Voice over 5G: The future of voice services

The impact of 5G communications in service provider networks

White paper

Voice will continue to play an important role in communication service providers' business models as the momentum builds towards 5G. Mobile subscribers expect voice as part of any commercial package and voice will also play a part in many of the new data services enabled by 5G. Voice is also a key component of 5G service bundles that form attractive, full featured offers to customers.

For all CSPs, regardless of access types they employ – fixed, mobile, cable, Wi-Fi®, or other – the only standardized way of providing voice over the new 5G infrastructure requires an IMS-based voice core network. This is true regardless of the 3GPP option chosen for 5G introduction. This same voice core can then be used to extend voice services over any of the other access types.

This is the first in a series of six white papers exploring Voice over 5G (Vo5G). Here we provide a high level overview, with the subsequent papers covering various aspects of the topic in more depth.

Contents

5G is gaining momentum

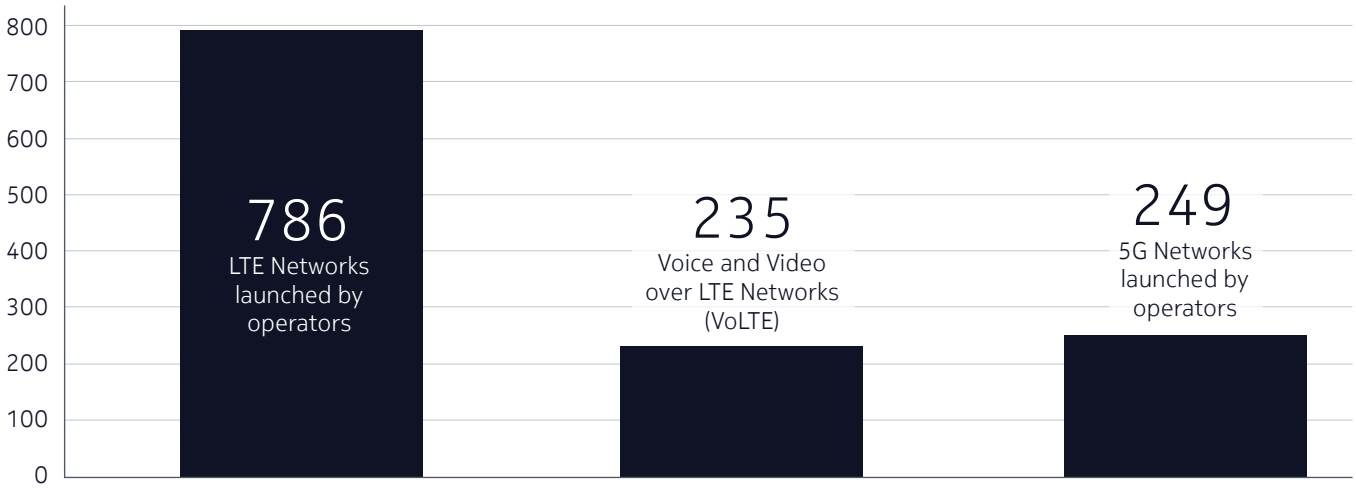
5G investment is rapidly gaining momentum, with 523 operators in 97 countries already investing in 5G networks, 249 5G deployments live at the time of writing, and more expected to be live by the end of 2023.

This is a strong start, and it's only the beginning. Today, 4G/LTE radio supplies mobile connectivity in 786 Communication Service Providers (CSPs).

Over the next few years, 5G will overtake and then displace 4G/LTE.

The deployment of Voice over LTE (VoLTE) is a strategically important service for operators and is typically part of a migration of voice services from 3G and old circuit switched mobile networks to the 4G LTE network. Originally slowed by technical challenges, VoLTE launches were accelerating. VoLTE is based on the IP Multimedia Subsystem (IMS) architecture, so the rise of VoLTE also coincides with CSP adoption of IMS.

Figure 1. Deployed LTE, VoLTE, and 5G networks (Source 3GPP[1] GSMA[2])



The emergence of new 5G networks is accelerating the introduction of IMS. This is because 5G itself does not provide native voice or video communications but relies on an IMS core to deliver those services. 5G also does not provide a way to use 3G (or earlier mobile networks) for voice services. So CSPs are discovering that to maintain voice services in a 5G world, they must deploy an IMS network if they don't already operate one.

1. Public Mobile Networks https://www.3gpp.org/news-events/partner-news/2023-04-gsa-lte-5g
2. GSMA, "All IP Networks Statistics", https://www.gsma.com/services/wp-content/uploads/2022/04/GSMAi-VoLTE-Market-Update-final.pdf

Voice in CSP business models

The contribution of voice to revenues varies widely between CSPs in different markets, but it remains a non-negotiable part of the package for mobile subscribers everywhere. Whatever is happening with other services and however modest its contribution to revenues, voice will remain an essential component of the business plan for every CSP.

As an example, Latin American provider América Móvil[3] attributed 51 percent of revenue to wireless voice and data in 2022.

This is why CSPs cannot afford to neglect voice services. Bundling voice with data removes the market for OTT providers to provide voice services atop the mobile data infrastructure created and paid for by the CSP. Adding additional services into the bundles (especially for premium service levels) further enhances return on investment for the CSP. The strategy is to maintain the subscriber as a full-service customer.

of the CSP for the top revenue-generating services, not just for the broadband mobile data connection, which is essentially a commodity.

This approach is not restricted to mature markets. Governments in some developing countries previously banned OTT services such as Skype or WhatsApp, supporting continued per-minute voice charging by CSPs for both fixed and mobile connections. However, such restrictions have largely disappeared, leading to tumbling per-minute prices. The result is that, as in other markets, carriers increasingly bundle voice and data together into their subscriber plans.

International voice continues to support per-minute charging to some extent, yet here too, traffic and prices are declining. International VoIP providers have sprung up to provide a cheaper alternative to carrier voice based on peer-to-peer revenue-sharing arrangements. As with domestic voice services, many carriers offer voice components in their service plans for international voice minutes at low fixed rates, up to a cap.

The bottom line is that the shift in revenue away from voice does not diminish its importance to the CSP. They can neither charge per-minute fees for voice calling nor can they remove it from their business model. In every market, voice continues to play a critical role in plans offered to subscribers. In fact, with the introduction of 5G and the Internet of Things (IoT), it is becoming even more important.

3. 2022 Annual Report Form https://s22.q4cdn.com/604986553/files/doc_financials/2022/ar/20F-2022-FINAL.pdf

Voice services in 5G

5G infrastructure enables a much wider variety of services than ever before. Most of these services will be packaged into market offers that combine data and voice capabilities tuned for specific use cases that take advantage of the new characteristics of 5G, such as very high mobile data rates, low radio latency, or network slicing.

One example is 5G Fixed Wireless Access (FWA), which will be among the first 5G native services to be deployed. FWA allows CSPs to provide broadband services to households and small/home offices in places where there is no fixed telecom infrastructure, and where it is not feasible to deploy such an infrastructure due to cost or time constraints. Even where wireline connections are already in place, FWA is usually a more cost-effective alternative, reducing the cost per bit to connect households to broadband by 74 percent[4].

The introduction of FWA allows CSPs to access new market segments and create attractive offers for previously underserved customers. These will take the form of premium bundles for consumers, such as high-speed internet access coupled with voice, gaming, video and music streaming services, as well as cloud-based business packages for small businesses and home offices.

Figure 2. Use case timeline for 5G Fixed Wireless Access

4G	5G First phase	5G Next phases
	Enhanced mobile broadband	URLLC, slicing
10 Mbps and higher for internet access	Fiber-like broadband speeds for immersive home (AR/VR/MR) experiences	Fiber-like broadband speeds for latency-critical immersive applications such as gaming and telepresence
	Applications for small business	

5G will also enable a wide range of truly novel applications that are only just emerging, and where voice will play an important role. For instance, in eHealth scenarios, 5G will help medics in ambulances maintain voice and video connections with ER staff or enable the remote care and tracking of elderly or otherwise vulnerable patients in their homes via wearable devices.

In all of these use cases, voice is a critical component of the overall service. And more generally, the rise of internet-enabled devices and the IoT will increase the importance of the voice interface as the most natural means of human-to-machine interaction, as services such as Amazon's Alexa or Apple's Siri already demonstrate.

4. GSMA, "Fixed Wireless Access: Economic Potential and Best Practices," 2018.

How voice over 5G works

Vo5G is similar to voice in today's 4G networks. In 4G LTE, voice calls are implemented as end-to-end Voice over IP (VoIP) connections managed by an IMS core. Voice and video communication services in these networks ride on top of the IP data connection. When the call happens over LTE, it is called Voice over LTE (VoLTE), and when it is over Wi-Fi, it is known as Voice over Wi-Fi (VoWi-Fi).

IMS itself is a collection of network elements whose functions and interfaces are standardized by the 3GPP and other standards bodies. It can provide voice calling over any IP interface, but the GSM Association (a trade body) specifies "IMS profiles" so that carriers can build interoperable networks. IMS VoLTE is defined as GSMA IR.92, for example[5].

Vo5G is typically implemented in one of two ways in a 5G network, based on the deployment approach employed by the CSP.

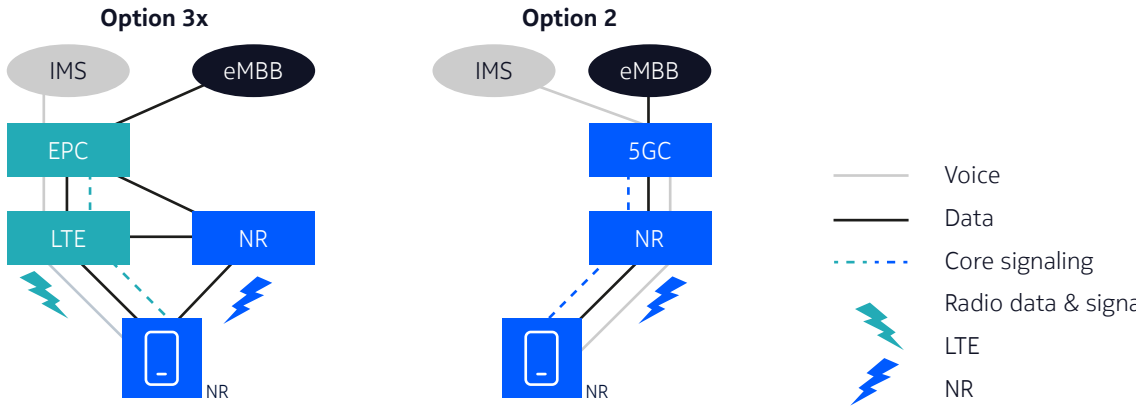
Most CSPs are starting their 5G deployments with 3GPP Option 3x. In this model the CSP has an existing 4G LTE network and deploys the 5G network alongside the 4G network. 5G NR is only added as a secondary cell, whereas the core technology is EPC. All RAN-core signaling is carried over the master cell, i.e. 4G. The UE registers to the IMS over EPS. When the 5G endpoint device launches (or receives) a voice call, this follows typical VoLTE procedures over the EPS system.

Alternatively, the CSP may choose 3GPP Option 2 to deploy the 5G network as a standalone entity, without relying on any other network. In this case, voice communications are provided by an IMS core providing voice as a 5G application service. The IMS network in this case will typically use GSMA NG.114 as the IMS profile, which is codified and released by the GSMA in Q1, 2020. Voice services on this kind of network are referred to as Voice over New Radio (VoNR).

Another approach when an operator deploys 3GPP Option 2 is known as "EPS fallback for IMS voice". During the early deployment of 5G technology, geographic coverage for 5G will be incomplete. When a mobile device moves out of a 5G NR coverage area, a VoNR voice call in progress would need to drop back to use the 4G network. Experience from LTE shows that hand overs for existing calls in progress to a previous network generation should be minimized, since the delay causes an interruption in the call. The

"EPS fallback for IMS voice" procedure avoids this by directing the UE to fall back to the EPS at the start of any voice call as soon as it is launched. Since the hand over occurs at call setup rather than while the call is already in progress, it does not affect the user's in-call experience.

Figure 3: Voice over 5G is only made possible by the deployment of IMS



5. GSMA https://www.gsma.com/newsroom/resources/ir-92-ims-profile-for-voice-and-sms-12-0/

Regardless of whether VoNR or EPS fallback is chosen, standardized voice and video communication services require an IMS core to provide the service in a 5G network.

IMS treats voice services as "access agnostic", which means that it can provide voice services for any type of access – fixed, cable, and 2G/3G – as well as for any 5G deployment model. But because 5G expects an IMS network to be present to handle voice services in all deployment types, the introduction of 5G acts as a catalyst that accelerates voice core modernization to IMS from older technologies in CSP networks.

Because 5G creates such a wide variety of service opportunities, the voice needs the same flexibility. Open application programming interfaces (APIs) provide the key enabler for voice services evolution within the IMS ecosystem. Open APIs can be used to customize call logic, extend functionality, and to create new services in areas such as call direction, call control, call notification, user interaction, call history, terminal status, and self-care.

Such additional functionality can be provided by the IMS vendor, CSP, ecosystem partners, or other service providers. In this way, new services can emerge from anywhere within the extensive global services ecosystem, rather than being limited by the resources of a few providers.

In a 5G world, voice services will depend on the presence of an IMS core network regardless of the deployment path for 5G. New device types (such as tablets, wearables, and virtual assistants) coupled with open APIs will result in a much wider variety of voice-enabled services. We consider all these use cases to fall under the Vo5G umbrella.

The role of VoLTE

4G LTE was the first generation of mobile network technology that did not have dedicated voice channels in the radio interface. Instead, it provides an IP data connection to the endpoint device. To provide voice and video services, the GSMA IR.92 IMS profile is implemented on an IMS core, and this is known as Voice over LTE, or VoLTE.

Until 4G LTE coverage becomes ubiquitous, it is necessary to provide a handover capability so that subscribers who exit a 4G service area can continue to use voice services on a 2G or 3G network. Single Radio Voice Call Continuity (SRVCC) techniques were implemented so that voice calling coverage is maximized.

This flexibility with VoLTE streamlines it for rapid growth. VoLTE subscriptions worldwide exceeded 5 billion in 2025.

Carriers know that voice is an important part of their business model. As they market 5G to consumers, they know that they need a voice component in their service offers. If they have an existing 4G LTE network, they can leverage it to provide voice services, and also allow for 2G/3G voice service continuity if a subscriber moves outside the 4G service area. However, if the carrier only has a 2G or 3G mobile network, they will need to deploy IMS for an Option 2 5G deployment.

This means that any carrier with aspirations to deploy a 5G mobile network must have an IMS core deployed, regardless of the 5G deployment path chosen, to support voice communications. The IMS core will either be supporting VoLTE explicitly or the VoLTE-like NG.114 IMS profile. Thus, in 5G network deployments, IMS VoLTE serves as a bridge between the new 5G radio technology and legacy network voice services.

6. GSMA intelligence: https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=54165912&file=061120-VoLTE.pdf

Conclusion

The contribution of voice services to CSP revenues has been shrinking in many markets but voice remains an essential part of the communications package for mobile subscribers. It will also play an integral role in many of the emerging generation of mobile data services. These are both reasons why voice will continue to be a vital part of CSP business models, regardless of how data services evolve over 5G.

VoLTE is currently leading the way in terms of investment and the deployment of voice services. For example, in 2023 Nokia was awarded its 150th VoLTE network deployment contract.

However, investment in 5G is accelerating and the arrival of 5G means big changes for many voice service providers. That's because, unlike for LTE, it is only possible to offer Vo5G by migrating to an IMS-based core network for voice. In addition, there is also growing interest in Fixed Mobile Convergence, with hybrid CSPs keen to find their best way forward.

This overview is the first of a series of six white papers in which we discuss Vo5G and the impact on carriers of deploying 5G technology. See the rest of the series for more details.

1. **Voice over 5G: The future of voice services,** (this white paper) in which we discuss the current state of voice, and what the introduction of 5G means for voice services.
2. **Voice over 5G: Deployment scenarios,** in which we go into more detail about the various ways in which 5G will be deployed and how voice is supported in those models.
3. **Voice over 5G: Readying the VoLTE network,** in which we explain how voice is currently supported in 4G VoLTE deployments, and what needs to be done to prepare the network for 5G. Hint: It depends on the 5G deployment model being used.
4. **Voice over 5G: Evolving your circuit switched network,** explaining steps that operators who do not currently have 4G VoLTE deployments need to take to prepare for 5G.
5. **Voice over 5G: Enterprise communication impacts,** in which we cover how the CSP business expands with 5G to offer completely new enterprise services, and the role that voice will play in those services.
6. **Voice over 5G: The ecosystem for voice networks,** in which we go into more depth on APIs and openness in 5G that allows carriers to partner with third parties for much faster service creation, enhanced innovation, and reduced time to launch new offers to the market.

Abbreviations

3GPP	3rd Generation Partnership Project
API	Application Programming Interface
CMTS	Cable Modem Termination System
CSP	Communications Service Provider
CSFB	Circuit Switched Fall Back
EPC	Evolved Packet Core
FWA	Fixed Wireless Access
GSM	Global System for Mobile communications
IAD	Interface Access Device
ICS	IMS Centralized Services
IMS	IP Multimedia Subsystem
IoT	Internet of Things
IP	Internet Protocol
LTE	Long Term Evolution
MSAN	Multi-Service Access Node
MSS	MSC Server System
N3IWF	Non 3GPP Interworking Function
OTT	over-the-top
RGW	Residential Gateway
SRVCC	Single Radio Voice Call Continuity
TAS	Telephony Application Server
URLLC	Ultra Reliable Low Latency Communications
Vo5G	Voice over 5G
VoBB	Voice over Broadband
VoIP	Voice over IP
VoLTE	Voice over LTE
VoNB	Voice over Narrowband
VoWi-Fi	Voice over Wi-Fi

Nokia OYJ
Karakaari 7
02610 Espoo
Finland
Tel. +358 (0) 10 44 88 000

Document code: CID206559 (October)