

Wi-Fi® first: Should I do it? How do I do it?

A business rationale paper for multiple system operators (MSOs)

Strategic White Paper

Bell Labs predicts that the mid-term communication and entertainment future will center on wireless consumption of service provider products and services. In this future, MSOs will have a major role to play in new value chains, not only in the provision of small cell backhaul services, but in providing mobility-based services and connectivity as extensions of their evolved fixed access offers. What this really means is that an MSO's future market success will leverage an extended fixed access network embracing wireless end points of all different types-licensed and unlicensed-that provide ubiquitous connectivity and entertainment to web-savvy subscribers. The move to this wireless future has already started. Wi-Fi is now a major component of some MSO mobility strategies and has been used to provide data connectivity in churn-reducing initiatives across the globe. Voice over IP (VoIP) service on Wi-Fi has also been used with varying degrees of success. What is clear to MSOs is that the technology is now available for the deployment of viable Wi-Fi first strategies. This paper describes what Wi-Fi first actually means to MSOs and addresses the key concerns with which MSOs currently struggle: What is the business case for Wi-Fi first and what's needed to make it work?

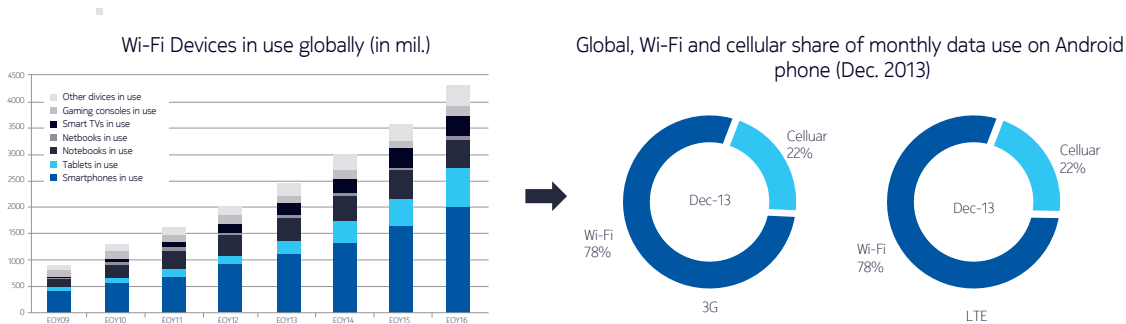
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Introduction

Like other communications or media industries, MSOs in all markets face a dynamic and extremely competitive market. End users expect the freedom to extend their fixed access broadband service to a nomadic environment. Growth in smartphones and tablets together with the rise in applications such as streaming, computing, storage, gaming, and communicating continue to drive the need for anywhere, anytime connectivity. In fact, surveys have shown that while a majority of Wi-Fi usage is at home and work, end users everywhere use Wi-Fi in public places. As a result, there has been a significant growth in Wi-Fi traffic driven by Wi-Fi enabled devices, especially tablets and smartphones (Figure 1). Globally, Wi-Fi carries over 70 percent of the traffic generated by handsets¹ and it is estimated that only four percent of smartphone data volume is consumed when on the move in places where there is no Wi-Fi coverage.

Figure 1. Wi-Fi device and traffic growth



Source: Gartner, Statista, HD Living, IT Candor, Cisco VNI

To address user expectations and demand, many MSOs have evolved their end user offerings to include market-leading fixed high speed internet access, Wi-Fi connectivity, and bundled mobile cellular services. Some in Europe, the Middle East and Africa (EMEA), as well as Canada are delivering these bundled services through partnerships with mobile virtual network operators (MVNOs). In some markets, MSOs have already invested in Wi-Fi and offer data connectivity services in and out of the home. This is not only a customer retention strategy, it also lets MSOs build out further value added services and can reduce data costs for those with MVNO agreements.

A Wi-Fi first strategy helps MSOs remain competitive. Although nuances in the business drivers for adopting such a strategy vary by region and existing MSO assets, this new network model turns the traditional cellular voice paradigm on its head.

What is Wi-Fi first?

Wi-Fi first is an evolution of what has been happening over the past five years with the delivery of voice and data services over Wi-Fi technologies. The term is used globally, but can mean different things to different MSOs and it's important to define it accurately.

Where an MSO has both Wi-Fi as well as cellular assets, usually via a Full-MVNO (F-MVNO) operation, the term refers to the fact that the network allows devices enabled with Wi-Fi to default to an MSO's Wi-Fi network for service and switch back to cellular when they are out of range of relevant Wi-Fi access points. In this case, a Wi-Fi first strategy can improve the user experience and profitability of an MSO equipped with an F-MVNO.

For MSOs without any cellular assets, Wi-Fi first is sometimes coined to imply the use of Wi-Fi calling over an MSO's Wi-Fi assets. This technique also applies to the use of devices not equipped with a subscriber identity module (SIM) to perform Wi-Fi calling.

Note that a Wi-Fi first strategy is not to be confused with the user device's natural preference for Wi-Fi. This is the behavior whereby a user device attempts to automatically connect to a Wi-Fi access point as soon as Wi-Fi is switched on. The device attempts to associate with open second service set identifiers (SSIDs)-with browser redirection to captive portals-and with known closed SSIDs for which the device contains previously configured login credentials.

There are data and voice aspects to the evolution of the Wi-Fi first concept.

The data angle

In recent years, some MSOs have been deploying Wi-Fi connectivity. Those with F-MVNO agreements are interested carrying data on Wi-Fi rather than using cellular data. The costs of maintaining a mobile data and voice partnership with a mobile network operator (MNO) are high. Therefore, some MSOs have been successfully offloading mobile data to their own Wi-Fi access points to save on the data costs related to their F-MVNO agreements. In EMEA, for example, MSOs have introduced managed Wi-Fi access points in their cable modems, broadcasting the same operator SSID over an entire country. Any self-configured private SSID is thereby complemented with an operator SSID that permits community Wi-Fi service in homespots and in public hotspots. This has addressed the needs of digital nomads and has evolved to the point where community Wi-Fi has become a key differentiator on top of a quad play offer-the fifth play.

With Wi-Fi, end users get quality data connections when they need them and a better user experience. Meanwhile, MSOs improve the business case for their F-MVNO agreements.

This community Wi-Fi service for mobile data coupled with new possibilities related to voice services has evolved into what is now called Wi-Fi first.

The voice angle

For voice, deploying Wi-Fi first is more challenging because smartphones do not have a natural preference to use Wi-Fi rather than 2G/3G circuit-switched calling or voice over LTE (VoLTE). The MSO network requires voice steering capabilities between its F-MVNO to Wi-Fi. However, many MNOs and MVNOs have succeeded to steer outgoing and incoming calls and texts over Wi-Fi using native dialers. These embedded or downloadable apps for Wi-Fi calling register with an IP Multimedia Subsystem (IMS) and a mobile device management (MDM) system to remotely configure the smartphones. This added level of complexity is why some MSOs may doubt the business viability of such a scheme and require further business case analysis.

Wi-Fi calling technology based on downloadable apps has been around for approximately five years and some MSOs already support some type of voice over Wi-Fi (VoWi-Fi) service. It should be noted that this is completely disconnected from a mobile service, which is the focus of Wi-Fi first. Typically for Wi-Fi calling, the service is enabled via an application that end users download to their devices. These apps are associated with the subscriber's fixed telephone number, which is usually provided as part of a triple play package and considered an extension of such. For example, in The Netherlands end users can download the Bapp app for their Ziggo service.

In most cases, MSOs use these apps because they see pressure on voice services from over-the-top (OTT) providers. The app offering is an attempt to retain end users. But because app-based voice service is really an extension of a fixed phone number, many observers believe that MSOs who deploy such strategies will see that the take up rate is low. To evolve this into a compelling service, native dialing is required as part of an overall mobility scheme that will provide the required user experience. The standalone application experience cannot offer this. The operation must be manually enabled in the smartphone and there is too much user intervention required for authentication and authorization. In short, it is not user friendly.

In summary:

- For MSOs with both Wi-Fi and cellular assets, Wi-Fi first refers to mobile devices and services that use MSO Wi-Fi as the primary network and cellular networks where the MSO does not have Wi-Fi service. The experience is expected to be user friendly and automatic
- For MSOs with only Wi-Fi assets, Wi-Fi first is sometimes used to describe a calling service that does not require any mobile subscription and may even be offered to devices without a SIM

For this paper, Wi-Fi first assumes that the MSO has both Wi-Fi as well as cellular assets, unless otherwise stated.

Who should be interested in Wi-Fi first?

MSOs are in different stages of evolution with different assets depending on their particular competitive and regulatory environment. For the purposes of this paper, three types of MSOs are considered as candidates for Wi-Fi first strategies.

Pure play cable operator

Typically, a pure play cable operator is one who offers Pay TV, fixed access and fixed voice services. The operator has a softswitch and is focused on fixed services. It will probably have Wi-Fi deployments already, which will range from large scale hot spot deployments such as seen with Cablevision in the greater New York area of the United States to small trial systems. And, most probably, it will also have Wi-Fi-enabled residential gateways. Typically, these operators are found in the United States, but there are some in Canada and EMEA.

For these operators, Wi-Fi deployments are used as a value added service that will open new revenue opportunities and reduce churn and market share erosion.

MVNO-enabled operator

A MVNO-enabled MSO is one that has evolved from pure play in terms of mobility. The operator offers mobility bundles to extend standard fixed offers for content and communications in full or light version offerings. When we consider Wi-Fi first, it is important to note that the solutions discussed later in this paper that give the MSO control over Wi-Fi and cellular assets apply only to F-MVNO-enabled MSOs. Those with a light MVNO do not own the required IP mobile core components to achieve this and are in the same position as a pure play cable operator architecturally.

The business model and Wi-Fi first service offers for these operators will depend on the market opportunity and usage projections in Wi-Fi coverage areas, which will drive the bundled “Wi-Fi First + Mobile Roaming” offer. And, MSOs can leverage their networks to backhaul Wi-Fi as well as MVNO partner small cell traffic.

This type of MSO is predominant in EMEA where there is a mixture of both full and light MVNO-enabled MSOs. Canada also has MVNO-enabled MSOs.

Converged MSO

A converged MSO is one that has been acquired by or who has acquired an MNO operation. Therefore, all of the operator’s fixed and mobile assets are in house. Wi-Fi steering and VoWi-Fi can help these operators reduce costs by leveraging fixed wireline assets. These assets can also be used to deploy licensed spectrum small cells inexpensively for coverage or capacity. Ultimately, this hybrid heterogeneous network (macro + small cells + Wi-Fi) will help the operator deliver ultra-broadband wireless access convergence. It will also make it easier for the operator to differentiate itself with policy-driven licensed and unlicensed access that provides the best service level and quality of experience (QoE) based on a combination of access technologies.

There are several examples of converged MSOs in EMEA. Variations of the converged MSO exist elsewhere, which are built around a traditional incumbent telco with some cable assets. Business case considerations for these types of operators are considered similar.

Converged MSOs have different drivers for deploying the Wi-Fi first solutions presented in this paper, but may also adopt other architectures that combine licensed and unlicensed components in the Radio Access Network (RAN), as well as the core of the mobile network.²

MSOs and Wi-Fi first

For this paper, Wi-Fi first relates to MSOs with the ability to participate in an unlicensed/licensed mobility scheme with the prime focus on Wi-Fi, LTE and then 3G. Typically, this type of MSO will be an F-MVNO-enabled operator, but could also be a converged MSO.

For these MSOs, the business case for Wi-Fi first can be built on the assumption that approximately 65 percent of end user calls made over the MSO network will be home based and that MSOs already have the home adequately covered with Wi-Fi. This alone can drive the business case for Wi-Fi first. It is not necessary for MSOs to provide national coverage given that, while on the move, cellular voice is probably the best option for service.

Pure play MSOs or those with light MVNO may coin the phrase Wi-Fi first, but in their case there is no seamless backup and the business drivers for deploying VoWi-Fi services are different. Without cellular backup, a Wi-Fi calling offering may not generate the level of uptake desired if the service is offered over an extended area that does not have ubiquitous Wi-Fi coverage. However, a pure play MSO might consider offering a Wi-Fi calling solution that lays the groundwork for a future Wi-Fi first strategy when a suitable an MNO partner is found.

Wi-Fi first enablers

Obviously, a Wi-Fi first strategy requires MSOs to have deployed network assets that will enable end user access.

Most MSOs already have a variety of Wi-Fi hotspot deployments in varying degrees of density coverage:

- Hotspot urban coverage
- Public venue coverage for large public spaces, such as stadiums or stations
- Community Wi-Fi coverage based on extending residential Wi-Fi with a second service set identifier (SSID), otherwise known as a home spot

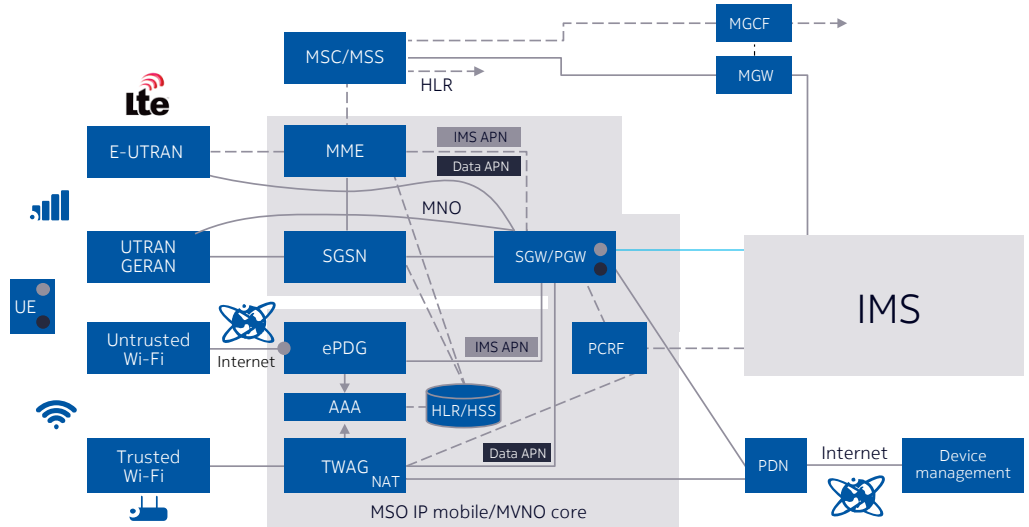
All of these types of hotspot deployments are usually backhauled via the MSO's own network and connected to an MSO-owned Trusted Wireless Access Gateway (TWAG). Typically, these Wi-Fi hotspot networks have been mainly used to enhance the customer experience by extending broadband access outside the home and to help provide TV Everywhere services.

In addition, some MSOs, such as those in EMEA or Canada, have or are building an F-MVNO network that enables them to deliver cellular-based mobile services to their customers via an MNO partner.

Some MSOs have also invested in 4G spectrum to extend fixed services outside of their hybrid fibercoaxial (HFC) network footprint. If MSOs decide to take a more traditional approach to 4G and deploy mobile coverage using 4G small cells, their own networks can provide backhaul for this traffic and Wi-Fi may be integrated into an MSO-owned heterogeneous network. This is possible for F-MVNO-equipped or converged MSOs as described above.

From a mobile core asset point of view, a converged MSO network has similar components to an F-MVNO network. The difference is in wireless access. The F-MVNO has to lease access from an MNO partner. The components usually found in the wireless access network for both types of MSO are presented in Figure 2.

Figure 2. Components of converged MSO and F-MVNO network



Go to market drivers for Wi-Fi first

As mentioned earlier in this paper, the savings achieved by steering voice calls to Wi-Fi while in the home may be enough to justify a Wi-Fi first deployment for most MSOs. But there are several additional considerations that will drive a Wi-Fi first strategy (Table 1).

Table 1. Summary of drivers/use cases for adopting VoWi-Fi or Wi-Fi first, per type of MSO

Type	Subscriber	NRP Saving	Coverage	International Roaming	MOS Improve	Setup Time	Value Added Services
Pure Play					✓	✓	✓
MVNO Enabled	Light MVNO				✓	✓	✓
	Full MVNO	✓		✓	✓	✓	✓
Converged	MNO/MSO		✓		✓	✓	
	Incumbent Telco+MSO		✓		✓	✓	

Savings on National Roaming Provider (NRP) costs

F-MVNO-equipped MSOs, as well as other F-MVNO operators, have suffered from the MVNO squeeze between falling retail tariffs and contracted wholesale tariffs. Without smartphones preferring Wi-Fi and already conveying 80 percent of mobile data via Wi-Fi, many F-MVNOs would not have survived. Some cable MSOs, such as Belgium's Telenet Group, are now buying their own MNO. This is one effective way to escape the squeeze. But Wi-Fi calling is a cheaper option in the short term and is the classic Wi-Fi first business case driver.

Coverage

Some MSOs want to enable Wi-Fi calling indoors because 3G and LTE above 1GHz can struggle. Deep indoor coverage by macro cells has actually not improved in the past years due to increasing home/office insulation in some markets and the transition from 900 MHz 2G to 2100 MHz 3G, 2600 and 1800 MHz LTE. This is relevant for converged MSOs or MSOs with a F-MVNO who want to offload MVNO costs while also improving the overall mobility experience.

International roaming costs

Consumers, businesses, F-MVNOs and Quad-Play MSOs share a common interest to lower their 2G/3G/LTE roaming fees, especially since the F-MVNOs and MSOs do not benefit from inbound roaming (i.e., they do not own a RAN). MSOs require their VoWi-Fi apps to register with their own IMS and that IMS accommodates more user agents than the native user app on iPhone 5/6, Galaxy S6, etc. (See detailed explanation in the solution overview.)

HD Audio

Following the packetization and compression of 2G/3G/landline circuit-switched calls, some MSOs want to raise the mean opinion score (MOS) of service provider voice again by avoiding intermediate media gateways and narrowband codecs. Wi-Fi calling allows service providers to reach an MOS of 4.0 or more, together with investments in VoLTE, residential and enterprise IMS. It is useful, but not strictly required, to complement Wi-Fi calling with Carrier Wi-Fi, prioritizing the IMS traffic as Sprint does on its network.³

Faster call set-up times

Wi-Fi calling provides two to three second set-up times instead of 10 seconds for 2G/3G circuit-switched voice. This may not seem to be a high priority driver, but it is an important feature that impacts the overall customer experience. Most users call more frequently when the setup time is shorter.

Presence information

Skype™ and other OTT calling applications display the recipient's current status. This is, of course, possible with Wi-Fi calling and is a differentiator against standard circuit-switched calling.

Video call offload

Video call offload from LTE to Wi-Fi enables MSOs to save capacity on their LTE networks. This could be a consideration for converged MSOs, although in some markets the LTE networks are not congested enough to merit a short-term solution.

Multi-device, one number

Some MSOs may want to move calls between devices. This is possible by leveraging IMS capabilities, although it is not high on the list of priorities for MSOs.

Migration from private SSID

For all types of MSOs, a Wi-Fi calling scheme or Wi-Fi first strategy may encourage those subscribers that have set up private Wi-Fi networks on the MSO access network to migrate to the MSOs Carrier Wi-Fi networks. This will give the MSO a higher visibility to the subscriber, keeping them on-net and help battle competition from OTT application providers.

The business case

Ultimately, for MSOs in all markets, the major concern about Wi-Fi first is the business case:

- What is the business benefit of steering voice calls onto the MSO network?
- What are the value added aspects of the service that could result in incremental revenue?
- What are the realistic incremental costs?

For most MSOs, there are two typical business case components, as noted in Table 2.

Table 2. Wi-Fi first business case components

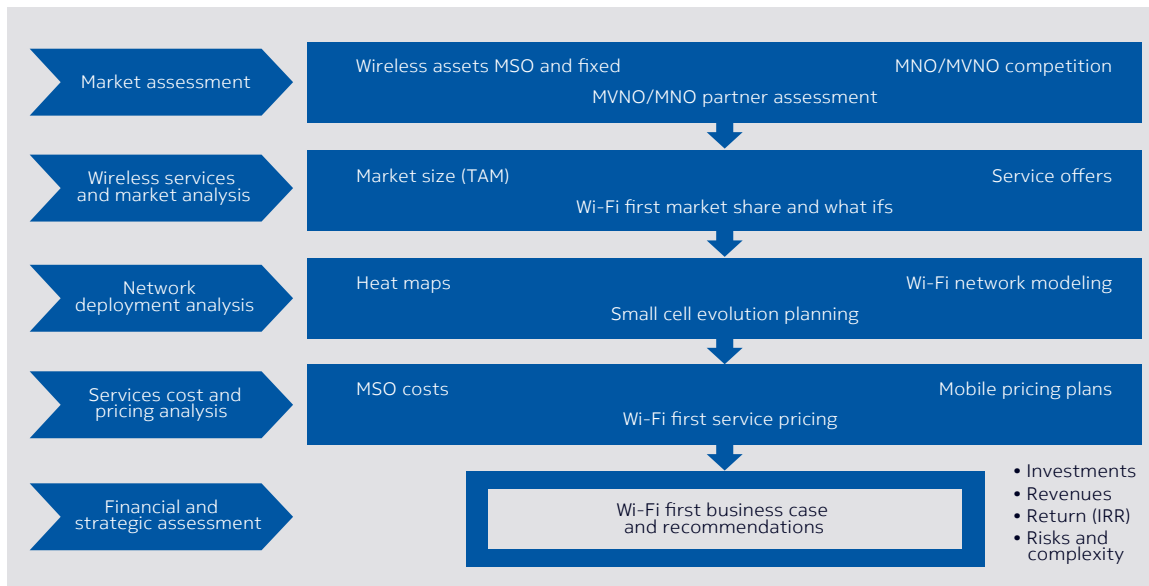
Investment	Revenues
<ul style="list-style-type: none"> • Solution deployment costs, licenses • Additional support costs 	<ul style="list-style-type: none"> • Home cellular voice call related cost savings: <ul style="list-style-type: none"> – For converged MSOs, savings on 4G small cell deployment capital expenditures (CAPEX) in house, lower total cost of ownership (TCO) per bit and improved experience – For F-MVNOs, savings from offloading cellular calls at home to Wi-Fi, and delivery of an improved experience • Churn reduction estimates avoiding costs of regaining lost customers (applies to all MSOs) • Incremental average revenue per user (ARPU) for service or tiered service offerings <ul style="list-style-type: none"> – For pure play, Wi-Fi calling can be an ARPU-generating strategy • Up-sell of value added services, higher tier phones, pay-as-you-go, service to competitor’s user phones to attract new customers • Resell Wi-Fi capacity to other MVNOs <ul style="list-style-type: none"> – For converged MSOs, resell combined 4G/Wi-Fi capabilities – Can apply to pure play as a new revenue business model

Many F-MVNO-equipped MSOs are interested in the possible cost savings that Wi-Fi first voice offload can deliver compared to the typical costs of leasing cellular voice services from a partner MNO.

These cost savings can be made by moving data from the MNO partner’s network to the MSO-owned Wi-Fi network. Cost savings will vary based on MNO wholesale rates in the market and network costs for public Wi-Fi, which vary by market and location.

Bell Labs consulting has a rigorous approach that enables MSOs to get a complete understanding of all the relevant business case components that must be considered (Figure 3).

Figure 3. Bell Labs Wi-Fi strategy assessment process



The solution

Beyond the business case, MSOs want to know what they need to make a Wi-Fi first strategy successful:

- Do we need to talk to Apple®?
- Should we go to market only with Android even though it is more complex to get going in an end-to-end ecosystem and requires an app to overlay the native dialer that will enable VoWi-Fi calling?
- What are the options?

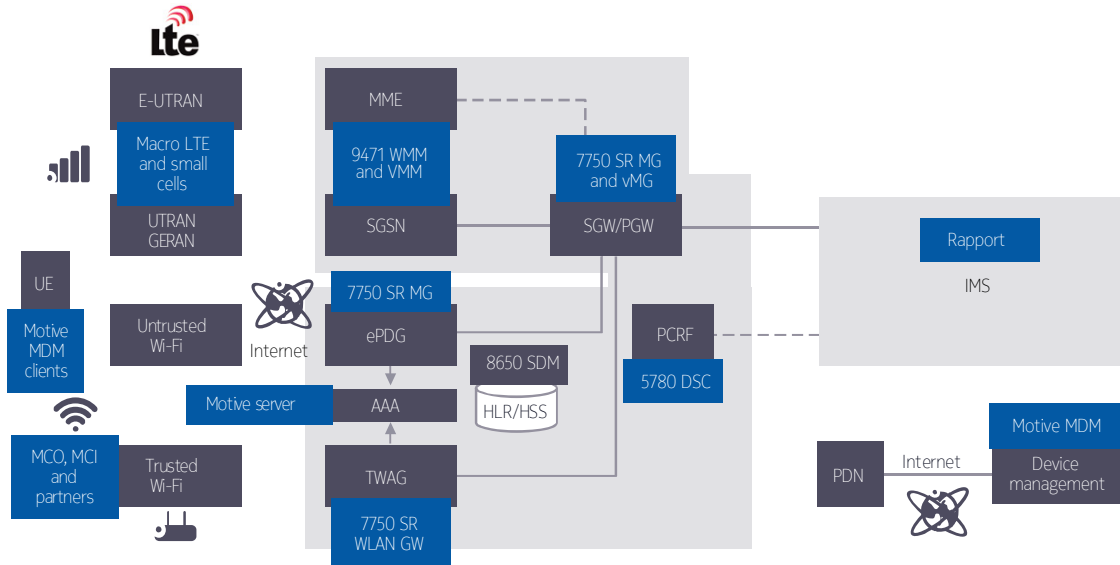
The network components usually found in mobility-enabled MSOs are presented in Figure 2 earlier in this paper. As noted earlier, a converged MSO network has similar components to those of an F-MVNO MSO network.

The difference is in wireless access. The F-MVNO has to lease access from an MNO partner.

Network components

Nokia provides all the components necessary to enable a successful Wi-Fi first MSO strategy. The solution is modular and MSOs may already have some required platforms (Figure 4). Key components are highlighted briefly below.

Figure 4. Nokia components related to Wi-Fi first MSO strategy



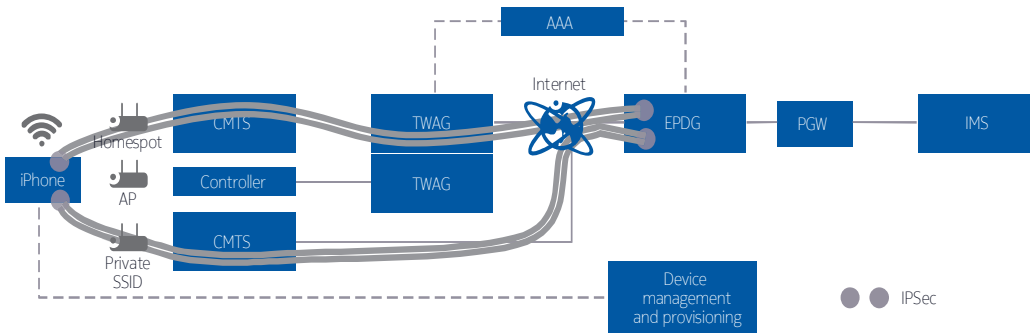
Evolved Packet Data Gateway (ePDG)

Figure 2, presented earlier, shows both trusted and untrusted Wi-Fi access. Most pure play MSOs will have a TWAG⁴, but no ePDG⁵. This platform is found in an F-MVNO core or a converged mobile operation. In a converged operation, the ePDG is part of the Enhanced Packet Core (EPC) and is connected to a packet gateway.

The ePDG is a fundamental component when:

- Enabling Wi-Fi first on the latest iPhone™ devices where it terminates IPSec tunnels from these devices, whether connected via trusted (TWAG) or untrusted (ePDG) Wi-Fi networks (Figure 5)
- Handling untrusted/third-party Wi-Fi networks (Not many MSOs currently employ this, but it is under analysis.)
- The ePDG acts as a security barrier because the IMS may be exposed to the Internet via third-party network connectivity

Figure 5. Wi-Fi first with iPhone and ePDG



PGW

For MSOs who already run an F-MVNO operation, the PDN gateway is a required function. It provides data connectivity between the wireless access domains and a packet data network, such as the Internet. It is the component in an end to end solution that acts as the anchor for IP addresses and allows for IP continuity across access domains.

The Nokia 7750 SR mobile gateway can act as the Serving Gateway (SGW), PDN Gateway (PGW)⁶ and/or Gateway GPRS Support Node (GGSN), either separately or in combination.

Authentication, authorization and accounting (AAA)

The authentication, authorization and accounting platform is a key component of a Wi-Fi first deployment and all MSOs already have one (even pure play MSOs who have trusted Wi-Fi access only and no HLR). In a Wi-Fi first network the AAA solution is required for both trusted and untrusted Wi-Fi working. The ePDG always has a connection via the AAA to the HLR/HSS to enable authentication⁷.

IMS

Many MSOs have or are contemplating the use of an IMS as they renew their voice networks. For a Wi-Fi first strategy, the IMS is needed to enable 4G and VoLTE. Converged MSOs will already have this element, but even with an F-MVNO, the MSO still needs IMS if subscribers are going to use VoLTE on the partner MNO network.

Nokia offers a full modular IMS solution, now fully re-architected for cloud deployment.⁸

UE provisioning

Wherever possible, a successful Wi-Fi first strategy must ensure that the provisioning of a subscriber’s mobile access is zero touch and operations over Wi-Fi and handovers to cellular are transparent to the end user. This will make Wi-Fi an attractive option and enhance the user experience.

Nokia Motive products address the requirements for zero-touch provisioning in a Wi-Fi first strategy. Furthermore, Motive is one of only three official Apple entitlement server providers. This makes it easier for MSOs to include new iPhone devices into their Wi-Fi first strategy.⁹

Going virtual

MSOs must also consider future virtualization options as they develop their Wi-Fi first strategies.

As a leading provider of complete end-to-end solutions for MSO Wi-Fi calling/ Wi-Fi first capabilities, Nokia offers all Wi-Fi first network components as virtualized platforms. This enables MSOs to embark on virtualization as an enabler of service velocity and scale as business grows and needs change.

End user smartphone clients

At the time of writing, there are three types of smartphone clients/agents that MSOs should consider when developing a Wi-Fi First strategy (Table 3).

Table 3. Smartphone clients and relevant Wi-Fi first features

Type	Explanation	Example Smartphone	Why MSOs May Want It	Solution Notes
Client 1: Native IMS user agent	A recent addition to top-end smartphone features with Wi-Fi first built in by the manufacturer.	<ul style="list-style-type: none"> • iPhone 6 (with iOS 8.1) • Nexus 6 (with Android Lollipop 5.1) 	<ul style="list-style-type: none"> • For all new smartphone subscribers on a VoLTE enabled network or F-MVNO operation • There is a particular focus on the iPhone 6 and it is a great solution when in-call handoff from Wi-Fi to 2G/3G is not relevant (i.e., main focus is VoWi-Fi on trusted or untrusted networks and handoffs to VoLTE) 	<ul style="list-style-type: none"> • Authentication is based on the SIM card (EAP-AKA) and the MSO will require an ePDG as part of the mobile core • Employs SIP registration to the IMS

Type	Explanation	Example Smartphone	Why MSOs May Want It	Solution Notes
Client 2: Pre-installed embedded IMS user agent	With this agent, the MSO pre-installs a client before shipment to the subscriber.	<ul style="list-style-type: none"> iPhone 5s and phones with Android 4.4+IMS accounts that don't support VoLTE, but do support Wi-Fi calling Also, any Android device with Taqua, D2tech, CounterPath user agents in the system partition 	<ul style="list-style-type: none"> Launch Wi-Fi calling on sponsored smartphone and tablets without the need to obtain VoLTE access from the partner MNO MSO does not have to sponsor flagship phones, such as iPhone 6 or Samsung S6 supporting VoLTE Can be used for devices without a SIM and can offer service to competitor's smartphones 	<ul style="list-style-type: none"> Requires an ePDG for certificate-based authentication (EAP-TLS over IKE)/username password Does not do VoLTE on the IMS APN, but uses 4G PS data APN (i.e., don't need VoLTE enabled on network)
Client 3: Native Session Initiation Protocol (SIP) or downloaded application from store	This client requires some user intervention in that the application has to be downloaded from the operator's application store.	Android 4.2+ phones	<ul style="list-style-type: none"> Achieve in-call Wi-Fi-to-2G/3G CS handovers, which at the time of writing, was still one of the highest requirements among all handovers in EMEA due to the current status of LTE deployments Establish relationships with new potential customers (children and other family members of the cable subscriber – pater familias) 	<ul style="list-style-type: none"> Does not do VoLTE on the IMS APN, but uses 4G PS data APN MSO does not need VoLTE enabled on the network Can do Wi-Fi to 2G/3G CS handover, as a unique differentiator, in addition to Wi-Fi to LTE PS handover Does not need an ePDG

Conclusion

There is no single solution that will enable a full-featured Wi-Fi first strategy for all MSOs in all regions. An important component of a Wi-Fi first strategy is handoffs to cellular services, which ensure a continuation of the mobile data and voice experience. Figure 6 shows the golden triangle of handoff capabilities related to the three types of clients described above and presented in Table 4.

Figure 6. Golden triangle of Wi-Fi, LTE and 2G/3G handoff capabilities

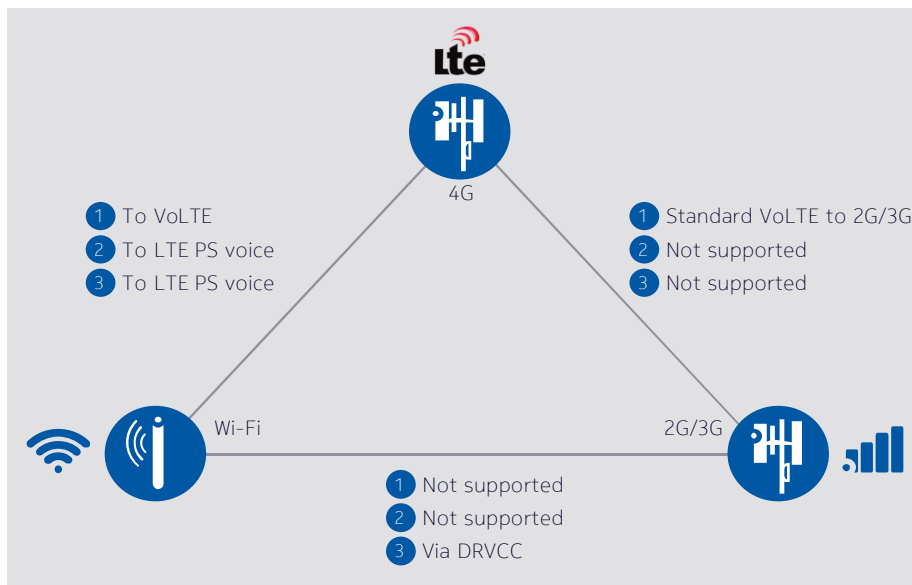


Table 4. Smartphone clients and relevant Wi-Fi first features

Smartphone Type	VoLTE Capable	4G PS Voice	2G/3G CS Voice	ePDG Required	SIM Required	IMS Required	Android User Agent
Client 1: iPhone6 Nexus6 IOS8.1, Android 5.1	✓	X	X	✓	✓	✓	X
Client 2: iPhone 5S and Android 4.4+	X	✓	X	✓	X	✓	✓
Client 3: Android 4.2+	X	✓	✓	X	✓ / X	X	✓

To enable the advanced level of handoff presented in Figure 7 for many smartphone types, MSOs will need a combination of Wi-Fi first technical solutions. The types of solutions deployed will depend on the competitive environment in their market, MVNO relationships, existing VoWi-Fi offers, and go-to-market use cases that must be enabled.

Bell Labs consulting has a rigorous approach that enables MSOs to get a complete understanding of all the relevant business case components that must be considered. But, it is likely that all MSO Wi-Fi first strategies will have to be implemented in phases as the combination of clients, functions and wireless networks mature.

For pure play operators, and those with light MVNOs, Wi-Fi first is not a true mobility offer, but depending upon expected nomadic voice usage, Wi-Fi calling services may be launched not only as a value add for service bundles, but as a possible revenue generating service.

For MSOs with F-MVNO, Wi-Fi first is a key strategy with varying go-to-market drivers. The classic Wi-Fi first use case is for an F-MVNO-equipped MSO where the MVNO cost savings may be gleaned for both data as well as voice as these services are delivered on-net. Where Wi-Fi coverage is not available, MSO subscribers will automatically connect via cellular data and voice services. For converged MSOs, Wi-Fi first is a consideration, as are other emerging techniques for combining licensed and unlicensed spectrum, which are not discussed in this paper.

Nokia offers a leading end-to-end ecosystem for Wi-Fi calling and Wi-Fi first strategies. This open, standards-based ecosystem integrates with existing network components to simplify Wi-Fi first implementations. Ecosystem solution components are available both in physical and virtualized platforms, and the virtualized options enable MSOs to take an easier path to Wi-Fi first and scale their networks as required.

Acronyms

CAPEX	capital expenditure
EMEA	Europe, the Middle East and Africa
EPC	Enhanced Packet Core
ePDG	Evolved Packet Data Gateway
F-MVNO	Full-MVNO
GGSN	Gateway GPRS Support Node
HLR	Home Location Register
HSS	Home Subscriber Server
HFC	hybrid fiber-coaxial
IMS	IP Multimedia Subsystem
MDM	mobile device management
MNO	mobile network operator
MOS	mean opinion score
MSO	multiple system operator
MVNO	mobile virtual network operator
NRP	National Roaming Provider
OTT	over the top
PGW	PDN Gateway
QoE	quality of experience
RAN	Radio Access Network
SGW	Serving Gateway
SIM	subscriber identity module
SSID	second service set identifier
SIP	Session Initiation Protocol
TCO	total cost of ownership
TWAG	Trusted Wireless Access Gateway
VoIP	voice over IP
VoLTE	voice over LTE
VoWi-Fi	voice over Wi-Fi

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