Ensemble Service Orchestrator
Multi-Vendor NFV Service Management and Orchestration System

Ensemble Service Orchestrator (ESO) is an open, extensible carrier-class NFV service and VNF lifecycle management and orchestration system. The system coordinates and connects virtual resources to physical network elements to create, activate and assure virtualized services across multiple networking layers.

ESO is comprised of the following major components:

- Web UI and REST Interfaces
- NFV Service and VNF Catalog Management
- ESO Core that supports NFV and VNF lifecycle processes
- Cloud, network controllers integration
- Ensemble Service Intelligence (ESI) integration

CENTRALIZED OR DISTRIBUTED NFV INFRASTRUCTURES
Designed specifically for the metro service edge, ESO supports the placement of virtual network functions (VNFs) in centralized data centers as well as distributed placement across multiple data centers, central offices, points of presence or even customer-located compute platforms.

PRODUCT HIGHLIGHTS

- NFV services lifecycle, events-driven orchestration
- Flexible, policy-driven and fully field-extensible implementation of NFV and VNF lifecycle processes
- Multi-tenant system enabling NFV administrative domains, diverse actors and roles
- Horizontally scalable cloud application
- Open support for any arbitrary virtual network functions (VNFs)
- Arbitrary VNF service graphs/chains comprising multiple VNFs
- Automation of VNF configuration and NFV service activation/on-demand testing
- Integrated Service Intelligence suite for full NFV service management and analytics
- Open REST APIs for integration into BSS/OSS, business applications or other network controllers
- Support for both centralized and distributed cloud environments including data centers, COs and customer premise clouds
- Seamless integration with Ensemble Network Controller (ENC) for management of Carrier Ethernet network services bridging the physical and virtual worlds
SUPPORT FOR ANY VIRTUAL NETWORK FUNCTION
To enable the broadest possible service definitions, ESO is capable of instantiating any arbitrary combination of VNFs from best-of-breed, third-party software vendors. ESO can automatically optimize placement of these VNFs based on pre-defined policies and available resources. VNFs as part of NFV services can be connected via arbitrary service graphs/chains within a cloud or across clouds over a physical network. ESO also provides full VNF lifecycle management.

WEBUI OR OPEN APIs FOR INTEGRATION INTO HIGHER ORDER SYSTEMS
Service providers may initially deploy ESO using its built-in, web-based graphical user interface and standard workflow. They can then transition to a fully automated environment by integrating ESO interfaces into higher level systems using a set of open APIs and customizing the NFV and VNF lifecycle management processes.

CARRIER CLASS ORCHESTRATION
ESO features a full lifecycle event-driven orchestration system. Lifecycle processes are implemented using a BPMN 2.0 compatible workflow engine making it completely field extensible and adaptable to the service provider’s operational processes. Further, NFV lifecycle processes are policy driven via a tightly integrated rules engine. Lifecycle control workflows and tasks can be fully modified at design or run-time in accordance with operator policies.

ESO has been designed to support the entire lifecycle of a VNF-based service starting with the VNF onboarding to creation of the service through maintenance to the tear down of the service and resource reclamation.

The NFV service lifecycle starts after the virtual network functions are selected and when these VNF properties are described to the ESO system during the onboard stage. Among the steps in this stage, the VNF is registered in the system’s catalog, its gold software image loaded, and the VNF descriptor, its logical interfaces, resource requirements, configuration scripts and any contextual information regarding the environment in which the VNF operates, is created.

During the design stage, combinations of VNFs are interconnected in graphs (aka service chains) and may be formed into pre-defined templates called “composite VNFs” in order to simplify future deployments. During this stage, VNF-specific configurations and policies are created so that ESO will automatically pre-configure each VNF as part of the initial deployment.

Turn up of a particular instance of a VNF or composite VNF takes place in the deploy stage. This stage is triggered by a service order, and includes the setup of the virtual machine environment as well as the connection, configuration and testing of VNFs and the NFV service.

It is in the operate stage where ESO working with ESI monitors the health of the VNFs and the overall service alerting the operator should any faults occur. It is also where the scaling and repair of VNFs happens. NFV scaling and repair is automated per rules and policies provided by the VNF vendor and operator.

During the maintain stage, services may be stopped and VNFs removed from service, tested and then restarted. New versions of the VNFs may also be turned up to enhance the service functionality. Finally, this is where services and VNFs may be uninstalled and decommissioned.

ENSEMBLE OSA
ESO is a key component of Overture’s Ensemble Open Service Architecture (OSA)™. Ensemble OSA is the industry’s first open architecture for software-defined services designed to connect multiple clouds and interoperate with existing Layer 2 and Layer 3 VPN services.

Providers can use the platform for network service automation and network functions virtualization (NFV).

Comprising three logical layers and a number of independent components interconnected with open APIs, Ensemble OSA is designed to easily integrate into the architecture and workflow of any communication service provider (CSP) environment.

The Orchestration and Control layer includes the following components:

• Ensemble Service Orchestrator (ESO),
• Ensemble Service Intelligence (ESI),
• OpenStack Cloud Controller and
• Ensemble network controller (ENC).

Open support for any arbitrary virtual network functions (VNFs)
CONNECTING THE VIRTUAL AND PHYSICAL WORLDS

For connecting the physical and virtual worlds in order to provide end customer services, ESO, working with the Ensemble network controller, leverages operator’s existing L2VPN and L3VPN services for services that span multiple clouds and customer sites. Data steering is carried out at the cloud edges in order to steer traffic into and out of the NFV clouds. ESO has an open architecture and can also leverage a network controller of the operator’s choice.

SERVICE INTELLIGENCE

Ensemble ESO in combination with Ensemble Service Intelligence (ESI) introduces a fundamentally new model for NFV service management and analytics. Service monitoring in the physical network function (PNF) world is vertically integrated so that the network function monitors the application and the infrastructure on which it is running. In the virtual world, the infrastructure is shared, so there is no permanent one-to-one relation between the application and the infrastructure. If each VNF were to adopt the same paradigm as the physical world, this would not scale. Each VNF is redundantly polling the same infrastructure and further introduces security issues where a rogue VNF may bring down the whole shared infrastructure.

Instead ESO’s service intelligence suite decouples the infrastructure and resources from the services and uses the IETF I2AEX model. ESO’s service intelligence suite consumes and records information from the orchestration, infrastructure layer and other diverse data sources in discrete, separate data channels. The SI then adopts a dynamic data modeling and correlation framework to correlate these information channels per specific management and application needs. The service intelligence suite is built on a Titan graph database and Cassandra data repository. The intelligence suite leverages these technologies to provide a powerful framework for management and analytics with a scalable and ultra-resilient data repository.

NFV USE CASES

While ESO supports any arbitrary combination of VNFs and general NFV use cases, there are a few specific use cases that Overture has tested and/or deployed under orchestration by ESO.

- **Virtual Enterprise Customer Premises Equipment (vE-CPE).** This use case is focused on replacing the multiple network elements required to deliver a number of managed enterprise services, including managed router, firewall, VPN, PBX, and application acceleration.

- **Virtual Test Head (vTH) and Virtual Network Probe (vNWP).** These use cases involve placing virtual traffic generation and measurement systems at various points in the network to monitor network performance or execute troubleshooting tasks.

- **Virtual IP Multi-media System (vIMS).** This combination of media gateways, telephony application servers and session boarder controller forms the foundation for multi-media communications services for carrier-based and over-the-top services.

- **Virtual Service Edge (vSE).** This is a variation on the vE-CPE in which the VNF host environment is located on the customer premises, in a micro-datacenter based on Intel’s x86 architecture.
## Ensemble Service Orchestrator

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open northbound and southbound REST APIs</td>
<td>With the ability to integrate into higher level web-based business applications, OSS/BSS systems, third-party orchestration systems and other domain controllers, ESO can fit into any service provider environment.</td>
</tr>
<tr>
<td>Flexible workflow engine</td>
<td>Customize the NFV and VNF management workflow for any stage of the service lifecycle with the easy-to-use Business Process Model and Notation (BPMN 2.0) that's built into the system.</td>
</tr>
<tr>
<td>VNF agnostic management and orchestration</td>
<td>Combine one or more best-of-breed virtual network functions from independent software vendors to rapidly create new services. Any arbitrary VNF can be on-boarded into ESO.</td>
</tr>
<tr>
<td>Dynamic optimization engine</td>
<td>Right-size the compute and storage resources, using only the required capacity. Dynamically scale services up and down as needed based on policy or real-time changes in the network or compute environment. Automatically respond to outages and other failures by dynamically restoring services on alternative resources.</td>
</tr>
<tr>
<td>Control multiple cloud environments</td>
<td>Seemlessly manage multiple distributed cloud environments by providing the appearance of a single virtual cloud with distributed NFV infrastructure for flexible deployment of VNFs.</td>
</tr>
<tr>
<td>Composite VNF</td>
<td>By pre-engineering services that require multiple VNFs, the instantiation and turn up of complex network functions is greatly simplified.</td>
</tr>
<tr>
<td>Integrated fault management and performance monitoring</td>
<td>The entire VNF environment, including virtual machines, physical resources and network connections is continuously monitored for both health and performance, ensuring service availability and accurate accounting.</td>
</tr>
<tr>
<td>Seamless integration with Ensemble Network Controller (ENC) for management</td>
<td>Orchestrate virtualized cloud resources and Carrier Ethernet WAN connections from a single ESO and a single northbound interface, simplifying and decreasing operational expenses.</td>
</tr>
</tbody>
</table>

## TECHNICAL SPECIFICATIONS

### SYSTEM REQUIREMENTS

**RECOMMENDED MINIMUM SERVER HARDWARE**
- Dual Intel XEON E5520 2.26GHz quad core processor
- 32 GB RAM
- 1 Terabyte hard drive
- 4 Gigabit NICs

**SERVER SOFTWARE**
- CentOS 6.5, Red Hat Enterprise Linux 6.5

**CLIENT SOFTWARE**
- Internet Explorer, Firefox, Chrome