



CableLabs[®]

Future of Connectivity

CableLabs

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A low-angle, shallow depth-of-field photograph of a person walking away from the camera down a long, brightly lit hallway. The person is wearing a brown jacket and blue jeans. The hallway has white walls with decorative molding and a polished wooden floor. The lighting is soft and even, creating a sense of depth and solitude.

In the near future, growing older will never be the same again.

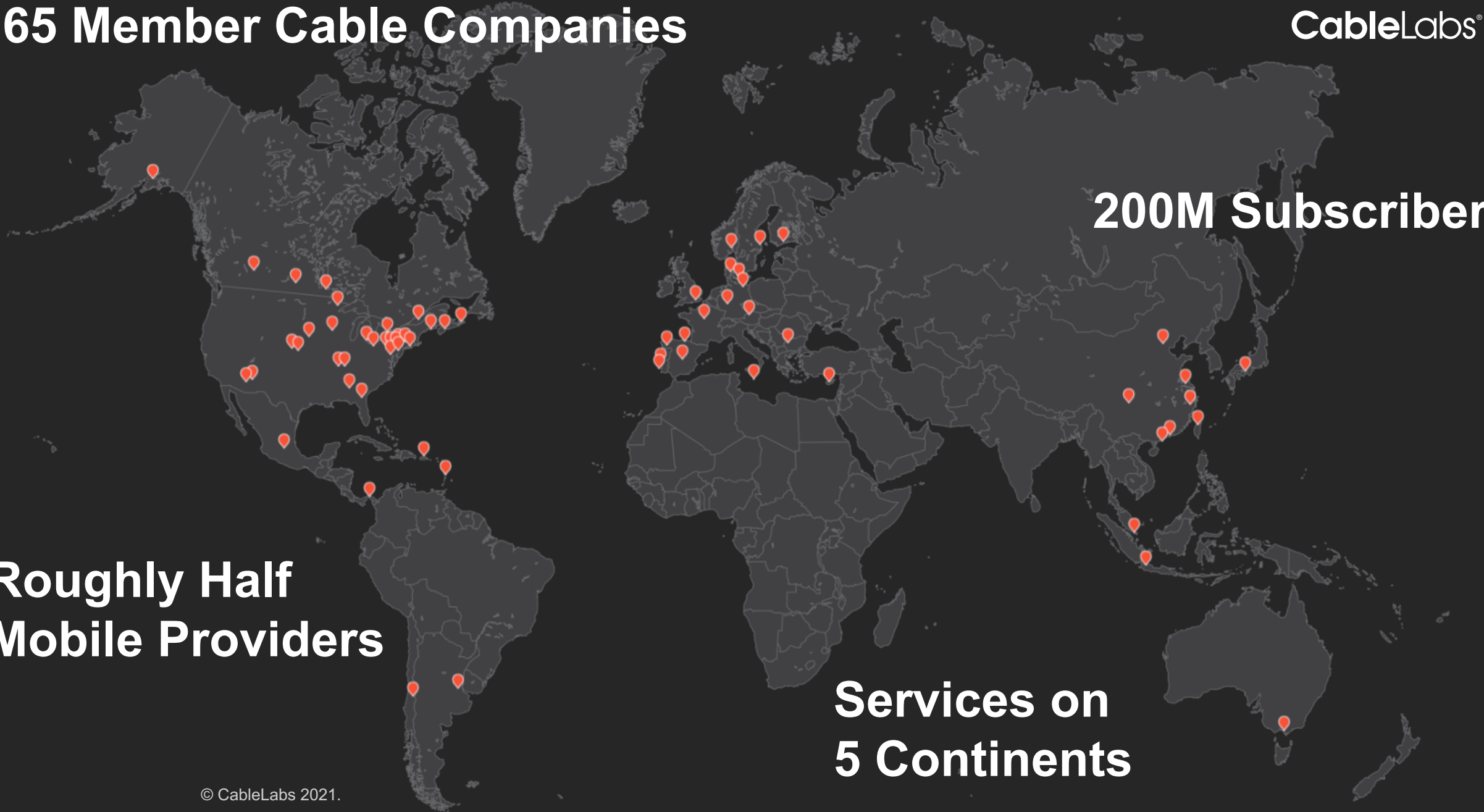
65 Member Cable Companies

CableLabs®

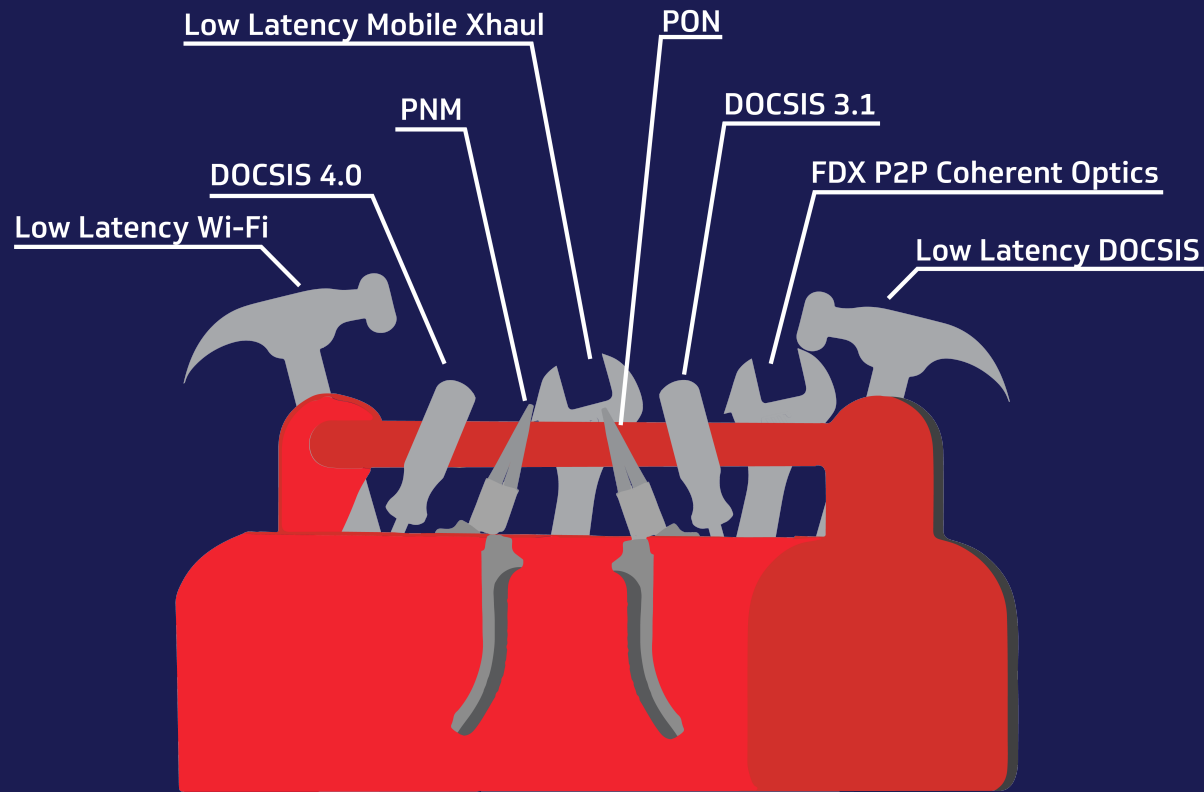
200M Subscribers

**Roughly Half
Mobile Providers**

**Services on
5 Continents**



10G



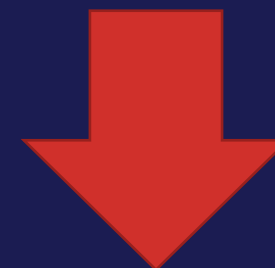
10x Speed



More Reliable



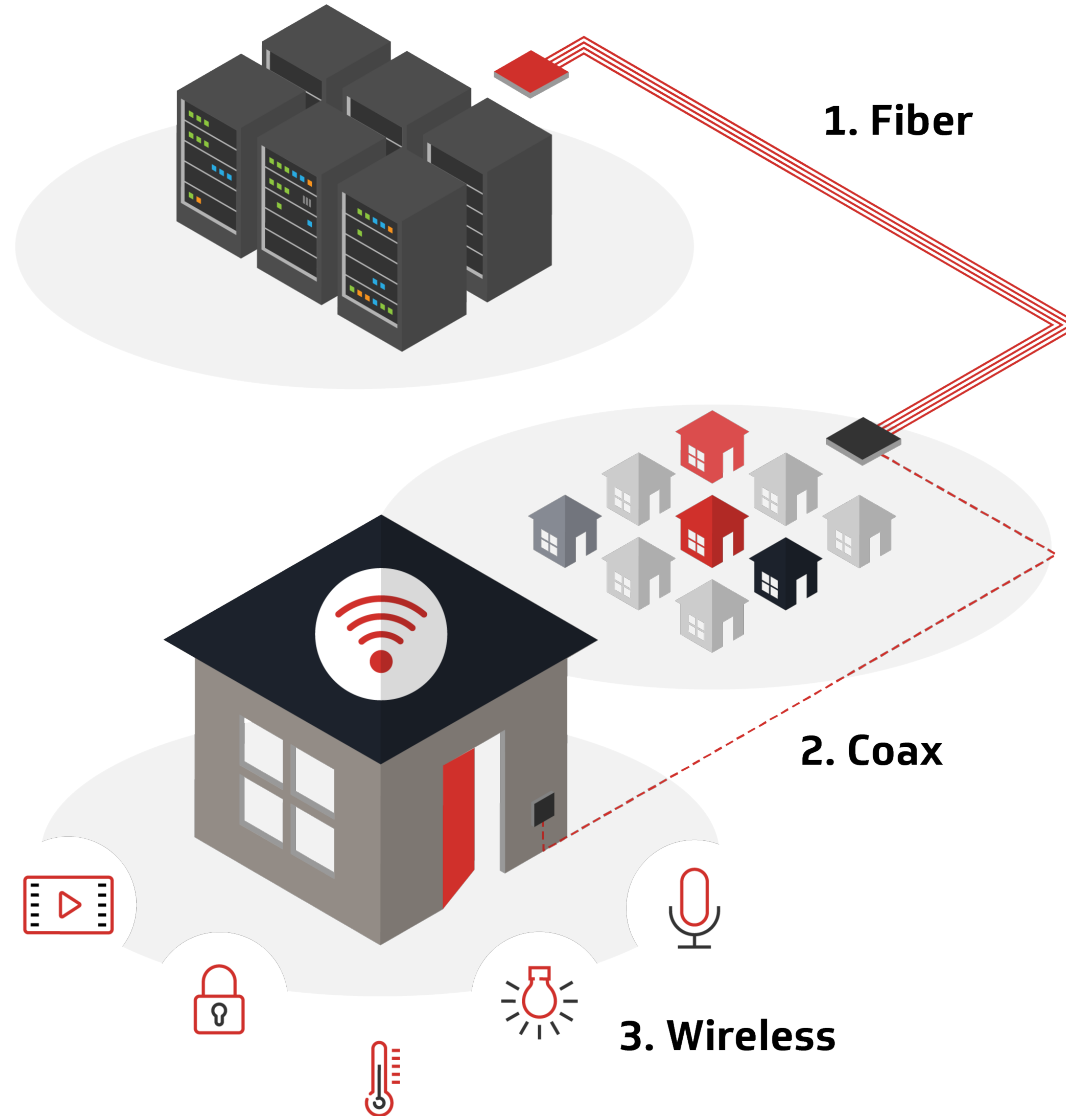
Better Security



Lower Latency

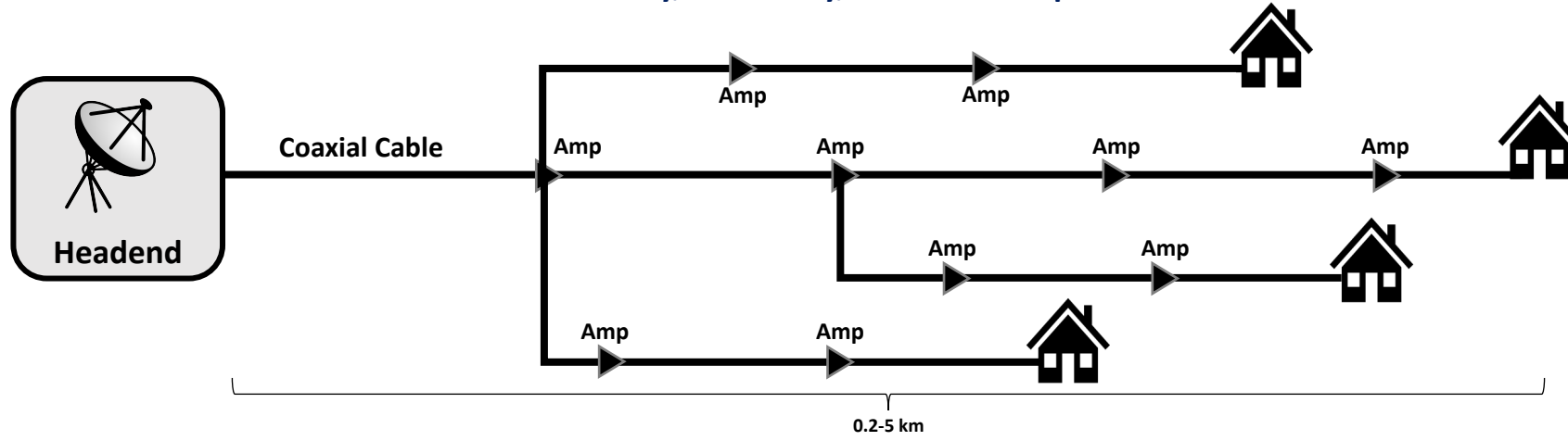


Cable's Hybrid Fiber-Coax Networks

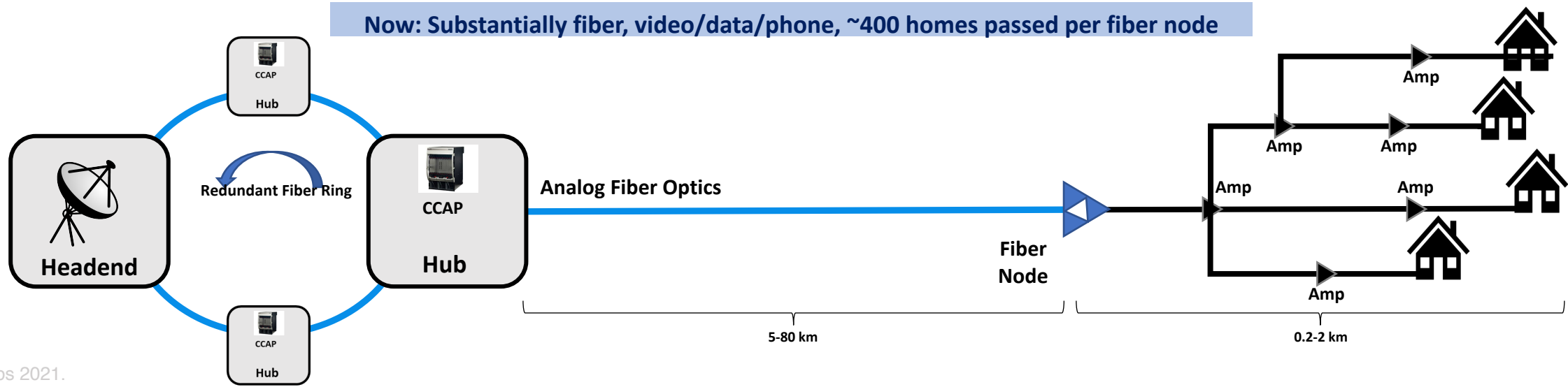


Cable Networks: Then and Now

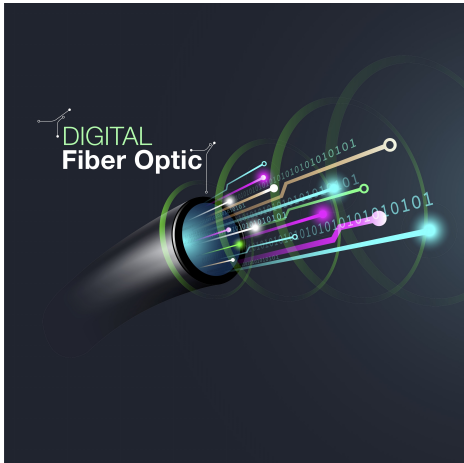
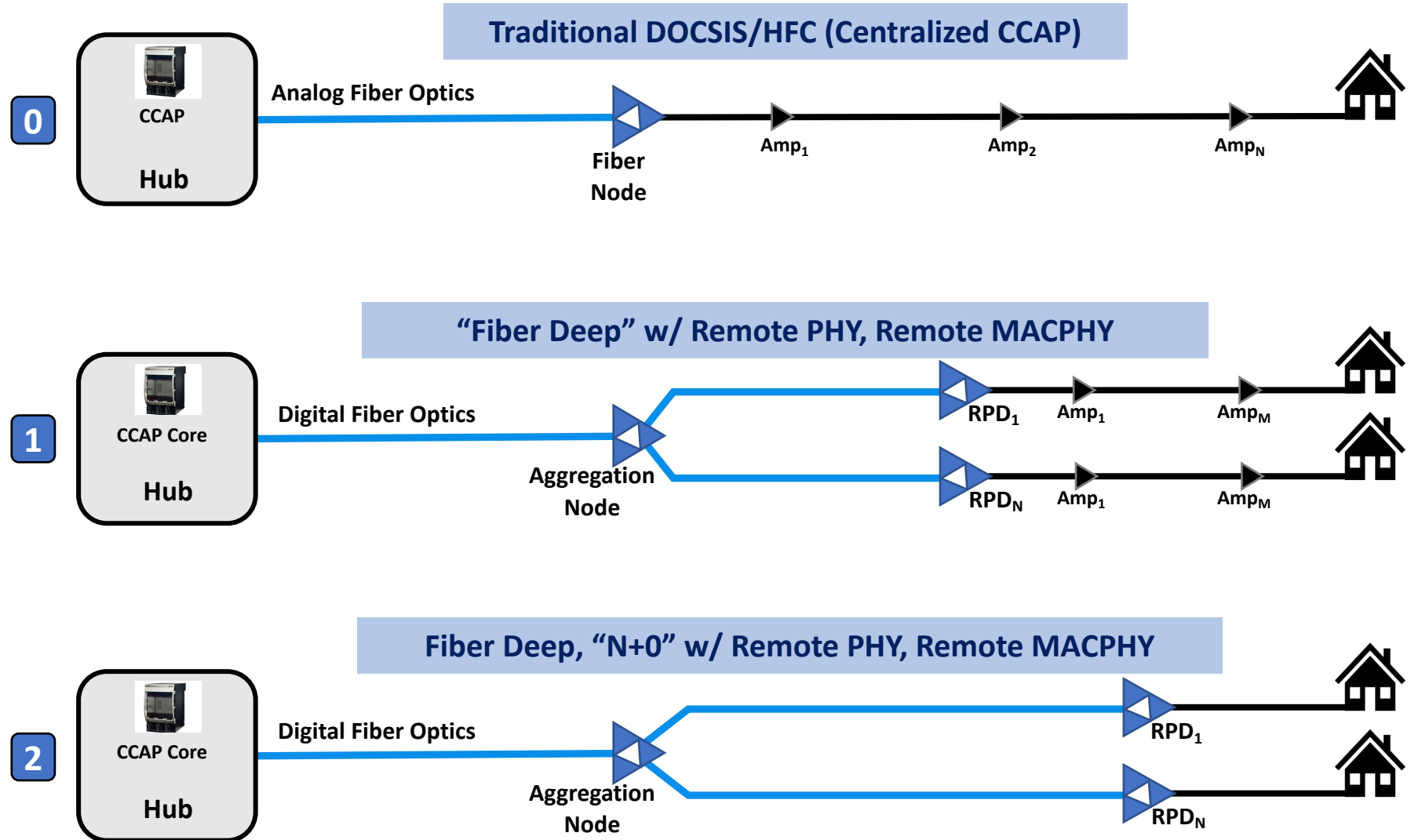
Then: Coax only, video only, ~2000 homes passed



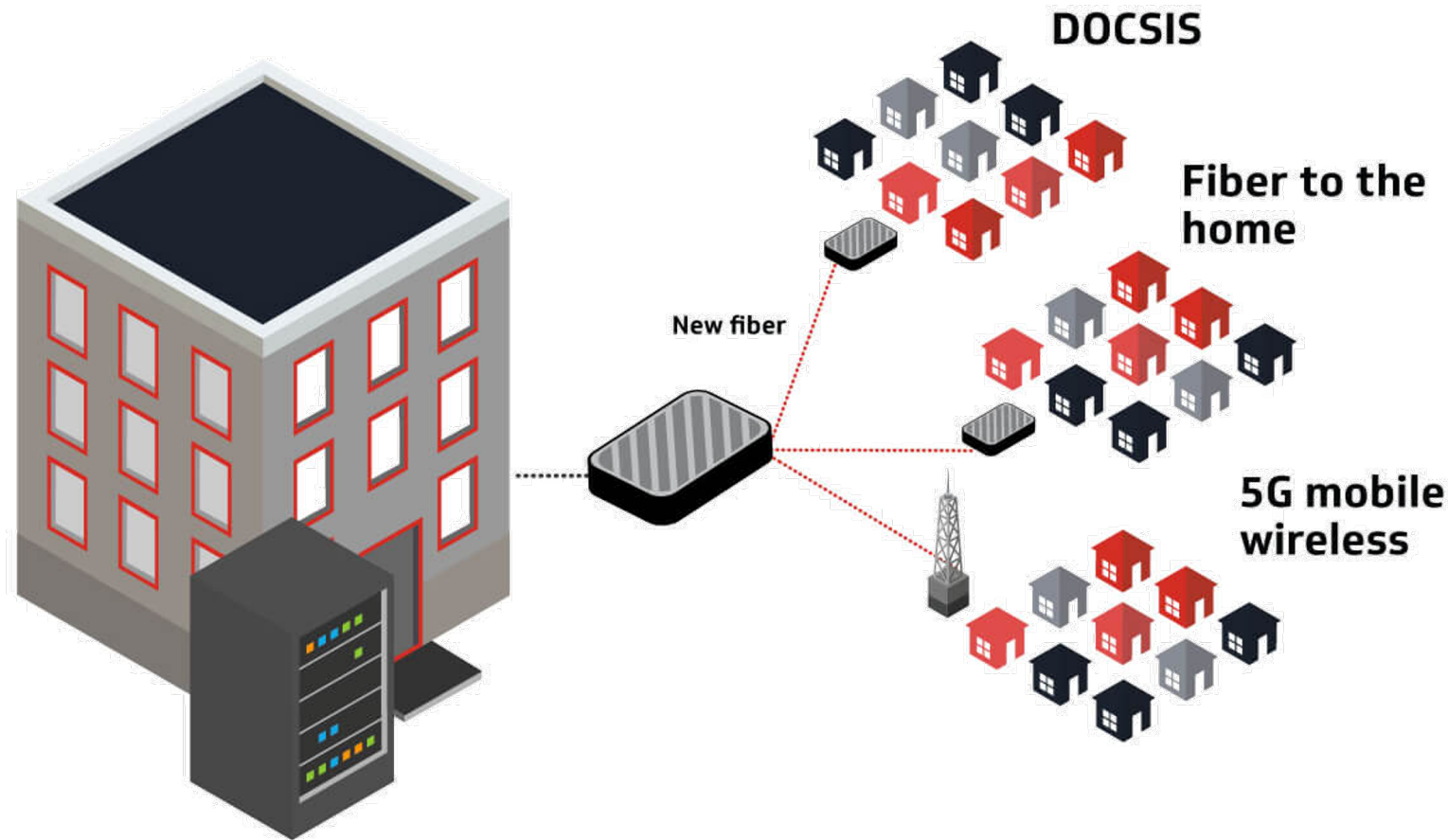
Now: Substantially fiber, video/data/phone, ~400 homes passed per fiber node



HFC Continuing Evolution – Fiber Deep



Convergence: Network and Services



The logo features the text "10G Speed". The "10" is in a dark blue, bold, sans-serif font. The "G" is in a bright red, bold, sans-serif font. Below the "10G" is a horizontal bar composed of ten vertical rectangular segments of varying heights, colored in a gradient from orange to red. To the right of this graphic, the word "Speed" is written in a large, black, sans-serif font.

10G Speed

Gigabit Broadband Now A Reality



Availability to US Housing Units

Cable Broadband: Minnesota



- Cable Broadband: Available to **almost 2 million Minnesota Housing Units** (approx. 79% of Total Minnesota Housing Units)
- Cable Gigabit Broadband: Availability to **over 96%** of Minnesota housing units passed by cable broadband
- CableLabs Members Operating in Minnesota:
 - Cable One, Inc.
 - Charter Communications
 - Comcast Corporation
 - Mediacom Communications Corp.
 - Midcontinent Communications (Midco)
 - Schurz Communications
 - Sjoberg's Inc.
 - Telephone and Data Systems, Inc. (TDS)

Source: FCC 477 data (Dec. 2019)

DOCSIS Evolution

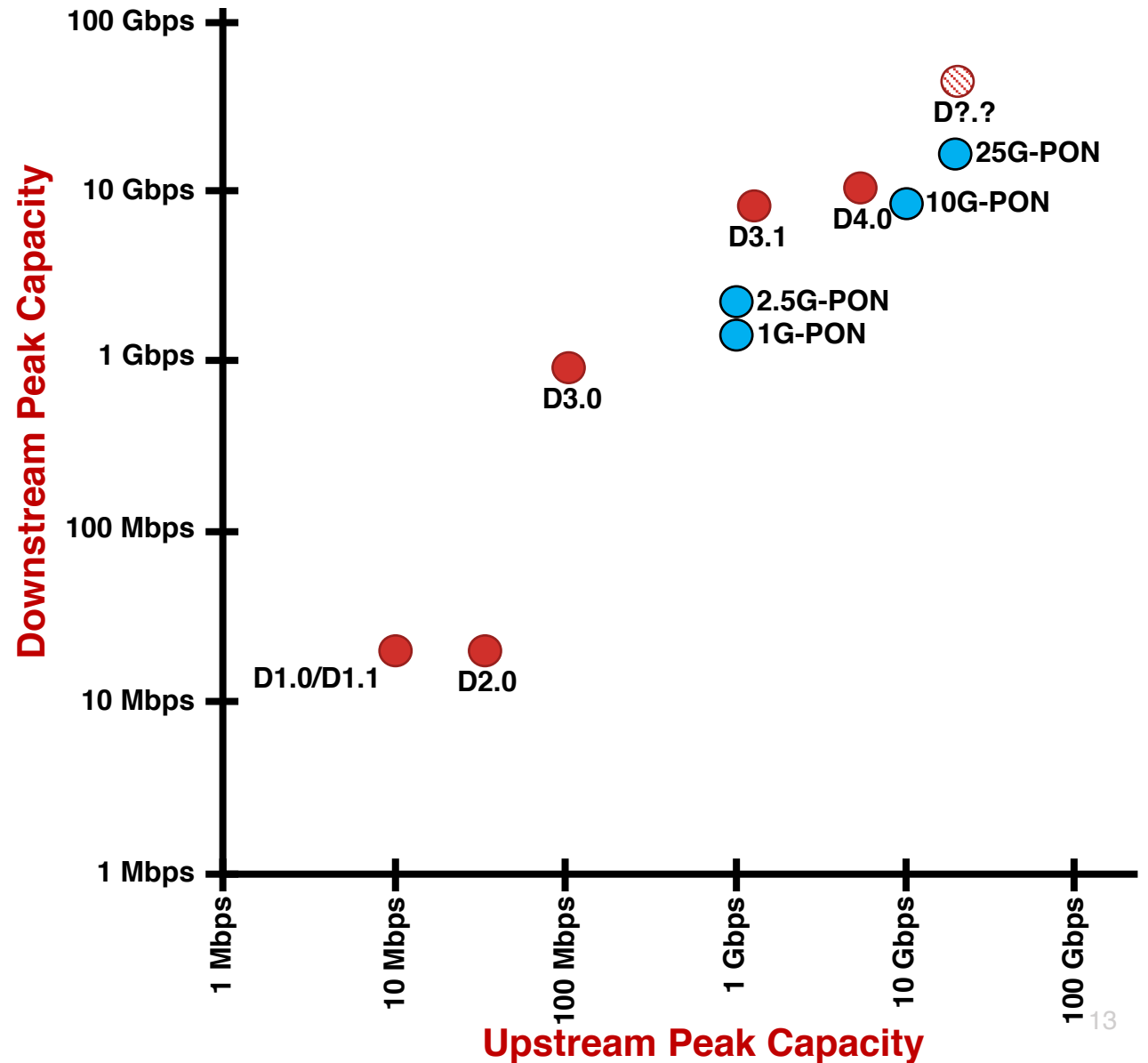
	DOCSIS 1.0	DOCSIS 1.1	DOCSIS 2.0	DOCSIS 3.0	DOCSIS 3.1	DOCSIS 4.0
Highlights	Initial cable broadband technology, high-speed internet access	Added voice over IP service, gaming, streaming	Higher upstream speed, capacity for symmetric services	Greatly enhances capacity, channel bonding, IPv6	Capacity and efficiency progression, OFDM, wideband channel	Symmetrical streaming and increased upload speeds
Downstream Capacity	40 Mbps	40 Mbps	40 Mbps	1 Gbps	10 Gbps	10 Gbps
Upstream Capacity	10 Mbps	10 Mbps	30 Mbps	200 Mbps	1-2 Gbps	6 Gbps
First Specification Issue Date	1996	1999	2001	2006	2013	2019

*The DOCSIS Evolution table describes the maximum capabilities of the specifications.

Peak Network Capacity Comparisons

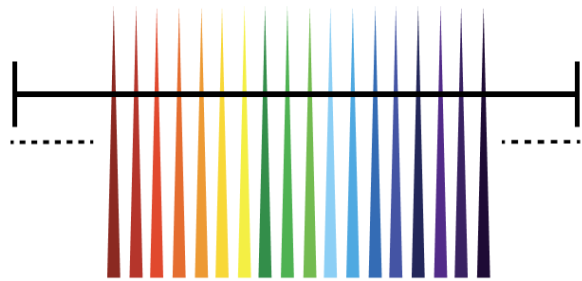
DOCSIS over Hybrid Fiber Coax keeps pace with fiber technologies

- DOCSIS/HFC
- Fiber to the Home/Passive Optical Networks (PON)



Coherent Optics

COMB + Coherent = 50Tb/s Capacity



ACHIEVED
2,000
Gbps

2016

ACHIEVED
8,000
Gbps

2018

ACHIEVED
15,000
Gbps

2019

TODAY
50,000
Gbps

2020

$$A_c \cos(2\pi f_c t + \phi)$$

Amplitude Frequency Phase

Angle
(Frequency = Rate of Change of Angle)

- Four dimensions:
 - Amplitude, frequency, phase, and polarization
- Significant increase in capacity per fiber
- Typically used in long haul and metro links – moving into access

The logo features the text "10G" in a bold, sans-serif font. The "10" is black and the "G" is red. Below the "10G" text is a horizontal bar composed of ten vertical bars of varying heights, colored in a gradient from orange to red. To the right of this graphic, the word "Reliability" is written in a large, black, sans-serif font.

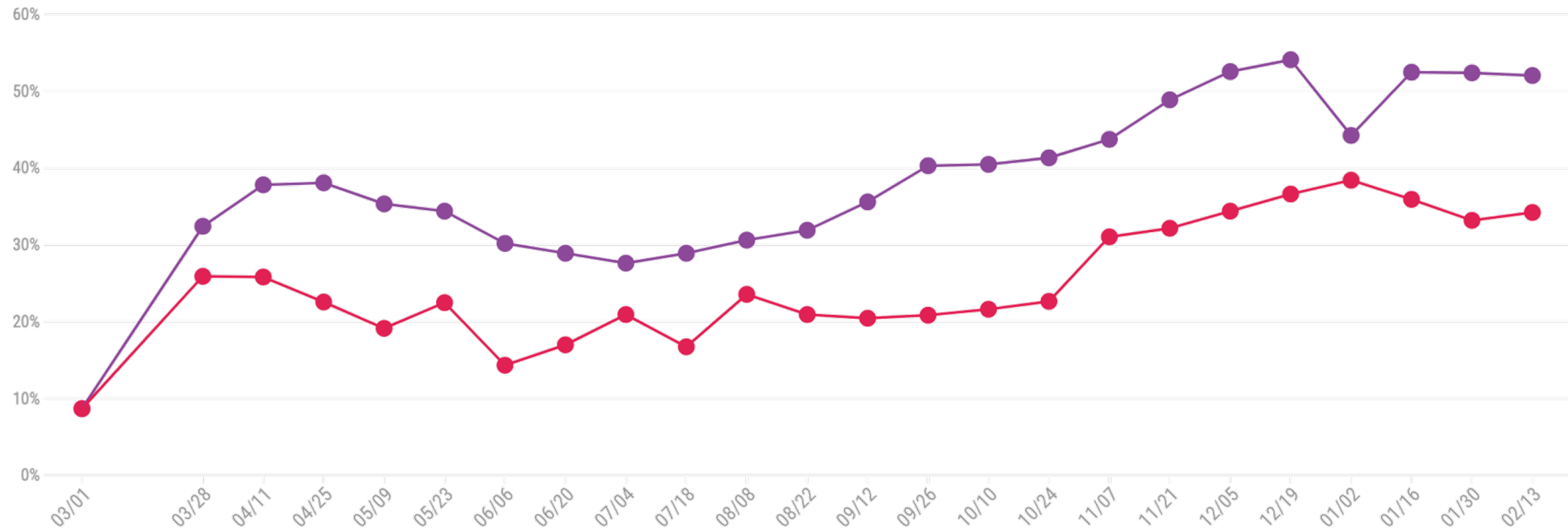
10G Reliability

National Peak Internet Growth During COVID-19

Observed Increase in Peak Consumer Usage Since Early March 2020

Overall change in pre-COVID internet usage since 3/1/20

Upstream Downstream



Covid-19: How Cable's Internet Networks Are Performing

Select your state to display network information.

Minnesota 

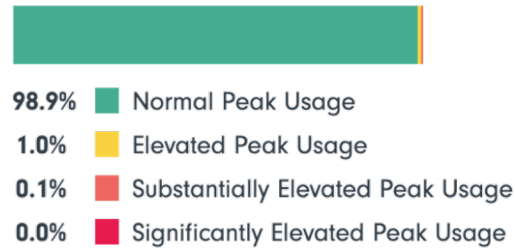
Downstream Growth (% of usage)

30.7 % OVERALL SINCE 3/1/20 **-3.6 %** WEEKLY 2/6-2/13/21

Upstream Growth (% of usage)

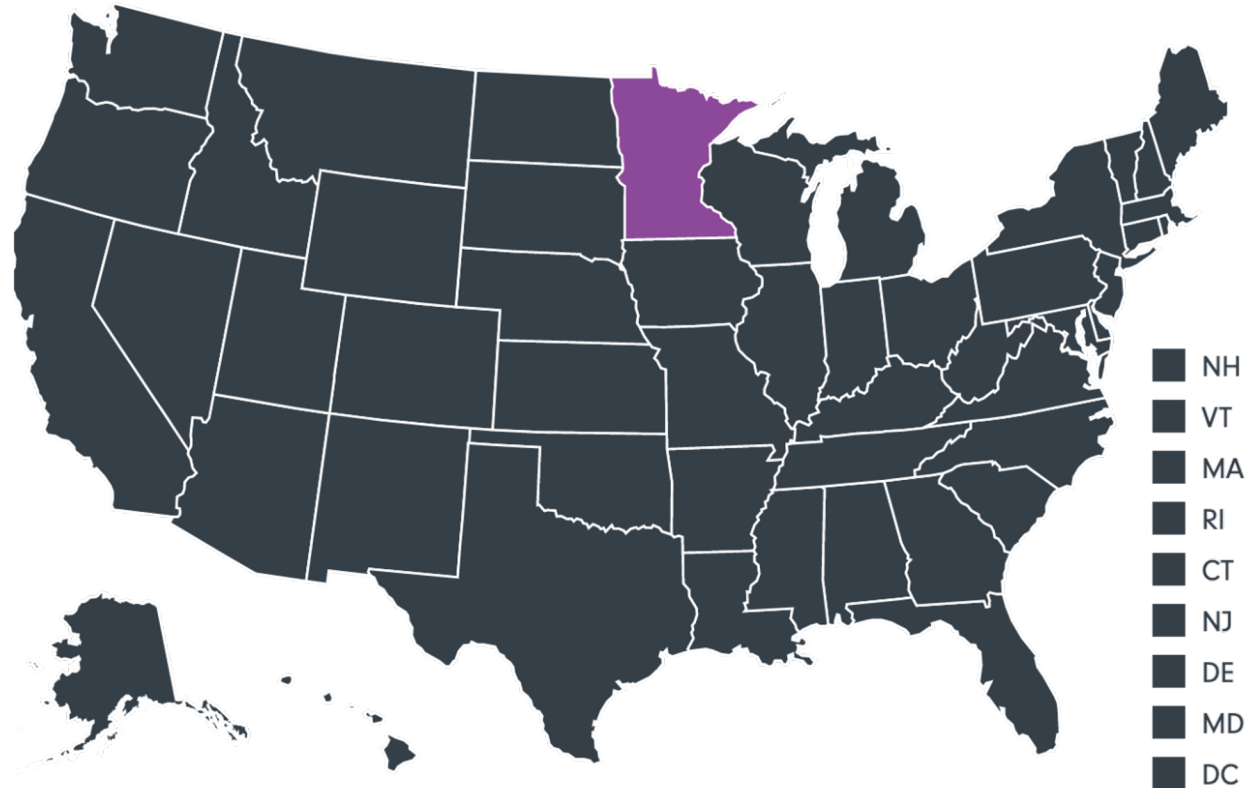
45.5 % OVERALL SINCE 3/1/20 **-1.8 %** WEEKLY 2/6-2/13/21

Network Performance (% of network)



Internet Service Providers

CHARTER COMCAST MEDIACOM MIDCO SJOBERG'S



Source: <https://www.ncta.com/COVIDdashboard>

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10G Security

Security Elements:



Device Identity



Availability



Onboarding/AAA



Lifecycle Management



Confidentiality



Upgradeability
& Future Security



Integrity

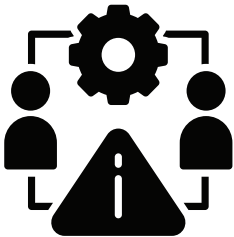


Assessment &
Conformance

Driving Increased Security:

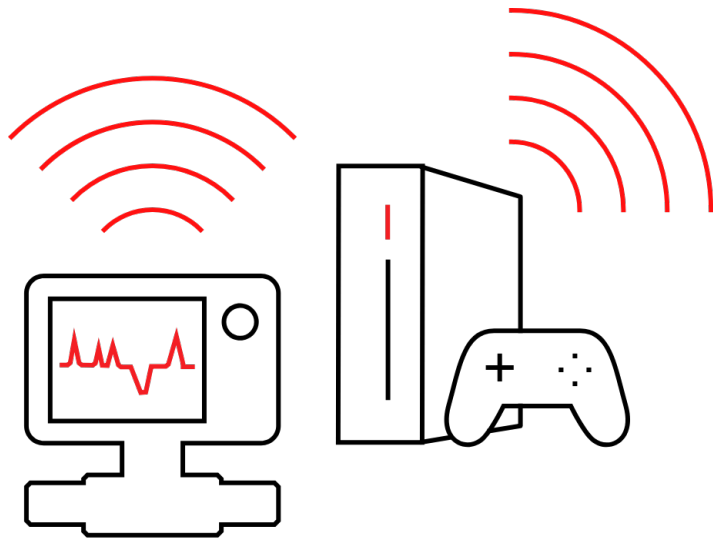


- DOCSIS Public Key Infrastructure (PKI)
 - 20+ years
 - Largest PKI outside finance and DoD
 - Over 750,000,000 consumer device certificates under CableLabs management



- Mitigating Insecure IoT Devices
 - Wi-Fi Easy Connect
 - Micronets
 - Transparent Security

10G Low Latency



- **DOCSIS 3.1 AQM:** 10 milliseconds
- **Low Latency DOCSIS:** 1 millisecond latency for a range of applications
- **Wi-Fi:** Applying low latency technologies to the home network
- **Improving UX:** Video conferencing, gaming, web page loading will all benefit
- **Enabling New Apps:** Real-time cyber-physical systems, interactive immersive VR experiences

...Under A Conducive Policy Environment

- **10G** will be the next leap forward in broadband connectivity
 - Faster speed, lower latency, better security, increased reliability
- The cable industry will further empower consumers and the digital economy via the 10G platform
- Requires a policy climate that fosters and incentivizes investment and innovation





The Future of Connectivity

CableLabs

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