1080 Up-conversion Advantage

The early consumer adopters of larger 4K/UHD TVs must rely on up-conversion of HD to Ultra-HD for much of their early 4K/UHD viewing pleasure, as original 4K programs will be limited. TV stations transmitting 1080i60 OTA (or through pay TV providers) may have an image quality advantage over the 720p60 in the up-conversion process to 4K/UHD. This "full HD" 1080 advantage may be more material in a 4K/UHD viewing environment than in the past HDTV environment, as resolution/sharpness differences between 720p and 1080i for moving images are NOT obvious to the average home consumer viewing even on a larger "full" HDTV screen. The up-conversion process of 1080i60 to a 4K/UHD larger screen may in fact present to the average viewer a 1080i60 TV image noticeably better in resolution/sharpness than the same program in 720p60 also up-converted to 4K/UHD. Let's call it oversampling advantage for the 1080 in the 4K/UHD TV.

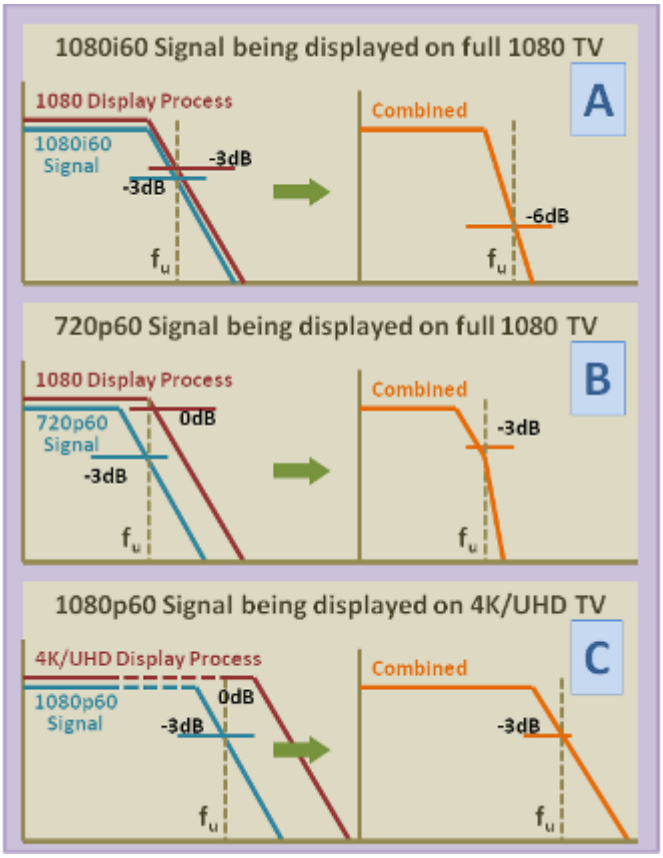
But does not 720p have the same (or similar) oversampling advantage? Yes, but that (up-conversion) oversampling advantage was "exhausted" by the up-conversion to full HD. No further 720p improvement is available by the 720p up-conversion to 4K/UHD. Look at the bandwidth plots to the right, which illustrate the theory behind this analysis.



4K/UHD spatial full frame resolution is 8.3 million pixels, while 1080 is 2.1 million (25%). 720 is only 0.9 million (11%). But remember that 720 includes 60 full frames per second, while 1080 only 30 full frames per second (60 fields).

The graphs below are based upon theoretical frequency responses where upper bandwidth limit is 3dB down, for each of 720, 1080 and 4K/UHD, to explain the theory. The real dB numbers may be vastly different, but the theory is the same.

Graph A below shows both the supplied 1080i60 signal and the HD TV 1080 display process each to be –3dB at the bandwidth limit, thus the combined response is –6dB. There is no oversampling.



Graph B above shows the supplied 720p60 signal to be –3dB at the bandwidth limit, while the full 1080 display process at the same bandwidth limit is flat (not started to roll off yet). Thus the combined response is unchanged at –3dB. There is some oversampling, and the 720 program will likely display with better sharpness on the full 1080 HD TV than on a 720 HD TV (where we have the combined –6dB effect).

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Graph C on previous page shows the supplied 1080i60 to be down –3dB at the bandwidth limit, while the 4K/UHD display process at the same bandwidth limit is flat (0dB), thus there is no degradation in the sharpness of the 1080 as compared with the sharpness at origination, while there may be reduced sharpness when displayed on a full 1080 HD TV (as compared with displaying it on a 4K/UHD TV).

We conclude the following:

720p60 originated program may offer improved perceived sharpness when displayed on a full HD TV as compared with displaying the 720 program on a 720 HD TV. Subject to high quality up-conversion.

1080i60/p30/p60 originated program may offer improved perceived sharpness when displayed on a 4K/UHD TV as compared with displaying the 1080 program on a full HD TV. Subject to high quality up-conversion.

720p60 originated program may NOT offer improved sharpness when displayed on a 4K/UHD TV as compared with displaying the 720 program on a full HD TV.

More actual viewing tests are necessary, but it is obvious that 1080p60 offers a higher level of resolution and perceived sharpness, as compared with 720p60, subject to acquisition and delivery in the 1080p60 format.

Word gets out . . . Ratings suffer

Once the fact is established (or perhaps just rumored), that the 180i60 TV station looks "much better" on the 4K/UHD screen than the 720p60 TV station, the 720p60 TV station may suffer in the ratings. And surely the 1080i60 TV stations local market competitors will take full advantage of the rumors flying around. The Author remembers one engineering colleague from many years ago. He just bought his first color TV set, and refused to watch any program in B&W from that day on!

Not viable to switch OTA Format

Your TV station has transmitted 720p60 OTA (Over-The-Air) and fed 720 to the CATV/Satellite/IPTV providers for years with success. Is it too burdensome to switch OTA format from 720 to 1080? Probably, and remember that only about 10% of all TV households get your signal OTA. 90% or so get your signal through CATV/Satellite/IPTV. Forget about switching OTA to 1080. You may have sub-channels and/or M-DTV service to worry about, so keep your OTA 720 format. And there is also the new ATSC3 standard coming within several years, plus the FCC spectrum grab, auction and channel/frequency reassignments. Also remember that the TV households (10%) receiving OTA (only) are less likely to buy new 4K/UHD TVs anyway!

But . . . change your 720 feeds to CATV/Satellite/IPTV to 1080

Make it possible for any of the 90% (average, of all TV households in your market area) CATV/Satellite/IPTV subscribers in the U.S. to watch your TV station's signal in the best possible light by supplying 1080 to the 4K/UHD TVs as the number of 4K/UHD TV households increases.

Over the next 5 years, about 30+ millions of 4K/UHD TVs are estimated to be sold in the U.S. Many more millions of full 1080 HDTVs will be sold, but NEXT to NONE 720 HDTVs will be sold.

The good news is that a broadcast quality 1080p30/60 will display very well on a larger 4K/UHD TV, being nearly competitive with 4K/UHD program material at traditional home viewing distances. 1080p30/60 could be the TV Broadcasters choice for next 3 to 5 years.

4K/UHD Not Likely to go OTA

To get 4K/UHD on the air, a compressed bitrate in the range of 25 to 30Mbps is required with HEVC compression including error correction. Without going into a detailed discussion for or against 4K/UHD OTA, the Author is of the opinion that, between the FCC, the cellular industry and telecom forces, TV broadcasting is likely to be limited to local TV stations each getting reduced spectrum, sufficient for 1080p60 only. 4K/UHD is not likely to go OTA. This will also be in line with "the best use of spectrum for public policy" as 90% of TV households are currently getting local TV station signals via CATV/Satellite/IPTV and over OTT Internet. In addition, the ever growing cellular wireless mobile reception of TV and video has no need for 4K/UHD resolution on tablets and smartphones. 1080p60 will do nicely!

Your TV Station's Future?

Dual Concurrent Transmissions of 1080p60 OTA and 4K/UHD Internet Streaming

By 2020, in the opinion of the Author, there will be dual concurrent broadcast television delivery vehicles for the same program:

1) Over-The-Air will be limited to 1080p60 using HEVC
2) Internet streaming of 4K/UHD, also using HEVC

If your TV Station is currently 720p60, then start producing all programs in 1080p60 and start streaming as soon as possible. So you have 5+ years to get into 1080p60 OTA and 4K/UHD streaming. What if you're 1080i60? Do the same thing. Start producing all programs in 1080p60 and start streaming!

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