

# Broadband at a Crossroads

Navigating Funding Shifts, Emerging Technologies, and the Business Model of the Future

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## A Turning Point for Broadband

For years, fiber broadband providers relied on a clear strategy: build fiber-to-the-home (FTTH) networks, leverage federal funding programs, and focus primarily on residential subscribers. Fiber-optic technology, supported by major federal initiatives such as the Broadband Equity, Access, and Deployment (BEAD) program, has long been the cornerstone of broadband expansion efforts in the United States.

Today, however, the broadband industry stands at a pivotal crossroads. Emerging technologies, shifting federal funding priorities, and rapidly evolving market conditions require broadband providers to reconsider how best to ensure sustainable, economically viable network deployments.

While policy shifts under the Trump administration may lead federal programs toward technology-neutral approaches, fiber remains unmatched as the preferred foundational broadband infrastructure. Its unique characteristics—including virtually unlimited bandwidth, inherent redundancy options, robust security, symmetrical speeds, and reliability—make fiber indispensable for ensuring the long-term economic health and technological competitiveness of any region.

## Shifting Federal Funding Priorities

Most recently the BEAD program, and similar federal broadband initiatives of the recent past, strongly favored fiber deployments, emphasizing fiber's superiority for broadband expansion. However, today's discussions indicate a shift toward greater technological flexibility. Programs like the Capital Projects Fund (CPF), administered by the U.S. Treasury, already permit funding of alternative technologies such as wireless and satellite-based services.

Similarly, challenges experienced with the Rural Digital Opportunity Fund (RDOF), initially fiber-focused, have generated discussions about embracing alternative solutions more broadly.

Despite these funding changes, fiber-based infrastructure remains uniquely positioned to fulfill broadband's long-term promise by serving diverse subscriber types and stabilizing the financial viability of deployment projects. Policy makers and ISPs must recognize fiber's irreplaceable role as essential broadband infrastructure for long-term growth and innovation.

## Emerging Access Technologies and Competitive Dynamics

The broadband landscape now includes significant new competitors utilizing alternative access technologies. Low Earth Orbit (LEO) satellites, particularly SpaceX's Starlink, have rapidly captured

subscribers in residential markets previously targeted by terrestrial fiber providers. With more than two million global subscribers, Starlink demonstrates satellite broadband’s viability in serving rural and remote customers quickly.

Meanwhile, 5G Fixed Wireless Access (FWA) solutions from major carriers like Verizon and T-Mobile have rapidly expanded broadband coverage to suburban and rural areas, challenging fiber’s market share in certain segments due to quicker deployment times and lower initial capital expenditures.

However, neither LEO satellites nor 5G FWA represent long-term replacements for fiber infrastructure. Instead, fiber ISPs have opportunities to strategically *partner* with these wireless and satellite providers, creating complementary solutions that benefit all stakeholders. Fiber backhaul remains critical for supporting these wireless technologies, reaffirming fiber’s essential infrastructure role.

Further, in the “total cost of ownership” analysis, over the useful life of the asset, *none of them* beat fiber’s efficacy.

### Cost Efficiency: Access Technology Comparison

Fiber’s long-term economic superiority is evident in the following comparative analysis of operating costs per Mbps, owing partly to the more-than-double useful life of fiber as compared to 5G and LEO:

Technology	Estimated Long-term Monthly Operating Cost per Mbps
Fiber-to-the-Home (FTTH only)	\$0.50 - \$1.00 per Mbps
5G Fixed Wireless (FWA)	\$0.80 - \$1.50 per Mbps
LEO Satellite (Starlink)	\$1.50 - \$3.00 per Mbps

*(Note: These figures are illustrative estimates based on industry reports and may vary depending on specific deployment scenarios and market conditions.)*

These figures illustrate fiber’s unmatched cost efficiency and sustainability for long-term deployments, reinforcing its strategic importance as core broadband infrastructure. Further, If the fiber deployment is mixed-use—meaning it simultaneously serves residential subscribers, businesses, institutions (such as healthcare, education, and government), and potentially supports wholesale or wireless backhaul—then the economics further improve... dramatically:

**Lower Cost per Mbps** - Because costs (deployment, operations, and maintenance) are spread across multiple subscriber types and revenue streams, the effective operating cost per Mbps decreases substantially.

**Greater Revenue Stability** - Diversification significantly reduces financial risk. If one subscriber type experiences economic fluctuations, the provider remains stable through revenues from other sectors.

**Enhanced Investment Return** - Mixed-use fiber networks can amortize initial capital expenses across a broader range of subscribers, improving financial sustainability. This model also becomes highly attractive to both public and private funding programs due to broader economic impact.

**Improved Utilization and ROI** - Serving multiple subscriber types maximizes fiber utilization. Enterprises typically pay higher service rates for dedicated bandwidth and higher-grade service-level agreements (SLAs), significantly boosting the revenue per fiber-mile deployed.

In summary, a mixed-use fiber network strategy is not only financially superior to a single-use residential deployment—it also positions the network as a critical, foundational infrastructure asset for long-term economic growth.

## Fiber Business Model Evolution: XR Optics, Type-B Protection, and AI

### Subscriber Diversification: Key to Financial Sustainability

Historically, broadband providers heavily focused on residential subscribers. With increased competition from wireless and satellite providers in this segment, however, fiber-based ISPs must diversify their subscriber base to achieve financial sustainability. Fiber networks inherently possess the capability to simultaneously support multiple high-value subscriber types, including enterprises, healthcare facilities, government agencies including public safety, and educational institutions.

By serving these diverse subscriber groups, ISPs distribute the substantial costs of fiber deployment over multiple revenue streams, enhancing financial stability and regional economic viability. Diversified subscribers also create resilient revenue models, reducing reliance on any single market sector.

### Hardening and Enhancing the Transmission Network

Fiber-optic technology itself continues to advance rapidly, further cementing its position as the preferred broadband infrastructure and improving its ROI. New technologies, particularly **XR optics**, significantly enhance active optical networking capabilities. XR optics technology provides coherent, point-to-multipoint connectivity, enabling ISPs to dynamically distribute extremely high capacities—up to 400Gbps—to enterprise customers over existing fiber infrastructure. XR optics reduces complexity, improves efficiency, and supports tailored enterprise-grade solutions previously too costly to deploy broadly.

In parallel, Passive Optical Networks (PON)—historically deployed primarily for residential broadband—have advanced significantly to speeds of 25-50 Gbps, making PON viable for small- and medium-sized businesses. To address the enhanced reliability demands of these commercial subscribers as well as those of public safety and healthcare, **Type-B protection** in PON networks has become an increasingly critical consideration, ensuring network resiliency, redundancy, and guaranteed service uptime, previously reserved for active Ethernet solutions.

Together, XR optics for active enterprise deployments and Type-B protection for high-speed PON networks provide fiber ISPs the ability to effectively serve a diversified subscriber base across multiple sectors, thereby enhancing their financial stability and competitiveness.

## **An AI-Driven Control Network: The New Frontier in Network Efficiency**

Amid the rise of LEO satellites, XR optics, enhanced PON technologies and 5G deployments, another critical evolution is reshaping broadband network economics: Network Management optimized through the use of Artificial Intelligence (AI). As broadband networks grow increasingly complex, the costs associated with managing and maintaining these networks also increase significantly. Network operators face challenges in efficiently allocating bandwidth, preventing outages, and reducing downtime.

Enter AI-driven network management—a game-changing approach to broadband service delivery. With AI, optical fiber networks are uniquely positioned for the transition from reactive problem-solving and management to proactive optimization. Machine learning algorithms can analyze massive amounts of data in real-time, predicting network congestion, identifying vulnerabilities before failures occur, and dynamically adjusting resources to maintain optimal performance.

AI also enables fiber ISPs to precisely forecast traffic patterns, automatically reallocating bandwidth to areas of greatest demand. This approach dramatically reduces the need for expensive over-provisioning, thereby decreasing both capital and operational expenses. By predicting network demands accurately, fiber-based broadband providers can significantly reduce their infrastructure costs while simultaneously improving customer experience.

Additionally, AI-powered predictive maintenance reduces costly service interruptions. Instead of reacting to failures, AI-driven fiber networks can continuously monitor performance metrics, detecting anomalies before they escalate. This allows providers to schedule repairs proactively, improving service reliability and customer satisfaction.

## **5G Partnerships: Opportunities Beyond Residential Broadband**

While fiber providers maintain their core focus on fiber deployments, strategic partnerships with 5G providers can open lucrative new opportunities beyond traditional broadband services. Specifically, three promising sectors—precision agriculture, vehicular technologies, and smart cities and infrastructure—benefit dramatically from 5G's unique capabilities.

- **Precision Agriculture:** 5G's low latency and high capacity enable IoT-driven smart farming. Real-time monitoring of soil conditions, automated machinery, and predictive analytics substantially boost agricultural efficiency and productivity. Fiber providers partnering with 5G operators can deliver robust, fiber-backed connectivity to rural farming communities.
- **Vehicular Technologies and Smart Transportation:** Connected and Autonomous Vehicles (CAVs) require ultra-low latency communication (V2V, V2I) only achievable through fiber-supported 5G networks. Smart traffic management, logistics optimization, and enhanced road safety all become viable through fiber-5G partnerships.
- **Smart Cities, Healthcare, and Public Safety:** Municipalities increasingly leverage fiber-backed 5G networks for critical applications such as telemedicine, real-time emergency response, and infrastructure monitoring. High-capacity fiber backhaul remains essential to fully realize 5G's potential in these mission-critical applications.

Through strategic partnerships rather than direct deployments, fiber ISPs can effectively capitalize on 5G's complementary capabilities without diluting their core focus on fiber infrastructure.

## Strategic Recommendations:

### For ISPs

To thrive amid disruption, fiber ISPs should adopt a clear strategic framework:

- Maintain fiber as their central infrastructure due to its unmatched capabilities, reliability, and long-term economic advantages.
- Embrace XR optics for advanced active enterprise services and deploy Type-B protection for enhanced PON reliability serving businesses.
- Deploy AI-based network management and fault isolation technologies for improved, dynamic grooming and network performance efficiencies.
- Seek strategic partnerships with LEO satellite and 5G providers to complement fiber infrastructure in rural and challenging geographic markets.
- Actively diversify subscriber bases to stabilize revenue streams and maximize fiber infrastructure's financial viability.

### For Investors:

- Focus on Future-Proofed Broadband Opportunities presented by fiber-based ISPs using financially and operationally disruptive emerging technologies and practices.
- Avoid funding ISPs with outdated business models focused solely on consumer broadband.
- Look for ISPs targeting business broadband, smart city networks, and industrial connectivity as well as consumer markets to ensure business case stability and sustainability.

### For Policymakers:

- Ensure funding programs support sustainable broadband growth by eliminating regulations that preclude serving all but consumers. A financially viable approach to broadband is to serve ALL potential subscriber types in an area. Approve applications based on their value to the community as a whole, while insisting that the project is not limited to, but serves all consumers.
- Promote a technology-neutral funding approach that considers LEO, fiber, and wireless access solutions. Encourage not only public-private partnerships to accelerate broadband deployment, but partnerships *between providers* using complimentary access technologies in order to enhance and ensure the benefits of broadband to the entire region.
- Focus on cost per Mbps and long-term operational viability when allocating funding.
- Eliminate the often-false differentiation between "last mile" and "middle-mile" in funding broadband. Broadband networks are flattening, and today's fiber networks can serve both

functions in a single cable, if not limited by funding restrictions. A network's value to a community extends far beyond directly "serving" a location. (e.g., Precision Agriculture).

## How Big Bang Broadband Can Help

Big Bang Broadband (BBB) offers expert guidance for broadband providers, investors, and policymakers navigating these complex changes. With decades of experience, BBB provides strategic consulting, broadband funding navigation, technology planning, and subscriber diversification strategies, ensuring sustainable, competitive broadband deployments.

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### About the Author

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