NC Broadband Matters *Tech Topics*

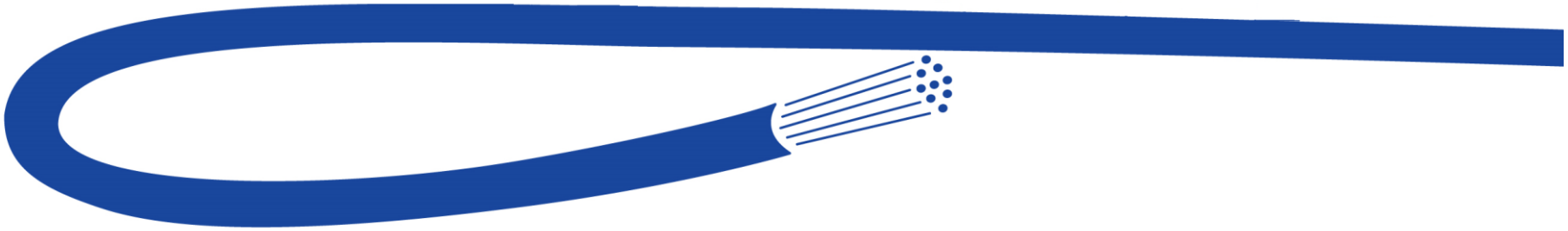
Why Upstream STILL Matters

February 24, 2022

DOUG DAWSON, President, CCG Consulting

MARK BOXER, Technical Manager, OFS

Kent Winrich, CTO, Open Broadband



To our beloved
Gene Scott

- Friend to us all
- Visionary
- Lover of all things fiber
- Passion for making the world a better place

WE WILL MISS YOU,

BUT WE WILL MAKE SURE YOUR DREAMS COME TRUE

What Have We Learned About Upload Broadband During the Pandemic

DOUG DAWSON, PRESIDENT, CCG CONSULTING

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What Have We Learned During the Pandemic

- We didn't have any appreciation of upload speeds before the pandemic.
- Many of us using upload broadband in new ways.
- Upload speeds can't support simultaneous sessions (people and students working from home at the same time).
- Home upload speeds are generally a lot slower than what the industry claims.

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The Uses for Upload

- Connecting to School Servers
- Connecting to Work Servers
- Zoom and other Video Calls
- Cloud-based Software
- Collaboration Software
- Cloud Gaming
- Uploading Files
- Video sharing and Picture
- Cellphone Uploads (using home WiFi)
- Security Cameras
- Machine-to-machine traffic

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Speed Tests

- Huge numbers of speed tests have been gathered during the last year. It's being collected by local governments, States, and federal agencies like the NTIA.
- An individual speed test is not a reliable judge of an ISP's quality – but large numbers of speed tests tell a great story.
- We've routinely seen ISPs delivering slower speeds than they claim in advertising and in reporting to the FCC.

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Example of Speed Test Results

The following speed tests come from a real county in Wisconsin that CCG studies. The results represent almost 13,000 speed tests. These are the average results using the Ookla Speed test.

	Download (Mbps)	Upload (Mbps)
Charter/Spectrum	67.06	9.82
AT&T	11.37	5.16
CenturyLink	12.14	2.47
Frontier	7.25	0.93
WISP	4.61	1.99
Satellite	12.60	1.53
Fixed Cellular	18.32	2.28

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Broadband Surveys and Interviews

CCG Consulting has conducted several surveys every month since the start of the pandemic. These are from all over the country is communities of a wide range of sizes. Here is what we learned:

- 30% of homes, including those using the cable company said they struggled to work and school from home during the pandemic.
- People with rural technologies like DSL were completely unable to work from home.
- Businesses had a hard time connecting to multiple employees at the same time – again because of upload speed limitations.

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January Upload for North America

The following Comes from Sandvine for January 2022

RTP	15.46%
IPTV	11.20%
Google	8.45%
Netflix	6.53%
BitTorrent	6.37%
YouTube	3.50%
iCloud	2.93%
Dropbox	2.14%
Nest	2.13%
IPsec	1.90%

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Other Lessons During the Pandemic

- Cable DOCSIS technology uses a noisy clutter piece of spectrum.
- Uploading is shared by the whole neighborhood in some technologies. When your neighbors are busy, the network quality degrades.
- Overcrowded networks have a cascading effect where lost packets have to be resent – making the network even busier.
- ISP speeds for many ISPs fluctuate wildly during the day.
- While evenings are still the busiest time in residential neighborhoods, the daytime usage caught up during the pandemic.
- Network performance usually varies by neighborhood.

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Upload Demand has Exploded

- Per Openvault, average home upload usage grew 58% from 3Q 2019 to 3Q 2020.
- They have now quantified the average amount of uploading per home per month at 25 gigabytes – a number that would have astounded any network engineer a few years ago.
- It's the first time that many homes have cared about upload speeds.

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Total Bandwidth Usage Continues to Grow

Average Monthly Home Broadband Usage From OpenVault:

1Q 2018	215 Gigabytes
1Q 2019	274 Gigabytes
1Q 2020	403 Gigabytes
1Q 2021	462 Gigabytes

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Power Users Have Exploded

The percentage of households using more than 1 terabyte of data per month, per OpenVault:

4Q 2018	4.0%
4Q 2019	7.3 %
4Q 2020	14.1 %

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Households Upgrading Speeds

Percentage of homes subscribed to various speed tiers from OpenVault:

	June 2020	June 2021
Under 50 Mbps	18.4%	10.5%
50 – 99 Mbps	20.4%	9.6%
100 – 199 Mbps	37.8%	47.5%
200 – 299 Mbps	13.5%	17.2%
500 – 999 Mbps	5.0%	4.7%
1 Gbps +	4.9%	10.5%

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About Doug Dawson

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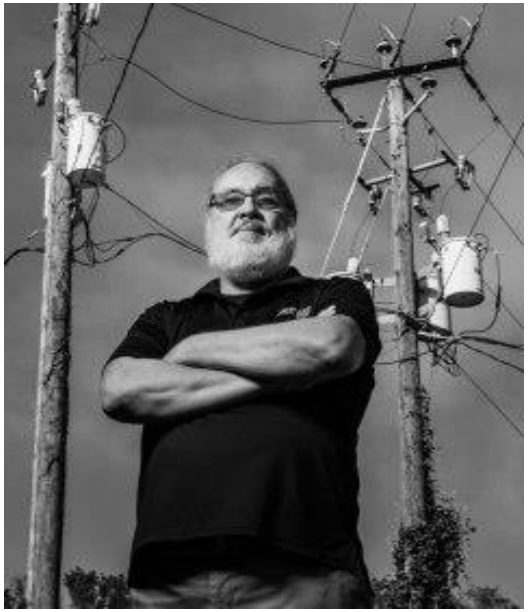

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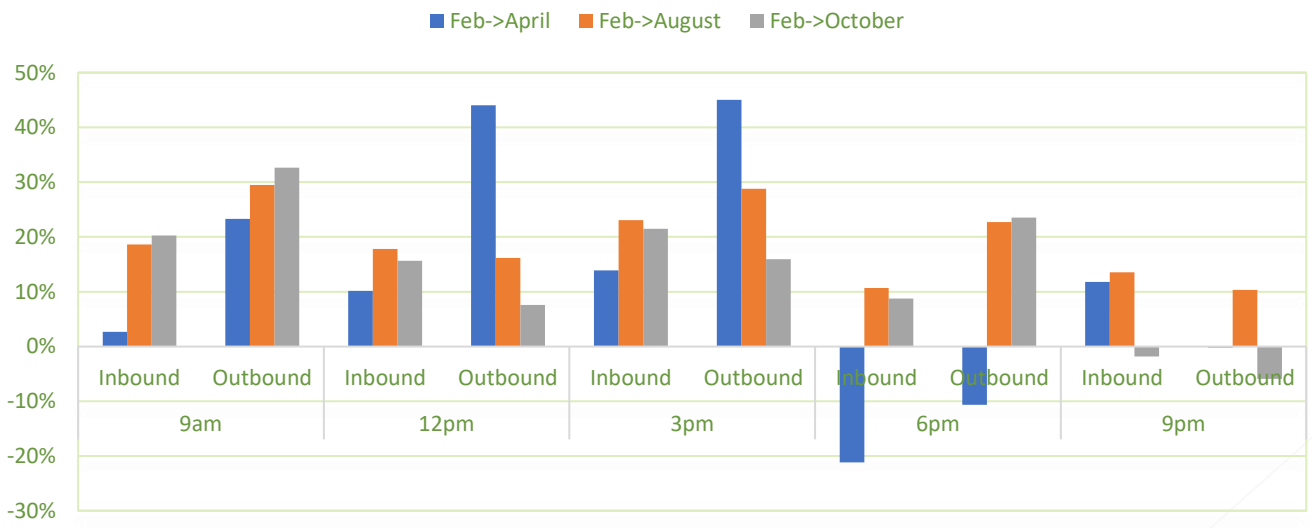
BANDWIDTH USAGE DATA

DATE/TIME	9AM		12PM		3PM		6PM		9PM	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
17-Feb-20	9080	983	11150	1208	11950	1134	14920	1227	19230	1575
17-Apr-20	9320	1212	12280	1740	13610	1645	11760	1096	21500	1572
17-Aug-20	11160	1394	13570	1441	15530	1593	16700	1588	22240	1756
17-Oct-20	11390	1460	13220	1307	15220	1349	16350	1605	18880	1487

* Total MB Used Inbound/Outbound

Percentage Used Increase/Decrease



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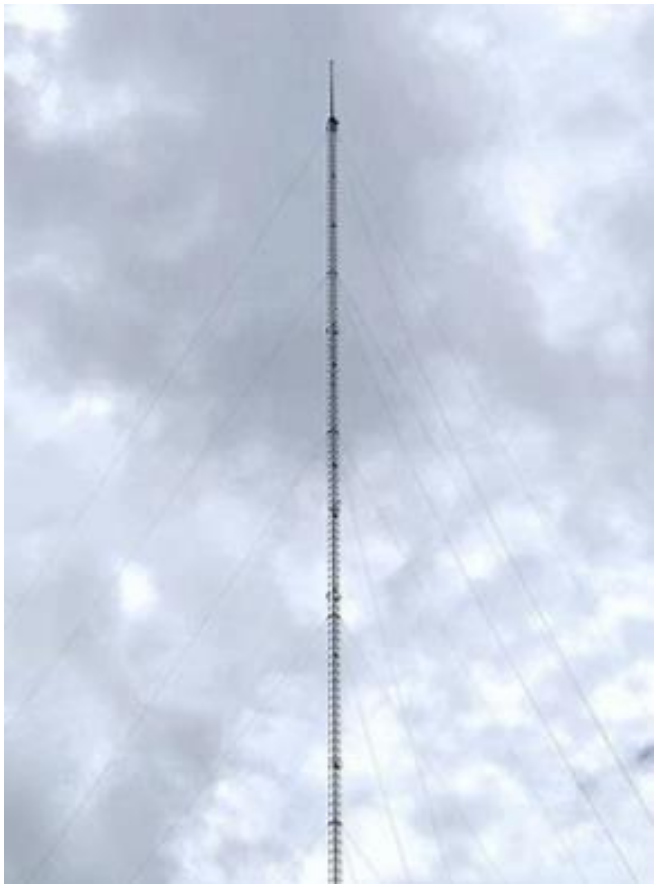
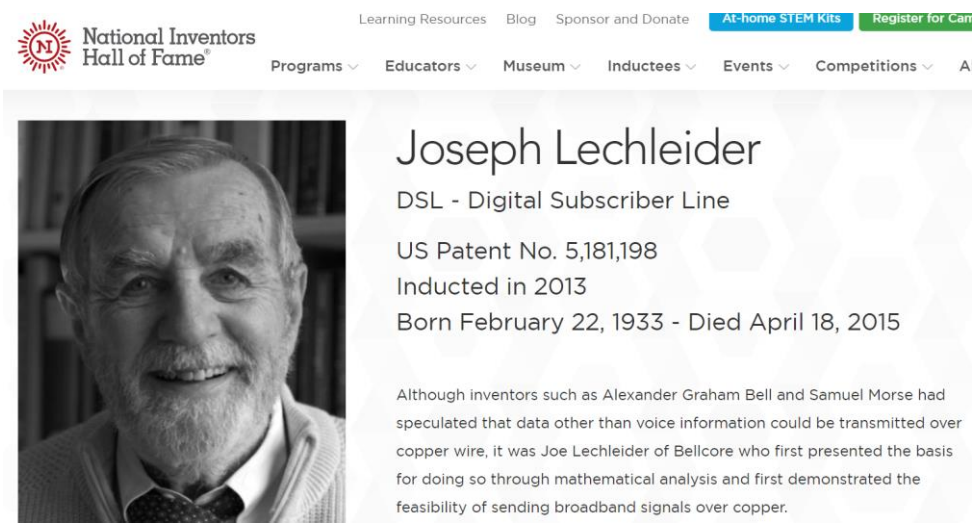
In the beginning….asymmetric was the norm



The early internet

- All technologies were downstream-favored
- DSL, cable, wireless, satellite, even fiber
- This matched demand for the early internet



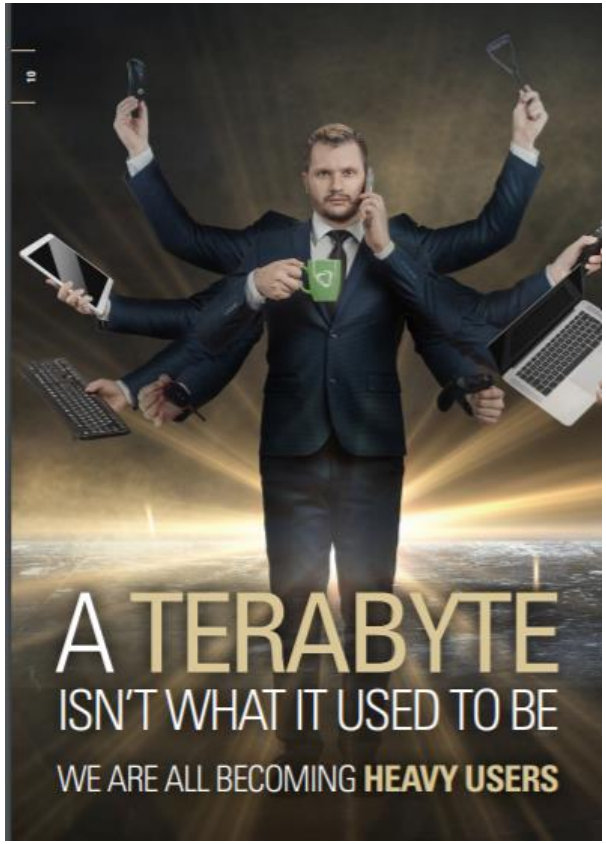
Crosstalk reduced with asymmetric speeds

Today - Remote everything

- Many communication trends formed during the Covid response are here to stay

- Remote work
- Remote play
- Remote healthcare
- Some remote learning

- All require significant amounts of upstream bandwidth

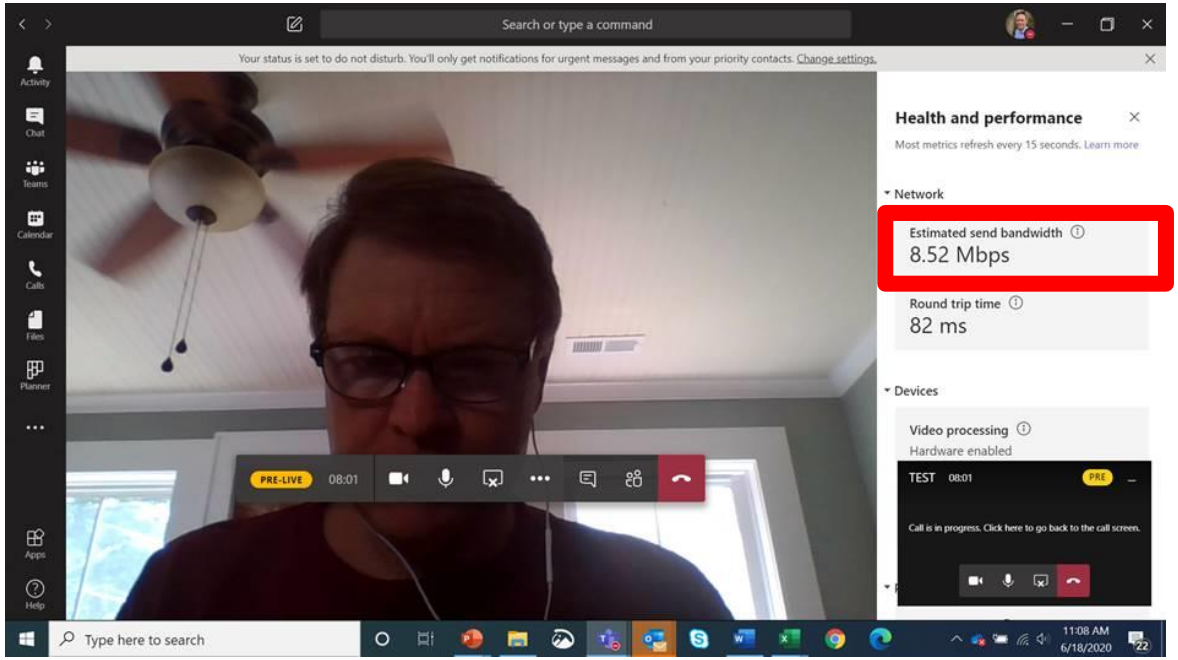


Source: Sandvine

The Global Internet Phenomena Report, January 2022

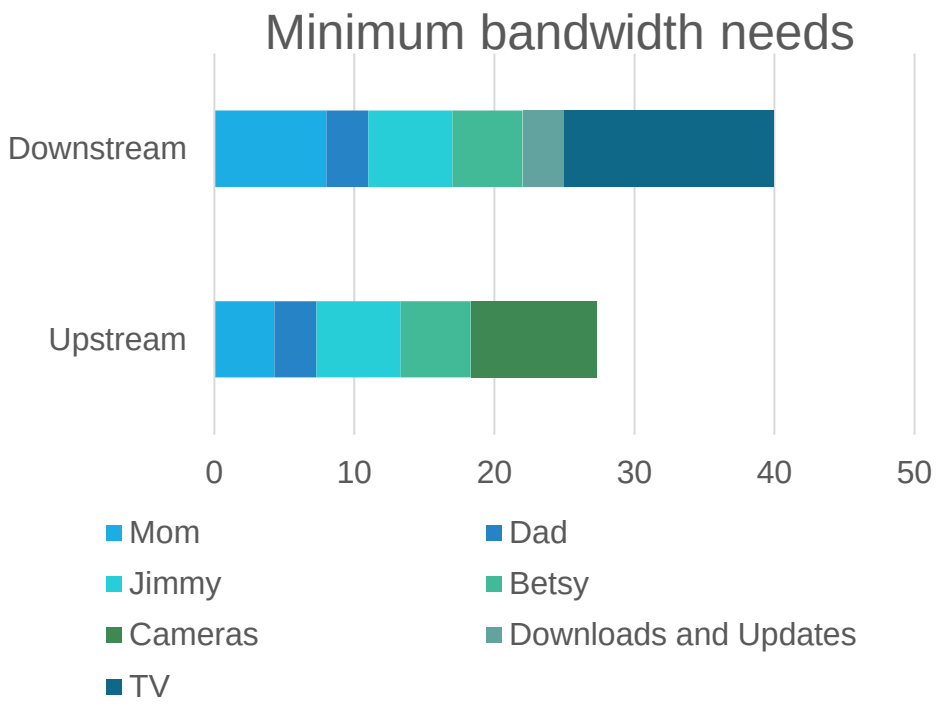
1 person, 1 stream – Microsoft Teams

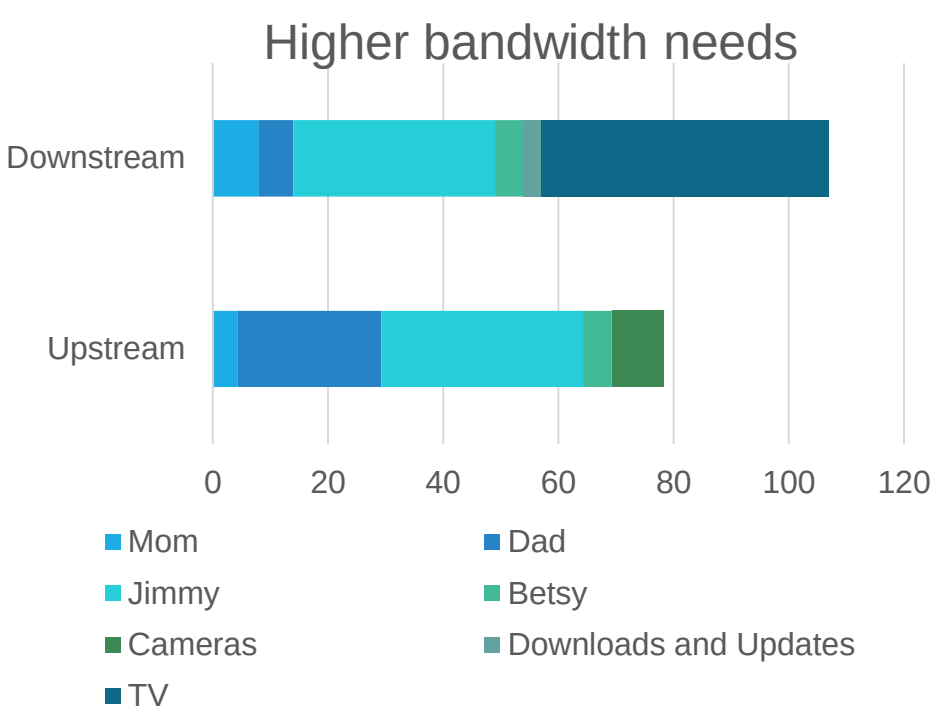
- Most applications scale to available bandwidth
- More bandwidth means higher quality
- Not enough bandwidth means low quality or delays



Now, scale across a household

Hypothetical household bandwidth needs - Mbps





Fiber Broadband Association
Accelerating the Connected Future

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Digital/Video Applications Bandwidth Demand

Digital Video	
4K HDR	25 Mbps
8K HDR	100 Mbps

Cloud Gaming	
720P, 60 FPS, Stereo Sound	15/15 Mbps
4K HDR, 60 FPS, 5.1 Surround Sound	35/35 Mbps
8K HDR, 120 FPS, 5.1 Surround Sound	100/100 Mbps

Video Conferencing	
Standard	1.8/1.8 Mbps
Immersive	20/20 Mbps

Source: Calix

Latency Impacted

IoT Applications Bandwidth Demand

Digital Doorbell 2/2 Mbps

Home Fitness 10/10 Mbps

Digital Assistants (*Alexa*) 1 Mbps

Digital Appliances* 26 Mbps

Security Cameras *(1080p)* **(*one camera*)** 2 Mbps

Source: Calix

Latency Impacted

**Assumes multiple appliances in use (Refrigerator, Washer/Dryer, Thermostat)*

Future Applications Bandwidth Demand

Virtual Reality	
Low Resolution 360 Degree	**25/25 Mbps**
HD Resolution 360 Degree	**100/100 Mbps**
Retinal 360 Degree Video	**600/600 Mbps**
Augmented Reality	
AR Applications	**100/100 Mbps**
360 Degree Low Resolution Video	**250/250 Mbps**
Retinal 360 Degree Video	**600/600 Mbps**
Telemedicine*	**10/10 Mbps***

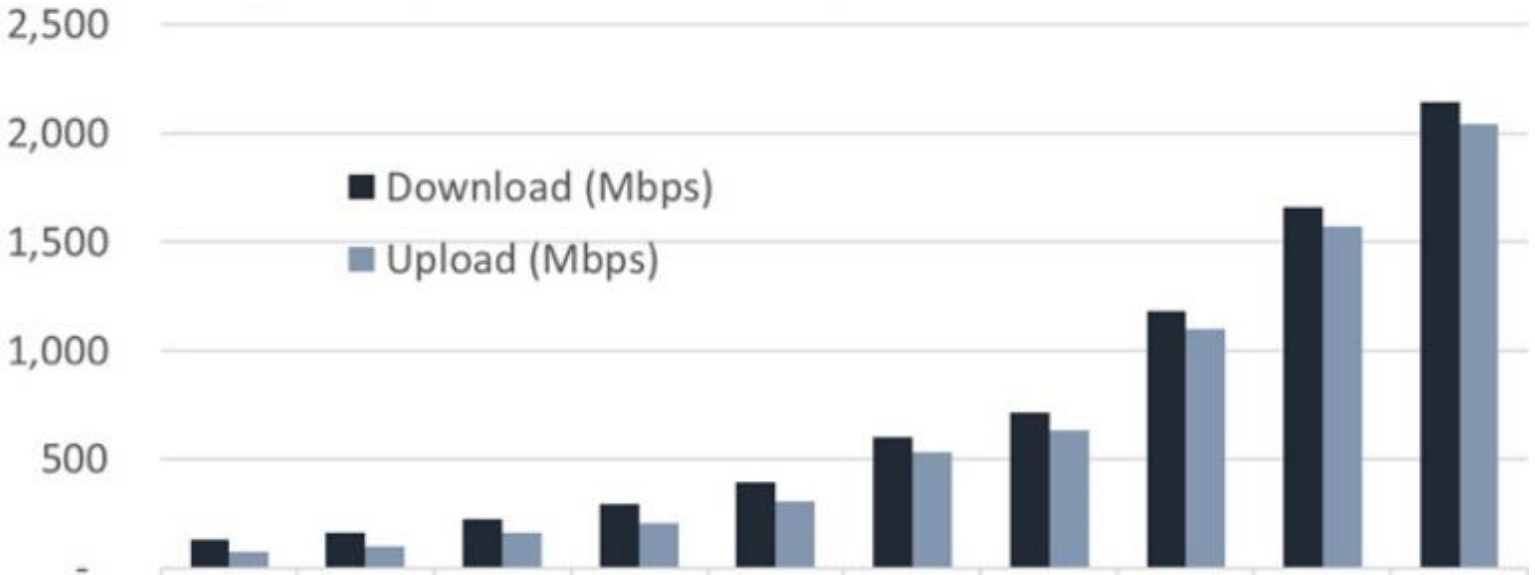
Source: Calix

Latency Impacted

** This value represents a holistic telemedicine approach and utilization including Teletherapy, Monitoring, Video Diagnosis, etc.*

Bandwidth Demand Will Likely Exceed Gigabit Symmetrical

PROJECTED PEAK BANDWIDTH REQUIREMENTS - HOUSEHOLD OF 4



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Download (Mbps)	131	158	222	293	396	601	709	1,182	1,658	2,141
Upload (Mbps)	73	98	160	203	302	529	633	1,100	1,570	2,044

- Does not include Robotics
- Early adopters, Radiologists, Power Users/Gamers, others may require much more

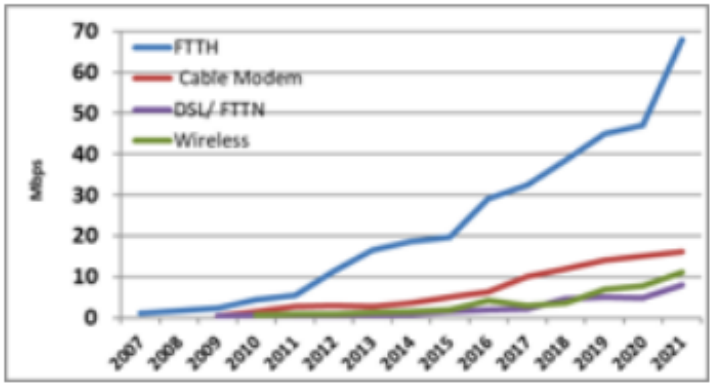
Source: Fiber Broadband Association Technology Committee

FBA TECHNOLOGY COMMITTEE BANDWIDTH DEMAND FORECAST

In the long run, fiber is the answer

- Only fiber **can scale** to meet both downstream **and upstream** bandwidth demands long-term
- Other technologies can assist short-term, but Fiber to the Home should be a long-term goal for digital equity

- Cable/DSL/wireless (and satellite) do not have the upstream capacity of fiber. Where fiber can effortlessly scale with demand, other technologies have upstream limitations.



Only Fiber Can Deliver the Required Tested Upload Speeds – RVA Consumer Studies

Fundamentals of Fiber, 7/2021
Fiber Broadband Association

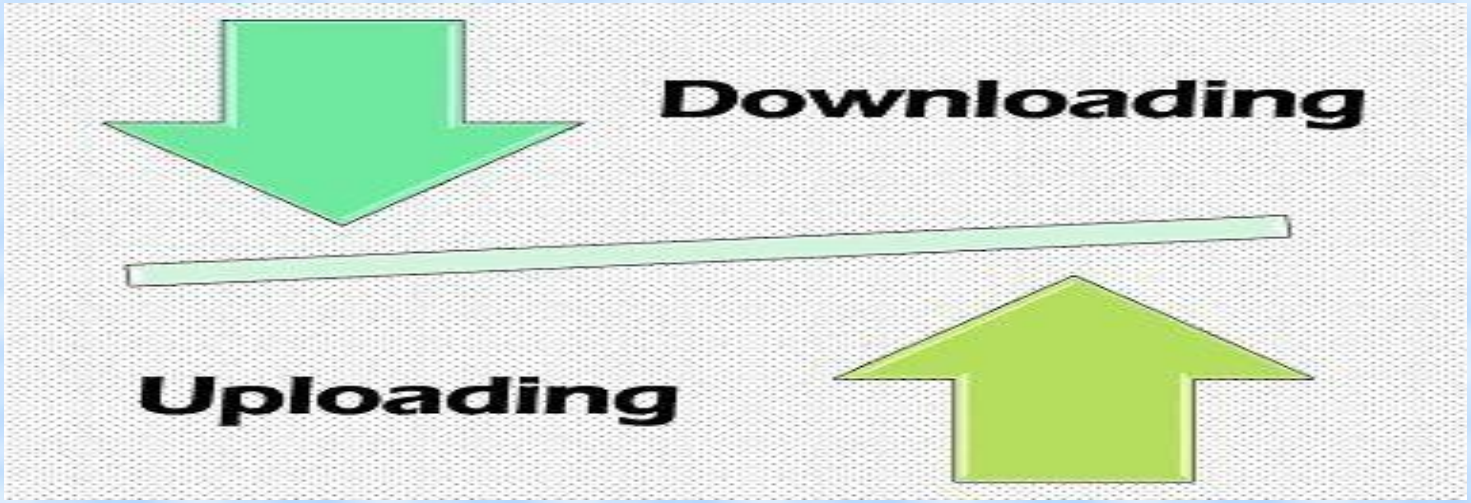
Kent Winrich – CTO OpenBroadband

- Regional Director WISPA
- Director of Muni Owned Fiber Network
- Senior Engineer – Hibernia Fiber
- Senior Engineer – Vidyo – Video Compression
- Director of Engineering – iHeart – Milwaukee
- Regional Manager – IBM
- Systems Analyst – BAE – US Army

open broadband

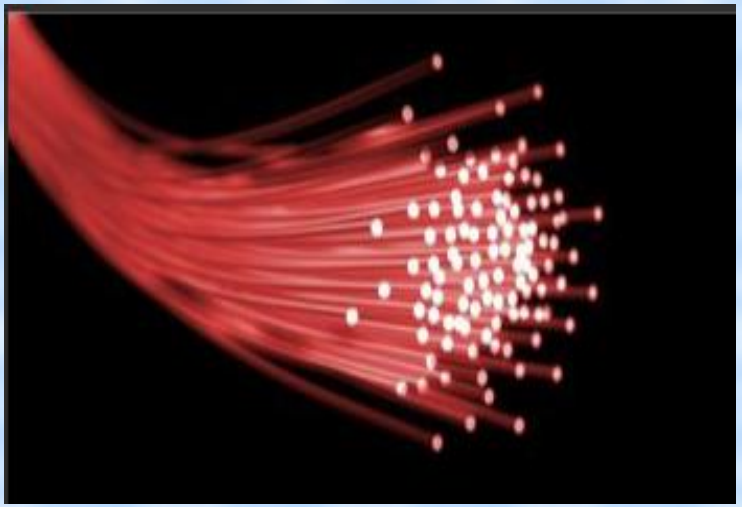
Symmetrical vs Asymmetrical Broadband

- Symmetrical – Download and Upload are the same rate
- Asymmetrical – Download is faster than the upload



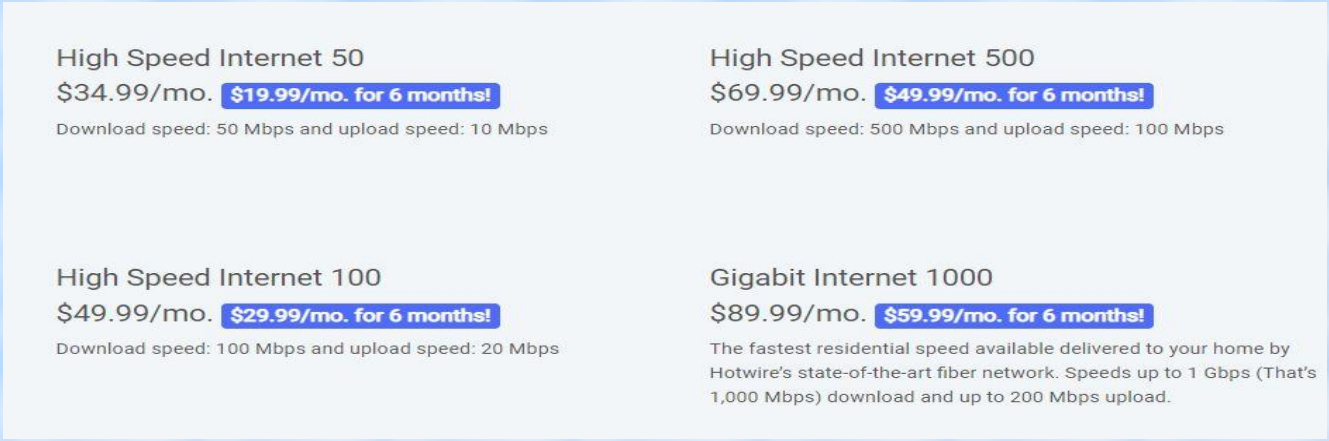
Examples of Symmetrical

- SOME Fiber Deployments
- SOME Wireless Deployments



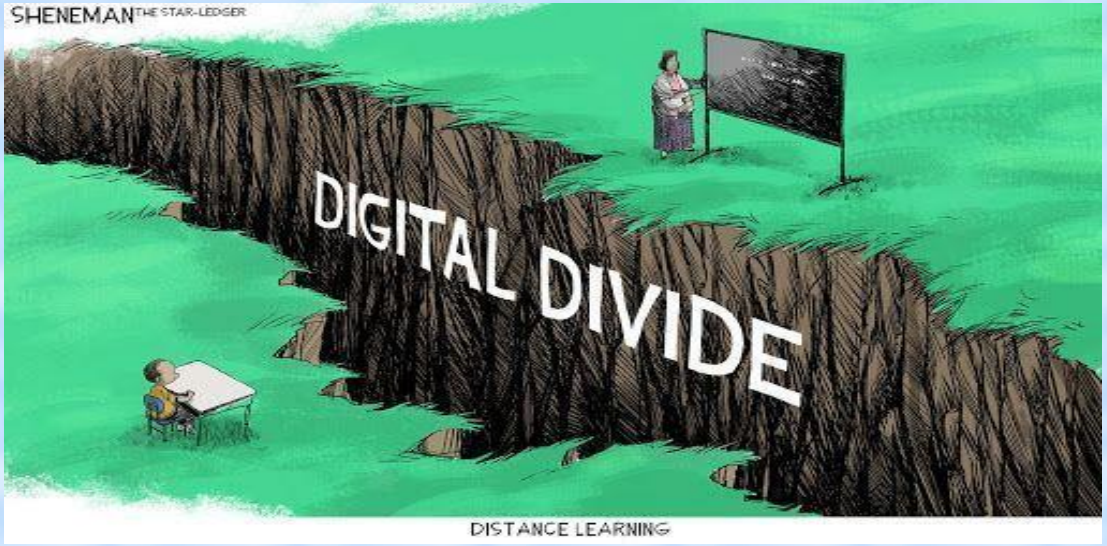
Examples of Asymmetrical

- ALL Cable
- GPON <--- YES, GPON**
  - GPON 2.488 down, 1.244 up PER PORT
  - XGPON 9.95 down, 2.48 up PER PORT
- Some Wireless
- ALL Cell, including 5G



Why Am I Promoting Asymmetrical?

- More technologies to fill in the Digital Divide
  - We are going to need all tools available
  - Supply Chain is a HUGE issue!
- TRUE Broadband Utilization



Lets Talk About Utilization

ncta

COVID-19 Positions Industry & Insights Media About

New Study Examines Internet Traffic Patterns and Bandwidth Requirements

July 15, 2021

As America climbs out of the COVID-19 pandemic, cable's broadband networks continue to prove their ability to handle unprecedented spikes in internet traffic—from the state lockdowns of last spring when more people than ever before connected online, to the present day as businesses and schools begin to experiment with new hybrid working models. But no matter what the "new normal" will be, one certainty is the importance of a reliable and robust broadband connection.

As we step back and assess how networks handled the pandemic surge in traffic, a new report by Cartesian, a consulting group with expertise in telecommunications, shines some light on how traffic flows over the network, how much bandwidth popular applications utilize, and how multi-person household needs vary depending on usage patterns. The full report can be found here.

Share

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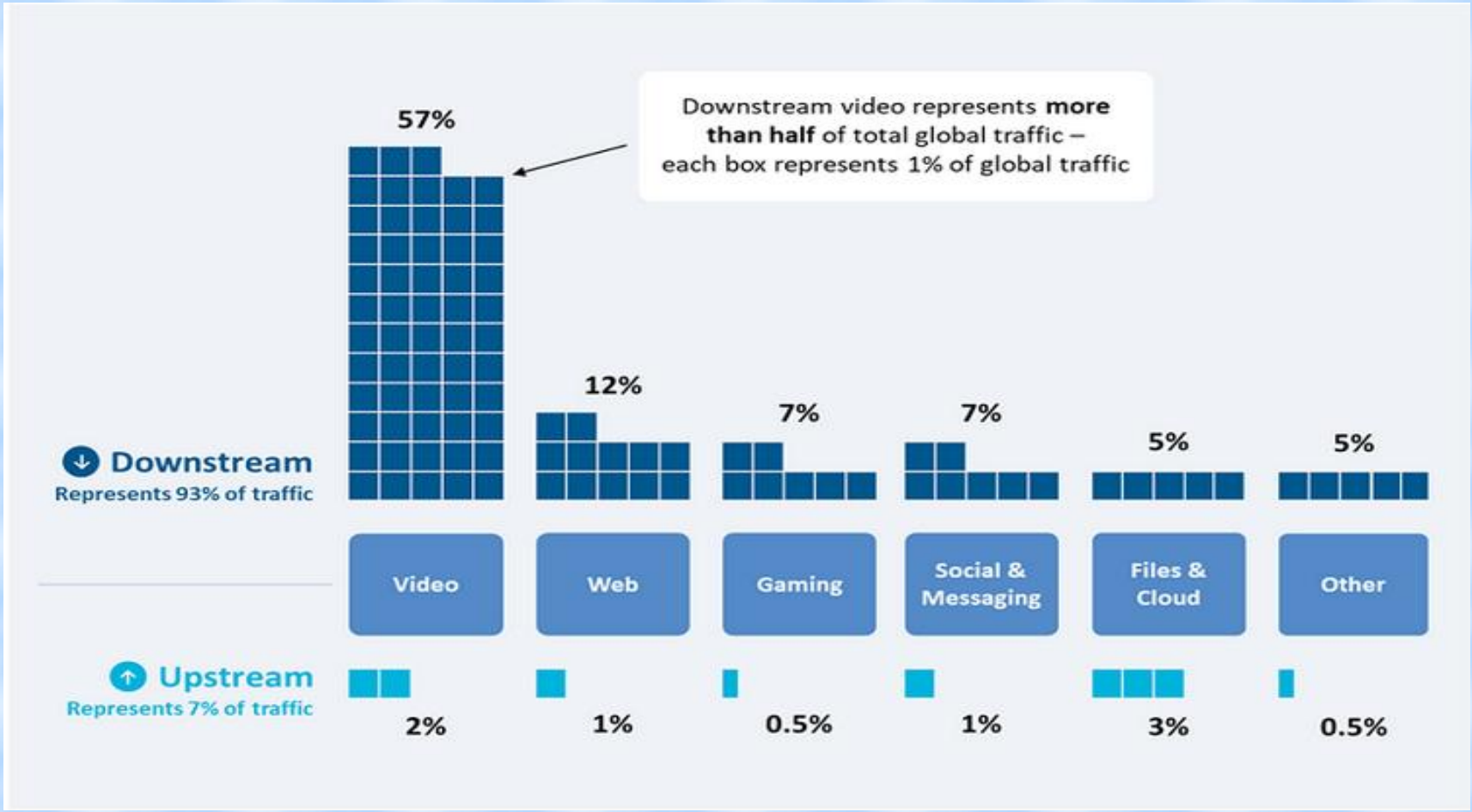
History Channel Premieres a 'Cinema Documentary' on Abraham Lincoln

February 18, 2022

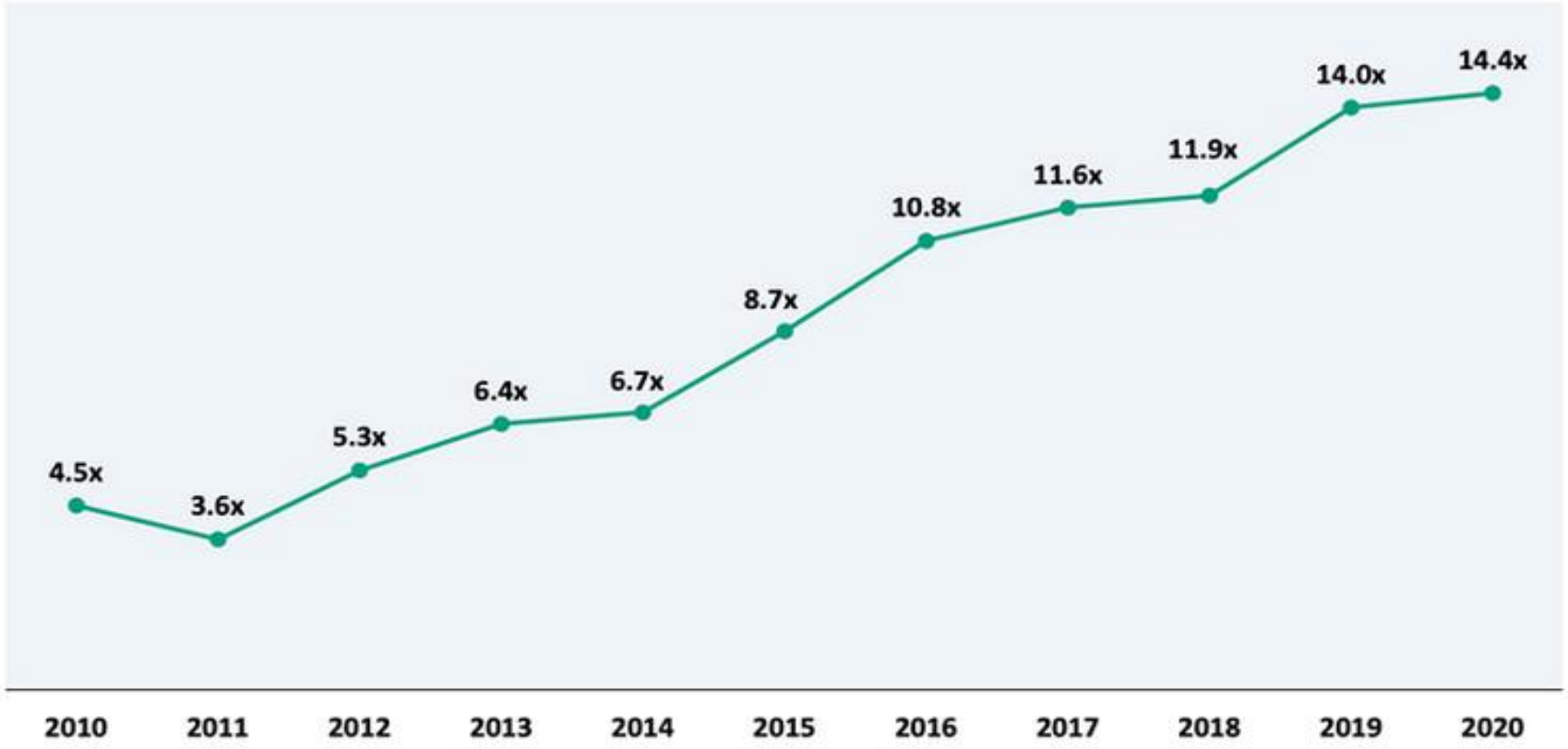
What Is Unlicensed Spectrum and

Video is the Biggest User of Bandwidth – BUT - CODECs



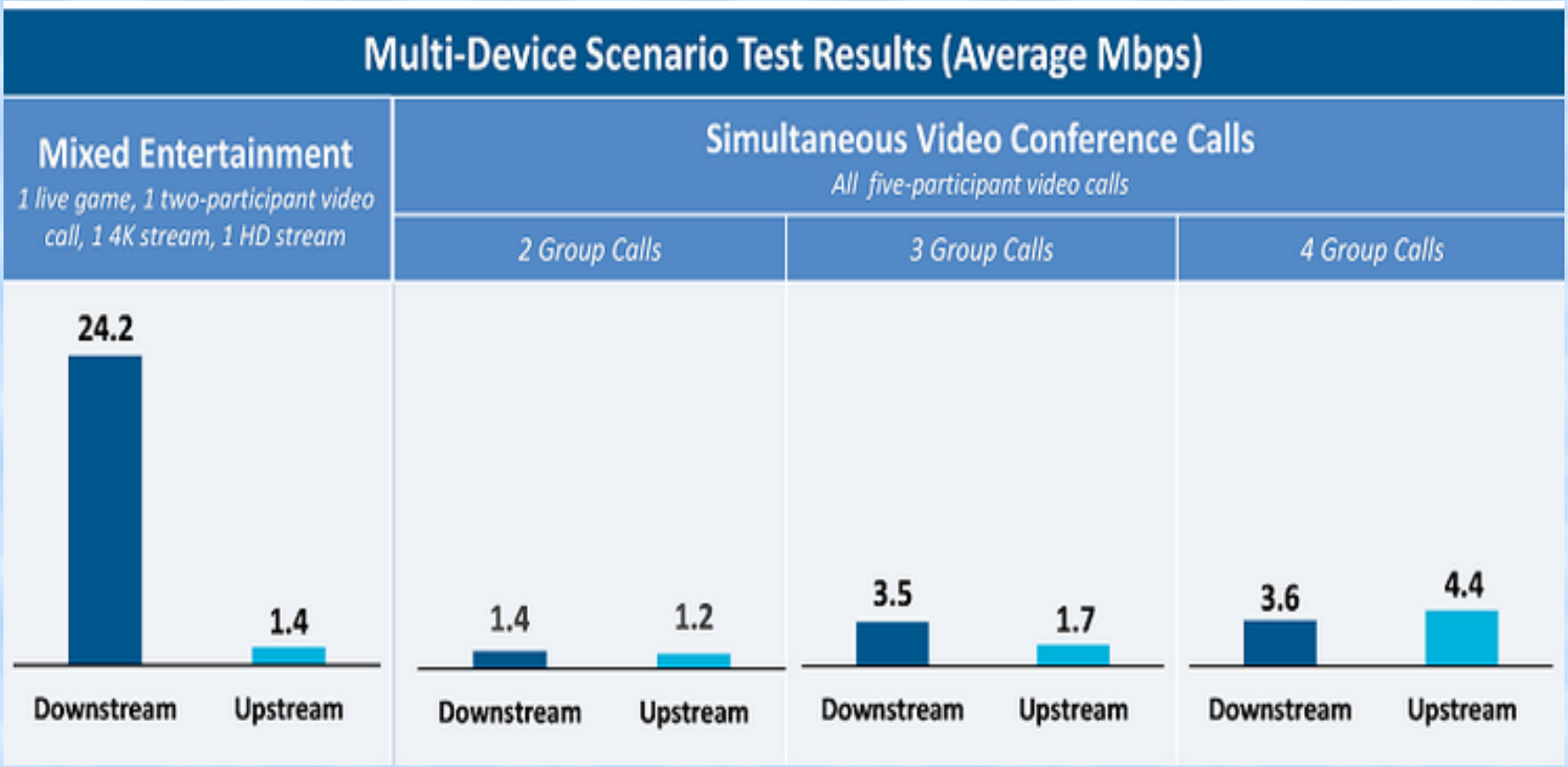
Downstream Ratio Increasing

FIGURE 2. AVERAGE US PEAK HOUR DOWNSTREAM TO UPSTREAM BANDWIDTH TRAFFIC RATIO: 2010-2020[4]



Source: CommScope

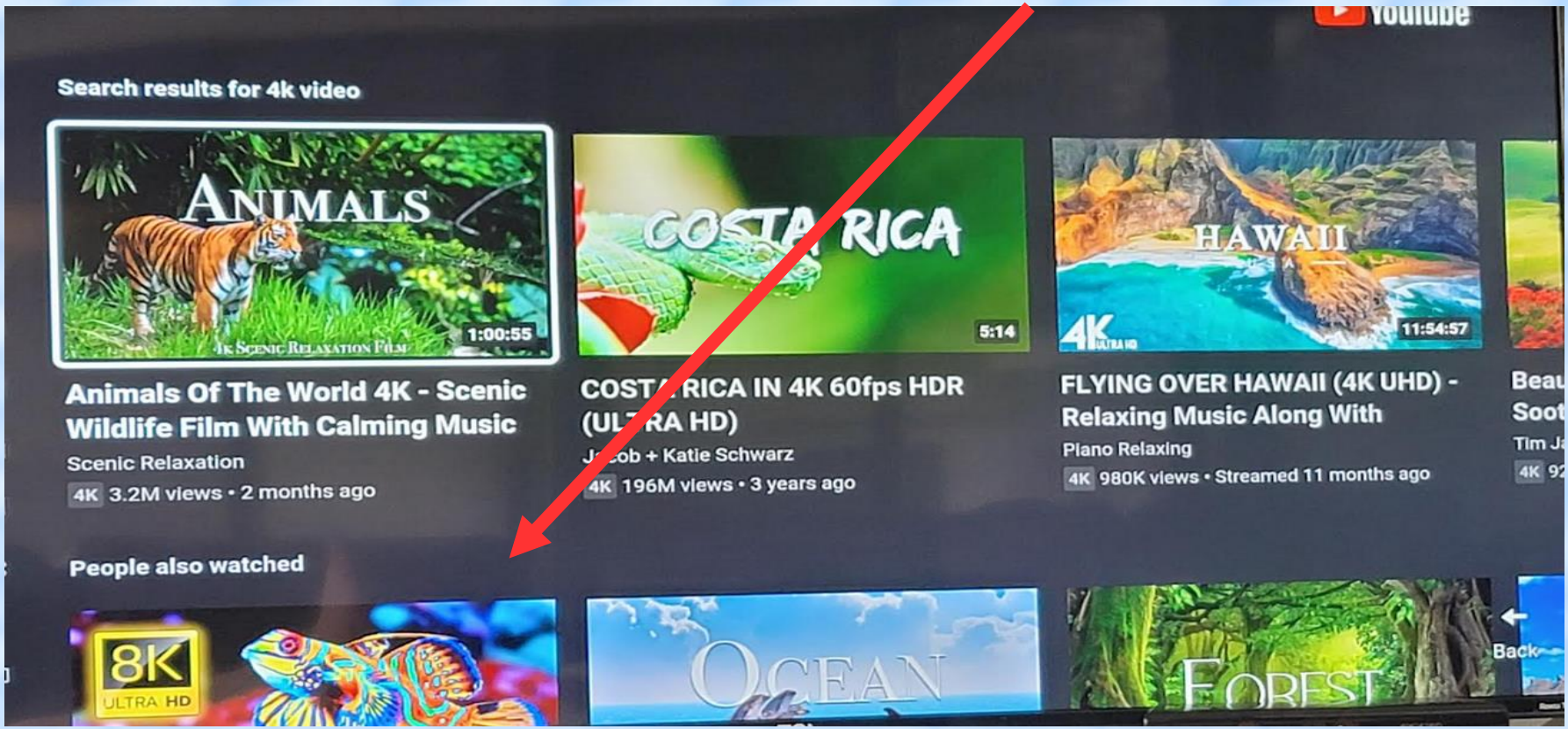
Multi-device scenarios show modest increases in bandwidth usage and do not reflect increases in consumption that are strictly additive**



BUT, BUT 4k Video.... or 8k...

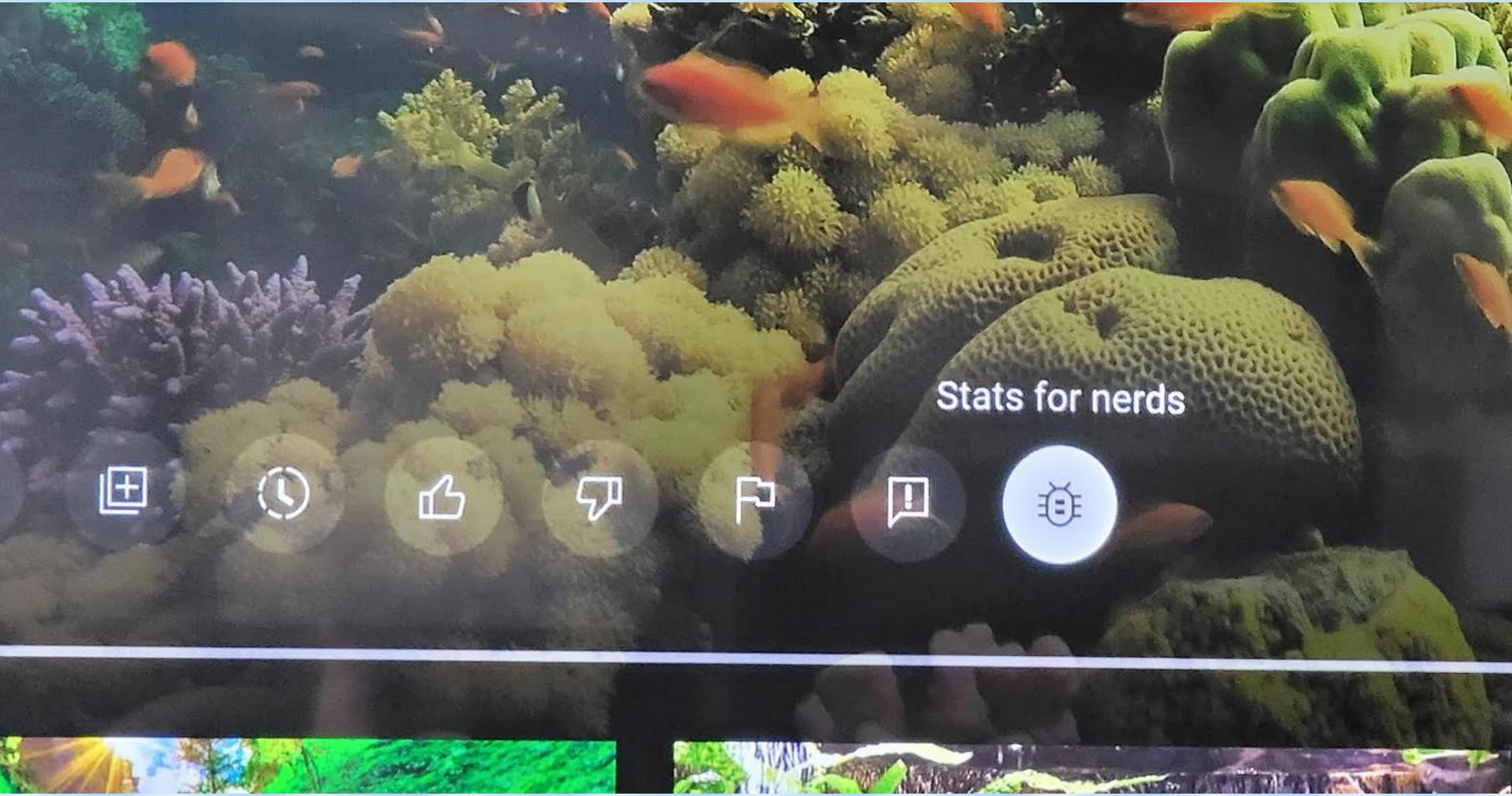
- CODECs are getting better and better.
- There are 4 and 8k TVs, Very little real programming
- Remember how 3D TV was going to be all of the rage?
- 8k is typically trans-coded to 4k
- 4k can run as low as <3MB

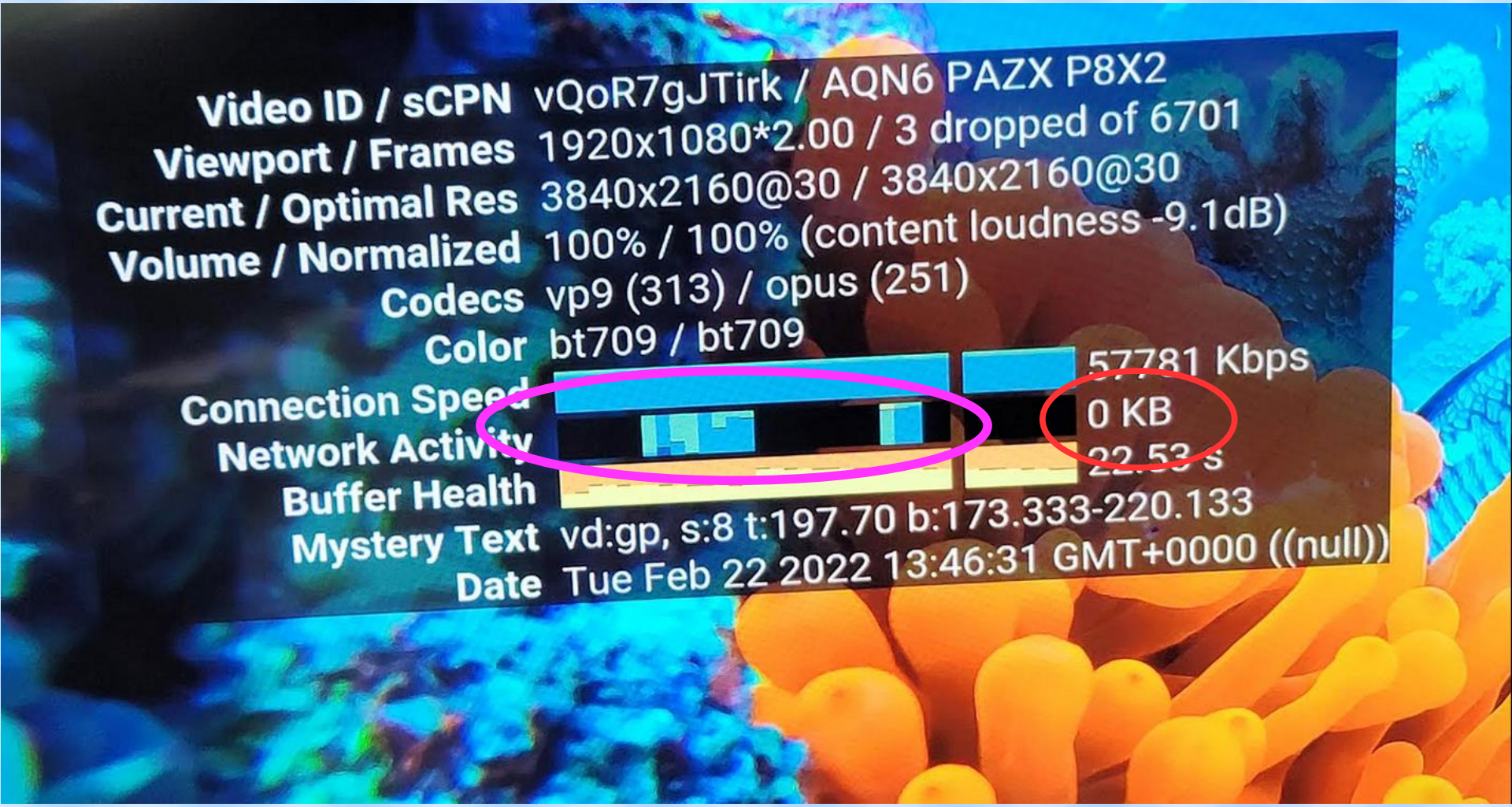
Lets look at YouTube 8k



8K
ULTRA HD
CHANNEL
SUBSCRIBE
TCL

Hint: Stats for Nerds

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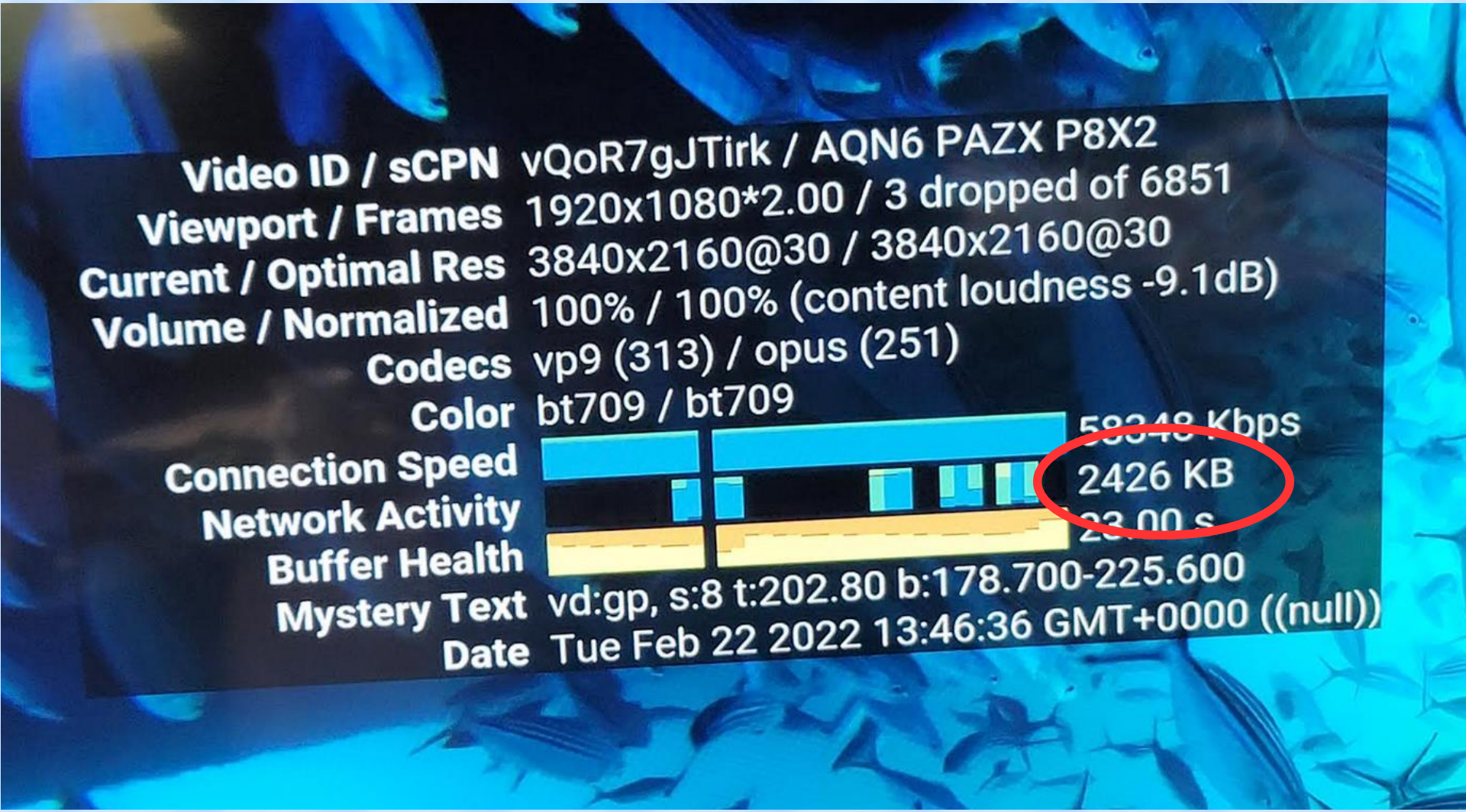
Viewport / Frames 1920x1080*2.00 / 3 dropped of 6701
Current / Optimal Res 3840x2160@30 / 3840x2160@30
Volume / Normalized 100% / 100% (content loudness -9.1dB)
Codecs vp9 (313) / opus (251)
Color bt709 / bt709
Connection Speed
Network Activity
Buffer Health
57781 Kbps
0 KB
Mystery Text vd:gp, s:8 t:197.70 b:173.333-220.133
Date Tue Feb 22 2022 13:46:31 GMT+0000 ((null))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Current / Optimal Res 3840x2160@30 / 3840x2160@30
Volume / Normalized 100% / 100% (content loudness -9.1dB)
Codecs vp9 (313) / opus (251)
Color bt709 / bt709
Connection Speed
Network Activity
Buffer Health
2426 KB
Mystery Text vd:gp, s:8 t:202.80 b:178.700-225.600
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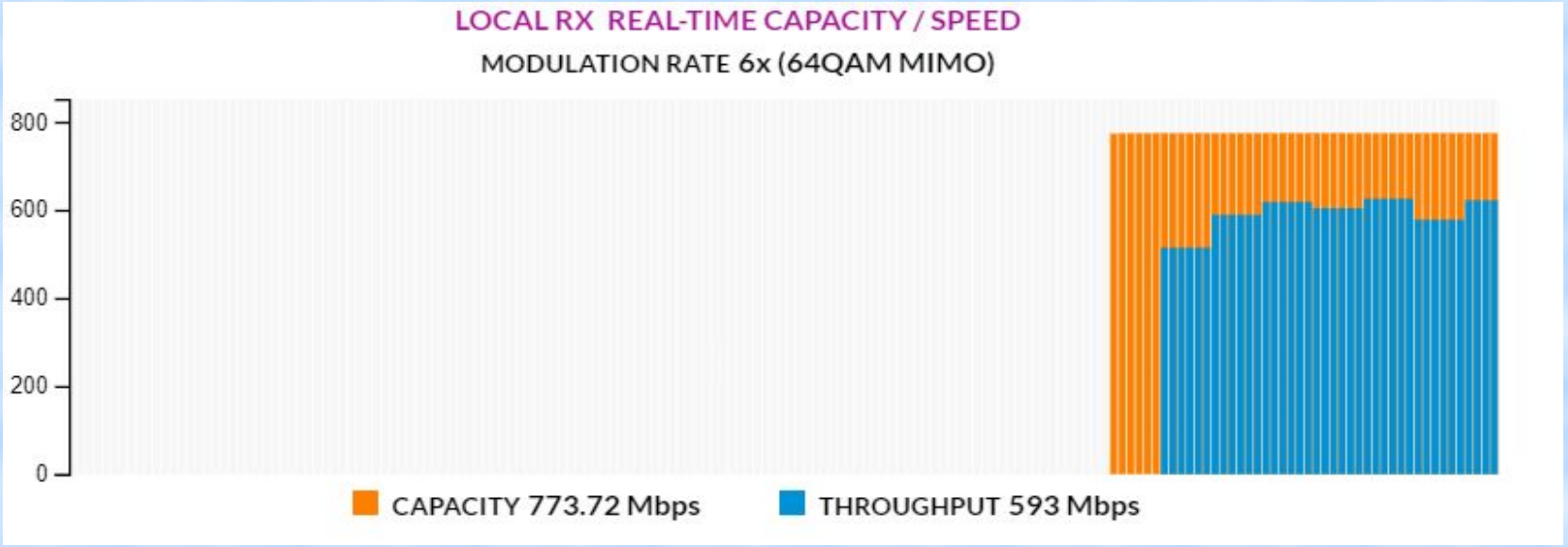
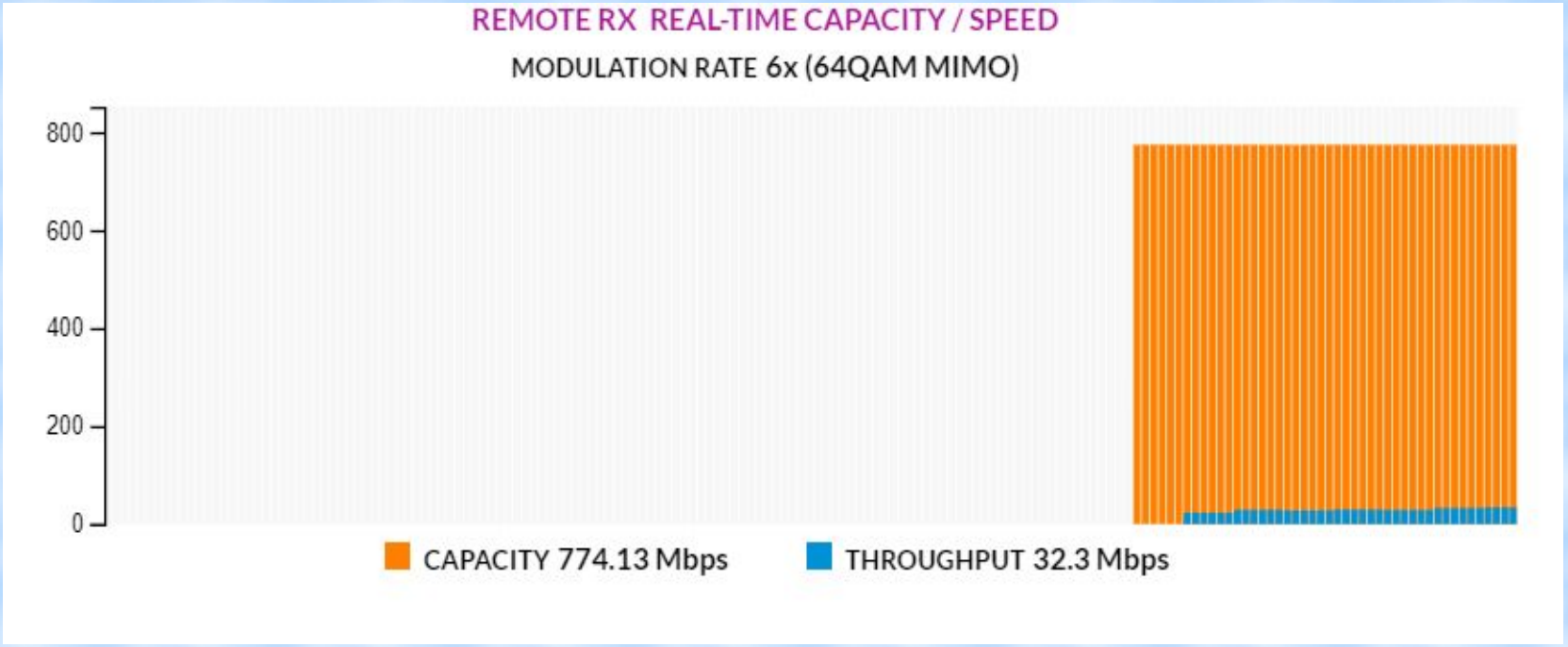

LOCAL RX REAL-TIME CAPACITY / SPEED
MODULATION RATE 6x (64QAM MIMO)
800
600
400
200
0
CAPACITY 773.72 Mbps
THROUGHPUT 593 Mbps


REMOTE RX REAL-TIME CAPACITY / SPEED
MODULATION RATE 6x (64QAM MIMO)
800
600
400
200
0
CAPACITY 774.13 Mbps
THROUGHPUT 32.3 Mbps

Questions?

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NC Broadband Matters encourages our viewers to validate for themselves any statements made by our speakers prior to engaging in their broadband planning.