Intelligent Access EDGE Solution Overview

EXECUTIVE OVERVIEW

To keep up with today's rapidly changing subscriber demands, deliver the ultimate subscriber experience, and win against the competition, broadband service providers (BSPs) must be agile, innovative, and deliver differentiated experiences. To achieve these goals, BSPs can simplify their access network by deploying solutions, like Calix's Intelligent Access EDGE solution, that consolidate network functions and move them closer to the subscriber-facing network.

By moving key functions like routing and subscriber management closer to the subscriber, service providers significantly cut capital expenditures (CAPEX) by reducing the number and scale of systems. More importantly, BSPs reduce ongoing and recurring operating expenses and boost productivity, lowering the total cost of ownership (TCO).

Intelligent Access EDGE focuses on automating many network tasks, including the provisioning of virtual local area networks (VLANs) for transport configuration changes, services when optical network terminals (ONTs) are moved or upgraded, and optical line terminals (OLTs) when put in service. Automation improves efficiency by reducing labor-heavy, manual, and error-prone tasks.

BSPs can deliver high-quality services faster by enabling common operational workflows across the entire subscriber-facing network, allowing rapid initial BSS/OSS integration. Intelligent Access EDGE also increases the access network's security and scalability—eliminating multiple systems and consolidating functions related to provisioning, monitoring, and managing subscriber services.

CALIX INTELLIGENT ACCESS EDGE

The Intelligent Access EDGE solution redefines the access edge of the network, enabling BSPs to build a network capable of delivering and maintaining many subscriber services for decades to come. It's truly the last network any broadband provider ever needs to build. Intelligent Access EDGE simplifies the architecture and operation of the network while eliminating nearly 40 percent of initial CAPEX and as much as 95 percent of recurring fees.

This is done by consolidating service-enabling network functions into optional specialized software modules—boosting productivity and reducing both TCO and time to market for new services. From a single point in the network with one common service model, the Intelligent Access EDGE solution enables BSPs to maintain all subscriber-facing services.

Intelligent Access EDGE provides:

- Enhanced analytics and automation to optimize network planning, automate critical tasks, and accommodate future capabilities and services.
- The ability to provision and manage existing EXA and AXOS networks with a single model.
- An integrated diagnostics toolbox to diagnose subscriber issues remotely, eliminating truck rolls.
- A virtual integration and testing sandbox environment that eliminates the need to build large labs to train personnel and integrate solutions into the network and BSS/OSS systems.

The Intelligent Access EDGE solution includes three key components: Intelligent Access EDGE Foundation, Intelligent Access EDGE Clouds, and Intelligent Access EDGE Software. To experience the full benefit of the Intelligent Access EDGE solution, BSPs must utilize all three—but simplifying operations with an autonomous network begins with the Intelligent Access EDGE foundation.

Figure 1: Intelligent Access EDGE Solution
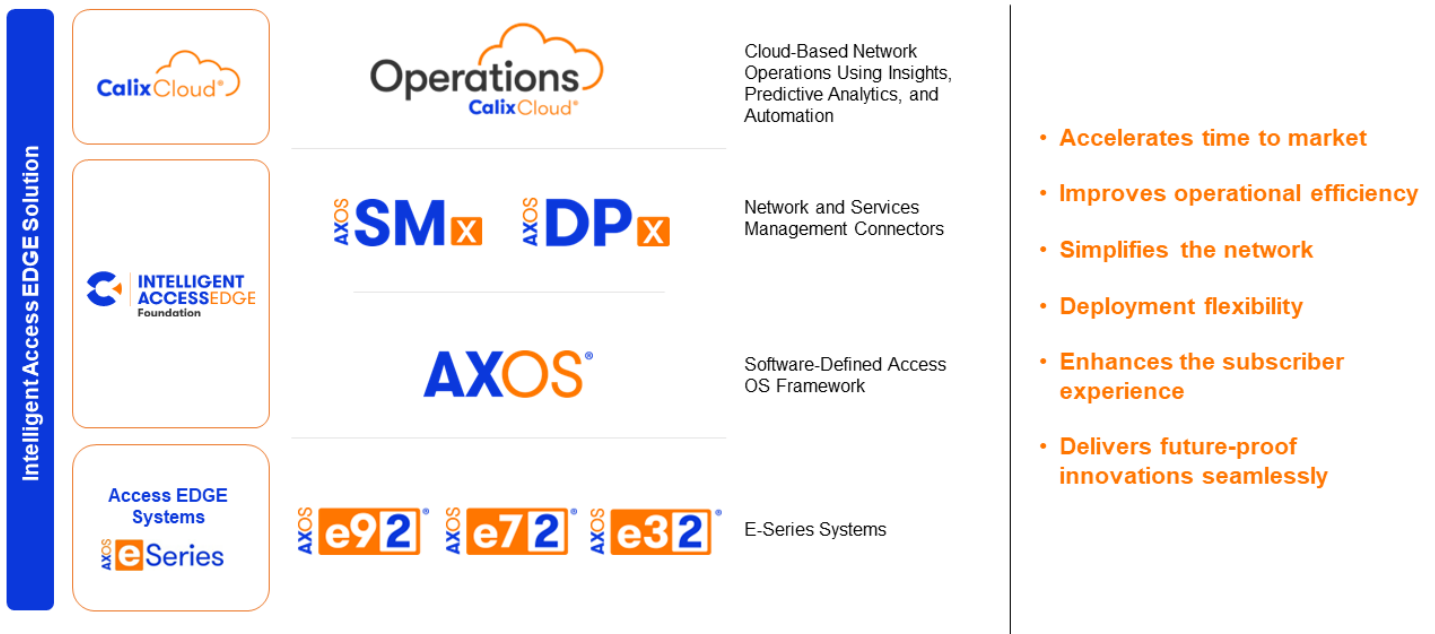
INTELLIGENT ACCESS EDGE FOUNDATION

Simplifying the network and its operations begins with the Intelligent Access EDGE foundation. It enables you to rapidly deliver broadband services to subscribers regardless of location—from high-density urban to remote low-density areas—while ensuring a high-quality experience with low operating expenses. The foundation includes the software-defined access OS framework, AXOS Network Innovation OS (AXOS).

The Linux-based, fully disaggregated network operating system and software solution provides the tools and connectors required to deliver a superior subscriber experience, reduce OPEX, and scale with the pace of subscriber demands. The Intelligent Access EDGE foundation includes Edge Systems (e.g., E9-2, E7-2, E3-2) and Access EDGE Framework (AXOS, SMx, DPx, Diagnostics Toolbox, Sandbox).

AXOS Framework

Intelligent Access EDGE runs on AXOS which enables the simplified network and an enhanced subscriber experience.

- **Modular Architecture:** AXOS is modular, enabling BSPs to rapidly include functions such as the subscriber management module (SMm) or advanced routing module (ARm). AXOS modules can be upgraded and restarted independently, ensuring that changes to one function do not impact other system functions. Modules are independent and use standard APIs.
- **Hardware Independence:** The hardware abstraction layer (HAL) emulates the underlying hardware, isolating the reusable modules above from the low-level chipset drivers so BSPs can adopt new technology without impacting subscriber services.
- **Services Abstraction:** The service abstraction layer (SAL) ensures data models and service interfaces remain consistent across all access technologies, systems, and deployment applications—simplifying operations.
- **Stateful Operations:** With AXOS, the variables required by each module are stored and available upon restart of any individual module. Any module can be upgraded and restarted without impacting other system functions—ensuring a self-healing network that is highly resilient.
- **SDN Ready:** AXOS uses standards-based deployable northbound interfaces (NETCONF/YANG) and is the world's only natively NETCONF-enabled OS. AXOS provides the northbound and southbound connections needed to eliminate middleware and reduce costs and complexity. Each AXOS software component has native-modeled APIs to control locally or remotely without losing function.

Figure 2: Network Innovation OS, AXOS
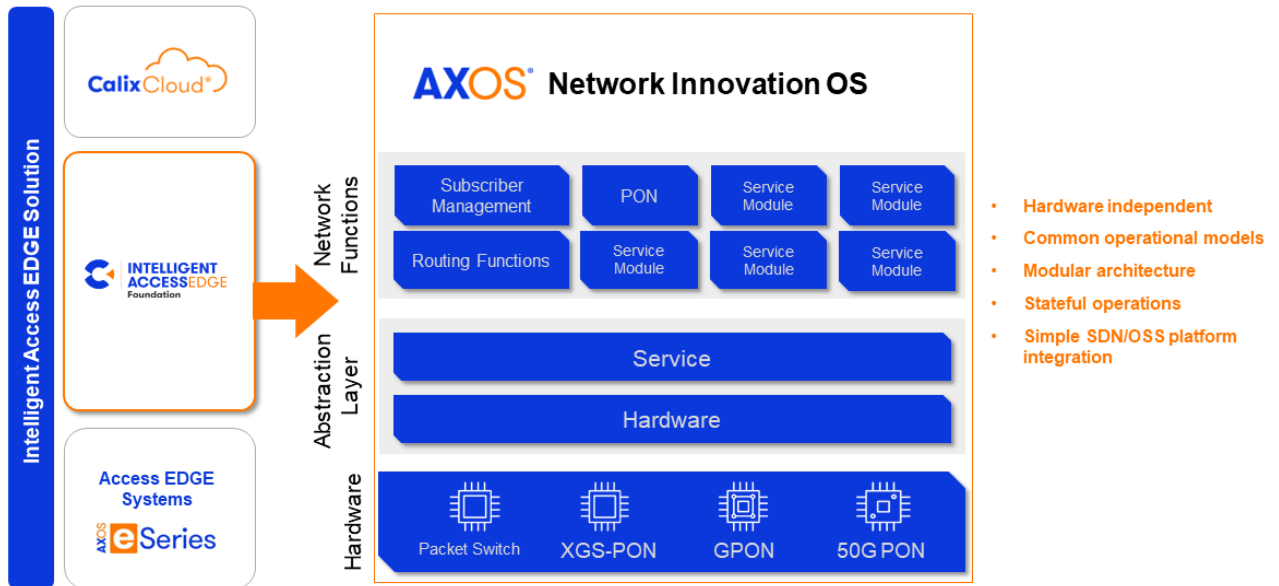
Services Management Connectors

The services management connector (SMx) is a software application for element and network management that provides an automated development, service normalization, and simplification environment. SMx is extensible to new applications and enables quick integration with other open solutions. SMx provides a REST/JSON northbound interface with integrated tools like SWAGGER for rapid back-office integration.

Diagnostics Toolbox

The AXOS Diagnostic Toolbox is an integrated set of network diagnostic tools—such as Wireshark, TCP Dump, and Video Channel Analyzer—that enables remote management and troubleshooting of the access network. These tools help reduce or eliminate costly truck rolls and enable network operations teams to ensure or restore high-quality services as quickly as possible.

Integration and Testing Sandbox

AXOS Sandbox is a virtual testing environment that dramatically improves service introduction by eliminating the need for physical lab systems. By deploying virtual instances of AXOS systems, BSPs can accelerate service delivery by reducing the time needed for lab testing, BSS and OSS integration, and software certification. AXOS Sandbox runs the actual production software release of each AXOS system.

Intelligent Access EDGE Systems

AXOS runs on the Calix E-Series family of modular, non-blocking systems. Not all deployments have

the same needs, so Calix designed the systems to meet the requirements of different locations:

- **E9-2:** Designed for data centers serving larger cities and towns where network systems are typically elastic—quickly enabling the addition of capacity and computing power by cabling additional systems together.
- **E7-2:** Designed for smaller central offices and remote cabinets serving lower-density locations—especially remote cabinets that require temperature-hardened systems and optical transport. Proper thermal and power analysis is critical for airflow and loading in larger deployments.
- **E3-2:** Designed for remote nodes serving very remote locations where it is not cost-effective to install a cabinet. Due to the remote location, the system must be void of parts that require servicing. The sealed nature of the E3-2 makes it ideal for deployments in locations without physical security (strand-mounted, wall-mounted, or pole-mounted.

By offering AXOS on the whole E-Series family of systems, Calix provides a common operational model and workflow across the entire subscriber-facing network. In addition, as new technologies are incorporated into the systems, the operating model remains the same—further reducing changes to back-office workflows and reducing the integration of new technologies from months or weeks to days.

Intelligent Access EDGE Software

In the AXOS modular architecture, the modules themselves have APIs that enable BSPs to incorporate additional capabilities that make sense for their specific network architecture, including:

- **Advanced routing module (ARm):** ARm is designed to help BSPs bring Layer 3 intelligence to the access network, including MPLS capabilities and L2/L3 VPN services. ARm provides the benefits of a routed network, including security and the ability to move caching and other edge computing closer to the subscriber without impacting other network functions. BSPs can reduce provisioning overhead costs, failure groups, and transport costs—and simplify the turn-up of services and subscribers.
- **Routing protocol module (RPm):** RPm provides the same benefits as ARm but is designed for BSPs that already have (or don't need) an MPLS solution.
- **Subscriber management module (SMm):** SMm is a software module that brings subscriber management capabilities to the access network—such as authentication, authorization, accounting of subscriber sessions, address assignment, policy management, security, and lawful intercept. BSPs gain unprecedented visibility into the traffic entering the network—enabling subscriber management and the use of policies and filters to prevent network attacks.

CALIX CLOUDS

Calix Cloud is a set of persona-based solutions built on a shared infrastructure with a single view into the BSP's business. Combining the clouds ensures that three critical BSP teams—broadband operations, customer support, and marketing and sales—have the data and insights to simplify operations, excite subscribers, and grow business.

Marketing and Sales

- Reduce churn
- Maximize profit
- Boosting marketing ROI
- Grow business

Network Operations

- Remote troubleshooting
- Optimize and automate workflows
- Proactive network health and monitoring
- SLA monitoring and assurance

Customer Support

- Lower average talk times
- Improve first resolution call
- Reduce truck rolls
- Proactively prevent calls

Calix Operations Cloud

Calix Operations Cloud (Operations Cloud) enables BSPs to offer subscribers self-service automated provisioning across the entire subscriber-facing network to deliver an amazing subscriber experience. Operations Cloud provides the ability to provision, monitor, maintain, and manage the whole end-to-end subscriber-facing network—from the subscriber's premises to the access network edge, ensuring BSPs can:

- Optimize and automate workflows to drive faster decision-making and problem resolution, fewer help desk calls, and eliminate error-prone repetitive tasks.
- Minimize truck rolls by understanding the causes of service issues and fixing them remotely.
- Reduce support costs with end-to-end network visibility—reducing resolution times and improving proactive and predictive maintenance.

Operations Cloud capabilities include:

- **Network automation:** End-to-end service provisioning (aggregation/access to premises ONTs) and discovery workflow.
- **Network alarms and traffic monitoring:** AXOS alarms such as loss of signal, quarantined ONTs, fiber cuts, PON capacity hits, or DDoS attacks—including correlating multiple alarms to simplify diagnosis.
- **Network performance insights:** View outage and degradation trends across systems to quickly identify impacted PONs and Ethernet uplinks or ONTs with low light levels and high BIP errors.
- **Recommendations to resolve upcoming or existing network issues:** By evaluating and analyzing the performance of various network elements, predictions can be made about the reliability of aging components of the network infrastructure.

Common Systems Provisioning and Management

As BSPs are better equipped to provide the ultimate subscriber experience, Calix understands the need to integrate existing subscribers and their services into a standard back-office provisioning and management view. This consolidated view simplifies the operation of the combined network and enables BSPs to focus on network growth. It also allows BSPs to maintain the existing EXA network—currently managed with Calix CMS—and add the Intelligent Access EDGE solution to provide operations teams with a single view of their BSS/OSS systems and operating environment.

LEARN MORE

Contact us today for a complimentary [Network Architecture Review Consult](#) with a Calix expert. Learn more about the Intelligent Access EDGE solution and how it can help reduce the network's TCO, boost productivity, and bring new revenue-generating services to the market faster.