Oracle Network Applications Platform (ONAP)
Technical Overview
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Introduction

The Oracle Network Applications Platform (ONAP) product provides an engineered solution for deploying telecommunications- and network-grade applications. The ONAP solution integrates the infrastructure stack components along with virtualization technologies to offer a robust and flexible platform for development and deployment. ONAP infrastructure components include the carrier grade Oracle Sun Netra 6000 Modular System and Oracle Sun ZFS Storage 7320 Appliance, along with Oracle Linux, Oracle VM Server, Oracle Enterprise Manager, and Oracle Clusterware technologies. Each technology stack component has been engineered and integrated to offer a market-leading vertically integrated solution. This integrated platform is greater than the sum of its parts, with the best in simplicity, flexibility, and reliability.

The ONAP architecture is designed to help customers maximize the value of their investments by leveraging a telecommunications platform that is agile to deploy. The architecture ensures optimized performance, seamless and integrated operations management, and high availability for mission critical deployments.

The following diagram details the ONAP Architecture:

ONAP architecture provides the key building blocks for end-user, network-centric applications. Typical network applications require life-cycle services for development, deployment, and upgrades. Data, middleware, presentation, and north- and southbound adapters are needed within the application services domain, while management, monitoring, and service availability
functionality is needed within the development and deployment functional domains. All of these capabilities are represented as building blocks within ONAP.

The ONAP architectural building blocks provide telecommunication and network end users with a foundation for mission-critical application development and deployment. With built-in tools for appliance assembly, an integration development kit, and a plug-in architecture for platform service modules (PSMs), ONAP provides a “single deployment solution” for current and next generation telecommunication and network application services.

ONAP provides end-to-end management across applications and stack tiers including infrastructure. This end-to-end management, or Unified Management, leverages Oracle Enterprise Manager as its foundation solution. The Oracle Enterprise Manager capabilities include automation of life-cycle management. The ONAP life-cycle management solution offers two implementation choices for end-users: a Command Line Interface (CLI), or a User Interface (UI). End users can leverage the single, web-based console from Oracle Enterprise Manager to manage the complete life-cycle services offered by ONAP.

Along with Unified Management, ONAP also provides Unified Availability across its stack tiers including infrastructure. Unified Availability leverages Oracle Clusterware (OC) and Oracle Communications Service Availability (OCSA) as its foundation solutions. By providing an enterprise-grade clustering solution through OC along with a carrier grade availability solution through OCSA, ONAP offers its end users an application availability implementation choice.

With the foundation provided by Unified Management and Unified Availability, capability to extend the functionality offered by ONAP is provided by PSMs. The plug-in architecture of ONAP, along with PSMs that can be added on demand, offers customers a comprehensive long-term technology choice for application development and deployment.

ONAP benefits cut across business and technology boundaries. Customers can achieve the following business benefits by standardizing the pre-configured, integrated, and tested ONAP, which delivers up to seven 9's (99.99999%) service availability and unified platform management:
• Reduce platform integration and testing costs by up to 33%, and lower operating costs by up to 64%\(^1\)

• Accelerate time-to market of new services by up to 40%\(^1\)

• Shift highly skilled resources to focus on innovation, resulting in up to 50% savings from application lifecycle spend\(^1\)

Similarly, ONAP customers can achieve the following technology benefits:

• End-to-end management across the hardware and software stack

• Complete lifecycle management across installation, configuration, monitoring, management, administration, diagnostics, testing, patching, and upgrades

• Increased manageability and reduced support cost through automation of various lifecycle services

• End-to-end availability across the hardware and software stack

• Creation of application appliances by leveraging the integration development kit. Accelerates both the application development and deployment processes

• Cost-effective technology refresh and choice for development and deployment

\(^{1}\) Source: Analysys Mason
ONAP Engineered System Solution

The ONAP engineered system is a carrier-grade solution that bundles hardware and software that is integrated, optimized, certified, and supported as a single coherent unit. The ONAP solution is reliable and secure, and provides a platform for consolidation and virtualization. It can be used for deploying various mission-critical types of telecommunication and networking workloads. Following are some of the properties of the ONAP solution:

- Integration within each stack layer
- Integration across the stack layers
- Integration with other systems
- Automation of life-cycle services

Architecture

ONAP uses several Oracle technologies for end-to-end management, availability, clustering, and virtualization, along with appliance-creation tools and utilities to facilitate and improve use of the system. ONAP also provides carrier grade security and a "single pane of glass" for end-to-end management.

ONAP architecture consists of both the hardware and software components. The software components are layered in a multi-tier architecture. These combinations of components within a multi-tier architecture make up a computing system or environment that interacts with the infrastructure layers—computing resources, networking, and storage—to offer a robust platform for development and deployment.

The following sections describe views of the ONAP architecture: hardware configuration and tiers, management system, high-availability system, operating environment, and appliance creation and deployment.
Hardware

Frame Architecture

From a hardware architecture perspective, ONAP systems are always delivered and deployed as complete frames. The ONAP frame uses an industry-standard 19” rack and contains all the computing servers, networking fabric, storage, and power distribution needed to support the ONAP management framework along with its hosted network functions and application services.

Computing servers within the frames are of two types: management and computing (also referred to as payload). While computing servers can be added subsequently to partially populated frames, no other hardware additions are permitted.

Components

The specific components of ONAP systems consist of servers, network switches, storage devices, and rack infrastructure—which in turn consists of a rack, power distribution, cabling, and an Ethernet switch used for certain internal connections. Following are some of the key ONAP infrastructure components:

- **Server Blades**: Sun Netra Carrier Grade Blade Servers are the servers of choice for the ONAP systems, with the Netra Blade X3-2B Server Module. The blades have dual Intel Xeon processors, 256 GB of memory, 4 on-board 600 GB hard disk drives, and dual 10 gigabit Ethernet (GbE) ports. An on-board service processor runs Oracle Integrated Lights Out Manager (ILOM), which enables full remote management of the blade and is integrated with the ONAP management framework. The blades are operated in the Sun Netra 6000 Modular System which can house up to 10 blades.

- **Server Chassis**: The Sun Netra 6000 Modular System is a 10 RU rack-mountable chassis that provides the blades with redundant power and cooling, I/O interfaces, and overall chassis-level management through a dedicated Chassis Management Module (CMM). The CMM is a service processor that runs Oracle ILOM and is likewise integrated with the ONAP management framework. To interconnect each blade’s dual 10 GbE ports, a redundant pair of Sun Netra 6000 Switched Network Express Modules (NEM) 24p 10 GbE is installed in each modular system. These modules allow high speed inter-blade communication within a modular system, and provide external ports for connection to other devices both within an ONAP frame and to customer networks.
• **Network Express Module (NEM):** The Sun Netra 6000 Switched Network Express Modules (NEM) 24p 10 GbE is a 24-port 10 GbE switch in Network Express Module form-factor. It has 10 internal ports that connect to the Sun Netra 6000 Modular System mid-plane and 14 external logical ports. The 14 external logical ports are made of up 2 SFP+ physical ports that can operate at 1 GbE or 10 GbE, and 3 QSFP physical ports that operate at 10 GbE each for an aggregate 4 x 10 GbE (40 GbE). There is also an on-board service processor that runs Oracle ILOM and is integrated with the ONAP management framework.

• **Storage Device:** Sun ZFS Storage Appliances are the shared storage solution for ONAP systems, with the Sun ZFS Storage 7320 Appliance being the specific model used. The Sun ZFS Storage Appliance file system, Oracle Solaris ZFS, seamlessly manages a storage appliance’s underlying storage devices which are a mixture of hard disk drives and solid state drives. Each storage appliance consists of a pair of controllers and either 2-disk or 4-disk shelves. A disk shelf contains 20 hard disk drives and 2 solid state drives. To achieve high availability, the disk shelves are linked together, with additional connections to both controllers thereby allowing either controller to access any disk within any disk shelf. As well as managing the storage pools, the controllers support a number of data-access protocols such as NFS and iSCSI. To transfer data, each controller has a pair of 10 GbE devices that are connected to the compute blades through the pair of Sun Netra 6000 Switched Network Express Modules 24p 10 GbE. The controllers also provide administrative access to the storage appliance as a whole, with on-board service processors running Oracle ILOM to manage each controller in turn. Subsequently, both these management interfaces (that is, at both the appliance level and at the controller level) have been integrated into the ONAP management framework.

• **Platform Frame:** The Sun Rack II 1042 is the frame of choice for ONAP. These rack cabinets are 42 RU high, 600 mm (19” wide), and 1058 mm deep. Each frame comes with 2 zero RU power distribution units (PDUs) for redundancy. The PDUs are single phase. In addition, each frame comes fully cabled for power and data cables are pre-installed. Finally, a top-of-the-shelf 10/100/1000 Ethernet switch is included that interconnects service processors within the frame.
Available Configurations

ONAP supports two frame level configurations: Compute plus storage and compute only. In the compute plus storage frame, a Sun Netra 6000 Modular System with up to 10 blades is combined with a Sun ZFS storage appliance. In the compute only frame, 2 Sun Netra 6000 Modular Systems, with up to 10 blades each, are combined. No storage is included in this configuration.

Figure 1: Physical layout of compute plus storage configuration

Figure 2: Physical layout of compute only configuration
The following diagram represents the logical layout of the compute plus storage configuration:

Networking

All of the networking inside an ONAP frame takes place over Ethernet connections. Consequently, several classes of network traffic need to be transported and managed. The most obvious classes are internal ONAP management traffic, service processor traffic, storage traffic, internal network application traffic (data), and finally, externally facing interface traffic (application). Traffic classes are modeled as VLANs to ensure appropriate segregation and quality of service.

Only traffic on the specifically selected management and application interfaces enters or leaves the ONAP frame. For redundancy, each external network interface and the modular system-controller network links are hosted on bonded pairs of ports, with each part of the bond located on a separate Sun Netra 6000 Network Express Module 24p 10 GbE.

Management System

Architecture

ONAP provides Unified Management—an end-to-end management system that manages the infrastructure and associated software components. It also provides a framework for the management of end applications deployed on ONAP.

Two blades from the ONAP configuration are reserved to host the management services. These two management blades are clustered in active-standby mode, and data between these two nodes is synchronized and replicated for consistency. Upon a failure of an active
management node, the standby node provides the necessary management services for complete ONAP management functionality. Management services represent the various functional components that help orchestrate, synchronize, and implement management functionality.

Following are a few sub-systems of the management system:

- **Telecommunications Mediation Layer (TML)** – This sub-system provides northbound management interfaces for integration with external management systems. ONAP supports a command line interface (CLI) and an SNMP interface.

- **Oracle Enterprise Manager Cloud Control (OEM)** – This sub-system provides the framework for connecting and orchestrating various infrastructure components to a centralized framework for management activities. It also provides a Graphical User Interface (GUI) for centralized management and control.

  The OEM framework is extensible. Leveraging the OEM framework and ONAP integration kit, end-user applications can be integrated within the ONAP management system for centralized, end-to-end management.

**Functionality**

The following functionality is provided by the ONAP Unified Management framework:

- **Life-cycle management services** – These services represent the installation (deployment), configuration, monitoring, events management, administration, testing, diagnostics, logging, patching/rollback, and upgrade functionality.

  Provisioning of Field Replaceable Units (FRUs) is also automatically managed by the life-cycle management services.

- **Security** – The authentication and security sub-system ensures that access to the ONAP management system is logged and tracked for secure access based on roles and privileges. Security is enabled end-to-end during access via CLI or GUI.
• **Access interfaces** – These interfaces represent the various integration or access interfaces that are available for the management framework. CLI, SNMP, and GUI are the three available interfaces.

High-Availability System

Architecture

ONAP provides Unified Availability, which is an end-to-end availability framework for infrastructure and associated software components. Within the ONAP availability framework, two distinct clustering solutions have been integrated and exposed for end-user integration:

• **Oracle Communications Service Availability (OCSA)** – OCSA represents the leading open standards-based high availability (HA) and systems management middleware for carrier-grade and mission critical systems. OCSA was designed to support the Service Availability (SA) standards to provide session integrity with stateful failover, and seven 9s service availability. The SA Forum Application Interface Specification (AIS) consists of an Availability Management Framework (AMF), and multiple distinct services that form the basis of service availability middleware. OCSA provides programmatic access to the availability system model, which is a subset of the information model, offering scalability to multiple nodes with stateful recovery, service groups, and multiple redundancy models (2N, N+1, N+M, N-way, No-Redundancy). OCSA combines hardware management, distributed messaging, and systems management services to deliver the highest levels of service availability. All OCSA services feature high performance, low resource utilization, and simplified development and implementation cycles.

• **Oracle Clusterware (OC)** – Oracle Clusterware is an enterprise-grade clustering solution that allows clustering of nodes or application processes so that they function as a single system or application. ONAP leverages OC and OCSA for its end-to-end high-availability management. Leveraging the “skgxnn” interface, OC integrates with OCSA for cluster notifications. This allows clusters that are OC-enabled to communicate with OCSA clusters through the Cluster Membership (CLM) framework.

As part of ONAP unified availability framework, OC gives administrators of end-user applications a choice for clustering. Either the OCSA framework or the OC framework can serve as the solution of choice for application availability.
management. End-user applications of both types, OC and OCSA, can co-exist and inter-operate within the ONAP operating environment

Functionality

The following functionality is provided by the ONAP Unified Availability framework:

- **Hardware Platform Interface (HPI)** – Provides availability support at the infrastructure level.

- **Cluster Membership (CLM)** – Cluster node management sub-system. Cluster nodes are managed by CLM based on the resource availability information received from HPI.

- **Cluster Definition and Integration Framework** – Applications that want to leverage the ONAP availability framework can define and specify definitions to integrate either through OC or through OCSA.

Operating Environment

Architecture

The ONAP operating environment represents the complete infrastructure and software environment to host end-user applications. Traditionally, a typical server that hosts end-user applications is made up of hardware components, firmware, operating system, and system and application libraries plus tools and utilities. The ONAP operating environment is similar in nature but the software components are “virtualized” for end-user application distribution and consolidation. ONAP leverages Oracle VM Server as the underlying foundation layer for virtualization.

Each ONAP compute blade can host one to four virtual machines (VM). Each virtual machine can be assigned a set of compute plus storage resources along with hosting of end-user applications. ONAP simulates a “virtualized infrastructure layer” and allows end-users to define their application deployment topology and resource needs.

Following is the logical layout of an ONAP compute plus storage system with virtual machines within compute blades (CB):
Functionality

The following functionality is enabled by the ONAP operating environment:

- **Oracle VM with Oracle Linux as guest Operating System** – End users planning to deploy mission critical applications are looking for a widely deployed, robust, and proven platform and related technologies for deploying their applications. They also aim to consolidate applications that can be co-located or hosted as a unit. Beyond consolidation, they want systems that allow for improving application deployment and management.

ONAP supports Oracle VM with Oracle Linux as the guest operating system. Oracle VM is a virtualization solution that makes applications of diverse workload types easier to deploy, manage, and support. It also provides a framework to facilitate the deployment and operation of applications that is rapid, repeatable, and error free. Oracle VM is proven to reduce operations and support costs while simultaneously increasing IT/datacenter efficiency and agility.

- **Resource Definition** – End users can define application specific resource constraints during application deployment. Networking, computing, storage, and clustering resource definitions can be provided for each application deployment. Resource definitions are important for the application to function within a “virtual” container.

ONAP leverages the resource definition for each application to allocate resources within the operating environment.
Appliance Creation and Deployment

Architecture

ONAP architecture allows application development and deployment. A typical application development cycle undergoes application implementation followed by testing for functionality. During application development or post application testing, the ONAP Integration Development Kit (IDK) framework can be used for application integration and deployment.

The IDK allows the component integrator to do the following:

- Integrate application management into the ONAP operating environment
- Integrate applications with enterprise-level (OC) or carrier grade (OCSA) service availability
- Use various tools to create user-defined packages and deploy an application release
- Rapidly test customer-created packages and application releases in increments before deploying a complete release

Functionality

The following functionality is enabled by the ONAP appliance creation and deployment framework:

- Extensibility Development Kit (EDK) – An integral part of ONAP architecture from Oracle Enterprise Manager. A key component of the Oracle Enterprise Manager is the Extensibility framework. To enable end users and customers to extend the Oracle Enterprise Manager platform, an Extensibility Development Kit (EDK) is provided with the product. Leveraging the EDK, applications can integrate with the ONAP Unified Management functionality for centralized management capabilities.

- Software Development Kit (SDK) – A collection of tools, utilities, and documentation. Leveraging the SDK, applications can integrate with the ONAP Unified Management and Availability functionality for management and availability capabilities.

- MINDConstructor – The graphical IDE supplied with the Telecom Mediation Layer (TML) of ONAP. In MINDConstructor, a TML meta-model is a visual representation of...
the ONAP management classes and notifications in a TML model project. MINDConstructor is used to facilitate the development of the ONAP management meta-model and the generation of any output based on the model definition.

- XML Specification – The TML meta-model that represents the ONAP management specification.

Conclusion

Customers seeking a mission-critical platform that is cost effective for application development; that is simple, repeatable, and reliable for application deployment; and that employs technologies with an existing ecosystem can adapt to ONAP to gain competitive advantage. By adapting to ONAP, customers will be able to achieve greater business agility and faster time-to-market end applications. In addition, they will increase flexibility across operations, improving their overall competitive advantage.