LF BROADBAND

Open, Observable, Intelligent

Building the Foundation for AI in Broadband

A White Paper from LF Broadband

June 2026

Contents

Executive Summary

Broadband operators are entering a new phase of network modernization. Fiber expansion continues across many markets, and current market analysis from Dell'Oro indicates that North America and Western Europe remain focused on XGS-PON as the principal next-stage PON technology even as operators balance modernization with capital discipline and uneven spending conditions.

Artificial intelligence is becoming increasingly relevant in that context, not because operators need AI for its own sake, but because they need better operational outcomes. In broadband, the strongest near-term AI use cases are practical ones: finding faults earlier, accelerating root-cause analysis, improving service assurance, optimizing capacity planning, and helping operations teams work faster and more consistently.

Yet AI does not become useful in broadband simply because a model is available. It becomes useful when the network is open enough to expose meaningful telemetry, observable enough to generate trustworthy operational data, and programmable enough to support bounded action. Closed, fragmented, and highly proprietary access environments make AI harder to deploy, harder to trust, and harder to scale.

That is where LF Broadband has a distinctive role. LF Broadband's work around VOLTHA and SEBA have created the foundational conditions that AI needs in real operator environments: multi-vendor abstraction, open interfaces, programmable control, and alignment with industry standards. VOLTHA is an open source project for PON broadband access that provides a vendor-agnostic abstraction layer, exposing abstract northbound APIs while integrating southbound with open source or vendor-specific OLT and ONU adapters. LF Broadband states that VOLTHA is in production with major operators including Deutsche Telekom, Türk Telekom, and Reliance Jio.

This paper argues that the future of AI in broadband will be determined as much by architecture and collaboration as by algorithms. The most credible path forward is not AI first, but foundation first: build the open, observable, standards-aligned broadband environment that allows AI to deliver real operator value.

AI IN BROADBAND: AT A GLANCE

WHY AI NOW IN BROADBAND

Rising network complexity
Cost pressure
Need for predictive operations

WHY OPEN SOURCE AND STANDARDS MATTER

Interoperability
Vendor neutrality
Deployable implementations

HIGHEST-VALUE USE CASES

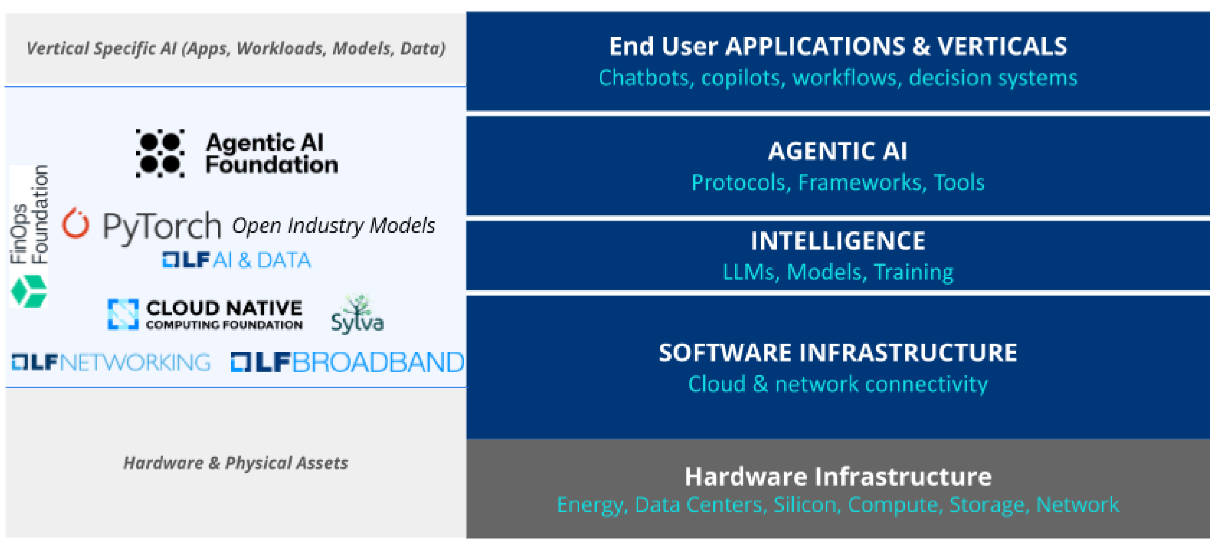
Predictive fault detection
Service assurance
Planning optimization
NOC copilots

WHAT OPERATORS SHOULD DO NEXT

Observability
Programmability
Bounded automation
Ecosystem collaboration

AI Across the Linux Foundation and Impact to Broadband

The opportunity before us is to define, collectively, in the open, the reference architecture for AI-native telecom infrastructure. Not AI bolted onto the side of a cloud stack, but AI as a first-class architectural concern: integrated into observability, woven into automation, governed by shared standards, and evaluated by common benchmarks. This effort is already underway. The LF Networking white paper “Architecting Autonomy: The Convergence of Agentic AI and Open Source Networking” (Joshipura, Tariq, Haiby, February 2026) proposes an Agentic AI Readiness Charter with ten architectural principles for building agentic-ready network applications, covering agent-native interfaces by design, intent as the primary abstraction, deterministic execution with governed autonomy, separation of reasoning and execution planes, first-class observability for agents, secure and auditable agent access, composable and discoverable capabilities, multi-domain coordination, backward compatibility, and open governance. These principles directly operationalize the four ecosystem collaboration pillars identified in Section 5.4 of the recent “AI and the Sylva Project’s Ecosystem” paper, and they explicitly position LF Broadband alongside Sylva, Nephio, ONAP, CAMARA, and SONiC as core LF Networking projects where agentic capabilities must be embedded. The paper also frames the dual transformation that Sylva enables: “AI for Networks” (agents that optimize and automate infrastructure) and “Networks for AI” (infrastructure optimized for distributed training and inference), both themes that run through the present document. The full paper is available at: **https://lfnetworking.org/architecting-autonomy-convergence-of-agentic-ai-open-source-networking/**. Both Sylva and MCP now live under the Linux Foundation. The standards bodies, ETSI, TM Forum, O-RAN Alliance, Broadband Forum and others are converging on closed-loop automation and intent-driven operations. The building blocks exist. What remains is the commitment to assemble them together, in the open, so that the next generation of autonomous telecom networks is built on shared foundations rather than proprietary silos. Putting LF Broadband in perspective with Linux Foundation Strategy for AI, here is a simple overview of projects across the Agentic AI ecosystem.

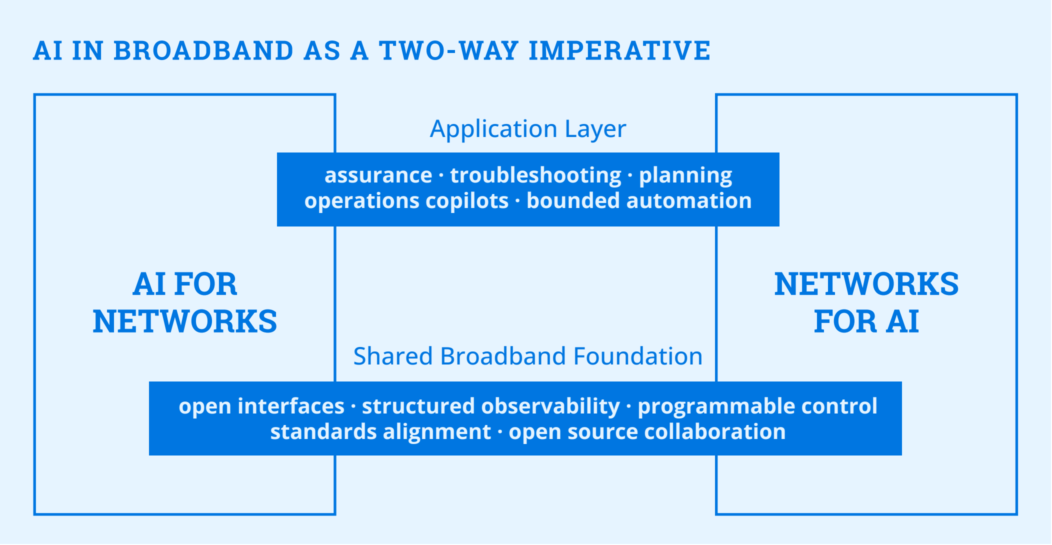


Introduction: Why AI, Why Now

The reason AI matters in broadband is not simply that it is the technology trend of the moment. It matters because access networks sit at the intersection of three structural changes. First, broadband operations are becoming more software-driven, more cloud-native, and more dependent on continuous orchestration across distributed environments. Second, operators are being asked to do more with tighter economic discipline, which raises the importance of automation, planning efficiency, and faster troubleshooting. Third, the services running over broadband are themselves becoming more intelligent and more demanding, which means the access network is under pressure both to support AI-enabled traffic patterns and to use AI internally to operate more effectively.

This is why the emerging industry distinction between AI for Networks and Networks for AI is useful. AI for Networks refers to the use of AI to improve assurance, remediation, lifecycle management, planning, and operations. Networks for AI refers to the need for network and infrastructure environments to adapt to new workloads, applications, and patterns of intelligence. In broadband, the most immediate opportunity lies in AI for Networks: using AI to help operators find issues earlier, correlate symptoms more accurately, improve customer experience, and make better engineering and operational decisions. But the broader context still matters, because the same open, programmable, and observable foundations that make broadband networks more manageable also make them better prepared for AI-driven services and future agentic workflows.

AI is no longer just an application layer add-on; it is becoming part of the architecture through which digital systems reason, act, and collaborate. For broadband, that does not mean jumping immediately to fully autonomous networks. It means recognizing that machine-consumable interfaces, structured observability, deterministic execution, and open-source collaboration are becoming prerequisites for the next phase of operations. In other words, the same foundations that enable trustworthy automation also enable practical AI.



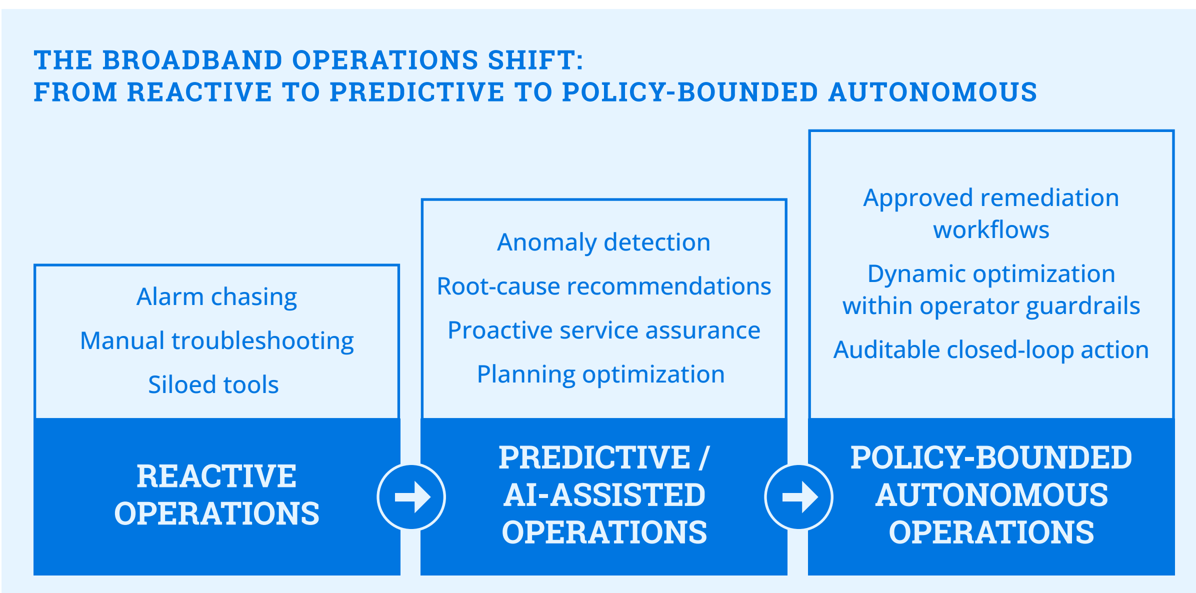
Seen through that lens, the use cases explored in this paper are not isolated experiments. They are the logical first applications of AI in an industry that already has rich telemetry, repetitive high-value workflows, strong requirements for auditability, and a growing need to turn data into action faster than human-only processes can manage. That is why predictive fault detection, service assurance, planning optimization, and bounded operations copilots rise to the top. They sit at the point where technical feasibility, operational value, and architectural readiness overlap.

1. Why AI Is Becoming a Broadband Priority

Broadband operators are under simultaneous pressure to expand capacity, modernize access infrastructure, improve customer experience, and control operating costs. That pressure is intensifying rather than easing. The broadband market is moving through a period in which fiber rollouts continue, XGS-PON remains the dominant technology focus in key developed markets, and spending patterns are uneven enough that operators must be highly selective about where they invest for the greatest impact.

At the same time, the operating model of broadband networks is changing. Broadband access is no longer just a matter of provisioning and monitoring physical infrastructure. It now involves software-driven control planes, multi-vendor device environments, cloud-based management, more demanding service-level expectations, and, in many cases, the need to correlate issues across the access network, customer premises equipment, and in-home Wi-Fi. That complexity creates a growing gap between the data operators collect and the amount of that data they can realistically interpret and act on using manual methods alone.

AI is gaining traction because it offers a way to close that gap. Properly applied, AI can help operations teams move from reactive to predictive modes of work. Instead of waiting for alarm storms or customer complaints to reveal a problem, operators can identify patterns earlier, correlate symptoms across domains faster, and respond more consistently. The practical appeal is straightforward: fewer avoidable outages, faster resolution times, better use of network assets, and improved customer experience.



That does not mean AI replaces engineering discipline. In broadband, AI is most valuable when it augments engineering and operations with better pattern recognition, more complete context, and faster execution. The strongest use cases are therefore not abstract demonstrations of intelligence. They are the ones tied directly to operational and business outcomes.

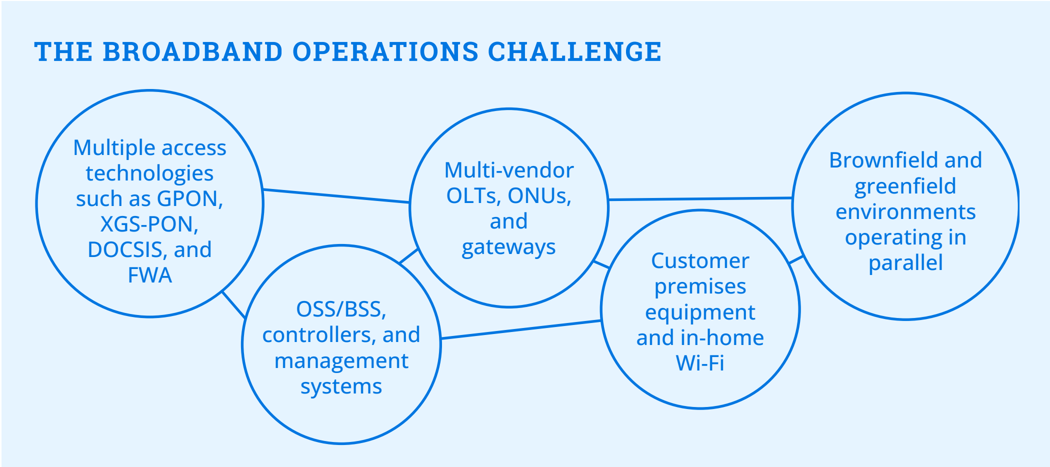
2. The Broadband Reality: Complexity, Cost Pressure, and Multi-Vendor Operations

Broadband networks are not becoming simpler. They are becoming more distributed, more software-driven, and more dependent on interoperability across vendors and domains. LF Broadband's own positioning reflects that shift clearly: open, disaggregated, software-defined broadband architectures are moving from concept to production reality because operators want flexibility, lower integration friction, and a way to avoid lock-in while still supporting brownfield and greenfield environments.

That complexity has several dimensions. One is technology diversity. Operators may need to support GPON, XGS-PON, DOCSIS, fixed wireless access, and increasingly sophisticated in-home Wi-Fi environments simultaneously. Another is lifecycle complexity. Access networks must be built, connected, provisioned, monitored, upgraded, and optimized on an ongoing basis, often without the luxury of starting from a clean sheet. A third is vendor heterogeneity. Operators frequently face inconsistent implementations of similar models and interfaces across OLTs, ONUs, controllers, and operations systems.

This is precisely the sort of environment in which AI can help, but it is also the sort of environment in which AI becomes difficult to operationalize if the underlying architecture is fragmented. AI models do not create consistency on their own. They depend on a control and data environment that makes network behavior legible and usable across multiple systems.

That is why the relationship between standards and open source is so important. Broadband Forum's WT-525 work is a bridge between CloudCO and SEBA and VOLTHA architectures, reducing integration risk and procurement friction while helping align standards with working implementations. The collaboration is a way to bring open standards and open source into closer harmony, particularly around architecture, interfaces, and operational flexibility.



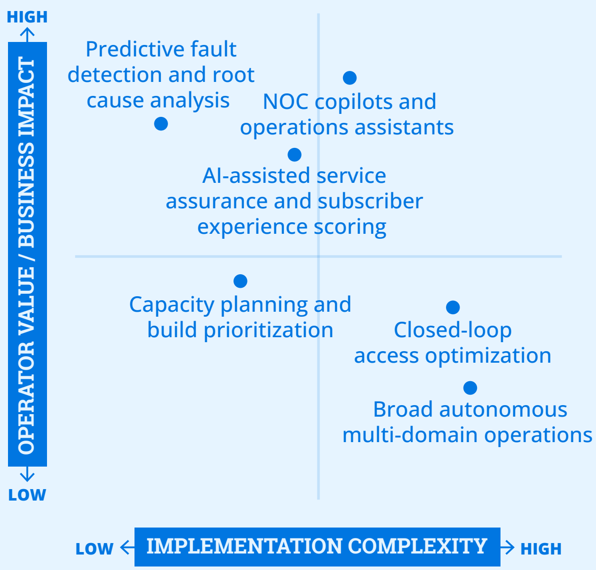
From an AI perspective, that matters because data models, interfaces, and abstraction layers determine how reusable analytics and automation can be. The more each environment is trapped in bespoke integrations, the harder it becomes to scale AI across real networks.

3. What AI Can Realistically Do in Broadband Today

The discussion around AI in telecom often jumps too quickly to fully autonomous networks. In practice, the strongest current use cases in broadband are more bounded and more operationally grounded.

One important area is predictive fault detection. Access networks produce a large volume of alarms, counters, and telemetry, much of which is difficult to interpret in real time through manual operations alone. AI can help identify unusual behavior, separate significant anomalies from background noise, and reveal early warning signs of service-affecting issues. It is possible to point to examples such as OLT optical drift, ONU misconfiguration, and interference-related conditions as useful targets for AI-driven anomaly detection and root-cause analysis.

WHERE AI CREATES THE MOST VALUE IN BROADBAND



Another important area is service assurance. Many broadband problems are not clean outages; they are degradations caused by subtle interactions among access conditions, device behavior, Wi-Fi performance, and service policies. AI can help by bringing those signals together into a clearer view of what the subscriber is actually experiencing and why.

A third area is operations support. Generative AI is often discussed in sweeping terms, but one of its most practical uses in broadband is as a constrained assistant for engineers and operations teams. Knowledge assistants, troubleshooting assistants, dashboard assistants, and artifact assistants support monitoring, troubleshooting, reporting, and workflow generation rather than taking unconstrained control of the network.

A fourth area is planning. AI can be valuable outside the NOC as well, particularly in capacity planning, build prioritization, and network design. Industry material increasingly points to digital twins, Geographic Information System-linked planning, and predictive modeling as ways to improve capital efficiency and long-term engineering decisions.

The common thread across these use cases is that they create value even before full closed-loop autonomy is introduced. They help operators make better decisions first. That is why they represent the most credible near-term path.

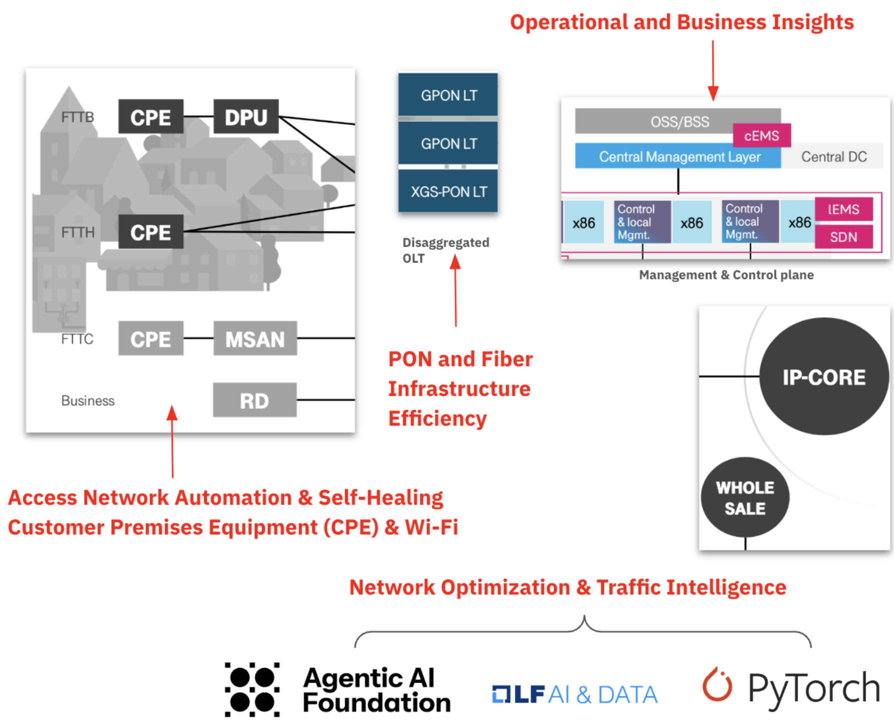
4. Use Case Spotlight: Predictive Fault Detection and Root-Cause Analysis

Predictive fault detection is one of the strongest near-term AI opportunities in broadband because it directly addresses uptime, repair efficiency, and OPEX. When an access issue develops, the operator is often confronted with a collection of symptoms rather than a single obvious cause. AI can help by identifying patterns across telemetry and alarm streams that would be difficult for humans to correlate quickly enough on their own.

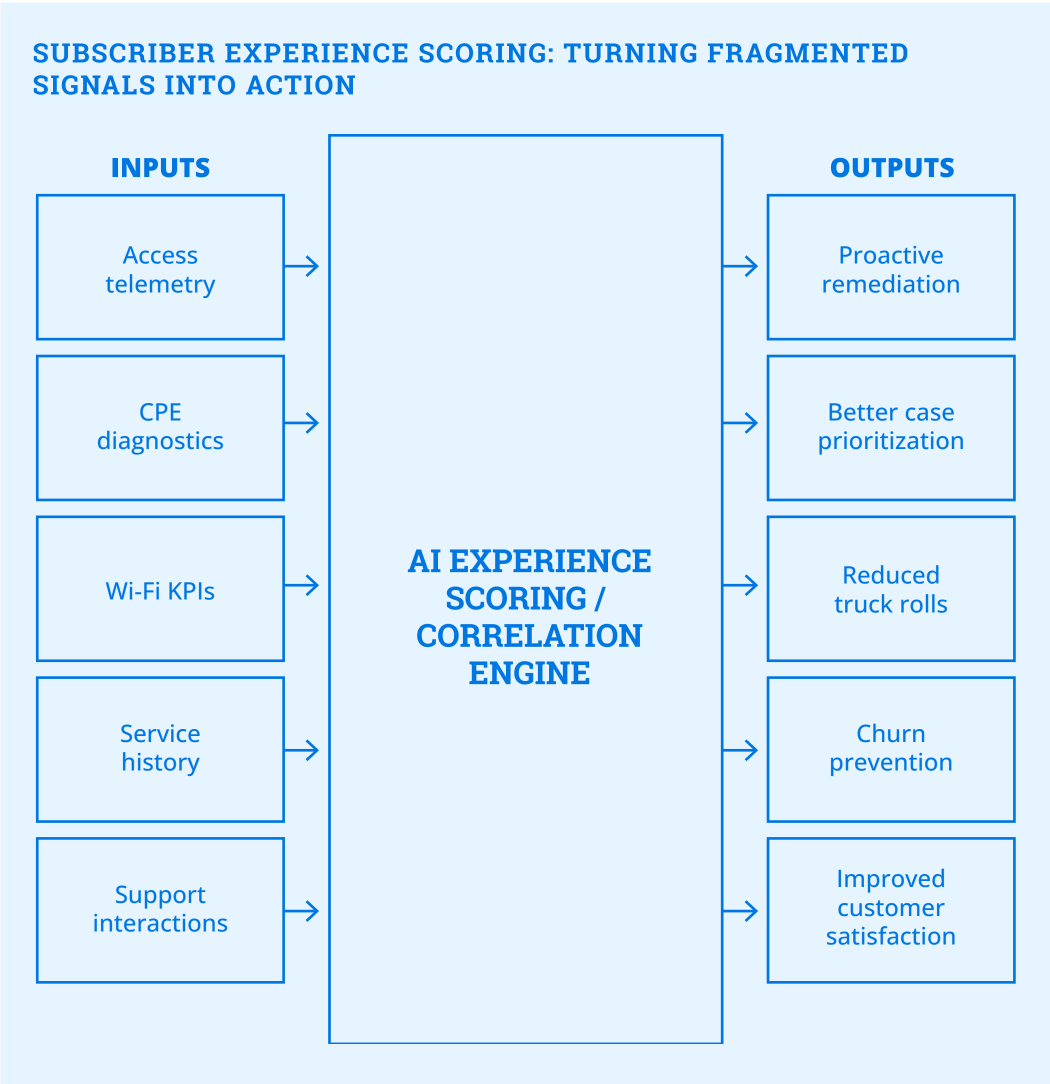
In practical terms, this can include recognizing abnormal optical trends, repeated ONU instability, provisioning inconsistencies, or clusters of issues linked to a shared channel termination or topology segment.

This use case is especially attractive because it can deliver meaningful value without requiring autonomous action. Even when AI is used only to narrow probable root causes, rank likely explanations, or recommend next steps, it can shorten incident resolution and reduce operational burden. The economics are favorable because operators often already collect much of the relevant data; the value comes from using it more effectively.

For LF Broadband, the larger lesson is architectural. Predictive fault detection works best when telemetry, topology, and device information can be interpreted consistently across vendors. Multi-vendor abstraction is not a nice-to-have here. It is a scaling requirement.



5. Use Case Spotlight: AI-Assisted Service Assurance and Subscriber Experience



A large share of broadband dissatisfaction is caused not by hard failures but by degraded experience. The user perceives slow internet or bad Wi-Fi, while the operator sees fragmented signals spread across access infrastructure, gateways, service history, and customer-premises conditions. AI can add value by synthesizing those signals into a more coherent view of subscriber experience.

Subscriber experience scoring is a concrete AI use case, involving the use of CPE telemetry, Wi-Fi data, and line metrics to generate real-time experience indices that can support churn reduction and better service outcomes. AI is a way to improve service quality, customer experience, and targeted operational response through better use of access and device data.

This matters because it turns observability into action. Operators can identify households or service areas with recurring degradation, prioritize support cases more intelligently, and intervene before dissatisfaction turns into churn or repeated support interactions. It is also one of the clearest examples of how AI can connect network operations to commercial outcomes.

The limiting factor is observability. To make this use case effective, operators need meaningful visibility into both access and in-home performance. Where that foundation exists, the business case can be strong.

6. Use Case Spotlight: Capacity Planning, Build Prioritization, and Digital Twin Analysis

Not all valuable AI in broadband is real-time AI. Some of the most durable benefits may come from better planning. Operators are making investment decisions in an environment shaped by changing technology cycles, uneven equipment spending, and long-term infrastructure commitments. Dell'Oro's current market outlook underscores that operators remain focused on FTTH expansion and XGS-PON evolution while navigating pauses and variability in spending patterns across geographies and product categories.

AI can improve planning by combining utilization data, subscriber trends, network inventory, demographics, GIS information, and other external inputs to identify where upgrades, buildouts, or targeted investment are most likely to create value. AI can be explicitly linked to network design, CAPEX planning, digital network twins, predictive maintenance, and the use of GIS and external datasets to improve business decisions.

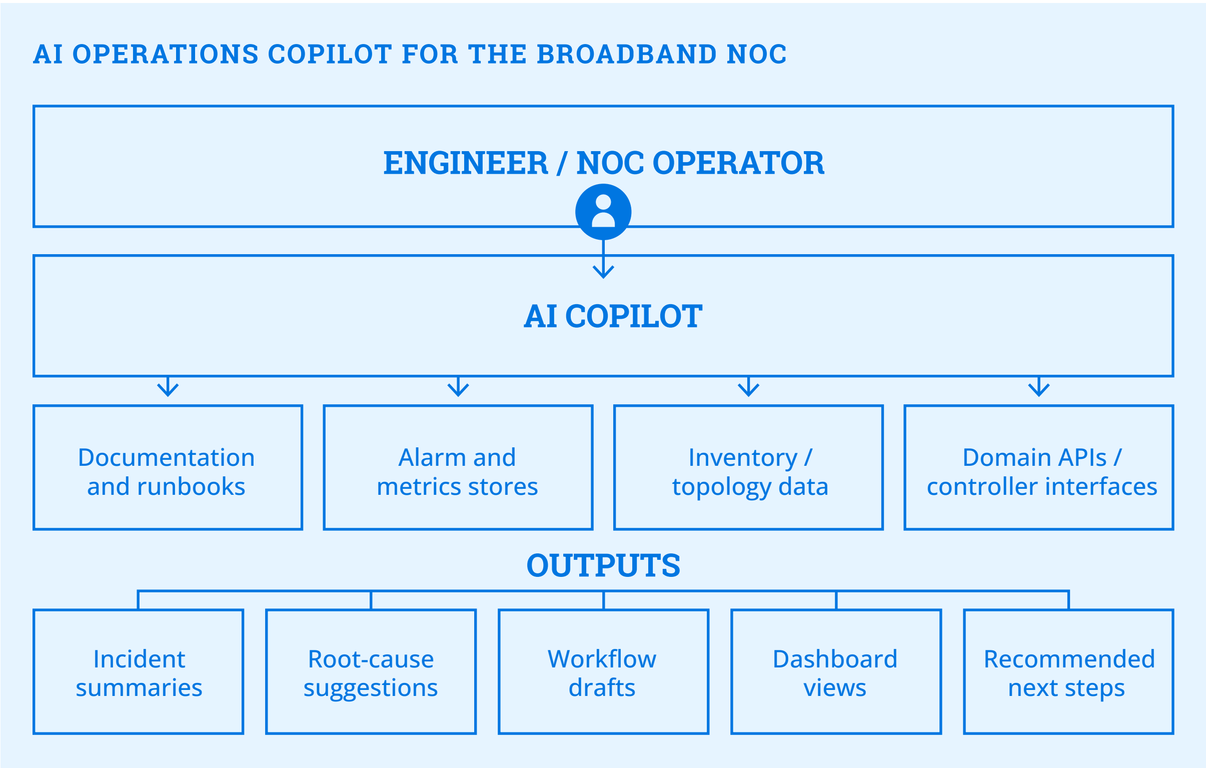
This is strategically important for two reasons. First, it can improve capital efficiency by helping operators prioritize where they build and where they defer. Second, it broadens the role of AI beyond operations into engineering, finance, and broader business planning. In that sense, AI becomes not only a network tool but a cross-functional decision-support capability.

This use case generally requires more data integration than fault detection, but it does not require high-risk autonomy. That makes it attractive as a medium-term step for operators that are building stronger data foundations.

7. Use Case Spotlight: AI-Enhanced NOC Assistants and Operations Copilots

Generative AI is often discussed as though it will directly run the network. In broadband, a more credible near-term role is the operations copilot: a bounded assistant that helps engineers search documentation, summarize incidents, analyze logs, answer operational questions, and generate workflow artifacts.

There is a set of assistive models including knowledge assistants, troubleshooting assistants, artifact assistants, and dashboard assistants which present an architecture in which language-driven workflows are grounded in documentation, structured data stores, operational metrics, and API-based interactions with live systems.



The appeal is obvious. An operations copilot can reduce search time, make institutional knowledge easier to access, and help teams move faster without requiring the operator to relinquish direct control over the network. It can also help narrow the skills gap by making complex environments easier to navigate for both experienced and newer staff.

The constraints are equally important. In broadband operations, a copilot must be grounded in authoritative data, constrained by permissions, and prevented from taking action beyond approved bounds. Deployed this way, it is not a novelty feature. It is a practical productivity tool.

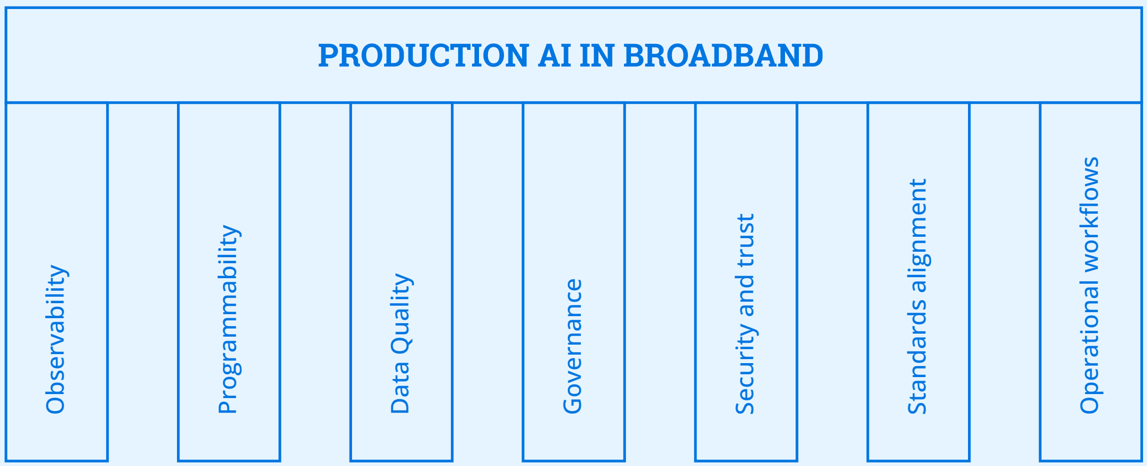
8. What Is Required to Move from Experimentation to Production

The biggest gap in AI for broadband is not a shortage of ideas. It is production readiness. Many use cases sound plausible in demonstrations. Far fewer can be deployed at scale in live, multi-vendor access networks with strong operator confidence.

For operators, the implication is straightforward: the path to broadband AI runs through better foundations. The more open, observable, and programmable the environment becomes, the more practical AI use cases become as well.

The first requirement is observability. AI needs reliable access to the underlying signals that describe network health and behavior, including alarms, performance metrics, topology, logs, inventory, and service context.

WHAT PRODUCTION AI IN BROADBAND REQUIRES

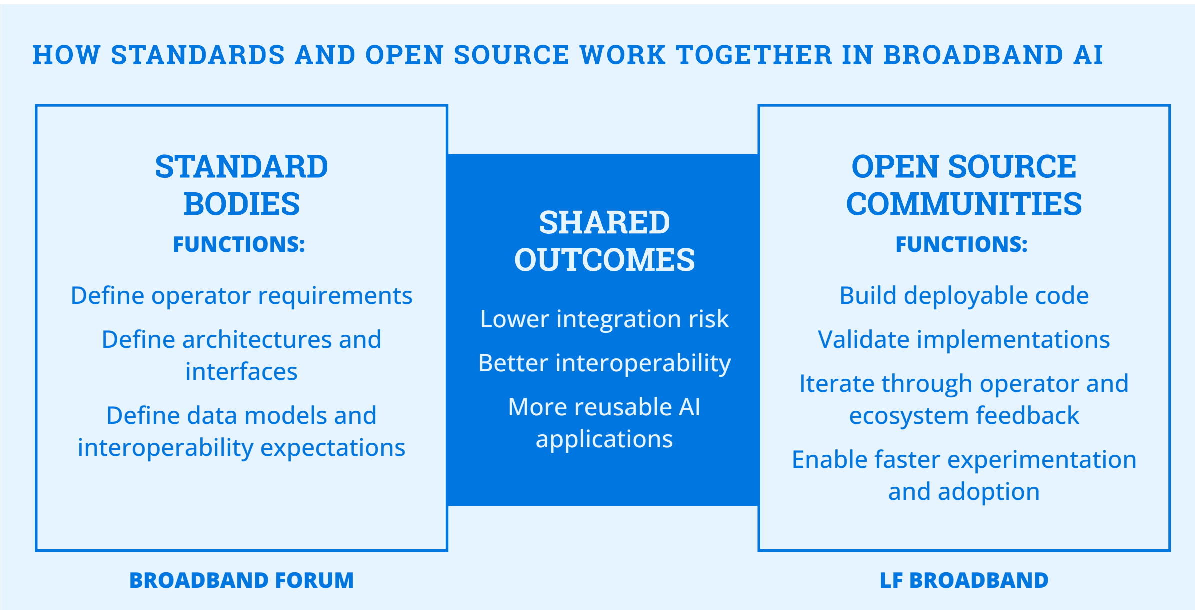


The second requirement is programmability. AI becomes much more useful when it can do more than observe. But bounded action requires deterministic interfaces, rollback logic, auditability, and clear policy around what actions are allowed. This is where LF Broadband's work is directly relevant. LF Broadband VOLTHA provides abstract northbound APIs that make the PON network appear as a programmable Ethernet switch to an SDN controller, while southbound device interactions are managed through vendor-specific OLT and ONU adapters.

The third requirement is governance. AI systems are only as reliable as the data they consume and the rules under which they operate. Practical concerns such as data readiness, security, privacy, trust, interoperability, cost, and change management are not secondary issues. They determine whether an AI capability can be used safely and economically in production.

9. Why Open Source and Standards Are Essential Enablers

Open source is not peripheral to AI in broadband; it is foundational. AI depends on access to usable data, interoperable control points, and the ability to operate across heterogeneous environments. Those conditions are much easier to establish in open, standards-aligned ecosystems than in closed proprietary stacks.



Open source matters first because it supports vendor neutrality. Analytics and automation become more reusable when they do not have to be rebuilt around each vendor's unique implementation details. It is important to emphasize multi-vendor control and management, support for both brownfield and greenfield environments, and a centralized management and SDN control model that reduces fragmentation.

Open source matters second because it accelerates practical collaboration. LF Broadband exists to turn shared operator needs into working code and real deployments. Standards bodies such as the Broadband Forum define requirements, interfaces, and data models; open source communities turn those into implementations that can be tested, improved, and operationalized. The intended model is complementary: standards and open source working together rather than competing with each other.

Open source matters third because trust and auditability become more important as AI moves closer to operations. Operators need to understand how systems behave, what data they rely on, and how decisions are translated into actions. Open architectures do not remove all risk, but they make inspection, testing, and ecosystem improvement substantially easier.

From the standpoint of broadband AI, then, open source is not merely a licensing preference. It is part of the operating model required to make intelligence scalable across real networks.

10. From AI Assistance to Policy-Bounded Autonomy

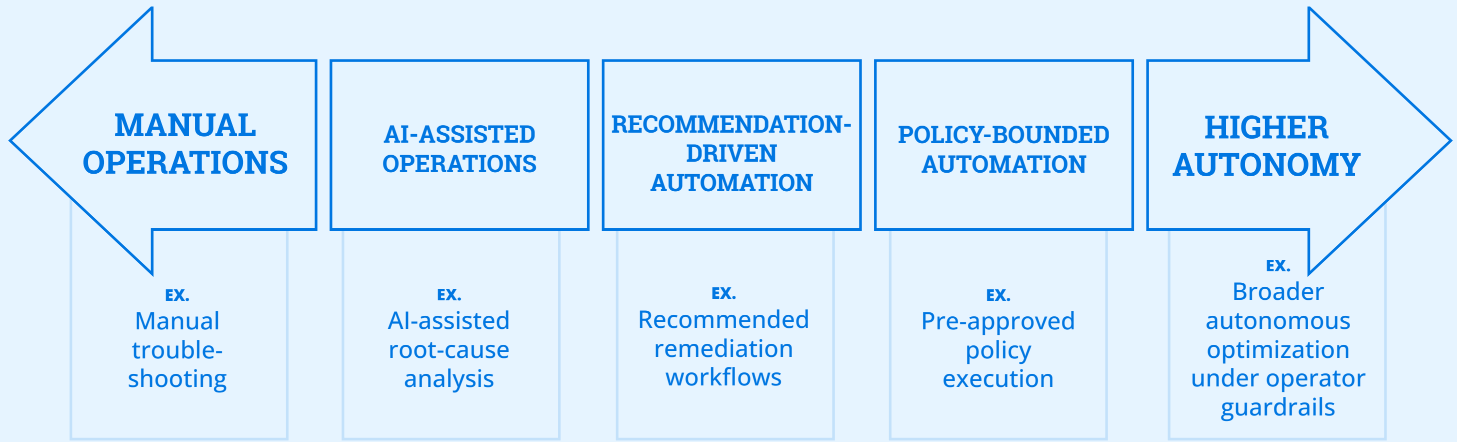
The long-term direction of travel is clear: the industry is moving from automation toward greater autonomy. TM Forum's Autonomous Networks framework is now widely used across the sector, and TM Forum states that many of its members are working to implement Level 4 highly autonomous networks in pursuit of benefits including operational efficiency, resource efficiency, and improved customer experience.

That direction is real, but it should not be overstated in broadband. Most operators are still earlier in the journey. The most sensible path is incremental. Begin with AI that detects, explains, recommends, and assists. Then extend into bounded automation where operators define what actions are permitted, under what conditions, and with what rollback and audit mechanisms.

LF Broadband's own AI framing aligns with this measured approach. The emphasis is on operator-controlled guardrails, deterministic interfaces, and bounded autonomous actions rather than unconstrained AI behavior. That is the right model for broadband, where trust must be earned through dependable outcomes rather than broad claims of autonomy.

In practical terms, the next few years are likely to be defined less by AI replacing operators and more by AI making operations more predictive, more collaborative, and more consistent.

FROM AI ASSISTANCE TO POLICY-BOUNDED AUTONOMY



11. Recommendations

For operators, the most important near-term priority is to improve the underlying environment in which AI will operate. That means investing in observability, normalizing operational data where possible, exposing cleaner interfaces, and strengthening the cloud-native control points that make bounded automation feasible. The first AI initiatives should focus on high-value, bounded use cases such as fault prediction, service assurance, planning support, and operations copilots.

ACTIONS BY STAKEHOLDER GROUP

	IMMEDIATE PRIORITY	MEDIUM-TERM PRIORITY	STRATEGIC GOAL
OPERATORS	Improve observability and data quality	Deploy bounded AI use cases such as fault prediction and service assurance	Build toward policy-bounded automation on open, programmable infrastructure
VENDORS	Expose cleaner telemetry and open interfaces	Support interoperability across multi-vendor environments	Enable AI-ready platforms that fit into standards-aligned, open ecosystems
DEVELOPERS	Build domain-specific tools grounded in real broadband data	Integrate analytics and assistants with operational workflows and controller APIs	Create reusable AI applications that work across heterogenous access environments
ECOSYSTEM / STANDARDS BODIES	Align architectures, models, and developer-facing interfaces	Bridge standards and deployable open-source implementations	Create a stronger shared foundation for interoperable, trustworthy AI in broadband

For vendors, the priority is interoperability. AI becomes much more valuable when telemetry, control, and lifecycle interfaces are exposed in ways that work across multi-vendor environments. Supporting open APIs, standards alignment, and collaboration with open source projects will matter more than simply branding existing features as AI.

For developers and ecosystem contributors, the opportunity is to build domain-specific tools that understand access-network reality: applications grounded in authoritative data, assurance tools that consume standard telemetry, and assistants that integrate cleanly with existing operator workflows.

For the industry as a whole, the recommendation is to keep standards and open source tightly linked. Broadband does not need isolated AI demonstrations. It needs deployable, trustworthy solutions that can work across suppliers, architectures, and operating environments.

Conclusion

AI matters in broadband because operations matter. The most valuable use cases are not the most theatrical ones. They are the ones that help operators detect faults sooner, resolve issues faster, improve subscriber experience, and make smarter investment and operational decisions with less manual effort.

That is why the foundation matters more than the hype. Open, observable, programmable infrastructure is what allows AI to move from concept to production. LF Broadband's role in this shift is to help build that foundation through open source collaboration, operator-driven implementation, and alignment with industry standards. VOLTHA and SEBA are production-oriented, open, disaggregated platforms, while VOLTHA's multi-vendor abstraction model is in production use with major operators.

The future of AI in broadband will not be determined by model sophistication alone. It will be determined by whether the industry continues to invest in open systems, shared architectures, and standards-aligned implementations that allow intelligence to operate across real networks. In that sense, the most durable broadband AI strategy is also the most practical one: build the open foundation first.