UNIFIED PLATFORM SERVICES FOR CLOUD-NATIVE NETWORK AND IT

White Paper on unified platform services for cloud-native network and IT workload in multi-cloud

Abstract

New age technology workload including 5G Network, IT applications, data and services requires a major shift in its management, integration and orchestration in cloud. Last 5 years have seen an exciting journey of network functions movement from proprietary hardware to virtualized infrastructure with SDN and NFV. ETSI MANO, ONAP provided key standardization, requirement & architecture for CSPs and vendor eco-system to allow them to build, deploy networking components, which could truly fit and support a fully virtualized infrastructure of servers, storage and networks. The current efforts of virtualization are primarily focused on supporting virtual machines based virtual network functions (VNF), running on hypervisors.

Virtualization and its management is going through major changes due to emerging containers and cloud-native nature of microservices based VNF/CNF, network, vRAN, 5G and network slicing. Similarly, other workloads of IT applications and data management are also transforming into cloud-native services and functions. The vibrant cloud-native industry landscape is making build-anywhere deploy-anywhere a reality and leading to the emergence of multi-cloud industry dynamics. Enterprises are adopting cloud-native microservices with great success, and telecoms should also benefit from these technologies in network and IT systems.

This paper discusses opportunities to leverage these advancements for evolution of cloud technology architecture and platforms refactoring options to multi-cloud converging network, IT and other services workload.

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1 Introduction

Software Defined Network (SDN) and Network Functions Virtualization (NFV) are enabling Communication Services Provider (CSP) to create agile and flexible communication infrastructure and have setup an important foundation for next generation 5G network. SDN and NFV are complementary but increasingly co-dependent in order for the benefits of software-defined networking to be fully realized. The telecom community has come together under Linux Foundation Open Networking Automation Platform (ONAP) and ETSI ISG MANO and developed standardization and platform to efficiently manage network functions.

SDN/NFV decouples propriety appliance based network components into virtual network functions (VNFs) and virtualized infrastructure on top of commodity general-purpose physical infrastructure. These VNFs are managed through APIs by normalized control plane. The efficient management of VNF and virtualization is critical for network of the future having empowered customer control, resilient network, IoT network, 5G.

The underlying core infrastructure can be available through private network cloud, private IT cloud, dedicated servers, or public IaaS cloud providers like Azure, AWS, and GCP.

Network cloud is mostly private, built using OpenStack, and provides virtualized infrastructure of compute, storage and network in form of virtual machines for VNFs, and corresponding IT applications & data workload.

ONAP and ETSI OSM provides a comprehensive platform for real-time, policy-driven orchestration and automation of physical and virtual network functions to rapidly automate new services and support lifecycle management. ONAP, OSM and Network cloud platforms are designed to manage VM-flavor of VNF and other workloads. However, container based cloud-native computing foundation (CNCF) and container centric applications have moved rapidly in recent times and provide many benefits for performance, fault tolerance and efficient management. Though there are still challenges for container based VNF, but its wider adoption is inevitable for network workload.

OSM, ONAP and Openstack based telco cloud can leverage many capabilities available through CNCF and container management frameworks, at the same time telco-cloud evolution have to address complexity arisen due to multiple kinds of packaging such as Tosca/Heat based VNFs, containers such as Docker, CRI-O, containerd etc.

Creating a Converged-PaaS kind of abstraction layer on Private-cloud/IaaS will cater to these expectations, and will provide many reusable, common capabilities, uniform infrastructure cloud management, orchestration and configuration for functions like VNFs, cloud, digital, security or network services of the future.

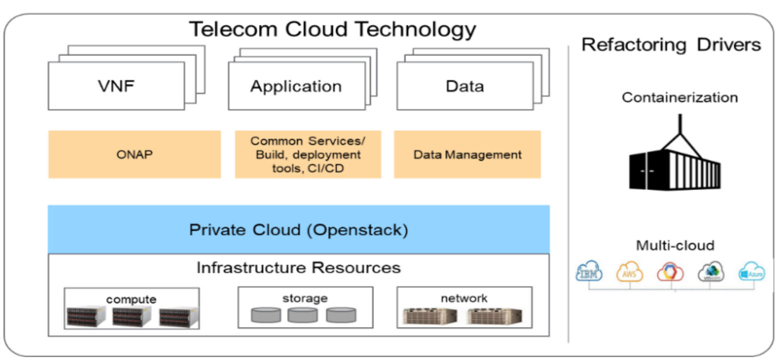

Figure 1 Telecom Cloud Technology Landscape

The subsequent sections describe the typical workloads that should be managed in a cloud infrastructure, the current technology stack to manage the different cloud workloads and the evolved cloud architecture to address the needs of current and future workloads.

2 Cloud workload

Public cloud or Private cloud with OpenStack provides core infrastructure cloud (IaaS) for cloud technology stack. The cloud handles three kinds of workloads: VNF, application functions and data services. All these workloads can be referred as 'virtual functions', and will need to be supported with 'cloud-native' principles.

2.1 VNF

Transformed network functions as virtualized network functions (VNFs) workload is key distinct workload on network cloud. VNF utilizes NFV Infrastructure (NFVI) for dynamic and flexible physical and virtual resources and can be provided by dedicated servers, on premise, or public cloud.

The following diagrams depicts NFVI, and VNF realization with VM flavor.

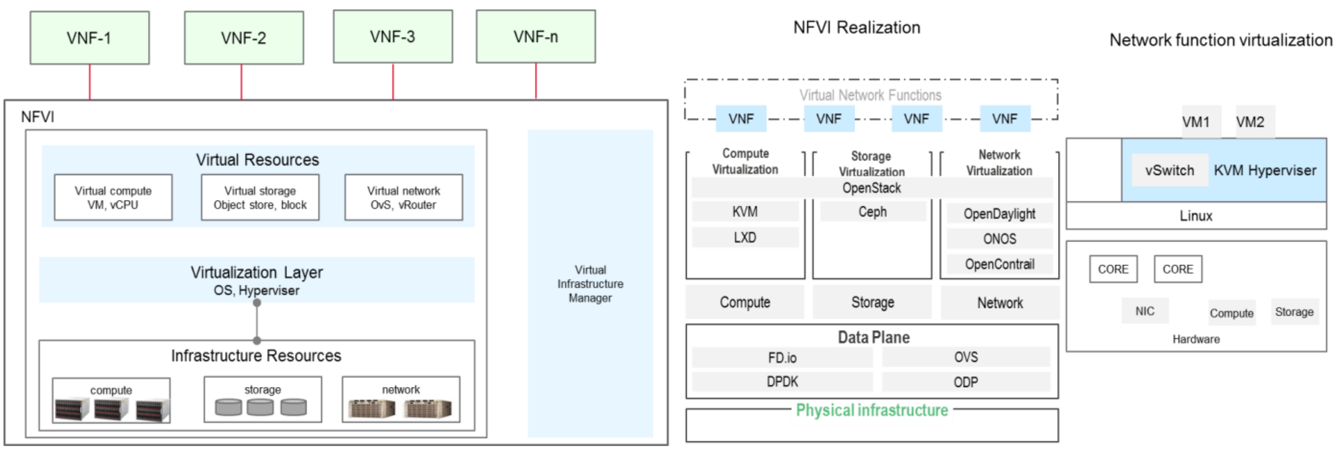

Figure 2 NFVI Components

Current VNFs are primarily based on virtual machines, but container based VNFs are emerging fast and container adoption will impact NFVI and VNF. Containerizing VNF has many benefits, particularly for resource constraint edge devices. Though there is lots of progress on containerized VNF, still some challenges exist for wide-spread industrialization, are being addressed by industry rapidly.

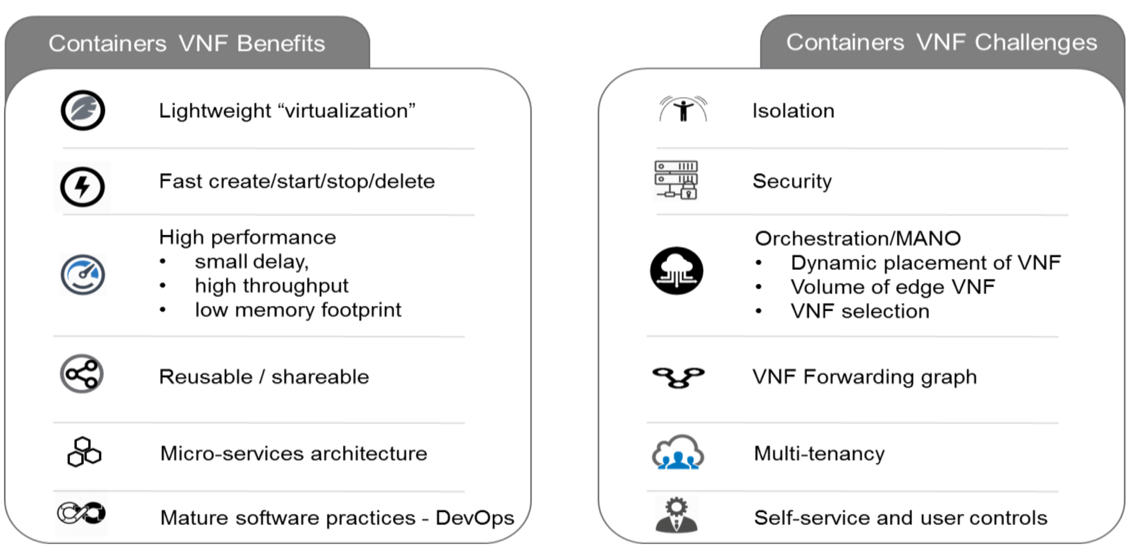

Figure 3 VNF containerization benefits and challenges

2.2 Application workload

A large carrier has variety of IT applications workload targeted for cloud adoption. Applications are being transformed to cloud-native microservices, some applications use virtual machines, and some enterprise applications continue to be monolith for some time. Future workload may include function as a service, which requires special handling from cloud standpoint. The four kinds of application workloads are:

- Monoliths: Integrated application that has a specific build, deployment and environment management
- Containerized applications: Monoliths repackaged in containers
- Microservices: Light-weight small containerized services
- Function as a Service (FaaS): Event-triggered short-lived serverless apps like AWS Lambda

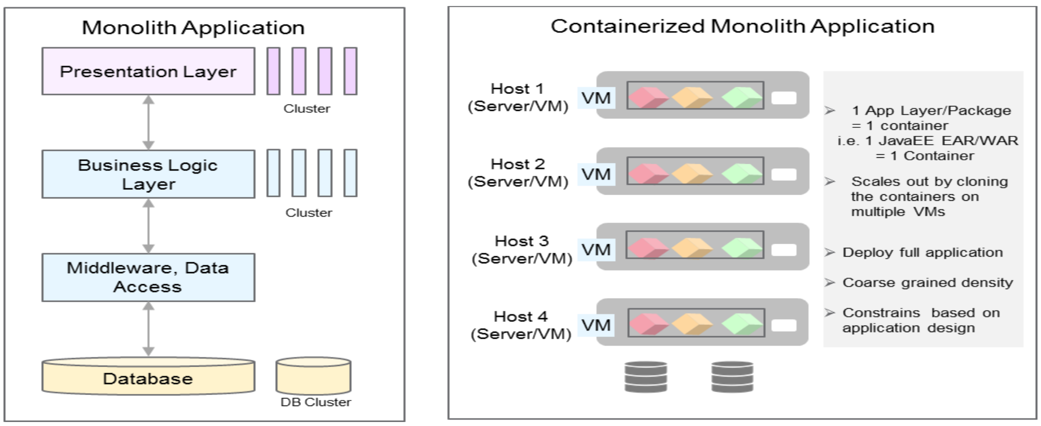

Figure 4 Monolith and containerized application workload

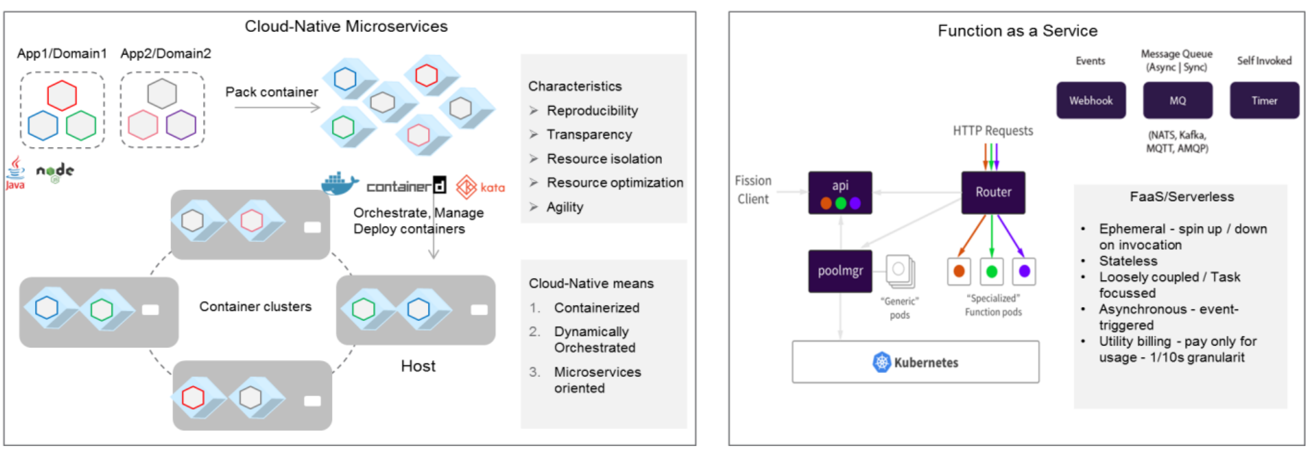

Figure 5 Cloud-Native microservices and FaaS workload

2.3 Data workload

Cloud infrastructure can manage three kind of data related workload. First, caching including video cache and data streams; second, big data analytics using Hadoop, HDFS or Ceph; and third, transactional workloads - NoSQL/Object storages, relational databases.

Most container workloads are stateless and independently scalable. Whereas stateful workloads require backing storage and keeping the state is critical for running the services to survive service restarts.

3 Current network and IT cloud technology stack

Cloud technology stack has been evolving over the years. The stack typically consists of infrastructure using dedicated servers, private cloud or public cloud; network automation through MANO/ONAP stack; cloud-native microservices management through its common services framework using kubernetes, mesosphere etc.

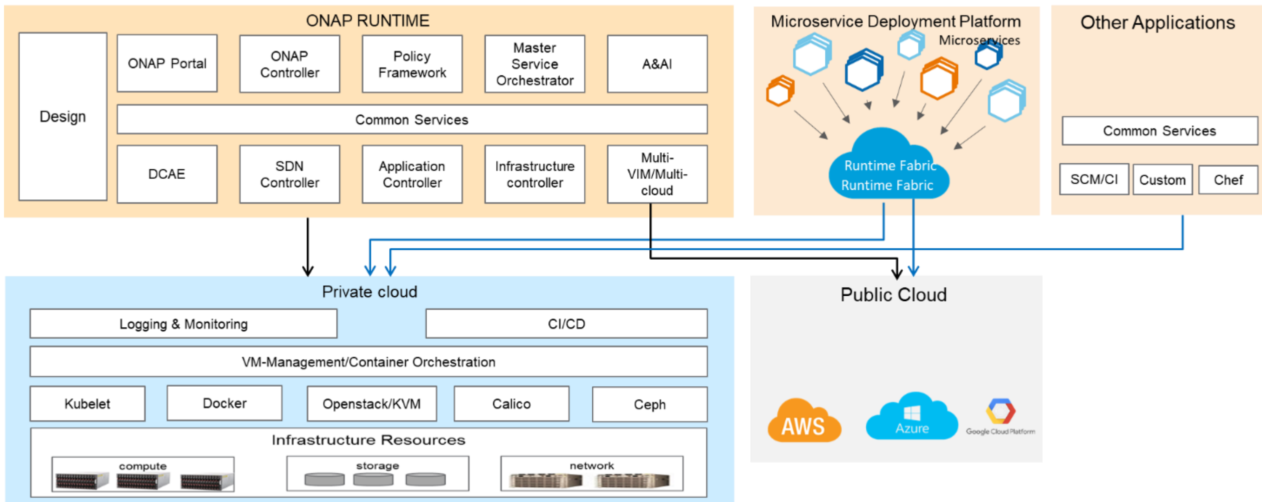

Figure 6 Cloud Technology stack

Network automation with ONAP

ONAP primarily consists of three kinds of components such as design tools, service and policy management and resources/infrastructure controllers. ONAP has a comprehensive strategy of interdependency of three different technology worlds of applications, infrastructure and network. This can interface multiple VIM or cloud with its multi-VIM, multi-cloud management component.

IT application management framework

The framework consists of set of tools providing many capabilities like CI/CD, messaging, data management, API management for IT applications. There are different tools for similar function depending on the nature and technologies of the applications. Most of the applications use tools like Jenkins, Chef, proprietary software managers, whereas some applications having cloud-native microservices uses kubernetes, mesosphere, docker-composer for container lifecycle management and automation.

Infrastructure

Typically, private cloud infrastructure is built around Openstack, and manages VM based workload. Significant enhancement of such cloud is required to leverage efficiencies, performance promises of container or cloud-native workloads.

4 Unified telco cloud architecture

The current cloud architecture requires further evolution for optimization of resources to handle future application needs, container based VNFs, increasing automation and leverage reuse. The future cloud technology stack needs to provide following key capabilities across all workloads. The key capabilities of the stack are:

- Self-service – no waiting, no in-house limitation
- Common platform services
- Cross regions/zones, on-prem availability
- Abstracting and dynamic replacement for multiple cloud, physical infrastructure
- High utilization, elastic, up/down resources based on workload
- Pay as you go, even for internal workload, create a project charging model
- Immutable code deployment

The stack needs to provide virtual resources to applications in multiple ways such as different types of virtual machines and containers. The cloud management responsibility varies based on application packaging and dependencies on libraries. The stack requires to build VM, and then manage VM based applications, whereas pre-deploys the libraries, and manages containers for container based applications. The following diagram shows the different virtual resources and their corresponding packaging structures.

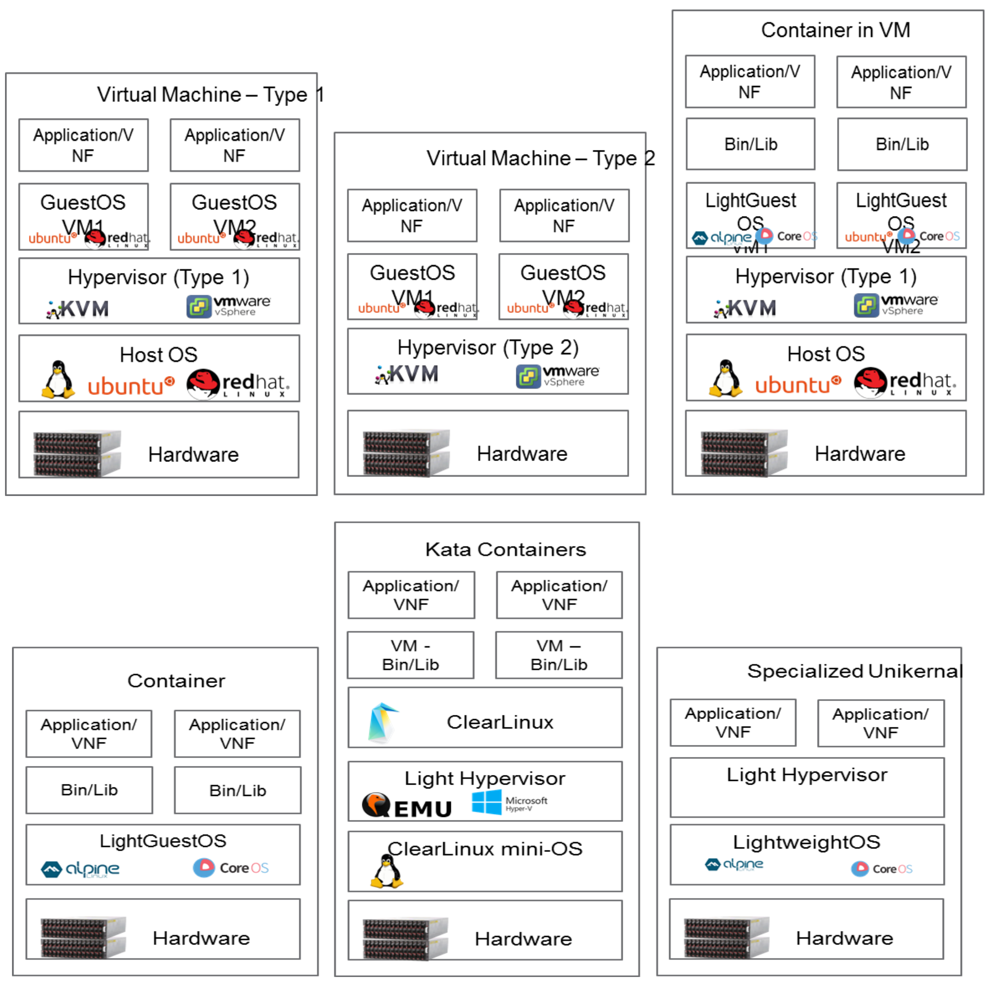

Figure 7 Virtual Machines and Containers

Unified Platform services for cloud-native Network and IT

The unified platform services layer on top of infrastructure, for all kinds of workload, as key component of the future cloud stack will simplify the architecture. This will provide network-IT data, insights, orchestration, and management collaboration opportunities. This layer will also provide generic capabilities required by all workloads, evolved from capabilities across multiple initiatives in organization, and reusable across network-IT to meet telco needs faster.

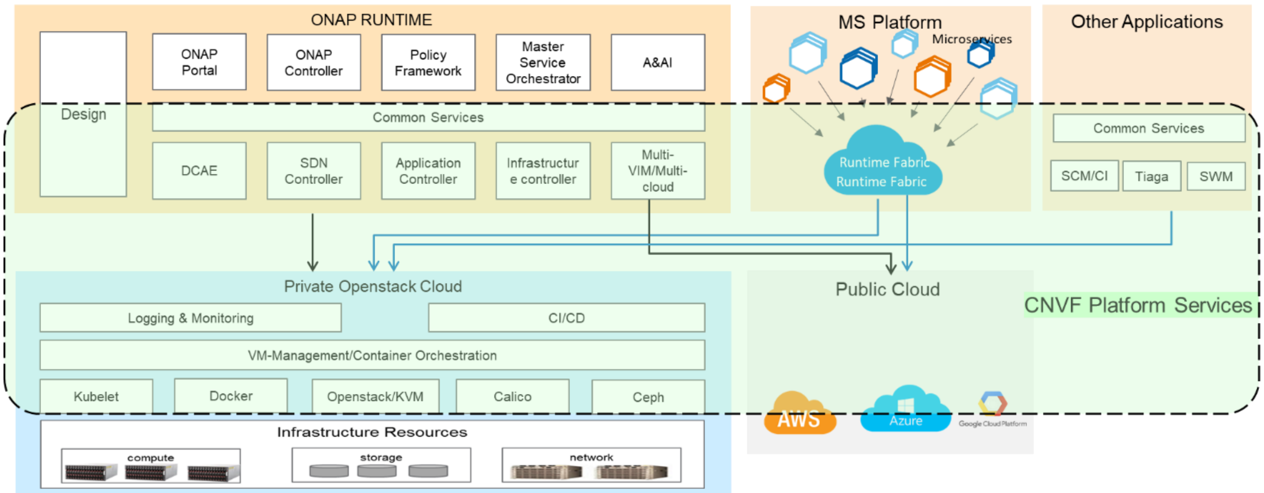

Figure 8 CNVF Platform services evolution – capability map

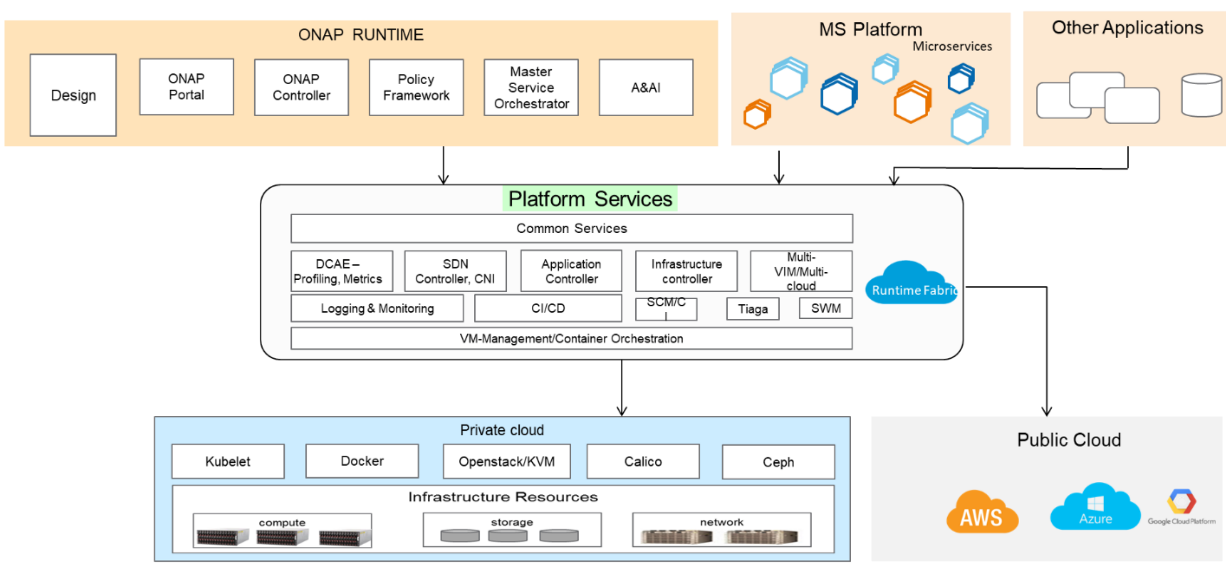

Figure 9 Telecom Platform Services

The capabilities of unified platform services layers can be part of extended cloud such as AWS, Azure or Private cloud as well as platform services, but it is better to maintain it as separate platform to better manage multi-cloud scenarios.

Unified platform services will provide reusable common services for microservices and VNFs besides management services. The capabilities provided are:

- Consistent applications, service, network function deployment automation across multi-cloud/VIM
- Charging models
- Application containerization services
- VF Common Services, VNFs/mS reuses these services at runtime, some examples are:

  - Efficient interoperability services,
  - VNF to VNF communication, messaging, event souring
  - Unstructured and structured data storage
  - Logging, metrics, monitoring, log aggregation
  - Identity, authorization
  - Service discovery
  - Service registration
  - Data serialization/de-serialization, compression/de-compression
- VF Barista (Productivity) Services, providing capabilities to speed up new services development, i.e.
  - Event based service choreographer
  - Translators
  - Services designers
  - Catalog, Metadata managers

The unified platform services deployed with virtual private cloud in multi-tenant setup improves isolation, fault tolerance capability, and help in maintaining higher level of service continuity. It brings such capabilities across multiple infrastructure components with higher (five or more nine's, i.e., 99.999% or higher) performance, availability, resiliency, and stability. This also provides advanced reusable common services capabilities to VNFs, which can be discovered and used through APIs by VNF at runtime.

The components of the unified platform services

- API-Server: Provide platform capabilities and/or services through common and open APIs.
- IaaS-Manager: Acquiring, setting up, integration and management of different NFVI platforms
- Config-Distributer: Configuration distribution system
- Charger: Provide project charging model, handling contracts, availability from public cloud internally
- Scheduler: Automatic management of demand for different types and amount of resources for varying loading conditions and services
- Resource-Plugins: Pluggable resources handlers for specific resource provider from NFVI/IaaS
- Side-cars: Provide capabilities reusable for consuming services, like monitoring, communication protocol implantation service like session initiation protocol
- Service choreographer: Provide capabilities to chain services based on dynamic business rules and events.

5 Conclusion

Telecom cloud technology stack requires major advancements in cloud-native container based landscape, and multi-cloud environments. A reassessment and unified approach of end-to-end telecom architecture is essential to simplify and improve network, IT and data cloud platforms.

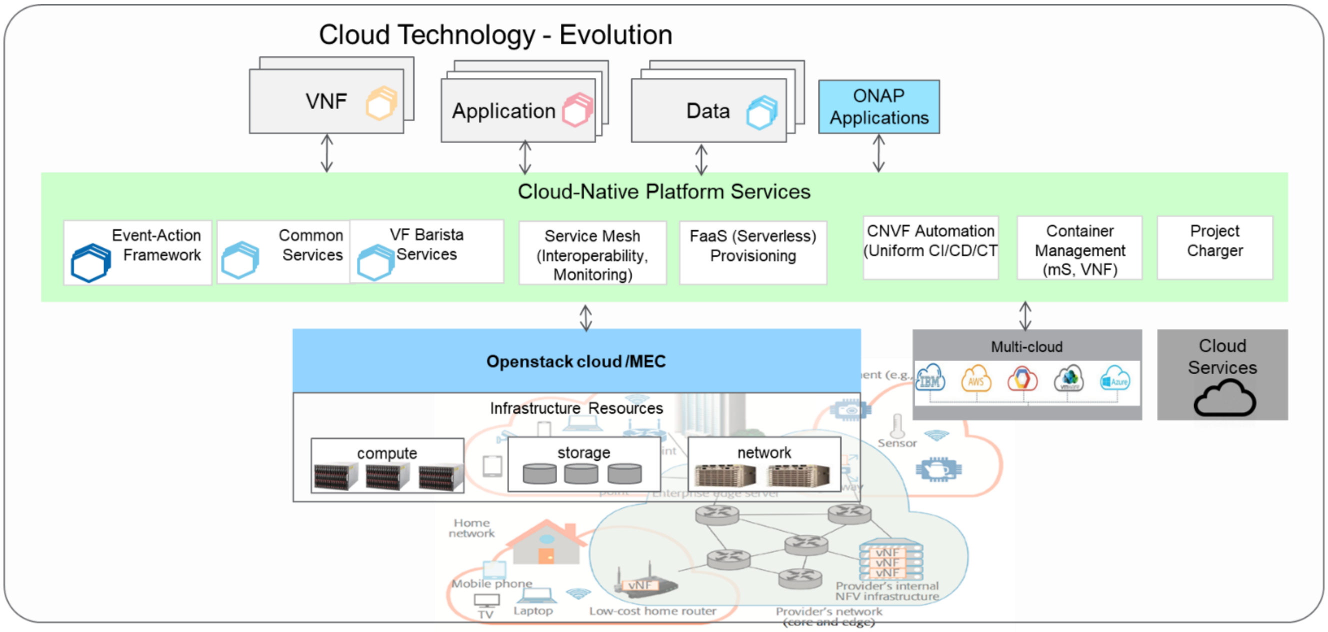

Figure 10 Telecom Cloud technology - Evolution

This whitepaper discussed various considerations and options for Telco cloud stack evolution and the formation of a unified platform services layer on core infrastructure. This simplifies the architecture to manage workload, enabling multiple infrastructure cloud options and providing reusable common platform services for network and IT applications. The approach also enables a holistic approach to cost and capex optimization for infrastructure capacity management to improve peak load management and resource utilization.

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