

**Return
to roaming**

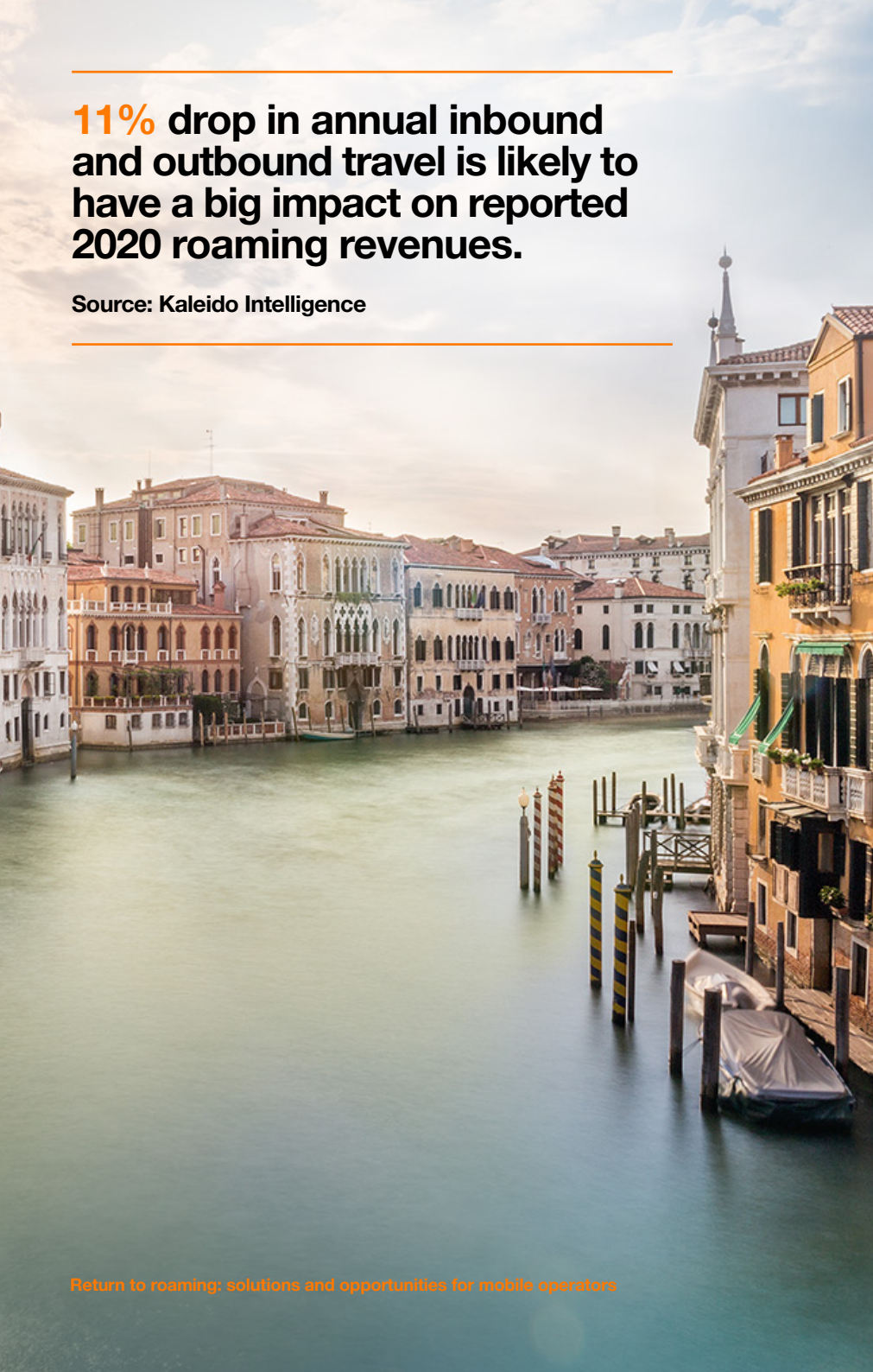
**Solutions and
opportunities
for mobile
operators**



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11% drop in annual inbound and outbound travel is likely to have a big impact on reported 2020 roaming revenues.

Source: Kaleido Intelligence

Where is roaming today?

Mobile roaming is about to enter a brave new world. The disruptions that the pandemic caused have presented mobile network operators (MNOs) with challenges that must be overcome to remain competitive and profitable.

Roaming is an established and time-honored challenge in the telecoms industry, but it is still an important route to revenues. According to Juniper Research, roaming can make up as much as 8% of total revenue for mobile operators – and that number can reach as high as 50% in smaller countries with significant tourism economies.

Today, roaming finds itself in a state of limbo. As of mid-2021, very few people around the world have been able to roam anywhere at all. Roaming was already facing challenges and declining revenues due to the emergence of things like OTT apps cannibalizing voice revenues – and then COVID-19 happened.

The impact on the industry was enormous, with business and leisure travel suspended immediately, meaning roaming activity almost ceased. The telecoms sector was impacted hugely, with telecom revenues falling by over 3% over the course of 2020, amounting to a \$43 billion hit compared to 2019, according to Analysys Mason. Loss of roaming revenues in 2020 amounted to between 11% and 15%, and analysts began to forecast that the industry would likely take several years to recover from the damage.

There are further challenges to overcome when people are able to travel and roam in large numbers again. Roaming revenues in Europe and some parts of Africa will be affected by **Roam Like At Home (RLAH) regulations**, for example. In Africa, the Economic Community of West African States (ECOWAS) has a plan in place to eliminate roaming charges across the region, though it has not implemented the plan as yet. As of January 1st 2021, the six countries of the Central African Economic and Monetary Community (CEMAC) also removed roaming fees between their member countries.

However, the growing availability of 5G connectivity will increase end-user consumption and expectation levels, so operators must prepare themselves to address the twin challenges of 5G complexity and increased end-user demands.

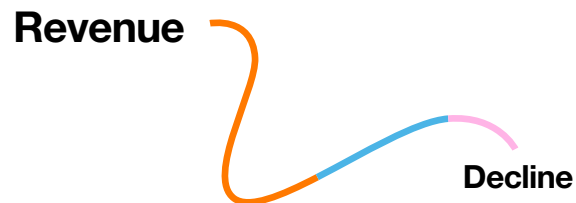
A very different travel and tourism sector

The COVID-19 pandemic was a crisis on a global scale that nobody saw coming – and it was impossible to foresee the impact it would have on global travel and the subsequent impact on roaming business.

It is conceivable that the travel and tourism industry will never again be what it was before COVID-19, and the telecoms industry must factor that into strategy and planning. It is entirely possible that any and all potential ways forward for the travel sector could have an impact on roaming.

Vacationing in your home country, or 'staycations', could become a longer-term trend on the back of imposed growth in 2020. According to The Economist, vacations will be "fewer, longer, and closer to home." So, there may be less air travel in general, and the world is yet to fully understand how tourism might work out: there is potential for some countries to move away from the mass tourism model of years past or only admit travelers from specific countries that meet certain requirements.

Business travel, traditionally one of the key revenue areas for roaming, was also impacted hugely by COVID-19 but shows indications of a faster recovery. Global revenues for business travel fell around 42% in 2020, and forecasts vary about when business travel might return to previous levels. A report by Braintrust estimates that business travel will return to 83% of 2019's level by 2022, but it is hard to make concrete predictions. This could have a significant impact on potential roaming revenues moving forward.



Issues affecting the new world of travel and roaming

- New travel habits will present new business model challenges for operators and MNOs
- Roam Like At Home (RLAH) increases network traffic, but MNOs must reduce costs or find new ways to encourage consumers to pay for usage and/or identify opportunities where they can sell bigger data packages
- Adapt roaming agreements by country/territory: MNOs must establish more roaming agreements, for example in Africa, to be able to propose RLAH under the Smart Africa Alliance umbrella
- MNOs will need to review the number of agreements they have – do you need an agreement with every operator?

Travel restrictions around COVID-19 saw international roaming subscribers drop by 73% to 243 million globally in 2020. Overall mobile roaming subscriber numbers will not recover to 2019 levels until 2024.

Source: Juniper Research





The evolving mobile landscape and the arrival of 5G

Times have been tough recently, but there are reasons for optimism about roaming: Juniper Research predicts that international 5G roaming subscribers will grow by 3300% over the next four years, reaching 147 million by 2025.

Roaming as normal in NSA 5G

As Non-Stand Alone (NSA) 5G uses the 4G evolved packet core (EPC), roaming is straightforward. So long as the home network, visiting network, and all international networks in-between are LTE-enabled and EPC-based, roaming can work perfectly well on these existing infrastructures. Roaming signaling is exchanged between 4G cores on Diameter/IP exchange (IPX), while legacy signaling SS7 (2G/3G) is still carried over IPX. Retail and wholesale operators now need to focus on upgrading IPX bandwidth to support 5G's increase in roaming data usage.

Big transformations ahead

This architecture cannot support all 5G use cases, however. It is not suitable for Enhanced Mobile Broadband (eMBB) where speeds faster than 4G are required, such as video streaming or online gaming. Ultra-Reliable and Low Latency Communications (uRLLC) use cases, like connected cars or telesurgery, require real-time connectivity and exceptional reliability levels. Massive Machine-Type Communications (mMTC) will support enormous volumes of lower-speed connections. As Stand Alone (SA) 5G is deployed to enable these innovative use cases, traditional voice and data roaming will be impacted.

Core network evolutions must be defined and tested

Both retail and wholesale operators will be impacted by 5G roaming. SA 5G requires a brand-new core network that relies on new technologies like software-defined networking (SDN), network function virtualization (NFV), network slicing, HTTPS proxies, regional P-Gateways and more. Signaling is based on service communication proxy (SCP), binding support function (BSF), and security edge protection proxy (SEPP) functions. 5G will also require HTTP as the transport protocol. This necessary network evolution is underway, but the industry is still in the process of defining standards.

Roaming agreements and interconnections to be implemented

All operators must sign new 5G bilateral agreements and establish interconnections with peers. This can be bilateral, but, like today, the complicated management and rollout of roaming agreements will be simplified using IPX and roaming hub providers. Signaling interworking will require a Security Edge Protection Proxy (SEPP), which ensures end-to-end confidentiality and integrity between source and destination networks. All signaling traffic across operator networks will transit via these security proxies. Authentication between operators' SEPP is required to prevent unauthorized communication between networks. Operators will benefit from connecting to a 5G-compliant IPX hub as it offers adapted levels of security from all the other operators connected to the hub.

VoLTE becomes mandatory to adopt full IP and allow 2G/3G sunset

VoLTE will become an essential service. Because 5G does not allow for circuit-switched fallback, reallocating 3G frequencies requires prior implementation of VoLTE, even for 4G roaming. According to the GSMA, only 30% of LTE operators have launched VoLTE, with only a few dozen operators having implemented VoLTE roaming. This is a key element in full SA 5G deployments with optimized frequency bands to support multiple use cases while optimizing costs. It is something the GSMA is urging all operators to progress.

29%

The number of commercial 5G devices grew by 29% in Q2 2021 to total 557 commercial 5G devices. Around half are smartphones.

Source: GSA

3 billion

5G subscriptions will comprise nearly 30% of global mobile market by 2025, just over 3 billion subscriptions.

Source: GSA

Agreements

Interconnections

New use cases: opportunities that come with more demands

As technology evolves, so too do use cases: streaming video and online gaming are two B2C use cases that grew exponentially during COVID-19 lockdowns for example. Streaming video use increased by over 14% in 2020, while mobile gaming grew by 28% in the US and 50% in the UK, respectively, according to Facebook. These trends look here to stay, and as such, could become new revenue-generating use cases to offer to end-users when traveling.

Other new use cases that could become a reality in 5G roaming will center around the use of connected objects, such as autonomous vehicles. There are Industry 4.0 use cases that will be viable, too, including remote monitoring and control of industrial equipment and processes.

It is possible that IoT roaming may not come into its own fully until more widespread deployment of standalone 5G. uRLLC and mMTC roaming use cases will likely take a few years more to become commercially available due to the 3GPP only having published the first key 5G specifications for uRLLC and mMTC relatively recently.

Examples of new use case growth and revenues



The number of connected vehicles will rise steadily and almost double between 2020 and 2025, from 111 million to 206 million globally. The Far East and China will see the highest growth: 32% on average annually over the period



The average data usage per cellular automotive connection per annum is set to more than double over the next five years globally. To extract value from this data, operators need to optimize their network and obtain the required licenses and roaming agreements



At the same time, the average revenue per bit of cellular automotive data globally will go down from \$1.84 in 2020 to \$0.68. This means that more revenue will need to come from additional services beyond data traffic



Smart manufacturing IoT connections will triple between 2020 and 2025 to reach 1.5 billion. While the majority of these connections use non-cellular connectivity such as fixed networks, Ethernet and Wi-Fi, 5G IoT has the potential to play a bigger role in the future of manufacturing, accounting for 17% of licensed cellular IoT connections by 2025

Sources: Juniper Research, GSM Association



The specific challenges of roaming in IoT

The telecoms industry faces challenges around critical IoT use cases, the most significant of which is that they need extremely low latency. Achieving latency of just a few milliseconds (ms) is impossible when roaming because of the need for home routing.

Home routing

Home Routing refers to traffic that has to be routed back to the end-user's home network before it can access the internet. It is how roaming has worked until now to enable the home operator to manage service continuity, policies, and billing. For example, if a connected object is operating in Japan, and has its home base in France, that traffic will be delayed because of the distance the traffic must travel home. In this case, latency will barely fall below 300ms. And while this might make sense for managing calls and internet traffic, it isn't helpful to ultra-low latency 5G use cases like connected cars, or augmented and virtual reality (AR/VR).

From a technical point of view, there are three main options available for operators to address the home routing question:

- 1 Local breakout (LBO).** With LBO, operators deliver internet traffic directly in the visited country, without routing back to the home network first. This greatly optimizes bandwidth usage and is the only way to reach latencies of a few milliseconds. There are other challenges involved in local breakout however: at present, there is no standard agreed for it, which makes invoicing complicated. Furthermore, LBO requires significant investments in local gateways thus needs high volume to make it profitable.

2 Regional breakout (RBO). This option presents operators with a viable way forward that can be deployed immediately. RBO is a simpler solution that does not impact the visited local network, making it easier to deploy. By using public breakout at a regional level and not routing data roaming sessions back to home networks, operators can ensure and offer improved data roaming speeds and connectivity, plus an overall enhanced QoS to end-users. In our French connected object roaming to Japan example, RBO can deliver latency of around 50ms. An additional point in favor of RBO is that operators can implement it now and give its benefits to existing 4G use cases too.

3 Development of international peering points. In order to improve overall performance, international carriers must increase numbers of regional peering points to optimize routes between carriers.

Permanent roaming

Another challenge to address concerning roaming connected objects - also known as Mobile IoT or M-IoT - is that they risk increasing “permanent roaming”. Permanent roaming is potentially a major barrier to multi-country IoT deployments using cellular connectivity.

What is permanent roaming? It refers to a situation where devices that are registered in another country are in a permanently roaming state. In the 2010s, many countries’ regulators introduced and enforced rules that prohibited permanent roaming. They did this as a move to protect their local markets and enforce local rules with which a roaming connection may not comply, such as lawful intercept.

Roaming agreements were designed to be reciprocal agreements between two mobile network operators, which included the exchange of roaming fees. Permanent roaming and M-IoT do not comply with this traditional model: the little traffic generated affects the receiving operator’s revenues, and may be considered as unfair competition. According to Transforma Insights, up to 50% of cellular IoT connections in a given country can be connected using ‘roaming.’ Originally, roaming was designed for travel, not for IoT. IoT and the rapidly-growing number of connected devices presents a new challenge.





The rise of eSIM

The eSIM market is ramping up. Consumer eSIM is now launched and should gradually find its place in smartphones, beginning at the top end of the market before spreading out further. This will generate a mutation in mobile roaming that presents new ways to address customers.

eSIM for broadband is a simple way to distribute credentials, which should be attractive to consumers at national level. Doubts remain about how attractive eSIM will really be to consumers when roaming. Roaming affects services: will travelers really want to change number every time they visit a different country? As such, it is possible eSIM may not transform roaming behaviors and that travelers may just stick with their home network when roaming.

As for mobile IoT, eSIMs are growing in popularity, as the integrated storage and remote management of multiple network operator profiles they provide gives multiple benefits:

- Future-proofing IoT devices: IoT device lifecycles are typically considerably longer than consumer devices. A smart meter can be in place in a remote location for 15 years or more. Installing an eSIM means technical or carrier lock-in impact is reduced
- Eliminate SIM switching costs: remote provisioning to allow switching to different carrier profiles enables organizations to remove the need to purchase new SIM cards and physically replace legacy SIMs. This is particularly beneficial where permanent roaming bans are in place - a profile can be switched remotely to a chosen local carrier
- Maximize returns on investment (ROI): by reducing costs and improving operational and logistical efficiencies, companies can minimize total cost of ownership (TCO) of connected devices and maximize returns on IoT investments.

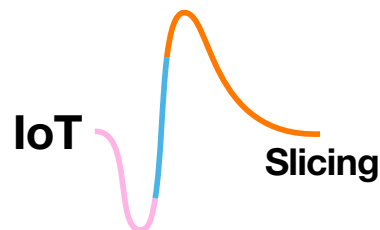
Following many years of non-interoperable eSIMs, the industry is now based on clear standards set by the GSMA and a large ecosystem of partners, with over 200 operators supporting eSIM. Beyond the usual SIM vendors, new players are positioning themselves to offer eSIM management platforms, with the temptation to add proprietary features. The interoperability of the IoT eSIM is bound to evolve further, both because of industrial needs and regulatory movements.

The growth of eSIM in IoT is inevitable and will become more widespread, as it offers the promise of remote provisioning to change operators, something that will truly enable cellular IoT projects to scale as required. But mastering the entire eSIM-based IoT ecosystem remains complex and technical: for bulk purchasing and sourcing requirements, wholesale organizations will be the choice for operators looking for strong, resilient suppliers.

Differentiated quality of service and slicing

One of the major improvements delivered by SA 5G will be network slicing. 5G network slicing enables the multiplexing of virtualized and independent logical networks on the same physical network infrastructure. Each network slice is an isolated, end-to-end network tailored to fulfil the diverse requirements of a particular application. Operators are going to need to use 5G slicing to deliver the QoS required for different IoT use cases. But, in the case of M-IoT, how will they ensure that each operator's slice characteristics are supported across different networks?

In IoT roaming traffic terms, the ITW Global Leaders Forum (GLF) is in the process of addressing the current absence of technical and commercial frameworks and standards around the separation of different types of IoT traffic by QoS when roaming. Options they are considering include increased local peering, RBO, and separation of critical M-IoT traffic from other traffic.



25%
**Total IoT cellular
connections will grow
25% YoY to 2025. IoT
roaming connections
will grow 36% per
year in that time.**

Source: Kaleido Intelligence





What should MNOs do when roaming restarts?

4G will remain the dominant access technology for several years still, so operators should seek to find ways to expand coverage, reduce costs, or increase revenues from 4G roaming while also preparing themselves for 5G roaming.

Optimize costs by simplifying management of IPX signaling

A first step to optimize roaming and its costs is moving from a bilateral to a multilateral roaming model. By connecting to the signaling hub of a large wholesale provider, operators can simplify operations as well as settlements. This will still be a valid model when SA 5G roaming comes. Rather than needing to set up, test and manage numerous bilateral 5G interconnections, connecting to a trustworthy hub will greatly speed up time-to-market and simplify operational activities in a wide-reaching ecosystem.

Outsource roaming agreements to speed up service and optimize rates

To satisfy roamers, it is important to propose an extensive worldwide roaming coverage combined with attractive rates. And time-to-market will greatly impact profitability. Whether 3G, 4G or 5G, this requires establishing agreements with multiple MNOs around the world. Negotiating, setting up and managing roaming agreements is a time-consuming, resource-hungry task. It may be easier and faster, especially for small operators or new MVNOs, to partner with one larger wholesaler, and immediately benefit from their roaming agreements. This also presents the potential for benefiting from optimized rates.

The big data factor

Big data can be a big advantage to MNOs: data analysis can help to understand roaming behaviors better, fight abusive usage or identify roaming profiles that could be targeted with specific roaming packages. This is a potential route to improved revenues and profitability.

One Orange International Carriers MNO partner is using data analysis to target promotions at customers who are beginning to roam again. New roaming price plans are communicated directly to end-users and promoted through travel companies. Big data is also enabling the MNO to identify the purpose of an end-user's roaming, which also helps them tailor price plans and promotions.

Big data can be a vital tool in helping drive maximum revenues from roaming customers: it can help detect the many silent roamers who are not using roaming for fear of bill shock. By combining traditional DCH TAP files with signaling data, operators can pinpoint silent roamers, reassure them, and encourage them to benefit from the improved experience that roaming delivers compared to Wi-Fi. Through increased knowledge of how roamers behave, Big Data can help MNOs uncover potential new value and revenues.

The importance of security

Security is always a hot button issue, and in 5G, increased IoT roaming means a larger potential attack surface for malicious actors. When it comes to roaming, signaling frauds can cause many issues. For example:

- Interception of end-user communications, breach of subscriber privacy
- Disruption of service by overloading a network node
- Disconnect customers, unable to make or receive calls
- Unauthorized tracking
- Hackers can exploit SS7 and Diameter flaws to drain bank accounts

In most cases, signaling fraud “only” deteriorates quality of service, but poor QoS can have a major impact on churn. In a world of slim margins and a need to regain revenues, operators cannot afford to lose any traffic to fraudsters.

What our customers think #1

One Orange wholesale customer based in Asia Pacific, comments:

“COVID-19 saw us experience disruption to our roaming business like everybody else - inbound and outbound tourism were affected, meaning roaming was impacted massively. As such we are targeting new ways to regain revenues and profitability from roaming as we move forward.

We see big data being highly important in 5G roaming: data analysis can help us understand subscriber roaming behaviors better, to target customers with tailored roaming packages for online gaming or voice.

We expect VoLTE to be significant too, as more companies embrace it. New packaged offers for travelers, potentially enabled by eSIM and delivered via the cloud will be a possible route to new revenues.

IoT roaming will be something else that becomes more prevalent, and we will need to enable reduced latency for IoT and other new roaming use cases. There is also the issue of local breakout architectures, which are yet to be defined. Access via your home network while roaming isn't viable for ultra-low latency 5G examples like connected cars. So regional hubs that do not impact visited local networks might be the way forward.”

Prepare to deliver the right 5G quality of experience without forgetting 4G

Implementing VoLTE for roamers is another must-have for operators. And when it comes to IoT, your network architecture will depend on the use cases you wish to support and the volumes you expect. The business case you choose for interconnections, LBO or RBO - or your choice of IPX partner - will depend on the QoS you will need to deliver.

Although SA 5G is increasing around the world, 4G will remain a major access technology for years to come, even in countries that have already launched SA 5G. It is therefore essential to anticipate use cases that are likely to transition frequently from 5G to 4G, since you do not want your customers to suffer any noticeable drop of quality of experience (QoE) in these instances. To avoid this, it is worth investing in harmonizing latency and other key 4G parameters with 5G.

What our customers think #2

An Orange International Carriers customer based in North America comments on the future of roaming:

“We believe data is going to play a major role in the future of roaming, especially as lots of companies embrace VoLTE. These two things will be big game changers when roaming comes back.

Another development we expect to see is increased cooperation – MNOs could work with telecom operators to unbundle data services, similar to what we did with voice. At the moment, if you roam with your existing SIM card, your data is served by your home network. That worked in the past, when the volume of data in roaming was significantly lower.

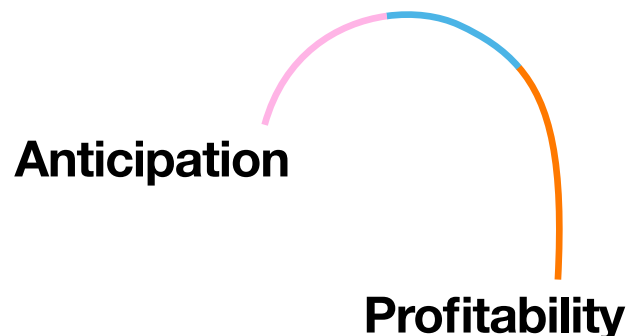
As roaming returns, we will need a solution that involves peer gateways in local regions. This can empower MNOs, as they will be able to offer a service that feels more local. In addition, we expect to see more use of eSIM – which can be delivered through the cloud and provisioned via a local peer gateway – and which can have roaming data packages delivered to it by MNOs. In terms of IoT roaming, I think it is possible that companies might negotiate roaming with permanent roaming factored into the agreement, with specific pricing models for IoT roaming.”

Get ready for a return to roaming

Roaming is likely to resume in coming months as people begin to travel again, although in lower volumes, and with more pricing limitations than in previous years. Moving forward, MNOs will face a more complicated roaming landscape, with new challenges piled on top of existing complexities. Profitability will be difficult to achieve, and there will be technical challenges to manage due to 5G deployments.

As these 5G deployments grow, so too will opportunities for new roaming use cases. However, they will not materialize unless major transformations in networks architectures and roaming agreements take place.

The telecoms industry has no alternative but to anticipate the future state of roaming. Preparations must start now, and to maximize the remaining and new opportunities, MNOs need to have the appropriate networks, architecture, expertise and advanced analytics and security solutions in place to succeed. Partnerships with expert roaming partners to entrust part or all of the management of roaming technical and commercial agreements can be a highly effective path to regaining profitability quickly.



Profitability planning: your key takeaways

With a large number of outgoing roamers, revenues are reduced: while this seems less likely for some time as the world recovers from COVID-19, MNOs still need to plan ahead for it. Things to remember for MNOs to prepare include:

- Establish a partnership with a Tier 1 international IPX provider who can offer a full reach of coverage supported by a strong network
- Under pressure from Roam like at Home, outsourcing generic roaming management to a global carrier and focusing on roaming for new 5G use cases could lead to a faster time to market and improved ROI
- Leverage big data as a way to maximize revenues from existing customers and target new ones
- Protect against fraud with a value-added service that protects QoS and helps retain existing customers and revenues

About Orange International Carriers

Orange International Carriers is the Wholesale Division of Orange Group, which has retail operations in 27 countries and provides business services in 220 countries and territories. In a marketplace that is constantly evolving, we bring our customers a true digital experience and make technology accessible to everyone.

We are a global solution provider for services in Voice, Data, Mobile and Security addressing the specific needs of retailers, wholesalers and OTTs worldwide.

With over 20 years of experience, more than 270 IPX PoPs and 400+ roaming partners, we offer you a complete portfolio of robust roaming solutions and value-added services to support your roaming business.

To learn more, please visit <https://internationalcarriers.orange.com/en/offers/roaming.html>

