WHITE PAPER

NEXT GENERATION DIGITAL OPERATIONS SUPPORT SYSTEMS (OSS)

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Introduction

Today, network and IT technologies are evolving at a much faster pace than ever which in turn enables equally fast service innovation. This is driving CSPs to revisit their business and operating models and partnerships to stay ahead in the competition. All this has placed OSS, which was once treated as backend operations, at the center of innovation. It will be imperative for CSPs to modernize their operations and processes and build a digital OSS system to support seamless customer experience, multiple services, technology, and network domains.

2. CSPs' Digital Journey

Communication Service Providers (CSPs) are in their digital journey, embracing digital natives' ways of working and business models. They are adopting Software Defined Networking, Network Function Virtualization, Cloud Native, Open Digital Architectures to demonstrate agility, address Customers OnDemand services, support evolving business models. New business models bring in digital bundle offers that includes Connectivity, Compute, Software Assets, 3rd party digital products and Vertical Industry Business Platforms. This requires going 'Beyond Connectivity', with focus on Partner eco systems, 'As A Service' platform business model, marketplaces to bring in Zero Touch Partnering and Orchestration of Services across eco systems. This requires CSP IT and Network to support dynamic capacity, multi domain orchestration, digital operations and care through AI and hyper automation. The roadmap to achieve the same is addressed through the OSS evolution drivers

Drivers for OSS Evolution

Digital Transformation & Online Experience to support Business Agility & Innovations in the Digital Drive

Monolith to Microservices architecture, Cloud adoption | Digital Experience and Engagement Layer

Modernize Legacy IT, adopting New Ways of Working, Disrupt Business Processes with Emerging Technologies to support evolving business models

Capability based architecture adopting ODA and Open APIs for plug-n-play architecture | Ordering, Catalog and Orchestration to drive new age Telco Network & Cloud eco systems | Simplify Complex Inventory, Customer 360 with Graph | Simplify / Disrupt specific business processes with Blockchain

Beyond Connectivity: driving new business models and digital bundles

Digital bundles supporting varied business models, covering CaaS, NaaS, Edge, Compute, Software Assets, Vertical Industry Business platforms | Partner Eco Systems collaborations through Zero Touch Partnering from On-boarding, varied contract models, dynamic orchestration across varied domains | Marketplace to enable partner collaboration, digital offers, smart contracts, as a Service model, varied billing and settlement process.

Network Transformation & Innovation: Embracing SDN / NFV, Cloud Native, Edge Computing, 5G, O-RAN, Fiber roll-outs, Optical SDN

Network Automation, SD-WAN, Cloud WAN, Hybrid, Multi Access Edge Compute (PNF, VNF, CNF on-boarding, orchestration) | Closed Loop Automation leveraging AI / ML | Network Slicing & Automation (RAN, Transport, Access), Network APIs (NaaS) | Connectivity as a Service (CaaS)

Digital Operations: integrated IT, Network and Eco systems

Data driven, enabled further by AI and automation, providing holistic view, moving away from siloed operations | Intent based, journey driven views to address next best offer, fall-outs, closed loop automation, predictive assurance, enhance efficiencies and reduce cost | Proactive updates on planned network outages

Enhance Customer Experience: Moving towards hyper personalization (N=1, support varied avatars)

Customer 360 view bridging customer, offer, product, service, resource, network and identify intent, impacts | Dynamic offers, proactive guidance and care services

3. Today's Challenges

Operators are facing multiple challenges as they are moving to a disaggregated and distributed network to support 5G and varied industry vertical use cases. Cloud-based implementations of network functionality create new, abstract layers in the architecture. Management of such multi-vendor Network and Ecosystem driven services could become quite a challenge if not approached well especially for incumbents. In Infosys point of view , following is a list of key challenges that the digital OSS platform will need to address

Heterogenous and Dynamic Ecosystem

Varied network flavors lead to operational complexity. Operators need to manage a growing diversity of network services and massive Internet of Things (IoT).

Lack of Automation

Lack of network automation leading to higher OPEX and CAPEX. Lack of centralized solution to manage 2G/3G/4G/5G network has increased operational complexity and costs

Inefficient Operations

Lack of a cloud native infrastructure and modern automated deployment pipeline resulting in inefficient IT development and release for OSS functions

Time to Market/ Reusability

Poor Adoption of industry standard models of product/service catalogs to promote reusability and allow faster time to value. Lengthy processes and custom solution cause delays and added costs to onboard new technology

Disconnected systems

Lack of automatic correlation & propagation of service faults to customer, resulting in bad customer experience. Many legacy processes & operations comprise of uncorrelated, inaccurate, incomplete, and inconsistent data which need to be uplifted.

Closed platforms

Closed platforms and proprietary vendor solutions have huge implications on 5G adoption and multi-vendor integration

E2E visibility

Poor end-to-end visibility into network and service performance

OSS needs a fresh look considering that the network capabilities are moving to cloud. There is need to assimilate the IT Orchestration and Management aspects with Network Management

4. Future proof OSS to drive agility, automation and monetization

Building future proof OSS to drive agility, automation and monetization by using digital technologies will help organizations to create proactively perfect business and operational processes to support to network automation and quick introduction of 5G use cases in a much faster and cost-effective manner. This will allow CSPs to be more competitive in the growing 5G market. It is business transformation that reimagines how CSPs do business and adds value to internal and customer interactions.

CSPs should focus on the following key principles to build a digital OSS to address the current market requirements and in moving from a traditional CSP to a digital partner.

- Support for to multi cloud environments, Containerization of digital OSS platform components, Micro-services-based architecture
- Modular digital OSS Platform, with Open APIs makes it easy to integrate applications and therefore a fast introduction of services
- Launch new products and services in days, Deliver new features in minutes via reusability in catalog and orchestration constructs
- Extreme automation via DevOps, Zero-touch onboarding and provisioning, closed-loop automation of business and technology operations
- Zero trust security paradigm. Protecting network in non-trusted dis-aggregated, multi-vendor environment
- Leverage real-time data, analytics and AI/ML for automated trouble-shooting and analytics
- Embrace Network as a Service abstracting the complexities of underlying network topology and vendor specifics especially for SDWAN and Network Slice Offerings

Following are the key themes that are required to accelerate OSS transformational needs to build a future proof OSS.

1. Catalog driven templatized design & run time
2. E2E service automation, cross domain orchestration,
3. Unified, real time service & resource inventory
4. Insights driven operations and closed loop automation
5. E2E network management covering Telco Cloud, Network Slicing, Edge services
6. Secure OSS for Secure Programmable Networks

Catalog driven templatized design & run time

Unified catalog plays a key role in faster time-to-market for launching new services by creating standardized product specifications across LOB. The key guiding principle of unified catalog is to decouple the commercial offers from technical implementation through CFS-RFS specification to achieve zero touch fulfillment. This will help to minimize the impact to the fulfillment layer for introducing new commercial offers thereby allowing faster introduction of services. Avoid order failure by reference to a single point of product, service and resource truth.

In the 5G era, the key is to automate VNF, CNF and PNF onboarding with each vendor providing standardized blueprints including all forms of processes required to deploy and manage the VNF, CNF and PNF. Catalog should support template driven service design using TOSCA, HEAT and Helm to define rules and policies, prerequisites, acceptance criteria, continuous probes etc. to capture intent and attributes for services modelling. OPEN APIs adoption will help to maximize interoperability between vendors

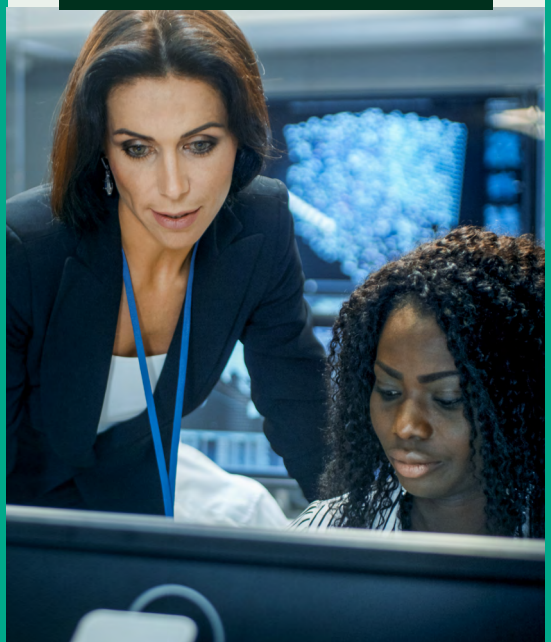
Infosys understand the need of a fully automated VNF, CNF and PNF onboarding and certification by integrating various systems to avoid the key concern of manual onboarding of network functions and certification. Infosys is working with multiple Telco's and playing a key role in standardization, CNF, VNF and PNF package certification and testing with multiple NFVI platforms and technology optimization/ transformation

E2E service automation, cross domain orchestration

E2E service automation ensures the end-to-end delivery of services across both physical and virtual domains which includes RAN, Core, Transport and Edge seamlessly. This will also include data management, analytics, self-heal, administrative functions and Configurations & policies all managed through a centralized orchestration platform. Well-defined automated and configurable orchestration workflows prevent any human error or process failure and improves operational efficiency.

AI/SON capabilities in the service management layer improves network performance, user experience and reduction in network operation cost. 3GPP standards are used to make SON vendor / technology agnostic.

Infosys has significant expertise in deploying and integrating digital OSS with multiple partner systems and telco networks. Infosys is a trusted partner with experience on leading OSS transformations and have built Infosys accelerators/ tools to accelerate digital OSS adoption journey for leading Operators.



Unified, real-time service & resource inventory

Unified Inventory provides a real-time, unified view of customer services and the associated resource inventory. Unified and dynamic inventory act as a single source of truth of inventory data which is the key enabler for intelligent automation . This will help CSPs to reduce order fallout and automatically remediate issues with closed loop automation using unified, accurate, end-to-end view of network and services data from unified Inventory. Unified Inventory paves way for creating a Single pane of glass' into operational environment – removing the silos of Network , Service Assurance, and Service provisioning. The advantages this brings to table are:

- Acceleration of 'Trouble to Resolve' process
- NOC and Engineering users do not have to swivel-chair between numerous systems in order to search for customer, service and network inventory information
- Insight into network and service impacts for planned scheduled maintenance of the network
- Simple user experience for Engineering and Operations personnel

Adoption of NetSecOps with a well-integrated and traceable unified inventory will bring agility into design, plan and build function and deploy infrastructure much more efficiently.

Infosys led inventory consolidation and transformation program for one of the telecom operators. This involved development of inventory solution leveraging open source NoSQL database. This solution allowed modelling of complex networks and dynamic relations across active and passive network inventory associated with optical networks and associated geospatial and service inventory data. This significantly improved plan and build agility and operational efficiencies for fibre roll outs.

Insights Driven Automation and Closed Loop Automation

Insight driven automation offers CSPs a new way to automate 5G network deployment to bring operational flexibility and optimization to manage the multi-vendor network . It utilizes data from the network resources, components, functions and supporting OSS/BSS applications to develop real-time, near-real time and on-demand analytics to derive descriptive, diagnostic, predictive & prescriptive statistics insights at various network function levels. The closed loop automation will leverage the insights generated from the analytics framework and the data generated at various sources to make meaningful decisions. Any low latency closed loop automation use cases that requires real-time action can be addressed in the edge AI/ML model and fed back into the system. The centralized closed loop automation will be sent back to the system through the centralized orchestrator.

E2E network management covering Telco Cloud, Network Slicing, Edge services

E2E network management solution provides automation and advanced capabilities for E2E management of telco network, network services, and network slices across RAN, Core and Transport. Increasing 5G deployments enables creation and introduction of innovative network-based capabilities to support varied 5G use cases such us autonomous vehicles, immersive experience, cloud-based gaming, etc. So, the digital OSS platform should introduce/integrate network functions from multiple vendors using open and standards-based interfaces and plug and play architecture to support a multi-vendor ecosystem.

Securing access to OSS functions and access to programmable networks will be key for digital networks.

5. Adoption of Open Source in the drive towards Next Gen OSS Innovation

In the last decade, Telecom industry has witnessed increased adoption of Open standards and compliance to specifications published by various bodies like 3GPP, IETF, ETSI, MEF, TM Forum etc. This trend along with advent of Virtualization technologies has assisted Operators in transitioning to modular OSS & Network architecture eliminating proprietary platforms and Vendor Lock-in concerns.

We are also witnessing the rise of new Open Source initiatives addressing specific functions in Telecom IT and Network space. While many mature Open-source options are now available to build Service Fulfillment & Assurance stacks in OSS ecosystem, last few years have seen operators collaborating under the ambit of organizations like Linux Foundation Networking, Open Networking Forum, O-RAN Alliance etc. to implement open-source, reference implementations of network facing platforms and even network functions. This trend enables Operators to share development costs for generic features while they focus on enhancing the MVP further to add differentiating, innovative offerings.

Open Network Automation Platform (ONAP) is one such Cloud Native, Open-source platform from Linux Foundation enabling Operators to quickly build Service and Network Orchestration capabilities with minimal TCO. It provides policy-driven, standardized framework for Design, Provisioning & Lifecycle management of all types of Network Functions (VNF, PNF, CNF) compliant to ETSI NFV specifications; as well as Service Orchestration, Modeling & real-time Inventory capabilities. Prominent operators and OEMs are supporting development of this platform along with a vibrant community thus accelerating the readiness of a Standardized solution approach for VNF management. ONAP comes ready with design blueprints for key network use cases like 5G, BBS, VoLTE, vCPE etc. tested using variety of network elements; thus expediting time to market for operators. Multiple Telcos have already built & rolled-out Orchestration solutions in Production utilizing ONAP components thus endorsing its maturity and scalability for large-scale, carrier grade deployments.

Magma 5G Core is another prominent Open-source project recently adopted into LF Networking purview. Magma is a Open-standards, SDN based fully virtualized network stack initially developed by Facebook team and comprises of 4G/5G Access and Core network components readily deployable on x86 platform. It enables small Operators to rapidly extend their capacity and customer base in weeks; thanks to 3GPP compliant RAN interface and lab-proven interop with few RAN vendors. To manage integration complexity and further accelerate adoption, it has a network of implementation partners which are also offering managed Private 5G deployments based on CBRS for Enterprises.

Further on, few more LF Networking projects are propelling the Network Virtualization track and defining standardization in this niche space. Anuket is creating Reference implementation and Modeling specs for Cloud Infrastructure to accelerate the definition, integration, testing and deployment of Virtual Network functions over NFVI, IaaS as well as CaaS.

LF Networking has kicked off **Nephio** project in May 2022. Nephio is offering Kubernetes based on standard control plane for CNF deployment. This project is driven by Google. ONAP along with Nephio allows automation of end to end network services by deploying workloads across public/private clouds and edge locations, and establishing secure service chains. **Sylva** is another LNF project incubated recently by European Telcos. This is talking about creating a Telco Cloud platform leveraging established LF Networking projects. LFN also started CAMARA API project for enabling seamless access to telco network capabilities. Digital OSS can consume these APIs for integrating with Telco network / Edge capabilities. Example, Edge cloud related APIs can be integrated with Digital OSS for edge workloads lifecycle management and configuring the traffic steering rules.

Open Source MANO(OSM) in another opensource NFV Orchestration platform aligned with ETSI NFV Information Models, which is a key enabler for zero-touch end-to-end network and service automation

Intel® Smart Edge Open is a free edge computing software toolkit that can host a wide range of services, from network functions such as 5G RAN and 5G core, to AI, media processing, and security workloads

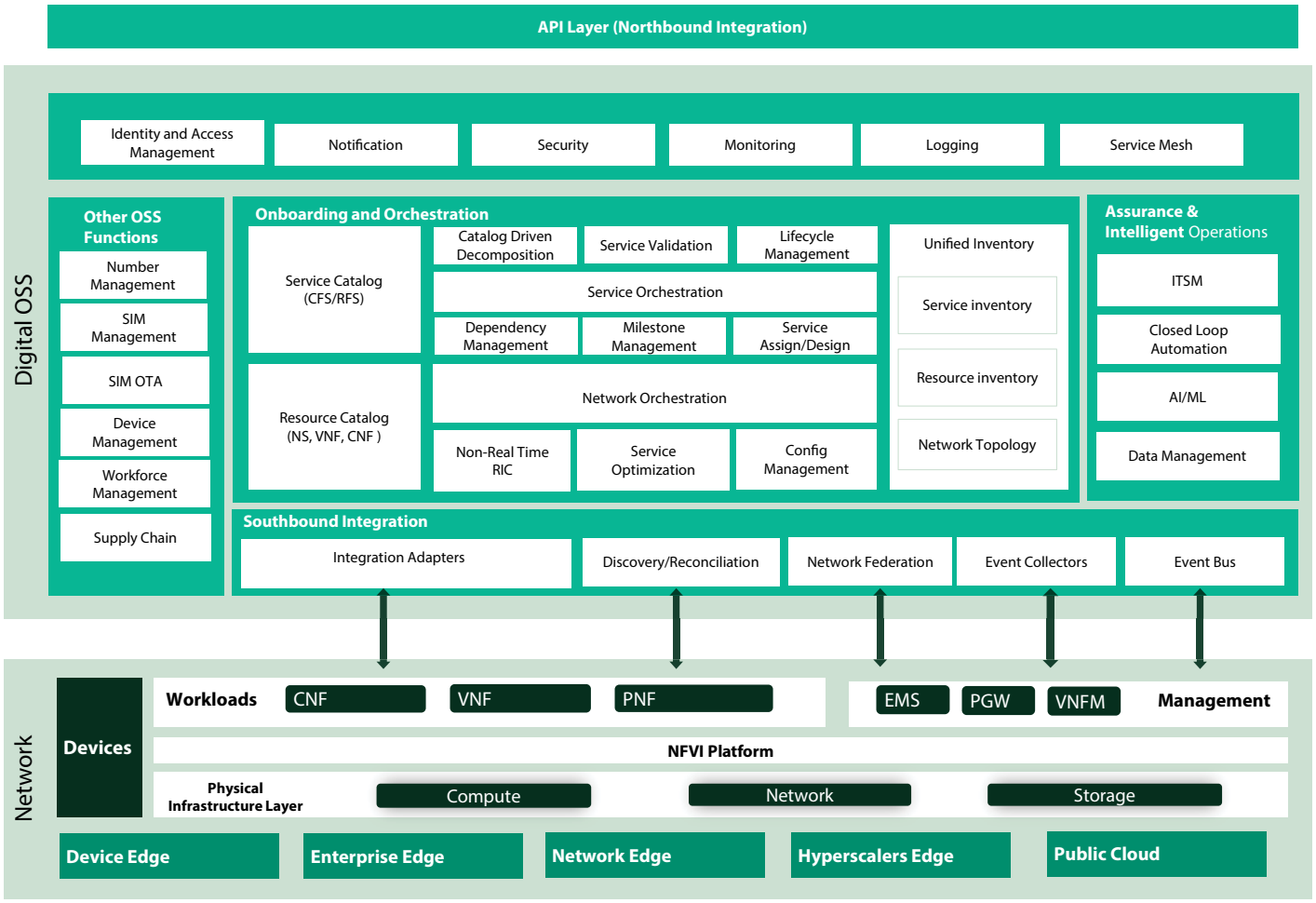
On similar lines, multiple robust SDN Controllers like ONOS, ODL, Ryu etc. have been developed as Open-Source Initiatives assisting Operators to migrate to Disaggregated Networks of the future. These SDN controllers have seen unprecendented adoption, especially in Data Center networks, and are driving the Control / User plane disaggregation across all Global network operators. Open Networking Forum has been at forefront of implementing SEBA/Voltha which is a mature open-source SDN-based platform for deploying FTTH Access network utilizing inexpensive Whitebox switches. Multiple Tier 1 Operators have utilized cloud-native ONF Voltha platform with further enhancements to manage xPON Access devices in their Fiber network roll-out; drastically reducing CAPEX as compared to Vendor solutions.

A relatively new entrant to this collaboration trend is O-RAN Alliance which is working towards an virtualized, open standards based vendor-agnostic solution for 5G Access network which promises to significantly trim the cost & challenges in complex 5G network rollout. ONF is also working on Software Defined RAN (SD-RAN) project which aims to create a reference implementation of Near-real-time Radio Interface Controller (nRT-RIC) and thus open-source even the RAN management & optimization function which is always traditionally owned by the RAN equipment vendor. Many more such initiatives around the world are fueling operators towards their vision of Next Gen OSS with lesser dependency on proprietary, vendor solutions. Even the private Telco Cloud Infra is mostly powered by some variant of open-source Kubernetes and Openstack projects; driving standardization in IaaS/CaaS track.

Last but not the least, LFN project CAMARA will enable abstraction of Telco Network APIs across heterogeneous environments and architectures to standard Service APIs. This will accelerate monetization of 5G and Edge Services.

6. Open Digital Architecture, Open APIs

Digital OSS Reference Architecture



Onboarding and Orchestration

Onboarding capabilities automate service and network functions onboarding with each vendor providing standardized blueprints including all forms of processes required to deploy and manage the network functions.

Orchestration functions automates the end-to-end delivery of services across different network domains. Policy driven automated provisioning and upgrades with the latest software and configuration makes the network functions fully functional and operational

Service Optimization capability support Self Organizing Network (SON) functions to improve network performance, user experience and reduction in network operation cost. SON functionality brings needed operational agility and efficiency for Self-Configuration, Self-Optimization and Self-Healing across RAN, Core and Transport.

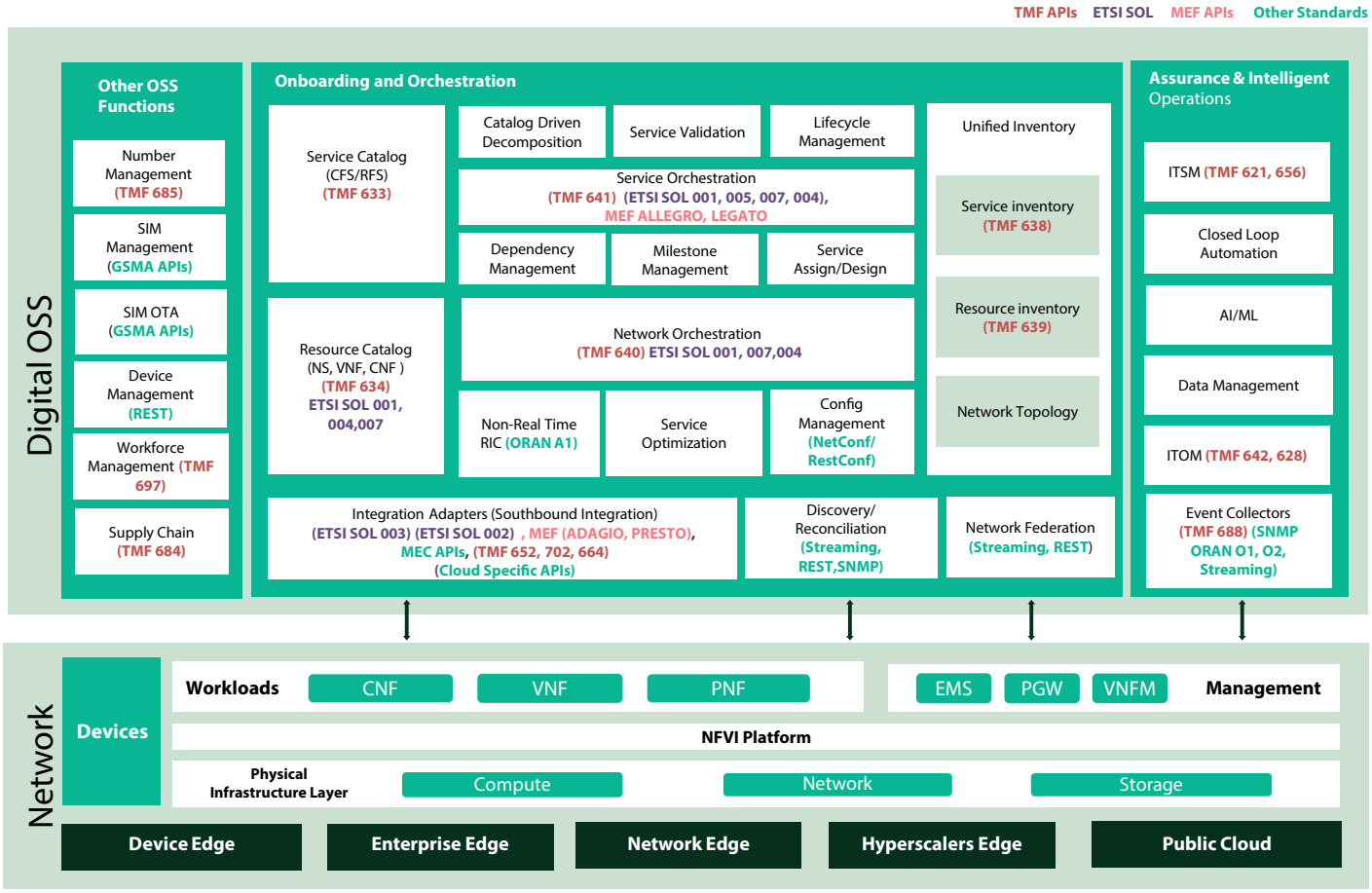
Intelligent Operations

To support the increased complexity of the 5G network, it will be necessary to monitor Network Services across multiple NFV infrastructure domains , automatically trigger actions or alerts for network functions and proactively intervene in dynamically changing network conditions. Intelligent operation functions are needed to collect and provide a topology view of network service (NS) instances, VNF instances, and NFVI resources across all NFVI-PoPs, including network connectivity endpoints and geographical locations.

Open API based Integration

The API Layer follow API First strategy to expose OSS capabilities by leveraging TMF open APIs. API-led integration and management allowing integration flows to be defined and reused by multiple parties internal and external, including integration with existing legacy platforms.

Different standards organizations are leading efforts on standardizing the interfaces towards network layer while TMF is kind of defacto standard for exposing network as a service towards BSS functions. There is good alignment across MEF and TMF APIs such that MEF differentiates with respect to service specific payloads while leveraging the principles and structure of TMF Open APIs.



Use Cases

Network slicing: To provide differentiated services for vertical industry which will have diverse needs in terms of throughput, latency, resilience, security, and capacity

Self Organizing Network (SON)

- Self-configuration & Deployment
- Self-Healing - SON Self-Healing FM functions capable of fault recognition, fault prediction, RCA, and fault self-recovery mechanisms for a given network slice and/or VNF, CNF and PNF.
- Self-Awareness of Cell Topology : Centralized management function of SON uses detailed configurations of cellular networks to identify cell topologies

Intent-based management: Automates intents to parameter-tuning procedures dynamically based on the changing state of the network

Optimization: Networking resources are provisioned and optimized for better QoE and QoS.

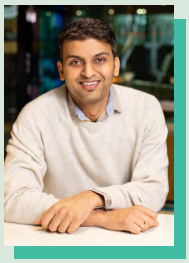
- RAN Optimization - Automatically configure RAN parameters in a cell in to achieve the optimal network performance.
- MRO Optimization - Automatically configure the handover parameters in cells to improve handover

Traffic Steering: Finding optimal path to send traffic across the network based on the network conditions predicted by AI

Customer Experience and Operational analytics - User cases like UE Mobility analytics, UE session interference & QoS degradation prediction, tracking performance of a slice , diagnosing problems in a slice

Automated closed loop : Automatic scaling of network functions based on usage statistics, automated network capacity upgrades based on the insights derived from analytics.

7. A Case Study : Telco Cloud Automation and Open Source OSS



Spark NZ partnered with Infosys for Telco Cloud Automation journey. Multiple solution options were deliberated for core network automation and then ONAP was selected for automating (VNF) virtualized network functions as it embraces open, modular cloud-native architecture aligned with industry standards. Being open-source platform, ONAP is cost efficient and allows Spark to leverage the community efforts and at the same time quickly bring the kind of differentiation required for their specific requirements without an external vendor dependency.

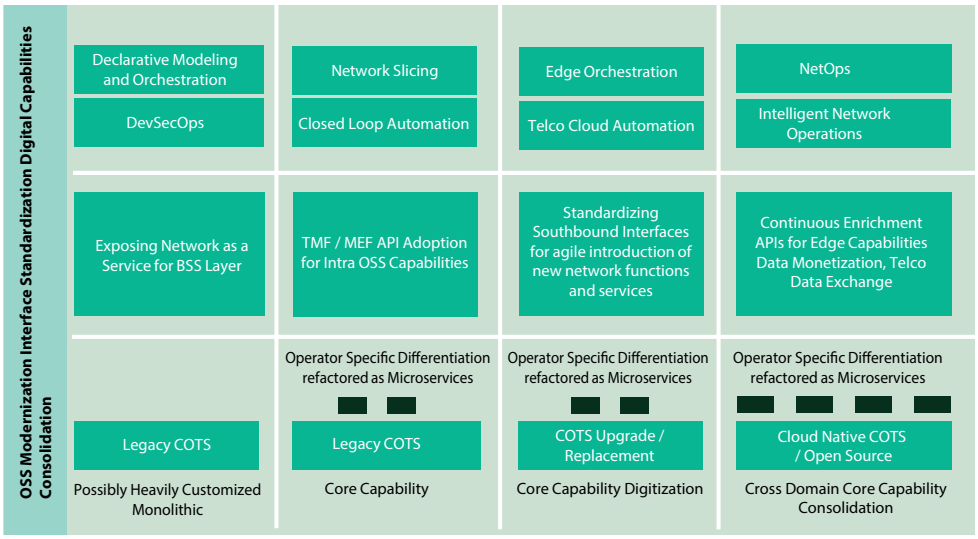
Infosys implemented on-boarding, deployment and configurations for initial set of virtual network functions and enhanced the platform from availability and security perspectives for production roll out. Automated VNF deployments driven by ONAP have replaced manual and repetitive, often error-prone, steps spanning multiple weeks with highly deterministic provisioning solution taking just couple of hours. This has established strong confidence to embrace end to end programmability and extreme automation for next generation networks and bring significant operational efficiencies for Spark.

Nilay Rathod - Tribe Lead, Technology Automations and Services

8. Next Gen OSS evolution

Phased approach for digital OSS evolution could differ from one operator to another depending on the existing capabilities and business priorities, however it's important to have a hardened architecture blueprint upfront. It will be important to define the impact on business outcome through different phases to sustain the efforts.

Roadmap



As telco's progress with Digital OSS evolution, significant improvement in time to roll out new network functions, services, time for service provisioning, guaranteed QoS, cost and operational efficiencies will be paramount.

This evolution is critical for business agility and customer experience in the context of operators going beyond connectivity, business value can be derived from

1. Quicker revenue realization
   a. due to faster roll out of new services
   b. faster turn around times for provisioning new orders/requests
2. Reduced revenue loss due to
   a. disruption in services
   b. increased automation reduces overall OPEX
3. Improved operational efficiency due to
   a. Insights driven operations
   b. Real time management of programmable networks
   c. Cloud adoption
4. Reduced Customer Churn due to responsive network and services
5. Scalability: Automated ways to size up to meet network demands
6. Improved QoS & QoE: By distributing workloads across different locations to deploy the use cases in order to ensure optimal user experience

Digital OSS will be crucial for keeping pace with network and service evolution with an eye on NPS and ARPU. Many a times, operators roll out new technologies and capabilities but are not able to sunset legacy; this only increases complexity and inefficiencies. Infosys brings in rich experience on OSS transformations and phased migration to support telecom operators in their evolution to Digital OSS.

About the Authors

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Priya has 29+ years of experience in Telecom & IT. She contributes to unit strategy, drives technology adoption for business solutions across varied programs globally. She has been driving Digital Transformation, Enterprise Architecture, IT roadmap, Micro Services, Cloud migration, Open Source Adoption, 5G / Edge, 5G Use Cases & Industry solutions, emerging technologies themes like Blockchain, Software Marketplaces, Data Modernization, Legacy & Technology Modernization, Innovation, guiding varied transformation & modernization programs for ECS global clients and part of Infosys Technology Council.

Priya contributes to varied programs in industry, technology forums, Open Source Communities like Linux Foundation Networking, TMForum, MEF, ETSI, IEEE, IEEE ComSoc, IEEE WIE.

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Nishi works with telecom operators on enterprise architecture consulting, architecture assessments, technology solution in B/OSS transformation. She also drives solution development on innovative business propositions and emerging technologies with various technology partners and telecom operators in the areas related to Digital Transformation, Telco Cloud Automation and 5G. Nishi contributes to various programs in TMF and follows the developments across LNF, MEF, IEEE on emerging areas.

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Praveen is a cloud technology specialist with 23+ years of experience in Telecom domain, leading the architecture and design initiatives in niche areas like 5G, Edge, Network Automation and Cloud Native OSS/BSS. Praveen actively participate and contributes to External Tech forums, , TMForum Catalyst programs and drive various technology initiatives in Infosys.

Girish Kumar

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Girish has over 20 years of rich experience in Telecom domain with expertise in Telco Cloud Orchestration, SDN/NFV technologies and VoIP/IMS Architecture. Girish has led architecture definition and development of multiple Client projects and Solution Initiatives from Concept to Market in networking domain using open-source libraries and platforms like ONAP, Voltha/SEBA, Mobicents and Magma.

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