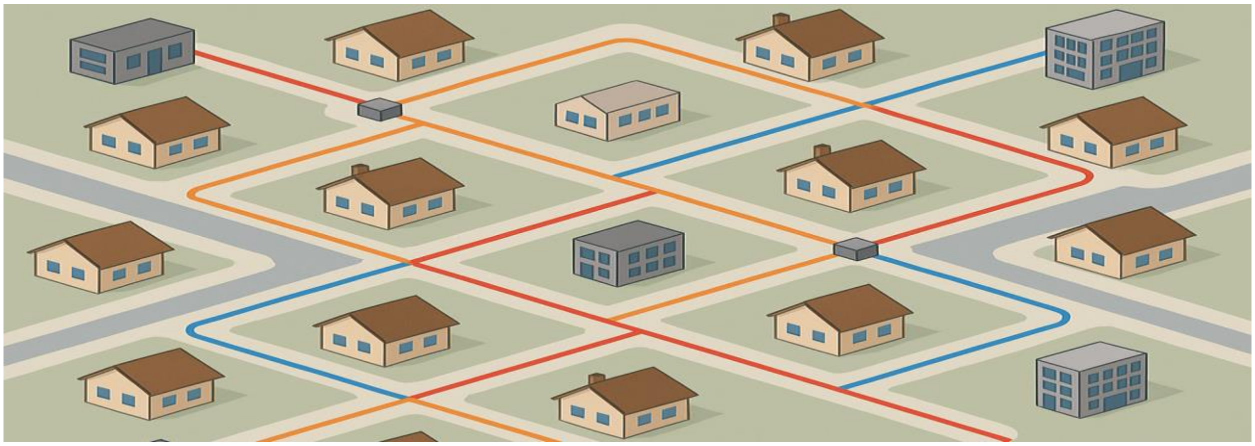
Broadband Beyond BIAS

Future-Proofing Communities: Why Open Access Networks Built on Fiber Are the Best Path to Sustainable Infrastructure



By David J. Malfara, Sr.

The Long-Term Vision for Community Broadband

As communities across the nation invest in broadband infrastructure, decision-makers must look beyond short-term connectivity goals and consider the long-term sustainability, flexibility, and total value of their investments. Open Access Networks (OANs) represent a powerful model that maximizes public benefit, fosters innovation, and ensures lasting economic impact. When deployed using a microduct matrix of optical fiber, these networks become uniquely capable of delivering a 50-year or longer useful life—something no other transmission medium can promise.

Expanding the Purpose of Open Access Networks

Open Access Networks are designed to allow multiple service providers to operate over the same physical infrastructure, creating competition, lowering costs, and increasing service quality for end users. But the true potential of OANs is realized only when their design anticipates not just today's broadband Internet access service (BIAS) needs, but the full spectrum of data transport and distribution requirements that communities will face for generations. This includes support for education, telehealth, smart grid modernization, support for other community-based utility control and management, public safety, business growth, and even emerging use cases such as precision agriculture, autonomous transportation, and immersive virtual environments. Fiber optics is the only transmission medium that meets the rigorous demands of this expansive vision of organic growth.

The Role of Microduct Arrays in OAN Sustainable Design

In the context of an Open Access Network (OAN), the most effective and future-proof deployment begins *not with fiber itself*, but with the thoughtful installation of a microduct matrix using microduct arrays as pathways between strategically placed hubs used for fiber transport and distribution.

These microduct arrays are deployed as bundled conduits (within a protective oversheath) between strategically located network hubs, and serve as the physical foundation of a flexible and resilient infrastructure.

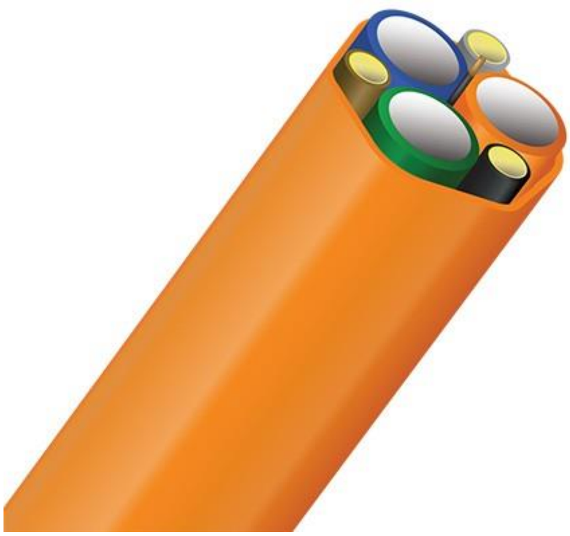


Figure 1: Dura-Line's FuturePath microduct array—an example of bundled conduit used to support flexible, scalable fiber deployment in Open Access Network architectures.

For municipalities and local governments considering Public-Private Partnerships (PPPs), this design approach offers maximum long-term value. The microduct matrix allows fiber to be blown in as needed, rather than all at once. This decoupling separates the expensive civil work of trenching and conduit placement from the design engineering demands for precise fiber count forecasting for the entire useful life of the infrastructure—normally required as a prerequisite of installation. Governments and network owners, therefore are better able to align initial capital spending with known service demand and conservatively estimated adoption rates. If those estimates are too low, augmentation can be done at a moderate cost and with minimal disruption. As a result, initial estimations can be kept conservative, putting less capital at risk, without experiencing a later penalty to accommodate unforeseen growth.

Each microduct in the matrix provides an independent fiber cable pathway, making it possible to build out fiber routes incrementally, adjust network topology over time, and provide route diversity for redundancy, protection, and resilience. This structure also supports multiple operators and/or service tiers—perfectly suited to the OAN model, where the infrastructure is shared and leveraged by various public and private entities for a wide range of services.

Redundancy, Reliability, and Matrix-Based Architecture

True sustainability in broadband infrastructure demands more than high capacity and long lifespan—it requires resilient network design built around redundancy and alternative pathways. This is true for active and passive optical networks and is best achieved through a matrix-based architecture at each network hierarchy level, where physical route diversity and redundant equipment paths are deliberately engineered into the system.

Beginning initial design with a microduct matrix approach ensures that critical communication links have the necessary avenues to maintain connectivity in the event of a failure, construction disruption, or maintenance event. At the access layer, this could mean multiple entry points into a neighborhood, campus, or building complex. At the distribution and core layers, it involves diverse microduct paths, multiple fiber trunk routes, and strategic microduct/fiber hub placement that allow for the re-routing of data through unaffected paths during outages.

Fiber is uniquely suited to support this matrix-based architecture due to its ability to carry enormous amounts of data per strand, and because each strand within a cable can be dedicated to specific traffic or redundant or protected services. With proper planning, an Open Access Network built on a microduct matrix and fiber can ensure maximum uptime, reliability, and fault tolerance across all service tiers.

Figure 2: Hexatronic's Microduct/Fiber Distribution Enclosure—an example of a modular hub that enables fiber drop and distribution in a microduct-based OAN deployment.

Unmatched Longevity and Scalability

Unlike coaxial cable, copper DSL, or wireless alternatives, fiber is not subject to bandwidth limitations, electromagnetic interference, or rapid technological obsolescence. A single strand of fiber can carry data at rates exceeding hundreds of gigabits per second, and each cable typically contains dozens or even hundreds of strands—each of which can serve a different purpose, client, or agency, simultaneously and securely.

The Benefits of Blown Fiber and Microduct Infrastructure

As mentioned above, when paired with microduct infrastructure in a matrix configuration, fiber deployment gains an additional dimension of future-proofing. Microduct arrays allow fiber to be blown in incrementally, enabling networks to expand initial service areas, add capacity, and support new use cases without costly excavation or reengineering. This modular deployment approach also aligns capital spending with actual demand, reducing financial risk while preserving strategic optionality.

Moreover, the majority of deployment cost—typically more than 75%—is associated with labor to install the supportive physical infrastructure. While it has been economically prudent to install high-capacity fiber with a limited number of reserve (additional) strands during the initial build (at a small increase in incremental cost), the microduct matrix approach greatly extends such expansion capabilities. Microduct, along with the high counts achievable using microfiber offers an intrinsic longevity, capacity, and flexibility offered by no other medium. (*e.g.,* Corning MiniXtend HD Cable – features SMF-28 Ultra 200 fiber that measures less than 0.5” in diameter and delivers fiber counts up to 432 strands.)

Security and Segmentation for Critical Infrastructure

Finally, fiber's physical security advantage cannot be overstated. Each strand is physically isolated, enabling the highest levels of security and reliability, which are essential for critical services like utility monitoring, emergency communications, and financial operations where discreet, isolated physical connections are the gold standard.

Conclusion: OANs built on Microduct/Fiber Design as 50-Year Infrastructure Investments

In short, an Open Access Network constructed on a robust microduct matrix and fiber foundation is not merely a broadband project—it is a 50-year infrastructure investment that multiplies public value over time. It supports economic development, resilience, and innovation. Communities that embrace this model position themselves not just to catch up to the digital present, but to lead in the digital future.

How Big Bang Broadband LLC Can Help

Big Bang Broadband LLC (BBB) is an expert broadband consultancy committed to helping public and private stakeholders recognize and implement the highest-performing, most sustainable broadband solutions available. BBB can assist communities in designing Open Access Network models using modern fiber deployment technologies, including microduct arrays, distributed hub architecture, and matrix-based redundancy. Through advisory services, feasibility assessments, and implementation support, BBB helps local governments, utilities, and consortia align broadband investments with short-term risk avoidance and long-term community growth and resilience.

About the Author

David J. Malfara, Sr. is a broadband infrastructure strategist and CEO of Big Bang Broadband LLC. With over 45 years in telecommunications and broadband, he has helped launch numerous broadband service providers and continues to advise government agencies and private developers on sustainable fiber deployment strategies. He is a senior member of IEEE and a member of the Open XR Optics Forum, and actively contributes to the development and communication of future-oriented broadband solutions.

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