

# Casa Systems Axyom™ Software Platform

Over the last few years and continuing through the next decade, all broadband networks will be transformed by Network Functions Virtualization (NFV) and Software Defined Networks (SDN). This shift to software-centric networks will deliver the scalability, lower costs, operational flexibility and service agility needed to compete in the future.

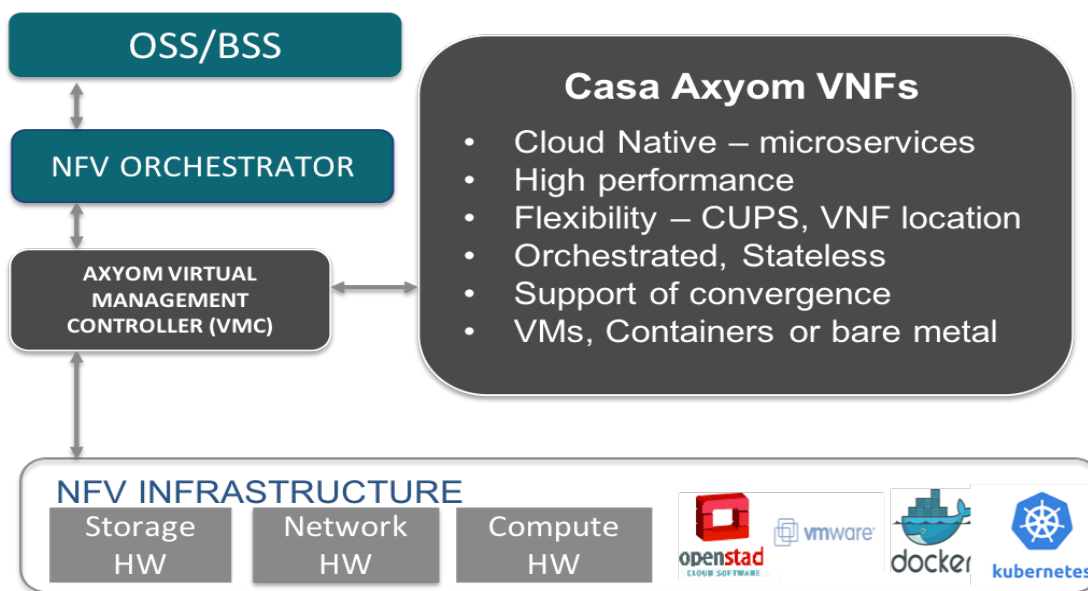
Service providers must choose the right software vendors and solutions as they make this transition. This document covers key aspects of the Axyom Software Platform, Casa's virtual software architecture. With Axyom, Casa delivers high performance, flexible scaling, and efficient operations to fixed, cable, and mobile broadband core networks.

## What is the Axyom Software Platform?

Axyom is a web scale solution based on a distributed micro-service framework. The Axyom Software Platform includes Casa Systems' virtual software workloads, and the software that manages those micro-services. The Axyom software architecture includes **VNFs for all broadband service providers -- mobile, fixed, cable and converged**. The Axyom software architecture and how it integrates into the ETSI NFV framework is shown in Figure 1.

Axyom Software Platform - The ETSI NFV Framework

Figure 1

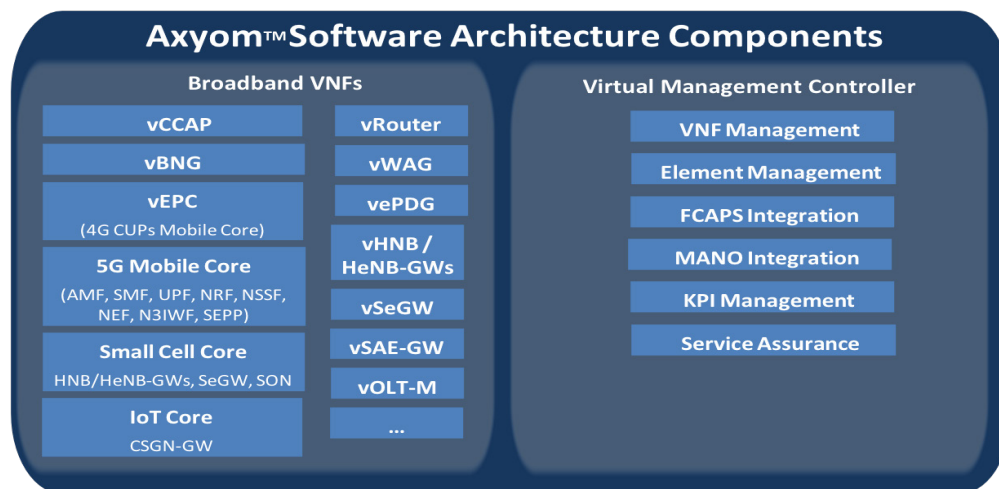


The Axyom software platform offers a large catalogue of ultrabroadband services, and we are adding new capabilities on an on-going basis.

The Axyom Virtual Management Controller (VMC) provides life-cycle VNF Management, EMS functions and Northbound interfaces to NFV Orchestrators and SDN Controllers. With the ability to support multiple application level KPIs, the VMC provides the control and visibility needed to orchestrate large numbers of VNFs instances running simultaneously and to manage them through their lifecycle.

The components of the Axyom software architecture are shown in Figure 2

Figure 2



Each Casa VNF is designed around the following design principles:

- Supports **stateless processing** – Axyom VNFs are designed to use a centralized in-memory data store for state and subscriber/session information.
- Can be **orchestrated** – Axyom VNFs have been integrated with ETSI MANO Open Source MANO (OSM) and Linux Foundation Open Network Automation Platform (ONAP) orchestration solutions. Integration has occurred between Casa's VMC and vendors, such as NetCracker, HP Enterprise and Amdocs. In a containerized environment, Axyom VNFs will run inside a self-orchestrated Kubernetes cluster.
- Composed of **microservices** - Casa's microservices operate at web-scale and can be individually managed. They include core microservices that implement business logic and support microservices that support all VNFs. Casa's IPv4/IPv6/MPLS virtual routing implementation is an example of a support microservice. This microservice captures Casa's cable broadband experience that has resulted in leading routing capabilities. With Axyom, the IPv4/IPv6 virtual routing microservice is used by cable, fixed and mobile VNFs ensuring that all of Casa's solutions benefit from Casa's routing leadership.

Overall Axyom microservices are designed to be self-contained so that they can be individually upgraded and also chained / clustered into VNFs and services. This cloud native approach provides maximum flexibility and operational efficiency.

- Supports **convergence solutions** - Many service providers serve a combination of mobile, fixed and cable broadband subscribers. The Axyom Software Platform not only delivers optimized solutions specific to mobile, fixed and cable broadband networks, but Axyom is also designed to support converged solutions.

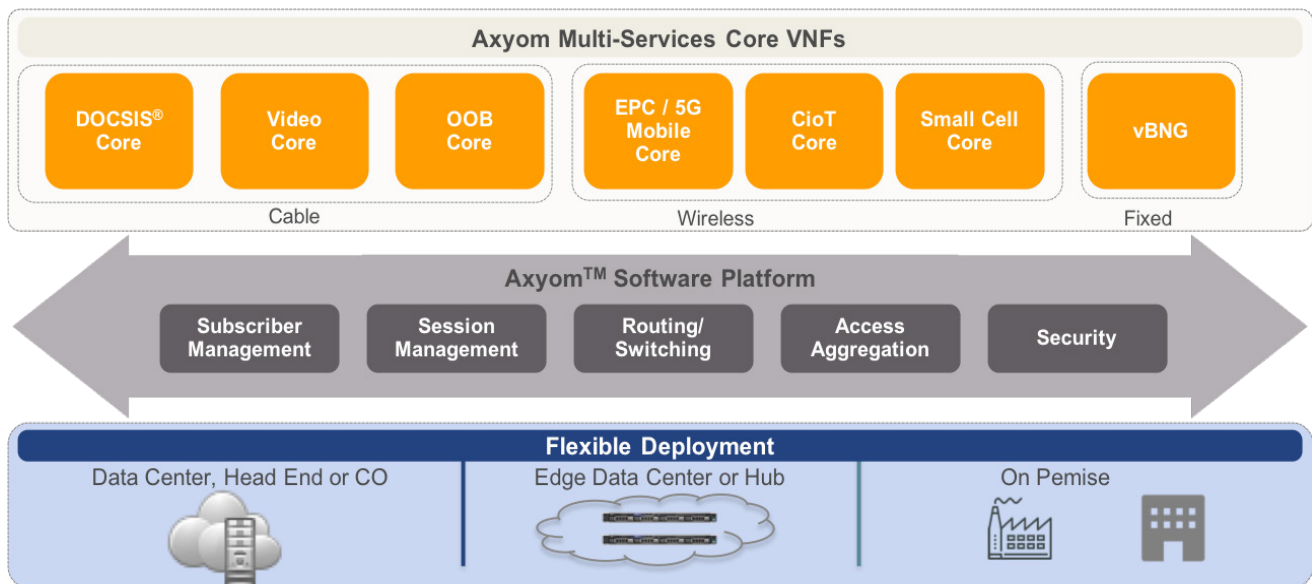
As can be seen in Figure 2, many specific VNFs for mobile, fixed and cable broadband are available. However, these VNFs can run in a single NFV network, run on the same NFVI, and can be managed by a single VMC. Also, Casa provides microservices that can share a common User Plane Function (UPF) in a multi-access environment. Finally, Casa's convergence capabilities provide service providers with common and superior resource management.

- Allows **location independence** - Casa's core network solutions are disaggregated, allowing control and user plane compute resources to be located in the right place for specific use cases. As an example, if the goal is low latency, Axyom allows the user plane VNF to be located on an edge server.
- Enables **deployment flexibility**- The Axyom Software Platform provides flexibility since it allows service providers to transition from current monolithic, legacy solutions to Axyom VNFs that can be run on bare metal or in virtual environments, either virtual machines or containers.

Casa supports the flexibility created by an open ecosystem. Casa has proven its interoperability with a variety of hypervisors, NFV/SDN orchestrators and x86 servers. Figure 3 captures many of the design principles.

Figure 3

### Axyom Software Architecture Design



### Why Axyom?

Several years ago, when we began working on virtualized solutions, we realized that incumbent suppliers were taking the easy way out. NFV allows for a fundamental re-architecture of network functions, beyond the “lift and shift” approach in which monolithic software is simply ported to x86 servers.

Lift and Shift allows the supplier to claim victory in the virtualization arena. However, the victory is hollow since it leads to poorly performing VNFs. The “Lift and Shift” penalty is paid by the service providers themselves, since the penalty shows up in high

server OPEX and CAPEX, along with a lack of service agility. To add insult to injury, some suppliers try to get their customers to buy proprietary data center servers; this means that even the savings from using x86 servers are lost.

Casa realized that there is a better approach. Casa's VNFs are developed from the ground up using cloud native principles to not only ensure scalability and flexibility but to ensure that the Axyom VNFs are optimized for the virtual compute environment in which they will run.

## The Value of Axyom

Using cloud native design principles, the Axyom Software Platform provides maximum performance and flexibility across the following:

- **Superior Performance** – Casa achieves up to 5X greater throughput per vCPU. In fact, in several cases Casa exceeds the throughput of its competitors by up to 10X. Software ported from an appliance design rarely adheres to virtual compute design principles. As an example, when designing its high performance virtual compute VNFs, Casa realized that it is imperative to allow only for local memory access, otherwise performance will be severely degraded. It is unlikely that code first developed for an appliance would make a distinction between local and remote memory.



Casa's performance advantage translates into financial benefits for the service provider. Higher performance means fewer x86 servers are needed to run Casa's VNFs. Fewer servers means significantly lower CAPEX and OPEX expense. These cost savings are material with servers costing \$10K or more, thousands of servers being deployed and the server OPEX often being over \$2K per year. Can you afford to keep poorly performing VNFs in your network? Contact Casa and we can help you work through the business case to quantify the value of superior performance.

- **Leading Virtual Compute Resource Efficiency** – Casa's virtual compute efficiency shows up in two ways:
  - Casa delivers an industry leading, minimal vCPU Virtual Network Function (VNF) footprint that ensures efficient resource utilization. Our VNFs can be scaled down to as low as 5 vCPUs with our "lean" configuration. Having small footprint VNFs allows service providers to reduce OPEX related to power consumption and to support multiple tenants on a single server.
  - Casa also provides elastic, two-dimensional vCPU scaling. Most people are familiar with horizontal scaling which adds or removes VNFs as capacity scales. Vertical scaling is an innovation that adds or removes vCPUs to a single VNF as capacity scales. With vertical scaling, the VNF is right sized and the service provider saves money because they are not forced to upgrade their servers to support bloated VNFs that are provisioned with a huge fixed number of vCPUs. Why provision and run a 50-vCPU cluster at times when only 5 or 15 or 20 or 30 or 40 vCPUs are needed to support the current throughput?

Vertical scaling also avoids inefficiencies if related VNFs (e.g. MME, SGW and PGW VNFs) are deployed on multiple servers. If a VNF must fetch data from memory on a different server, overall throughput and performance dramatically decreases. To maximize flexibility, Casa's answer is to provide both lean, right-sized, vertically scalable VNFs along with horizontal scaling to deliver elastic, two dimensional vCPU scaling.



- **Maximum Service Flexibility** – Casa has implemented 3GPP Release 14 Control and User Plane Separation (CUPS) and location independence, to provide service flexibility.

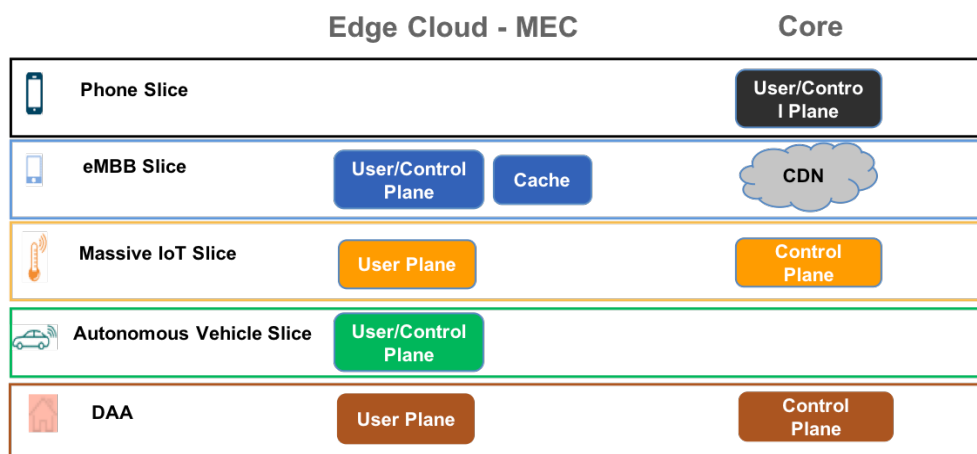


From its initial development, CUPS has been part of the Axyom Software Platform. CUPS allows service providers to independently locate and scale their control and user plane VNFs. Figure 4 shows several different wireless and cable broadband examples of Axyom VNFs located at either the network edge for lower latency or at the data center for maximum efficiency.

Locating compute resources at the network edge is referred to as, Multiple Access Edge Computing (MEC) or Distributed Access Architecture (DAA) depending on your market segment. Casa's support of location independent VNFs and dynamic network slicing enables the flexibility to put virtual compute resources and functions in the optimal location.

### Axyom - Geographic Independence with CUPS

Figure 4

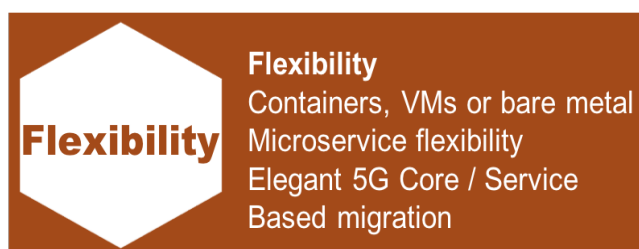


- **Superior Deployment Flexibility** - Since NFV/SDN has been a work-in-progress for several years, service providers need a supplier who provides them flexibility today and in the future.

Casa's Axyom VNFs can run on bare metal or in a container-based environment. Many current wireless NFV deployments have been implemented using OpenStack. Cloud Native design principles, from the data center world, use containers due to their ability to spin up faster and thus adjust more rapidly to capacity surges. No one has a crystal ball about the evolution of NFV - staying flexible is critical.

In addition, Casa's microservice based Axyom design allows for faster introduction of new services and more maintenance flexibility since fixes can be made to a microservice only, rather than having to struggle with modifying and testing a monolithic code base.

Flexibility must extend into the 5G future. As mobile, fixed, cable and convergence networks evolve to a service-based architecture with network slicing and web-based protocols for network exposure and service agility, a software architecture, such as Axyom, that supports the ability to provide elegant overlays and easy migration is essential. If flexible migration paths are not provided for the service provider, today's investments will soon become tomorrow's regrettable spend.



## Summary

Your edge and core networks can become a powerful asset. To support the migration to NFV/SDN you must choose a partner that delivers cloud native designs along with performance and flexibility leadership.

Most current core vendors have "Lifted and Shifted" their appliance-based code as they virtualized. The good news is that service providers can now use x86 servers, the bad news is that these "Lift and Shift" virtualized solutions are very inefficient and will drive significant unneeded server CAPEX and OPEX. As service providers evolve to NFV/SDN and then to a converged 5G Core architecture, the current inefficiencies will only increase.

Casa's Axyom Software Platform is the right solution. It was built from the ground up using cloud native design principles. As a result, Axyom VNFs are optimized for the virtual compute environment on which they will run. The Axyom architecture delivers the following values across mobile, cable, fixed and converged networks:

- Superior performance
- Leading virtual compute resource efficiency
- Maximum Service Flexibility
- Superior Deployment Flexibility

Contact us at Casa Systems to begin your journey and learn about a better way to implement core network solutions with Axyom.