Communications Software
and Network Solutions

ribbon®

Optimized MEC and 5G Transport

Integrating MEC, Connectivity and Automated Operations for
Optimized Service Assurance, TCO and Revenue-Generation

White Paper

Executive Overview

Service providers are building out their networks with distributed core and edge cloud systems and multi-access edge computing (MEC) to help realize the new revenue-generation opportunities and operational efficiencies promised with MEC and 5G. Many are also partnering with, and in some instances, competing with the hyper scale cloud providers in these deployments. To achieve the revenue generation, service assurance and operational efficiency goals, it is crucial that the underlying network components and connectivity are well integrated, allowing service providers to meet the varied services requirements such as ultra-high capacity, low latency, high availability, security, strict timing and service isolation.

This paper demonstrates how network and services value can be maximized by tighter integration of distributed MEC with converged IP and Optical transport. In doing so we will show how automation, orchestration, analytics, cloud-native and open approaches are key components of this overall approach (as shown in Figure 1) for optimizing service assurance, increasing revenue opportunities and reducing total costs.

This paper highlights:

- A MEC platform that optimizes the integration of service provider assets, 3rd party application partners and hyper-scaler compute resources providing intelligent insights, real-time policy actions and application feedback to achieve network and service requirements.
- A Converged IP Optical approach for connectivity that uses the most appropriate IP or Optical transport technology to transport the services to where they are required in the network and enables concepts like hybrid slicing whereby Quality of Service (QoS) based soft slicing can run side by side and on top of the strict hard isolation technologies provided by hard slicing.
- A holistic approach combining optimized transport connectivity and intelligent MEC through end-to-end orchestration, automation and analytics to meet function and performance needs of service provider customers.

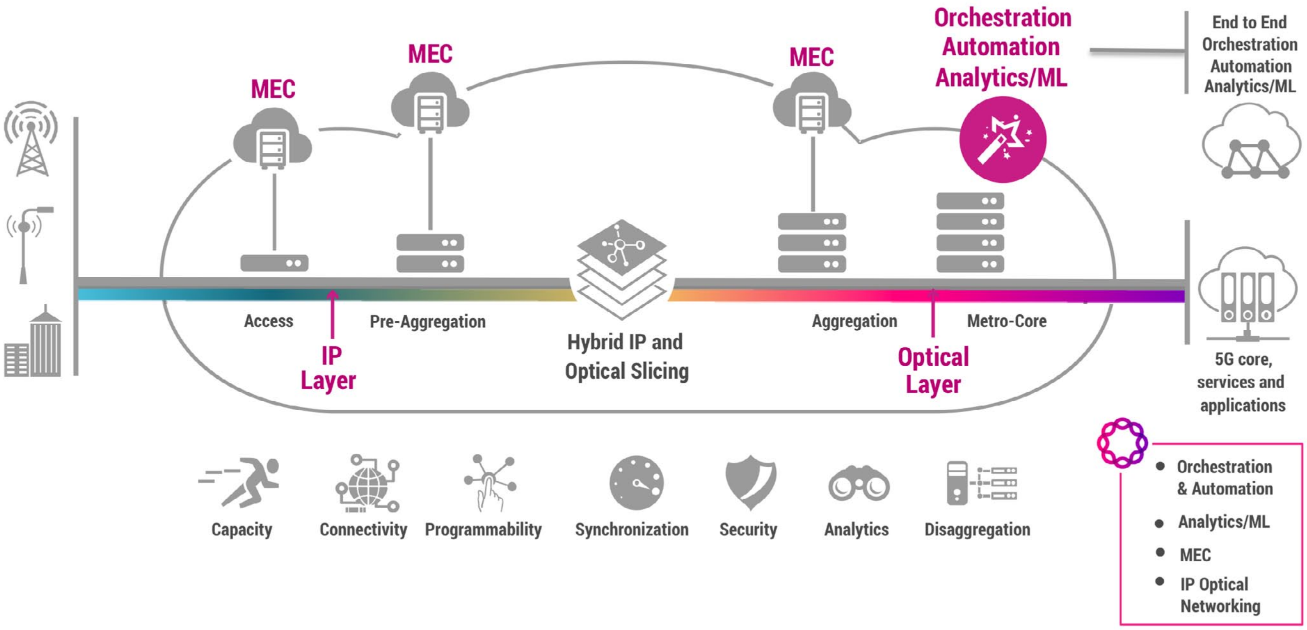

Figure 1. 5G and MEC – Distributed Telco Cloud with Integrated Operations, Transport and Analytics

Multi-Access Edge Computing (MEC)

With 5G technology acting as the catalyst, telecommunications service providers are transforming their networks into dynamic platforms to deliver innovative services quickly and economically in a digital economy. The call-out on the next page highlights the architectural options for enterprise opportunities. New revenue opportunities are envisioned across manufacturing, transport, gaming and other applications that require low-cost localization, distributed deployment of high bandwidth content, and ultra-low latency connectivity at the edge. More specifically, service providers are pursuing two major thrusts. First, they are turning to distributed MEC platforms to generate revenues from hosting applications close to end-users. Second, they are turning to agile network slicing of the RAN, core and transport. 3GPP specifies slicing for the RAN and the core, but not for the transport network. This paper focuses on the slicing of the IP Optical transport network to allow service providers to tailor the network to meet a diverse range of SLAs when providing connectivity between end-users and applications hosted on MEC platforms, and the centralized cloud.

A high-bandwidth, low-latency connection between a device, machine or user and the edge enables new use cases and business models. Enabling applications to be localized in edge compute close to end users also improves network transit latency. As the number of "edge" locations increases significantly and compute grows closer to the endpoints at various edge points (as shown in Figure 2), service providers require a low cost, highly reliable and efficiently scalable MEC solution to help address the challenge for 5G and MEC build outs which is to balance network infrastructure costs against the promised revenue opportunities with 5G and edge computing.

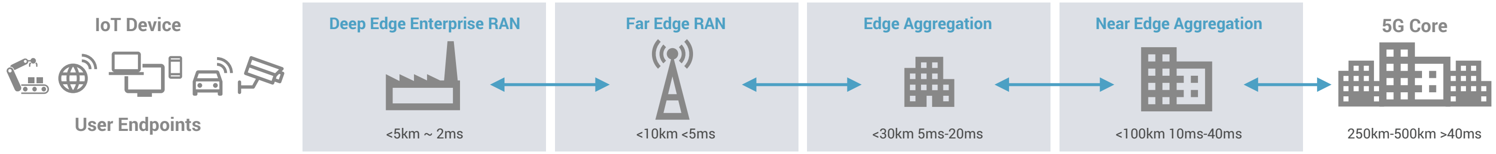

Figure 2. Multiple Edge Locations

MEC Platform Build-Out

Service providers should identify a cloud-native MEC platform and approach that can economically support distributed MEC build-out and is fully compliant with 3GPP 5G specifications and the ETSI MEC standard. This will enable service providers to offer ultra-reliable low latency communication applications and services across multi-access networks. The MEC platform (see figure 3) allows service providers to host and run applications closer to the end users or enables them to partner and/or compete with hyperscalers (like AWS, Google, Azure) for edge computing.

In addition, service providers require a collocated User Plane Function (UPF) at the MEC that not only allows for steering user plane traffic towards the targeted MEC applications, but also supports several complementary features for optimizing MEC clouds. These can include ability to scale in and out based on load, traffic optimization functions, and programmatic reporting to handle lawful intercept and charging. Local visibility and automation is also enhanced via analytics running as an application at the edge.

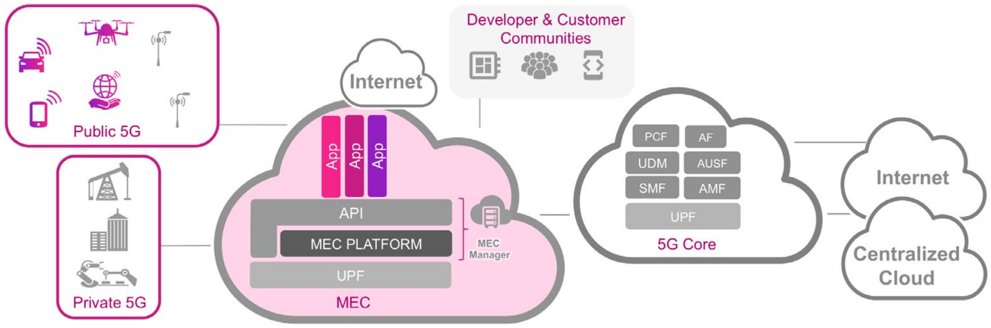

Figure 3. Multi-Access Edge Computing (MEC) Network Architecture Components

Three Network Architectural Options for Enterprises

NPN (Non-Public Networks), per 3GPP, are intended for the sole use of a private entity, such as an enterprise. NPNs can be deployed in a variety of configurations, utilizing both virtual and physical elements. NPNs might be offered as a network slice of a Public Land Mobile Network (PLMN), be hosted by a PLMN, or be deployed as completely standalone networks.

5G networks can meet the needs of enterprises requiring wireless real-time communications or near-real-time communications with three architectural options:

1 5G PNI-NPN (Public Network Integrated - NPN) w/Public MEC is a 5G private network offered as a network slice of a PLMN. All network functions are shared with the PLMN, with the proviso that the 5G SP has provided Public MEC nodes deep enough into the edge to meet the enterprise latency requirements.

2 5G PNI-NPN w/Private MEC is a 5G private network hosted by a PLMN. The 5G SP must integrate its public network with an on-premises RAN and an on-premises MEC exclusively reserved for private enterprise use. The CP is shared with the PLMN. The RAN spectrum can be owned by the enterprise, supplied by the 5G SP, or utilize unlicensed spectrum.

3 5G SNPN (Standalone NPN) (w/Private 5G Core) is deployed as an on-premises 5G SA private network that includes on-premises RAN and on-premises 5G Core exclusively reserved for private enterprise use. No network functions are shared with the 5G PLMN.

Source: How 5G Service Providers Can Capitalize on The Wireless Enterprise Market Opportunity, Dell'Oro Group

Converged Transport: IP Optical Connectivity and Networking

As stated in the previous section, 5G and MEC give service providers the opportunity to substantially increase their revenues. New applications such as gaming, AR/VR, video-conferencing and real-time video events can increase the ARPU (average revenue per user) from existing markets and the improved network performance will reduce churn. However, 5G also promises to open up a whole new set of revenue streams from strategic enterprises and industry verticals which are looking to modernize and to become “Smart”. These include manufacturing, utilities, transportation (highways/rail), and governments and local authorities looking at the benefits that Smart Cities can offer. To support these new revenue streams, 5G and MEC introduce a new, dynamic, high-capacity, scalable, disaggregated, virtualized architecture. The RAN, the 5G core and the applications themselves are disaggregated and virtualized, allowing them to be instantiated on MEC infrastructure, whenever and wherever required. In many instances, the IP Optical x-haul network and the MEC infrastructure will be multi-tenant (shared by multiple mobile network operators). This will be the case when a group of mobile network operators (MNOs) are sharing a network or when a transport network operator is wholesaling x-haul and/or MEC to multiple MNOs.

Traditional static connectivity, deployed to support previous mobile generations, is no longer adequate to meet all these requirements. **A new, Converged IP Optical network is required.**

The IP Optical network dynamically provides connectivity to the MEC (and core) locations whenever and wherever required. Advanced engineering techniques such as Segment Routing Traffic Engineering (SR-TE) provide the deterministic IP transport required to guarantee this connectivity meets the SLAs defined for the applications (and 5G functions) in terms of latency, reliability, timing, capacity and quality of service (QoS). Hard slicing techniques such as FlexE are used by the IP Optical network to provide the network isolation required in multi-tenancy networks and the service isolation required by strategic enterprises running mission critical and business critical applications. Finally, the dynamic network control provided by SDN gives the IP Optical network the agility to react to rapidly changing service demands, allowing it to dynamically evolve to meet any service mix in real time.

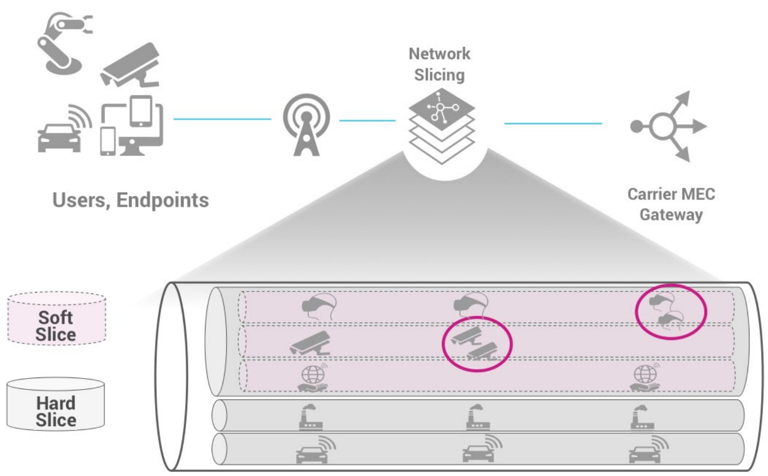

Figure 4. Hybrid Network Slicing: Delivering connectivity with the performance levels required

A converged IP Optical transport network makes a hybrid network slicing approach possible as shown in Figure 4. In this approach the QoS-based soft slicing approaches are run side by side and on top off the strict hard isolation approaches provided by hard slicing technologies. With hybrid network slicing, service providers have the full network slicing toolkit they require to offer new high value services, enter new markets, support multi-tenant networks while maximizing operations efficiency and minimizing network costs.

Bringing It Together with Efficient Cloud-Native Operations: Orchestration, Automation and Analytics

Once the basic infrastructure is in place to realize MEC opportunities in a 5G enabled network with optimized transport, a mechanism is needed to achieve the full operational value across the different network domains through software-defined automation and intelligent monitoring and optimization of the MEC infrastructure. 3GPP recognizes the need for automation of management by introducing new management functions such as a ONAP communication service management function, ONAP network slice management function and a network slice subnet management function to provide an appropriate abstraction level for automation.

The glue that ties this together is combined orchestration and automation of the MEC and transport resources – essentially fusing the MEC MANO with transport SDN – to create a seamless MEC and transport infrastructure for delivering low latency applications which:

- Respond rapidly to new service requests and changing traffic flows.
- Guarantee SLAs using dynamic reallocation of resources.
- Are secure across multiple dimensions, including isolating service flows, and protecting against misuse.
- Optimize resources for low first cost.
- Automate ongoing operations for low ongoing costs.

This overall approach is illustrated in Figure 5 tying into the end-to-end service provider's orchestration system. Analytics is used to gather the data from across the distributed MEC and in conjunction with a comprehensive centralized view, acts as the engine for directing multiple value-added operations.

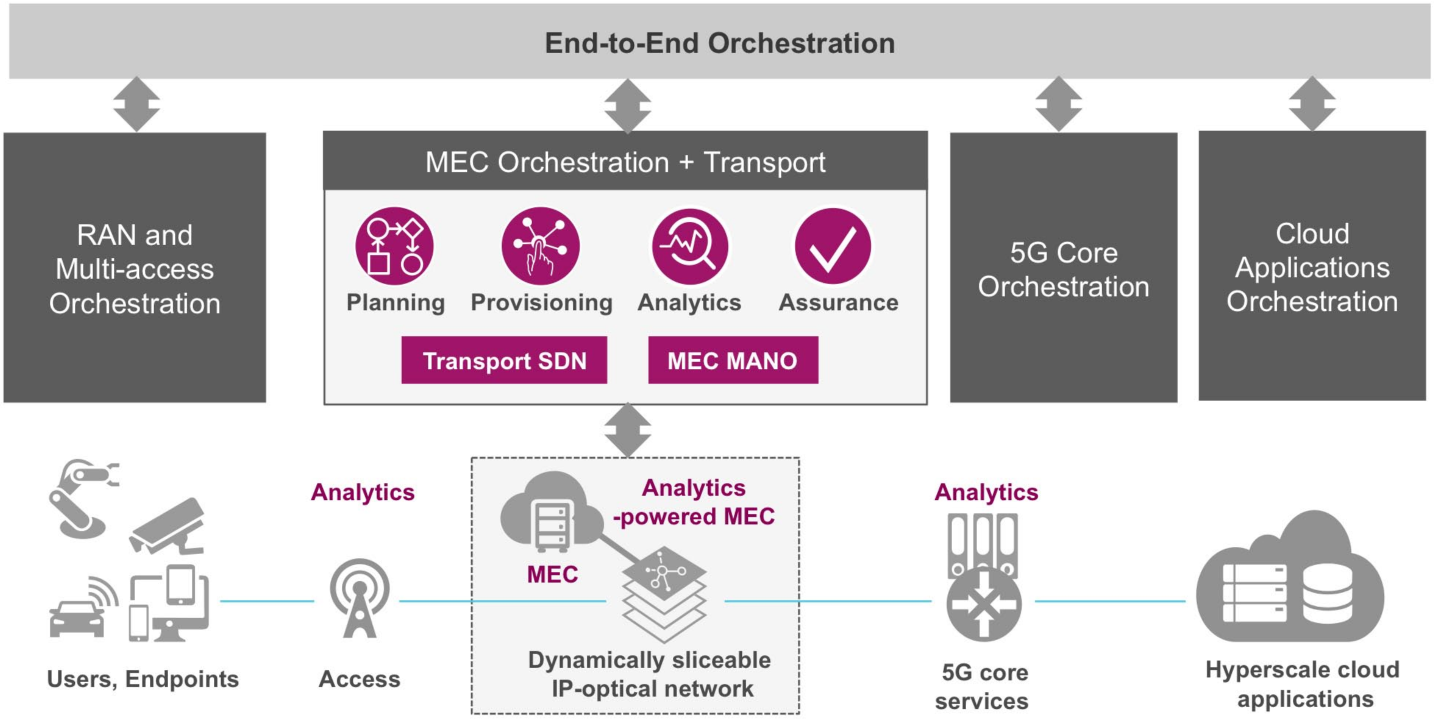

Figure 5. Fused Transport-plus-MEC as part of a Total Telco Cloud

A combined transport-plus-MEC orchestration solution (Figure 6) optimally combines lifecycle management and advanced automation capabilities. Typically, lifecycle management capabilities include:

- State-of-the-art planning tools that optimize networking and MEC resources based on selectable factors such as latency for different classes of MEC and cost. Upon completing a network design, configuration files should be downloadable to sites for fast and error-free turn up.
- Ready-to-use service provisioning templates, where users populate fields such as for end-points and desired performance. Upon completing a template, the orchestrator should automatically assign underlying network resources and verify SLAs prior to service activation. Network operators should also be able to design new service templates from scratch.
- Web UIs, featuring intuitive programmable dashboards, make it easy to maintain the network and MEC resources on an ongoing basis, including tracking and investigating alarms, monitoring performance, running diagnostics, and analyzing historical trends.

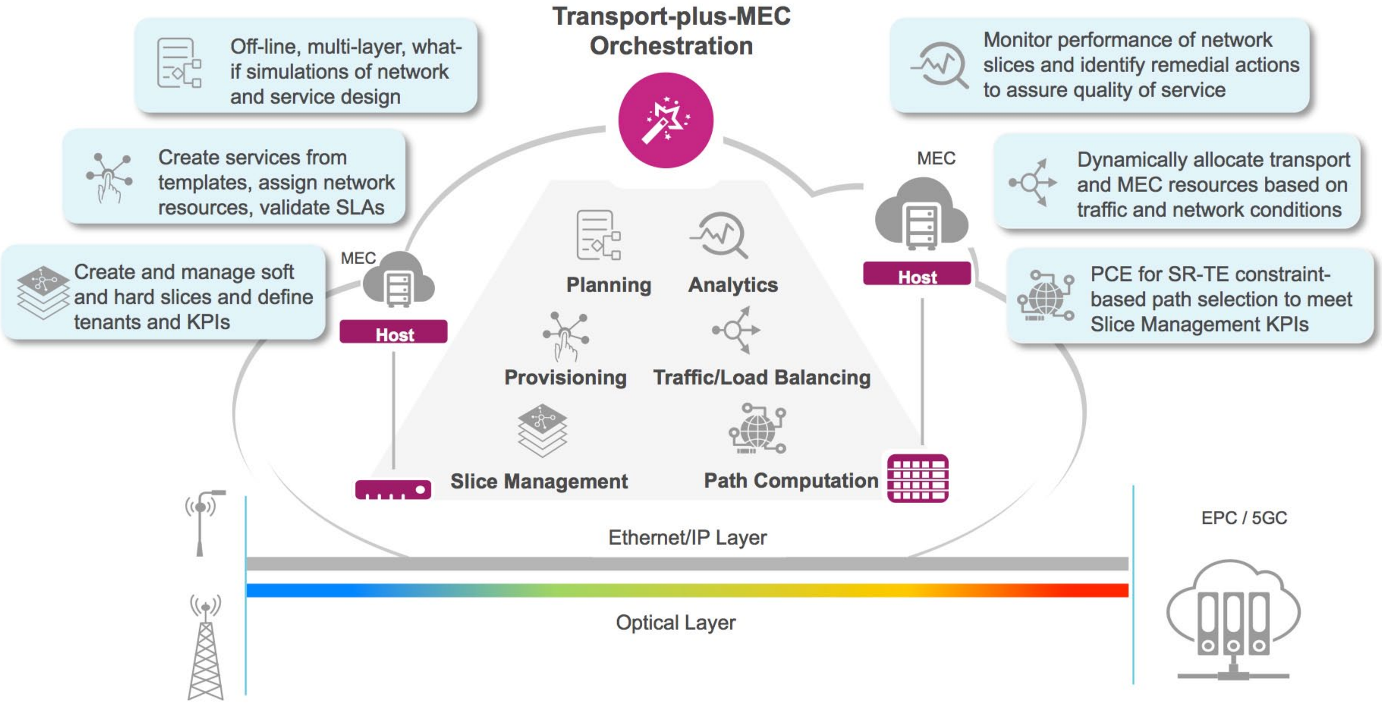

Figure 6. Fused Transport-plus-MEC Orchestration

A transport-plus-MEC orchestrator can include advanced capabilities such as:

- Closed loop automation to speed up "time to revenue" in responding to new service requests, lower costs through continuous resource optimization, and increase network availability through self-healing dynamic restoration. It should be possible to apply automation in stages, enabling a smooth migration from human assisted, to intent based, to full machine control.

- Multilayer processing optimizes resource use across the IP Optical network and MEC processing layers and ensures efficient delivery of 5G traffic flows to the MEC platforms. It verifies that backup routes have no common underlying points of failure, and when problems do occur, it coordinates between layers to restore services as quickly and effectively.
- Advanced "what-if" analytics models a wide range of potential failures and advises on how the network can achieve higher resiliency. By flagging risks before services are affected, it drives efficient preventative measures. Furthermore, running analytics at the edge, service providers can improve the computing experience by lowering the latency of responses and provide the scalability crucial for analyzing the large volume of data coming from sensors and network devices. To reduce the strain on the central analytics resources, edge analytics enables service providers to scale out their processing by decentralizing to the location where the data is collected. Both centralized analytics and edge analytics will supplement each other in delivering data insights. A distributed Analytics solution should adapt and operate in the following ways:
    - Provide end-to-end visibility across core to the edge computing network
    - Offer real-time customer experience and network performance visibility
    - Seamlessly monitor both current and historical data, including all the traffic from apps, networks, and devices
    - Proactively troubleshoot with root cause analysis for things like User Plane congestion management, detecting and mitigating security threats
    - Automate service assurance with machine learning and predictive analytics, to continuously learn from past data that signaled network issues and to predict future problems before they occur

  With Edge Analytics providing:
    - Support for standard MEC information services (e.g., Radio Network Information Service)
    - Programmatic visibility into User Plane activity to understand MEC application SLA and performance
    - Optimization for access technology

  And Centralized Analytics providing:
    - Centralized monitoring and operations for deployed MEC apps
    - Cloud-native, open APIs for a customizable BI platform
    - Ability to be integrated with/deliver on Network Analytics Data Analytics Function (NWDAF)
- Network sharing and network slice management allows operators to "carve out" virtual subnetworks from a common physical network. This makes it possible to create slices for dedicated MEC applications for enterprise customers. It also enables service providers to sell Infrastructure as a Service, where each tenant, such as an enterprise (or another service provider), and the orchestration environment only allocates resources belonging to their slice.

Orchestration is not an island and should subscribe to open networking principles for integrating into multivendor ecosystems (Figure 7). All basic and advanced functionality needs to be controllable via standard northbound interfaces, to integrate with BSS and OSS, as well as higher-level network orchestrators. Standard southbound interfaces should also extend functionality to network networking equipment and MEC platforms from multiple vendors.

Above all, orchestration is expected to be thoroughly cloud-native to align with modernized control architectures targeted by network operators. This includes being hardware and operating system agnostic, employing a Platform as a Service for flexible scaling and easy onboarding of new applications, and delivering applications using microservices and containers for continuous integration and deployment. Most importantly, the orchestration function must be carrier-grade, with five 9s availability and geographic redundancy.

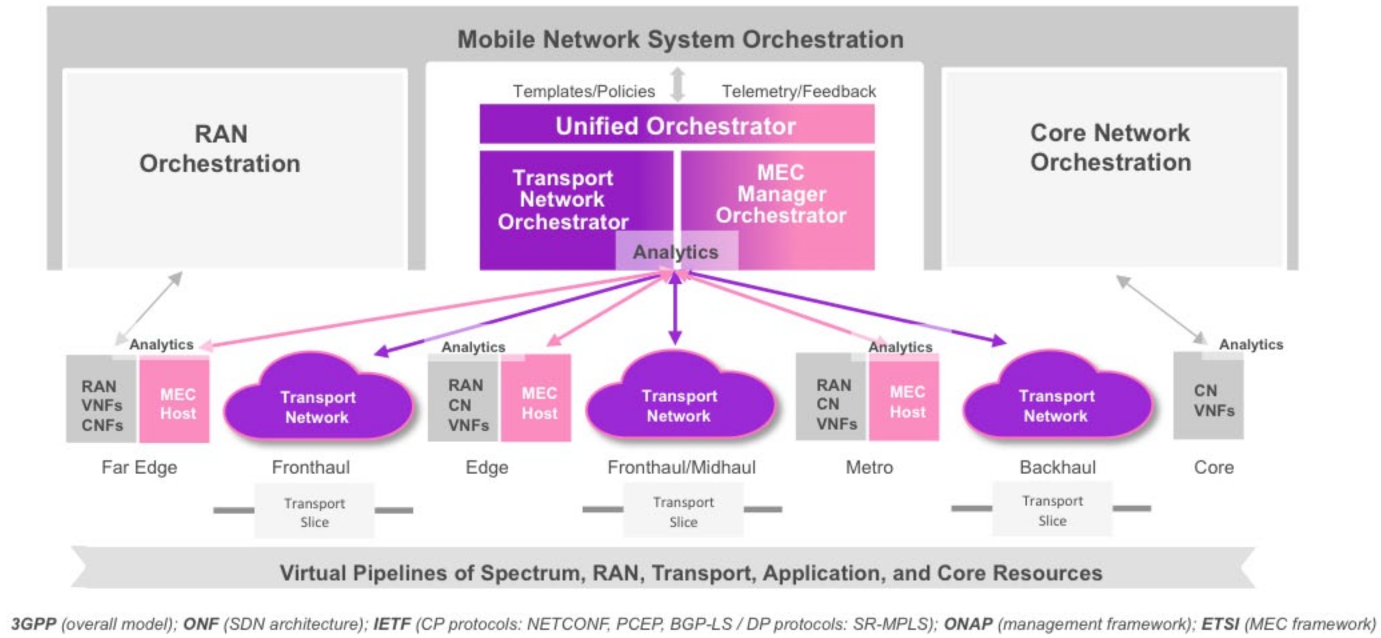

Figure 7. Fused Transport-plus-MEC Orchestration with Analytics as Part of E2E Value Chain

Summary

To achieve the revenue generation, service assurance and operational efficiency goals for MEC and 5G network deployments, it is critical that the underlying network components and connectivity are tightly integrated, allowing them to meet the varied services requirements such as ultra-high capacity, low latency, high availability, security, strict timing and service isolation.

Network and services value can be maximized through tighter integration of distributed MEC with converged IP and Optical transport, fully optimized service assurance, increased revenue opportunities and reduced total costs through automation, orchestration, analytics, and cloud native open design.

To achieve the operational, services and TCO goals, optimal 5G and MEC build-outs require:

- A MEC platform that optimizes the integration of service provider assets, 3rd party application partners and hyper-scaler compute resources by integrating intelligent insights, real-time policy actions and application feedback to achieve network requirements.
- A Converged IP Optical approach that uses the most appropriate IP or Optical transport technology to transport the services to where they are required in the network and enables concepts like hybrid slicing whereby QoS-based soft slicing can run side by side and on top off the strict hard isolation technologies provided by hard slicing.
- A holistic approach combining optimized transport connectivity and intelligent MEC through end-to-end orchestration, automation and analytics to meet the functional and performance needs of service provider customers.

About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. To learn more about Ribbon visit rbbn.com.