ITIF Technology Explainer: DOCSIS 4.0

DOCSIS: EXPLAINED

Broadband speed—the capacity at which information moves across broadband networks—is the product of multiple factors like network technology, subscription speed, and even the provider's overall traffic burden at the time of use. On the user side, *experienced* broadband speed is vulnerable to each of those factors in addition to the quality of consumer-end devices, particularly the speed of the modem (the box that connects your in-home network to your internet service provider) and in-house Wi-Fi providing the direct connection to most users.

For coaxial cable networks offered by traditional cable providers, interoperability between modems and networks—and the quality of both—is ensured by adherence to Data Over Cable Service Interface Specifications (DOCSIS). DOCSIS is an industry standard, set by cable industry group CableLabs, that specifies high-bandwidth data communications. Essentially a set of instructions for each generation of cable technology, DOCSIS helps ensure cable broadband is fast enough, meets necessary specifications, and adheres to consistent standards to maximize interoperability between devices.

Since the emergence of DOCSIS 1.0 in 1996 (which set network capacity at 40 Mbps downstream and 10 Mbps upstream), CableLabs has moved through multiple iterations until finally hitting the current standard, DOCSIS 3.1, in 2013. Next in line is the DOCSIS 4.0 standard, which was released in 2020 and demoed at a CableLabs interop in July 2023. As of June 2023, CableLabs was ready to start certification testing for DOCSIS 4.0 modems. Products should hit the shelves later in the year.

TECHNICAL ADVANTAGES

The most immediately notable real-world impact of DOCSIS 4.0 is that it will enable cable companies, using their existing coaxial cable networks, to offer high—as in multi-gigabit—and sometimes even symmetrical speeds.

Though the technical limits of current DOCSIS 3.1 technology are 10/1 Gbps down/up, broadband users rarely reach those theoretical limits. DOCSIS 4.0 should make multi-gigabit symmetrical speeds a reality; provide lower latency; and enable more proactive network maintenance, which will bolster network resilience.

Importantly, the 4.0 standard increases the amount of spectrum (essentially space within the cable used for transmitting data as electrical signals) available for consumers, but the specific network designs may still vary based on spectrum allocation. Cable company Charter, for example, anticipates DOCSIS 4.0-supported speeds of 5-10 Gbps downstream and 1 Gbps upstream because they plan to use "high splits" (a distinction between upstream and downstream-allocated spectrum) in spectrum for the coaxial part of their networks. Comcast

plans to set aside more spectrum for both downstream and upstream use to prioritize symmetry and has reportedly achieved speeds of 6 Gbps down/4 Gbps up during testing.

Network security should also see a boost. A stronger authentication system will strengthen communication between consumer premise equipment and the network itself, and upgraded encryption algorithms provide a greater barrier against attack. 10G networks, paired with DOCSIS 4.0, are being built with upgraded security protocols like device fingerprinting and machine learning-based threat detection. Always a critical part of network infrastructure, network security has become even more important as both the sensitivity of applications and the number and diversity of connected devices have grown.

POLICY IMPLICATIONS

The broadband marketplace exists at the front line of digital innovation, so the first-place spot is always vulnerable to displacement by technological advancement. Today, wired broadband is generally looked at as superior to wireless because of its added reliability and protection from external interference, which can even include events like heavy rainfall. Between major wired technologies, fiber optic networks promise higher symmetrical speeds and greater durability than traditional coaxial cables, but the high price tag of new fiber deployment chips away at their net benefits.

Fiber is certainly an attractive and often aspirational technology, and many policy priorities reflect that. Fiber coverage across Organization for Economic Cooperation and Development (OECD) countries has increased by nearly a quarter over five years. Closer to home, well-known U.S. municipal networks usually choose fiber when funded enough to afford it, and forthcoming Broadband Equity, Access, and Deployment (BEAD) funds, which put billions into building broadband infrastructure to close the digital divide, prefer projects that plan to connect end-users to fiber. The problem is that even BEAD funding is finite, which means that ardent prioritization of much more expensive fiber would ultimately come at the cost of some households not being connected at all and fewer resources being directed toward other high-value policy priorities like broadband adoption and digital inclusion.

For most of the population without current access to fiber, fiber networks are more financially and logistically *impractical* than any other type of network, especially when traditional cable networks already reach the majority of the population. Expanding the capabilities of preexisting cable would connect households to quality broadband more cheaply: Estimates put the cost of upgrading DOCSIS infrastructure at around $100 or $200 per location (though this does not include related costs like replacing modems), a fraction of the comparable costs of laying new fiber. What matters to end users is the quality of the service they receive, not the technology that sends it, and the speeds and performance of DOCSIS 4.0 standards mean that many users, at least most small businesses and households, will see no real difference between that and a fiber connection.

Getting everybody connected to some form of quality broadband and scaling up capacity as applications consume more bandwidth are both valid goals in the long term. But since something is better than nothing, the former must edge out the latter in priorities now. It is still an unfortunate pattern—with ramifications that will compound over time—for those last to be connected to ultimately be connected to a lower-quality network while other parts of society get

superior fiber. Since cable is still more widely deployed than fiber, DOCSIS 4.0 can help minimize those gaps by offering comparable speeds to fiber through a more realistically scalable technology.

While today's applications have lower usage requirements such that most users will never use gigabit or multi-gigabit speeds (and therefore see no practical difference between cable and fiber), future uses could possibly depend on them. Burgeoning applications like artificial and virtual reality are setting the stage for more complex, bandwidth-heavy applications—like real-time multiplayer VR gaming—in the future. Policymakers and local governments must weigh the merits of both while crafting infrastructure policy and digital inclusion policies necessary to finally close the divide. There will always be trade-offs when allocating limited funds, but technological improvements that increase the capabilities of existing infrastructure can help make that choice a little bit easier—for now.

RECOMMENDED READING

Jessica Dine, "The Digital Inclusion Outlook: What It Looks Like and Where It's Lacking" (ITIF, May 2023).

Diana Goovaerts, "Fierce Fundamentals: What is DOCSIS 4.0?" *Fierce Telecom*, May 13, 2022, https://www.fiercetelecom.com/telecom/fierce-fundamentals.

Doug Jones, "On the Path to 10G: CableLabs Publishes DOCSIS® 4.0 Specification," *Informed* by CableLabs, March 26, 2020, https://www.cablelabs.com/blog/on-the-path-to-10g-cablelabs-publishes-docsis-4-0-specification.

Jeff Baumgartner, "Security locked in for next DOCSIS 4.0 interop," *Light Reading*, August 8, 2023, https://www.lightreading.com/cable-tech/security-locked-in-for-next-docsis-40-interop/d/d-id/786011?_mc=RSS_LR_EDT.

Joan Engebretson, "Fiber Vs. DOCSIS 4.0: How Long Will Fiber's Edge Last?" *Telecompetitor*, February 1, 2023, https://www.telecompetitor.com/fiber-vs-docsis-4-0-how-long-will-fibers-edge-last/.

Jeff Baumgartner, "CableLabs kicks off DOCSIS 4.0 modem certification program," *Light Reading*, June 8, 2023, https://www.lightreading.com/cable-tech/cablelabs-kicks-off-docsis-40-modem-certification-program-/d/d-id/785227.