5G ROAMING: MNO OPPORTUNITIES & IPX REQUIREMENTS 2022

A Kaleido Intelligence Whitepaper for iBASIS

iB∧SIS



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Executive Summary

This latest edition of the 5G Roaming white paper from iBASIS and Kaleido Intelligence highlights the opportunities that 5G will bring for operators, alongside the associated MNO requirements and expectations from IPX vendors. 5G will drive roaming revenues over the coming years and will enable new consumer and enterprise use cases. In order to take advantage of this opportunity, MNOs must partner with the right IPX vendor and adopt a holistic approach to implementing 5G roaming, with a specific focus on capacity, QoS, analytics and security. This will enable MNOs to realise the predicted roaming revenue opportunities as well as to meet any new challenges posed by 5G.

Kaleido Intelligence surveyed 92 respondents across tier-1 MNOs, MVNOs and IoT service providers around the world on their 5G roaming, security and private networks deployment plans during January-February 2022 to learn more about their current and future roaming plans as well as commercial and technical requirements from an IPX and security perspective.

Key Takeaways



5G NSA Roaming in 2022: 86% of the MNO operator respondents surveyed claims to have 5G NSA roaming by the end of 2022.

5G SA Roaming in 2022 & 2023: 53% stated that they will launch 5G SA roaming in 2022 and 2023.

53%



Top 3 MNO IPX Requirements: Enabling a wider range of 5G SA use cases, supporting advanced network slicing functions and testing support by IPX vendors found to be the top 3 MNO requirements in 2022.

Analytics is Critical: Real-time intelligence found to be the #1 5G roaming service innovation that operators expect from their IPX vendor.





Demand for VR/AR Use Cases: 67% expects to prioritise VR/AR applications amongst all international uRLLC use cases, compared to industrial and automotive ones.

Quality of Service Essential for IoT: 60% expect strict QoS and delay performance for different IoT devices or slices from their IPX provider.



Key Takeaways



Security Budgets Rise in 2022: 91% of respondents expect their security budgets to increase by up to 25%, owing to the challenges posed by 5G roaming.

Demand for Hosted/Hybrid SEPP: 92% of respondents expect their IPX vendor to implement a hosted or hybrid SEPP model.





SEPP is the #1 Priority: Investment in Security Edge Protection Proxies (SEPP) is the most important priority in 2022 for 87% of the respondents.

5G Security Implementation Model: 84% stated their intention to implement 5G security services via a combination of in-house capabilities and either an IPX (41%) or a third-party specialist (43%).





GTP-U & GTP-C QoS Requirements: Reporting and charging capabilities found to be the #1 QoS/QoE expectation by 67% of the MNO respondents.

The 5G Roaming Roadmap to 2026

With mobile operators accelerating their 5G rollouts and IoT monetisation strategies, 5G roaming has become the most important priority for roaming business units around the world.

Despite the impact of COVID-19 on the economy and the semiconductor industry, 5G investment continued to increase over the last 24 months. 5G is the fastest growing generation of mobile technology and will enable new opportunities from IoT and consumer use cases.

As of March 2022, 195 operators in 62 countries/territories have launched commercial mobile 5G services, up from 61 commercial networks in 2019.

5G deployments primarily have been on nonstandalone network (NSA) modes, utilising existing 4G infrastructure; primarily Option3 model, where both LTE and 5G NR (5G New Radio) radio access are present and controlled by the EPC (Evolved Packet Core). However, operators are increasingly launching 5G standalone (SA) networks and commercial services, where radio part is 5G NR and the core part is 5GC (5G core).

As of March 2022, around 119 operators are investing in public 5G SA networks (in the form of trials, planned or actual deployments). More than 20 operators in 16 country markets have launched domestic 5G SA networks, with another 10-15 expected to launch over the next 12 months. 5G NSA roaming is available in more than 50 international markets, as of Q1 2022. In comparison, 5G SA roaming is expected to launch later this year, with several operators now trialling the same.

5G Adoption Grows Worldwide

Global 5G Connections in Millions, 2020-2026

The adoption of 5G services across key verticals will drive the total number of 5G consumer and IoT connections to reach nearly 4 billion in 2026. This is up from just over 500 million in 2021, and will represent an average annual growth of 50% over the 5 years.



According to the survey, around 86% of the participating operators will have launched 5G NSA roaming services by the end of 2022. This seems logical given the fact that operators continue to prioritise 5G roaming to unlock new revenue streams for their roaming business units. However, around 14% of the respondents do not have 5G NSA roaming in their roadmap, potentially due to a shift in priorities following the impact of the pandemic.

With several operators currently testing and trialling 5G SA roaming interoperability, around 33% of the respondents expect to launch 5G SA roaming in 2022. Despite the fact that operators expect a significant rise in roaming usage across 5G networks, around 40% of the operators surveyed stated that 5G SA roaming was not in their current roadmap. This outlines the standardisation and implementation challenges being highlighted by many mobile operators.

MNO 5G Roaming NSA & SA Launch Plans

5G Roaming Deployment Plans: When will you launch 5G roaming? (Select based on NSA/SA architecture)



The 5G Roaming Opportunity

5G roaming represents a significant opportunity for mobile operators and enables new use cases and enriched data services including but not limited to high speed and immersive video, industrial applications, automotive use cases and healthcare applications.

In addition, with travel recovery beginning to peak and enterprises accelerating their IoT strategies, operators must now ready their 5G roaming strategies for a surge in international network usage and data traffic. Kaleido predicts that revenues from outbound and inbound roaming traffic generated by 5G consumer mobile and IoT devices will exceed **\$18 billion in 2026**, representing an average annual growth rate of 217%. 5G roaming revenues from both outbound and inbound traffic will represent well over 26% of total roaming revenues by 2026, this is up from less than 5% in 2022.

5G will enable faster data speeds, increased reliability, ultra low-latency and business-critical roaming use cases, as well as new differentiated services. However, with these benefits comes fundamental challenges that operators will need to address: these include ensuring the capacity to meet the surge in roaming data traffic from consumer and machine connections, meeting security requirements, ensuring strict QoS and CoS levels as well as the 5G SA rollout journey including upgrading to a virtualised core network, automation to help with process management and VAS enablement.



Global 5G Roaming Outbound & Inbound Revenues in USD Million Per Annum, 2021-2026



5G roaming revenues from both outbound and inbound traffic will represent an average annual growth rate of 217% between 2022 and 2026.

5G Roaming Use Cases

5G will create innovation and value services across all international connectivity verticals. Kaleido's research previously identified critical use cases that 5G roaming will drive across eMBB, mMTC and uRLLC.

Compared to previous years, the 2022 survey found an increased awareness and interest amongst operator respondents to enable international VR/AR applications, perhaps as a result of the impact of the Metaverse. There continued to be a high volume of interest in industrial and vehicle applications, with 53% of the respondents confirming plans for international services in these verticals. However, to ensure a high-quality roaming experience across these use cases mobile operators will expect local and regional breakout options from their IPX vendors.

#1 VR/AR applications gains on industrial and automotive use cases +67%

What are your plans for international uRLLC services?



Security & 5G: Why'Best-in-Class Security' is a 'Must Have'

Network Complexity

Historically, mobile network security has been approached in a fashion that was reliant on trust between roaming partners in addition to the implementation of security measures, such as firewalls, built on top of existing networks as part of an 'after the fact' process.

While this may have broadly worked for networks when roaming agreements were relatively limited in scope, the advent of LTE and now 5G roaming has signalled a dramatic shift in both roaming usage as well as perceptions around mobile network security principles.

Today's mobile networks are fundamentally complex. SS7 signalling is now considered a legacy interconnect protocol, although considerable SS7 traffic still travels across IPX and direct interconnect routes. With Diameter (LTE) and HTTP/2 (5G) offering, on the one hand, it improves security while on the other, it adds more signalling protocols into the traffic mix. It is this mix; not only of SS7, Diameter and HTTP/2, but also GTP and SIP; that brings an inherent complexity for mobile network operations that is fundamentally difficult to manage.

Additionally, the limited roaming partnerships of former years have been overtaken by hundreds of agreements in order to allow customers to access a global roaming footprint. Mobile Network Signalling Protocols

SS7

Designed in 1975, SS7 (used in 2G & 3G networks) offers no authentication or encryption. Remains in common use for mobile roaming applications, as well as a mechanism to issue control commands to IoT devices.

GTP

Used over the control plane (GTP-C). It remains a fundamental protocol for enabling data services across the network, but does not require any user authentication, nor does it apply encryption.

Diameter

Forms the backbone of 4G signalling. While it represents a significant security upgrade from SS7, the protocol is rarely encrypted end-to-end.

SIP

The designated protocol for VoLTE signalling. The protocol can directly be accessed by applications running on the end user device, allowing relatively simple modifications of packet headers by fraudsters.

HTTP/2

The designated protocol for 5G signalling. For MNOs and other CSPs, it represents a new, possibly unfamiliar protocol that requires new expertise. In contrast, many cybercriminals will already have significant expertise in the protocol's use and weaknesses through years of experience.

Taking Action on Security

As a tool for the 'Internet of Everything', 5G architecture and service-orientated design has accelerated the possibility to better address customer needs and operator monetisation opportunities through services such as network slicing, private 5G networks in addition to Multi-Access Edge Computing (MEC).

Naturally, these new services bring new threat scenarios with them: not least in the form of DDoS, but also in terms of data theft or manipulation and fraud.

The vast majority of operators agree that migration to 5G creates new challenges to mobile network security: over 70% of those surveyed agreed that 5G poses either a very important or extremely important threat to security, with 83% of operators aiming to deploy more security measures across their networks as migration to 5G takes place.

This sentiment is reflected by the fact that 91% of the respondent base reported that their security budgets are likely to increase by up to 25% during this fiscal year, undoubtedly to prepare for the challenges posed by 5G roaming security threats.

Interestingly, 15% of the respondent base reported that they will be taking fewer security measures: perhaps an indication that they have already invested in the necessary systems and solutions to mitigate 5G roaming security threats.

Are you taking more or fewer measures on security, given the impact of 5G and IoT roaming?



Source: Kaleido Intelligence



Do you expect security budgets to increase over the previous financial year and by how much?

IPX Innovation: MNO Expectations & Requirements

5G SA Roaming: Operator Priorities & Requirements

5G SA roaming will enable faster broadband for consumers and ultra-low latency and higher bit rates for the enterprise verticals, driving new eMBB (enhanced Mobile Broadband), mMTC (massive machine type communication) and uRLLC (ultrareliable low-latency communication) services.

The most fundamental step towards 5G SA roaming according to MNOs are to ensure:

- 1. Upgrading the core to a a 5G service based architecture Core
- 2. End to end testing of different 5G SA roaming functions and scenarios
- 3. Supporting the various signaling interconnection models

Indeed, the launch of 5G, especially in a SA architecture will require comprehensive testing, trials and optimisation prior to the deployment phase. Around 33% of respondents observed testing SA roaming functions as the most immediate requirement.

IPX Vendor Requirements

What do you perceive to be the top 5 most immediate

5G SA Roaming: MNO Requirements





Source: Kaleido Intelligence

With mobile operator requirements and needs evolving at a faster rate while migrating to 5G SA roaming, operators need IPX vendors to deliver reliable and secure interconnect services, while maintaining quality necessities.

According to the survey, operators expect IPX vendors to deliver a wider range of 5G SA use cases and support advanced network slicing functions across these use cases; this was found to be the top 2 requirements. With 5G deployments rapidly expanding, IPX providers must be able to enable operators to target not just a wider range of use cases but also to fully utilise and realise the potential of 5G to support several aspects of IoT roaming services via a dedicated, secure and effective interconnect service.



What are your top expectations from your IPX vendor while launching 5G SA roaming?

Source: Kaleido Intelligence

Network slicing, where a portion of the available network is sold and run as a separate entity from the rest of the network with specific features based on latency, bandwidth, pricing and QoS guarantees, will open up significant revenue opportunities for mobile operators even in a roaming context.

IPX vendors are well positioned to enable MNOs to develop the way these dedicated networks are built, managed and monetised. It is crucial that IPX vendors have the capability to provision end-to-end managed network slices with different characteristics and requirements, and with full service assurance. Operators will need a reliable, robust and comprehensive IPX solution to support the expected growth in roaming data traffic alongside support for newer protocols and network functions such as SEPP and HTTP/2.

As is evident from the above two figures, end to end testing is critical to ensure a smooth rollout of 5G SA roaming services, new signalling protocols and network functions. Indeed, there is an urgent need amongst operators to fulfil this requirement and IPX vendors are well positioned to test and validate different 5G roaming scenarios including basic roaming, policy control, charging, and HTTP/2 interoperability.

IPX Service Innovation

In addition to the top expectations from their IPX vendors, Kaleido also asked operators on the kind of technological IPX innovations that they demand. Real-time intelligence, VoLTE and non-VoLTE interworking, and guaranteed QoS/QoE were found to be the top 3 most important 5G roaming service innovation that operators expect.

5G will accelerate the next industrial revolution, driving the uptake of new and granular use cases across different verticals. One key requisite for this is network data analytics and management. Real-time intelligence enabling actionable insights and supporting better quality services, further managed by advanced machine learning algorithms, will provide detailed information on 5G roaming connection behaviour and consumption. Based on Kaleido's previous MNO surveys, real-time analytics has remained the top priority for the operators, at least for the last 3 years. Nearly 87% of the operator respondents found this to be the top expectation from their IPX vendor.

With mobile operators sunsetting their 2G/3G networks, VoLTE roaming has become inevitable and become one of the top priorities for mobile operators in 2022. However, a significant number of operators continue to rely on and use 2G/3G networks, meaning that VoLTE and non-VoLTE interworking become important and around 73% found of our survey respondents found this to be an important service that they expect from their IPX vendor.



What kind of services or innovation you expect from your IPX provider?

Source: Kaleido Intelligence

Meanwhile, around 67% of the respondents expected guaranteed QoS as one of the most important service requisites from IPX vendors. Ensuring strict QoS and CoS levels to meet any 5G SA use cases or applications is of critical importance, with operators now prioritising customer experience management. In addition, 60% of the operator respondents found signalling interworking as most important and IPX providers will play a crucial role facilitating the interworking between operators with different technology maturity as well as between 5G greenfield operators with no 4G or 3G network to fall back to.

Addressing A New Security Architecture & The IPX Role

5G SA roaming will introduce the Security Edge Protection Proxy (SEPP), which enables end-to-end confidentiality of signalling. Playing a similar, but much-enhanced role compared to the LTE Diameter Edge Agent (DEA), it offers application layer security in addition to Transport Layer Security (TLS), determination of appropriate security mechanisms between SEPPs and security certificate exchange capabilities. As a fundamental part of 5G SA roaming, it is not surprising to see that 87% of survey respondents view SEPP investment as a core priority for 2022, given that 5G roaming initiatives are accelerating.



Source. Nateria o Interligence

However, the end-to-end encryption that the 5G standard brings highlights a new challenge: how to enable Value-Added Services (VAS) such as analytics and security solutions to ensure roaming QoS and KPIs.

The majority of the respondents viewed the IPXhosted SEPP/ hybrid SEPP model as the route forward for IPX VAS enablement, representing around 92% of the MNO respondents. In terms of the hosted SEPP, the MNO will outsource the SEPP function to the IPX provider, and the hybrid model combines the hosted SEPP and Direct TLS (Transport Layer Security). Which security method(s) do you expect your IPX in 5G to use to provide you VAS services for 5G; how do you expect your IPX provider to address these?



Threat Landscape & Operator Approaches

Encouragingly, 66% of survey respondents reported that they intend to direct investment this year towards multi-protocol correlation and advanced security solutions.

Earlier we have observed how 5G must accommodate a considerable mix of legacy and modern signalling protocols – each with known vulnerabilities.

In this context, this means that attacks that target multiple signalling protocols are becoming more common: for example, the SS7 protocol is known to be vulnerable to leaking subscribers' International Mobile Subscriber Identity (IMSI) and Mobile Station International Subscriber Directory Number (MSISDN) information, which can be used to commit subscriber fraud over the GTP protocol.

Do you expect IPX providers to offer security services, or do you believe that security must be implemented in-house?



It is thus not surprising to see that operators view signalling interworking, multi-protocol attacks and fraud as the top 3 challenges for 5G roaming security.

#1 Signalling interworking



#2 Multi-protocol attacks

+24%

#3 Fraud & Inter-operator security



How the organisation is structured to manage roaming security threats is critical. Having a disjointed view of the security environment is likely to lead to slow response times, which in turn may lead to revenue loss.

84% of surveyed operators stated their intention to implement security services via a combination of in-house capabilities and either an IPX (41%) or a third-party specialist (43%).

Whichever route is chosen, a holistic view of the security environment will be key to avoiding the pitfalls of oncoming 5G roaming security challenges, particularly as mission-critical IoT services are deployed and increases in sensitive personal and commercial data transport are observed.

The Essential Actions For 5G Roaming Success

5G Roaming Outlook

5G is set to take the centre stage in 2022 once again, after a period of disruption and uncertainties: both domestic and international roaming deployment will ramp up significantly this year. Alongside a surge in IoT deployments by enterprises around the world, international trip volume is expected to approach 1.2 billion this year, more than double that of 2021 levels and representing 57% of pre-COVID levels. In addition, the emergence of new 5G mMTC and uRLLC use cases will boost MNO investments in 5G security and fraud management, placing a strong demand for such solutions.

This highlights the importance of the role that an IPX vendor will play in 2022, focussing primarily on three main areas:

- 1. Capacity and the ability to scale up and support high bandwidth and low-latency use cases across consumer and enterprise sectors.
- 2. Delivering a robust and secure interconnect solution, maintaining the integrity of the IPX network.
- Maintaining strict SLAs and delivering an enhanced QoS and QoE as demanded for by the MNOs.

According to the survey, around 67% of the MNO respondents highlighted the need for GTP-U and GTP-C reporting and charging capabilities as an important QoS/QoE expectation going forward, from their IPX vendor.

QoS & QoE Expectation Intensifies

What are your QoS/QoE expectations from your IPX provider, compared with today?



Conclusion

Kaleido's research and operator survey demonstrates that, alongside significant opportunities, there are critical challenges that operators face to deliver a seamless 5G roaming experience. In order to maximise this opportunity, mobile operators must work with IPX vendors to address 5G roaming requirements more effectively.

The report found that with mobile operator requirements and needs evolving at a faster rate while migrating to 5G SA roaming, operators need IPX vendors to deliver reliable and secure interconnect services, while maintaining quality necessities.

5G roaming inevitably means additional security challenges for operators and it is recommended that operators utilise the best protection scenarios to maintain the integrity, efficiency and reliability of the network. Alongside, mobile operators must evaluate their analytics strategies and IPX partnerships in place in order to integrate analytics and real-time management capabilities. Beyond enhanced next-generation fraud protection, IPX vendors are able to provide a holistic view of the roaming network and services.

In addition, network slicing will play an important role in future roaming services and implementing analytics will assist not just in reducing roaming fraud and device monitoring, but enables demand-driven service guarantees across roaming slices and ensures QoS commitments. Partnering with a reliable and innovative IPX vendor to deliver an optimal 5G roaming experience, with a clear focus on capacity, security, QoS and analytics is fundamental.



ABOUT iBASIS

iBASIS is the leading communications solutions provider enabling operators and digital players worldwide to perform and transform. Powered by Tofane Global, iBASIS is the first independent communications specialist, ranking third largest global wholesale voice operator, Top 3 LTE IPX vendor with 700+ LTE destinations, and a leading Carrier Cloud Communications player and IoT solution provider. iBASIS today serves 1,000+ customers across 21 offices worldwide.

iBASIS is taking major steps to help mobile operators prepare for 5G Standalone (5G SA) roaming enablement with a flexible step by step approach. iBASIS has deployed a 5G SA testing hub, a comprehensive and evolutionary trial environment with new service based architecture, and is now in the phase of connecting Mobile Operators. The 5G SA hub allows to test a full range of technical operations, including the signalling interconnection scenarios as recommended by the GSMA, data exchange, voice call flow testing, as well as 4G-5G interoperability and SEPP outsourcing. Additionally, iBASIS plan to expand the scope to test a real live 5G SA peering as well as slice based routing scenarios and 5G SA roaming VAS.

To know more about the multiple scenario and use case testing please contact:

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For more information, please visit iBASIS.com.

ABOUT KALEIDO INTELLIGENCE

Kaleido Intelligence is a specialist consulting and market research firm with a proven track record delivering telecom research at the highest level. Kaleido Intelligence is the only research company addressing mobile roaming in its entirety. Our Mobile Roaming & Connectivity research service covers industry leading market intelligence and publications on Wholesale & Retail Roaming, eSIMs, 5G Roaming, IPX, Private Networks, IoT MVNOs, IoT Roaming and Roaming Analytics & Fraud. Research is led by expert analysts, each with significant experience delivering roaming insights that matter.

For more information on this market study or if you have further requirements, please contact:

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Publication Date: 12th April 2022

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