PRIORITY BROADBAND PROJECTS IN THE AI ERA

Statutory Mandates, Engineering Realities, and Long-Term Oversight Requirements Under the

Broadband Equity, Access, and Deployment (BEAD) Program

Abstract

This white paper examines the statutory, engineering, and economic foundations of Priority Broadband Projects (PBPs) under the Broadband Equity, Access, and Deployment (BEAD) Program, with a focus on the operational demands created by the AI era. It demonstrates that Congress intentionally embedded long-term scalability requirements in 47 U.S.C. § 1702(a)(2)(I) and that these requirements must be enforced throughout the ten-year performance period that begins when BEAD-funded networks are certified as operational.

The paper analyzes engineering realities that determine whether networks can satisfy the statutory mandate, explains the economic consequences of underbuilt infrastructure, and details the oversight responsibilities assigned to states by NTIA. It concludes by presenting the Priority Broadband Project Operational Framework developed by Big Bang Broadband LLC—a practical, standards-based compliance system that operationalizes federal requirements and provides states with a scalable mechanism to verify performance, enforce statutory obligations, and protect communities from long-term infrastructure deficiencies.

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DEDICATION AND ACKNOWLEDGEMENTS

Dedication

This work is dedicated to the communities across the United States that have waited far too long for broadband infrastructure capable of supporting their full economic, educational, medical, and civic potential. The BEAD program represents an opportunity to repair decades of structural disadvantage, and this white paper is offered in service of ensuring that the infrastructure built under this program delivers the long-term performance, scalability, and accountability that these communities deserve.

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Special appreciation is extended to the broadband engineers and operational experts who have spent their careers designing, testing, and maintaining the nation's networks. Their real-world experience grounds the statutory and policy analysis presented here and ensures that the solutions proposed in this white paper reflect practical, enforceable engineering realities rather than theoretical abstractions.

Gratitude is also expressed to the individuals and organizations who have participated in developing, evaluating, or refining the Priority Broadband Project Operational Framework. Their engagement has helped shape a compliance system aligned with federal law, engineering best practices, and the performance expectations of the AI era.

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EXECUTIVE SUMMARY

Artificial intelligence has become an immediate and defining force in the economic, institutional, and social activity of the United States. AI-enabled tools now shape the operations of households, businesses, hospitals, schools, governments, and public safety agencies. These applications depend on real-time inference, continuous upstream data transfer, predictable low latency, and stable concurrency. The arrival of the AI era is not speculative—it is a present operational condition, and it now intersects directly with the deployment of BEAD-funded broadband infrastructure.

Congress anticipated this convergence when it enacted the Priority Broadband Project (PBP) definition in the Infrastructure Investment and Jobs Act (IIJA). Under 47 U.S.C. § 1702(a)(2)(I), PBPs must (1) deliver reliable broadband service of at least 100/20 Mbps with latency not exceeding 100 milliseconds, and (2) "*easily scale speeds over time*" to meet the evolving connectivity needs of households and businesses and to support advanced services, including 5G, successor wireless technologies, and future capabilities. Congress further required that PBPs maintain this capability for the entire ten-year performance period beginning upon project certification, as reflected in NTIA's BEAD NOFO. These statutory and administrative requirements form the backbone of BEAD's long-term infrastructure mandate.

Engineering realities make this requirement unavoidable. A network can satisfy the statutory PBP definition only if it is engineered as an end-to-end system with scalable access, sufficient local transport, resilient aggregation, and upgradeable backhaul. AI-enabled applications already produce continuous, bidirectional, latency-sensitive traffic, making scalable engineering necessary to support the applications communities rely upon today—not merely those expected in the future. The requirement to maintain scalability throughout the performance period reflects these operational realities.

Economic consequences follow directly from these engineering truths. Communities whose networks cannot scale experience compounding disadvantages: reduced productivity, diminished institutional performance, business relocation, workforce decline, and loss of opportunity. These effects are not hypothetical—they are the observed consequences of inadequate digital infrastructure. The BEAD performance-period requirement exists to protect communities from exactly these long-term harms.

Oversight is the mechanism that converts statutory obligations into real-world outcomes. NTIA guidance makes clear that states must enforce ongoing performance requirements and ensure compliance throughout the ten-year period. Without structured, standards-based oversight, networks drift out of compliance, engineering assumptions go untested, and economic harm becomes inevitable.

The Priority Broadband Project Operational Framework created by Big Bang Broadband LLC provides a practical, standards-based enforcement structure aligned with these statutory and NTIA requirements. By requiring system-level testing, recurring compliance checkpoints, and independent evaluation by Professional Engineers, the Framework operationalizes the federal mandate and ensures that scalability is demonstrated throughout the performance period rather than assumed at turn-up.

The BEAD program represents one of the most consequential infrastructure investments of the century. Its success will not be measured solely by miles built or locations served, but by whether communities receive networks capable of supporting the AI-driven economy that already defines American life. Priority Broadband Projects are the legal and practical mechanism through which this purpose is fulfilled. Ensuring their long-term credibility is not an administrative detail—it is a responsibility owed to the communities these networks are being built to serve.

SECTION 1 — THE MOMENT OF INFLECTION

As the National Telecommunications and Information Administration (NTIA) accelerates approval of state BEAD Final Proposals, the program has reached a pivotal moment in its transition from planning to execution. This acceleration aligns with remarks from Secretary of Commerce Howard Lutnick, who stated publicly that BEAD funding would begin flowing before the end of the year **[1]**. With NTIA racing to complete remaining approvals and states preparing for the buildout phase, the real work now begins: ensuring the **statutory credibility** of Priority Broadband Projects (PBPs), as defined under the Infrastructure Investment and Jobs Act (IIJA).

Congress imposed a dual-prong definition for PBPs under 47 U.S.C. § 1702(a)(2)(I):
(1) the ability to provide reliable broadband service of at least 100/20 Mbps with latency less than or equal to 100 milliseconds **[2]**, and
(2) the obligation to "*easily scale speeds over time*" to meet evolving connectivity needs of households and businesses and to support future advanced services **[3]**.

This statutory mandate is not optional and applies throughout the ten-year performance period that begins after project certification **[4]**.

The urgency of this requirement is heightened by the fact that BEAD-funded construction is occurring during the very period in which AI-driven applications are being adopted at scale. AI-enabled tools—ranging from real-time inference systems to latency-sensitive analytic applications—already influence residential, commercial, educational, and institutional workloads. These are not future expectations; they are present operational realities. BEAD networks must therefore be engineered from inception to support the connectivity profile of the AI era, not the streaming-era assumptions of prior decades.

But while the moment carries genuine optimism, it carries a parallel warning:
the long-term credibility of BEAD-funded infrastructure will depend entirely on whether PBPs are continually assessed, audited, and enforced in accordance with the statutory scalability requirement. If states or subgrantees drift into the familiar habit of designing networks to pass today's speed test rather than to maintain functional scalability over the full performance period, entire regions risk being locked out of the AI-driven economy for a decade or more.

This is the danger Congress sought to prevent—and the obligation BEAD now requires states to uphold.

SECTION 2 — WHY AI DEMANDS A DIFFERENT CLASS OF BROADBAND INFRASTRUCTURE

Artificial intelligence is now a primary driver of network demand, reshaping how households, businesses, institutions, and public agencies use broadband. AI-enabled applications rely on real-time inference, sustained bidirectional data transfer, and predictable low-latency pathways. These requirements are already influencing broadband behavior across access networks, aggregation layers, and backhaul systems. The transition to an AI-dependent connectivity ecosystem is not theoretical—it is well underway.

Traditional broadband frameworks were designed for an era dominated by web browsing, video streaming, and modest upstream activity. But AI-enabled tools—including real-time diagnostics, language agents, video analytics, distributed data processing, and sensor-driven automation—depend on performance characteristics that exceed the expectations embedded in prior eras of network design. These include sustained upstream capacity, deterministic latency, low jitter, and the ability to support concurrent, continuous workloads. These performance demands correspond directly to the expectations Congress encoded in the Priority Broadband Project definition under 47 U.S.C. § 1702(a)(2)(I), which requires both baseline performance and the ability to "*easily scale speeds over time*" to meet evolving connectivity needs **[5]**.

The operational pressures introduced by AI make this statutory obligation immediately relevant. Households now use AI-enabled tools that require sustained upstream throughput and responsive inference cycles. Businesses increasingly depend on AI-supported workflows for customer interaction, logistics, analytics, and production. Hospitals rely on AI-driven imaging and diagnostics that collapse without stable low-latency connections. Schools employ AI-assisted tutoring, accessibility tools, and adaptive learning systems that place continuous demands on network responsiveness. These environments illustrate why networks must be capable of supporting the connectivity requirements of the AI era from the moment they enter service.

AI also changes the geography of computation. Many inference workloads now operate on premises, at the edge, or in near-edge compute environments, requiring stable, low-latency connections between user devices and localized compute resources. These conditions amplify the need for scalable access networks and robust local transport. They also highlight why Congress obligated PBPs to support "*advanced services*" such as 5G, successor wireless technologies, and future technologies yet to emerge **[6]**. AI is precisely the kind of "advanced service" this statutory language anticipated.

Artificial intelligence is now the single most important source of incremental broadband demand. Its requirements are not future concerns—they are present conditions. If BEAD-funded networks are not designed to accommodate these realities from the outset, they risk becoming obsolete before construction is complete. And because PBPs are legally required to scale throughout the performance period, failing to engineer networks for the current AI era demand profile contradicts the core statutory intent of the BEAD program. The statute requires networks capable of supporting the applications households and businesses rely upon today and those that will continue to evolve throughout the ten-year performance period.

SECTION 3 — THE STATUTORY FRAMEWORK: WHAT CONGRESS ACTUALLY REQUIRED

The statutory obligations that define a Priority Broadband Project (PBP) did not emerge accidentally or ambiguously. Congress created a precise, forward-looking mandate within the Infrastructure Investment and Jobs Act (IIJA) to ensure that BEAD-funded networks would remain viable and scalable across a ten-year operational period. Congress understood that broadband infrastructure must support the continuing connectivity needs of communities and that networks built today must remain functional for a decade after certification. These obligations appear in 47 U.S.C. § 1702(a)(2)(I), enacted through Public Law 117-58 **[7]**.

Under this statutory definition, PBPs must satisfy two separate requirements. First, they must be capable of providing reliable broadband service of at least 100 Mbps downstream and 20 Mbps upstream with latency not exceeding 100 milliseconds **[8]**. Second, they must be constructed such that the resulting network "*can easily scale speeds over time*" to meet the evolving connectivity needs of households and businesses and to support the deployment of 5G, successor wireless technologies, and other advanced services **[9]**. Congress did not treat scalability as optional. Both prongs apply concurrently, and together they form the legal foundation upon which BEAD-funded PBPs must be engineered, tested, and maintained.

The statutory context further clarifies Congress's intent. The IIJA was enacted at a time when device density, application complexity, and user-side demand were all accelerating rapidly. Cloud computing, edge processing, and AI-enabled applications were expanding in real-world adoption, and Congress understood that these technologies would place sustained, bidirectional pressure on broadband networks. Rather than specifying particular technologies or architectures, Congress required that PBPs remain capable of supporting "future connectivity needs" throughout the performance period **[10]**. The statute therefore embeds a technology-agnostic mandate aimed at ensuring that BEAD networks do not become obsolete or undersized as the AI era emerges.

A critical dimension of the statutory mandate is often overlooked: the obligation attaches to the functioning **network**, not merely to the BEAD-funded components. The statute requires that the "*network built by the project*" must be capable of maintaining scalable performance **[11]**. Nothing in the IIJA supports the interpretation that scalability applies only to new access plant. If a subgrantee relies on existing local transport, aggregation, or middle-mile segments to support a PBP, those segments must not impair the project's ability to meet its statutory obligations. If they do, the provider remains responsible for upgrading them to achieve compliance. Design choices cannot override federal law, and the statute does not permit partial compliance.

The BEAD NOFO further reinforces this requirement by establishing a **ten-year performance period** beginning once the project is certified as operational **[12]**. During this period, the subgrantee must maintain the network's ability to satisfy both prongs of the statutory definition. A network that meets the requirement at turn-up but lacks economical upgrade paths for the ensuing decade is not compliant. Across a ten-year span—typically two full refresh cycles for access electronics, aggregation gear, and backhaul capacity—usage patterns evolve, device capabilities increase, AI-enabled applications intensify, and performance expectations rise. Congress designed the PBP definition to ensure that BEAD-funded networks would remain aligned with these realities.

This long-term obligation makes periodic verification essential. A network cannot be presumed to maintain compliance across an entire decade without structured testing. BEAD guidance and NTIA Frequently Asked Questions documents emphasize that states must evaluate the ongoing performance of BEAD-funded infrastructure and enforce compliance expectations throughout the lifecycle of the award **[13]**. Long-term functionality must therefore be demonstrated through regular, standards-based evaluation. Reliance on unverified assumptions would not satisfy the statutory purpose of the PBP classification.

The AI era makes these requirements even more relevant. Although the IIJA does not mention AI explicitly, the scalability prong clearly anticipates the types of demands introduced by AI-enabled applications: continuous upstream load, real-time inference behavior, and sensitivity to latency and jitter. These demands are already emerging across homes, businesses, and public institutions. A network that cannot support them during its own buildout or early operational phase fails the statutory intent of the PBP definition.

Congress ultimately structured the PBP definition to ensure that BEAD-funded networks deliver long-lived, scalable infrastructure consistent with current and evolving technological needs. Dual-pronged performance obligations, a decade-long performance period, and the requirement for continuous compliance collectively create a statutory framework designed to protect communities from underbuilt or rapidly obsolete networks. The arrival of AI simply underscores the accuracy and foresight of Congress's design.

SECTION 4 — ENGINEERING REALITY: WHAT SCALABLE INFRASTRUCTURE ACTUALLY REQUIRES

Statutory obligations alone do not ensure that a Priority Broadband Project will remain viable over the ten-year performance period that begins once a network is certified as operational **[14]**. The law defines the requirement, but engineering practice determines whether a network can sustain the load, reliability, latency, and concurrency pressures that households, businesses, and institutions already generate in the AI era. This is where the full weight of the statutory definition becomes operational: networks built merely to satisfy a momentary performance threshold cannot fulfill Congress's mandate. Only systems engineered for end-to-end scalability can satisfy the dual-prong requirement established under 47 U.S.C. § 1702(a)(2)(I) **[15]**.

In engineering terms, scalability is not a projection or an aspiration; it is a continuous operational property. A network is scalable only if it can increase capacity, improve concurrency handling, and maintain predictable latency as user-side demands grow over time. This is why Congress required that PBPs "*easily scale speeds over time*" and support evolving household, business, and advanced-service needs **[16]**. Scalability must be feasible, economical, and aligned with the rate of real-world technological evolution. Because AI-enabled systems already depend on stable upstream performance and low-latency inference paths, scalable engineering is not preparation for future use—it is necessary to support the applications communities rely upon today.

Engineering realities underscore the importance of evaluating the network as an integrated system rather than an assembly of isolated components. Access-layer performance cannot be meaningful if it is constrained by insufficient local transport, oversubscribed aggregation, or inadequate backhaul. The statutory reference to the "*network built by the project*" confirms that the obligation applies to the full operational path **[17]**. If any segment of the network cannot maintain scalable performance under real-world conditions, the PBP fails to satisfy the statutory requirement regardless of how well the last-mile segment performs in isolation.

AI era traffic patterns make these constraints more pronounced. Modern AI applications generate continuous bidirectional load, depend on real-time inference cycles, and are sensitive to jitter and latency variations. Deterministic latency—latency that remains stable and predictable under varying load—is increasingly treated as a design requirement in real-time networked systems, as recognized by standards bodies including ITU-T **[18]**. When inference occurs on premises or at the network edge, latency budgets shrink even further, and any bottleneck along the access, aggregation, or backhaul path can impair the application's operation. These pressures are present now, not emerging in the future.

The ten-year performance period established by NTIA requires that networks remain aligned with this evolving environment throughout at least two complete upgrade cycles **[19]**. Over such a period, customer devices become more capable, institutional workloads expand, and real-time applications grow more sophisticated. Architectures that incorporate standards-aligned upgrade paths—such as wavelength expansion in optical systems, extended-spectrum upgrades in DOCSIS, and densification strategies in fixed wireless—can maintain compliance across these refresh cycles. Architectures with limited headroom or without economical upgrade paths cannot.

In practical terms, the scalability prong of the PBP definition acts as an engineering filter. Fiber systems with adequate strand counts and standards-based optical roadmaps can expand capacity predictably. DOCSIS networks engineered for full-duplex and extended-spectrum operation can scale effectively if supported by adequate backhaul. Fixed wireless systems require disciplined spectrum management, continuous backhaul improvement, and appropriate densification. Low Earth Orbit (LEO) systems must demonstrate that constellation size, ground segment capacity, and spectrum availability can expand in tandem with usage patterns. The statute does not prohibit any of these technologies, but it requires each to maintain functional scalability under real-world conditions for the duration of the performance period.

For these reasons, engineering assessments under the PBP definition must evaluate the performance of the entire end-to-end system. Tests taken only at the ONT, the gateway, or a radio head do not reveal whether the network is capable of sustaining utilization, concurrency, and latency performance throughout the operational path. Standards-based performance verification—drawing from ITU-T, IEEE, IETF, CableLabs, and 3GPP methodologies—is essential for determining compliance **[20]**. Scalability cannot be certified based on isolated component performance; it must be demonstrated across the complete operational environment.

Taken together, these engineering realities show that the PBP definition functions exactly as Congress intended. It requires networks built today to support the operational realities of the AI era and to remain viable across a decade of technological evolution. The statute's dual-prong structure, combined with the ten-year performance obligation, ensures that PBPs are engineered not as static systems, but as continuously scalable infrastructure. Scalable engineering is therefore not optional—it is the only means by which a network can satisfy federal law and meet the needs of the communities it serves.

SECTION 5 — ECONOMIC CONSEQUENCES: WHAT HAPPENS WHEN NETWORKS CANNOT SCALE

The economic consequences of inadequate broadband are well understood in general terms, but the consequences of networks that cannot scale—particularly during the AI era—are more significant and less widely recognized. Under the BEAD program, the central question is not merely whether a community receives broadband infrastructure, but whether the infrastructure it receives is capable of supporting the connectivity demands already present in households, businesses, and institutions. This obligation is defined not only by engineering necessity but by federal law. The requirement that PBPs "*easily scale speeds over time*" to meet evolving connectivity needs is embedded directly into the statutory definition under 47 U.S.C. § 1702(a)(2)(I)(ii) **[21]**.

Economic activity across the United States increasingly depends on AI-enabled systems that require sustained upstream capacity, real-time inference, and stable, low-latency connections. Hospitals rely on AI-assisted diagnostics, imaging workflows, and clinical decision support systems that depend on responsive, bidirectional connectivity. Manufacturers incorporate computer vision, robotics, predictive analytics, and distributed control systems into production lines, all of which rely on continuous data movement. Local governments use AI-supported translation, accessibility tools, workflow automation, and public safety modeling to meet rising service demands. Schools employ AI-enabled tutoring and adaptive learning systems, and small businesses rely on AI-assisted forecasting, inventory control, customer interaction, and e-commerce automation. These examples illustrate that scalable broadband infrastructure is not a luxury—it is a prerequisite for functional participation in the modern economy.

When networks cannot scale, the economic effects compound rapidly. Businesses that rely on modern tools find that they cannot operate reliably and often relocate to regions where digital infrastructure supports their needs. Local firms that might otherwise modernize remain constrained by limited upload capacity and unpredictable latency. Productivity gaps widen between regions with scalable networks and those without them. Skilled workers—particularly remote and hybrid workers who depend on stable, high-quality connectivity—migrate to more capable markets, reducing local tax bases and weakening workforce potential. The inability to support AI-enabled operations deprives communities of opportunities for local business growth and new enterprise formation.

The consequences extend to public services. Communities with inadequately scalable networks experience diminished access to digital public services that increasingly rely on AI-enabled analytics and real-time interaction. Emergency response systems dependent on predictive modeling and live data ingestion cannot operate effectively under conditions of congestion or jitter. Telehealth systems fail when upstream throughput collapses under load, limiting access to healthcare. Educational institutions fall behind in adopting modern tools that depend on stable network performance. These disparities increase inequality and limit the ability of underbuilt regions to keep pace with advancing national standards.

From the perspective of state and local governments, the economic divergence caused by underperforming infrastructure can become self-reinforcing. Regions with scalable networks attract businesses, investment, and skilled workers; regions without them experience stagnation or decline. Public infrastructure becomes more expensive to support because it must serve a community that is not growing economically. The BEAD NOFO underscores the importance of building networks that comply with statutory performance expectations throughout the entire ten-year performance period **[22]**—a requirement that protects communities from being locked into low-growth trajectories by underbuilt infrastructure.

The rise of AI amplifies these dynamics. Because AI-enabled applications rely on sustained upstream load, predictable latency, and stable concurrency, networks that cannot support these behaviors become bottlenecks that immediately constrain economic potential. A region may technically be "served" according to legacy speed-test criteria, but it is economically disadvantaged if its infrastructure cannot sustain the performance required by AI-enabled households, businesses, and institutions. This is precisely the long-term harm the PBP definition was crafted to prevent.

Viewed this way, the scalability requirement embedded in the statute is not simply a technical expectation. It is an economic safeguard designed to ensure that BEAD investments result in infrastructure that supports—not undermines—the growth and competitiveness of the communities they were meant to serve. A PBP that cannot sustain the connectivity requirements of the AI era throughout the ten-year performance period does more than fail legally; it impairs the economic foundation upon which communities rely.

SECTION 6 — OVERSIGHT, COMPLIANCE, AND THE ENFORCEMENT ARCHITECTURE

The statutory framework governing Priority Broadband Projects establishes clear performance expectations, but the statute does not enforce itself. Long-term scalability, continuous performance, and the ability to support evolving connectivity needs throughout the ten-year performance period must be demonstrated through ongoing testing and verification, not assumed. Oversight is therefore not a supplemental aspect of the BEAD program; it is central to fulfilling the statutory obligations imposed under 47 U.S.C. § 1702(a)(2)(I) **[23]**.

Oversight must begin at the design stage. Subgrantees' engineering plans must demonstrate not only the ability to meet baseline performance but also the capacity to support scalable operation for the entire ten-year performance period that begins upon project certification, as required by NTIA **[24]**. This includes showing that access, local transport, aggregation, and backhaul components all possess viable, economical upgrade paths aligned with recognized technical standards. Scalability is not theoretical; it is defined by how real networks behave under real usage conditions.

Once a network is built, compliance cannot rely on unverified claims. Subgrantees must maintain performance throughout the full performance period, satisfying the statutory requirement to support evolving household, business, and advanced-service needs **[25]**. This obligation cannot be met through marketing assertions or speed-test snapshots. It must be demonstrated through standards-based testing that reflects actual load, typical usage patterns, and operational conditions in the AI era.

The ten-year performance period introduces additional complexity. Networks degrade, usage patterns evolve, equipment becomes outdated, and performance expectations increase. NTIA guidance underscores that states must monitor long-term compliance and enforce corrective actions when necessary **[26]**. Without structured oversight, networks drift out of compliance well before the performance period concludes. Periodic verification ensures that subgrantees remain accountable for maintaining the statutory performance obligations established by Congress.

Oversight also protects state broadband offices. When networks fail to perform as expected, households, businesses, and institutions often direct their complaints to the state rather than the provider. Without a structured, standards-based oversight system, states can become inundated with complaints that BEAD-funded networks are unreliable or unable to support the applications users depend upon. Proactive performance verification allows states to identify issues before they escalate, ensuring that BEAD investments deliver the service quality communities were promised.

To fulfill these requirements, state broadband offices need a structured enforcement architecture with clearly defined responsibilities, repeatable processes, and objective metrics. The BEAD NOFO specifies that subgrantees must meet ongoing performance requirements throughout the ten-year period and that states must ensure compliance **[27]**. Effective enforcement requires mechanisms for annual testing, periodic scalability reviews, transparent reporting, and corrective actions. Professional Engineers (P.E.s) play a crucial role by independently certifying compliance using recognized standards, validated projections, and verifiable performance data.

The Priority Broadband Project Operational Framework created by Big Bang Broadband LLC provides a practical, standards-based enforcement architecture aligned with these statutory and NTIA requirements. It requires system-level evaluation rather than component-level testing, ensuring that performance is measured across access, transport, aggregation, and backhaul. It defines methodologies grounded in internationally recognized standards (ITU-T, IEEE, IETF, CableLabs, 3GPP) and establishes recurring checkpoints—baseline certification, annual verification, and biennial scalability assessments—that correspond directly to the statutory mandate for ongoing performance.

The Framework also offers states flexibility. It can be adopted directly, adapted to state-specific conditions, or integrated into existing oversight systems. Its modular structure allows it to accommodate diverse technologies while maintaining uniform enforcement standards consistent with federal law. In this way, the Framework operationalizes the statutory PBP definition, ensuring that BEAD-funded networks remain capable of supporting the connectivity demands communities face throughout the entire performance period.

A Priority Broadband Project is not simply a build; it is a ten-year operational commitment enforceable under federal law. Oversight is the mechanism that ensures this commitment is met. Without structured, standards-based enforcement, the statutory obligations embedded in the PBP definition would lose their force. With it, states can ensure that BEAD funding results in infrastructure that is reliable, scalable, and aligned with the economic and technological realities of the AI era.

SECTION 7 — THE BBB PRIORITY BROADBAND PROJECT OPERATIONAL FRAMEWORK: STRUCTURE, ROLES, AND METHODOLOGY

The enforcement obligations embedded in the Priority Broadband Project definition require a structured, repeatable, and technically rigorous method for evaluating network performance throughout the ten-year performance period that begins upon project certification **[28]**. While the IIJA defines the statutory obligation under 47 U.S.C. § 1702(a)(2)(I) **[29]**, it does not prescribe how states are to implement ongoing verification. NTIA guidance makes clear, however, that state broadband offices bear responsibility for ensuring long-term compliance with BEAD performance requirements **[30]**. Without a structured operational framework, states would struggle to determine whether PBPs continue to satisfy statutory expectations as demand grows and technologies evolve.

The Priority Broadband Project Operational Framework created by Big Bang Broadband LLC is designed to meet this need. It translates statutory and NTIA requirements into a practical compliance system rooted in engineering best practices and standards-based evaluation. The Framework begins with the recognition that a PBP must be assessed as an end-to-end functional system. This aligns with the statutory requirement that the "*network built by the project*" must maintain scalable performance **[31]**. Accordingly, the Framework evaluates access, local transport, aggregation, and any BEAD-funded backhaul as components of a single operational path, ensuring that performance metrics reflect conditions users experience in real time.

Routine verification also serves an important public stewardship function. When networks fail to perform as expected, households, businesses, and institutions often direct their complaints not to the provider, but to the state broadband office. NTIA's guidance reinforces that states must maintain oversight throughout the performance period **[32]**. Without structured testing, states risk being overwhelmed by complaints that BEAD-funded networks are unstable, inconsistent, or unable to support the applications users rely upon. By conducting periodic, standards-based performance verification, states can identify and resolve issues early, ensuring that BEAD-funded infrastructure delivers the level of service communities were promised.

Central to the Framework is the role of the Professional Engineer. The P.E. serves as the independent technical authority responsible for certifying compliance at three stages: initial baseline certification upon project completion, annual performance verification, and biennial scalability assessment. Each of these checkpoints corresponds to a distinct dimension of the statutory mandate: initial operability, ongoing compliance, and long-term scalability across the ten-year performance period. The Framework ensures that these evaluations rely on standards-based methodologies from ITU-T, IEEE, IETF, CableLabs, and 3GPP, which provide objective and widely accepted testing practices **[33]**.

The Framework also defines how performance must be measured. Rather than relying on marketing claims or theoretical projections, it requires testing grounded in internationally recognized standards. Latency must be measured under realistic load conditions, not laboratory scenarios. Throughput must be assessed based on sustained performance, not burst rates. Concurrency testing must reflect aggregate traffic patterns generated by households, businesses, institutions, and public agencies—patterns that already include AI-enabled workloads. By enforcing these requirements, the Framework ensures that compliance is tied to observable behavior across the end-to-end system.

Because scalability is a continuous operational requirement—not a one-time condition—the Framework mandates periodic reassessment of upgrade paths, capacity forecasts, and equipment viability. Networks degrade, usage patterns shift, and device capabilities expand throughout the performance period. NTIA guidance emphasizes that states must respond to these changes and ensure ongoing compliance **[34]**. The Framework provides states with a structured method for enforcing this obligation, requiring subgrantees to maintain the upgradeability and performance necessary to satisfy the statutory requirements.

The Framework's modular design allows state broadband offices to adopt it directly, adapt it to local conditions, or integrate it into existing oversight systems. It supports diverse technologies—fiber, DOCSIS, fixed wireless, and LEO—while maintaining uniform enforcement standards consistent with federal law. In this way, the Framework operationalizes Congress's intent, ensuring that PBPs deliver the long-term scalability required to support the evolving needs of households, businesses, and advanced services throughout the ten-year performance period.

Ultimately, the Priority Broadband Project Operational Framework serves as the operational mechanism through which statutory intent becomes practical reality. It ensures that performance is demonstrated rather than assumed, that scalability is maintained rather than projected, and that states are equipped to enforce the obligations embedded in federal law. By grounding compliance in engineering best practices and standards-based evaluation, the Framework protects the value of BEAD investments and ensures that communities receive the scalable infrastructure they were promised.

SECTION 8 — INTEGRATING STATUTORY, ENGINEERING, AND ECONOMIC LOGIC: WHY OVERSIGHT PROTECTS COMMUNITIES

The statutory, engineering, and economic dimensions of the Priority Broadband Project definition are often discussed as separate considerations, but in practice they form a single, integrated system. Congress did not design PBPs as a performance benchmark alone. It created a legal mechanism under 47 U.S.C. § 1702(a)(2)(I) to ensure that communities receive infrastructure capable of supporting the continuing connectivity needs of households, businesses, and advanced services throughout a ten-year performance period **[35]**. This requirement is the foundation upon which all engineering and economic analysis must rest.

The statutory mandate provides the structural backbone of the BEAD program. The dual-prong definition requires PBPs to (1) provide reliable broadband service of at least 100/20 Mbps with latency not exceeding 100 milliseconds **[36]**, and (2) maintain the ability to "*easily scale speeds over time*" to meet evolving connectivity needs and to support advanced services, including 5G, successor wireless technologies, and future capabilities **[37]**. These obligations apply for the duration of the ten-year performance period that begins upon project certification **[38]**. Congress constructed this requirement precisely to prevent public funds from being used to build infrastructure that cannot support real-world connectivity demands as they evolve.

Engineering practice is the means by which this statutory intent becomes operational. A network can satisfy the statutory requirement only if it is engineered as an end-to-end system with scalable access, sufficient local transport, resilient aggregation, and upgradeable backhaul. Because AI-enabled applications already depend on low-latency, high-concurrency connectivity, the requirement to support “evolving” household and business needs is not future-oriented—it reflects current conditions. Engineering therefore serves as the interpretive lens that determines whether the statutory mandate is technically achievable for a given architecture.

Economic reality amplifies the consequences of failure. Communities with networks that cannot scale experience immediate and compounding economic disadvantages. Productivity gaps increase, businesses relocate or fail to modernize, institutions become less effective, and households lose access to tools that shape labor markets and education. These are not speculative outcomes; they are observable patterns in regions with inadequate digital infrastructure. The BEAD NOFO emphasizes that the purpose of the ten-year performance requirement is to ensure that infrastructure remains capable of supporting community needs over time rather than degrading into a new form of long-term disadvantage **[39]**.

Oversight is the function that binds these dimensions together. Without structured oversight, statutory requirements remain untested, engineering assumptions remain unverified, and economic outcomes deteriorate. NTIA guidance makes clear that states bear responsibility for ensuring ongoing performance compliance throughout the entire ten-year period **[40]**. A network that meets the requirement at turn-up but cannot maintain performance as usage grows is not compliant with federal law. Without regular evaluation, states risk discovering network deficiencies only after they have impaired households, businesses, and institutions.

The Priority Broadband Project Operational Framework created by Big Bang Broadband LLC operationalizes the integration of these elements. It converts statutory obligations into engineering processes, translates engineering assessments into compliance checkpoints, and ensures that economic protections are realized through continuous verification. By requiring system-level testing anchored in internationally recognized standards, the Framework ensures that PBPs can be evaluated on actual performance rather than on marketing claims or isolated component benchmarks. This structured approach enables states to enforce the statutory requirement and protect communities from the long-term harm caused by underbuilt infrastructure.

At its core, BEAD is an economic development program structured through statutory and engineering mandates. Networks that cannot sustain real-world performance in the AI era undermine the intent of Congress and compromise the economic prospects of the communities they were meant to serve. Oversight ensures that BEAD-funded networks fulfill their purpose: delivering scalable, reliable, and enduring infrastructure that supports the activities and opportunities households, businesses, and institutions rely upon today and throughout the entire ten-year performance period.

SECTION 9 — CONCLUSION: BUILDING FOR THE ECONOMY WE ALREADY LIVE IN

The BEAD program arrives at a moment when broadband infrastructure has never been more essential to the economic, social, and technological life of the nation. The convergence of widespread AI adoption, rapidly evolving user-side capabilities, and a statutory mandate requiring long-term scalability creates a unique opportunity—and an equally significant responsibility. Congress designed the Priority Broadband Project definition in 47 U.S.C. § 1702(a)(2)(I) to ensure that BEAD-funded networks would support the continuing connectivity needs of households, businesses, and advanced services across a ten-year performance period **[41]**. This requirement is the foundation upon which the success of the entire program depends.

AI-enabled systems are no longer speculative—they are embedded in the everyday operations of households, businesses, hospitals, schools, governments, and public safety agencies. These applications depend on real-time inference, continuous upstream transfer, predictable latency, and resilient concurrency. Networks must therefore support these conditions from the moment they enter service. Because the performance period begins upon project certification and extends for ten years **[42]**, BEAD-funded networks must be engineered for the connectivity profile of the present AI era, not the expectations of a prior generation of applications.

The statutory framework anticipates this need. PBPs must (1) deliver reliable broadband of at least 100/20 Mbps with latency less than or equal to 100 milliseconds **[43]**, and (2) "*easily scale speeds over time*" to meet evolving connectivity needs and support advanced services, including 5G, successor wireless technologies, and future capabilities **[44]**. These obligations apply throughout the ten-year performance period. The statute ties compliance directly to the capabilities of the "*network built by the project*," meaning the entirety of the operational path must remain scalable **[45]**. A network that satisfies the requirement at turn-up but cannot maintain performance as usage patterns evolve is not compliant with federal law.

Engineering practice makes the statutory requirement operational. Scalable networks must be evaluated and maintained as integrated systems with upgradeable access, transport, aggregation, and backhaul. Because AI-enabled applications are already dependent on continuous, bidirectional, latency-sensitive traffic, the requirement to support evolving connectivity needs reflects present-tense conditions. Engineering thus becomes the mechanism that determines whether the statutory mandate is technically achievable and sustainably enforceable.

The economic implications of failing to meet these requirements are immediate and compounding. Communities whose networks cannot scale experience widening productivity gaps, diminished institutional effectiveness, business relocation, declining workforce competitiveness, and loss of economic opportunity. These outcomes are not hypothetical—they are the observable effects of inadequate digital infrastructure. NTIA's performance-period obligations underscore the necessity of ensuring that BEAD-funded networks support community needs throughout all ten years of required operation **[46]**.

Oversight ties these dimensions together. Without structured, standards-based oversight, statutory obligations remain unverified, engineering assumptions degrade over time, and economic harm becomes inevitable. NTIA guidance affirmatively places responsibility on states to ensure ongoing compliance, evaluate long-term performance, and enforce corrective actions when needed **[47]**. Networks cannot be presumed to remain compliant throughout the performance period; they must demonstrate compliance on a recurring basis.

The Priority Broadband Project Operational Framework created by Big Bang Broadband LLC operationalizes this requirement. By translating statutory obligations into engineering processes, defining system-level performance testing, requiring independent evaluation by Professional Engineers, and establishing recurring compliance checkpoints, the Framework ensures that scalability is demonstrated rather than assumed. It provides states with a practical enforcement mechanism aligned with federal law and engineering best practices, protecting communities from the long-term consequences of underbuilt infrastructure.

The BEAD program is one of the most consequential infrastructure investments of the century. Its success depends not merely on the number of miles built or the number of locations served, but on whether the resulting networks remain capable of supporting the applications, services, and opportunities that define modern American life. That is the standard Congress set. That is the standard engineering reality demands. And that is the standard communities deserve.

In the end, BEAD's purpose is not only to connect the unconnected—it is to connect Americans to the economy we already live in. Priority Broadband Projects are the mechanism through which this purpose becomes real. Ensuring their long-term credibility is not an administrative detail—it is a commitment to the future of America's communities, and it must be honored with the rigor, foresight, and responsibility that this moment requires.

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ABOUT THE AUTHOR

David J. Malfara, Sr. is the Founder and Principal Consultant of **Big Bang Broadband LLC**, specializing in broadband network design, grant program compliance, and long-term infrastructure strategy. A **Senior Member of the Institute of Electrical and Electronics Engineers (IEEE)**, Mr. Malfara brings more than 45 years of executive-level experience in telecommunications, broadband engineering, and the operational launch of multiple network operating companies he helped build from inception. He has served **multiple times as a testifying subject matter expert in federal court and in formal proceedings before state public utility commissions**, bringing litigation-grade analytical rigor to broadband engineering, operational statutory interpretation, and long-term infrastructure compliance.

He is recognized nationally for his expertise in emerging BEAD **Priority Broadband Projects (PBPs)** and the statutory requirements embedded in **47 U.S.C. § 1702**, including scalability mandates, evolving performance obligations, and multi-year compliance standards. Mr. Malfara developed the **Priority Broadband Project Operational Framework**, one of the first practical mechanisms for auditing PBP performance and verifying compliance over the full ten-year statutory performance period. His framework is under active discussion with major broadband software platforms and infrastructure partners seeking to operationalize BEAD's long-term oversight requirements.

In addition to his engineering and policy work, Mr. Malfara serves on the **Local Technology Planning Team (LTPT)** for Marion County, Florida, advising county leadership on broadband deployment, infrastructure modernization, and the integration of **AI Era** requirements into public-sector planning. His research and analysis on AI Era networking demands, fiber scalability, and edge-compute readiness have informed discussions across the broadband industry, including fiber manufacturers, construction firms, data-center operators, and national broadband associations.

Mr. Malfara consults with public- and private-sector organizations seeking to build resilient, future-proof broadband networks aligned with federal law, engineering best practices, and the emerging performance requirements of the **AI Era**.