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The Future of Connectivity

CableLabs

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65 Member MSOs Around the World

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Gigabit Broadband Now A Reality

DEC 2016
9%

CURRENT 80%

Availability to US Housing Units

Source: CableLabs
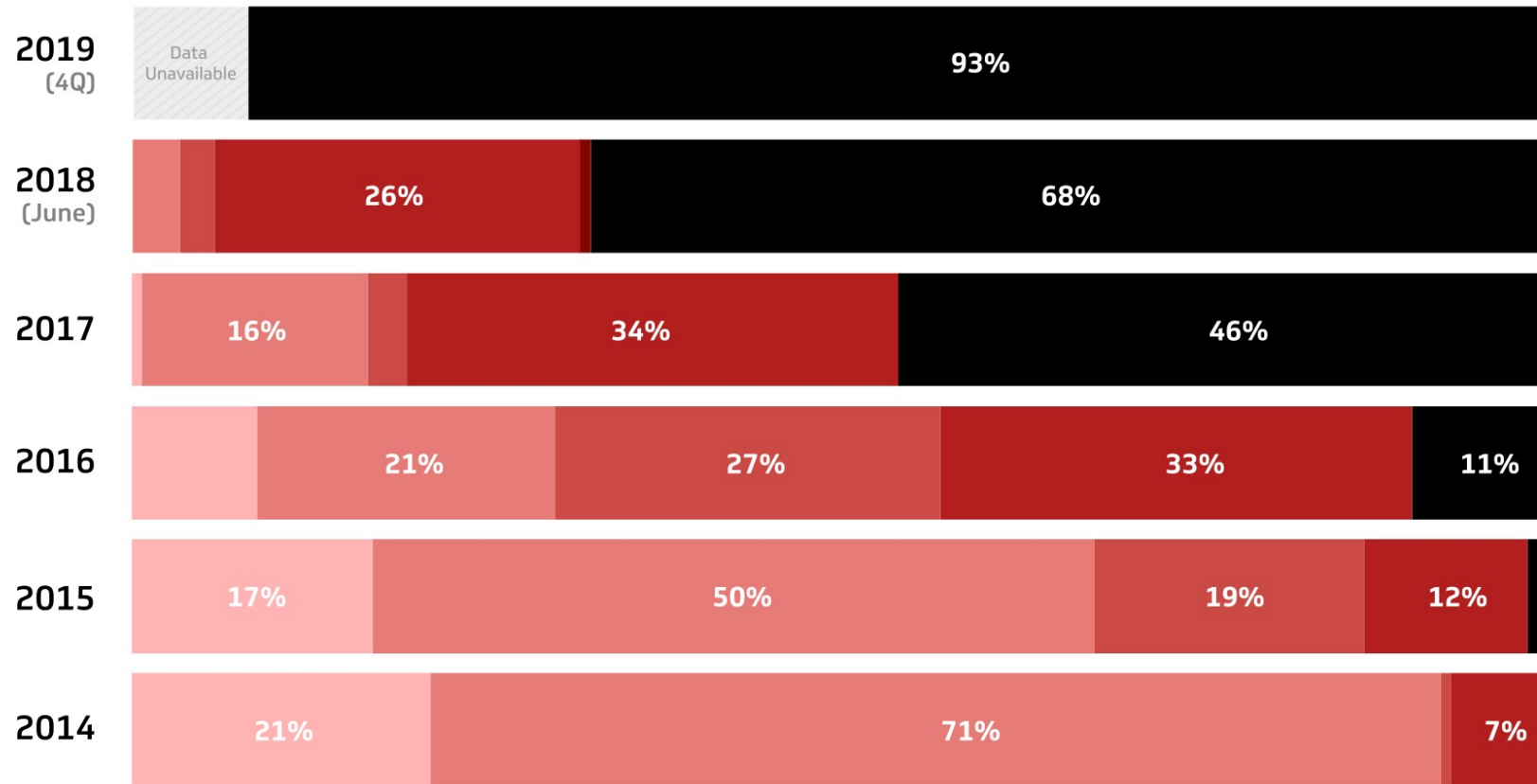
Progress in Available Broadband Speeds…

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Cable Broadband Service: Max Available Download Speeds (Mbps)

■ <100	■ 100-200	■ 200-300	■ 300-500	■ 500-940	■ 940+

2019 (4Q) — Data Unavailable — 93%

2018 (June) — 26% — 68%

2017 — 16% — 34% — 46%

2016 — 21% — 27% — 33% — 11%

2015 — 17% — 50% — 19% — 12%

2014 — 21% — 71% — 7%

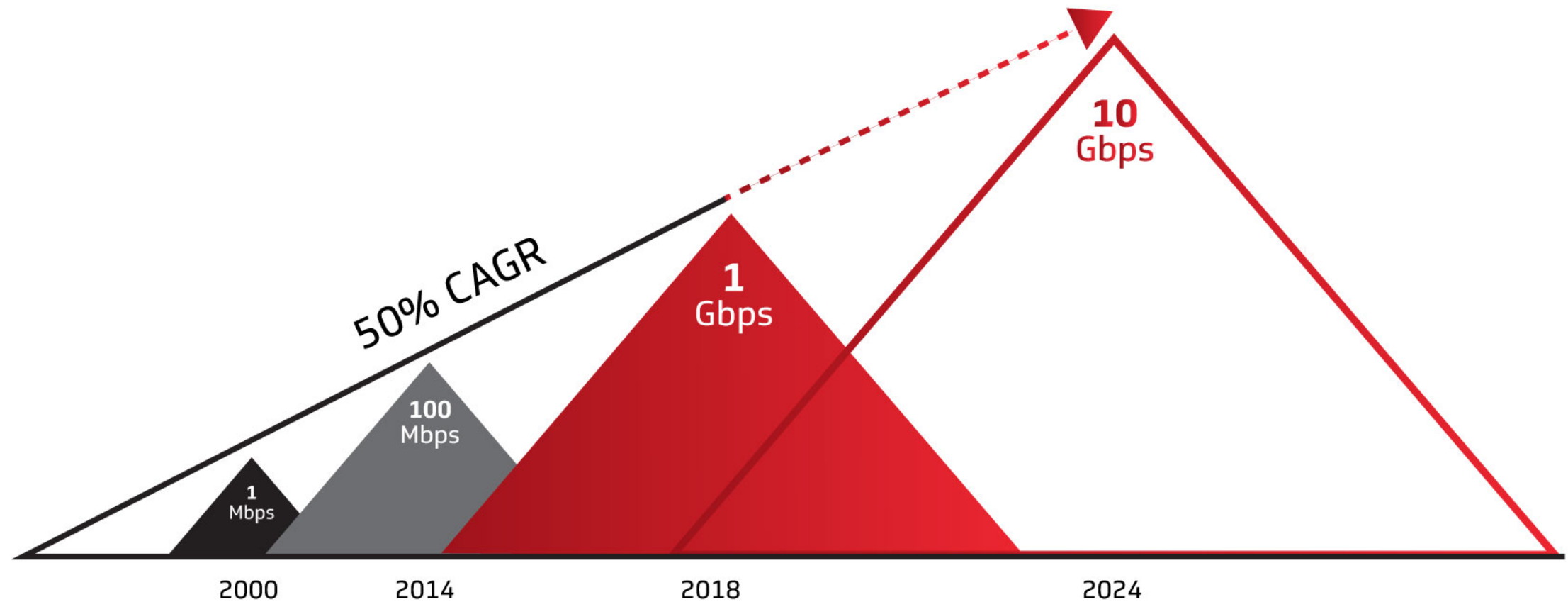0% **Percentage of U.S. Cable Housing Units** 100%

Source: CableLabs

Montana: Fixed Broadband Availability (25/3 or higher) (as of Dec. 2018)

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Access Technology Type	Population	% Population	Housing Units	% Housing Units
All Fixed (fixed terrestrial wireless, satellite, and wired)	1,049,814	99.94%	510,353	100.00%
Fixed Terrestrial (fixed wireless and wired)	915,551	87.16%	435,891	85.41%
Wired Only (DSL, cable, fiber)	835,650	79.55%	397,347	77.86%
Cable Broadband	622,580	59.27%	287,702	56.37%
Cable Gigabit Broadband (940+)	616,388	58.68%	283,875	55.62%

10 Gigs on the Horizon

50% CAGR

1 Mbps — 2000
100 Mbps — 2014
1 Gbps — 2018
10 Gbps — 2024

Source: https://www.nngroup.com/articles/law-of-bandwidth/

Cable's Hybrid Fiber-Coax Networks

1. Fiber

2. Coax

3. Wireless
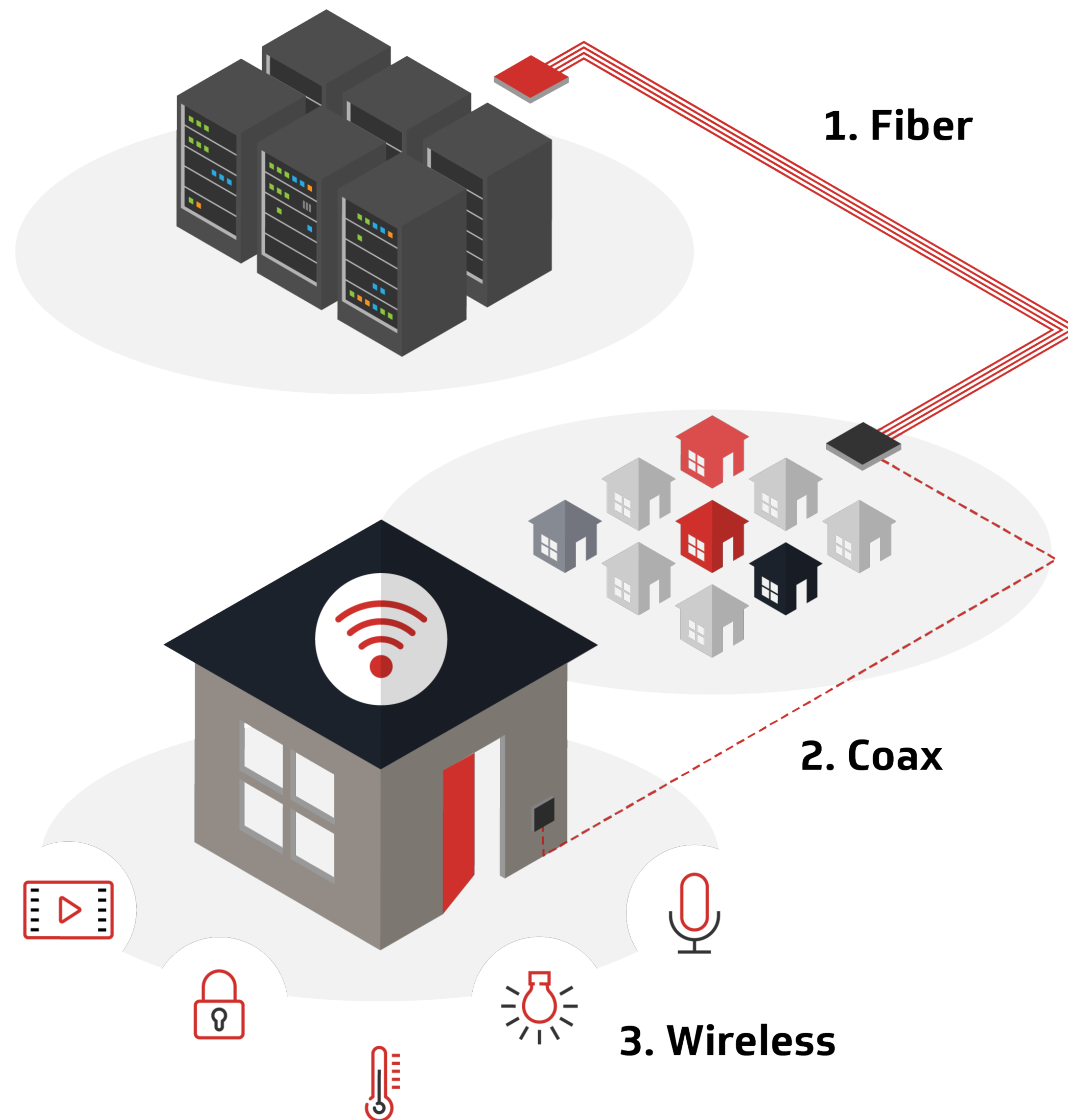
10G Speeds: DOCSIS

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The Evolution of DOCSIS

|	DOCSIS 1.0	DOCSIS 1.1	DOCSIS 2.0	DOCSIS 3.0	DOCSIS 3.1	**DOCSIS 4.0**
Highlights	Initial cable broadband technology	Added voice over IP service	Higher upstream speed	Greatly enhanced capacity	Capacity and efficiency progression	**Symmetrical streaming and increased upload speeds**
Max Downstream Capacity	40 Mbps	40 Mbps	40 Mbps	1 Gbps	10 Gbps	**10 Gbps**
Max Upstream Capacity	10 Mbps	10 Mbps	30 Mbps	100 Mbps	1-2 Gbps	**10 Gbps**
Initial Specification Date	1997	1999	2001	2006	2013	**2019**

Coherent Optics: Boosting Capacity in the Fiber Network – Access Network Optical Technologies

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	Analog	Digital-Direct Detect (10 Gbps)	CableLabs Digital-Coherent	CableLabs Full Duplex Coherent
Description	Modulates a continuous signal	On-Off Keying: Rapidly cycles the laser "on" and "off" to transmit data	Modulates amplitude and phase along two polarizations to transmit data	Using coherent techniques, enables data to be transmitted in both directions, simultaneously, using the same wavelength on a single fiber strand
Capacity Per Wavelength	10 Gbps	10 Gbps	700 Gbps*	700 Gbps (in each direction)
Typical Number of Wavelengths Used	4	40	80	80 (in each direction)
Total Capacity Per Fiber Strand	40 Gbps	400 Gbps	50 Tbps	100 Tbps (combined capacity for both directions)
Initial Spec Date	Early 1990s	2002	2018	Early 2019

* CableLabs has demonstrated data transmission rates of up to 700 Gbps per wavelength under lab conditions. However, we expect initial field deployments to achieve data transmission rates, more on the order of 100-400 Gbps per wavelength.

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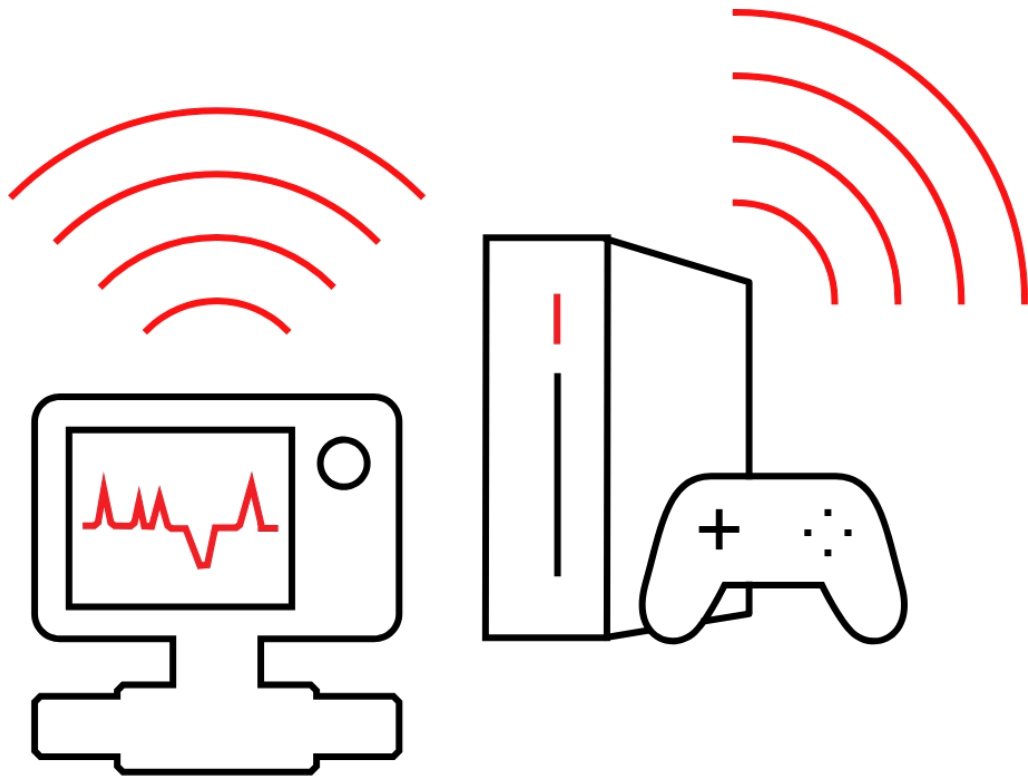
Low Latency

- **Reducing Latency:** 1 millisecond latency for a range of applications

- **Improving UX:** Web page loading, gaming, video calling will all benefit

- **Enabling New Apps:** Medical, vehicular, & other apps require low latency

Security: CableLabs® Micronets

- **Ease of Use:** leveraging SDN, AI, and machine learning to minimize the burden on the consumer

- **Mitigating Insecure IoT:** Quarantining compromised devices

- **Providing Enhanced Security:** Isolating and securing high-value or sensitive devices

- **Transparency:** Visibility and auditability of network events

10G Wi-Fi

- **Faster Wi-Fi:** Keeping pace with network performance
- **Whole-Home Coverage:** Connectivity everywhere
- **Seamless:** Easy, secure, high-performing wireless

10G Convergence

DOCSIS

Fiber to the home

New fiber

5G mobile wireless
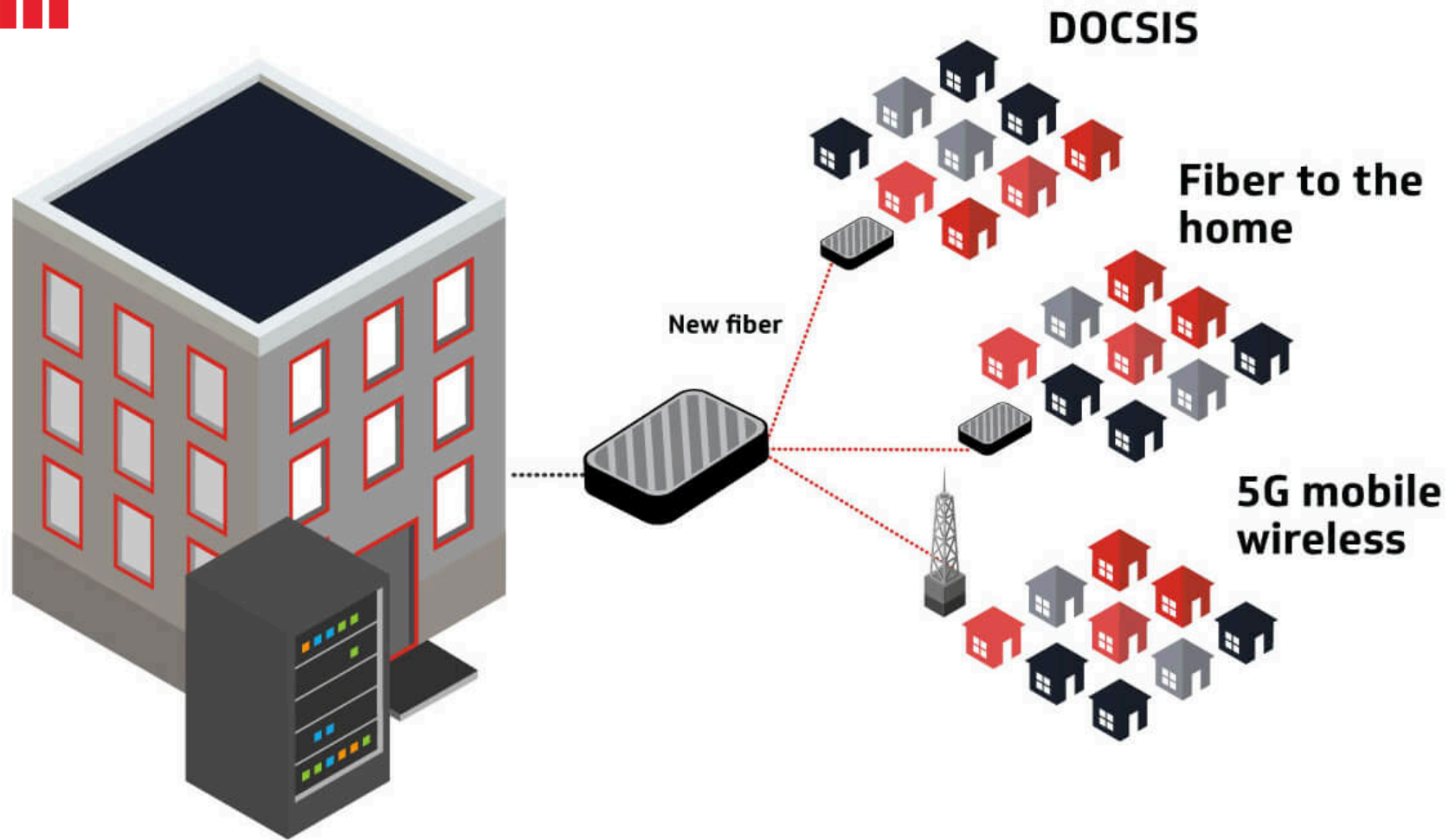
…Under A Conducive Policy Climate

- **10G** is a leap forward for American broadband connectivity
  - ➤ Faster speed, lower latency, better security
- The cable industry will newly empower consumers and the digital economy via the 10G platform
- Requires a policy climate that fosters and incentivizes investment and innovation

Questions?

Appendix: CableLabs Resources

- "10G: The Next Great Leap in Broadband"
  - https://www.cablelabs.com/10g-the-next-great-leap-in-broadband (Whitepaper)
- "Driving Gigabit Speeds from Lab to Consumer" –
  - Cablela.bs/GIS (Microsite) / Cablela.bs/GIS-Whitepaper (Whitepaper)
- "Cable: 5G Wireless Enabler" –
  - Cablela.bs/5G-Wireless-Enabler (Whitepaper)
- CableLabs® Micronets –
  - Cablelabs.com/micronets (Microsite) / Cablela.bs/Micronets-Whitepaper (Whitepaper)
- "Securing Networks in the Broadband Age" –
  - Cablela.bs/SNBA-Whitepaper
- "A Vision for Secure IoT" –
  - Cablela.bs/Secure-IoT-Whitepaper
- "The Near Future" –
  - https://www.cablelabs.com/thenearfuture (vision videos)