

ONAP 5G

Blueprint Overview

ONAP Promises to Automate
5G Deployments

OVERVIEW:

- 5G poised to transform the global economy
- ABI Research predicts 5G economic output to be \$10T by 2035
- 5G is characterized by extreme broadband, machine-to-machine/IoT communication, and low latency

CURRENT PROBLEM:

- Radio technology will require 10x number of RF heads
- Order of magnitude greater network service lifecycle management and RF/network optimization complexity
- Edge automation required to support hybrid radio and new applications

SOLUTION:

- ONAP 5G blueprint will be developed over multiple releases
- Key initiatives include PNF support, network slicing, network optimization, and lifecycle management
- Casablanca release introduces the first set of functionality

Overview

The move from 4G to 5G has already started. The true promise of 5G is not just the 50x more speed, 10x lower latency, and 1000x more capacity¹, but that it will dynamically support multiple different services concurrently.

This combination of capabilities will transform the global economy by unlocking new use cases such as immersive media, autonomous vehicles, smart factories/cities/buildings, connected health, next generation education, and others. Unlike previous generations, 50% of the data generated in 5G will be through IoT devices. With these new 5G applications, ABI Research predicts that the total 5G economic output by 2035 will be \$10T.

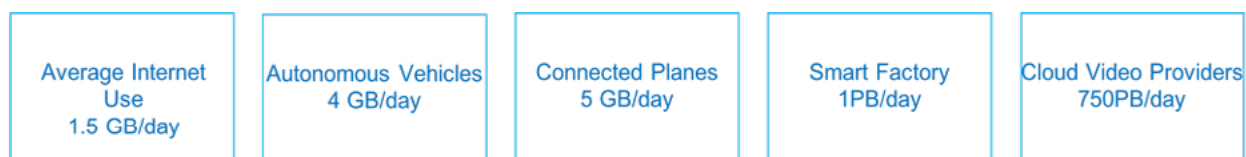


Figure 1: Mobile Network Data by 2020 For Sample Applications²

Some key technologies in 5G are:

- **eMMB (enhanced mobile broadband):** Promises to provide broadband capability to users with a peak data rate of 20 Mbps enabling services such as immersive video.

¹ Cisco VNI Forecast and Methodology, 2016-2021

² "Network of Tomorrow — 5G and Edge" presentation at Open Networking Summit Europe 2018

- **uRLLC (ultra-reliable low-latency communications for remote device):** Guarantees sub millisecond response times enabling services such as industry 4.0, remote surgery, AR/VR, and rescue and smart car applications.
- **MMTC (massive machine-type communications):** Supports 1 million devices per km2 enabling applications such as autonomous vehicles, M2M applications, and IoT.

These new use cases and technologies bring with them a level of dynamic network behavior unlike previous generations of wireless technologies.

Problem

The level of dynamic behavior stems from different applications requiring different levels of latency, reliability, availability, mobility, bandwidth, and cost. For example:

Autonomous vehicle	Low latency, high mobility
IoT	Low cost, low bandwidth
Factories	High reliability, low mobility
Video	High bandwidth, high latency

Table 1: Different 5G Applications Have Different Needs

The core technology that supports these diverse requirements is called network slicing, that per 5G.co.uk is the ability to “provide dedicated virtual networks with functionality specific to the service or customer over a common network infrastructure”. Furthermore, the environment becomes even more dynamic with the need to deliver edge computing applications to subscribers on-demand.

To support 5G networks, network automation becomes a key consideration, and the following new requirements emerge for the management and orchestration (MANO) layer:

1. **Hybrid 5G radio network:** 5G will require some parts of the radio network to be implemented in the form of Physical Network Functions (PNFs). This means that a 5G network services will need to support both PNFs and virtual network functions (VNFs³).
2. **Edge Automation:** Traditional networks services and their constituent VNFs have been deployed in big datacenters. With 5G, centralization of radio processing and decentralization of core/edge application processing is expected to create a large number of highly distributed edge locations.
3. **Real-time analytics:** 5G networks will need to optimize themselves in real-time in response to subscriber requests and network behavior. This means that edge locations will need to perform real-time analytics to influence the lifecycle management actions such as scaling, fault management, performance optimization, and others.

Solution

The Open Network Automation Platform (ONAP) project automates 5G using software defined networking (SDN) and network functions virtualization (NFV) technologies.

ONAP is an open source project that provides a common platform for telecommunications, cable and cloud operators and their solution providers to rapidly design, implement and manage differentiated services. ONAP provides orchestration, automation and end-to-end lifecycle management of network services. It includes all the Management and Orchestration (MANO) layer functionality specified by the ETSI NFV architecture; additionally, it provides a network service design framework and FCAPS (fault, configuration, accounting, performance, security) functionality.

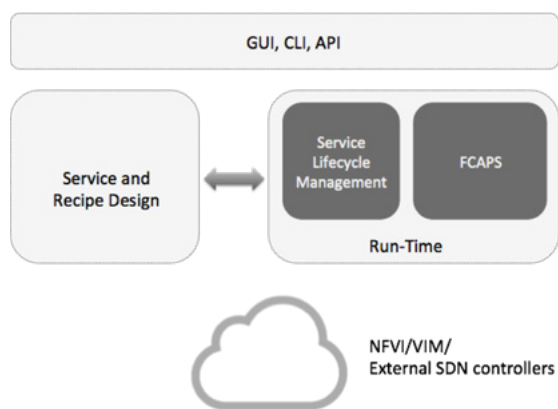


Figure 2: ONAP Functionality

³ PNF/VNF are jointly referred to as xNF for convenience

5G automation is a complex topic that will be fully addressed over multiple ONAP releases. The Casablanca release enables an initial set of 5G features and sets the overall direction for subsequent releases. The major 5G related ONAP initiatives include:

- PNF discovery & integration
- Network slicing (Not included in Casablanca, planned as a roadmap item)
- 5G network optimization

PNF Integration

With 5G, CSPs need to deploy disaggregated 5G Radio Access Network (RAN) elements (3GPP 5G Option 2-2 configuration). Some of these network functions are virtualized, running on an edge cloud infrastructure while others are appliance-based or PNFs. ONAP lays the groundwork to support the complete lifecycle management of PNFs. The various steps to support PNFs are:

- **Design time**
 - PNF modeling
- **Runtime**
 - PNF instance declaration
 - PNF bootstrapping
 - PNF registration
 - PNF activation

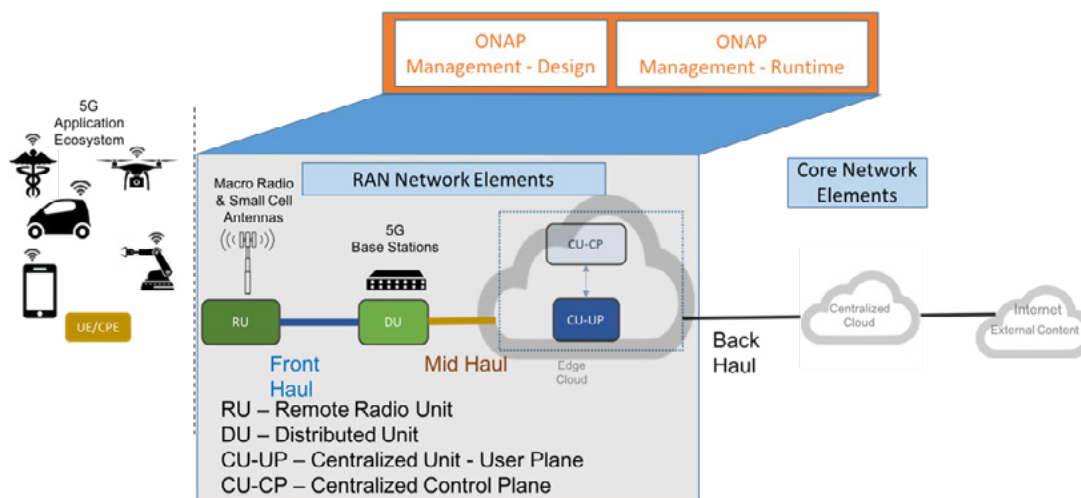


Figure 3: Disaggregated Hybrid RAN

Network Slicing

The Casablanca release does not include any Network Slicing functionality yet, but rather lays the foundation for subsequent releases by kicking off modeling work; nevertheless, this section is included for completeness.

As discussed above, different 5G services require different latency, reliability, availability, mobility, bandwidth, and cost requirements. End-to-end network slicing as defined by 3GPP provides specifications for creating efficient multiple logical networks using common network infrastructure that can meet requirements for each of the services. Over subsequent releases, ONAP will support the complete orchestration and lifecycle management of such 5G E2E network slicing. To accomplish this, ONAP will need to support slice design, orchestration, configuration, automatic re-configuration due to requirement or condition changes, transport network configuration, and vEPC configuration.

5G Network Optimization

A CSP will need to, in real-time, optimize the performance of the 5G service. This optimization will require dynamic configuration of relevant 5G radio and backhaul network parameters. To date, optimization functions have been realized in 3G and 4G networks via vendor-proprietary hardware and software. ONAP will enable the design and implementation of an open ecosystem for 5G optimization across multiple releases.

The list of network optimization ONAP features, current and future, is:

- **High Volume Performance Management:** 5G requires real-time analytics for time sensitive Performance Management (PM) data delivered at frequent intervals (less than one minute) from a large number of edge locations. This analytics data is used to drive network and customer experience optimization. Until 4G, optimization algorithms have resided in network elements; ONAP will change that by absorbing these algorithms to unburden xNFs. This analytics capability will ultimately lead to AI/ML based algorithms that will fully automate the network.
- **Bulk Analytics:** 5G also requires batch processing of bulk PM data delivered less frequently (say every 5-15 minutes) for optimization purposes.
- **Homing:** ONAP will find the best edge location for a given workload. Workloads include VNFs, edge analytics, and possibly edge computing (MEC⁴) applications. Homing includes considerations such as Physical Cell ID (PCI) and RF optimization. ONAP also allows homing policies based on hardware platform awareness.
- **Scaling & Healing:** With the sheer increase in edge locations, it becomes important to automatically scale-in/out Centralized Units (CU) and other VNFs to provide a balanced network with the right amount of capacity. Self-healing goes hand-in-hand with scaling.
- **Edge Automation:** For all of the above reasons, it is critical to onboard and register edge compute locations with ease.

In addition to these three major initiatives, the community has also been active in service definition and management, dynamic network inventory management, and harmonizing model definitions with 3GPP and ETSI to allow vendors to easily support multiple platforms.

⁴ Multi-access edge computing

Implementation Details

ONAP Casablanca provides the first installment of 5G functionality with the following key features.

- The ONAP Service Orchestrator (SO), various controllers (VF-C, APP-C), Active & Available Inventory project (A&AI), Data Collection Analytics and Events (DCAE), and VID (Virtual Infrastructure Deployment) projects support PNF registration and PNF discovery, orchestration, lifecycle management, and monitoring.
- A new high volume VES collector that uses Google Protocol Buffers encoding over TCP/TLS allows, ONAP DCAE to now support real-time PM data collection. DCAE also supports File collection to ingest bulk PM data.
- The MultiCloud project has tighter integration with SO simplifying onboarding of edge clouds.
- The OOF project has a number of homing improvements to support 5G requirements such as PCI optimization and Hardware Platform Awareness (HPA).
- The Policy project supports requirements such as PCI control loop.
- The modeling project has made advances in PNF Descriptor Resource Information Model.

By utilizing these features, the ONAP community has shown five demonstrations: 1) PNF support using a 5G Distributed Unit (DU) emulator, 2) PNF software upgrade using an external Element Management System (EMS), 3) real-time high-volume PM data collection, 4) bulk PM data collection, and 5) homing optimization for PCI (a SON Self-Optimization Use Case).

Summary

CSPs consider 5G to be a critical use case for ONAP. The 5G blueprint is a multi-release effort, with Casablanca introducing some key capabilities around PNF integration and network optimization. Modeling and platform enhancements in Casablanca will set the stage for full 5G support in later releases. Given that the operators involved with ONAP represent more than 60% of mobile subscribers and the fact that they are directly able to influence the roadmap paves the way for ONAP to become a compelling management and orchestration platform for 5G use cases.

References

[5G Use Case Proposal](#)