



Telfor 2022

Novembar / Beograd

SBB 20 godina

Kada smo počeli 2002. godine, bilo nas je osmoro.
Sada nas je **2000**. I dalje rastemo.

Pružali smo usluge u sedam, danas smo prisutni u **32 grada** širom Srbije.

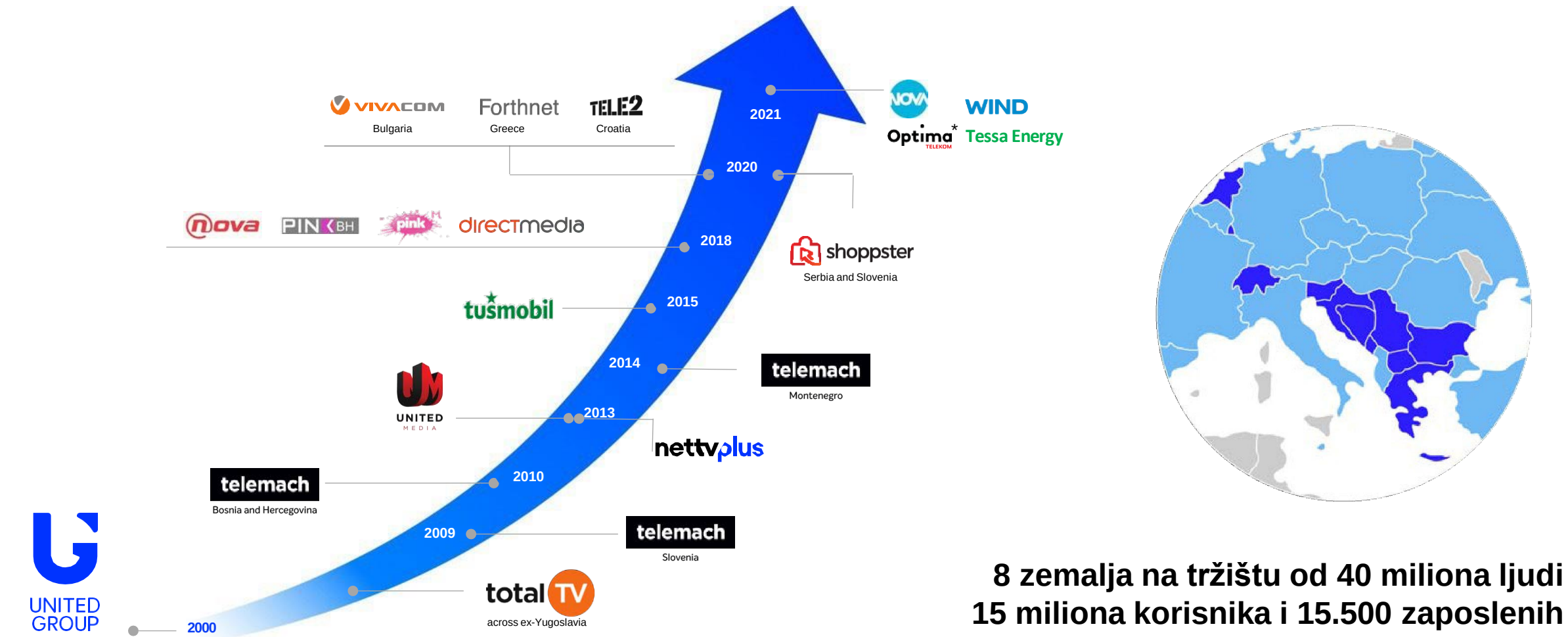
Prve godine pružali smo usluge za 20.000 korisnika. Danas SBB usluge koristi **3 miliona građana**.

Već **20 godina** donosimo inovacije i trendove na tržištu telekomunikacija u Srbiji.

Naša **vizija** je da korisnicima pružimo najkvalitetnije servise i najbolje korisničko iskustvo.

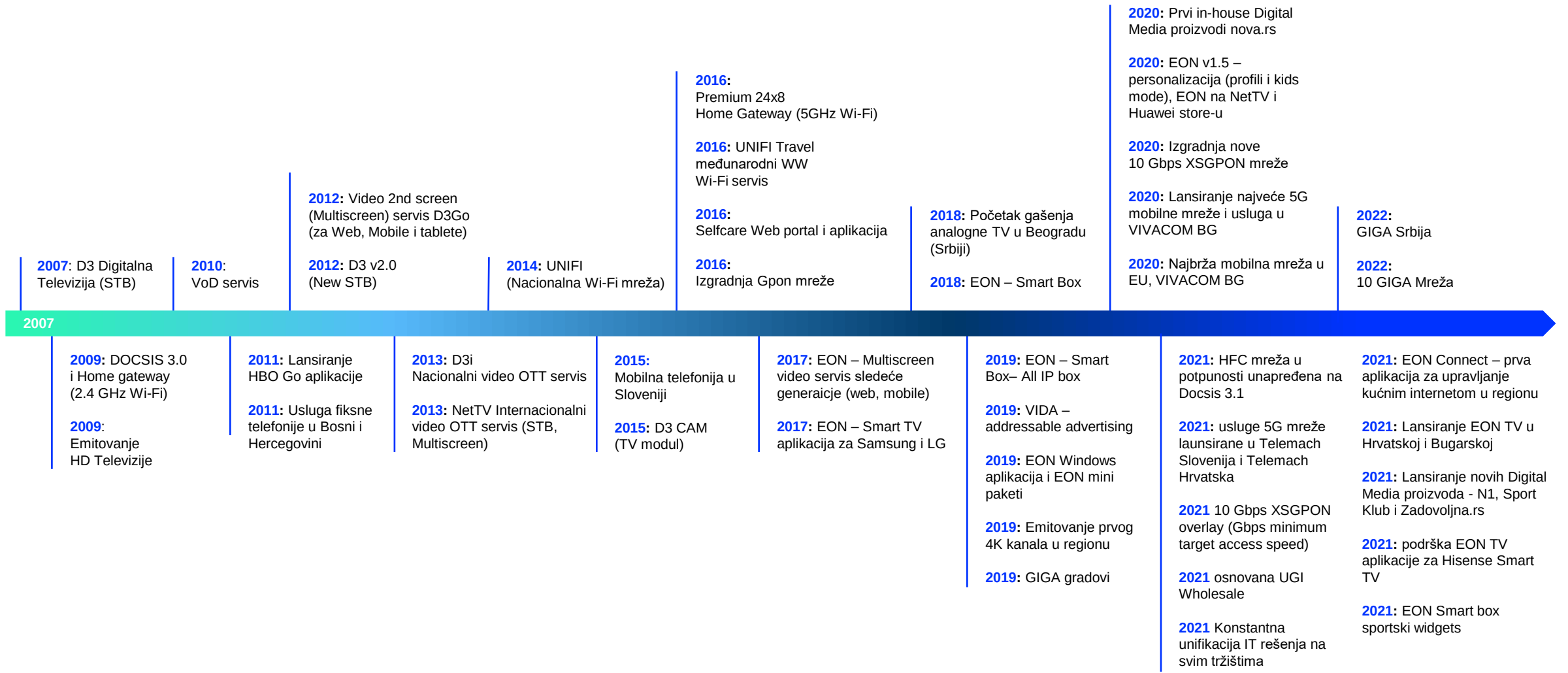


SBB posluje u okviru United grupe



8 zemalja na tržištu od 40 miliona ljudi
15 miliona korisnika i 15.500 zaposlenih

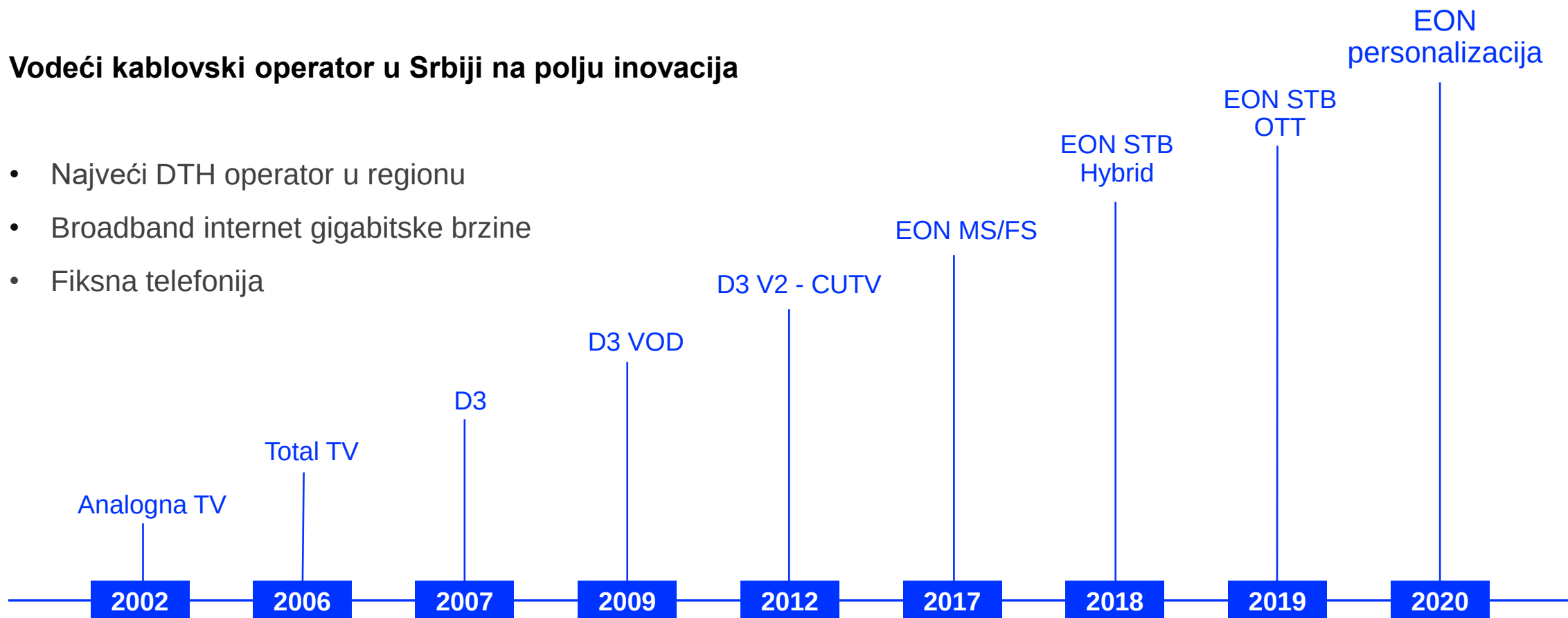
Konstantno praćenje tehnološkog razvoja...



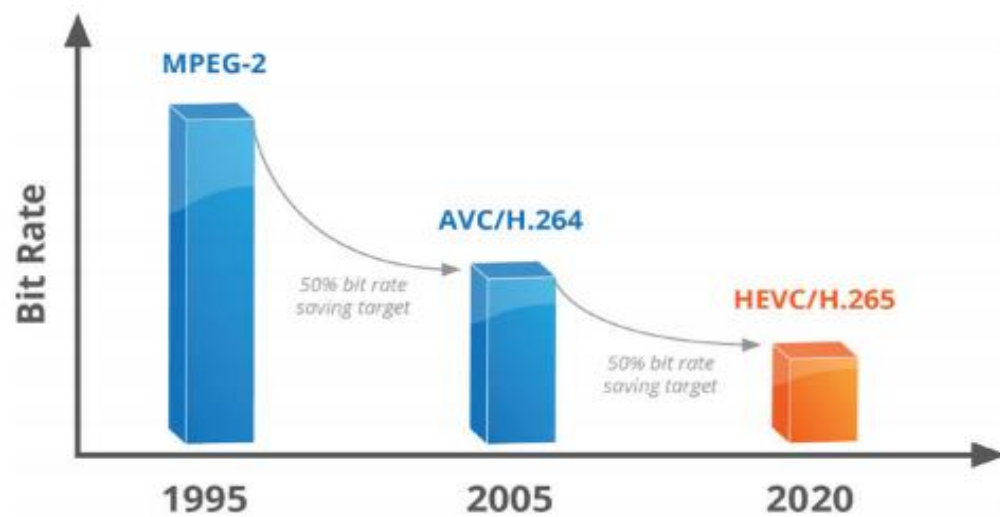
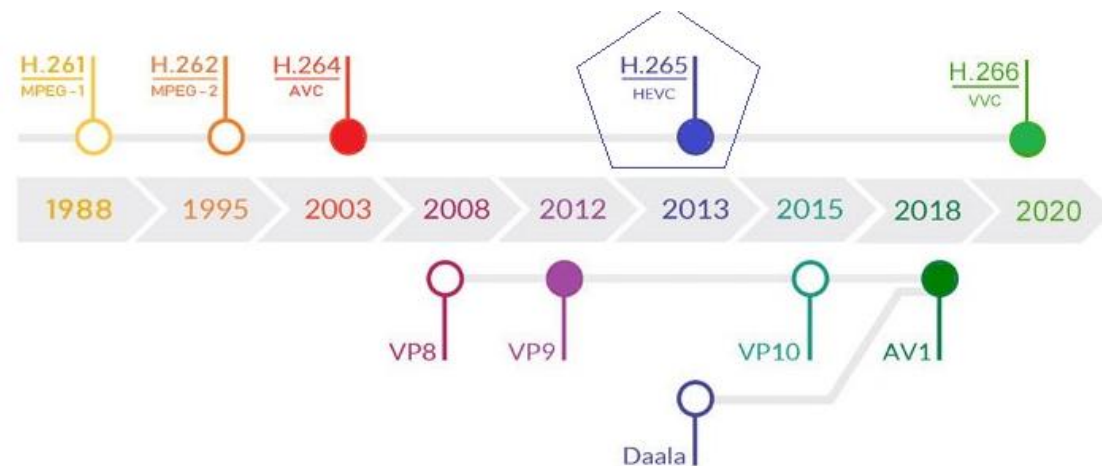
SBB – (R)evolucija video servisa

Vodeći kablovski operator u Srbiji na polju inovacija

- Najveći DTH operator u regionu
- Broadband internet gigabitske brzine
- Fiksna telefonija



MPEG razvoj



Trendovi

Kreiranje sadržaja



Operatori dobijaju sve bolje izvore od emitera i dugotraženi sadržaj je u porastu LIVE TV je „življi“ nego ikad.

OTT postaje naplativ. Korisnici očekuju kvalitet i dostupnost emitovanog sadržaja.

„Cloud“ je spreman za distribuciju strimova visokog kvaliteta. Pomeranje ka novim vidovima video transporta.

Ekrani su sve boljeg kvaliteta kako kod TV uređaja (4K, 8K) tako i kod mobilnih Video kvalitet nikad nije bio važniji.

Korisnici očekuju isto iskustvo na svim ekranima – broadcast i OTT. Konvergencija se dešava.

Korisnici očekuju da video bude dostupan bez ikakvih prekida. Stabilnost i dostupnost je ključ.

Video korisnici

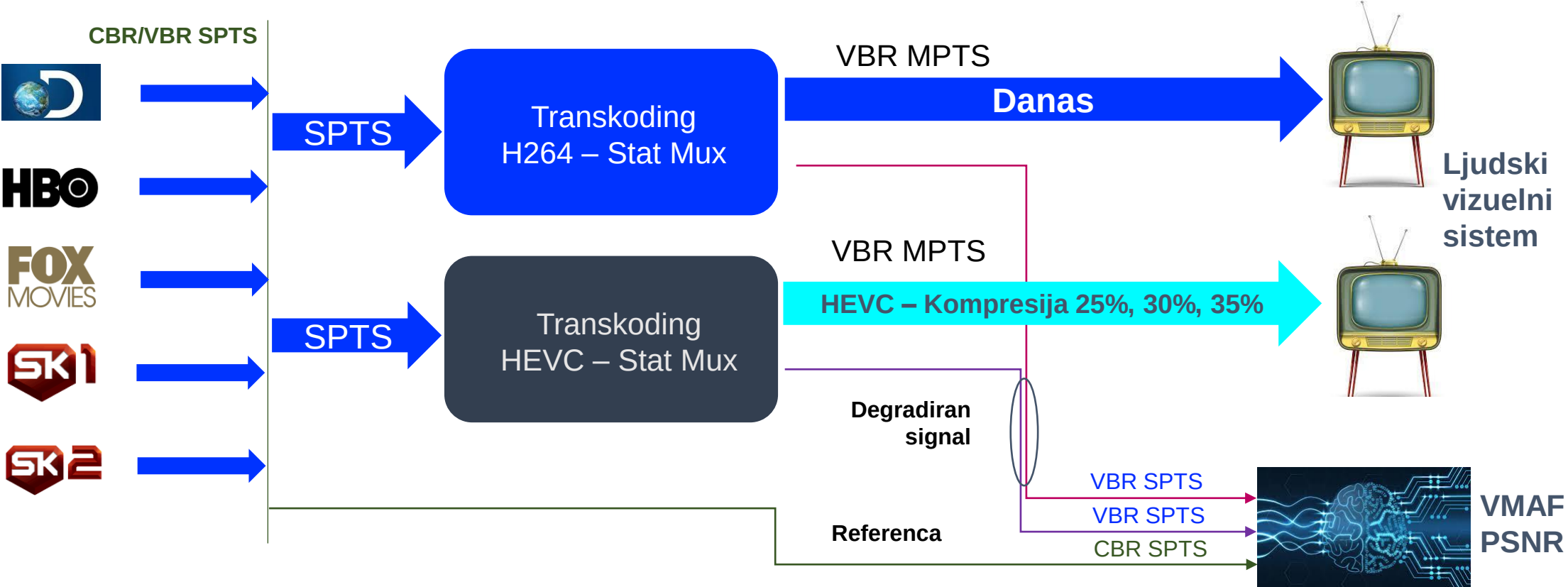


Metrike video kvaliteta

- VMAF
- PSNR
- SSIM



Objektivno i subjektivno



Source	Format	Content	Bit Rate	Hor resolution	Ver resolution								
d	1080i	Sport channel 1	7Mbps CBR	1920	1080								
9	1080i	Sport channel 2	7Mbps CBR	1920	1080								
5	1080i	Sport channel 3	5.4Mbps CBR	1920	1080								
1	1080i	Movie channel 1	7.5Mbps CBR	1920	1080								
2	1080i	Movie channel 2	7.5Mbps CBR	1920	1080								
3	1080i	Doc channel 1	10.2Mbps CBR	1920	1080								
10	1080i	Doc channel 2	6.9Mbps CBR	1920	1080								
7	1080i	Doc channel 3	4Mbps VBR	1920	1080								
6	576i	SD channel 1	3.1Mbps CBR	720	576								
4	1080i	SD channel 2	3.1Mbps CBR	1920	1080								
H264 today Reference	Format	Content	Bit Rate	Hor resolution	Ver resolution	VMAF	New CBR H264	Format	Content	Bit Rate	Hor resolution	Ver resolution	VMAF
1	1080i	Sport channel 1	4.5Mbps	1920	1080	99.75	1	1080i	Sport channel 1	4.5Mbps	1920	1080	96.53
2	1080i	Sport channel 2	4.48Mbps	1920	1080	93.64	2	1080i	Sport channel 2	4.5Mbps	1920	1080	97.45
3	1080i	Sport channel 3	4.52Mbps	1920	1080	91.31	3	1080i	Sport channel 3	4.5Mbps	1920	1080	96.75
4	1080i	Movie channel 1	4.44Mbps	1920	1080	95.83	4	1080i	Movie channel 1	4.5Mbps	1920	1080	96.91
5	1080i	Movie channel 2	4.39Mbps	1920	1080	91.89	5	1080i	Movie channel 2	4.5Mbps	1920	1080	96.2
6	1080i	Doc channel 1	4.77Mbps	1920	1080	95.78	6	1080i	Doc channel 1	4.5Mbps	1920	1080	97.61
7	1080i	Doc channel 2	4.76Mbps	1920	1080	94.67	7	1080i	Doc channel 2	4.5Mbps	1920	1080	96.78
8	1080i	Doc channel 3	4.57Mbps	1920	1080	95.75	8	1080i	Doc channel 3	4.5Mbps	1920	1080	97.99
9	576i	SD channel 1	1.6Mbps	720	576	96.63	9	576i	SD channel 1	1.75Mbps	720	576	97.59
10	576i	SD channel 2	1.8Mbps	720	576	85.82	10	576i	SD channel 2	1.75Mbps	720	576	92.8
New SMX H265	Format	Content	Bit Rate	Hor resolution	Ver resolution	VMAF	New CBR H265	Format	Content	Bit Rate	Hor resolution	Ver resolution	VMAF
1	1080i	Sport channel 1	26.5	1920	1080	99.37	1	1080i	Sport channel 1	3.15Mbps	1920	1080	97.82
2	1080i	Sport channel 2		1920	1080	99.36	2	1080i	Sport channel 2	3.15Mbps	1920	1080	99.07
3	1080i	Sport channel 3		1920	1080	99.36	3	1080i	Sport channel 3	3.15Mbps	1920	1080	97.73
4	1080i	Movie channel 1		1920	1080	97.73	4	1080i	Movie channel 1	3.15Mbps	1920	1080	99.39
5	1080i	Movie channel 2		1920	1080	95.01	5	1080i	Movie channel 2	3.15Mbps	1920	1080	95.9
6	1080i	Doc channel 1		1920	1080	95.56	6	1080i	Doc channel 1	3.15Mbps	1920	1080	97.04
7	1080i	Doc channel 2		1920	1080	96.72	7	1080i	Doc channel 2	3.15Mbps	1920	1080	N/A
8	1080i	Doc channel 3		1920	1080	95.32	8	1080i	Doc channel 3	3.15Mbps	1920	1080	98.02
9	576i	SD channel 1		720	576	99.37	9	576i	SD channel 1	1.25Mbps	720	576	100
10	576i	SD channel 2		720	576	95.24	10	576i	SD channel 2	1.25Mbps	720	576	97.18

Kompresija 25%

24.3Mbps

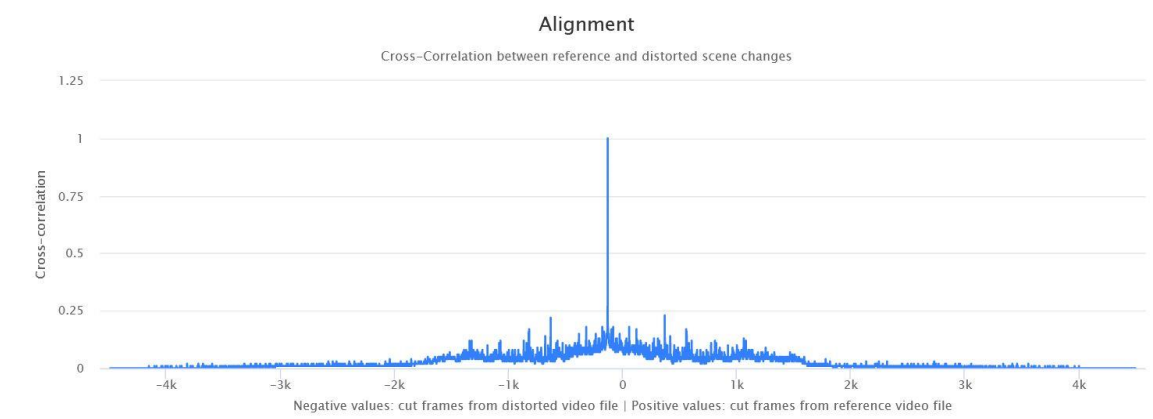
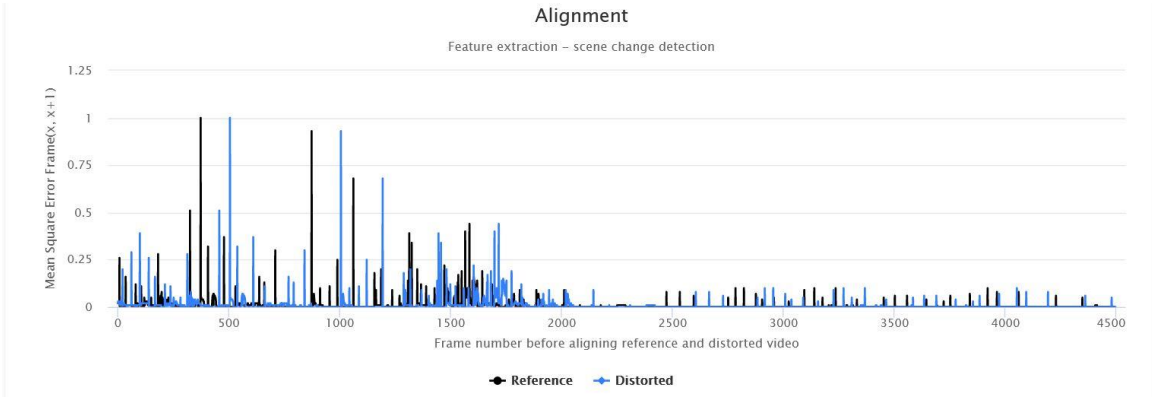
Name	Current (Mbps)	Avg (Mbps)	Min (Mbps)	Peak (Mbps)	Comp. rate (%)
Discovery HD H.264	5.915	4.913	3.613	6.036	
HBO HD H.264	3.097	4.637	2.480	5.915	
Fox Movies HD H.264	4.894	5.065	3.405	6.275	
SK 1 HD H.264	5.915	4.849	3.035	6.270	
SK 2 HD H.264	3.953	4.819	2.889	6.563	
Discovery HD HEVC	2.703	4.382	2.686	6.213	11%
HBO HD HEVC	2.644	2.811	1.848	4.183	39%
Fox Movies HD HEVC	3.297	3.078	1.611	5.422	39%
SK 1 HD HEVC	5.878	3.924	2.251	5.882	19%
SK 2 HD HEVC	4.568	4.892	3.280	7.213	-2%

19.1Mbps

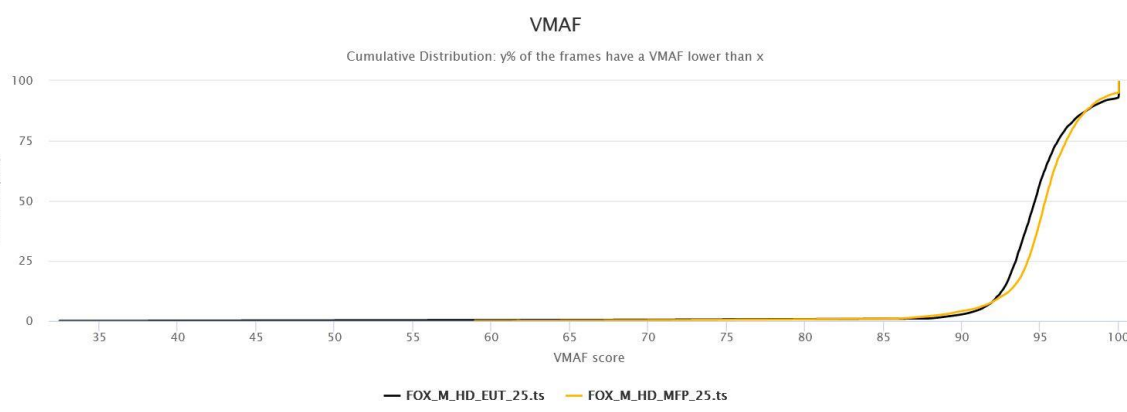
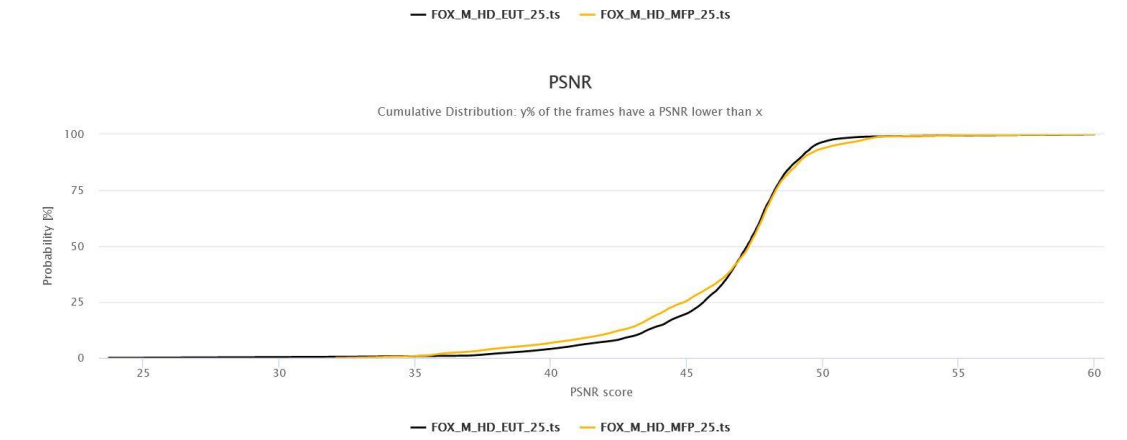
Zaključci o uštedama:

- Sportski HD kanali mogu ići sa 20% nižim bitrate-om
- Filmski HD kanali mogu ići sa 40% nižim bitrate-om
- Dokumentarni HD kanali mogu ići sa 15% nižim bitrate-om

Kompresija 25% - filmski kanali



Align offset: 370 frames



Kompresija 25% - filmski kanali

	FOX_M_HD_EUT_25.ts	FOX_M_HD_MFP_25.ts
Legend		
Resolution	1920x1080	1920x1080
Framerate	25.00 fps	25.00 fps
Pixel format	yuv420p	yuv420p
Codec	hevc	h264
Duration	179 s	179 s
Duration	4499 frames	4496 frames
Upload Date	2021-10-28T15:34:53.074Z	2021-10-28T15:36:01.714Z
VMAF mean	94.85	95.21
PSNR mean	46.58 dB	46.31 dB

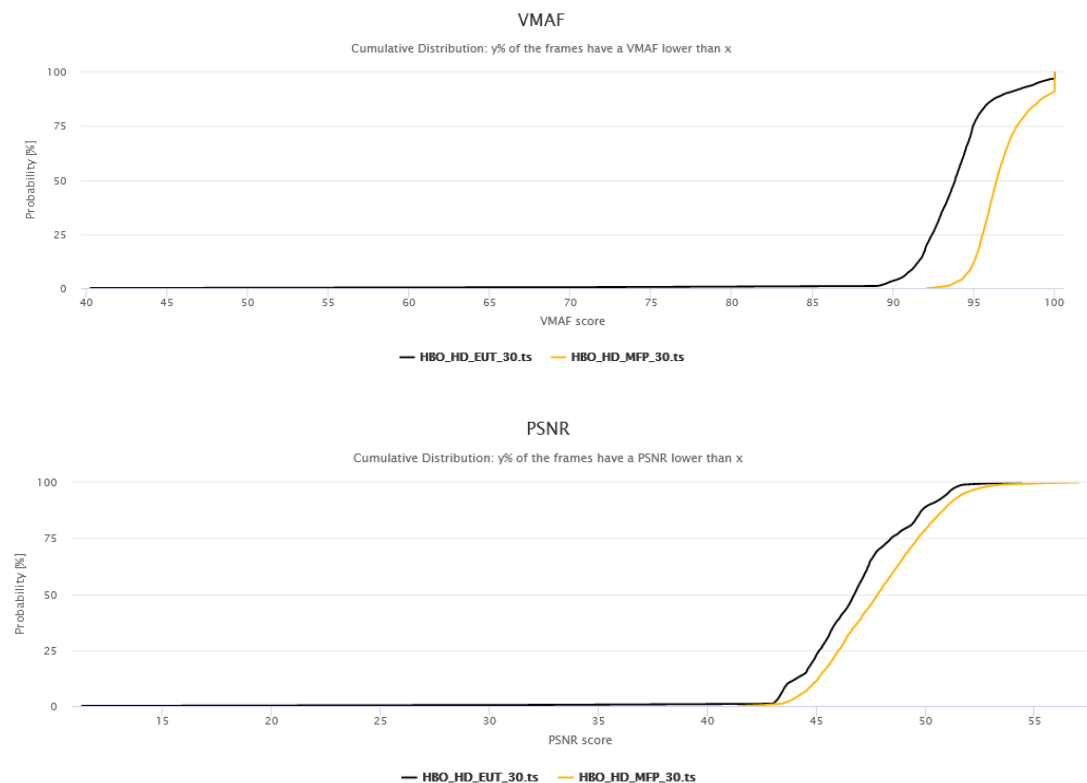
Kompresija 30%

24.3Mbps

Name	Current (Mbps)	Avg (Mbps)	Min (Mbps)	Peak (Mbps)	Comp. rate (%)
Discovery HD H.264	4.671	4.389	1.307	6.216	
HBO HD H.264	5.914	5.089	3.261	5.965	
Fox Movies HD H.264	5.133	5.197	2.042	6.418	
SK 1 HD H.264	3.763	4.595	2.67	6.275	
SK 2 HD H.264	4.523	5.046	2.889	6.679	
Discovery HD HEVC	5.533	3.851	0.883	6.175	12%
HBO HD HEVC	1.892	2.369	1.083	5.008	53%
Fox Movies HD HEVC	1.982	2.577	1.48	4.903	50%
SK 1 HD HEVC	2.465	3.691	1.515	4.476	20%
SK 2 HD HEVC	4.616	4.000	1.56	7.681	21%

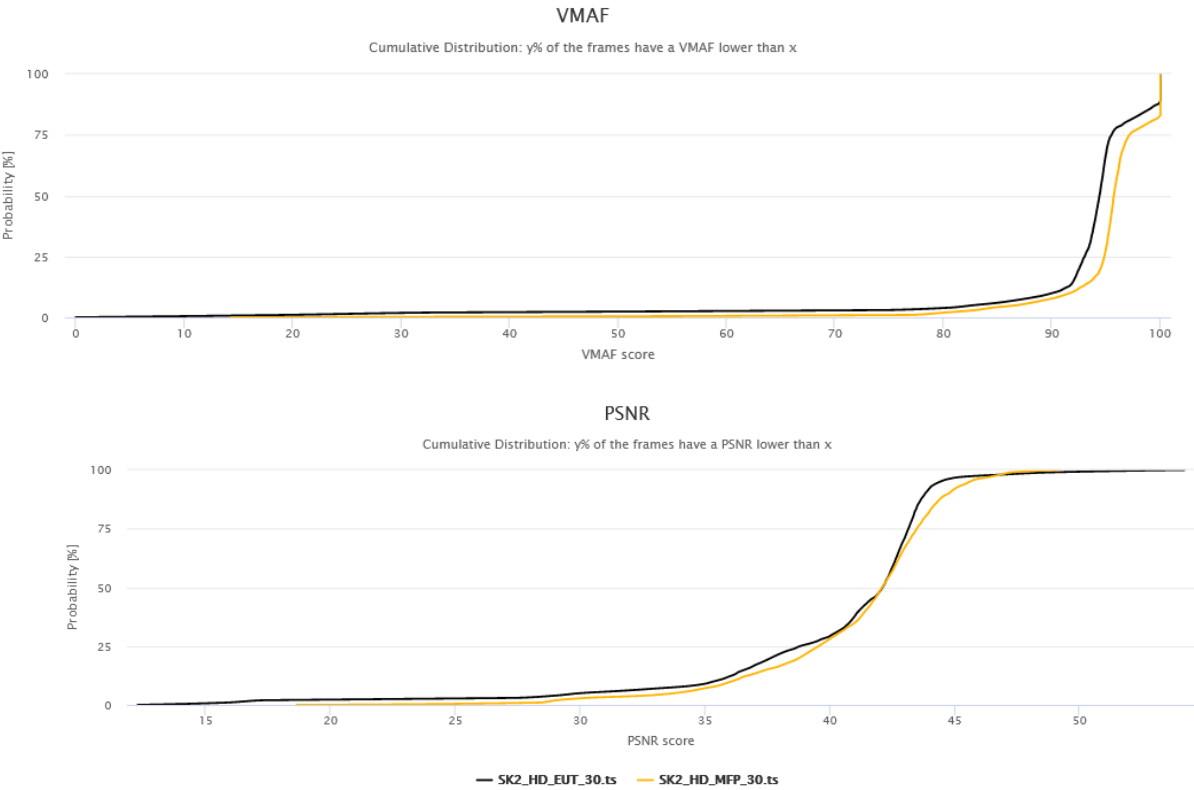
16.5Mbps

Kompresija 30% - filmski kanali



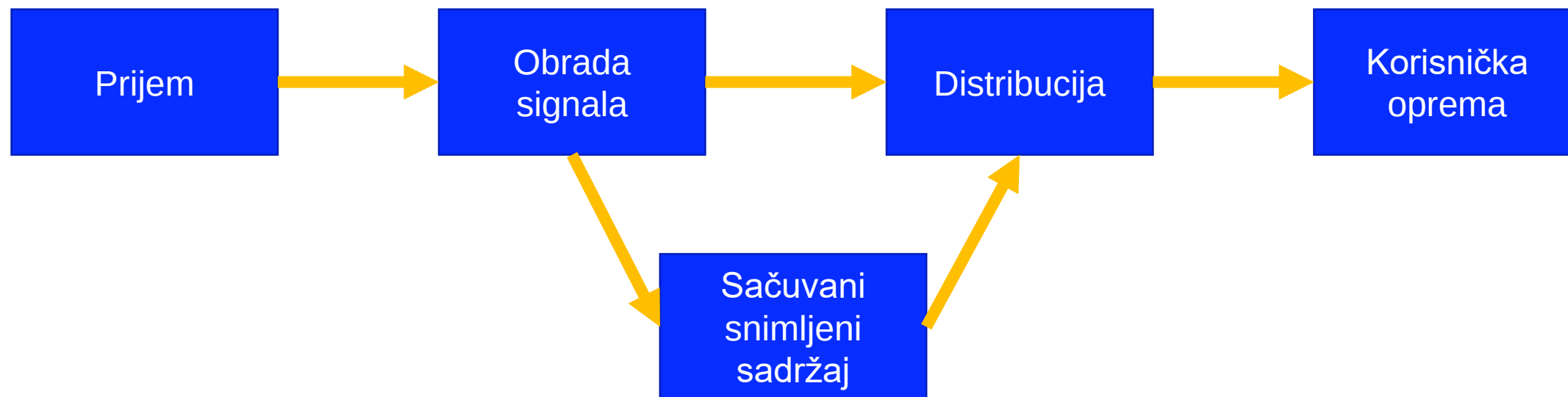
	HBO_HD_EUT_30.ts	HBO_HD_MFP_30.ts
Legend		
Resolution	1920x1080	1920x1080
Framerate	25.00 fps	25.00 fps
Pixel format	yuv420p	yuv420p
Codec	hevc	h264
Duration	176 s	180 s
Duration	4405 frames	4500 frames
Upload Date	2021-10-28T15:49:36.675Z	2021-10-28T15:52:16.343Z
VMAF mean	72.1	96.93
PSNR mean	40.07 dB	47.7 dB

Kompresija 30% - sportski kanali



	SK2_HD_EUT_30.ts	SK2_HD_MFP_30.ts
Legend		
Resolution	1920x1080	1920x1080
Framerate	25.00 fps	25.00 fps
Pixel format	yuv420p	yuv420p
Codec	hevc	h264
Duration	176 s	179 s
Duration	4416 frames	4487 frames
Upload Date	2021-10-28T15:56:42.958Z	2021-10-28T15:57:55.903Z
VMAF mean	92.38	95.35
PSNR mean	40.26 dB	41.11 dB

Uprošćena blok šema sistema



DVB-C HEVC – UHD kanali

Info bitrate = Symbol rate x **n** (gde je **n** stepen modulacije, 2^n QAM) x 188 / 204

Info bitrate = $6956 \times 8 \times 188 / 204 = 51.28$ Mbaud/s

Info bitrate = $6956 \times 6 \times 188 / 204 = 38.46$ Mbaud/s

gde je **n** stepen 2 za QAM (64QAM - $2^6 \rightarrow n=6$, 256QAM - $2^8 \rightarrow n=8$)

4Kp60: HEVC 15-25 Mbps

H264 30-50 Mbps!?!

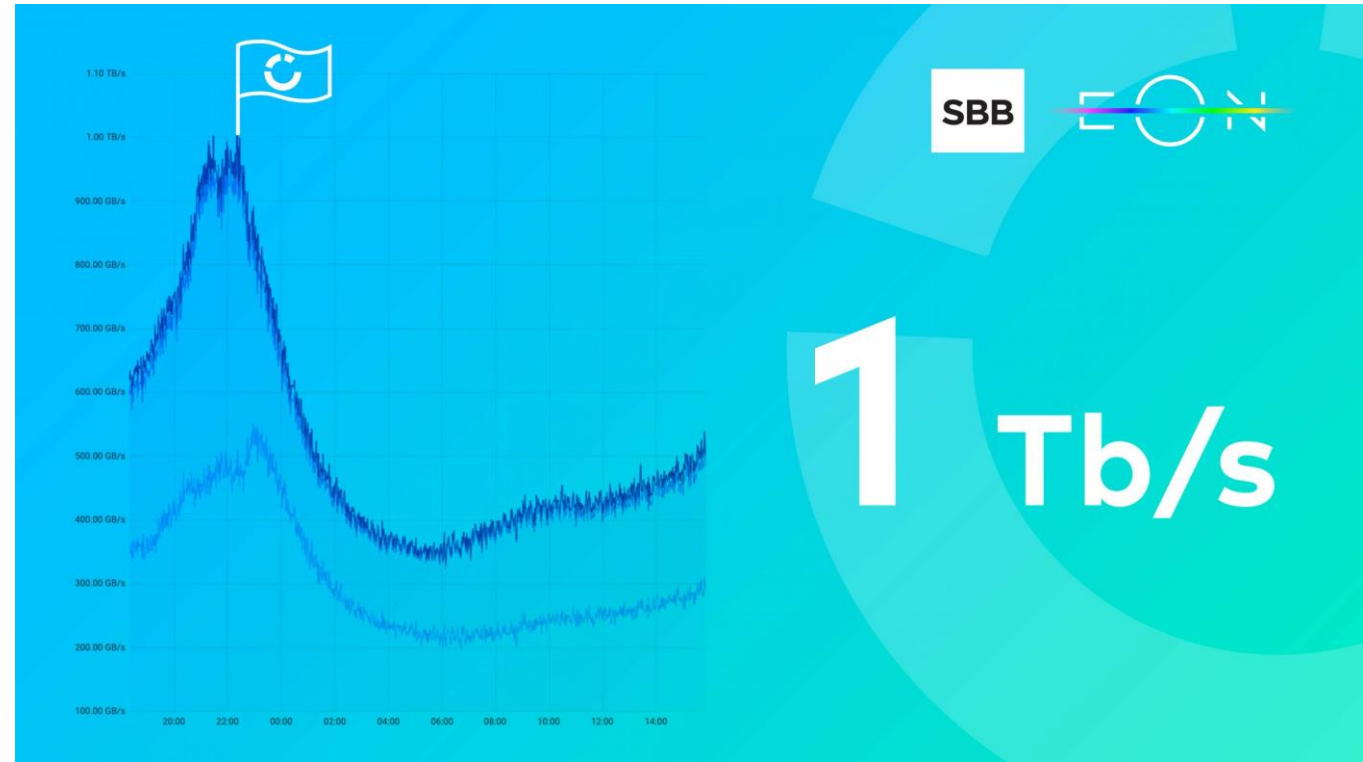
EON HEVC – pre i posle

	Prosečna sesija TS Mean	Prosečna sesija TS Max
Pre izmene	4.43	4.57
1. iteracija	4.30	4.43
2. iteracija	4.08	4.22
Posle izmene	3.62	3.73

Inženjerski izazovi – CDN dimenzionisanje

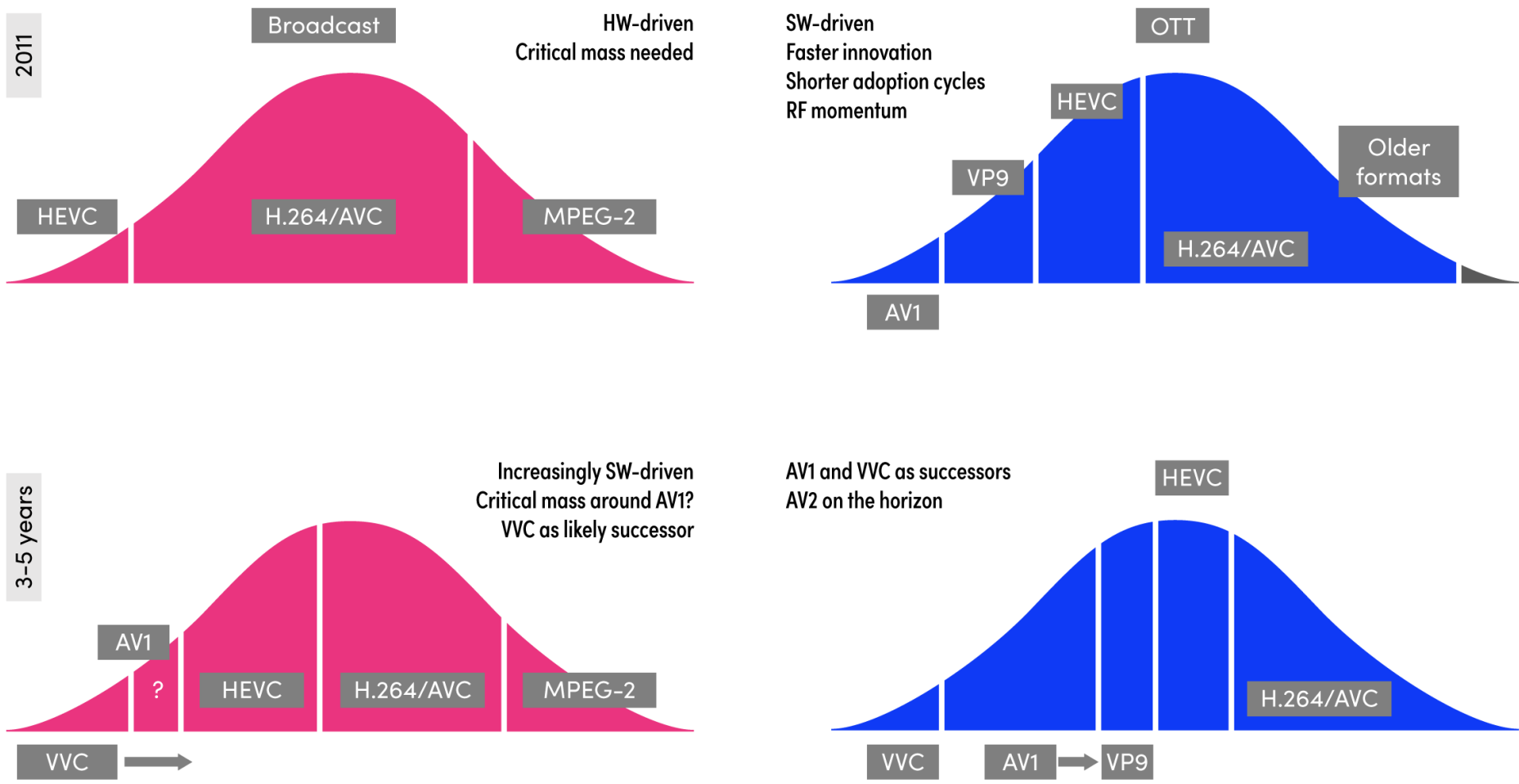
Veliki broj faktora koji utiču na dimenzionisanje

- Broj Hibridnih i OTT STB-ova (First screen)
- Broj multiscreen uređaja
- Očekivani „concurrency rate“ za linearne i nelinearne sadržaje first screen/multiscreen
- Rezolucija najgledanijih sadržaja
- Optimalan nivo redudanse
- Projektovanje CDN-a za najgledanije sadržaje



Battle of the codec

Introducing VVC & AV-1: Roadmap available



Hvala!

