

Broadcasting Trends in the USA

April 2023 Update

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Broadcasting Trends in the USA

- ❑ Streaming growth has intersected with Pandemic related demand, thereby accelerating the rise of a subscription economy and disrupting linear TV. Going forward, successful video services must meet consumer needs for high speed access, attractive / predictive User Interface, availability of broad premium content libraries and live sports, on **any device**, at **any time**, and in **any location**.
- ❑ In order to compete in the global streaming market, content producers and distributors are looking to mergers, acquisitions and Joint Ventures to reach a scale of more than **200 million subscribers**. This scale is necessary to compete with Netflix, Amazon Prime, and Disney+ on a global basis.
- ❑ **86% of all U.S. households now subscribe to a high-speed internet service.** This will increase with the proposed Infrastructure Plans now in Congress.
- ❑ Local Over-The-Air (OTA) Group Broadcasters are also entering the direct to consumer streaming market with Services such as, Vuit, STIRR, Bally Sports, Quest, and True Crime. (discussed later in the deck)
- ❑ As a result, this “Broadcasting Trends” deck has been updated to reflect the rapid changes that have occurred from July 2022 to April 2023.

Broadcasting Trends in the USA

- Streaming Trends
- Decline of Pay TV (Cable TV and Satellite TV)
- Next Generation TV - ATSC 3.0
- 4K UHD TV
- High Dynamic Range (HDR)
- IP Production

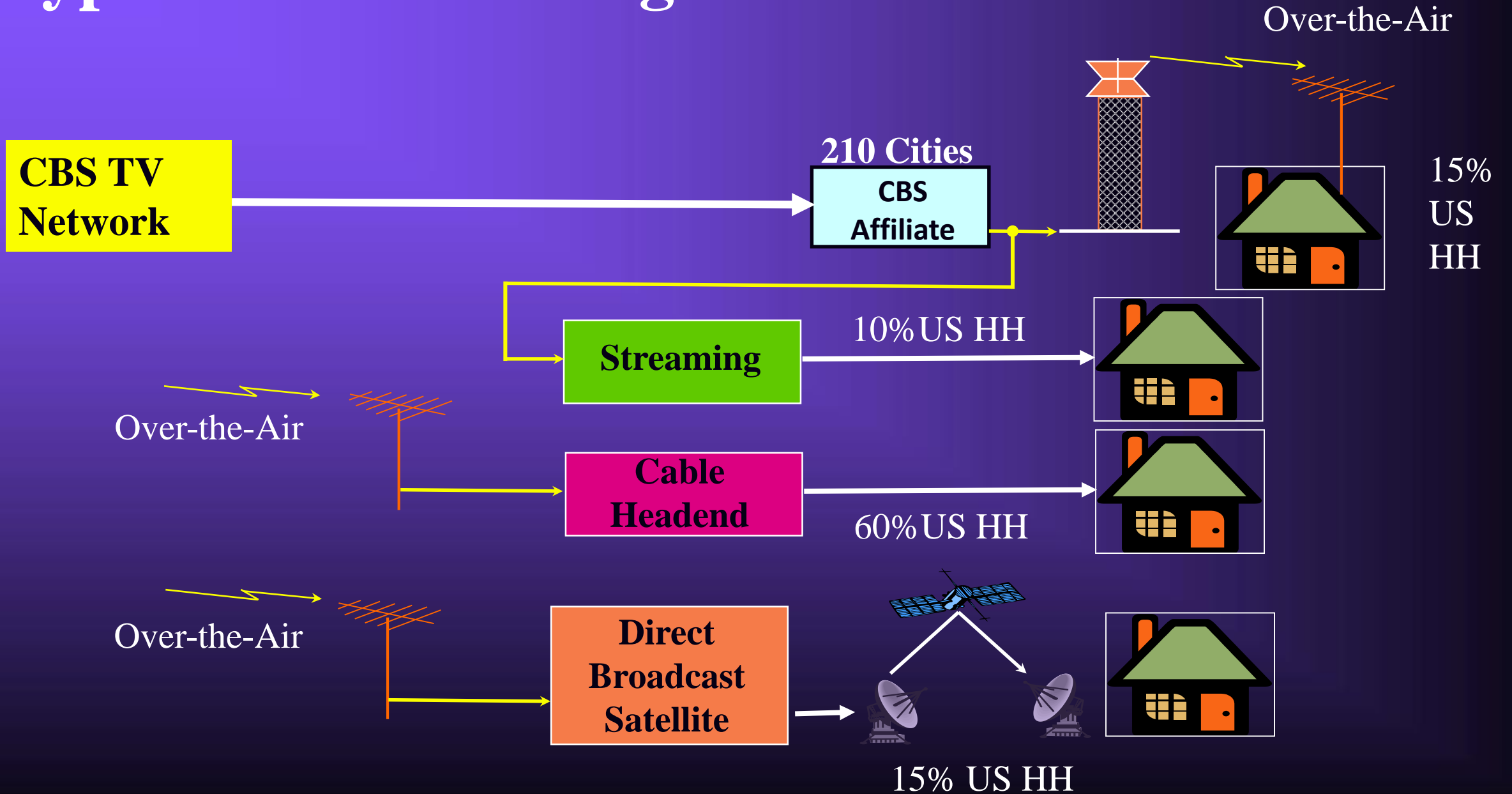
Steaming Definition of Terms

- **AVOD**-Advertiser Video-On-Demand.
- **SVOD**-Subscription Video-On-Demand.
- **FAST**-Free Advertiser-supported Streaming TV.
- **Identical Ad load** - If OTT viewing is to be added to Over-the-Air(OTA) viewing numbers, then the commercials must be identical.
- **Targeted Ads**- Inserted Ads are based on geo-graphic location, age , sex, or other demo-graphic data.
- **Audio Watermarking**- Audio signals that are not detectable by the human ear, but can be detected by audience measurement meters to identify date, time and source of the content (Source IDentification -SID).
- **ID3 tags** - are the same data as contained in Audio Watermarks, but sent separately from the audio/video signal. The same data format is used by i-Tunes to identify song title, musician, duration, etc.

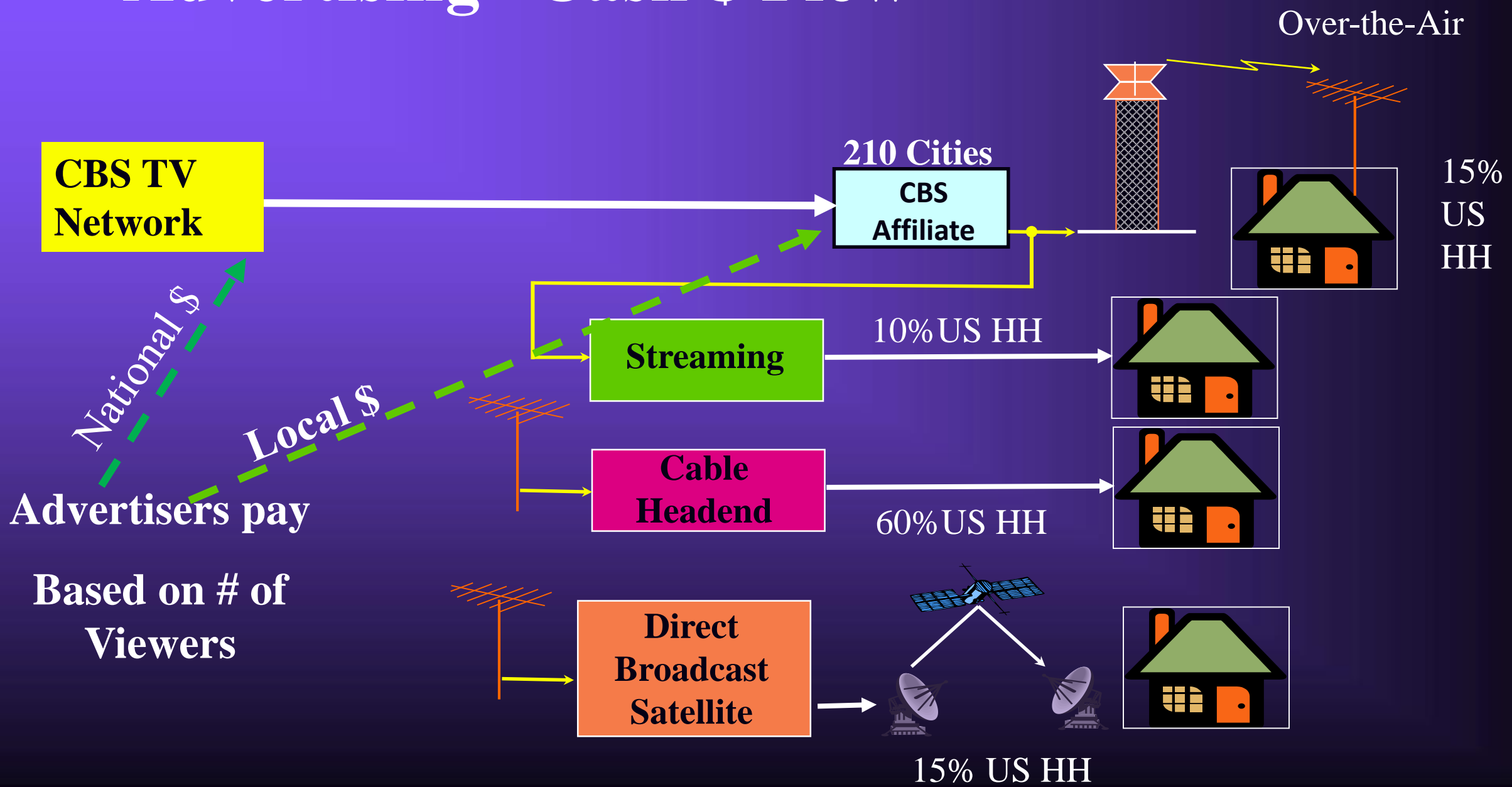
Broadcast TV Revenue Sources

1. Advertising (National and Local).
2. Retransmission (Payments from Cable and Direct to home Satellite to the Broadcaster for use of their signal).
3. Subscription (Direct to Consumer streaming).

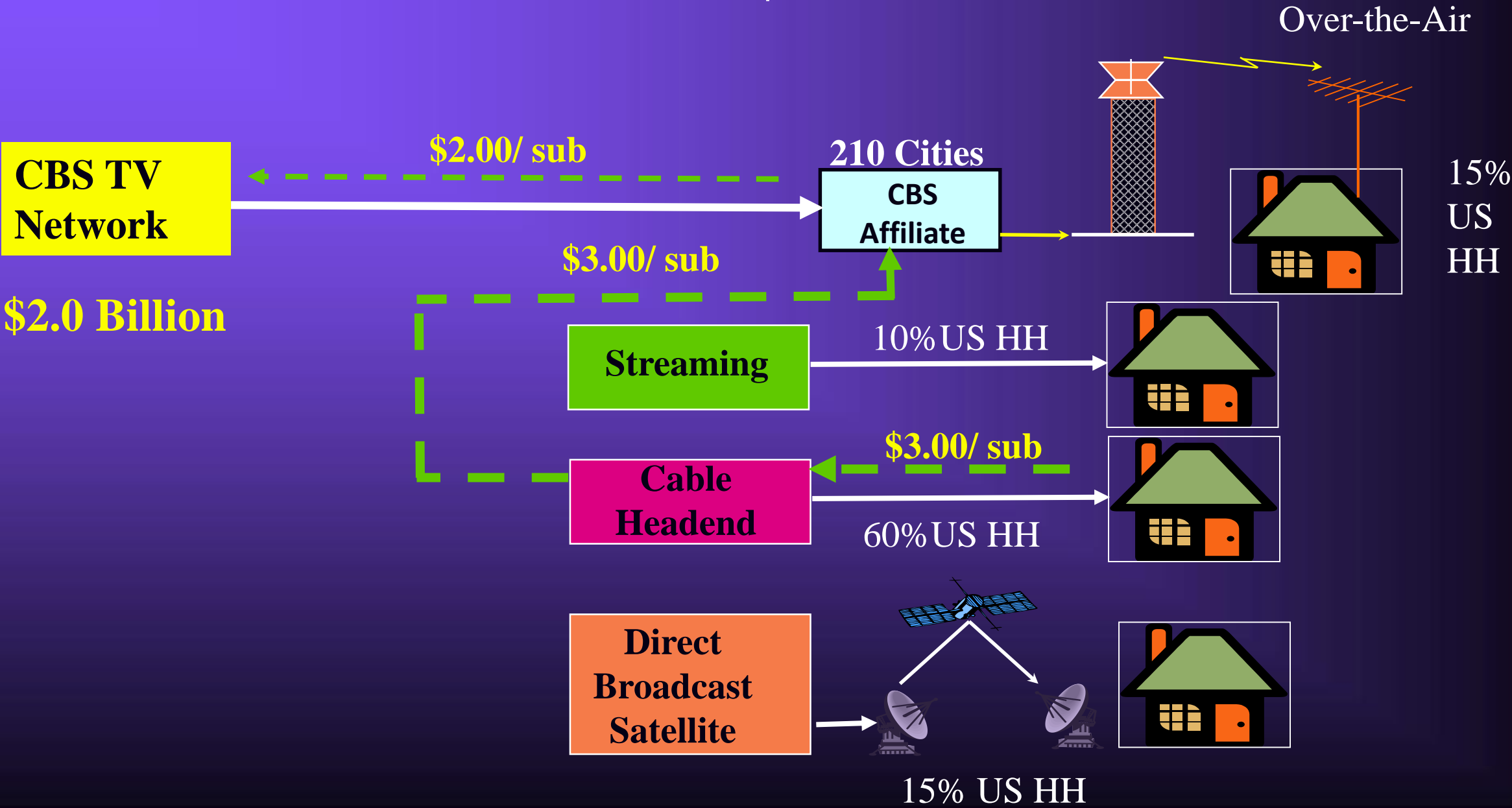
Typical Broadcast Signal Flow



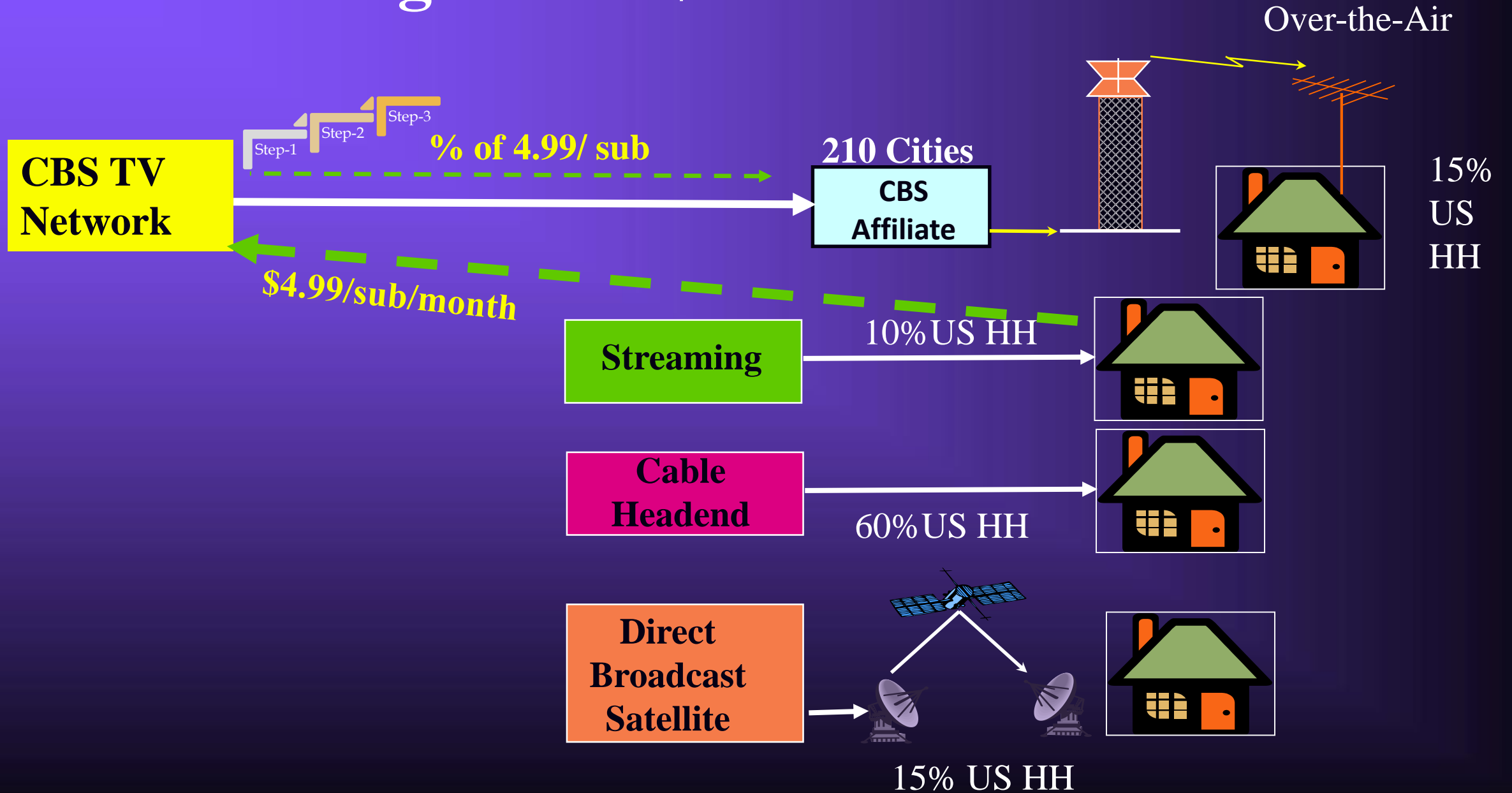
“Advertising” Cash \$ Flow



“Retransmission” Cash \$ Flow

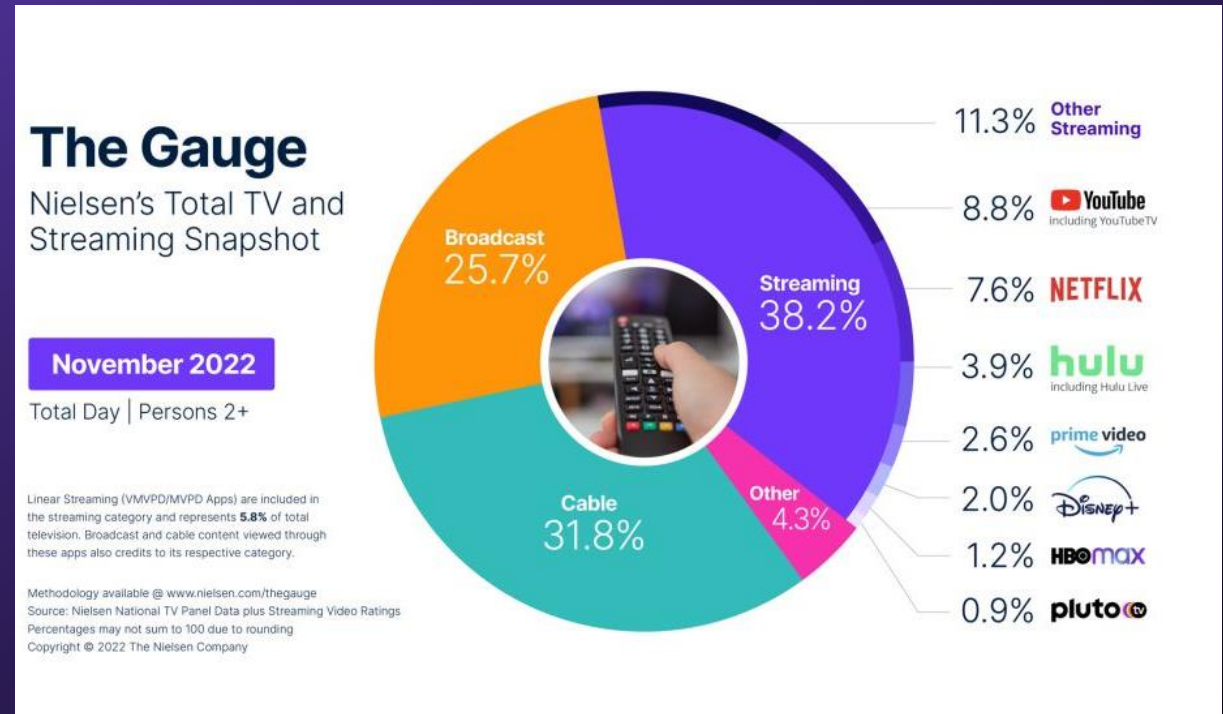
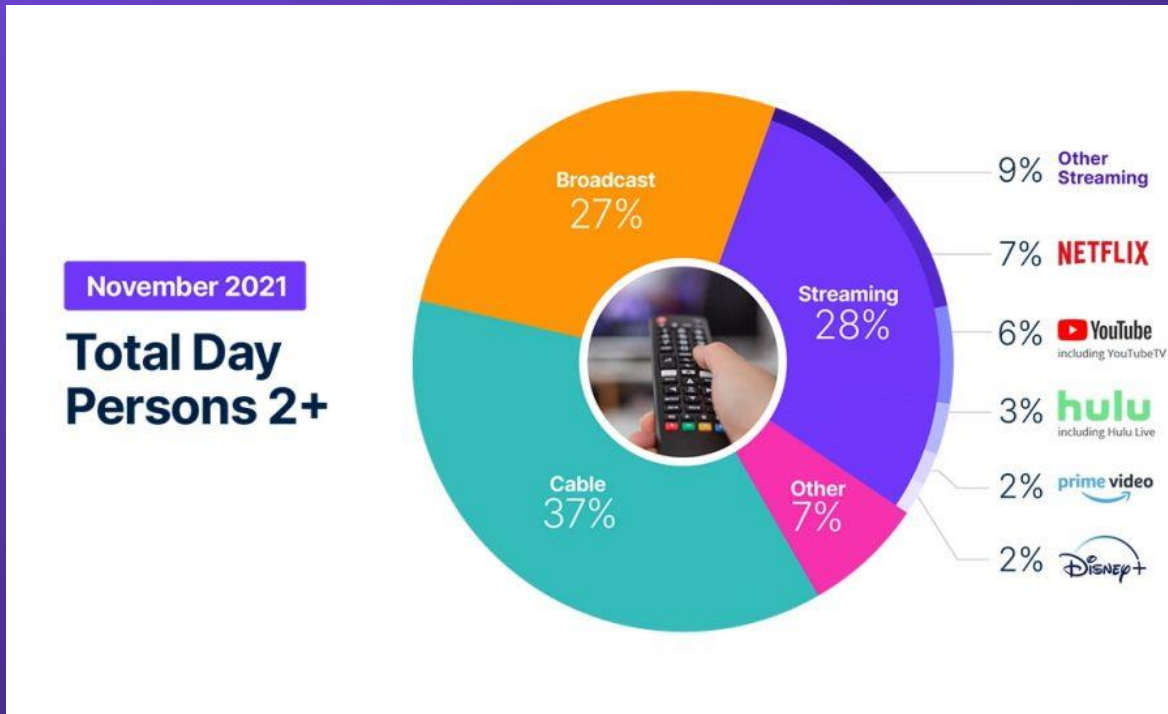


“Streaming” Cash \$ Flow



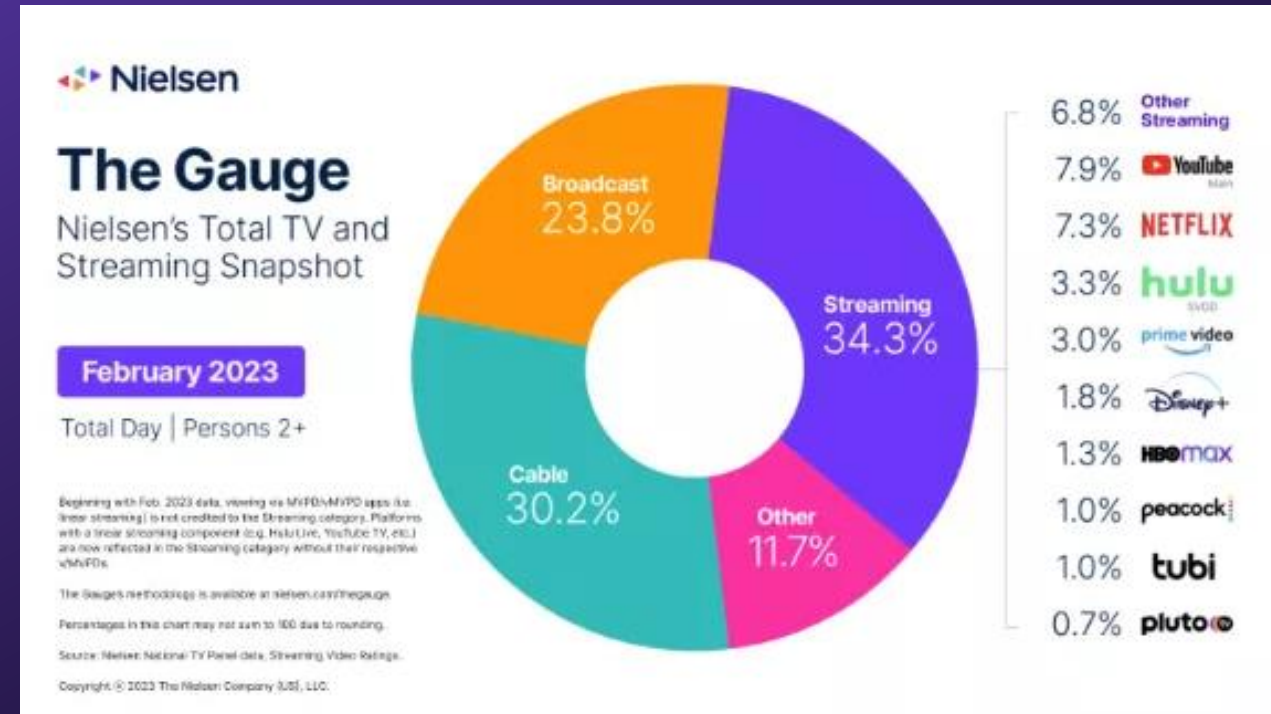
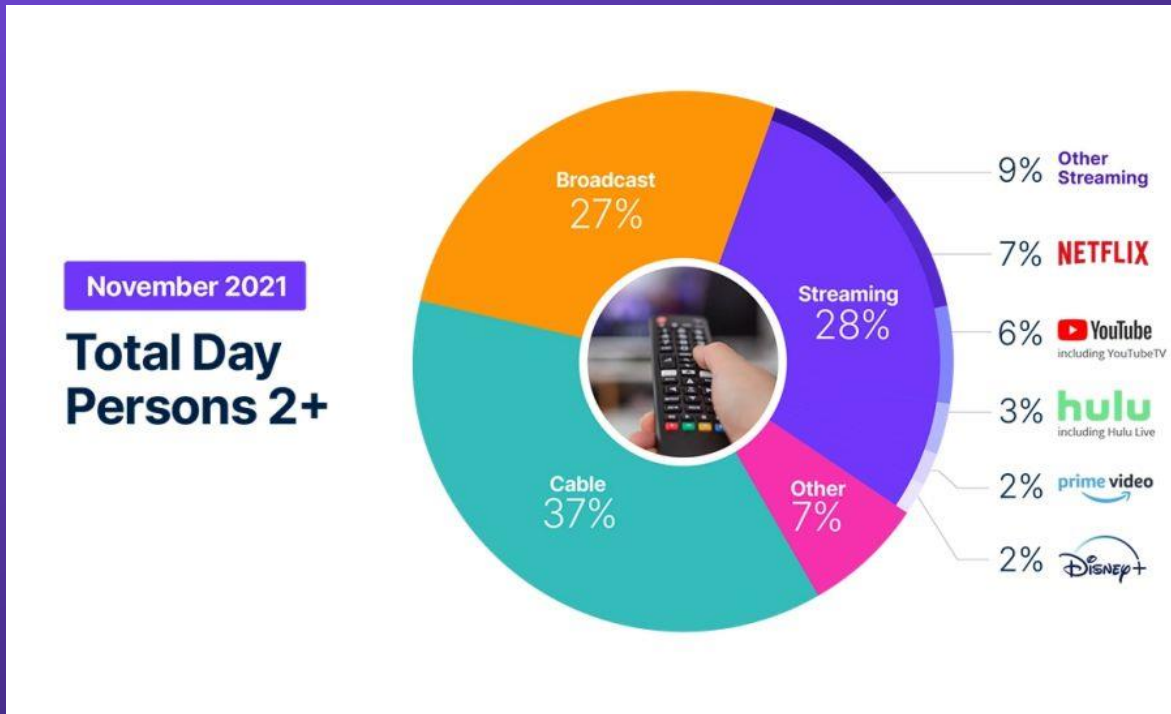
Streaming in the USA

- Per Nielsen's, "The Gauge", as of Nov 2022, 38.2 % of US TV viewers are now watching streaming services, surpassing Cable at 31.8 % and the Broadcast channels (≈25.7%). Overall, broadcast and cable continued to dominate total viewing in Nov. 2022 with a 57.5% share. However, down from the 64% share in Nov 2021. Streaming services were up 10% year over year.



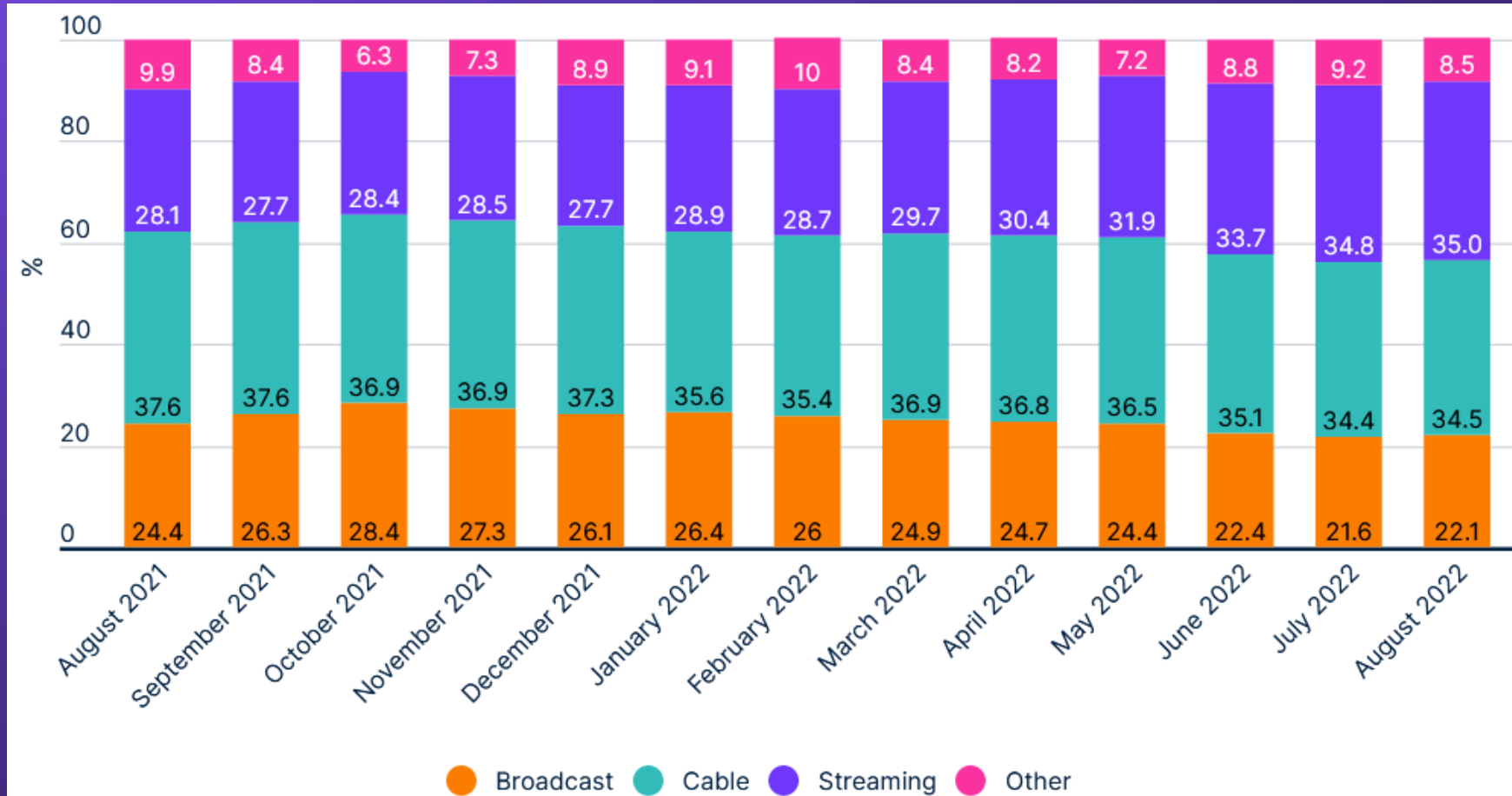
Streaming in the USA

- Per Nielsen's, "The Gauge", as of Feb 2023, 34.3 % of US TV viewers are now watching streaming services, surpassing Cable at 30.2 % and the Broadcast channels (≈23.8%). Overall, broadcast and cable continued to dominate total viewing in Feb 2023 with a 54.0% share. However, down from the 64% share in Nov 2021.



Streaming in the USA

- Broadcast percentage of viewers continues to decline and Streaming continues to increase

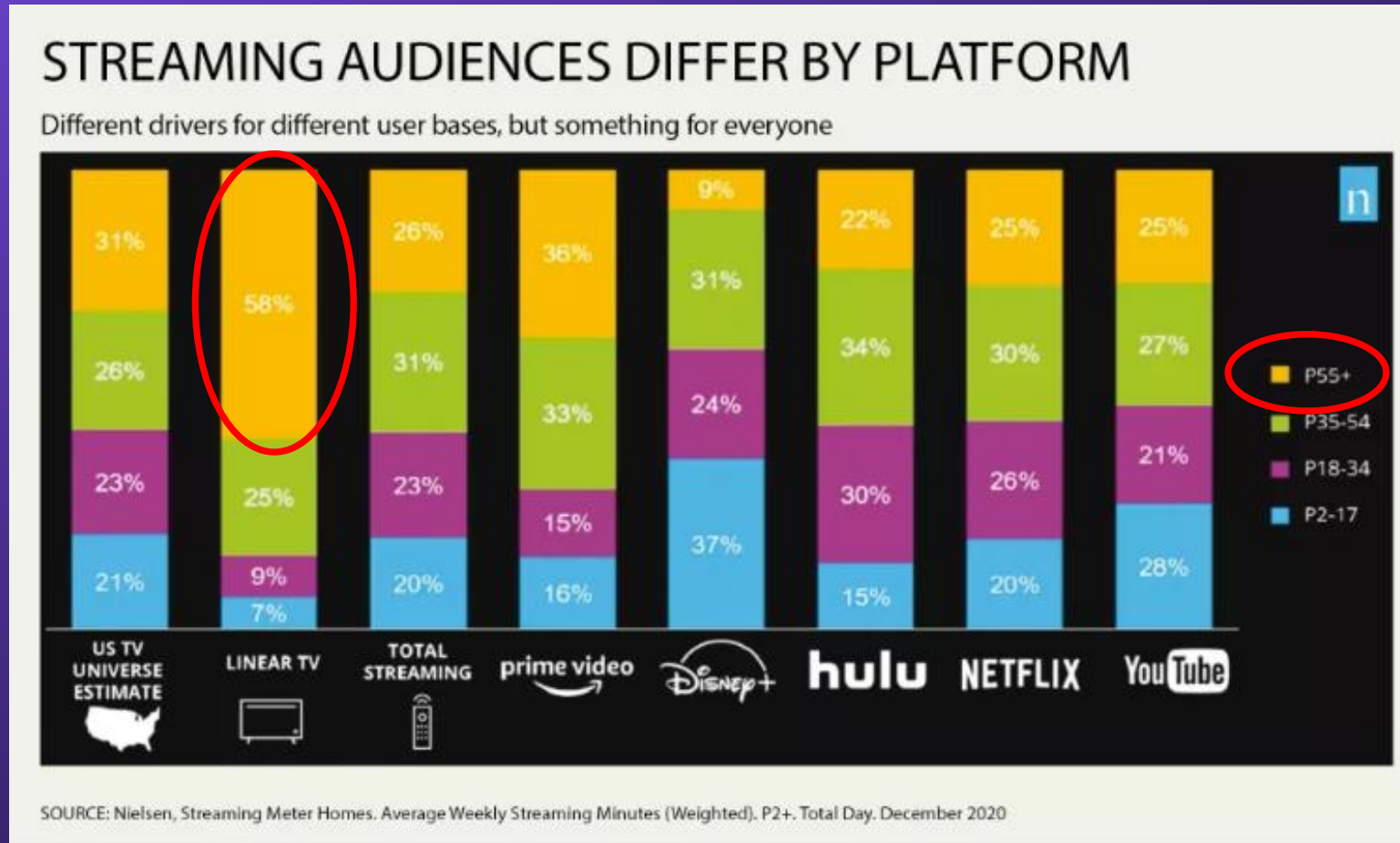


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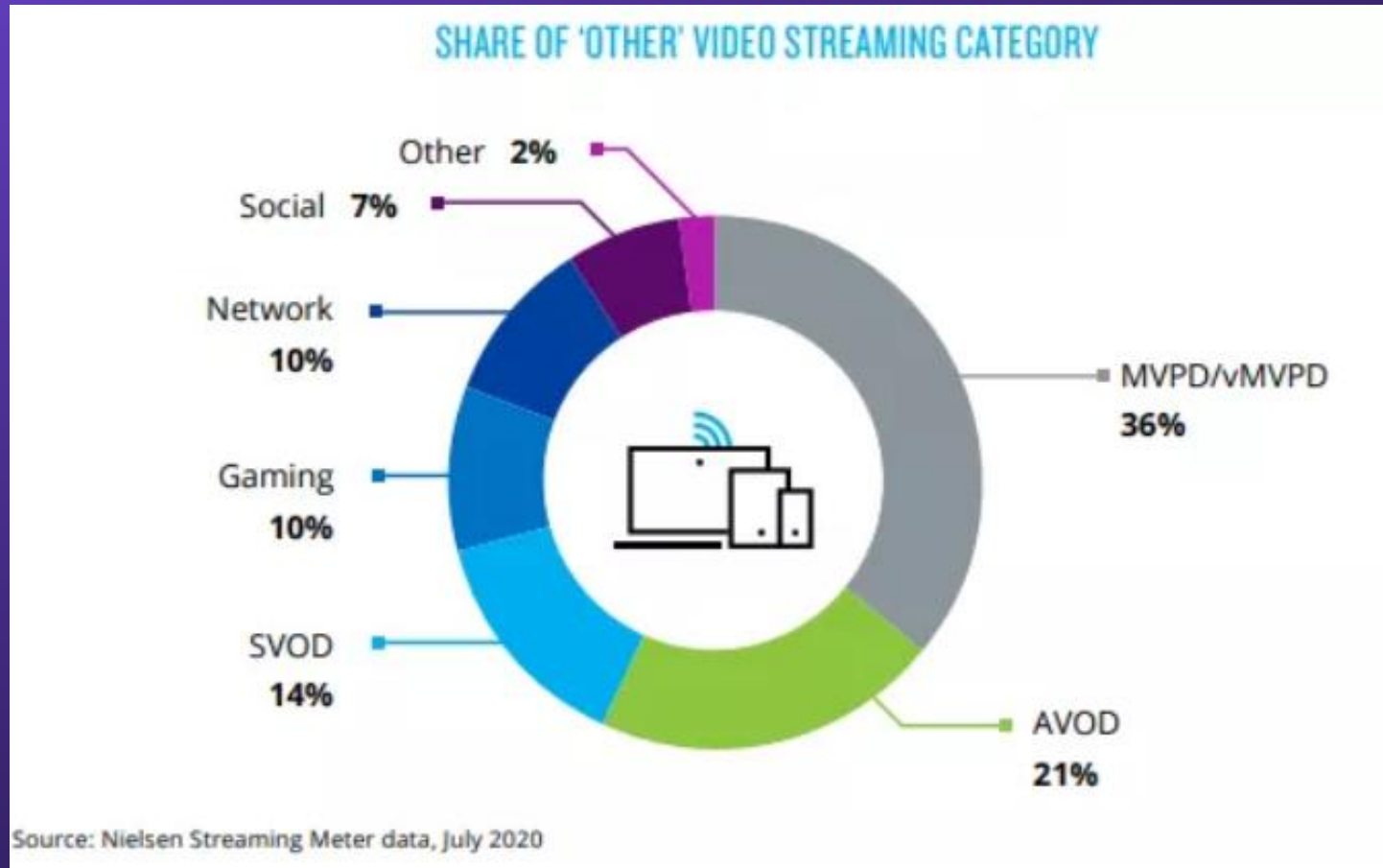
Streaming in the USA

- The total streaming audiences across all age categories were very similar to the segmentation of traditional (broadcast and cable) viewing. However, the assessment also showed that older viewers (age 55 and up) are now among the biggest users of linear, rather than on-demand, streaming services — reflecting their comfort level with linear, ad-supported formats. (FAST)



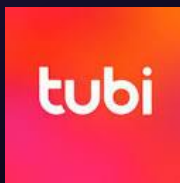
Streaming in the USA

- ❑ Ad-supported Video on Demand (AVOD) accounts for nearly 5% of time spent streaming.
- ❑ In a new report, titled *Beyond SVOD*, Nielsen noted that when it measured streaming in July 2020, time spent viewing video sources “Other” than the big subscription VOD (SVOD) services -- Netflix, YouTube, Hulu, Amazon, Disney Plus--accounted for a 23% share and minutes spent viewing rose by 57%.



Streaming in the USA

- ❑ All the major Broadcast and Cable Networks now offer a Direct To Consumer (DTC) streaming service.
- ❑ Many networks are removing their content from Netflix and making it available on their own streaming service, including Disney/ABC, Fox, NBCU, Paramount +(ViacomCBS), Showtime, HBO, etc.
- ❑ In March 2020, Fox purchased Tubi for \$440 million. As of Q1 2023, the valuation was \$1.0 billion. (Tubi is a streaming service based in San Francisco, California, United States, that launched in 2014. It is a free, ad-supported service, with advertisements shown during un-skippable commercial breaks during programming.)



Streaming in the USA

- ❑ Disney+ signed up over 10 million subscribers in the first week (11/2019). The worldwide Disney subscriber numbers as of Dec 2022, which includes their three services Hulu, Disney +, ESPN+ , have grown to over 235 million. Disney + alone, reported 161.8 million.
- ❑ However, Disney's Direct to Consumer (DTC) streaming services lost \$1.5 billion in 2022.



Streaming in the USA

- All of the major streaming services continue to post billion dollar losses (EBITDA) over the Trailing 12 Months (TTM), with the exception of Netflix.

Calendar Q3 & TTM DTC EBITDA				
	3Q22	2Q22	3Q21	TTM
Netflix	\$1,770	\$1,812	\$1,921	\$6,543
Paramount	-\$343	-\$445	-\$198	-\$1,746
Warner Bros. Discovery	-\$634	-\$558	-\$309	-\$2,574
Peacock	-\$614	-\$467	-\$520	-\$2,096
Disney	-\$1,381	-\$972	-\$532	-\$3,649

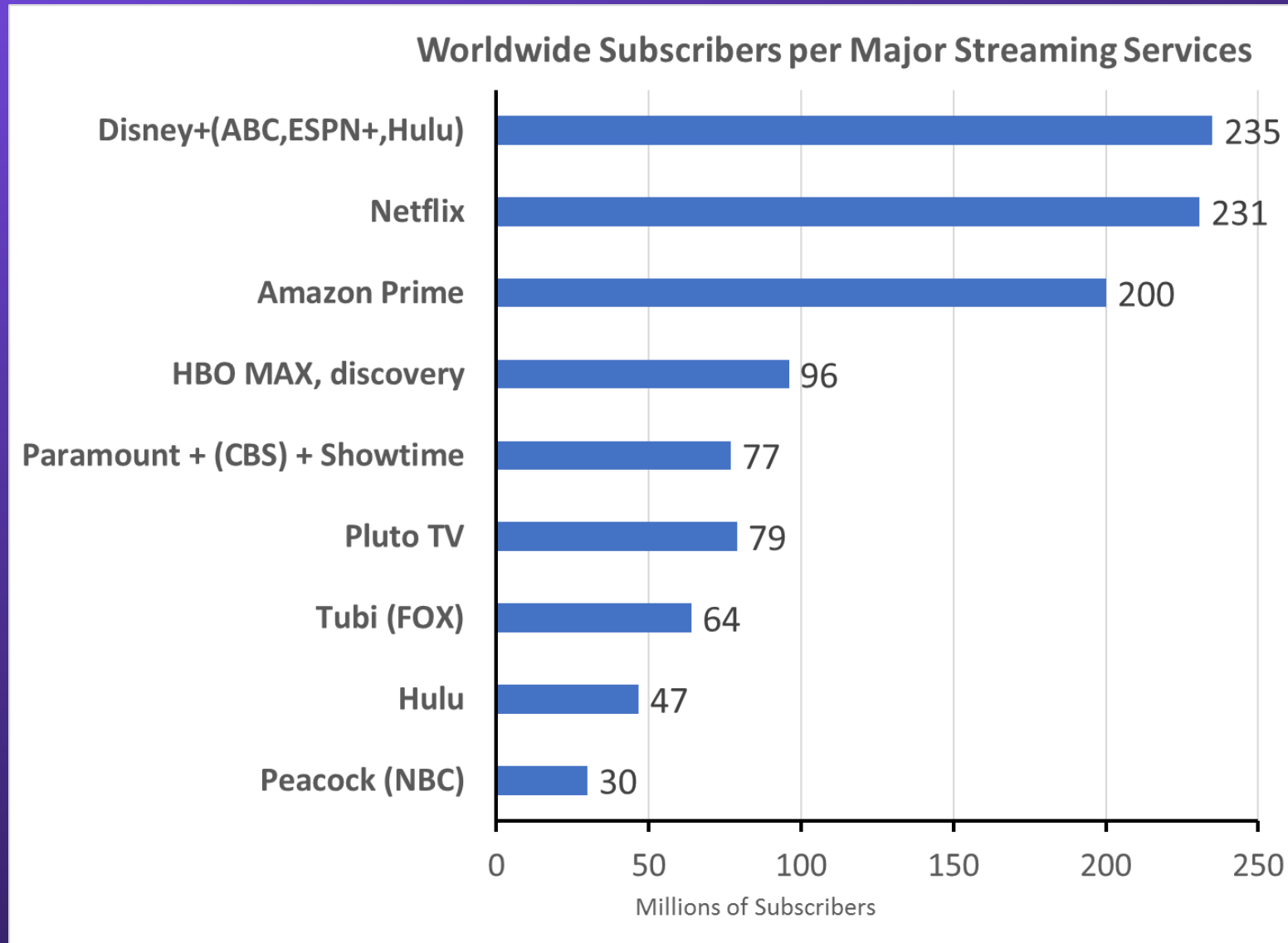
Source: Company Reports, LightShed Partners

Financials in \$mm

Note: Disney DTC EBITDA losses assume ~\$365M FY22 D&A

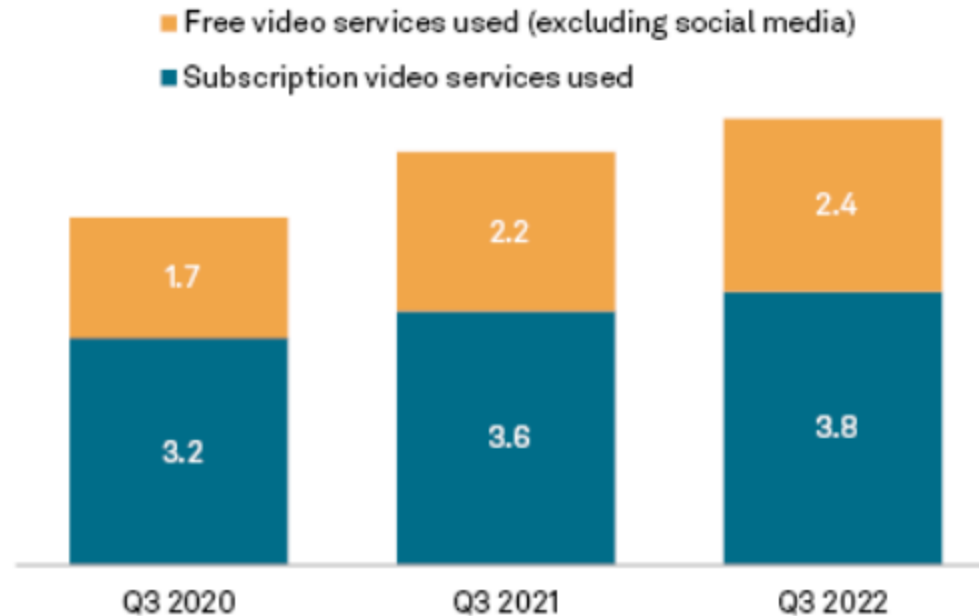


Streaming in the USA



Streaming in the USA

Average number of streaming video services used in the US, Q3 2020 to Q3 2022



Question: Which subscription or free online video services do you or someone in your household use to watch online video?

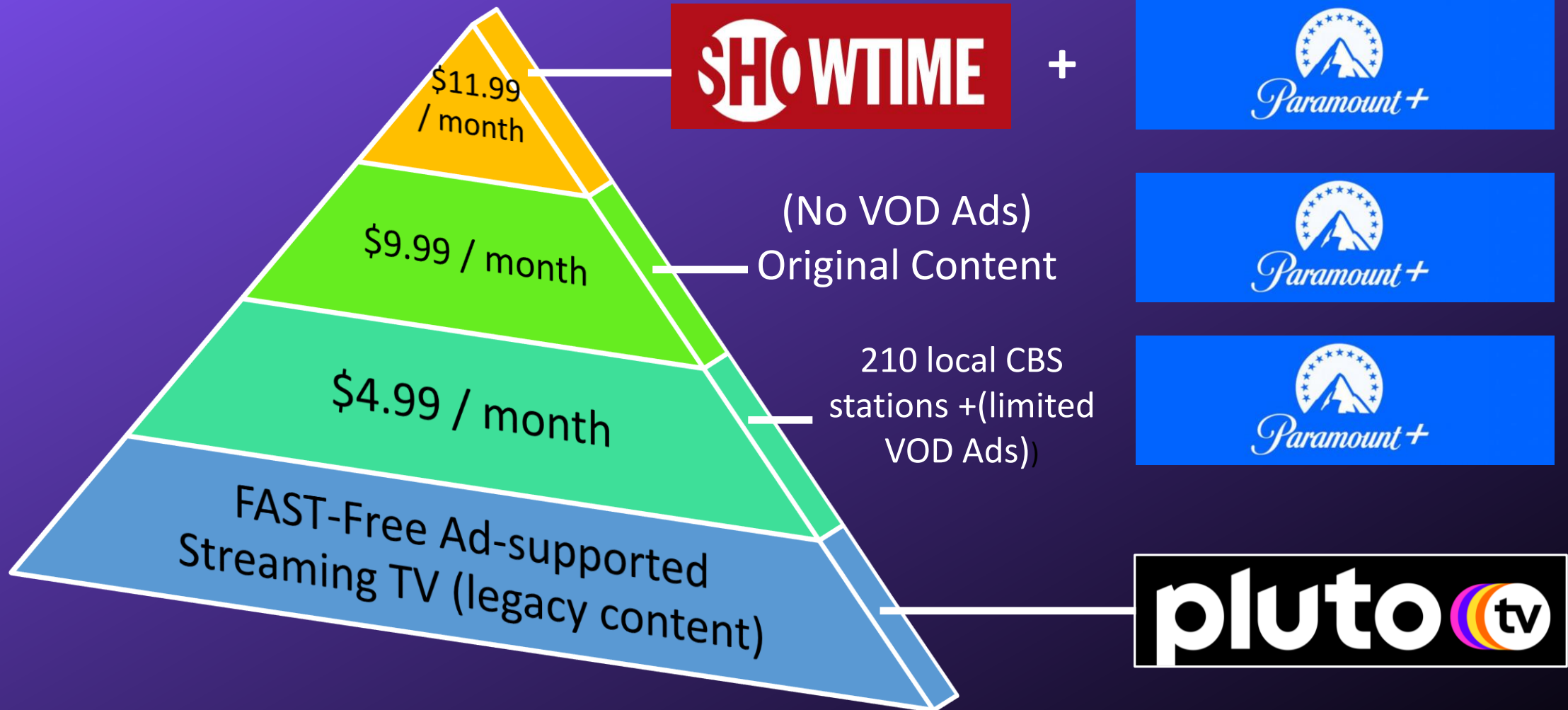
Base: approximately 2,500 U.S internet adults each survey.

Source: U.S. Consumer Insights surveys.

Kagan, a media research group within the TMT offering of S&P Global Market Intelligence.

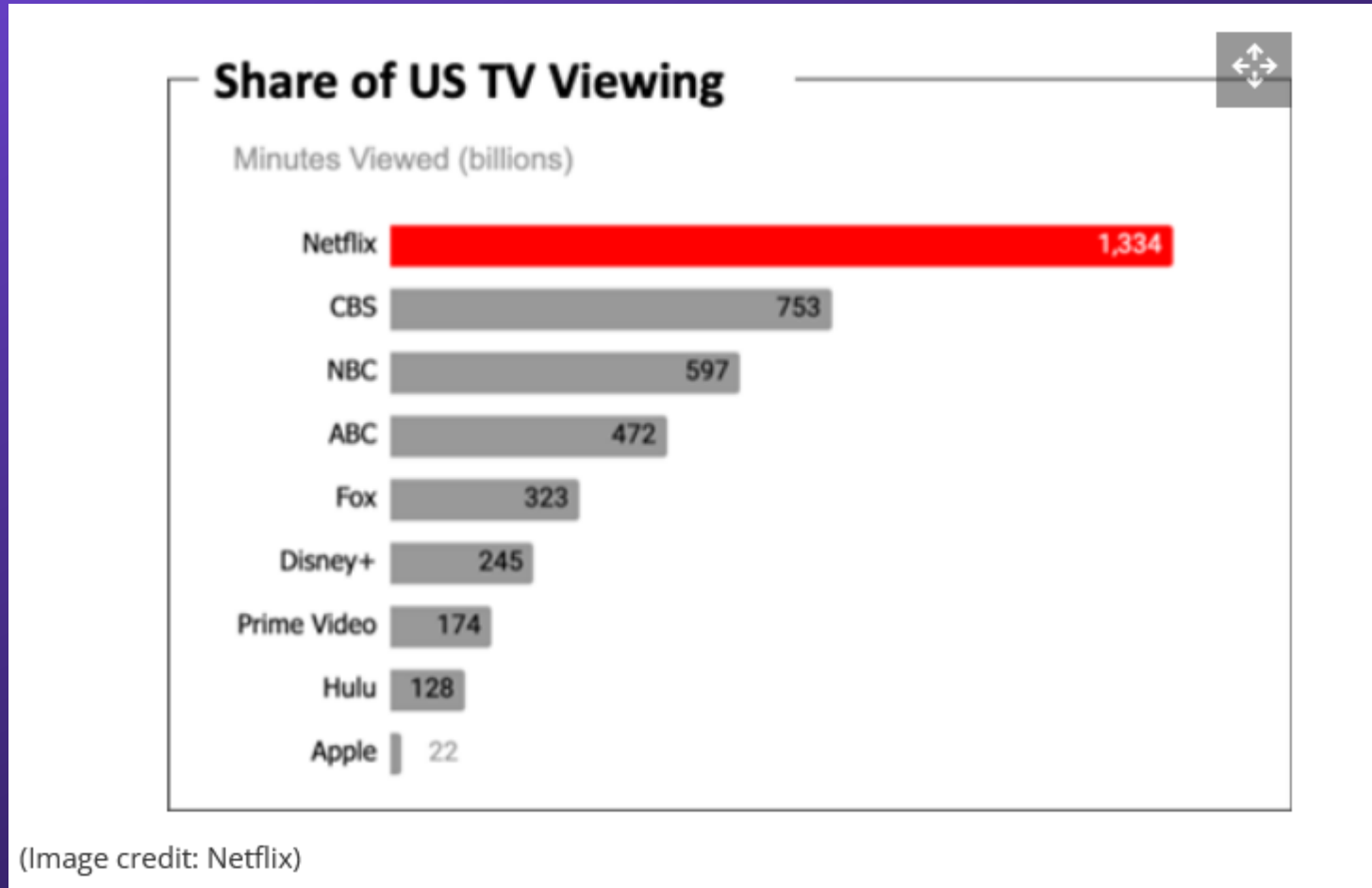
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Paramount / CBS Tiered Streaming Services



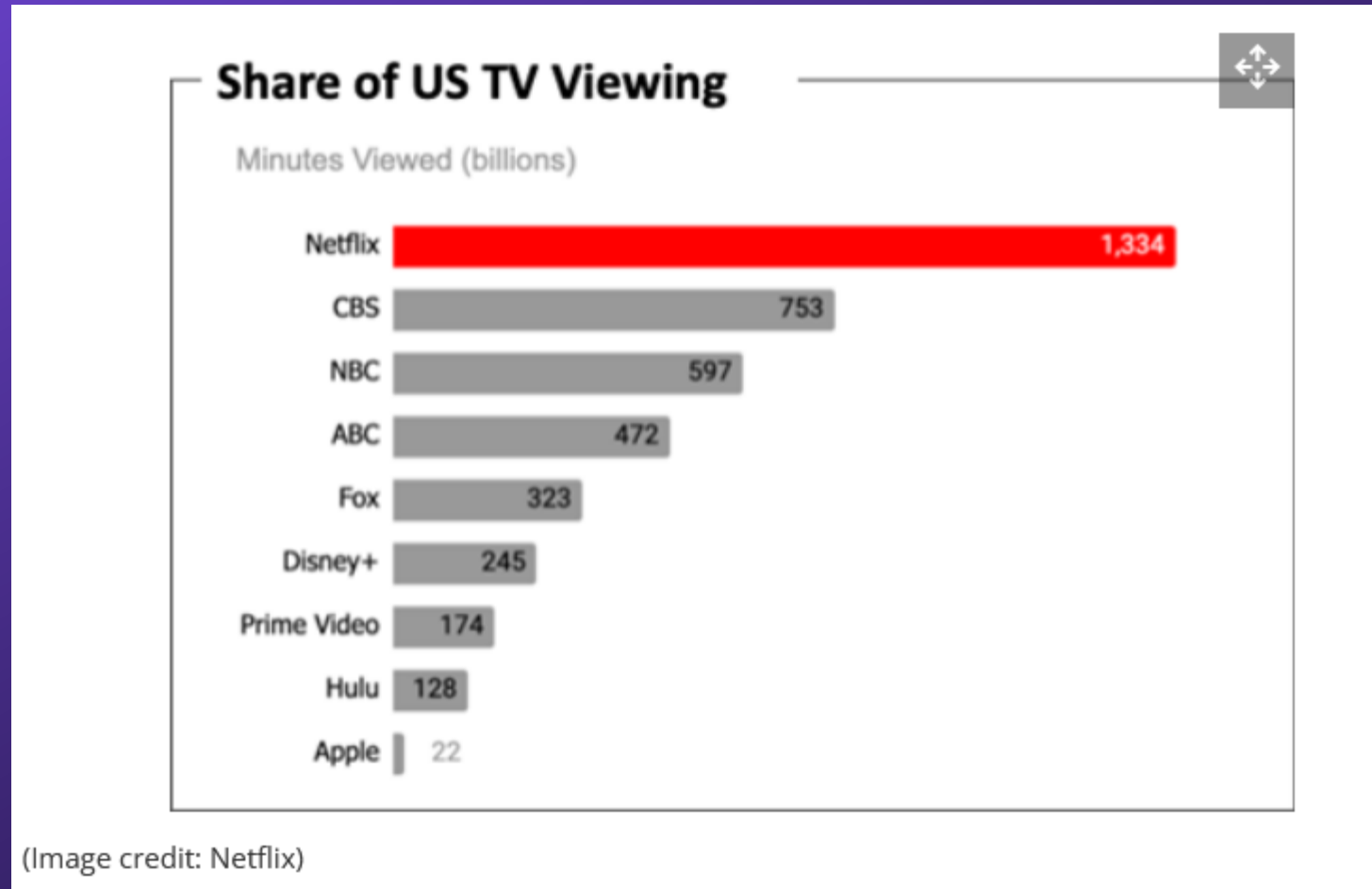
Streaming in the USA

For the 2021-22 TV season, Netflix nearly matched the combined total viewing minutes of the two most watched broadcast Networks, CBS and NBC.



Streaming in the USA

For the 2021-22 TV season, Netflix's 1.334 trillion minutes viewed were also exponentially larger than the nearest streaming competitors (Disney+ at 245 billion minutes, Prime Video at 174 billion and Hulu at 128 billion).

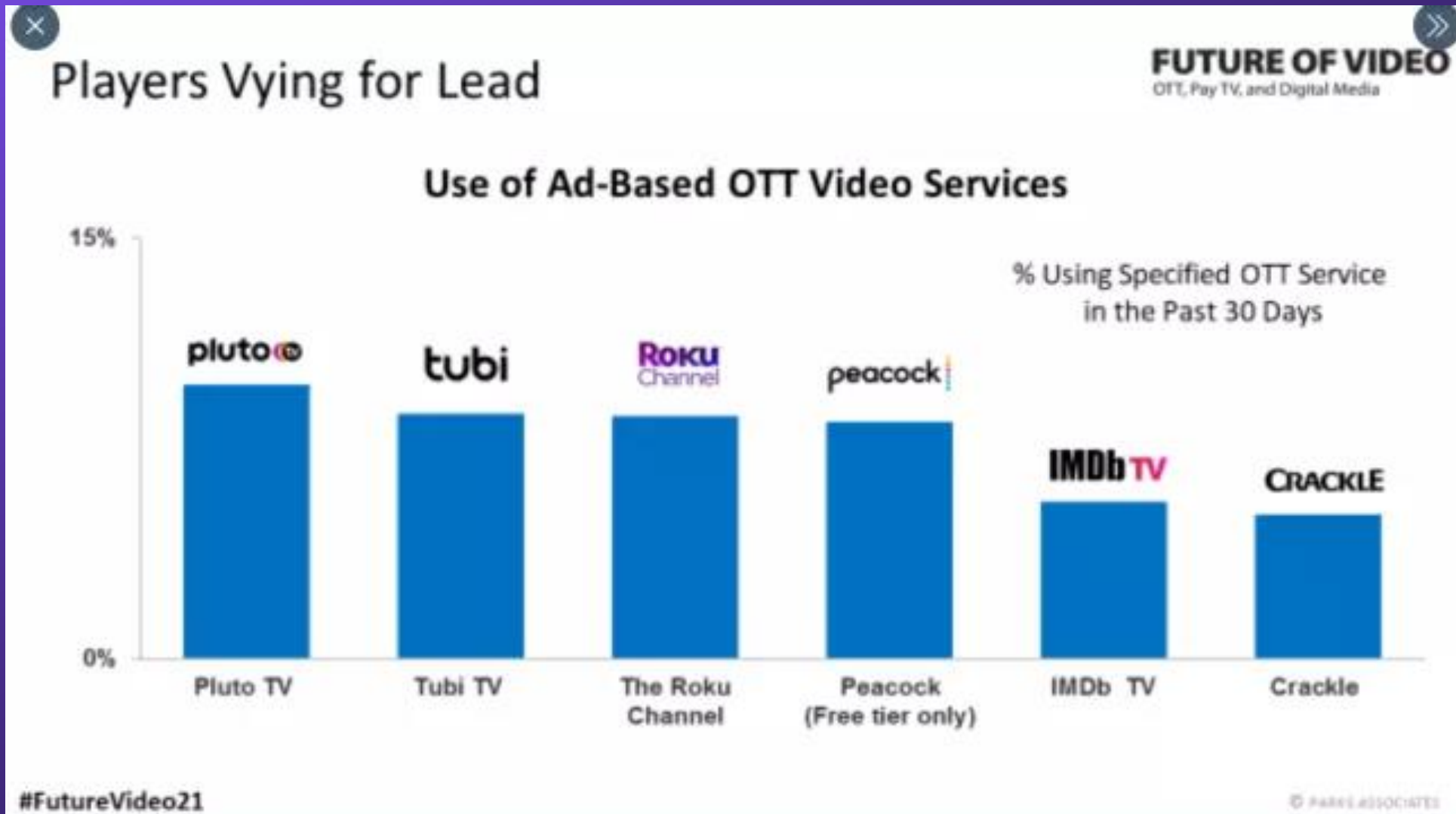


Streaming in the USA



- ❑ Viacom/CBS has rebranded **CBS ALL ACCESS** as **Paramount+** and added content from their cable channels: BET, Comedy Central, MTV, Smithsonian, and Nickelodeon.
- ❑ Paramount + has more than 77 million global subscribers.
- ❑ Pluto TV is ViacomCBS's Free Ad-Supported Television (FAST) service that has over **250+ channels** and **thousands of movies**. In 2022, Pluto generated over \$1.0 billion in revenue with 52 million active users in 25 countries, with profit margins approaching that of Broadcast.
- ❑ In Q4 2022, Paramount+ (DTC) posted a revenue growth of **30 % to \$1.4 billion** as **subscription revenue jumped 48 percent**. The quarterly adjusted **operating loss** before depreciation and amortization (OIBDA) in the DTC segment again widened though to **\$575 million**.

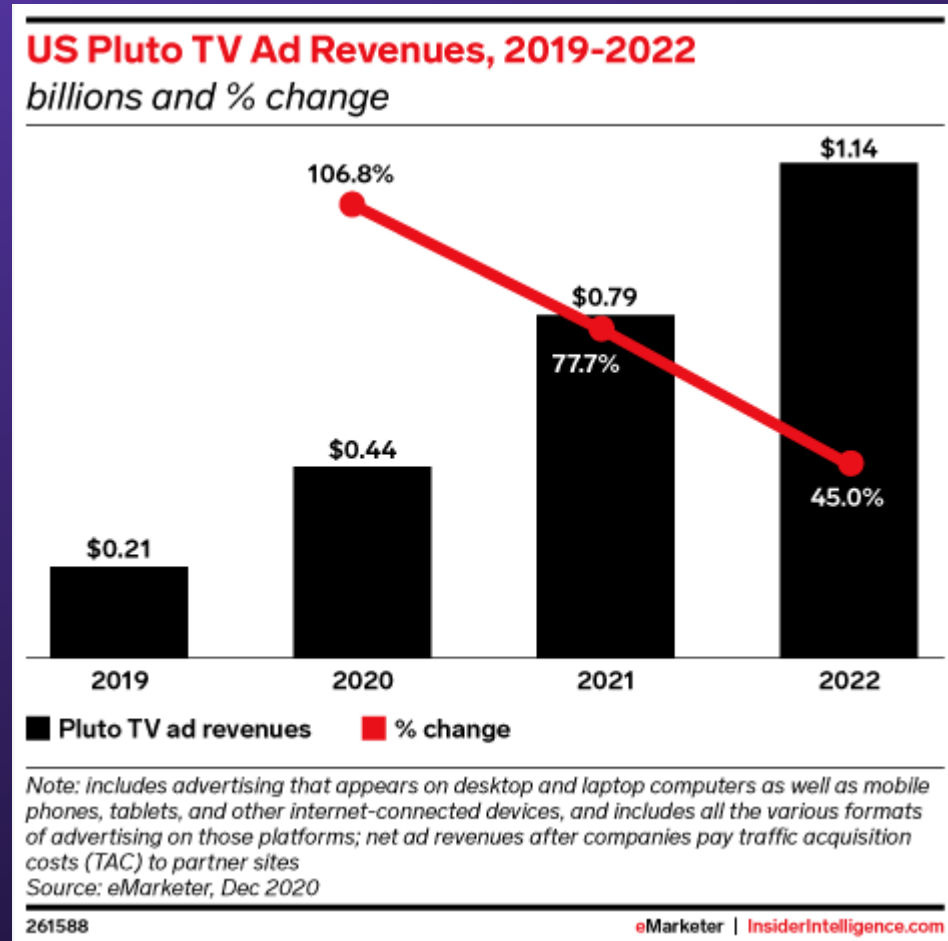
Advertising-based Video –On-Demand (AVOD) Streaming in the USA



Free Ad-supported Streaming TV (FAST)



- Pluto TV is owned and operated by Paramount Global (Viacom/CBS).
- In 2022, Pluto TV's net US Ad revenues surpassed \$1 billion.
- If the channel is not owned by Paramount, then the Ad revenue is split with the content owner.





Free Ad-supported Streaming TV (FAST)



Live TV

On Demand

Search



Latest New York News & Headlines

08:00 PM

09:00 PM



News + Opinion

Crime

Reality

Game Shows

Now: 08:33 PM

Next

Timeline >>

©CBS NEWS PHILADELPHIA

Women's History Month Special ⓘ
26 min left

Latest Philadelphia News & Headlines ⓘ
09:00 PM - 09:30 PM

Collegiate... ⓘ
09:30 PM - 10:00 PM

©CBS NEWS NEW YORK

Latest New York News & Headlines ⓘ
S1
Top stories in New York.

Now News ⓘ

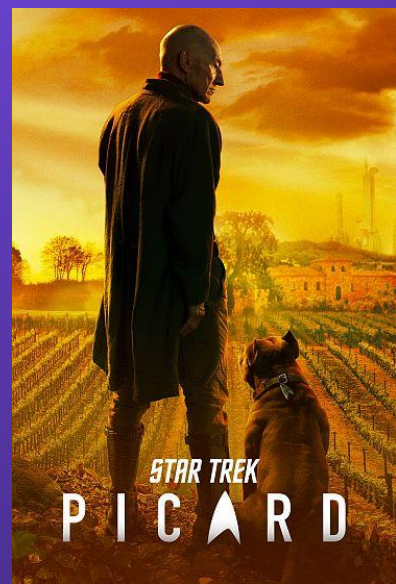
Latest News ⓘ

Guide

Streaming in the USA



- ❑ Paramount + is offering first run exclusive programming to drive subscriber growth.



Streaming in the USA

- ❑ Paramount + also provides the live local CBS TV stations in 210 cities.
- ❑ In addition to first run TV series, Paramount + offers over **30,000 TV episodes** and **2,500 movies**, as well as Sports and local news.
- ❑ Paramount + is available on a wide variety of mobile phones, tablets, gaming platforms, TV sets and other in-home devices.

android

Apple iPad

Apple iPhone

Apple tv

chromecast

firetv

LG

PS4

Roku

SAMSUNG

VIZIO

XBOX ONE

Streaming in the USA

- ❑ The following CBS owned stations are offering a 24 hour a day, 7 day a week local news stream- CBSN. It is available for free as a stand-alone service and/or part of the Paramount+ Subscription:
 - New York, Los Angeles, Boston, San Francisco, Chicago, Dallas-Fort Worth, Philadelphia, Minneapolis-St. Paul, Denver, Baltimore, Miami, Pittsburgh, Sacramento.
- ❑ CBS is also offering 24 /7 CBS Sports HQ and a Hollywood news magazine stream, “ ET Live”.



Streaming in the USA

- ABC/ Disney launched a new 24 hour / 7 days a week streaming service that streams content from eight of its local TV stations. The streaming channels feature a mix of live and on-demand 24/7 local news coverage, breaking news, weather forecasts (January 31,2022.) NYC, LA, Chicago, Philadelphia, San Francisco, Houston, Raleigh, Fresno, CA.



US companies Streaming in Europe

The Peacock logo, featuring the word "peacock" in a white, lowercase, sans-serif font on a black background. To the right of the text is a vertical column of five colored dots: orange, red, purple, blue, and green.The SkyShowtime logo, featuring the word "sky" in a white, lowercase, sans-serif font and "SHOWTIME" in a white, uppercase, sans-serif font, both centered within a black circle. The circle is set against a background of colorful, overlapping circular segments in shades of purple, blue, and red.The Paramount+ logo, featuring a white mountain peak with a circle of stars above it, all on a blue background. Below the graphic is the word "Paramount+" in a white, cursive font.

- ❑ Comcast Corp. (NBCU Peacock) and ViacomCBS (Paramount +) announced that they have formed a partnership (Joint Venture - JV) to launch a subscription video on demand service in Europe - called **SkyShowtime**.
- ❑ **SkyShowtime** launched on June 22nd 2022 in the UK, Ireland and South Korea. It will be available in 20 European countries covering **90 million** homes. The service will feature programming from the NBCUniversal, Sky and ViacomCBS portfolio of brands, including titles from Showtime, Nickelodeon, Paramount Pictures, Paramount Plus Originals, Sky Studios, Universal Pictures and Peacock.
- ❑ The **SkyShowtime JV** will permit the two companies to compete with Disney +, NetFlix, and Amazon Prime in the global marketplace.

Streaming in USA



- ❑ The U.S. subscription streaming business expanded by nearly 20% in 2021, driven by the launch of two new services, Discovery Plus and Paramount Plus, reaching \$25.3 billion, according to figures published by Digital Entertainment Group (DEG).
- ❑ The U.S. SVOD industry grew more than 19% in the fourth quarter alone, to \$6.64 billion, the group also said.
- ❑ Sales of movies and shows on DVD and Blu-ray disks were down nearly 20% to just under \$2 billion. Rentals of discs, meanwhile, dropped 21.2% to \$822.7 million.

Streaming in the USA

- ❑ **Free Advertiser-supported Streaming TV (FAST)** platforms such as Vuit are being used by local broadcasters to attract more viewers. Local stations provide Vuit with programs and commercials, which Vuit then streams to consumers. The revenue is split between Vuit and the local stations.
- ❑ <https://www.vuit.com/live/>
- ❑ As of 9/7/2021, there were 272 local stations producing and distributing streaming content on Vuit. Vuit is used by local stations affiliated with the 4 major commercial networks.



- ❑ Vuit is owned and operated by Syncbak.
- ❑ Syncbak is the service provider used by CBS to geolocate and distribute the live streams for their 210 affiliates.
- ❑ Sinclair Broadcast Group has a similar service called STIRR.

Streaming in the USA



- ❑ STIRR is an ad-supported video streaming service owned by **Sinclair Broadcast Group** (294 TV stations). The streaming service is available on the web and via apps for iOS, Android devices and various streaming TV devices, including Amazon Fire TV, Roku, Apple TV, Chromecast and Android TV. Stirr's slogan is “The new free TV”
- ❑ <https://stirr.com/watchnow>
- ❑ The service offers over 100 channels of content.

Streaming in the USA

- ❑ The Bally Sports Regional Networks (RSNs) are a group of regional sports networks in the United States owned by Diamond Sports Group, a joint-venture company of the **Sinclair Broadcast Group** (owns 294 TV stations) and Entertainment Studios. The group is branded after **casino operator Bally's Corporation**, which purchased its naming rights.
- ❑ Sinclair Broadcast Group raised **\$600 million** to fund the 2022 direct-to-consumer streaming launch of its Bally Sports Regional Sports Networks, The package is priced at **\$19.99 per month**.
- ❑ Bally Sports is carrying \$9.0 billion in debt service and has filed for bankruptcy in March 2023.



Streaming in the USA

- ❑ **YouTube (Google)** won streaming rights for “NFL Sunday ticket”, reportedly valued at \$2 billion a year, which allows subscribers access to ALL (16) NFL Sunday games, not just the ones broadcast in the local markets by CBS, FOX, NBC, ABC. Subscription price \$449 / year.
- ❑ Thursday Night Football (NTF) is only available on **Amazon Prime** video.



While Amazon's \$1 billion-a-season acquisition of the NFL's Thursday Night Football package failed in its inaugural all-streaming season to deliver the mass-audience it had on broadcast television (-41%), it did yield more Amazon Prime Video subscription sign-ups than any other show or movie ever presented on Amazon Prime.



(Image credit: Ronald Martinez/Getty Images)

Streaming in the USA

- ❑ **Tegna Broadcast Media**, that owns 67 TV stations, said its Quest digital multicast network is launching an ad-supported linear streaming app that will give viewers access to science, history and engineering programming on demand.

<https://quest-on-demand.com/#/landing>



- ❑ Brian Weiss, VP of entertainment programming and multicast networks at Tegna, said *Twist*, an OTA multicast channel aimed at women that Tegna launched in April “could be coming down the road” as an ad-supported linear streaming service”.



Streaming in the USA

- ❑ NewsNation is a subscription television network owned by the **Nexstar Media Group** that owns 199 TV stations. NewsNation is available on YouTube, Hulu, FuboTV, Vidgo, Sling TV.

- ❑ <https://www.newsnationnow.com/>



- ❑ Newsy is a news network owned by the **E. W. Scripps Company** that also owns 66 TV stations. Its content can be found on subscription OTT platforms including Pluto TV, YouTube, fuboTV, Philo, Sling TV.

- ❑ 27 of Hearst's Very Local news channels.



<https://localnow.com/>





Streaming in the USA

Local Now- (450 FAST channels)

local Now

Home Channels Movies Shows

MY CITY Belle Mead, NJ

Local Now News
2:00 PM - 3:00 PM • 46m left
Local

Ch 3142 local Now New York

MORE CITIES

Channel	On Now	Up Next
212 NewsChannel 5 Now (Nashville)	2h 44m left	4:58 PM NewsChannel 5 Now
214 WAAY (ABC) News 31 Huntsville, AL	46m left	3:00 PM WAAY (ABC) News 31 Huntsville, AL
216 LOCAL 6 WPSD (NBC) News 6 Paducah, KY	46m left	3:00 PM WPSD (NBC) News 6 Paducah, KY

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Got it!

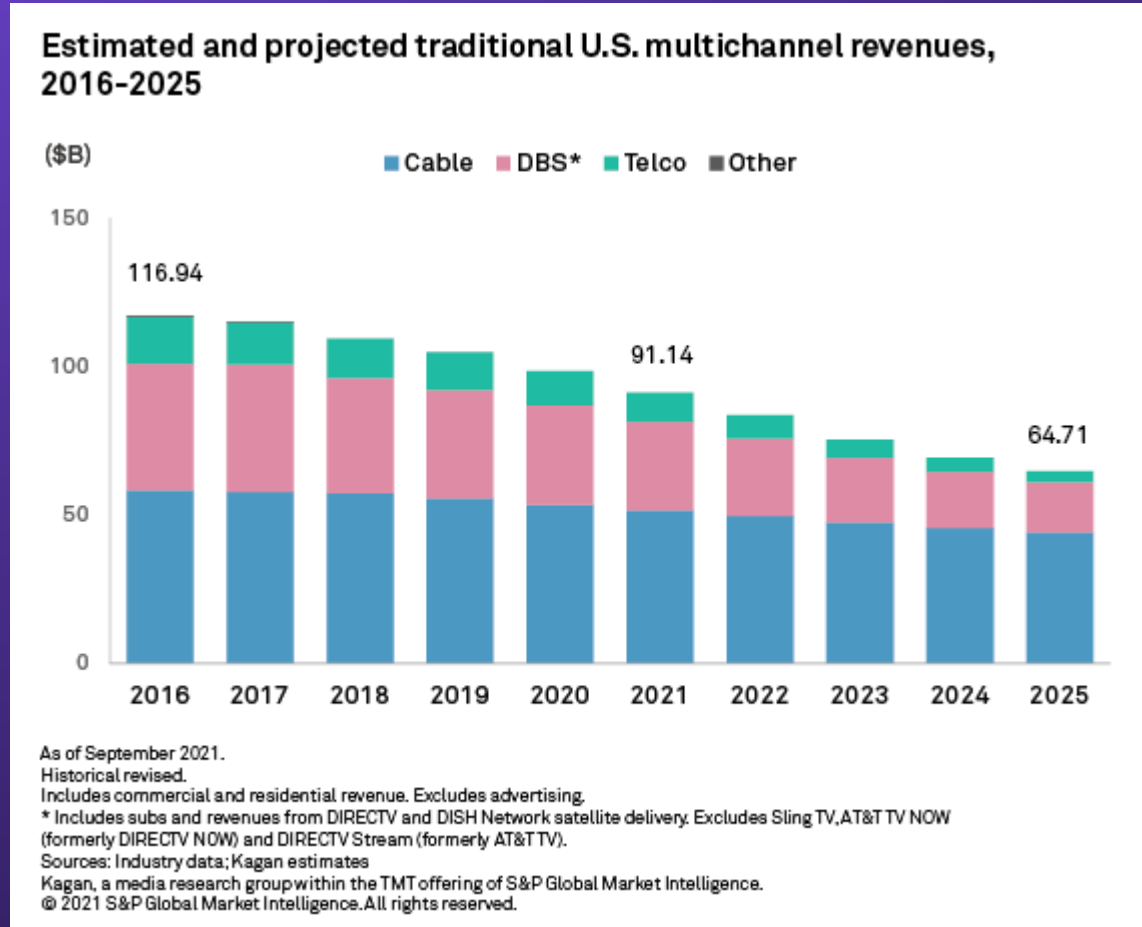
Streaming in the USA

□ Cost per month for streaming services.

Service	Price /mth with comm	Price /mth without comm
Amazon Prime Video	\$14.99	
HBO MAX	\$9.99	\$14.99
Hulu +Disney+ ESPN	\$13.99	\$19.99
Netflix (standard)	\$15.99	-
Disney +	\$7.99	\$10.99
Paramount + Essentials (CBS affiliates)	\$4.99	
Paramount + (premium)		\$9.99
Showtime & Paramount +		\$11.99
Apple TV	\$4.99	-
NBCU Peacock (Ad supported)	(1) Free limited programming; (2) Ad-supported complete version, free to existing Comcast customers; (3) \$4.99 non-Comcast customers	\$9.99
ABC	Linked to TV provider subscription	

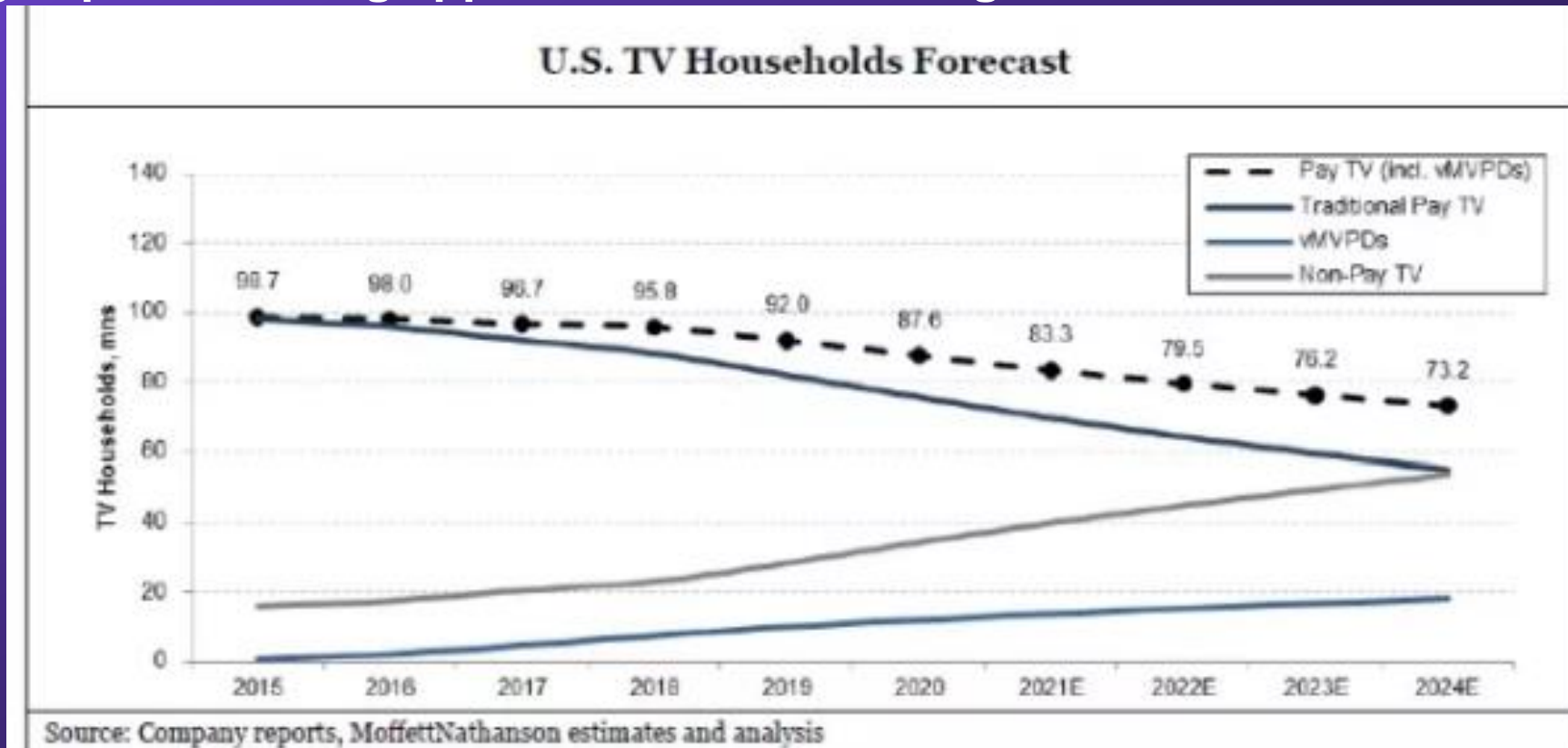
Streaming in the USA

- ❑ Cord-cutting is projected to cost Pay TV Operators \$33.6B in Revenue by 2025.



Streaming in the USA

- ❑ The number of pay TV homes (i.e. cable, satellite, vMVPDs) will drop to 73.2 million households by 2024, from 83 million at the end of 2021, according to MoffettNathanson Research.
- ❑ The analysts say the cord-cutting will continue at a 4% to 5% annual pace, even though sports viewing appears to be rebounding.



US pay-TV viewers continue to “cut the cord”

- ❑ Pay-TV penetration in the United States will continue to decline over the next few years, dropping to under 50 per cent by 2026 according to analysis from Digital TV Research. **8% less subscribers in 2022**, and **8% projected loss of subscribers in 2023**.
- ❑ The analysts forecast the US will have **60 million pay-TV subscribers by 2027**; **declining from 105 million in the peak year of 2010**.
- ❑ The number of households without a pay-TV subscription will rise from 11.34 million in 2010 to 72.86 million in 2027 due mainly to cord-cutting.
- ❑ 52% – of cord cutters say they don’t miss anything about their old Cable or Satellite TV. If they did miss anything, it was typically live events (23%), local and national news (22%), and sports (19%).
- ❑ Comcast Cable lost 2.034 million pay-TV video subscribers in 2022, significant uptick over the 1.67 million lost in 2021 or a **11.2% loss of subscribers Year of Year**. Comcast now serves only around 16.1 million subscribers.
- ❑ Comcast’s subsidiary streaming service, Peacock, report **2.3 billion loss in 2022**, and projects a **3.0 billion loss in 2023**.



US Cable Companies shifting from Broadband coax to Fixed Wireless Access (FWA)

Broadband 50-750 MHz
Coax or fiber

200 channels



HDMI



Streaming



Ethernet LAN

OR



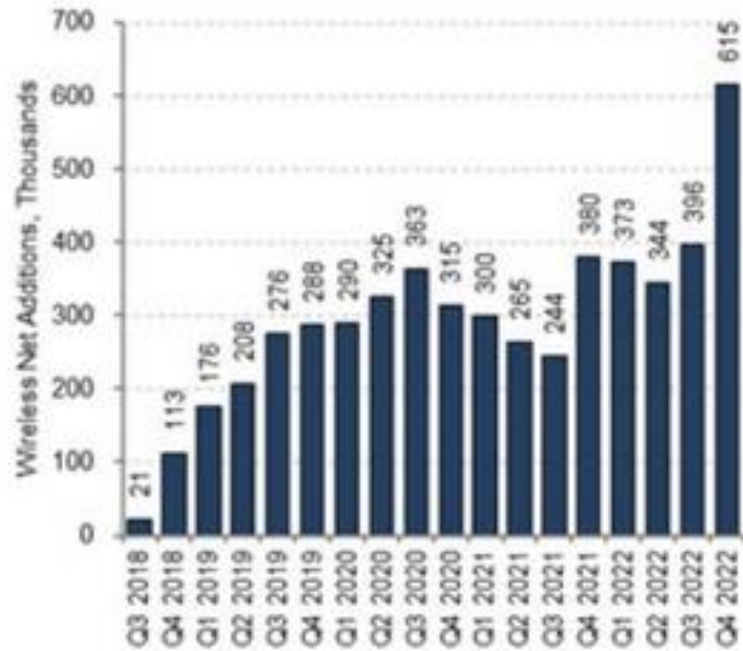
T-Mobile and Verizon collectively added nearly 3.2 million **fixed wireless access** customers in 2022.

Customer installed modem

US Cable Companies shifting from Broadband coax to Fixed Wireless Access (FWA)

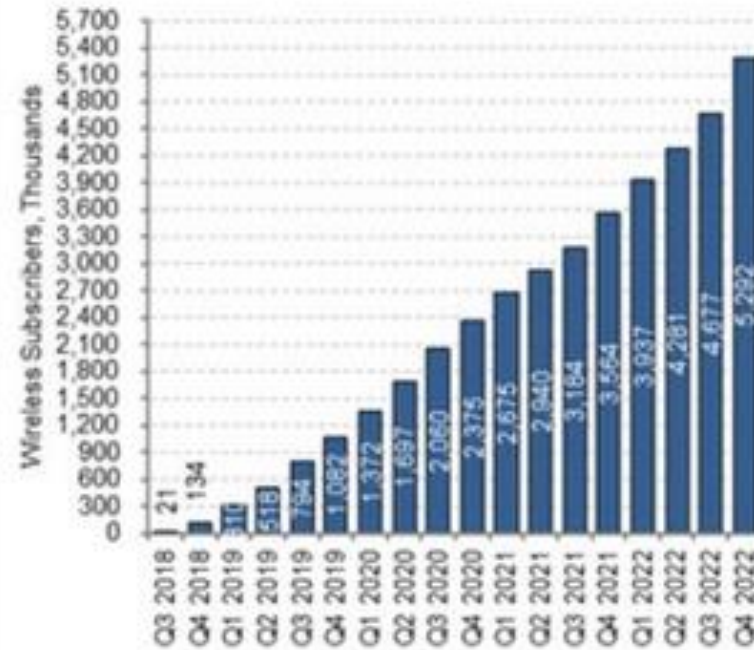
T-Mobile and Verizon collectively added nearly 3.2 million fixed wireless access customers in 2022,

Charter: Wireless Net Additions



Source: Company reports, SVB MoffettNathanson estimates and analysis

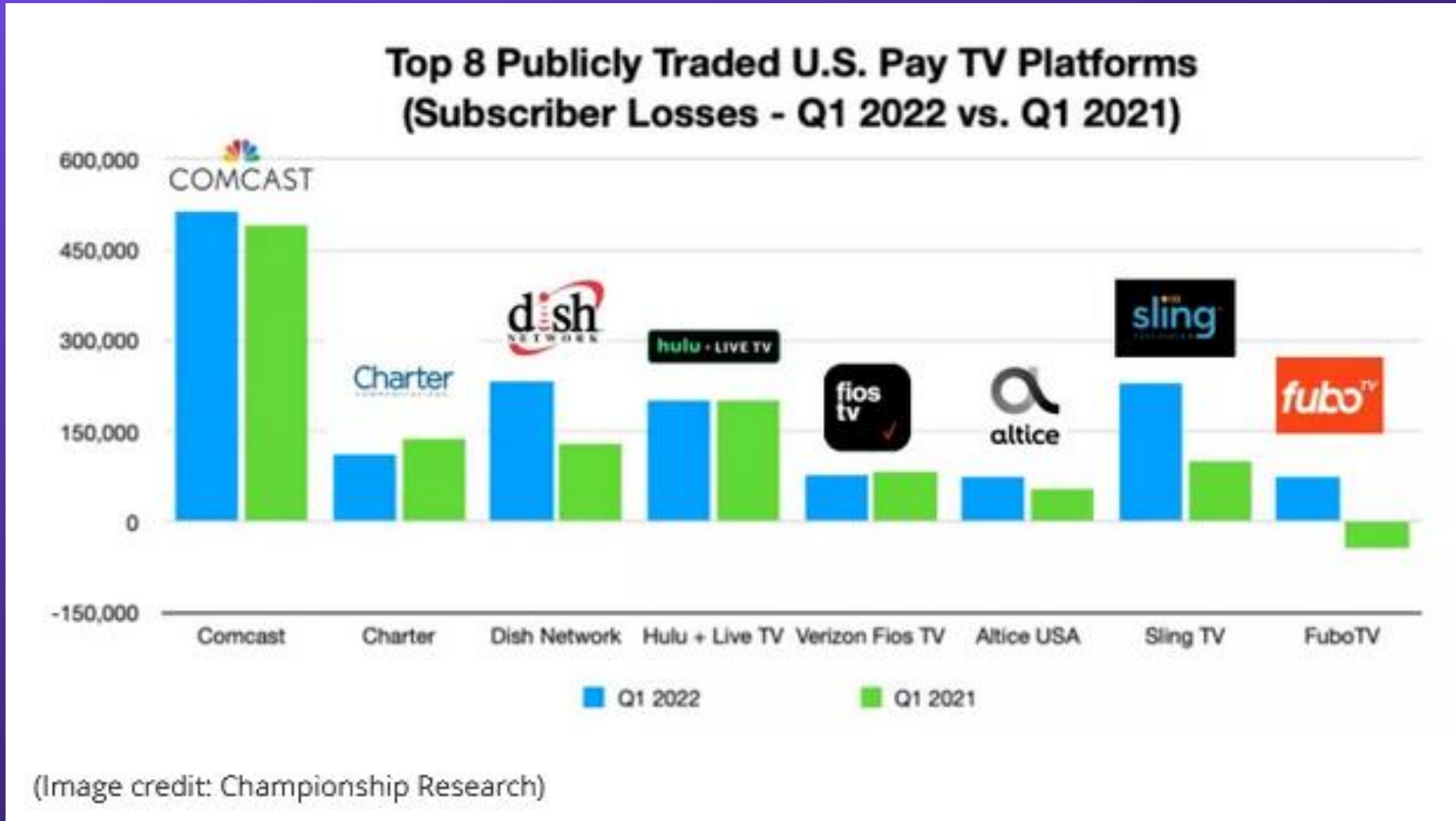
Charter: Wireless Subscribers



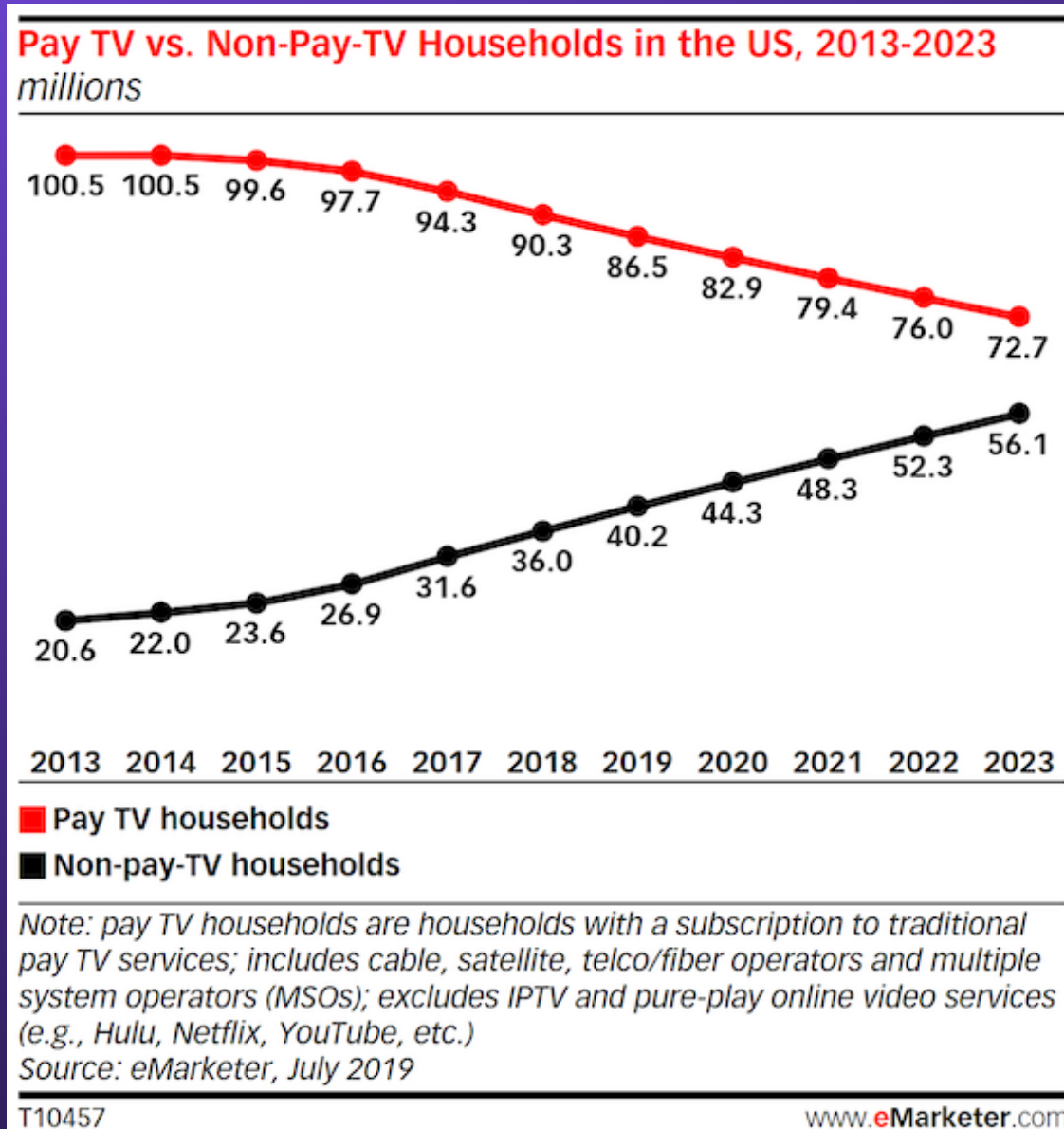
Source: Company reports, SVB MoffettNathanson estimates and analysis

Streaming in the USA

- From Q1 2021 to Q1 2022. “Cord Cutting” increased by 31%



US pay-TV viewers continue to “cut the cord”



Streaming in the USA

- ❑ One major challenge for all streaming services is customer retention. Subscribers cancel their subscription after watching a show of interest and then sign up with another service. This subscriber “Churn” has changed during the pandemic.
- ❑ Pre-pandemic churn rates were 20%, then went down during the early months of the pandemic, then shot up to 85% and have now leveled off at 35 - 37%.



ATSC 3.0 Next Generation TV in the USA

Next Generation TV- ATSC 3.0 in the USA

- ❑ While the Federal Communications Commission (FCC) has approved the use of the ATSC 3.0 modulation standard, they have not provided any new spectrum to broadcast the new TV signal.

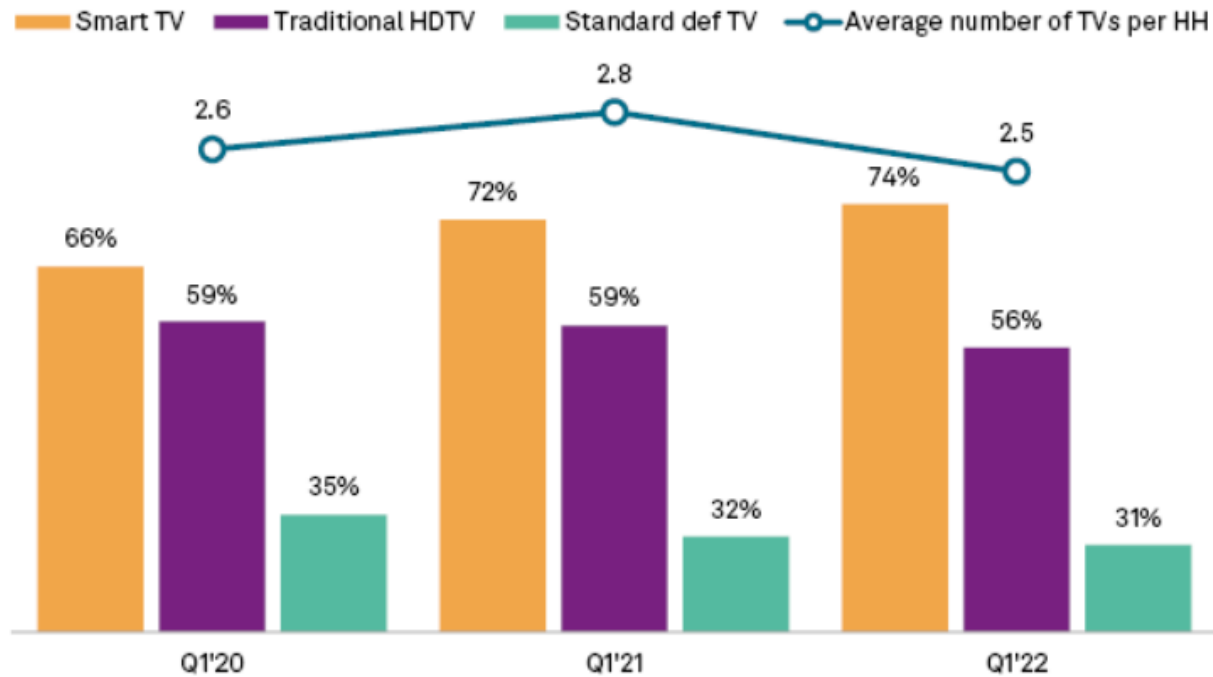


- ❑ The FCC has not mandated a transition to ATSC 3.0, so it is a voluntary local TV station decision.
- ❑ The FCC has not required TV manufacturers to include this new technology in the TV sets. It is a voluntary receiver manufacturer decision. 20 different TV models from three manufacturers—LG, Samsung, and Sony started producing ATSC 3.0 TV sets in 2020, 2021 and 2022.
- ❑ The FCC has not required the Cable and Direct Broadcast Satellite providers to carry the ATSC 3.0 signal or its enhanced features, such as HDR, 4K , targeted Ads, etc.
- ❑ The business plan to support this new technology needs to be clarified.
- ❑ As of April 2023, at least **one ATSC 3.0 station is on the air in 76 out of 210** markets. However, **only 34 % of USHH have the big four commercial Networks (ABC,CBS,FOX, NBC) on the air. 11 markets** have ABC, CBS, FOX, NBC and **PBS** on the air with ATSC 3.0.

Streaming in the USA

While the analog over the air standard definition service (NTSC) was turned off in 2009, 13 years later, more than 30% of the TV viewing is still on standard definition TVs. This long lifecycle could be a factor in the ATSC 3.0 conversion.

Average number of TVs per HH and TVs by technology, 2020-2022



Q. Please indicate the devices that you personally own and have used in the past 6 months.

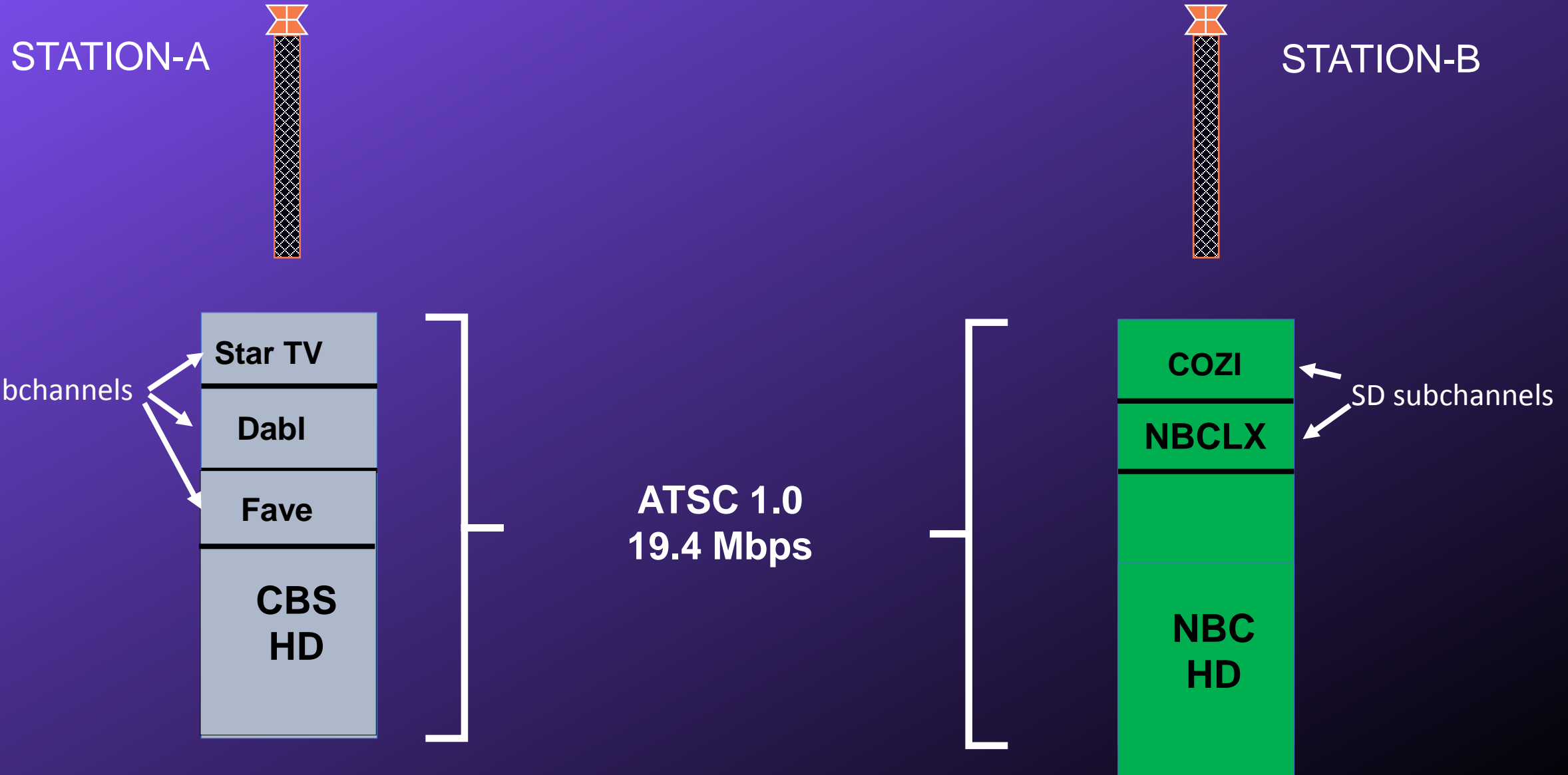
Base: 2020 – 2,501; 2021 – 2,626; 2022 – 2,519.

Sources: Kagan U.S. Consumer Insights surveys 2020-2022

Kagan, a media research group within the TMT offering of S&P Global Market Intelligence.

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Simplified Transition from ATSC 1.0 to ATSC 3.0 with no new spectrum (current situation)



Transition from ATSC 1.0 to ATSC 3.0 with no new spectrum

STATION-A
"HOST"
ATSC-1.0



NBC station-B would place their programming on the CBS station-A to support existing ATSC 1.0 TV receivers.

CBS station-A would place their programming on NBC station-B for the new ATSC 3.0 receivers

It is unclear what will happen to the subchannels. In a given market, there may be 30 subchannels.

Start TV ??

Dabl ??

Fave ??



ATSC 1.0
19.4 Mbps

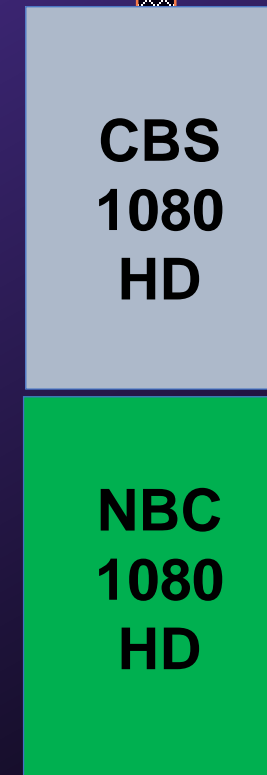
ATSC 3.0
23 Mbps

STATION-B
ATSC-3.0



COZI ??

NBCLX ??



It is unclear what will happen to all the current (33) OTA ATSC 1.0 SD Sub-Channel Networks



Two Lighthouse ATSC 3.0 stations per Market will be Required

STATION-A
ATSC-3.0



In order to broadcast all the major Networks in each city, it will be necessary to have at least two ATSC 3.0 stations per market.

Because the video compression format (HEVC) used in ATSC 3.0 is more bit efficient, it is possible to have more HD signals per transmitter.

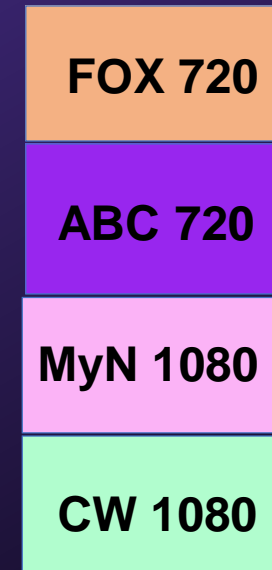
In this example, both Station-A and Stations-B have a 4 channel HDTV multiplex.

STATION-B
ATSC-3.0



ATSC 3.0
23 Mbps

ATSC 3.0
23 Mbps



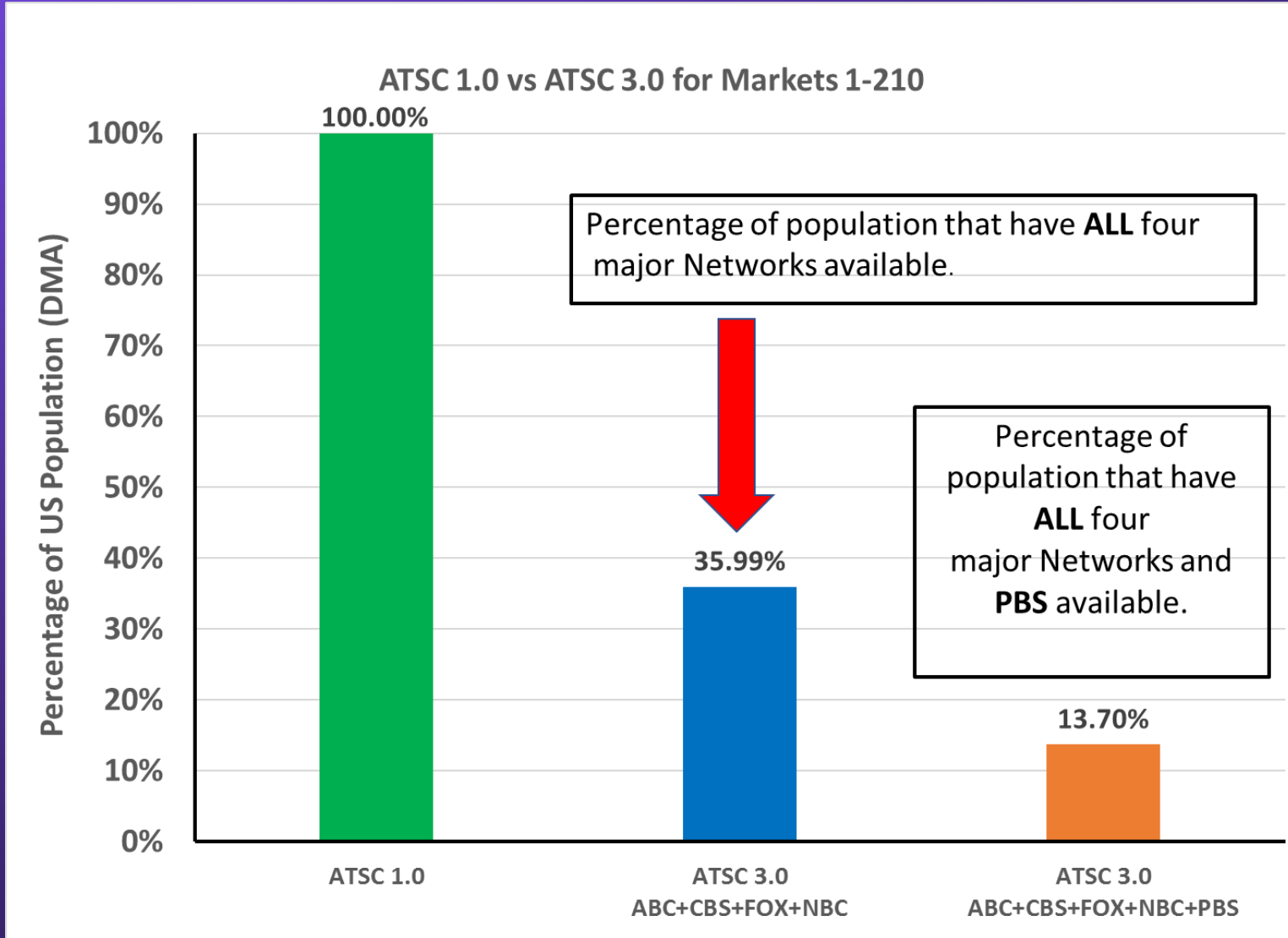
FOX 1080

Next Generation TV- ATSC 3.0 in the USA

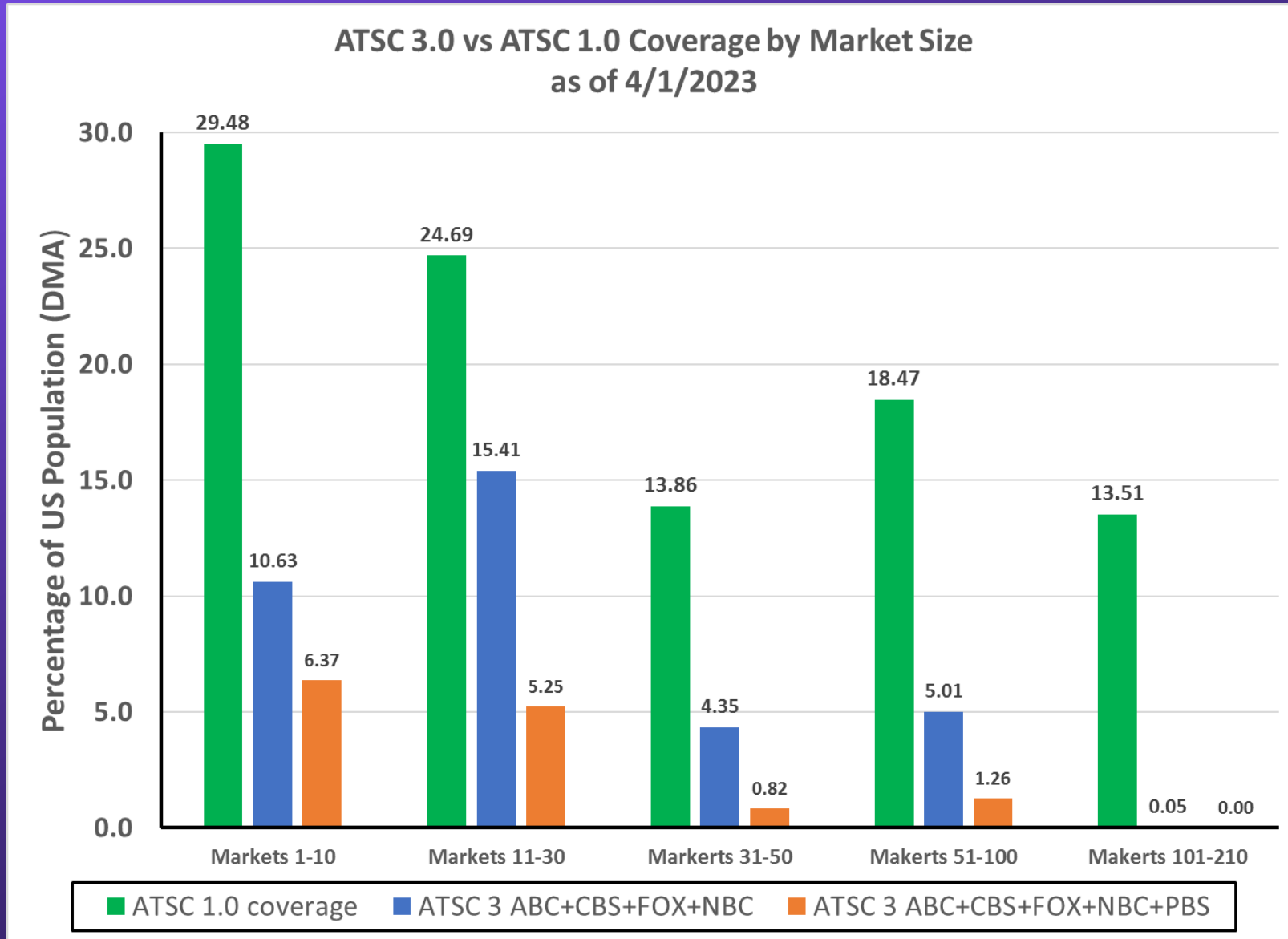
- ❑ In order to broadcast all the major Networks (ABC, CBS, FOX, NBC, PBS) in each city, it will be necessary to have at least two ATSC 3.0 stations per market.
- ❑ The Phoenix, Arizona market is an example of a two station multiplex:
 - KFPH carries: Independent, PBS, Univision, UniMas, Telemundo.
 - KSAW carries: ABC, CBS, CW FOX, NBC, My Network.

Next Generation TV- ATSC 3.0 in the USA

as of 4/7/2023

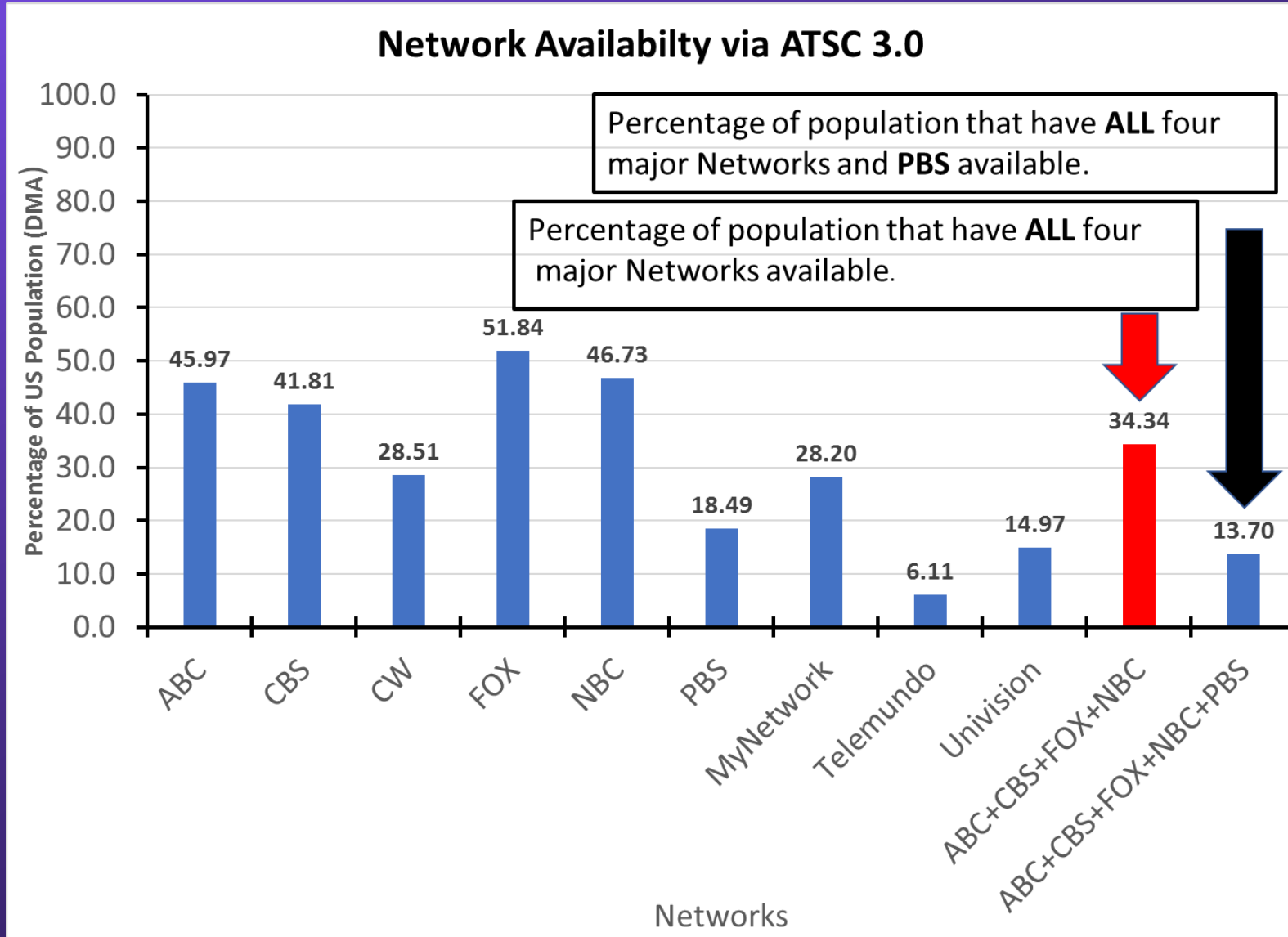


Next Generation TV- ATSC 3.0 in the USA



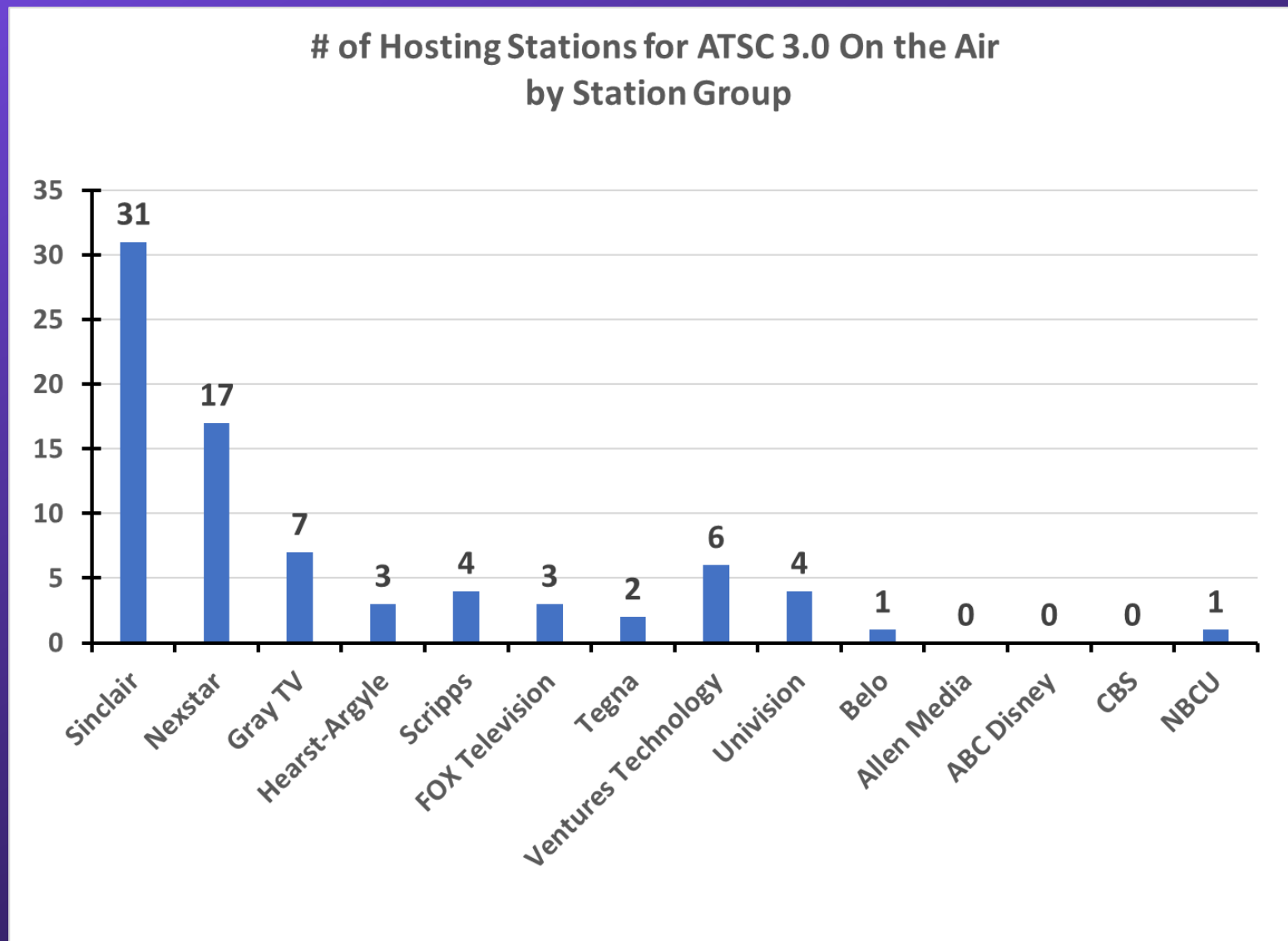
Next Generation TV- ATSC 3.0 in the USA

as of 4/7/2023



Next Generation TV- ATSC 3.0 in the USA

as of 4/7/2023



Next Generation TV- ATSC 3.0 in the USA

- ❑ Nielsen estimates there are currently 120.6 million US TV Households. That equates to 307.3 million people. (i.e. on average 2.54 people per USHH).
- ❑ Nielsen also estimated that **15.8% of the USHH receive their TV signals via Over-The-Air (OTA)** reception. Other survey estimates of 4,500 homes say 10%.
- ❑ Since ATSC 3.0 is not carried by cable or satellite distributors, it is only available to OTA viewers; the potential population served is much less. (see calculation below)
- ❑ As of 4/7/2023, the number of markets with all 4 major Networks (**ABC, CBS, FOX, NBC**) broadcasting ATSC 3.0 over the air, equates to **34.3 % of USHH**, Therefore, the potential ATSC 3.0 USHH can be computed by:
$$34.3\% \times 15.8\% = \mathbf{5.0\% \text{ of US HH.}}$$
- ❑ Markets that have two ATSC 3.0 stations on the air and could potentially carry all the major Networks (**ABC,CBS,FOX,NBC,CW,PBS, My Network, Univision**) account for **30.4 % of USHH**.
 - Therefore, the potential full service ATSC 3.0 USHH can be computed by:
$$30.4\% \times 15.8\% = \mathbf{4.8\% \text{ of USHH.}}$$

ATSC 3.0 Business Opportunities and Challenges

ATSC 3.0 Additional Business Opportunities

- ❑ **Data Broadcasting**-Excess channel capacity can be used to send data files for mass distribution.
- ❑ **Targeted Advertisements**- Additional advertisements can be sent to home or mobile devices that are targeted based on: location, personal preferences, age or other demographic data.
- ❑ **Geolocation Services**.- A South Korean Hancom drone was demonstrated using the local ATSC 3.0 signals for improved geolocation.



- ❑ **Automotive Services**-South Korean auto parts manufacturer, Hyundai Mobis, has developed an ATSC 3.0 receiver for use in vehicles: the company expects the first commercially available 3.0-enabled vehicles to be on the road in the United States in 2023.



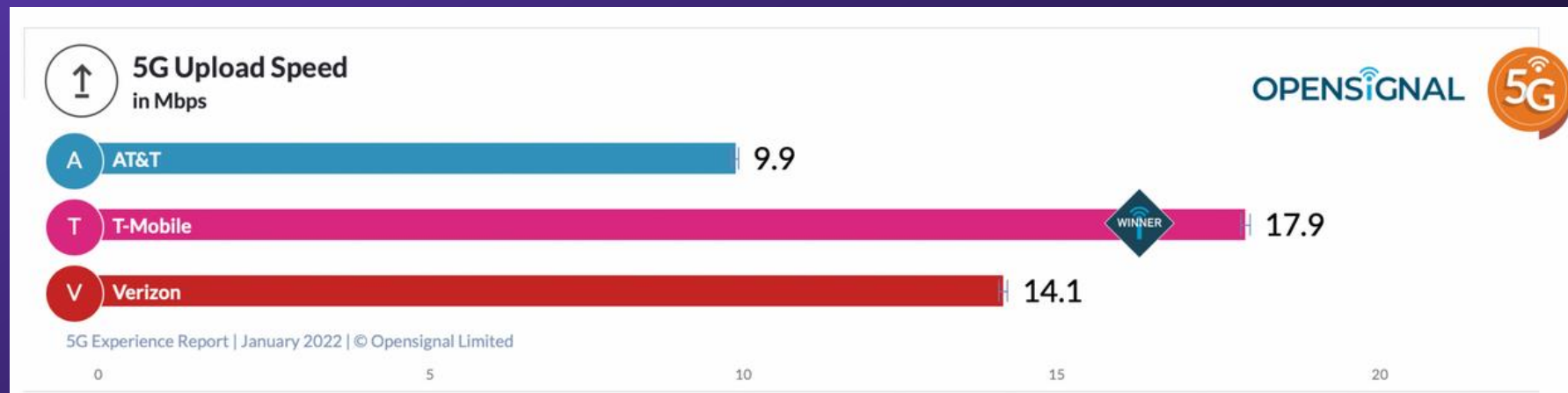
ATSC 3.0 for Data Broadcasting

- ❑ Some proponents of ATSC 3.0 plan to use the new standard for Data Broadcasting and forecast \$4 billion in revenue by 2032.
- ❑ The current transition plan will require two ATSC 3.0 stations in every market to transmit the major Networks (ABC, CBS, CW, FOX, NBCU, PBS, Telemundo, Univision) leaving very little capacity for Data Broadcasting unless additional stations are dedicated to ATSC 3.0.
- ❑ The competitors to the ATSC 3.0 Data Broadcasting business are the major Cellular Telephone carriers. The Telco's just made larger purchases of C-band satellite spectrum for 5th Generation cellular service:
 - ❑ Verizon \$45.5 billion
 - ❑ AT&T \$ 9.1 billion
 - ❑ Dish \$7.3 billion
 - ❑ T-Mobile \$2.9 billion
- ❑ Other competitors include WiFi -6 and Cable TV new cable modem **DOCSIS 4.0** that can deliver 10 Gbps.

ATSC 3.0 Data Broadcasting Competitor Comparison Chart (Download vs Upload)

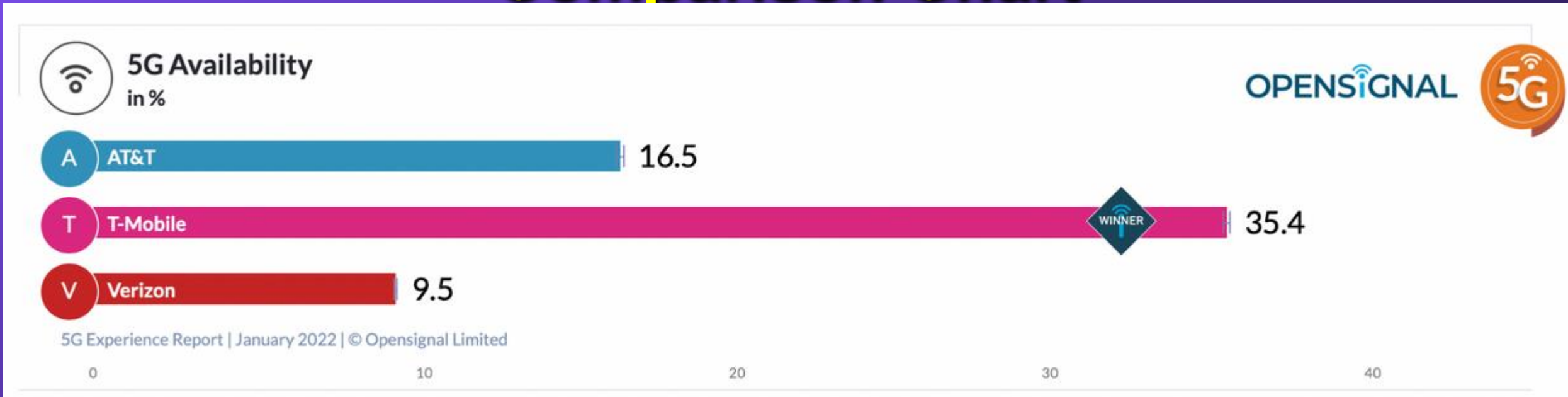


ATSC 3.0 max capacity 24 Mbps – 4K video service 12 Mbps = 12 Mbps



ATSC 3.0 zero Mbps

ATSC 3.0 Data Broadcasting Competitor Comparison Chart



- While 64 % of the USHH now have access to at least one “Lighthouse” station carrying multiple HDTV signals in the ATSC 3.0 format, a nationwide Data Network has not yet deployed. It has been estimated it will take over 10 years for the consumers to replace their existing ATSC 1.0 TV sets before a nationwide data network can be deployed and the ATSC 1.0 stations converted to ATSC 3.0 for a data network.

ATSC 3.0 Geo-location services

- ❑ At the 2022 NAB show in Las Vegas, drone technology was demonstrated that uses multiple ATSC 3.0 stations for improved geographic position information.



- ❑ Existing basic GPS satellite signals have an accuracy of 15 meters (50 ft.) horizontally and 4 meters vertically.
- ❑ The existing GPS system has added a Wide Area Augmentation System (WAAS), which increases the accuracy to 3 meters (9.8 ft.) with an availability of 99.9% of the time.
- ❑ The Federal Aviation Administrations (FAA) is adding Local Area Augmentation System (LAAS) that increase the accuracy <1 meter horizontally and < 1 meter vertically.

ATSC 1.0 Geo-location services

- This concept was first proposed in 2005 using the existing ATSC 1.0 signals and even NTSC, with no market acceptance.

PrimeTime Positioning

Using Broadcast TV Signals to Fill in GPS Acquisition Gaps

Max Martone and Jon Metzler, Rosum Corp.

material value exist.

While network-assisted GPS (A-GPS) can extend the operational range of classic autonomous GPS, in some situations its efficacy and reach are insufficient. There is a clear need for a cost-effective system that sustains performance indoors and in urban canyons. Furthermore, GPS itself is susceptible to jamming and other man-made interference. A solution that is distributed and robust to jamming is desired.

We advocate the use of broadcast TV signals as an augmentation to, or substitute for, GPS-based solutions. The core idea is to exploit the existing commercial broadcast TV infrastructure to obtain ranging information anywhere GPS solutions are not able to provide acceptable performance.

GPS generally provides global outdoor coverage, but its shortcomings in urban and indoor environments mean its effective real

New Positioning Channel

The basis of the technology lies in the innovative concept of using unmodified commercial broadcast TV signals for positioning. TV signals are broadband signals with a bandwidth of 6 MHz to 8 MHz — much wider than the primary lobe of the civil GPS C/A-code, thereby permitting higher-accuracy tracking. TV signals are at lower and more-diverse frequencies and are much higher in power, making them optimal for indoor and urban reception. They were designed for the purpose of indoor reception. TV picture information is not demodulated in our system.

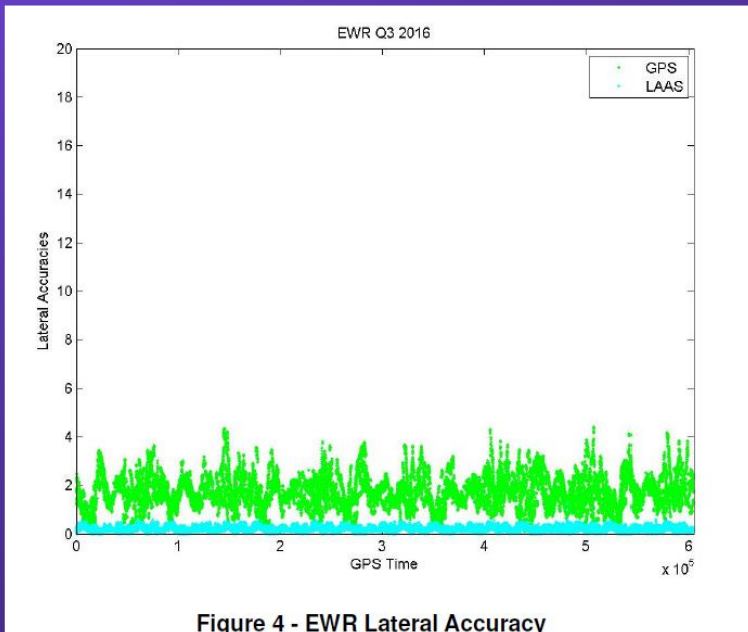
TV signals occupy nearly half of the spectrum between 30 MHz and 1 GHz. Our company has implemented a first-generation system that exploits Advanced Television Systems Committee (ATSC) digital and National Television System Committee (NTSC) analog TV signals and is functional

52 GPS World SEPTEMBER 2005

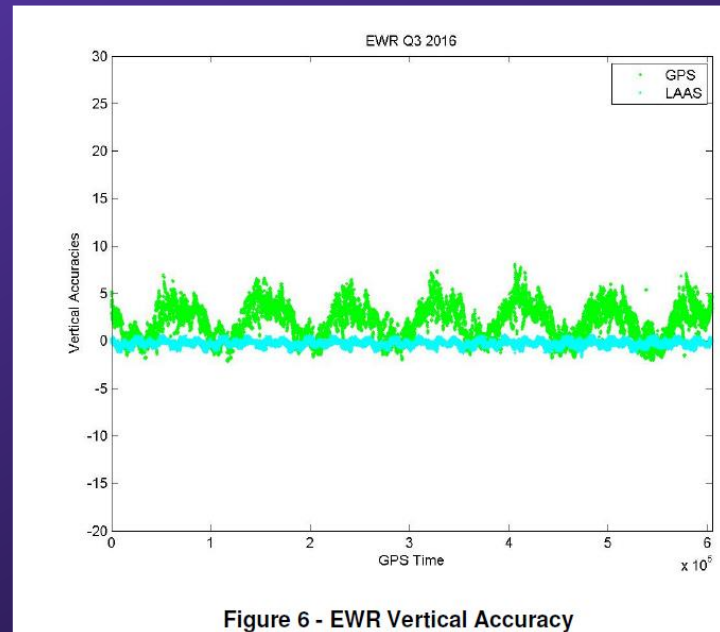
ATSC 3.0 Geo-location services

- Considering the GPS System is already very accurate with a high degree of reliability (see graphs below), and is provided free of charge by the U.S. Government across the nation, is there a need for ATSC 3 broadcasters to provide a similar service? What is the business model and potential liability to broadcasters if their data is in error or unavailable?

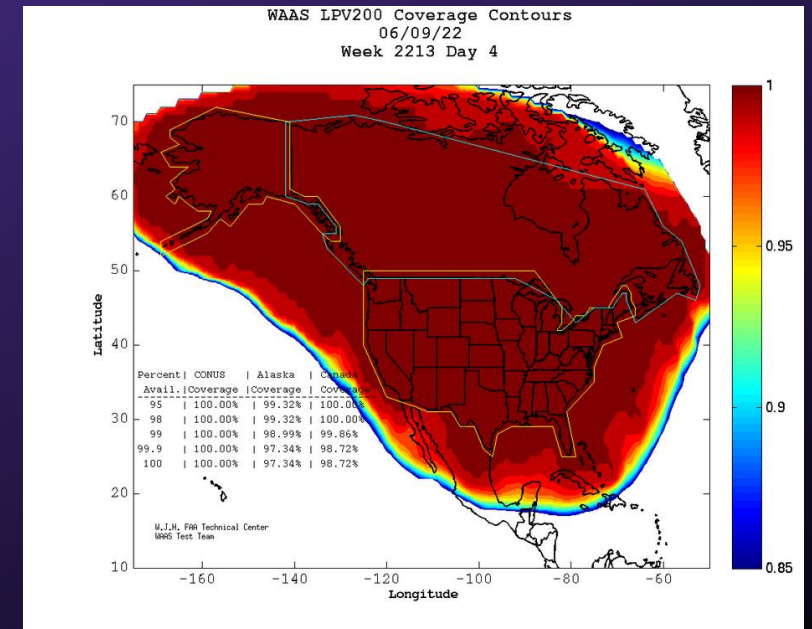
Newark Airport Lateral Accuracy
with LAAS



Newark Airport Vertical Accuracy
with LAAS



100 % available with 100% coverage



https://www.nstb.tc.faa.gov/24Hr_WaasLPV200.htm

ATSC 3.0 Target Advertising

- ❑ The Cable TV and Satellite industry that delivers the broadcasters' signal to 61% of US Household has **no plans to carry the ATSC 3.0** signal or its enhanced services such a Targeted Ads.
- ❑ A new law, **American Data Privacy and Protection Act** has been proposed in the U.S. Congress (House of Representatives (H.R.6416) and Senate (S.3520) that will **prohibit advertising facilitators** (e.g., publishers) from engaging in or enabling an advertiser or third party from engaging in **targeted advertising** using consumers' personal information.

Summary of ATSC 3.0 Business Challenges (Practical business and competitive issues)

- ❑ **Data Broadcasting**- ATSC 3.0 is a one-way data path that needs to rely on WiFi or cellular connections for the return path. The cellular carriers have a large installed bases of cellular sites that have nationwide coverage, more capacity, with unlimited data plans.
- ❑ **Targeted Advertisements**-The Cable TV and Satellite industry that delivers the broadcasters' signal to 61% of the US Household have no plans to carry the ATSC 3.0 signal or its enhanced services such a Targeted Ads. A new law, **American Data Privacy and Protection Act** has been proposed in the U.S. Congress (House of Representatives (H.R.6416) and Senate (S.3520) that **will prohibit advertising** facilitators (e.g., publishers) from engaging in or enabling an advertiser or third party from engaging in, **targeted advertising** using consumers' personal information.
- ❑ **Geolocation Services**.-The existing GPS satellite service is provided **free of charge** by the US Government with excellent accuracy, high reliability, and a high degree of redundancy.
- ❑ **Automotive Services**-Many states (37 of 50) have laws that prohibit television screens from being visible to front seat occupants. Example Washington State **"No person may drive any motor vehicle equipped with any television viewer, screen, or other means of visually receiving a television broadcast when the moving images are visible to the driver while operating the motor vehicle on a public road"**

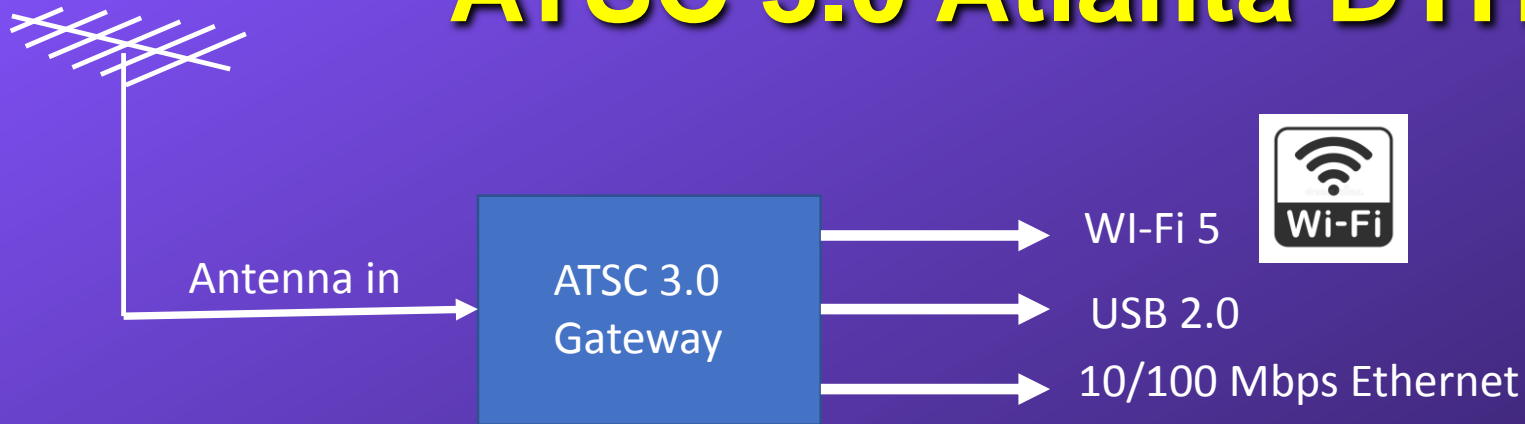
NextGen Broadcast Conference Uncovers Rift Between Consumer Technology Association (CTA) and National Association of Broadcasters(NAB)



(Image credit: ATSC)

- ❑ CTA President Gary Shapiro and NAB CEO & President Curtis LeGeyt were downright confrontational.
- ❑ Shapiro noted that ATSC is a “wonderful mechanism composed of super-competent people” who came together and agreed on a goal for NextGen TV. “I think that’s great, but when you asked about the partnership between the industries and organizations and how this would be promoted, **it’s tough to promote it when someone has a knife, and they keep trying to stab you.**”

ATSC 3.0 Atlanta DTH Gateway

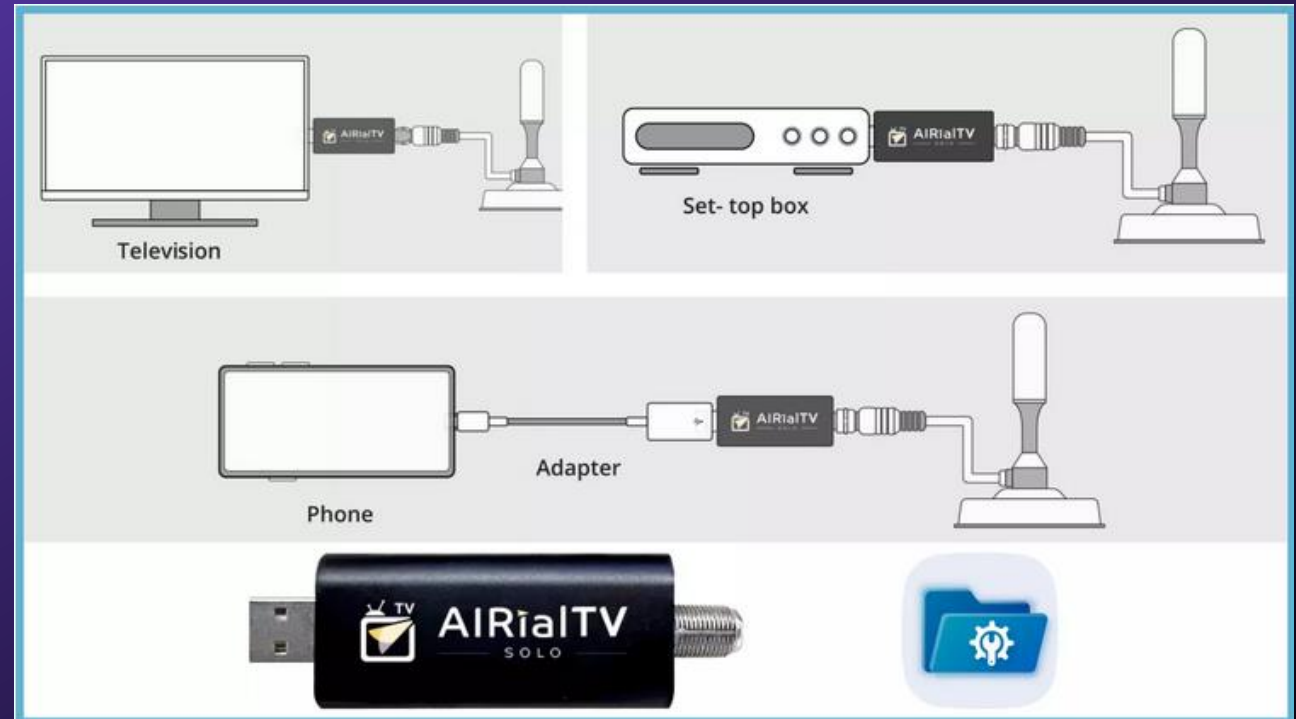


- ❑ Dual tuners and a built-in Wi-Fi 5 transmitter enables simultaneous viewing of preselected channels or a second channel on a mobile computer, media tablet or smartphone.
- ❑ Pause a show for up to 60 minutes and rewind it for up to five minutes.
- ❑ <https://adth.com/>
- ❑ Potential lost revenue (leakage) for pay services: Paramount+, Disney+, Peacock.

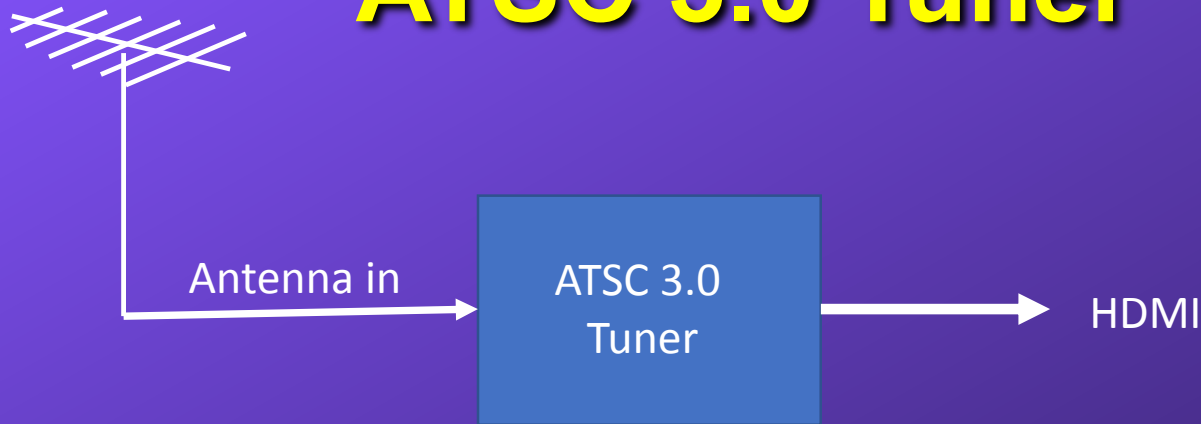
ATSC 3.0 Aerial TV Gateway



- ❑ Data rates of up to 36 Mbps
- ❑ 2160p60 4K UHD and HD multicasting.
- ❑ Initial price \$74
- ❑ Potential lost revenue (leakage) for pay services: Paramount+, Disney+, Peacock.
- ❑ www.adth.com



ATSC 3.0 Tuner “Dongle” for HDMI



- ❑ 2160p60 4K UHD and HD multicasting.
- ❑ Initial price \$
- ❑ However, Vizio’s, VP of platform content, has stated that “The Dongle is dead” , since only 7% of their viewers use HDMI dongles to watch OTT services.
- ❑ **Potential lost revenue (leakage) for pay services: Paramount+ Disney+, Peacock.**
- ❑ www.adth.com)

ATSC 3.0 Security Authority

- ❑ In order to prevent unauthorized distribution of the ATSC 3.0 broadcast signal on the Internet, ALL consumer receiving devices and broadcaster will need to comply with the **ATSC 3.0 Security Authority**.



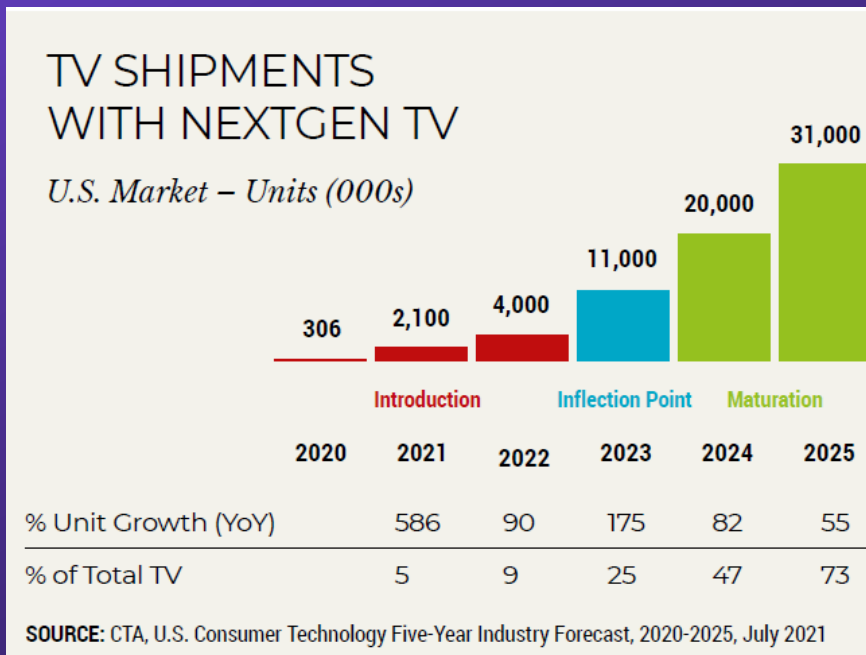
- ❑ **A3SA will provide device manufacturers and broadcasters with access to protection and security credentials that will enable secure delivery of high-value television content through the use of the ATSC 3.0 standard.**
- ❑ Participating Broadcasters: ABC, CBS, FOX, NBCU, Graham Media, Gray Media, Hearst Television, Meredith Corporation, NPG OF California, Scripps Media, Sinclair Broadcasting Group, Tegna, Univision.
- ❑ Participating Manufacturers: **Hisense**, LG Electronics, Samsung, Sony.
- ❑ <https://a3sa.com/>

Next Generation TV- ATSC 3.0 in the USA

- ❑ The transition plan does not provide for any 4K UHD TV.
- ❑ All stations would broadcast in the 1920 x 1080 / 59.94 or 1280 x 720 / 59.94 P Progressive video format.
- ❑ There may be some HDR services available.
- ❑ Cable and Satellite providers have indicated they do not plan to carry the ATSC 3.0 signals. Since the cable and satellite audience accounts for 61% of US TV Households, only a small percentage of the viewers will be able to see the ATSC 3.0 broadcasts. (≈15.8% of USHH)
- ❑ The question is: “Has the ATSC 3.0 Technology been overtaken by streaming services that has rolled out 4K, HDR, and targeted Ads much faster and are available on the mobile 3G, 4G , 5G cellular and WiFi networks, on millions of existing streaming TVs, gaming consoles, phones, tablets and PCs ?”
- ❑ Can ATSC 3.0 compete as a data delivery platform against 5G cellular and high speed WiFi that have faster data rates, two-way data service, and millions of installed cells and WiFi hot spots?

Next Generation TV- ATSC 3.0 in the USA

- ❑ ATSC 3.0 tuners are starting to appear in high-end 8K and 4K TV sets from Samsung, LG and Sony. Unfortunately, all of the ATSC 3.0 stations are broadcasting in the 720 or 1080 video formats. (what justifies the added cost?)
- ❑ On average, there are 2.5 TV sets per US TV Household and there are 120.6 million US TV Households or 301.5 millions TV sets will need to be replaced or have set-top converter boxes to move from ATSC 1.0 to 3.0. (Consumer Technology Association (CTA), estimates there are currently 285 million televisions in use.)
- ❑ At the projected growth rate, it will take 8-10 years to complete the conversion.



HDR Trends in the USA

- ❑ One of the challenges with High Dynamic Range (HDR) production and distribution is there are a multiplicity of HDR formats.
 - Hybrid Log-Gamma (HLG) ITU BT.2100.
 - HDR 10 (PQ) SMPTE ST 2084-ITU BT.2100.
 - HDR 10 +
 - HDR +
 - S-LOG (Sony)
 - SL-HDR-1
 - Dolby Vision IQ (Ambient light sensor + dynamic metadata).
 - Advanced HDR by Technicolor
- Multiple HDR formats are creating confusion in the marketplace and conversions between HDR formats can create issues.
- ❑ A method to automatically adjust the TV to the HDR format needs to be developed or the industry needs to standardize on a single format.
- ❑ Not all TVs support all the HDR formats.

HDR Trends in the USA

- HBO MAX announced all eight seasons of “Game of Thrones” will be available in 4K Ultra HD with HDR, as well as its new “House of the Dragon” series.



(Image credit: HBO Max)

4K / HDR Trends in the USA

- Over The Top (OTT) streaming services are currently the primary method for 4KHDR distribution in the USA.

Streaming Service	# of 4K Titles	HDR Format	# of 4K Titles in HDR	% of 4k Titles in HDR
Amazon Prime	590	HDR10+/Dolby Vision		35%
Apple iTunes	707	HDR10+/Dolby Vision		74%
Disney+	136	HDR10/Dolby Vision	104	14%
Fandango Now	284	HDR10		0%
Fubo TV	Note:1	HDR10		
Google Play	447	HDR10+/HDR10/Dolby Vision	426	95%
HBO MAX	21	HDR10+/Dolby Vision	21	100%
Hulu		none		
Netflix	851	HDR10/Dolby Vision	360	42%
Paramount+	45	Dolby Vision	4	
Peacock	Note:1			
Vudu	713	HDR10/Dolby Vision	531	74%
YouTube	170	HLG/HDR10+/HDR10/Dolby Vision	?	

Note:1 on the road map

4K / HDR Trends in the USA

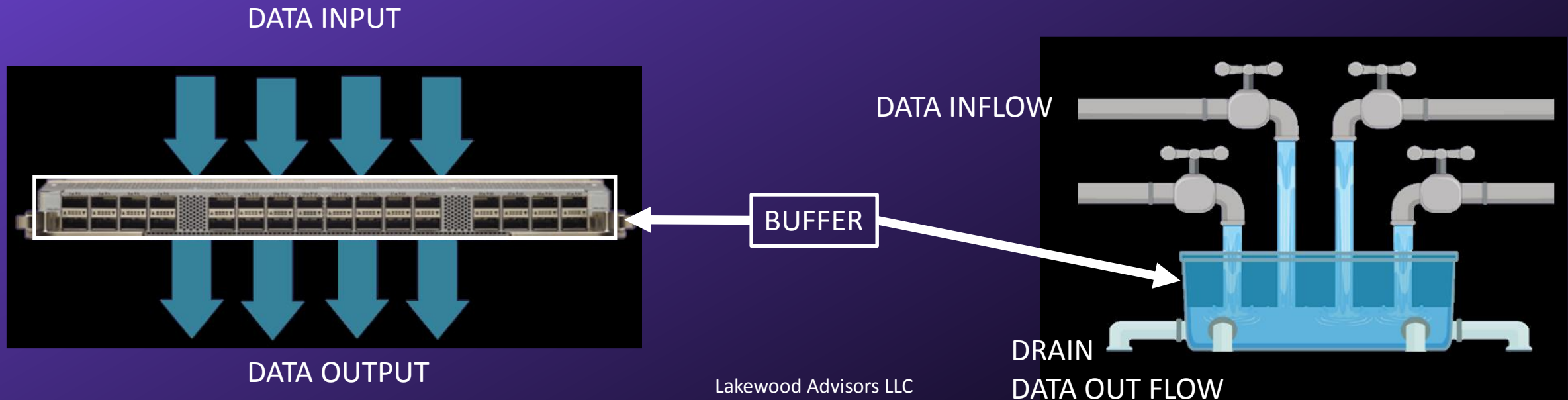
- ❑ Since 4K UHD TV signals require more data bandwidth than HD signals, none of the ATSC 3.0 stations are carrying 4K UHD TV over the air on their multicast channels.
- ❑ Cable distribution of 4K UHD TV is very limited to a few live sporting events.
- ❑ For the summer Olympics, NBCU made a 4K HDR signal available to all of the cable networks, satellite providers and online streaming platforms that carry NBC programming. However, so far only a handful have said they will be offering it to viewers, such as Comcast, Dish Network, and DirecTV. The 4K HDR signal will not be live and offered on a delayed basis.
 - Many of the 4K HDR signals were down converted from the NHK 's Super Hi-Vision 8K (7,680 x 4,320) HDR (HLG) format.
 - NHK is now streaming 8K Super Hi-Vision in 80 Mbps.



IP Production

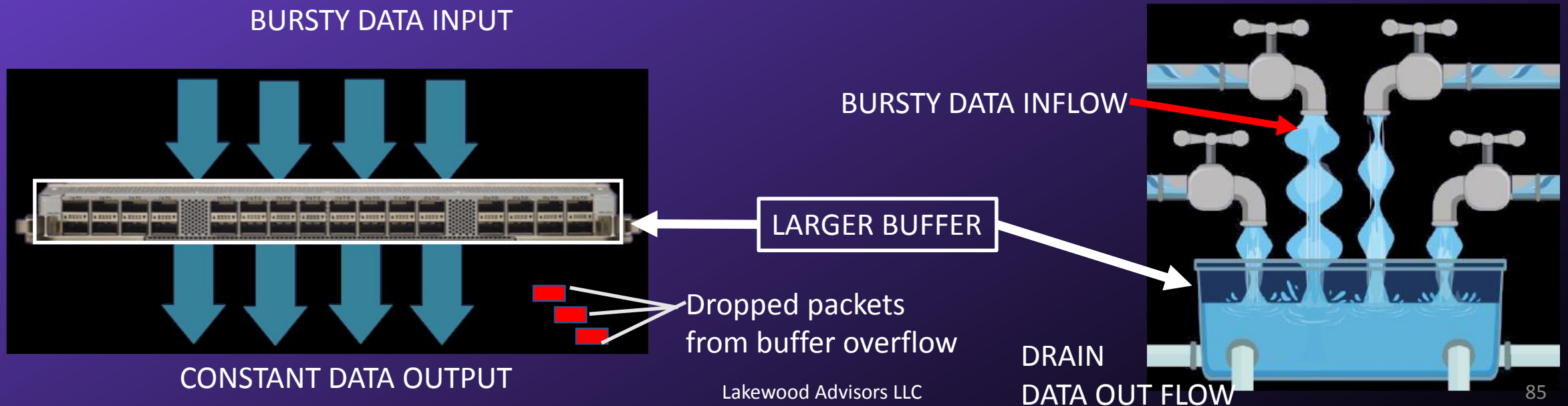
SDI vs IP Production

- ❑ One of the differences between Serial Digital Interface (SDI) and Internet Protocol (IP) switching is that SDI switching is “non-blocking” with guaranteed through-put from the source to the destination.
- ❑ With IP switching, it is necessary to manage the amount of data transmitted by the sender to the receiver, as well as understanding the buffer size in the ethernet switch. In this diagram, the data inflow rates are constant.



SDI vs IP Production

- ❑ Data input flows can increase and decrease creating “bursts” of transmitted data.
- ❑ Random and unregulated traffic patterns may temporarily overflow buffers, even if average bandwidth is not exceeded.

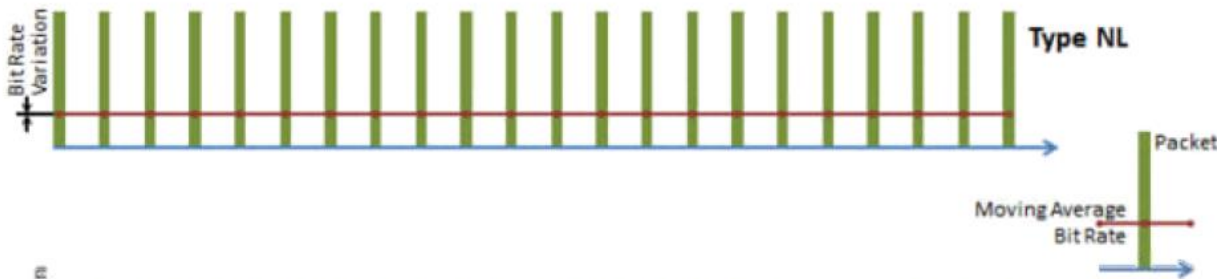


SMPTE ST 2110-21 Video – Traffic Shaping and Delivery Timing

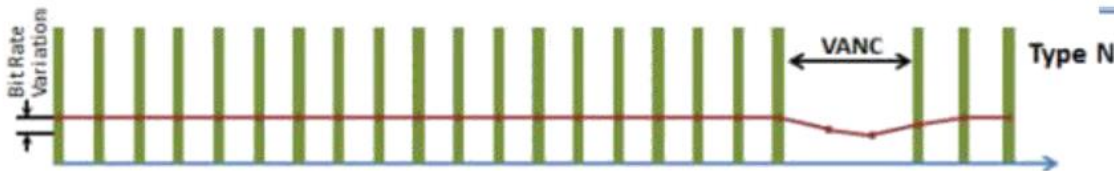
- In order to address different types of data flows from the sender, SMPTE defined sender - drain behavior (packet egress pacing and spacing) and (receiver) buffer requirements.
- •There are 3 models or Types of sender traffic shaping:
 - Narrow-linear (**NL**) Sender– packet are drained evenly distributed across the frame period .
 - Narrow (**N**) Sender– packet drain closely follows SDI signal timing (no packets during VBI and VANC) .
 - Wide (**W**) Sender– allows increased “burstiness” (accommodates Software -based senders).
 - The moving average is shown by the **redline**. Please refer to the SMPTE standard for the mathematical formulas.

- 3 models:

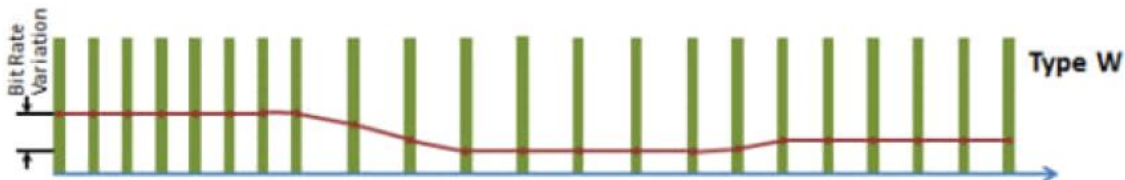
- Narrow-linear



- Narrow



- Wide



IP Production in the USA

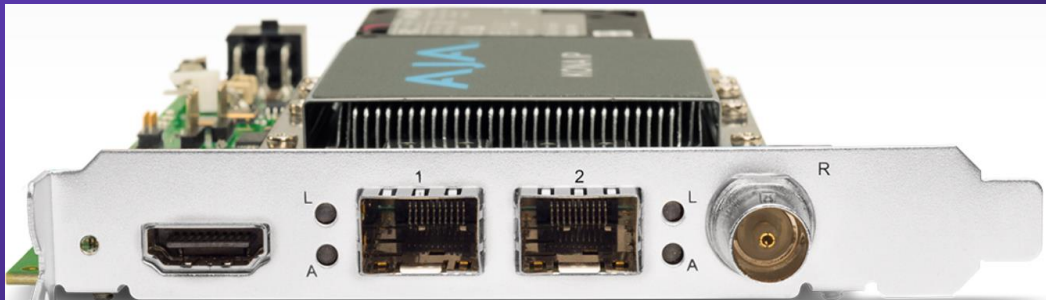
□ Canadian Broadcasting Corporation (CBC) Lessons learned:

- Each individual (or enterprise) has a different definition of COTS (Commercial Off-The Shelf).
- Specialized ST2110 hardware based Network Interface Cards (NIC) work very well.
- With reference to the SMPTE 2110-21 Types: N (or even W) profiles are difficult to achieve in software.
- The best software based senders meet the N –Profile(Narrow) 99.9% of the time, however, they exceed the profile 0.1 % of the time , which can cause intermittent issues. The W- Profile is easier to meet. However, in practice, the software exceeds the W-profile a small percentage of the time. (i.e. packets arrive late). As a result, the W-profile sender never achieved market acceptance and most manufacturers do not use software based sender and instead use purpose-built NICs.
- First generation gateways (those that were shipped as ST2022-6) are very limited in terms of functionality (# of audio streams, ability to support W senders, ...).
- “Precision Time Protocol (PTP) is hyper critical ... and the initial CBC design created an internal Distributed Denial of Service (DDoS)! It’s a bad idea to slave a grandmaster to Black Burst sync. Some gateways requires both PTP and Black Burst sync.”
- **CBC’s project ran over budget.**



IP Production in the USA

- ❑ While pure–software based senders never achieved market acceptance, there are some NIC-assisted transmitters, such as Mellanox ConnectX that uses a special driver.
- ❑ The third alternative for software based products is to use a purpose – built Network Interface Card (NIC), such as the AJA KONA-IP that can support one or two HD signals or at the high end, the Matrox X.MIO5 Q25 that can support one or two UHD signals.



IP Production

- There are two primary IP production formats SMPTE 2022 and SMPTE 2110.
- Large mobile unit (OB) vendors such as, NEP, Game Creek are building only IP based production OB vans.



- NBC's coverage of the 2021 Olympics in Japan was based on a Grass Valley IP /Cisco router.
- The Canadian Broadcasting Corporation's (CBC) new Broadcast Center is based on IP audio/ video distribution.



SMPTE 2110 IP Facilities

- ❑ Home Shopping -QVC Japan / USA (UHD/HDR overbuild).
- ❑ tpc UHD1 Mobile – UHD/HDR compact mobile unit.
- ❑ Sky UK / SkySport UHD/HDR transition – mix of 2022-6 legacy and 2110.



SMPTE 2110 IP Facilities

NFL Media – full 2110 uncompressed, UHD/HDR capable, six studios, four controls rooms, many external transmissions in/out



Chase Center Stadium (NBA).



Lucas Oil Stadium (NFL).



Fiserv Forum Stadium (NBA).



SMPTE 2110 IP Facilities

- ❑ Bally Sports (Sinclair, operating at Encompass Atlanta) Operations Center.
- ❑ Tennis Channel (Sinclair) ST2110 new build, Sony cameras & Switchers.
- ❑ EI Towers (Italy) Lega d'Italia network build. IP integration/distribution network connecting 17 football stadiums and production centers – mixed ST20226 and ST2110.



SMPTE 2110 IP Facilities

Project Columbus

- Private Cloud based Network Origination and playout.
- Content origination network from Supper NAP in Las Vegas and KMTC.
- Disney's private data center in Kings Mountain, NC.
- Total of 24 channel playout supporting ABC Network using 2022-6.

Project Rogue

- **Disney Cable Networks** cloud-based origination and playout
- Disaster Recovery based at KMTC .

FX and National Geographic (NatGeo) Migration

- Migration of FOX Cable Networks to Disney including FX, NatGeo, FX Mundo.
- Move to new **Digital Center 3 (DC3)** facility in The Woodlands, TX.
- 38 channels of playout.

ABC OTV Hub Spoke Network Migration to DC3

- **8 ABC Owned and Operated** stations.

ABC Network Origination Migration to DC3

- Moved from New York City to DC3.

ABC Network Disaster Recovery

- Moved from Los Angeles to Bristol, CT.
- 29 Disaster Recovery channels.



SMPTE 2110 IP Facilities

- ❑ Tencent- Chinese multinational technology and entertainment conglomerate.
- ❑ Central China TV, CCTV 8K UHDTV service.
- ❑ Italian RaiWay - RAI TV stations.



- ❑ TV2000 (Vatican)



SMPTE 2110 IP Facilities

□ BBC Cymru Wales Facility

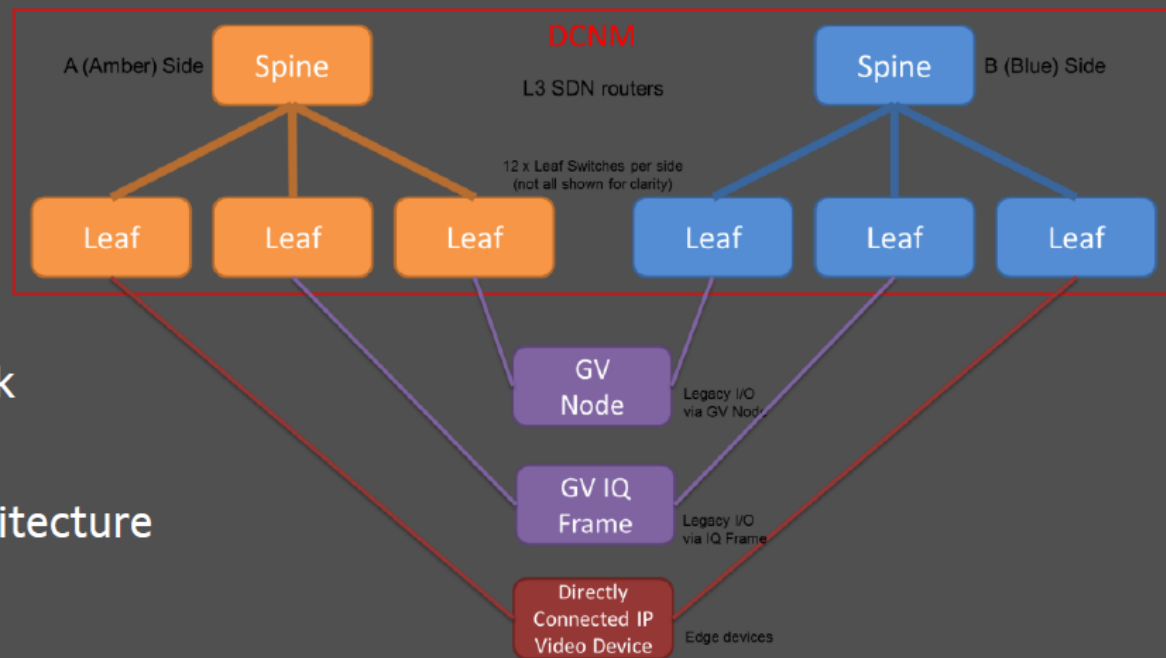


SMPTE 2110 IP Facilities

□ BBC Cymru Wales Facility

ST2110 MEDIA TOPOLOGY

- There are 2 separate (A/B) media networks for ST2110 IP flows
- There is another separate control network (a shared broadcast control network)
- The media networks use a leaf-spine architecture with 1 spine switch (Cisco 9508) and 12 leaf switches (Cisco 9236) per side
- The media networks are fibre based running at up to 100Gbps and using Single Mode MPO optics
- There is a pair of leaf switches provided on every floor with multiple leaf switches in the CAA
- The media networks are controlled using Cisco DCNM (a form of SDN)
- There are no direct connection to the BBC's business networks

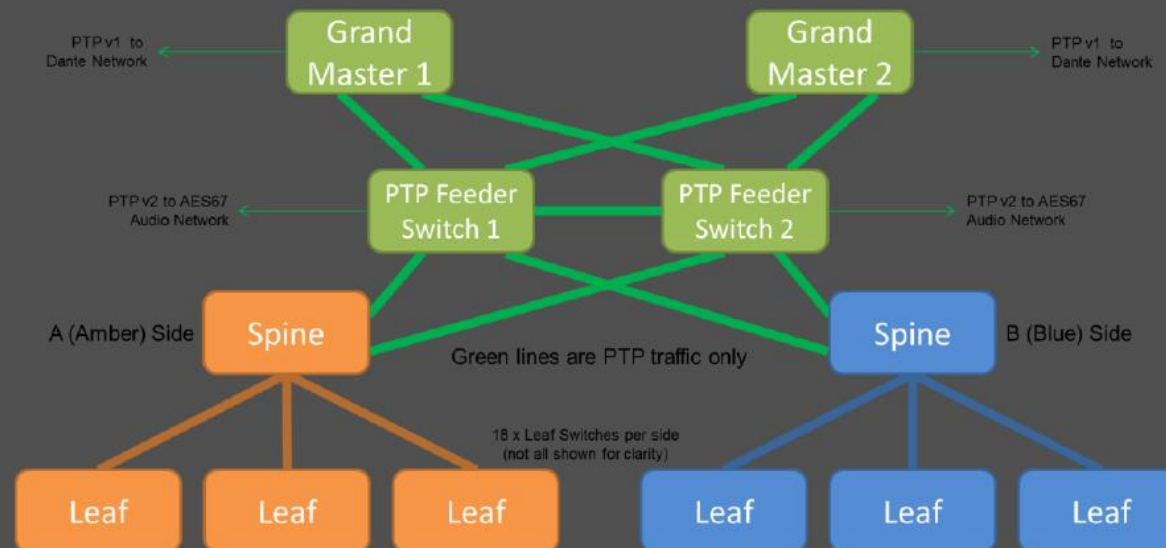


SMPTE 2110 IP Facilities

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PTP TIMING

- Getting the PTP design correct is difficult!
- 2 separate Meinberg master clocks with GPS and GLONASS antennas
- Each master clock has multiple PTP v2 outputs connected to feeder switches
- The feeder switches connect to the spine switches
- All switches operate as boundary clocks
- Separate PTP v1 feeds are used for the Dante network
- PTP is expensive to implement!



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LESSONS LEARNED FROM TESTING

- Interoperability testing is vital
- Involvement from the Systems Integrator is essential from an early stage
- New skills and new test equipment are required which are not always available
- A formalised approach using IT techniques (in our case TestRail & JIRA) is essential to manage regression testing and to track progress between test runs
- Large ST2110 systems are very complex to find faults in
- It's very easy to get stuck trying to fix issues
- Configuration errors can be missed by vendors which cause key tests to fail
- The testing approach can unexpectedly break the system under test
- Testing takes much longer than expected, timelines based on legacy planning need extending
- ST2110 works for media transport but the overall 'stack' still has some way to go before it is anywhere near 'plug and play'. In particular there are problems with control and timing is different rather than easier.



IP Production in the USA


- ❑ CBS updated their Washington News Bureau to an IP infrastructure (SMPTE-2110). However, there are very few IP sources and destinations, so there are many SDI to IP and IP to SDI gateway converters. Even with redundant IP routers, major air losses have occurred resulting in a complete loss of the Evening News broadcast to major markets.

<https://variety.com/2020/tv/news/cbs-evening-news-technical-issue-norah-odonnell-mark-zuckerberg-1234611340/>

- ❑ Comcast / Telemundo Center in Miami is a 13,000 x 13,000 IP router and distribution system. (SMPTE 2110).
- ❑ Comcast Lessons learned:
 - Each SDI to IP (Encapsulation) and IP to SDI (Decapsulation) is a separate process that must be managed. (i.e. audio / video lip sync)
 - Redundant paths are essential.
 - Deployed 3 separate networks: **ST2110**, **Revenna** for Communications, **Dante** for audio sources.
 - Segmented IP production Network from IP Acquisition Network.
 - **The project ran over the budget and was delayed.**



IP Production Benefits / Challenges

- ❑ IP Production is very flexible and easily expanded.
 - ❑ When interconnecting two or more OB VANs, IP address space can be difficult to coordinate or require Network Address Table (NAT) mapping that can add path timing delays. Other issues that need to be managed closely to protect the IP Network from system wide failures are “Broadcast storms” and duplicate IP addresses, managed data flows, Precision Time Protocol (PTP) attacks.
 - ❑ **IP equipment is currently more expensive than SDI** and has not yet provided the predicted cost savings by using Common Off The Shelf (COTS) hardware that should have provided cost savings from economies of scale.
 - ❑ When **installing and testing IP Systems, it takes 2 to 3 times longer.**
 - ❑ The “cost of ownership” should include testing time for continuing software upgrades.
 - ❑ Engineering and Maintenance Staff will require additional training.
 - ❑ The US government has started to jam GPS signals used for IP network timing. The GPS jamming is to prevent unmanned aerial vehicles (“ drone “) attacks of elected officials (i.e. President of the US)
 - ❑ IP production systems are susceptible to “hackers”. Additional time and equipment must be budgeted for Cybersecurity. The **Sinclair Broadcast Group lost \$74 million** from the October 2021 ransomware attack and was off-line for weeks. Ex. Protection from the Russian Fancy Bear. **The FCC has ban IP equipment from Huawei Technologies, ZTE Corp., Hytera Communications, Hangzhou Hikvision Digital Technology and Dahua Technology**, as well as their subsidiaries and affiliates.
- 
- ❑ Must implement on-going software upgrades and testing to correct cybersecurity threats . “Patches”. Triple level firewalls, Active directory, Penetration tests, failover testing, dual IP meshed routing.
 - ❑ **An off-line test facility is highly recommended.**

Thank you

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