Cisco Ultra Services Framework

Cisco® Ultra Services Framework provides an intelligent, inline service delivery platform allowing operators to scale services on a service chain, instantiate new service chains without affecting existing ones, and add services to or remove services from a service chain.

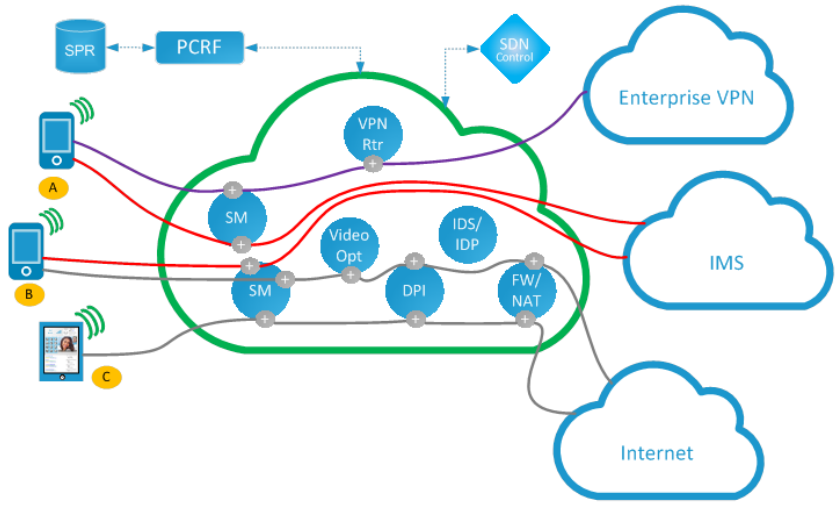
Product Overview

Cisco Ultra Services Framework, a component of the Ultra Services Platform, uses two complementary technologies to provide a highly scalable and intelligent inline service delivery platform on Gi-LAN network functions virtualization (NFV) and software-defined networking (SDN)—for an innovative approach to architecture and implementation of the Gi-LAN, the segment of the network for which service providers deploy IP functions between the packet gateway and the Internet.

NFV is used for virtualization and management of Gi-LAN service functions; SDN is used for separation of the control and forwarding planes and orchestration of service chains in the Gi-LAN. The virtualized Gi-LAN solution becomes extremely flexible because of the integrated, policy-driven Gi-LAN controller used by the NFV Orchestration Framework and SDN solution. Ultra Services Framework allows operators to flexibly scale services on a service chain, instantiate new service chains without effect on existing ones, and add services to or remove services from a service chain.

Cisco Ultra Services Framework is based on a number of standards-based virtualized components that are integrated with an SDN network, a set of virtual service chains, which are dynamic service paths consisting of a number of network services that need to be executed for a specific application flow in a specific order. (See Figure 1.) Application flows are steered to specific service chains using a traffic classification function, which classifies them based on subscriber and application policies received from the policy and changing rules function (PCRF). In the Cisco Ultra Services Framework model, network services are contained within a single virtual machine and are load balanced in order to scale beyond the limits of what a single virtual machine can offer.

Figure 1. Virtual Service Chains



Cisco Ultra Services Framework uses quintuple flow information to classify packets based on subscriber policies. After being classified, packets are steered to appropriate virtual service chains consisting of network forwarding path information. Classification rules can be organized into different network contexts (VLANs), and each contextual classification table can contain a default chain in case flow is not matched to a more specific rule.

Features and Benefits

Table 1 summarizes the Cisco Ultra Services Framework features and benefits.

Table 1. Cisco Ultra Services Framework Features and Benefits

Feature	Benefit
Intelligent, policy-based flow steering	Each traffic flow is relevant to the subscriber policy, thereby removing capacity waste by steering traffic through unnecessary service functions, resulting in less CapEx/OpEx. Policy-based steering allows operators to create many new differentiated services targeted to specific sets of subscribers.
Embedded load balancing and subscriber stickiness	No need for external, costly load balancers for managing clusters of service functions as each cluster grows.
Automated management	Reduction of OpEx to manage a multivendor set of third-party service functions through common lifecycle management services. Real-time capacity management becomes simpler through automated deployment and elastic scalability.
Open platform for third-party virtualized service functions	Quickly and easily onboard third-party service functions through the use of automated tools (Ultra Automation Services) and integrate them into the platform for full lifecycle management capabilities.
Automated install and start	Faster, more efficient way to deploy and manage enhanced service delivery infrastructure in new data centers.

Intelligent and Scalable Services Framework

Cisco Ultra Services Framework addresses mobile operator challenges to enhance and monetize content delivery through comprehensive, virtualized inline subscriber services. Ultra Services Framework overcomes the limitations associated with physical service chains, including: poor scalability, limited service functionality, and other operational challenges.

Dynamic, Composable Services

Cisco Ultra Services Framework uses the network service header (NSH) to dynamically steer subscriber traffic onto one or more service functions. NSH is a data plane protocol that represents a service path in the network and provides a common service plane that is fully orchestrated from top to bottom. The path information is akin to a subway map: it tells the packets where to go without requiring per flow configuration. Metadata is information about the packets and can be consumed or injected by service functions to enable policy. NSH is added to packets through a classifier and is carried along the chain to services. Intermediate nodes do not need to be NSH-aware (a proxy can take over the NSH function so that non-NSH-enabled services are supported). The addition of metadata through the NSH header in the IETF SFC protocol enables the evolution of service creation from a dumb set of nonrelated building blocks to composable services that can pass and react to imputed data and mid-service computational results. Beyond simple linear graphs, any kind of directed graph can be supported with a dynamic component whereby a graph node can, through policy, make an autonomous determination to resteer a flow. Additionally, the presence of programmable metadata enables new opportunities for compliance and assurance.

Powerful Automation Tools

To simplify the launch in a virtualized environment, Cisco Ultra Services Framework uses powerful automation tools—AutoIT and AutoVNF—to expedite the process of launching Virtual Network Function Manager (VNFM) and Ultra Services Framework components, respectively. Both AutoIT and AutoVNF are parts of the larger Ultra Automation Services (UAS) solution. UAS runs as a virtual machine instance (optionally in one-to-one redundant mode), typically on a staging server, where software binaries are stored. AutoIT and AutoVNF expose RESTful APIs to create, delete, and update VNFM and USF deployments:

- **AutoIT**: Automates upgrades and installation of Cisco Elastic Services Controller (ESC) as a VNFM with all required Openstack artifacts and configurational parameters.
- **AutoVNF**: Automates Ultra Services Framework deployment, including third-party service functions, with the required configuration. AutoVNF can use existing Openstack artifacts (tenant, networks, flavors, and so on) or create these artifacts through the VNFM.

Efficient Subscriber Identification

The session function interacts with PCRF to perform subscriber policy look-ups. Subscriber identification is either based on GTP-C information (in the PCEF-based deployment model) or based on the subscriber's IPv4 or IPv6 address (and optionally a network identifier). Upon the look-up, the session function determines the appropriate subscriber policy for the flow. It then programs all the network functions instances in the USF to install a flow entry for the given subscribers so that subsequent packets after the first sign of life (FSOL) are processed on fast path toward the appropriate location where the virtualized service function is hosted. Ultra Services Framework provides subscriber-aware and session-aware load balancing across multiple instances of virtualized service functions and service chains to ensure subscriber stickiness across the system.

Policy-aware Forwarding of Subscriber Packets

Network functions contain the required flow entries to forward subscriber packets toward the correct service chain to which each given subscriber flow is subjected to and belongs. Flow entries can be dynamically programmed through a programmable interface based on layer 3 (network layer) and layer 4 (transport layer) information. The network function also serves as an aggregation networking point for all other internal components by exposing external connection points to head-end and tail-end data center routers.

Flexible Traffic Steering

Application functions are proxy to hosted onboard service functions as part of the overall platform. Each onboarded service function is associated with one or more defined service paths. Each service path can specify a single service function instance or process a sequence of multiple service functions. The application function performs NSH proxy functions by stripping off and encapsulating packets with NSH headers as packets traverse in and out of each service function.

Ultra Service Components

Ultra Service Components (USCs) refer to a virtualized service function that provides value-added services such as Network Address Translation/Firewall (NAT/FW), content optimization, and URL filtering. USCs may be Cisco's own or third-party provided VNF components. In any case, all service functions must be onboarded into the Ultra Services Framework so that internal orchestration, lifecycle management, and automation elements can perform create, read, update, and delete (CRUD) functions consistently, regardless of the source of the software.

The following virtualized service functions have been onboarded and validated in USF as of the 5.0 release:

- Cisco Adaptive Security Appliance Virtual Appliance
- Juniper vSRX Integrated Virtual Firewall
- Openwave Mobility IP Traffic Manager
- Openwave Mobility DynaBoost
- Sandvine Policy Traffic Switch Virtual Series

Additional virtualized service functions can be onboarded into USF using the USF Software Developer's Kit (SDK).

Simpler Management of Virtual Network Function Components (VNFCs)

During the virtual machine lifecycle, the external VNFM needs to interact with each virtual machine to carry out various lifecycle-related actions, such as deploy, undeploy, update, delete, and more. In order to perform those functions, the VNFM needs to contain the required logic and script for every virtual machine type. Integrating VNFM with NFVO (over Or-Vnfm) whenever new service functions are added into the system becomes a repetitive and costly exercise, especially when there are multiple vendors providing the required service functions. Ultra Services Framework simplifies integration with other virtual machines.

Easy Service Configuration and Management

Ultra Services Framework is managed by a single element manager. In addition to the VNFM proxy, the element manager provides abilities for service configuration management, SLA management, and northbound programmable interfaces for operation support system/business support system (OSS/BSS) integration. The element manager makes the entire USF self-sufficient for provisioning, operating, and managing services without complicated functional and integration dependencies with other ETSI-NFV components, such as VNFM, NFVO, and OSS. Northbound APIs allow operators to integrate with their existing BSSs/OSSs to further simplify various business processes and interworking with other network services.

Intuitive Customer Portal

Ultra Web Services is a customer portal that gives operators control to provision and monitor network services through a web interface. The dashboard provides a consolidated view of service status, resource consumption, and SLA management.

Hardware Compatibility

Cisco Ultra Services Framework requires the following minimum specifications:

- Cisco UCS® C220 M3 Rack Server or equivalent
  - Intel Xeon Processor E5-2680 v3
  - Intel Ethernet Converged Network Adapter X520-DA2 (2 x 10Gb)

Software Compatibility

Cisco Ultra Services Framework requires the following host operating system and Openstack releases and features:

- Host operating system: Ubuntu 16.04LTS or Red Hat Enterprise 7.2
- Openstack/KVM hypervisor: Ubuntu Mitaka or Red Hat Open Stack Platform 8
  - Open vSwitch (OVS) Data Plane Development Kit (DPDK)
  - Single-root I/O virtualization (SR-IOV)
  - CPU pinning, non-uniform memory access (NUMA), large pages
  - OVS ip-flow-cache
  - OVS port binding
  - Jumbo frames

Virtual Machine Sizing Requirements

Cisco Ultra Services Framework is composed of multiple types of virtual machine instances running on an NFV infrastructure (NFVI). Depending on its function, each type of virtual machine instance requires different amounts of vCPUs, memory, and storage resources. (See Table 2.)

Table 2. Cisco Ultra Services Framework Control and Management Plane Virtual Machine Sizing

Virtual Machine Type	Redundancy	vCPU	Memory (GB)	Storage (GB)	Notes
Control function	1:1	8	16	40	Total of two instances are required.
Session function	N:1	28	96	2	Each active session function instance yields approximately 850K subscriber sessions. These three instances are required at a minimum: • Session function active • Session function demux (does not actively handle sessions) • Session function standby (does not actively handle sessions)
Network function	N+1	16	96	6	Each active network function instance yields approximately 3.5M flows. These two instances are required at a minimum: • Network function active • Network function active providing redundancy
Element manager	1:1	4	4	32	Total of two instances are required.

Although virtual machine instances for management and control plane functions can be sized more predictably, virtual machine instances for data plane functions are highly subject to multiple variables, including service function performance provided by third-party vendors, the number of service functions residing on the same physical host, DPDK support, and more. (See Table 3).

Table 3. Cisco Ultra Services Framework Data Plane Virtual Machine Sizing

Virtual Machine Type	vCPU	Memory (GB)	Storage (GB)	Notes
Application function	8	16	6	One instance is required per physical host. Performance of each active instance is dependent upon various factors, including the number of service functions co-located on the host and the performance of each virtualized service function.

Ordering and Licensing Information

You can purchase Cisco Ultra Services Framework directly from Cisco or from any Cisco partner. Cisco Ultra Services Framework is only available as standalone software as part of the 5.0 release, but will be offered as part of the Ultra Services Platform in the near future.

Service and Support

You can purchase Cisco Software Application Support plus Upgrades (SASU) to receive technical support.

For more information about Cisco Software Application Support plus Upgrades (SASU), visit http://www.cisco.com/en/US/services/ps2827/ps2993/services_data_sheet0900aecd803f3d93.pdf.

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