Axyom Ultra-Broadband Software Framework

MULTI-SERVICE ACCESS AND CORE SOLUTIONS

Expanding Quantity and Variety of Broadband Network Connections

The Internet of Things (IoT), high-definition everything, virtual and augmented reality, ever bigger data tsunamis – this is the not-so-distant ultra-broadband future.

To continue to achieve profitable growth from the opportunities this future presents, service providers must thoughtfully but proactively transform their networks, operations and services.

The future requires mass customization to ensure network assets are used most efficiently and effectively to deliver this increasing variety of services. Virtualizing network functions so they can be dynamically applied as needed is a first step. But virtualizing the network as a mirror of its former physical self isn't enough. We have to fundamentally reimagine how networks should work in order to enable simultaneous optimization in multiple dimensions, as shown in Figure 1.

The right solutions must achieve many objectives that are at odds with each other from an engineering and business perspective, as shown in FIgure 2. For example:

- Securing mobile and Wi-Fi traffic before it enters the core network, while simultaneously delivering throughput at ultra-broadband speeds;
- Extracting and processing real-time intelligence about subscribers, sessions and applications, while simultaneously scaling to millions of IPSec tunnels;
- Handling high numbers of sessions or calls while delivering millisecond latency;
- And, deploying highly dense fabrics of small cells and Wi-Fi access points, while achieving profitable growth.

It's an engineering challenge well suited for Casa Systems' heritage as a provider of innovative cable network access solutions which incorporate RF engineering, high density access aggregation, software innovation and extreme subscriber management capabilities.

Axyom Ultra-Broadband Software Framework

With these challenges in mind, Casa Systems developed the Axyom Ultra-Broadband Software Framework. This virtualized platform encompasses the access and core functions service providers need for fixed, mobile and Wi-Fi services, uniquely tailored for the applications providers are delivering today and will deliver in the not-so-distant future.

Axyom leverages the modular software approach Casa developed to deliver the fixed broadband industry's first and highest density converged access platform. Now, Casa's engineering strength is applied to solving tough challenges in mobile networks as well, as shown in Figure 3.

Casa Systems' Axyom ultra-broadband

Figure 1.

Simultaneous, multi-dimensional optimization required.

Figure 2.

Current solutions tend to trade-off one axis to optimize the others

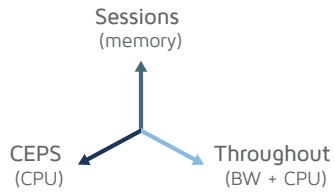
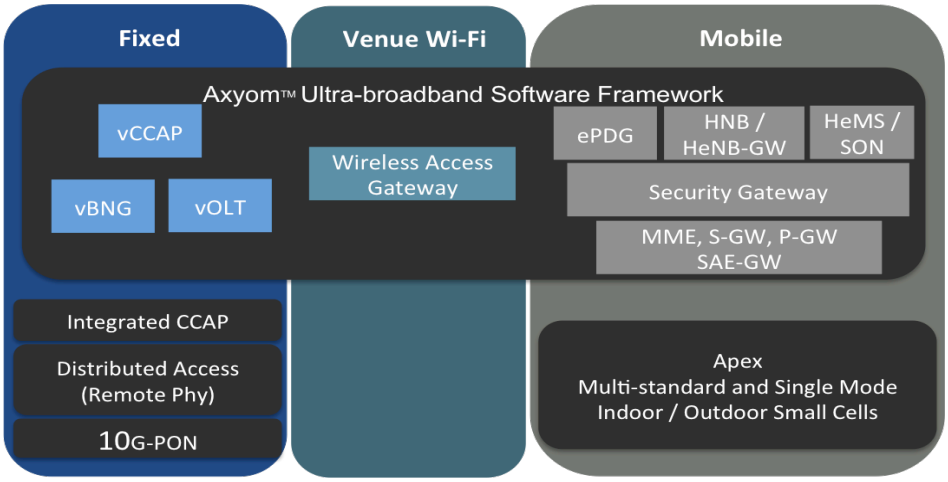


Figure 3.



Casa Systems Portfolio

software framework is a fully virtualized, integrated multi-access solution, which delivers multi-standard access functions for 3G/4G and trusted/untrusted Wi-Fi access. All the access and core network functions service providers need to enable ultra-broadband mobile and Wi-Fi services are available in the Axyom software platform, as shown in Figure 4.

Deployable on premise in a 1 or 2RU COTS x86 server, at the network edge or as independently scalable control and service forwarding elements at a centralized location, Axyom's flexible architecture enables placement of network functions where they make the most sense. This allows dramatic improvements in performance, protects the network core and enables higher QoE. Simultaneous scaling in multiple dimensions is enabled by Casa's unique approach to network functions virtualization, (NFV) as required by 5G.

A Fresh Approach

Casa Systems fundamentally rethought the way mobile services are delivered. While virtualization of RAN and core functions at the network edge is a step in the right direction, there is a real need to move beyond NFV 1.0, where network functions are virtualized as mere mirrors of their former physical selves. Instead, Casa stepped forward to NFV 2.0, where network functions are optimized to dynamically scale in the multiple dimensions required by the applications service providers offer today and will offer in the future. Designed to simultaneously scale CPU, memory and throughput, Casa's Axyom ultra-broadband edge platform eliminates the performance trade-offs present in many of today's solutions and delivers best-in-class (on a per RU basis):

Figure 4.

Axyom Ultra-Broadband Software Framework

Deployable as a Mobile Edge Computing Solution on a 1RU / 2RU Server or in **a** data center cloud environment

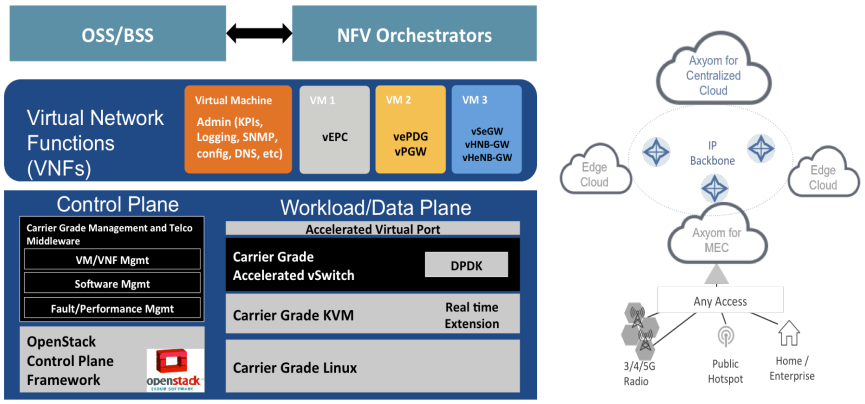
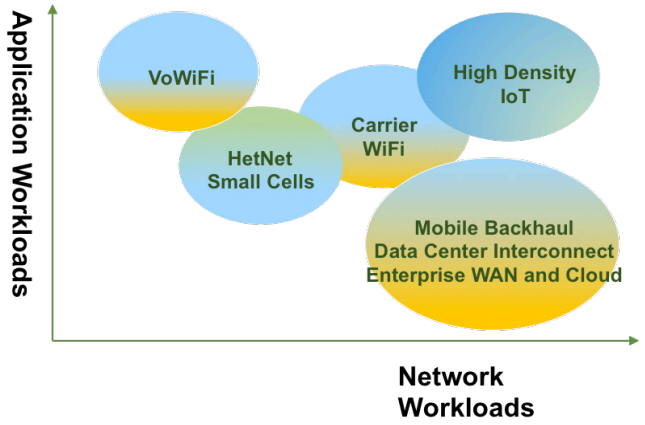


Figure 5.



Comparison of Optimization Dimensions

- Number of IPSec tunnels
- IPSec tunnel setup rate
- Number of subscribers
- Lowest latency
- Throughput for small packets (@128 bytes)

Coupled with our own, or third party, small cells and/or Wi-Fi access points, Axyom is designed to deliver ultra-broadband services from a variety of access types, and provides security, aggregation and management functions as well as easy integration with other open solutions and existing architectures.

Designed to Improve Network Performance

Virtualization gives service providers the opportunity to address numerous inefficiencies that exist in legacy network architectures, including:

- **Rigidity –** Packets cannot easily be treated to "optional" services and are not routed using the shortest logical path (e.g., only particular nodes can process tunnel encapsulation/decapsulation so packets are routed to those nodes by design);
- **Ignorance –** Network functions are unaware of specific application/device requirements;
- **Signaling overhead –** Tunnel establishment and modification incur a large number of unnecessary signaling messages;
- **Header overhead –** Consumes backhaul bandwidth and slows processing;
- **Offload –** Full distribution of content or localization of application requires special solutions (i.e., LIPA/SIPTO).

Casa's Axyom solution addresses all the above through intelligent pipeline processing, performance acceleration and application of real-time intelligence. For example, consider the task of assuring security across a variety of access types. As shown in Figure 5, some are more I/O intensive, requiring ultra-low data plane latency. Others are more compute intensive, characterized by, among other things, a high UE attach/detach rate.

Casa's Axyom optimizes for each of these dimensions simultaneously to drive the highest performance for all services. Scaling IPSec control and data plane functions independently enables rapid adaptation to variable bandwidth and compute-intensive traffic. It's this kind of engineering that allows Axyom to outperform legacy solutions many times over, as shown in Figure 6.

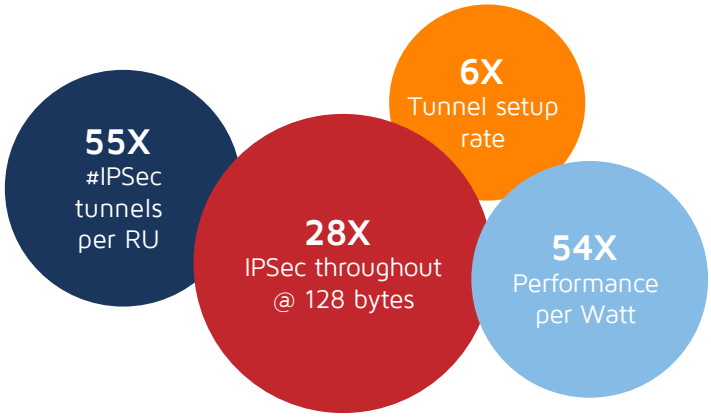
Axyom Highlights

- Modular architecture integrates multiple access and core functions on the same software platform
- High performance – best-in-class throughput, particularly for small packet sizes like voice and streaming video
- Carrier-grade reliability
- Common, reusable security framework with dedicated security processing
- Industry-leading performance for encrypted traffic in both the control and data planes
- S1/X2 proxy functions to simplify macro integration
- High-performance, zonal-presence capability for precision location tracking while shielding the EPC core from incremental signaling storms
- Real-time integrated subscriber, session and application intelligence for both optimization and monetization

Built to Reduce Network Complexity

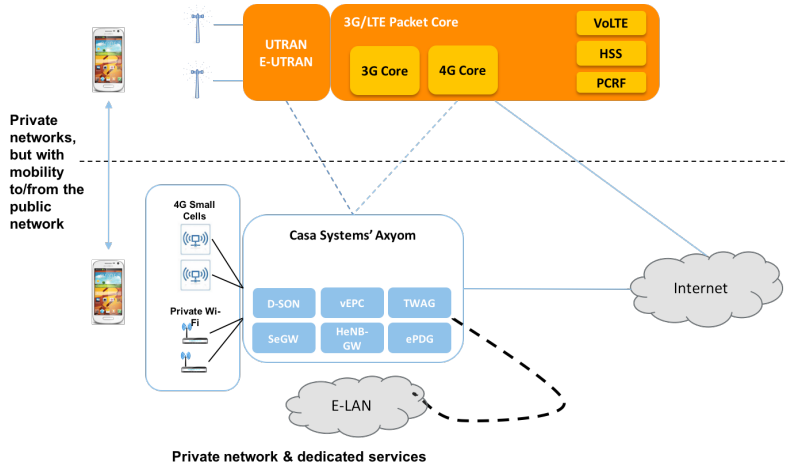
The Axyom framework provides key access and core functions service providers need to enable ultra-broadband services, regardless of access type. The architecture speeds traffic

Figure 6.



Casa Systems' SeGW Performance per RU Compared to Leading Incumbent Alternative

Figure 7.



Private LTE example

flow and reduces the number of network nodes required. Our small cell gateways provide S1/X2 proxy functions, enabling abstraction of the small cells as a single logical interface, simplifying integration with macro networks.

All management and control of small cells is accessible from a single pane of glass via an intuitive graphical user interface (GUI). Hybrid SON enables auto-configuration, self-optimization and self-healing. Casa's Axyom offers multi-standard support, tight integration with macro networks, integration of open source solutions and interoperability with third-party software.

Service providers need alternatives that enable adoption – and adaptation – of virtualized edge solutions. Axyom is designed to address emerging use cases and incremental opportunities for service providers while providing backward compatibility with existing assets and solutions.

For example, increasingly service providers are recognizing the power of private LTE networks as a way to reduce enterprise churn, deliver incremental value to enterprises and economically address M2M requirements. Axyom provides all the components providers need to offer private LTE solutions, and to do so incrementally and rapidly, as shown in Figure 7.

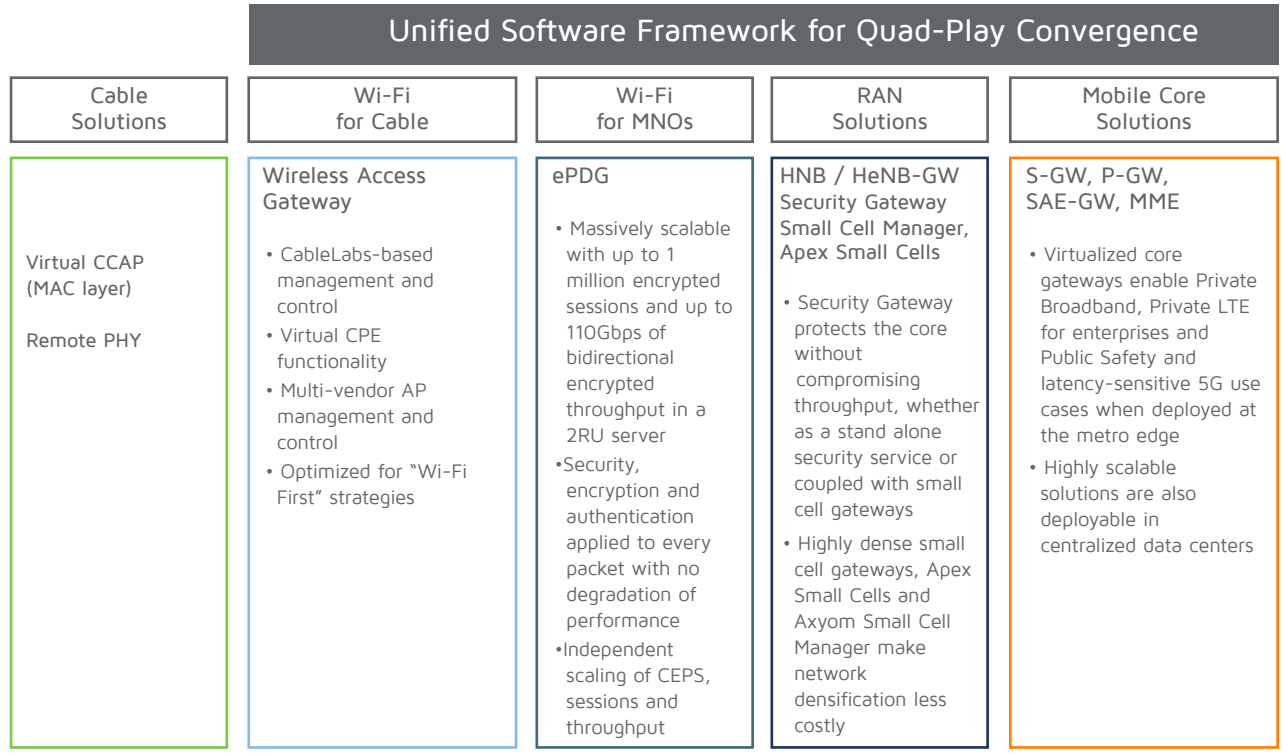
Addressing Service Provider Priorities

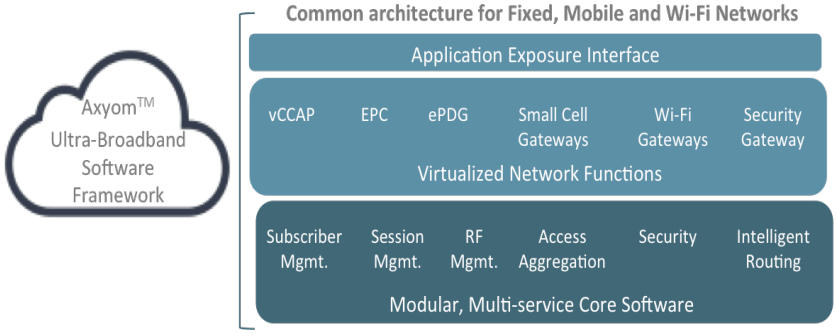
As service providers reach beyond legacy service offerings toward new revenue streams, it is possible that the demarcations between cable service providers and telecom service providers will grow less discernable. Already video is a key contributor to mobile data growth and a key opportunity for mobile network providers. Simultaneously, cable service providers continue to add mobility solutions to their portfolios through a variety of tactics. For all service providers, solving the data demand equation will require some use of unlicensed spectrum, but QoE needs to be addressed.

MSOs wishing to treat carrier-managed Wi-Fi spectrum as a strategic asset recognize the need for automation and simplification to enable network-wide optimization to drive quad-play services beyond the home. Solutions like MulteFire, which uses LTE scheduling on the unlicensed carrier to improve QoE, while leveraging a spectrally more efficient technology, may prove to be a game changer – owning spectrum no longer means holding keys to the subscriber.

MNOs facing the realities of user data demand and the Internet of Things find current mobile network architectures are not built to handle web-scale demands for capacity and cloud-based services. The promise of NFV and SDN to deliver

Figure 8.





programmable networks that can address ultra-broadband, ultra-narrowband and ultra-low latency has been much hyped, but slow to appear.

Axyom provides a unified software framework to simply and economically enable quad-play offerings today, and to extract value from the Internet of Things as that ecosystem emerges.

Casa Systems continues the value we have always provided our cable customers, enabling multiple practical paths to quad-play, as shown above, in Figure 8. As the industry and network convergence continue, service providers can look to Casa for solutions.

Networks are evolving from vertical silos toward horizontally layered multi-service architectures. Compute and core functions are moving to the edge for shortest delay in data path. SDN control of services and networks is on the rise. And, Casa Systems' Axyom Ultra-broadband Software Framework is ready.

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