



Status of UHDTV broadcasting in Republic of Korea

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- ❖ Backgrounds
- ❖ Terrestrial UHDTV broadcasting
 - General Information
 - System information, Encoding, Transmission, Field test
 - 4K content
 - Future plan
- ❖ Satellite UHDTV broadcasting
- ❖ Cable UHDTV broadcasting
- ❖ Conclusion

Backgrounds in Rep. of Korea

- ❖ Successful termination of terrestrial analog broadcasting in 2012
 - ATSC, Video : 1920x1080i MPEG-2, Audio : Max 5.1ch AC-3

- ❖ Requesting a post-HDTV broadcasting service in Terrestrial
 - 2010 ~ 2011 : 3DTV
 - 2012 ~ : UHDTV

- ❖ UHDTV, not only by Satellite TV but also Terrestrial Broadcasting

- ❖ Problems of Terrestrial UHDTV broadcasting
 - **Huge amount of video data**
 - **Narrow and limited frequency bandwidth**

Backgrounds

- ❖ **Need** new technology and equipment for making 4K video and terrestrial broadcasting
 - **4K camera → 2009 ~, RED, Sony, Canon**
 - **High speed & mass storage or media** for 4K video recording
→ **SSD or memory based storage**
 - **Transmission → DVB-T2, 2008**
 - **Video Codec → HEVC, 2013, JCT-VC**

Terrestrial UHDTV broadcasting

- ❖ In 2012, 4 major terrestrial broadcasters in Rep. of Korea participate in the project UHDTV
 - Supported by the regulatory body of MSIP(Ministry of Sciences, ICT and Future Planning) and KCC(Korea Communications Commission)



❖ UHDTV Trial License : Phase I

- Sept. 1 ~ Dec. 31 2012
- Just 4 months
- Licensed by KCC

❖ Main Feature of UHDTV Trial

- World's First Terrestrial **4K 30P** Trial On-Air
- Tx Scheme
 - DVB-T2 256QAM, 6MHz Bandwidth
 - Tx Power : 100W
 - Frequency : 785MHz
- Codec System
 - HEVC Encoding / MPEG-2 TS
 - 4K 30P Content Production
 - Real Time Decoding & **4K 30P** Display

❖ UHDTV Trial License : Phase II

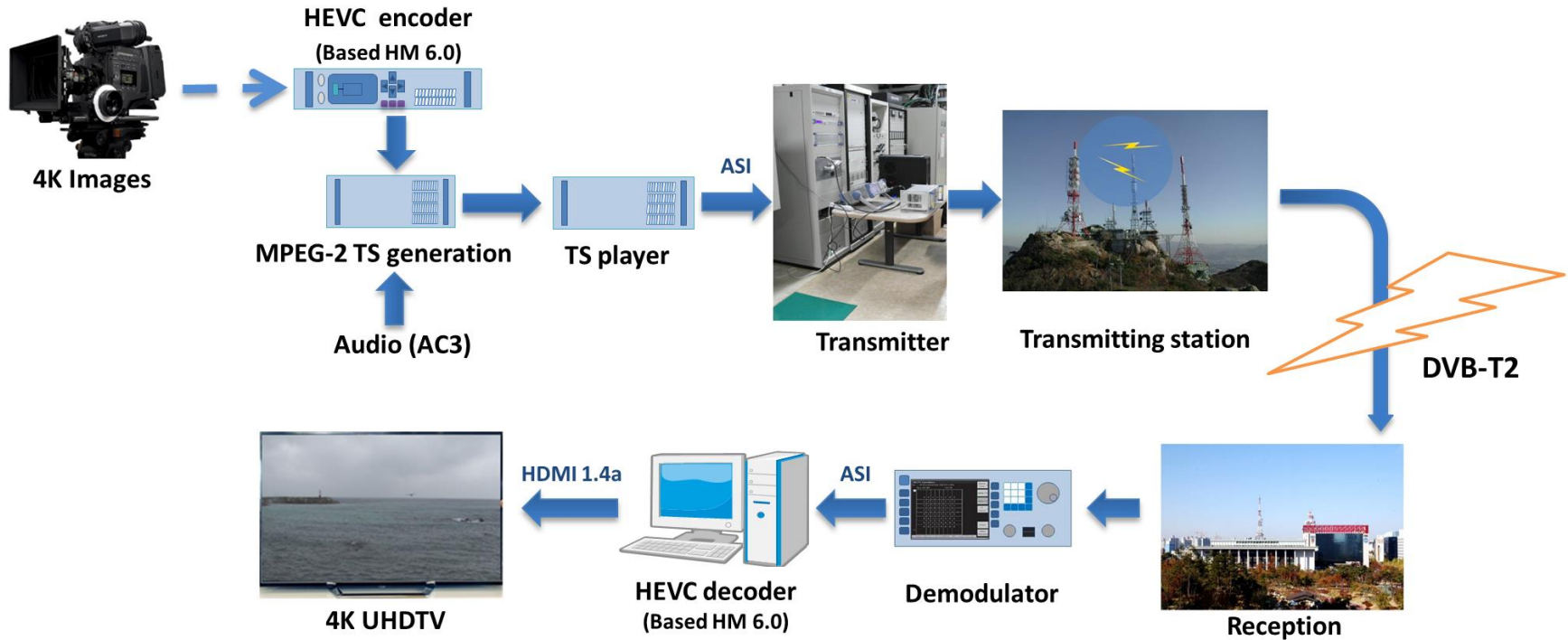
- May. 10 ~ Oct. 15 2013
- About 5 months
- Licensed by MSIP

❖ Main Feature of UHDTV Trial

- **4K 60P** Trial On-Air
- Tx Scheme
 - Same System and Tx Power
 - Various System Parameters
- Codec System
 - HEVC Encoding / MPEG-2 TS
 - 4K 60P Content Production
 - Real Time Decoding & **4K 60P** Display

System Configuration – Phase 1

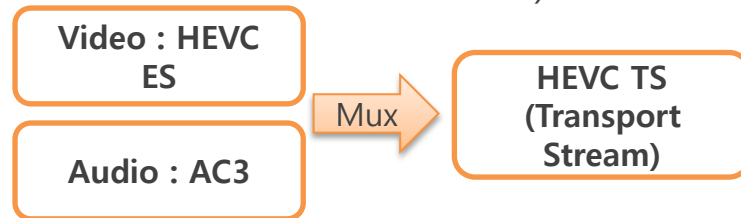
Sept. 1 ~ Dec. 31 2012



Encoding – Phase 1

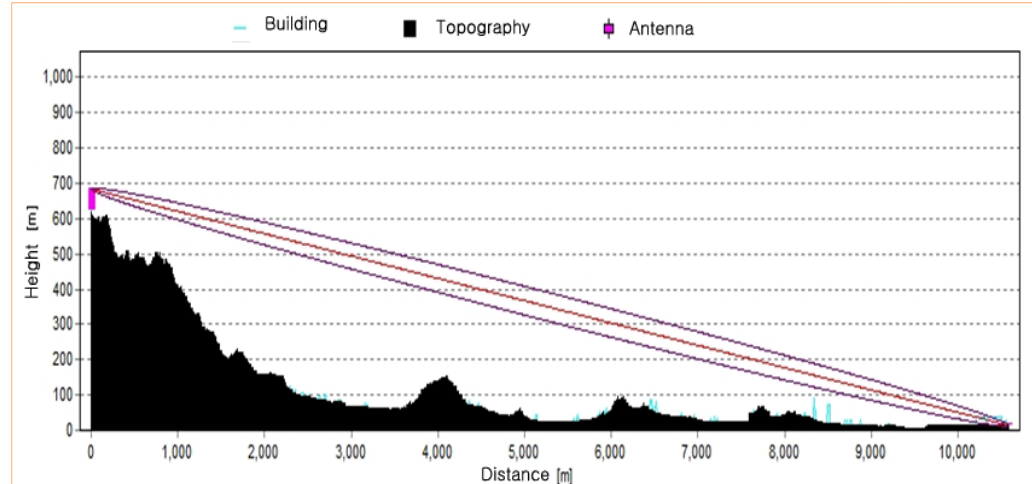
- ❖ Video Codec : HEVC (HM v6.0)
- ❖ Video format : 4K(3840x2160), 4:2:0, 8bits, 30fps
- ❖ Encoder type : non real-time S/W encoder
(Usually, it takes over a day to encode a video of one minute long)

- ❖ Encoding settings for 4K-UHD experimental broadcasting
 - Profile : main profile
 - Maximum coding unit size : 64x64
 - Intra Period : 32
 - GOP size : 8
 - Bitrate : 30Mbps approx.
 - Rate control : not applied
 - Quantization parameter : manually adjusted
(28, 30, 32, 34...)



DVB-T2	Parameter	Note
Bandwidth	6MHz	
Channel Number	UHF 66ch (Fc 785Mhz)	
Transmission Power	100 W	
Transmission Distance	10.61 km(Line of Sight)	Transmitting station <--> Receiving point
Valid Data-rate (maximum)	36.56 Mbps	

DVB-T2 Parameter		
1	FFT Size	32K
2	Pilot Pattern	PP7
3	Symbol Mapping	256-QAM
4	Constellation Rotation	ON
5	FEC(Forward Error Correction)	LDPC 64,800 blocks
6	Time Interleaver	Single Type
7	Time Interleaver Length	3
8	Guard Interval	1/128
9	Code Rate	5/6



Real-time HEVC Decoder (Government-run R&D project)



HDMI 1.4a x 1 (30P)
DVI x 2 (30p, 60P)
HD-SDI x 4 (30p, 60P)





- ❖ In December 2012, we were on going the field test for 4K UHDTV transmission by DVB-T2
- ❖ **5Km** away from KBS Gwanak Tx Site.

	Reception Level[dBm]	MER[dB]	TS Error	Reception
1	-50.8	32.7	No Error	Good
2	-59	29.3	No Error	Good
3	-43.7	35	No Error	Good
4	-42.4	37.6	No Error	Good
5	-54.7	30.9	No Error	Good
6	-74.8	N/A	N/A	Bad
7	-57.1	29.8	No Error	Good
8	-63.8	25	N/A	Bad
9	-84.9	N/A	N/A	Bad
10	-54.6	28.6	No Error	Good
11	-60.7	N/A	N/A	Bad
12	-57.9	27.6	No Error	Good
13	-58.5	29	No Error	Good
14	-60.4	27.4	No Error	Good
15	N/A	N/A	N/A	Bad

- ❖ 2010. Drama "The slave hunters"
24 episodes, 4K 24p by Red One
- ❖ 2011. Drama "The Princess' Man"
9 of 24 episodes, 4K 24p by Red Epic
- ❖ 2012. Drama "Gaksital"
4 of 28 episodes, 4K 24p by Red Epic
- ❖ 2012. Two short documentary,
4K 30p by Sony F65
- ❖ 2012~2013. Long term documentary "Colors for Desires"
4K 60p by Sony F65
- ❖ 2013~ . Long term documentary "Food Odyssey"
4K 60p by Sony F55, Red Epic and Canon C500



The Slave Hunters



The Princess' Man



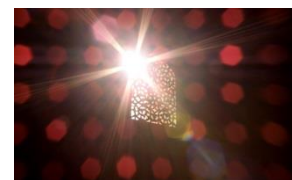
Gaksital



Jungsun & Naksan



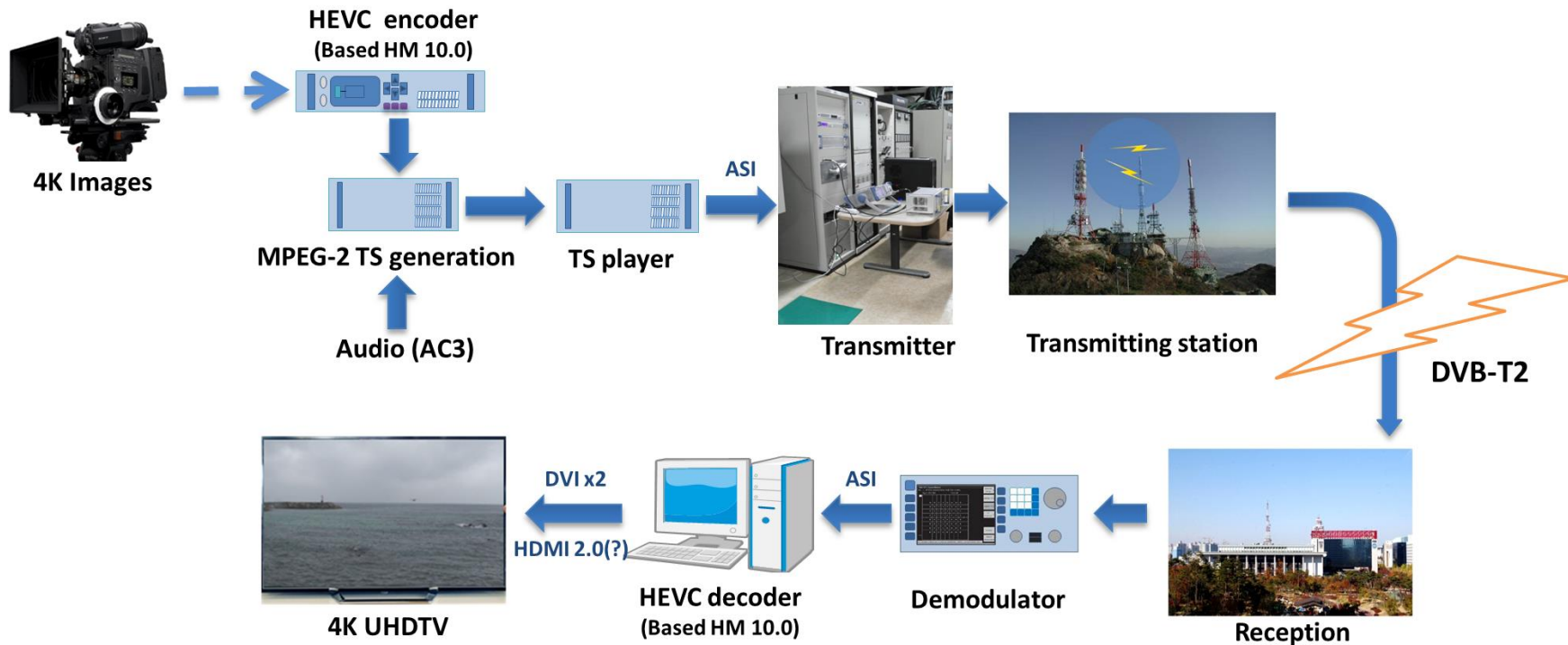
Colors for Desires



Food Odyssey

System Configuration – Phase 2

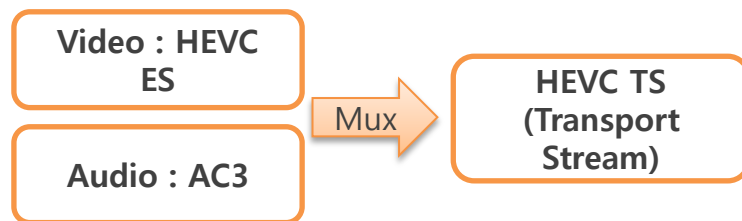
May. 10 ~ Oct. 15 2013



DVB-T2	Parameter	Note
Bandwidth	6MHz	Same parameter as Phase 1
Channel Number	UHF 66ch (Fc 785Mhz)	
Transmission Power	100 W	
Transmission Distance	10.61 km(Line of Sight)	
Valid Data-rate (maximum)	36.56 Mbps	

- ❖ Test with variable DVB-T2 parameters for 4K 60p
- ❖ Wide Area Field test

- ❖ Video Codec : HEVC (HM v10.0)
- ❖ Video format : 4K(3840x2160), 4:2:0, 8bits, 60fps
- ❖ Encoder type : non real-time S/W encoder
(Usually, it takes over a day to encode a video of 10 minute long)
- ❖ Encoder set-up for 4K-UHD experimental broadcasting
 - Profile : main profile
 - Maximum coding unit size : 64x64
 - IntraPeriod : 64
 - GOPsize : 16
 - Bitrate : 25Mbps approx.
 - Rate control



- ❖ Test for Bit Rate increase
- ❖ Increase **15~40%** Bit rate over HD resolution on condition of same QP(video quality)
- ❖ Average **30%** increase

Test Sequences	QP	30P		60P		BD	
		Bitrate (kbps)	PSNR-Y	Bitrate (kbps)	PSNR-Y	PSNR	rate mode (%)
BQTerrace HD(1920x1080) JCT-VC	22	15,812.02	36.795	18,631.29	36.306	-0.2697	17.82
	27	3,872.01	34.866	4,205.54	34.744		
	32	1,476.70	33.473	1,567.59	33.439		
	37	719.79	31.760	756.81	31.762		
Cactus HD(1920x1080) JCT-VC	22	8,933.35	38.051	10,383.02	37.854	-0.4222	18.22
	27	3,394.45	36.315	3,938.54	36.256		
	32	1,614.56	34.210	1,857.01	34.195		
	37	843.56	32.001	962.14	31.995		
Color HD(3840x2160) KBS	22	106,840.81	39.609	148722.41	38.996	-0.9227	32.25
	27	25452.59	36.154	34284.64	35.436		
	32	7408.75	34.852	9616.56	33.716		
	37	3022.75	33.475	3787.51	32.520		
average						-0.5382	22.76



<BQTerrace>



<Cactus>



<Color>

- ❖ Experimental 4K UHD TV Broadcasting Phase III in 2014
 - Upgraded video : 4K 60p 8bits to 4K 60p 10bits
 - Upgraded Power : 5KW
 - SFN test
 - Period : March 24 ~ Dec. 31 2014

- ❖ Establishing standard of organization for terrestrial 4K UHD TV

- ❖ Big Events related to 4K and 8K UHD TV
 - 2014 : Asian Athletic Games in Incheon, Rep. of Korea
 - Live 4K
 - 2015 : Willing to start 4K UHD TV
 - Start time is in talks with the government
 - 2018 : Pyeongchang Winter Olympic Games, Rep. of Korea
 - 8K UHD TV



4K UHD TV plan – Satellite and Cable

❖ Satellite (Ka and Ku band)

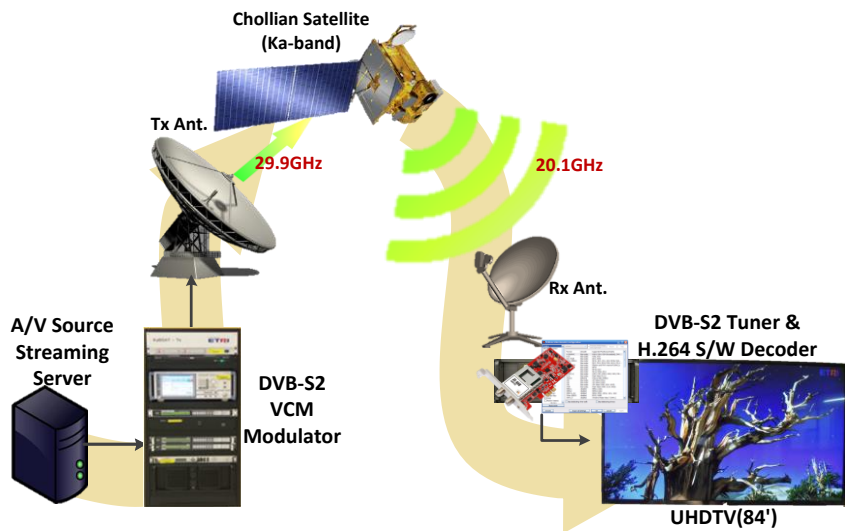
- 2013 : Established national standard for satellite broadcasting
- 2014 : Experimental and Test broadcasting
- 2015 : Start broadcasting

❖ Cable

- 2013 : Established national standard for cable broadcasting
- 2014 : Test broadcasting with set-top box built in UHD TV
- 2015 : Start broadcasting

4K-UHDTV trial broadcasting - Satellite

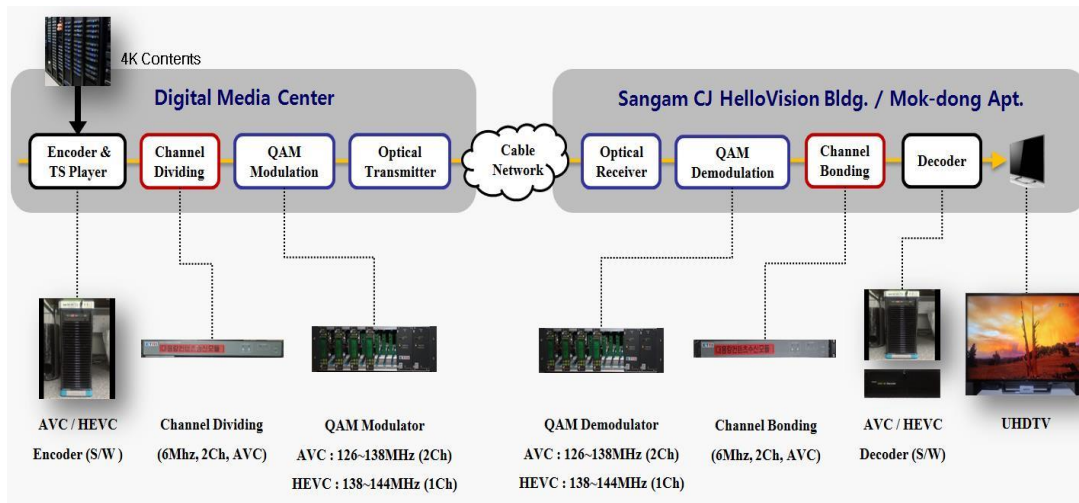
- ❖ Satellite based 4K-UHDTV trial broadcasting by ETRI-KT Skylife (Oct. 2012~ Jan. 2013)
 - 4K-UHD video transmission experiment through Ka-band Chollian satellite
 - H.264/AVC S/W NRT Encoding and RT Decoding for 4K-UHD source



AV format	3840X2160, 30p, YUV4:2:0, 8bits / 5.1channel
AV Coding	H.264/AVC, MPEG-4 AAC
Transmission	DVB-S2, 8PSK $\frac{3}{4}$
Bitrate	40Mbps/26MHz

4K-UHDTV trial broadcasting - Cable

- ❖ Cable based 4K-UHDTV trial broadcasting by ETRI - CJ HelloVision (Jan. 2013~)
 - Transmission of max. 70Mbps using Broadcast Channel Bonding over legacy digital cable broadcasting system



AV format		3840X2160, 30p, YUV4:2:0, 8bits / 5.1channel
Method-1	AV Coding	H.264/AVC, AC-3
	Transmission	ITU-T J.83 Annex B 256QAM with 2 channels bonding
	Bitrate	70Mbps
Method-2	AV Coding	HEVC, AC-3
	Transmission	ITU-T J.83 Annex B 256QAM with a channel
	Bitrate	40Mbps

Conclusion

- ❖ Rep. of Korea has a very concrete plan to open UHDTV era for terrestrial, cable and satellite TV
 - Start time of terrestrial 4K UHDTV is in talks with the government
- ❖ We found a possibility of 4K UHDTV broadcasting using terrestrial DTV channels thanks to DVB-T2 system and HEVC
- ❖ Need more test and trials for 4K video encoding with HEVC
- ❖ For immersive UHDTV viewing
 - High resolution (4K, 2012) → High Frame rate(60p, 2013) → Deep bit depth(10bits, 2014) → Wide and exact color (4:2:2, Rec2020, 2015) → High Dynamic Range → 8K UHDTV



Thank You.