The Imperative of MSO Future Wireless

Strategies, Services and Architectures

A Technical Paper prepared for SCTE•ISBE by

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Introduction

The traditional MSO business is facing unprecedented competitive threats resulting in customer churn, revenue decline and margin erosion. Telephone companies (Telcos) are deploying 5G services which they expect will provide a consumer experience comparable to the current cable experience. Over-the-top (OTT) players threaten to convert the MSO service to a connectivity play and skim the cream off the top by delivering high margin consumer and enterprise services. We already see this competition show up in the landscape in all segments such as:

Consumer

- 5G Home broadband at 300Mbps
- NFL/Venues immersive experience
- Live TV streaming services

Enterprises

- Fixed 5G for primary/secondary connection
- 5G enabled eHealth for hospitals
- 5G for education and training

Public sector

- 5G First Responder –Public Safety
- Smart City applications

To reverse the revenue and margin declines, MSOs are planning new wireless services. These services improve competitive positioning of current consumer and enterprise products and add net new revenue through new product offerings.

However, wireless is a new business for MSOs, who often lack adequate resources to accelerate its deployment. Strategy teams are experimenting with many different business models and use cases, which result in product churn and indeterminate timelines of the new portfolio. With these challenges, it is important for MSOs to identify a low risk foundational architecture to learn, experiment and become technically and operationally ready to launch new wireless services aligned with market needs.

In this paper, we will discuss the future architecture which will support new wireless services. We will develop a foundational architecture common to most services, and which enables experimentation and readiness development in short order. We demonstrate that the foundational architecture needs 20-30% CAPEX investments of a service architecture and allows MSOs to prepare for a vast number of services. Adopting this approach, MSOs will be able to counter the lack of clarity of the future wireless imperative and reduce product development cycles through an investment protected architecture.

Content

1. Background

MSOs are facing immense competitive threats to their traditional businesses. Telcos and new entrants are experimenting with 5G, LEO (Low Earth Orbit) satellites and HAPS (High Altitude Platform Station) to expand their consumer broadband solutions to broader coverage areas, offer higher speeds and lower tariffs. Current and new OTT players are offering enterprise and consumer services that threaten to convert the MSO offerings into a low margin connectivity play. These threats, if not addressed will end up in lowering MSO revenues and margins. Hence, many MSOs are considering new wireless services to improve the competitive positioning of their current services and expand their product offerings. The main objective is to reduce churn, improve ARPU and add new revenue streams.

Samples of the wireless services that are being considered include

- Consumer
  - MVNO
  - Fixed Wireless
  - IoT-Home
- Enterprise
  - IoT -Verticals
  - Private LTE
  - 5G front/backhaul
  - vRAN hosting
- Public Sector
  - Smart City
  - Public safety
  - Fixed wireless

The challenge facing MSOs is uncertainty. MSOs will have to launch many products quickly knowing that changing market conditions will churn the product portfolio. This coupled with limited wireless expertise will result in unexpected surprises in commercial readiness of the new products. New partnership models may also pose threats to revenue.

The "Agile" way is to launch massive "distributed experimentation" of wireless services. Distributed experimentation unshackles cross-functional teams to rapidly ideate, innovate and test the business and technology viability of many different products. The emphasis is to encourage risk taking and allow for failures. If an idea fails to meet predetermined technical or business viability objectives, then learn from the failure and find some other idea to innovate.

However, distributed experimentation by many teams needs to have good governance so that the efforts are mutually beneficial and learnings from all projects benefit the final commercial product. For this strategy to work, the MSOs need to settle on two very important points on the roadmap

1) The end point– Future Wireless Network Architecture
2) The start point – Foundational Wireless Network Architecture

By fixing the start and end points of the network architecture, the teams working on wireless services will have a good platform to start experimentation and clear direction to execute their projects and test for success.

This paper demonstrates this concept by proposing the future MSO wireless architecture and the foundational architecture. Then taking a few sample services like Private LTE, Fixed wireless and Full MVNO, we demonstrate how the foundational architecture can grow to a service architecture. This paper also analyzes the CAPEX investments that would be needed for the foundational architecture and the extension of those to full service architecture.

2. Architecture principles of the future MSO wireless network

The new wireless use cases are typically categorized as below

- Enhanced Mobile Broadband (eMBB): requiring high data rates across a wide coverage area.
- Ultra-Reliable Low Latency Communications (URLLC): places a premium on latency and reliability performance SLAs and are interesting for mission critical communications, such as Industrial automation
- Massive Machine Type Communications (mMTC): support unprecedented number of connected devices, which may only send data sporadically, such as Internet of Things (IoT) use cases.

When we analyze the requirements from these use cases, we uncover a picture that is shown in Figure 1.

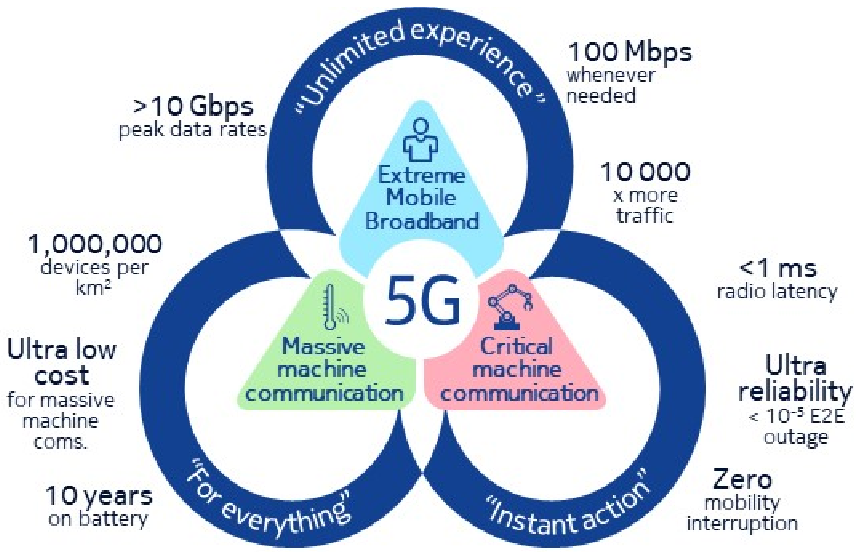

Figure 1 - Requirements of the future wireless services

As is obvious from Figure 1, the requirements of the future wireless services in the new world of 5G are diverse and will conflict with each other. This means that the traditional principles of network architecture need to be modified to support these services.

To make matters more complicated, there are considerations beyond just technology that also impact the network architecture.

The network architecture will need to be flexible to support experimentation. In addition, MSOs already have deployed networks which can serve as an asset to accelerate service deployment. If not managed properly, MSOs can end up with a complicated multi-layer network which exponentially increases operational costs.

In face of these challenges, we propose that MSOs build their new wireless network adhering to the following principles.

- Cost and risk reduction through **convergence** across access, transport, common NFVI and services

- Simplification and improved quality with service centric **automation**
- Scalability and low latency through edge cloud **virtualization**

These principles will reduce TCO, leverage existing assets and enable fast service deployment using network slicing. In the following sections, we will build the network architecture that adheres to these principles and meets the new wireless needs.

3. Future Wireless Architecture – Converged and Virtualized with massive automation

The proposed future wireless architecture, aligned with the concepts of convergence, virtualization and automation is shown in Figure 2.

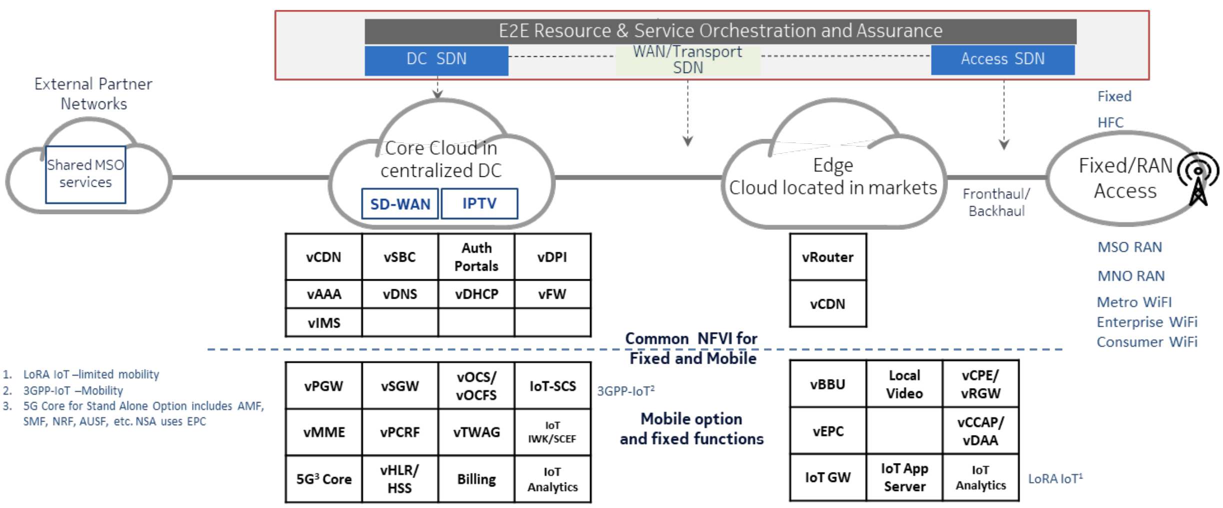

Figure 2 - Future wireless architecture

The key points of this architecture are described below

1) Convergence: The network functions that are above the dotted line in Figure 2 are used in both wireless and fixed networks and collapsing them reduces the TCO of the overall network.
2) Distributed and Virtualized Edge Cloud: MSOs have a unique advantage of assets like regional data centers and hubs that are deployed very close to where the services are consumed, which can be leveraged for the edge cloud. In addition to supporting the MSO needs, these edge cloud assets can also be monetized by offering them as a service to other operators (e.g.: BBU hoteling).
3) Massive automation: This architecture transitions from hardware centric physical assets to software defined networks which enables automations like Network slicing, engineering and deployment of services and zero touch close loop assurance.
4) Interworking with partner networks: This programmable network exposes control of functions via APIs to partner networks.
5) Multi-wireless access: It is expected that MSOs may need to deploy multiple different wireless technologies and networks including
   a. WiFi: Enterprise, metro, hospitality, Consumer
   b. RAN: 4G and future 5G Fixed wireless, Small cell offload, private LTE
   c. IoT: LoRA, NB-IoT, LTE-M

It is important to note that the above architecture is the "end point" for the future network. It is not anticipated that MSOs will get to this end point in one step, rather we expect an evolution that will be driven by business needs.

4. Foundational Network Architecture- the starting point for the future

The MSOs need a minimal architecture that enables them to start the journey towards the future. The main considerations to select the network functions in this architecture is that they should be common across multiple services and support technical experimentation. The foundational architecture is not a complete service architecture.

This architecture is shown in Figure 3.

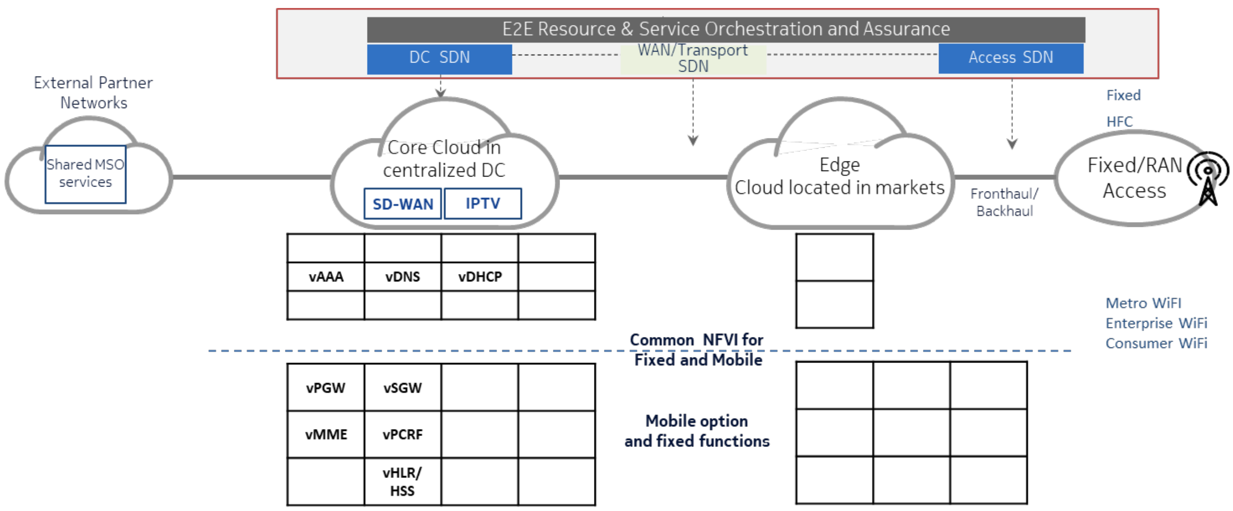

Figure 3 - Foundational architecture for future wireless services

The functions included in this foundational architecture include the Packet core for the wireless network (vMME, vPGW, vSGW, vPCRF), vHSS for control of the end user and vAAA for authentication function. These minimal functions show up in all service architectures and it is optimal to pull these together in the foundational network. The resulting platform can be used to start developing service architectures.

5. Full MVNO, Fixed Wireless and Private LTE architecture

In this section, we extend the foundational architecture to support Full MVNO, Fixed Wireless and Private LTE services.

Figure 4 shows the service architecture that will support full MVNO services including core functionality to control user sessions and seamless offload.

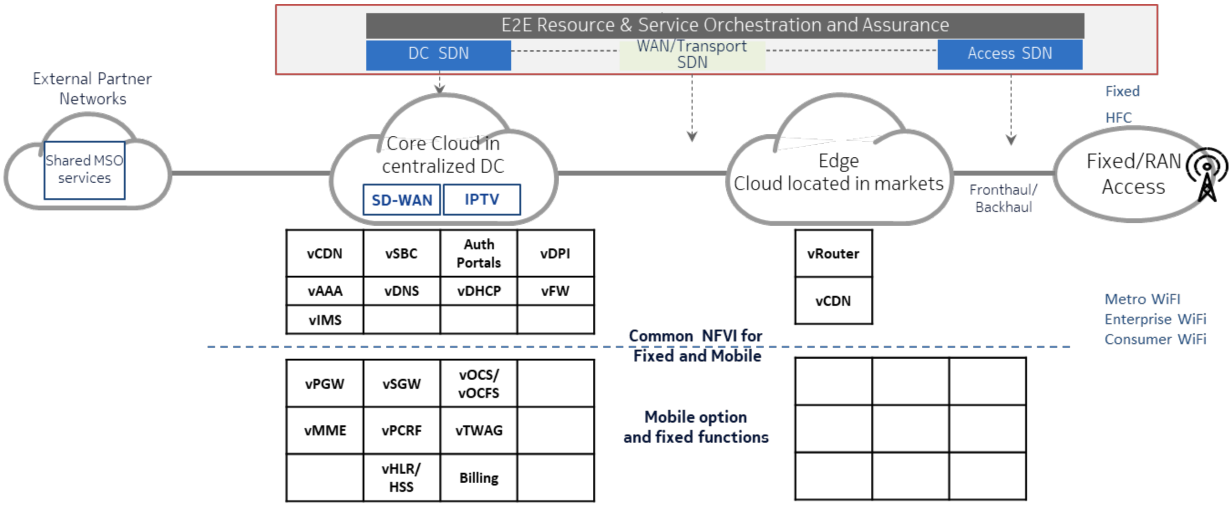

Figure 4 - Full MVNO service architecture

We observe that the enhancements are on the Core, especially to support WiFi and Wireless interworking. This architecture uses the RAN from a partner MNO. In addition, the edge network has limited functionality, as there are no low latency services needed.

Figure 5 shows the service architecture for a fixed wireless service potentially over CBRS spectrum that can provide a Home Hotspot broadband solution. This architecture can also be used as a potential offload architecture for the MVNO service.

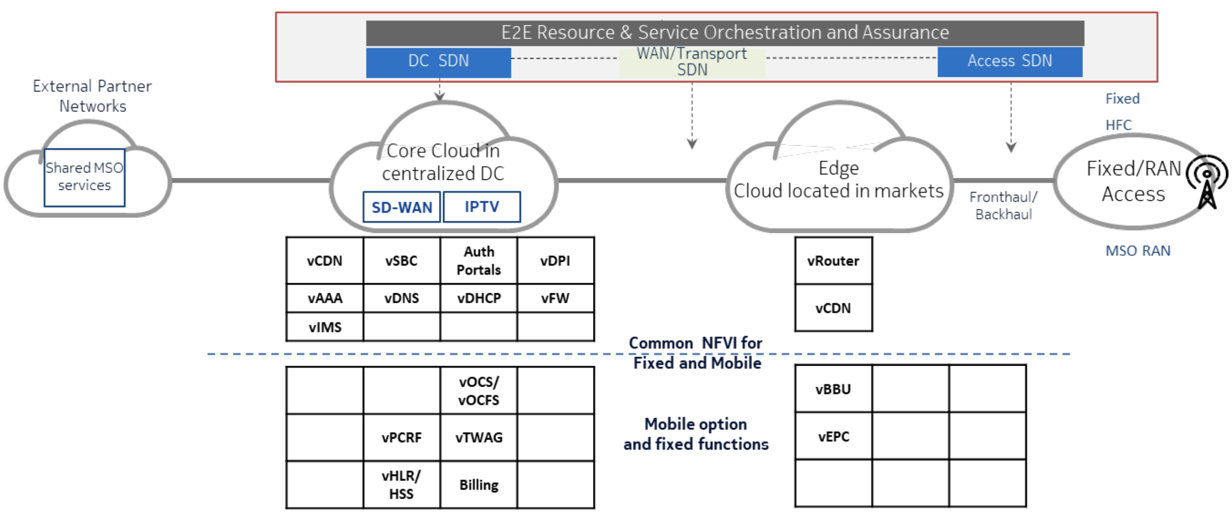

Figure 5 - Fixed Wireless service architecture

This architecture adds the MSO RAN components, which can be in the form of small cells, Fixed wireless CBRS or mmWave cell sites. Also, the vBBU and the vEPC network functions can be moved to the edge if there is a need for low latency services.

Private LTE network can be supported by an architecture shown in Figure 6.

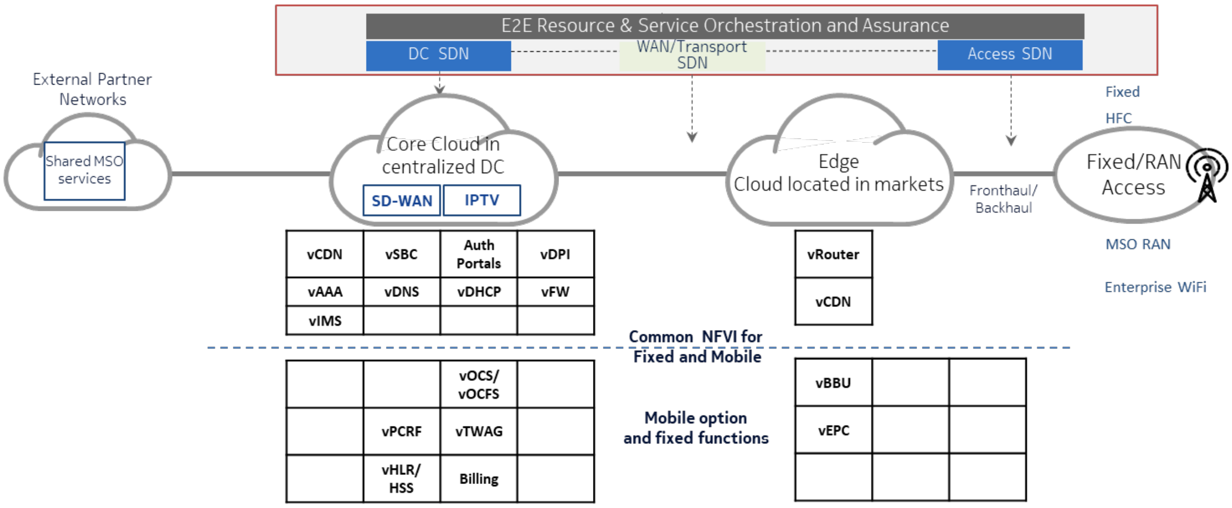

Figure 6 - Private LTE network architecture

In this architecture, MSOs will need to be ready to deploy the edge cloud with vBBU and vEPC functions at the edge to support the services needed.

6. Investment comparisons

We observe that the foundational architecture is persistently needed in all service architectures. In some services a function like the vEPC may need to be relocated to the edge, which is simpler in the programmable virtualized architecture.

This proves the value of the foundational architecture to provide solutions to the challenges that we discussed earlier.

In addition, from an investment perspective, the foundational architecture serves as a low risk bet to get the MSO organization ready for business, technology and operations to support new wireless services.

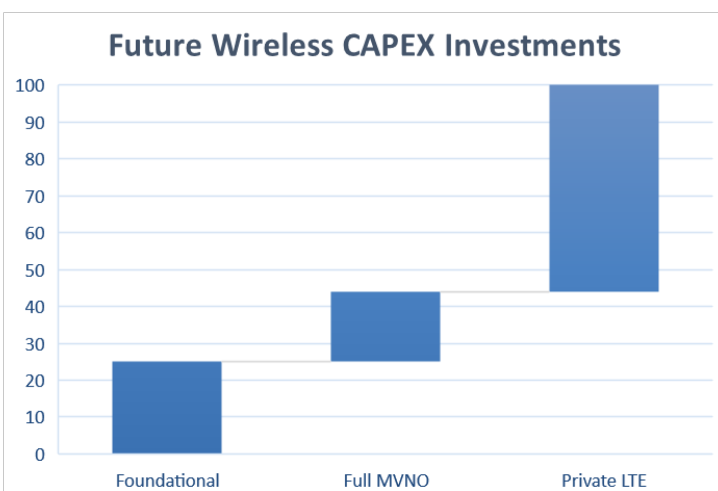

Figure 7 - CAPEX investment comparison for foundational v/s full architecture

Figure 7 analyzes the CAPEX investments needed in the foundational architecture as compared to the service architectures for Full MVNO and Private LTE networks. We observe that an additional investment of approximately 20-30% will enable an accelerated launch of new wireless services.

Conclusion

In this paper, we analyzed the imperative of a new approach towards wireless. Enabling rapid experimentation can be effectively utilized to satisfy both technical and business models. This approach is possible by deploying the foundational architecture before any of the service deployment decisions have been made. This low risk architecture needs only 20-30% of the investment and accelerates deployment of services such as Full MVNO, Private LTE and Fixed Wireless. This provides a cost-effective and yet flexible solution.

Abbreviations

AP	access point
bps	bits per second
FEC	forward error correction
HFC	hybrid fiber-coax
HD	high definition
Hz	Hertz
ISBE	International Society of Broadband Experts
SCTE	Society of Cable Telecommunications Engineers
5G NSA	5G Non-Standalone
5G SA	5G Standalone
AMF	Access and Mobility Management Function
AUSF	Authentication Function
CBRS	Citizens Band Radio Service
CDN	Content Delivery Network
CPE	Customer Premises Equipment
IWK-SCES	Interworking Services Capabilities Exposure Server
LoRA	Long Range
LPWAN	Low Power Wide Area Network
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
NRF	Network Repository Function
OCF	Online Charging Function
OFCF	Offline Charging Function
RPD	Remote PHY device
RMD	Remote MAC/PHY Device
SBC	Session Border Controller
SCS	Service Capabilities Server
SD-WAN	Software Defined Wide Area Network
SMF	Session Management Function
TWAG	Trusted Wireless Access Gateway
vAAA	Virtual Authentication, Authorization and Accounting

vBBU	Virtual Base band Unit
vEPC	Virtual Enhanced Packet Core
vHLR	Virtual Home Location Register
vHSS	Virtual Home Subscriber Server
vMME	Virtual Mobility Management Entity
vPCRF	Virtual Policy and Charging Rules Function
vPGW	Virtual Packet Gateway
vSGW	Virtual Serving Gateway