CloudBand Network Director

Release 19

Nokia CloudBand Network Director (CBND) automates network services delivery and operation in a distributed, multi-tenant, multi-vendor NFV environment while optimizing and governing the usage of the platform resources.

Overview

New virtualized services require an efficient NFVO to realize agility and cost advantages. CloudBand Network Director provides two main functions: As a Network Service Orchestrator, the system onboards Network Services (NS), automates their lifecycle, and provides monitoring and troubleshooting tools. As a Resource Orchestrator, CloudBand Network Director administers, provisions, monitors and optimizes NFV Infrastructure (NFVI) resources across geographically distributed NFVI nodes.

CBND focuses on the automation of recurring service deployments and lifecycle processes ranging from single-VNF network services to SD-WAN with dynamic service chaining, VoLTE, vEPC, Cloud RAN and Gi-LAN services.

Through the support of TOSCA, an open, domain-specific model for NS, and open source workflow and policy engines, operators benefit from the rapid pace of open source innovation in carrier-grade software that is ready for deployment.

The architecture of CBND (Figure 1) is based on a set of micro-services. Plugins and ETSI NFV compatible APIs ensure maximum flexibility by enabling it to work with any vendor’s Virtual Infrastructure Manager (VIM), VNF manager (VNFM), SDN controller (SDN-C), EMS or physical network function. CBND is pre-integrated with CloudBand Application Manager (VNFM), CloudBand Infrastructure Software (VIM and NFVI), and Nuage Networks VSP SDN-C. Nokia Global Services offer integration services for components from other vendors.

Figure 1. Logical Architecture
Benefits

Network Services and VNF management:
• Rapid, repeatable introduction of NS
• NS and VNF Lifecycle management automation (create, deploy, terminate, delete, configure, update (scale, heal, upgrade, etc.), disaster recovery)
• Simplified creation and management of complex Service Function Chains

Resource management:
• Simplified management of large-scale, multi-tenant, multi-site, multi-vendor, multi VIM/ VNFM/SDN-C NFV clouds
• Automate prerequisite (Day -1) tasks needed for NS/VNF deployment including identity management (projects, users, etc.), resource configuration (host aggregates, VM flavors, etc.) and VNF Package management (VNF package onboarding to VNFM, Image distribution to VIMs, etc.)
• Automate resource lifecycle management and maintenance operations such as upgrades, patch distribution, batch configurations, and emergency actions

Deployability and operations:
• Alignment with open source upstream for rapid innovation, lower costs, and no vendor lock-in
• User-extensible plugins and ETSI NFV API interfaces allow easy integration with third-party elements
• Enhanced assurance with network service monitoring & topology, resource monitoring, and root cause analysis
• Standalone NFVO or integrated into full Nokia stack (NFVO, VNFM, SDN-C, VIM, NFVI)

Network Service Orchestrator

A Network Service, according to the ETSI NFV definition, is a collection of Network Functions (Virtual and Physical) connected by a VNF forwarding graph.

CloudBand Network Director models and orchestrates Network Services using OASIS TOSCA templates and OpenStack Mistral workflows. It supports NS onboarding and cataloging. Onboarding is achieved by modeling the service as a Network Service Descriptor (NSD), with a collection of VNFs connected with a forwarding graph, a set of resource requirements and a collection of workflows describing its lifecycle actions. The resulting model is documented as a Cloud Service Archive and stored in the NS catalog. With its domain-specific model and workflow engine, the clear majority of Network Services/Network Functions can be onboarded without software changes.

Once a Network Service or Network Function has been onboarded, higher level orchestrators or human operators can trigger CBND to deploy or update an instance of the NS as part of the service orchestration process.

As a first step of the deployment process, the set of VNFs and VNF forwarding graphs is determined based on the NSD. Then, CBND identifies a VNFM to execute the lifecycle of the VNFs. It then instructs the VNFM to deploy and commission the VNFs and configure connected PNFs to work with the VNFs. It requests an SDN controller to establish the VNF forwarding graph between the Network Functions. The forwarding graph can be a collection of virtual links with or without service chaining. For service chaining use cases, Network Forwarding Paths are configured as defined in the VNF forwarding graph.
During the lifetime of the NS, CBND captures Network Service records and VNF records, monitors the health status of the service and scales, heals, and updates the service according to policies described in the NSD.

**Resource Orchestrator**

As an NFV Resource Orchestrator, CloudBand Network Director offers a global view of all available resources across NFVI nodes, as well as information on how VNFs and NS use these resources (Figure 2). This unique position and insight allows it to manipulate, police, analyze and then optimize the behavior and the utilization of the NFV platform.

CBND administers resources such as VIMs of multiple NFVI nodes, VNF managers and SDN controllers. It maintains an inventory and a topology map of the nodes and their resources, regardless if the resources were allocated through it or through direct VIM API calls. It monitors the overall status and health of these resources and reports this information to higher level OSS and human operators.

CBND enables the modeling of Operational Services in a similar manner to how NS are modeled and expresses them as items of the CBND Catalog. Heat Orchestration Templates and OpenStack Mistral workflows can be written and then executed on applicable targets enabling to configure VIMs/VNFMs/SDN-Cs and additional plugin-based managed resources. It enables also to configure operational tasks related to preparing the NFVI for NS/NFV deployment (Day -1 Operations) as well as operational tasks related to resource lifecycle management such as patch management, emergency actions, etc. These operational tasks can be executed on multiple targets in parallel (batch operation).

The Policy Engine is used to apply configurable policies and to govern VNF and NS lifecycle management actions across the platform. Policies can be applied relating to the placement of each resource, such as affinity, priority or quotas.

CBND accepts or rejects resource requests from VNF managers and other systems based on such policies. It optimizes the use of resources to achieve higher performance and better utilization and recommends placement of VNFs and NS across different NFVI nodes, with enhanced platform awareness.

Based on resource usage analytics, CBND supports NFVI capacity management and planning. By analyzing trends in capacity and disaster recovery requirements, it can forecast what capacity will be needed. In addition to the planning aspects, the analytics engine suggests better ways of using current capacity based on simulations.

Figure 2. CBND Dashboard
Monitoring, assurance and disaster recovery

CloudBand Network Director facilitates fault monitoring by tapping into capabilities of various fault management applications such as EMS/NMS, VIM, VNFM and SDN controllers. Faults received from these sources are enriched with information about associated NS to simplify network troubleshooting. Troubleshooting and automatic repair use a common topology and correlation engine based on OpenStack Vitrage, a root cause analysis tool.

CloudBand Network Director, with its lifecycle management engine, supports high availability and several automated disaster recovery models that can be described and configured in the NSD/VNFD.

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| Addressing the full operational spectrum of the NFV domain | Day -1: All infrastructure preparations before the Network Service can actually be deployed/instantiated  
Day 0: Delivery of the NS into the network domain  
Day +1: Ensuring the service is operating with the right SLAs |
| Standalone NFVO or pre-integrated with Nokia’s MANO stack and VNFs | Part of a tested and validated end-to-end NFV offering or available on a standalone basis |
| Embedded support for multi-VIM/VNFM/EMS/SDN solution integration | Plug-in architecture enables short integration cycles in a multi-vendor environment |
| SDN integration for complete NS connectivity | Generic solution for networking requirements of Network Services across data centers and WAN, interconnected with the VNFs deployments across multi-VIM/VNFM environments  
Decoupling of the VIM and SDN controller enables deployment scenarios without VNFs and their VIMs |
| Analytics and policy engine for optimizing resource utilization of the NFV platform | User-extensible tools for controlling NFV platform behavior and usage patterns |
| Open source descriptor model (TOSCA), workflow engine (OpenStack Mistral) and topology & correlation engine (OpenStack Vitrage) | Simplify network operations and reduce OPEX by relying on common and open technologies including workflow, policy, identity management, topology and correlation |
| Resiliency | High availability with load balancing and anti-affinity rules ensure no single point of failure.  
Geo Redundancy  
Disaster recovery modeling of Network Services. |
| Operability | Workflow engine visualization, NSD viewer & editor, backup & restore, log auditing and analysis, NSD versioning (backward compatibility) |
| Multi-tenancy and Role-based access control | System is partitioned to realms (tenants). Each realm operates as a logical NFVO offering independent management of NFVI nodes and Network Services |
| Lean and proven | Lean, small footprint micro-services, deployed at production by multiple customers within multi-vendor environments |

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