IN-DEPTH ANALYSIS

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European Parliament

Roaming: One Year After Implementation

Policy Department for Economic, Scientific and Quality of Life Policies
Directorate-General for Internal Policies
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Roaming: One Year After Implementation

Abstract

This in-depth analysis was prepared by Policy Department A at the request of the ITRE Committee. It examines the impacts one year after implementation of the EU's Roaming Regulation that introduced *Roam Like at Home* (RLAH), by reviewing both the retail and wholesale markets. The retail roaming market was found to be performing well for most stakeholders. However, in the wholesale market, adjusting the wholesale price cap is necessary so that MVNOs may compete more effectively.

This document was requested by the European Parliament's Committee on Industry, Research and Energy.

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LIST OF ABBREVIATIONS

BEREC	Body of European Regulators for Electronic Communications
DSM	Digital Single Market
EEA	European Economic Area
FNO	Fixed network operator
FUP	Fair use policy
IMEI	International Mobile Equipment Identity
IMR	International Mobile Roaming
IMSI	International Mobile Subscription Identity
IoT	Internet of Things
IOT	Inter-Operator Tariff
MNO	Mobile network operator
MTR	Mobile Termination Rate
MTBF	Mean time before failure
MTTR	Mean time to repair
MVNO	Mobile virtual network operator
NDA	Non-disclosure agreement
NRA	National regulatory authority
OTT	Over-the-top (access to the Internet via the mobile data channel)
RLAH	Rome Like at Home
TSM	Telecommunications Single Market

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EXECUTIVE SUMMARY

The introduction of Roam Like at Home (RLAH) services in June 2017 has transformed the EU's internal roaming market. The impact on the retail market for consumer and business users has been a major success:

- RLAH services have enabled a substantial increase in EEA country roaming traffic of all types. In Q3 2017, about 90% of data roaming traffic was based on the data tariff for RLAH
- Similarly, voice minutes enjoyed with RLAH tariffs accounted for the vast majority of voice traffic. About 91% of voice call minutes made and 91% of minutes of received calls were generated by subscribers using RLAH tariffs in Q3 2017. For SMS text messages sent while roaming within EEA countries in Q3 2017, RLAH tariffs accounted for nearly 95% of the total.
- Lower tariffs have generated increased traffic volumes, which can be clearly observed between Q3 2016 and Q3 2017:
    - Data traffic increased by 435% in Q3 2017 compared with Q3 2016.
    - The average EEA roaming subscriber used 14.2 voice minutes per month in calls made in Q3 2017 in comparison to 8.8 minutes in Q3 2016, an increase of 62%. While abroad, the received voice call minutes averaged 11.1 minutes per month per EEA roaming subscriber in Q3 2017, v 9.5 minutes in Q3 2016, an increase of 12%.
    - Looking back at recent years, data traffic increased 36% from Q3 2015 to Q3 2016, so the total increase of data during the period in which regulation of roaming came into force as RLAH has substantially changed retail market volumes.

There have been some (comparatively minor) problems with RLAH implementation:

- Consumer awareness of RLAH has actually declined in the year following its introduction.
- Derogations permitting higher tariffs (given to MNOs if international mobile roaming (IMR) costs have been shown to exceed roaming caps) have been granted in some member states but are generally few in number.
- Fair use policies – whereby a home MNO may halt or impose supplementary charges after four month's roaming abroad in the EU – seem to be appropriate in the retail consumer market but currently MNOs have shown little interest in enforcing them. In the retail business market, major users may be able to negotiate deals but some discounting has suffered.
- "Roamingless" domestic packages have appeared but have not become the norm.

Turning to the impact on wholesale markets, average tariffs are below the market caps sets for RLAH for June 2017 and are on a slow glide path – for 2018 they are at €6/GB. However, while the wholesale market works successfully in controlling IMR *retail* prices charged by MNOs, that is not the case for wholesale users, such as mobile virtual network operators (MVNOs). This is a significant problem for new and emerging B2B markets related to the Internet of Things (IoT), for vertical cross-EU sectors. They are served by wholesale operators, principally specialist MVNOs. Trans-European customers, such as major aerospace companies and the car industry need to operate production facilities and supply chains across many EU member states. For wholesale roaming, fair use policies potentially present an obstacle to MVNOs who wish to offer long-term IoT roaming packages such as for connected cars and aircraft. Thus, for the wholesale roaming data market, there is a concern over whether it is operating competitively. MVNOs have difficulties in obtaining offers from visited MNOs for roaming packages as they are at a disadvantage in negotiations on wholesale tariffs. Our findings show that the current

wholesale price cap could be at least 10 times higher than the cost price. Overall, if MVNOs are disadvantaged in the wholesale roaming market, then competition suffers in both wholesale and retail markets.

In consequence, the report makes a number of recommendations which are ranked according to their likely impact as follows:

- **Promote lowering of the wholesale cap for IMR towards cost-based pricing**: The glide path forecast in Regulation 2017/920 should be reviewed so that the wholesale roaming cap for data is in line with costs. An approximate indicator may be set by the average domestic retail price (€/GB) across the EU for bundled data. This should be brought into force in a short timeframe.
- **Enable permanent roaming at a wholesale level for IoT application providers**: For the new generation of industrial mobile applications based on Europe-wide roaming for certain vertical sectors (e.g. car industry, aerospace, logistics, etc) the specialised service providers need long term wholesale access. Effectively that requires permanent roaming agreements, usually at wholesale level.
- **Promote sharing of future 5G networks with open access to all service providers**: Access to 5G networks for IMR for all service providers, including MVNOs is a prerequisite of the next generation of infrastructure for the DSM. Major EU opportunities for MVNOs may come from access to IMR networks for M2M/IoT applications on 5G networks so all players should have the same open access, at wholesale level, to ensure competition. That implies no restrictions on wholesale access to 5G networking, and not being blocked by traditional incumbent operators promising to invest in new infrastructure.
- **Consider regulation to harmonise/merge MTRs with IOTs**: This would include assessment of whether transit carriers' charges should be regulated, and verification that regulated termination rates are available across Europe. Effectively this implies merging wholesale domestic and Europe-wide Inter-Operator Tariffs (IOTs) with MTRs, so that there is a single basis for roaming agreements between operators across the EU.
- **Consider a publicity campaign to raise consumer awareness of RLAH**: consumer awareness of RLAH has actually declined since the 2017 roaming regulation was implemented. Consideration should thus be given to a publicity campaign.

1. A NEW ROAMING MODEL FOR EUROPE – A 10-YEAR PROCESS

To understand the complexities of the EU roaming market and the impact of the 2017 regulation, it is necessary to understand how it has been shaped over the past decade, the issues that have emerged and the regulatory responses.

1.1. The Background – a History of EU Roaming up to 2007

The market for roaming services really began in 1998 when mobile network operators (MNOs) started to charge supplementary tariffs for international voice calling, although the first mobile roaming agreement between MNOs was signed in 1992 between Vodafone UK and Telecom Finland (Sutherland, 2010). As roaming agreements expanded, so the GSMA, the trade body that represents the interests of mobile network operators, proposed a framework to simplify MNO roaming negotiations – the *Standard Terms for International Roaming Agreements* (STIRA). However, this violated EC Article 85 (1) of the EC Treaty, as it set trading conditions, so the European Commission granted a "letter of comfort" to the GSMA for the STIRA under Article 85 (3) on 11 November 1997, which permitted exemptions for an agreement (European Commission, 1997). STIRA treated all MNOs and their price terms equally under its principle of non-discrimination. That had an unanticipated anticompetitive effect, effectively suppressing competition and discounting. Moreover, it restricted international roaming agreements to operators holding a spectrum licence. That excluded mobile virtual network operators (MVNOs) and network service providers offering fixed-line services. Prices agreed were called Normal Network Tariffs (NNT). For its pricing, the visited MNO would charge what was termed the *normal retail tariff* as the *wholesale* charge. The home MNO then added up to 15% on top of this as its retail margin. Retail and wholesale pricing were linked.

But DG Competition did not consider the wholesale or retail pricing to be cost based, being built on *domestic retail* pricing in the visited country, plus an arbitrary margin. The European Commission therefore required a modified scheme. As a result, the framework was revised by the GSMA and termed the Inter-Operator Tariff (IOT) scheme. IOTs did not assume any preconditions on wholesale levels or margins and so, in theory, could introduce competition.

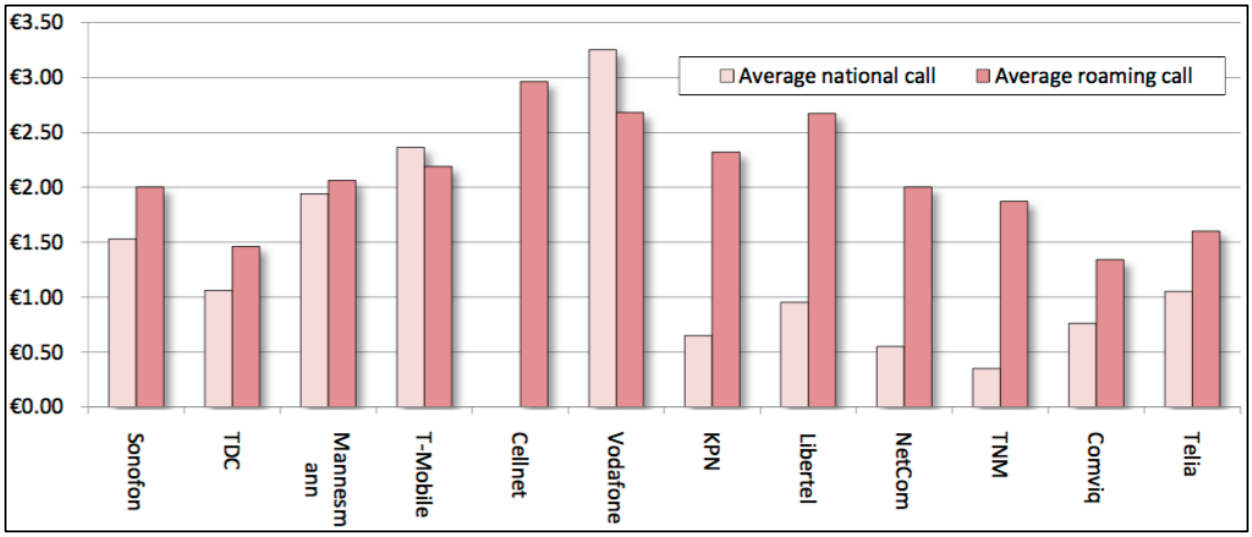
This was implemented by MNOs between May 1998 and April 1999. With such conditions of negotiation, IOTs did not have to reflect actual wholesale costs as they only defined an agreement on the tariffs to be charged between the two MNOs, independent of cost. Thus, every agreement could be unique. Moreover, subscribers were charged for calls forwarded from their home MNO for the first time.

However, there were unintended consequence. Wholesale market prices were effectively free to float, so they increased – and with them – retail prices. Thus, in the early 2000s, the volume of wholesale minutes handled by a visited network was determined by its market share and coverage, rather than by the wholesale price offered. **There was virtually no link between the wholesale price and the volume of wholesale minutes handled.** As a result, commercial logic inclined MNOs to charge high prices for wholesale services. Those revenues, through cross subsidisation, could then be used to reduce the retail tariffs of domestic services, wherever MNOs were in intense competition for market share.

In its 1997 decision, DG Competition failed to realise that the industry would be under no pressure to relate IOT levels with the costs of the International Mobile Roaming (IMR) service provision. A comparison between the last NNT-based charges and those under IOT in Q4 2000 showed increases of over 212% for peak and off-peak IMR voice calls between EU member states for certain MNOs (European Commission, 2000).

Thus, roaming charges were high and inexplicably random, as Figure 1 from 1999 shows.

Figure 1: Comparison of Local and Roaming Voice Call Rates in 1999 (€)



Source: Fischer-Madsen, 1999 (cited in Sutherland, 2010).

Consequently, in response to these market conditions, the European Commission took action. An array of instruments was gradually put in place over the decade following a 2007 decision, under what we refer to below as Roaming I, II, III and IV.

1.2. Roaming Regulation 2007-2017

Roaming I (the 2007 Regulation): Following a near-unanimous parliamentary vote in Spring 2007, the first Regulation on international roaming services within the EU was published on 29 June 2007. Caps for both wholesale and retail voice calls under a *Eurotariff* were the main instrument. The caps applied to roaming retail charges for active (outbound voice) and passive (received) calls, and on the wholesale charges made to the home network operator of the roaming customer by the operator of the visited network carrying the roaming call. Roaming outside the EU remained unregulated. Roaming I also covered transparency aspects. Significantly reduced prices soon underlined the success of this roaming regulation, and retail prices have remained at or just below the price cap ever since (BEREC, 2018).

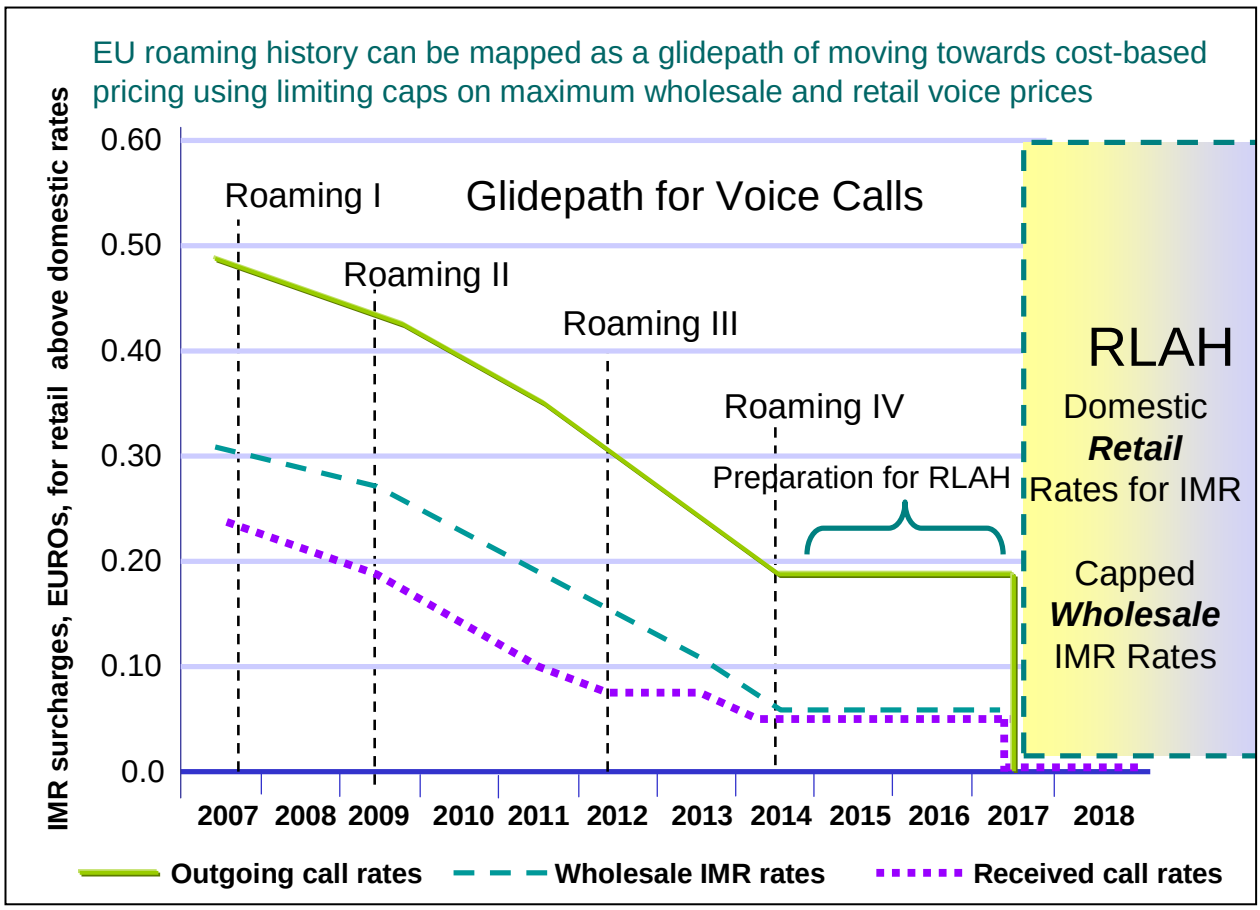
Roaming II (the 2009 amended Regulation): The amended 2009 Regulation introduced the concept of glide path decreases, with price regulation of data roaming services at the wholesale level, as the European Parliament adopted Regulation (EC) No. 544/2009. It amended Regulation (EC) No. 717/2007, bringing early tariff decreases for voice services with retail and wholesale caps, under a glide path of progressive decreases aimed towards cost-based pricing. SMS roaming services also became subject to price regulation at wholesale and retail level. This regulation was due to expire in 2012 (BEREC, 2018).

Roaming III (the 2012 Regulation): Taking a ten-year view following public consultation in December 2010, the Commission developed its Roaming Regulation to run from July 2012 to June 2022. It was revised in 2016, with a new glide path and a timetable for Roam Like at Home (**RLAH)** at domestic pricing for 15 June 2017. It broadened the wholesale price regulation for data with annual decreases in levels of the caps until 30 June 2014. Note that the *data services' allowances and tariffs* became the prime benchmark for consumer pricing, not voice, as over-the-top (OTT) services began to dominate.

The focus on wholesale data pricing was seen as critical for successful take-up of EU-wide IMR services. Such caps were to remain in force until 30 June 2022 but with a further review, before 30 June 2016, when retail price regulation of data roaming services was revised, with a cap to remain in force until 30 June 2017. For voice and SMS, an extension of wholesale and retail price regulation was enacted with annual decreases in caps until 30 June 2014 ***with those caps to remain until 30 June 2022 for wholesale services*** but **until 30 June 2017 for the Eurotariffs**, again with a further review before 30 June 2016. An obligation for MNOs to meet all reasonable requests for wholesale roaming access was also mandated, whether direct or for resale from 1 July 2014. Consumer safeguards required service providers to offer "cut-off mechanisms" with maximum financial or volume limits on data roaming for an agreed period (BEREC, 2018).

Roaming IV (the 2012 amended Regulation): Under Regulation for a European Single Market for Electronic Communications (termed the Telecommunications Single Market, TSM) the European Parliament on 3 April 2014 resolved to abolish retail roaming surcharges, with Regulation (EC) No. 2120/2015, so that subscribers would "**Roam Like at Home"** but with a fair use limit (BEREC, 2018). Exceptions were permitted under a fair use policy (FUP) with surcharges for breaching a four-month EU roaming limit, or a data volume cap under Article 6c, if roaming services are provided below cost. Regulation (EC) No. 2017/920 set the wholesale IMR rates. The overall glide path towards cost-based pricing from 2007 is shown in Figure 2.

Figure 2: Glide Path of EU Tariff Caps for Voice Roaming, 2007-2017



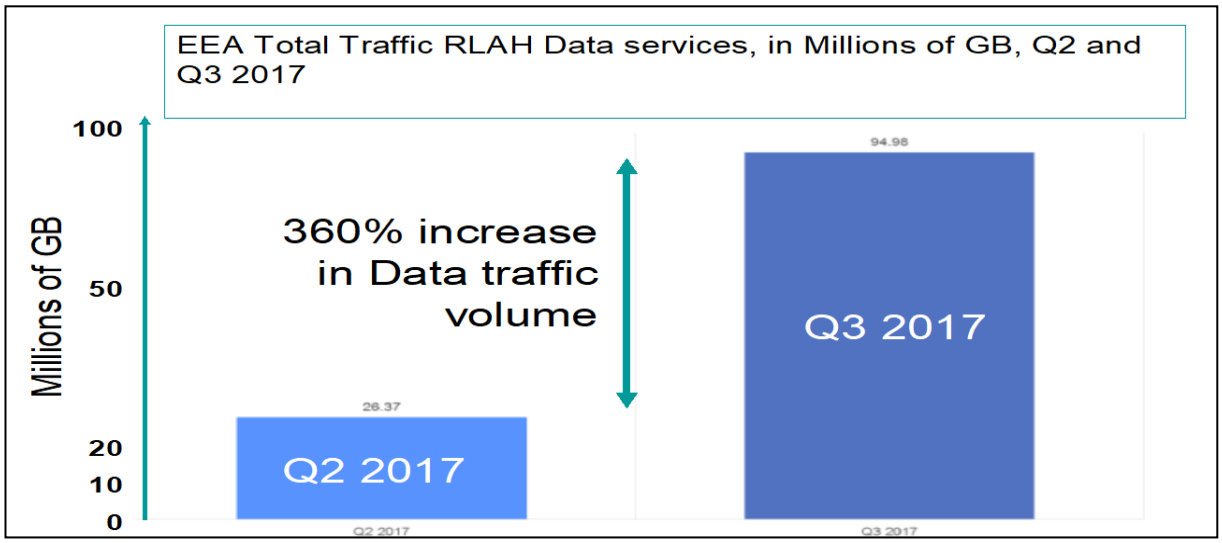
Source: Authors.

2. IMPACT OF THE 2017 REGULATION ON THE RETAIL MARKET

2.1. Impact of RLAH on Data and Voice Traffic

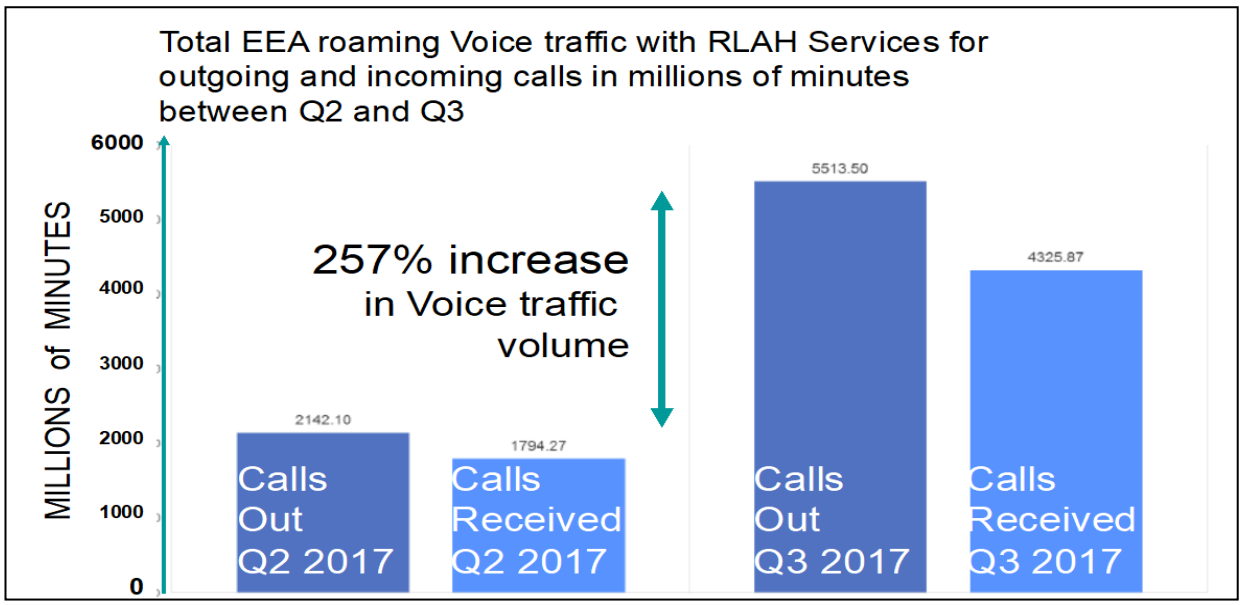
Even though only limited data is currently available, it is already apparent that the use of roaming across the European Economic Area (EEA) has increased dramatically since the implementation of RLAH. In its first benchmarking report since the 2017 regulation came into force, BEREC (2018) concluded that, "The introduction of RLAH services, coupled with the growing demand for data services, has changed the international roaming market. RLAH services enabled a substantial increase in international roaming traffic." BEREC's benchmarking report shows that data traffic grew by more than 350%, and voice traffic by more than 250%, in the quarter immediately after the 2017 regulation came into effect (see Figure 3 and Figure 4).

Figure 3: EEA Growth in RLAH Data Traffic Between Q2 and Q3, 2017



Source: BEREC, 2018.

Figure 4: EEA Growth in RLAH Voice Traffic Between Q2 and Q3, 2017

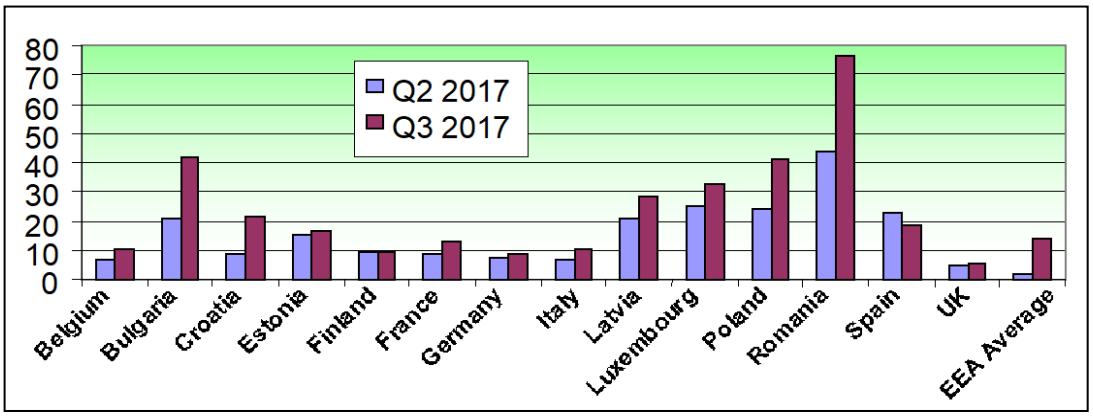


Source: BEREC, 2018.

International roaming services are, of course, subject to high seasonal variations and there is typically an increase in roaming traffic between Q2 and Q3. Results for Q3 2018 are not yet available but data roaming traffic increased by 434.55 % when comparing data from Q3 2016 and Q3 2017. The average EEA subscriber spent 14.23 minutes per month in roaming calls made in Q3 2017 in comparison to 8.8 minutes in Q3 2016.

Regarding the impact by member state, as might be expected, those with large migrant populations working in another EU member state showed the largest increase in traffic, that is, Romania, Bulgaria and Poland. Figure 5 shows the growth in voice minutes for roaming subscribers in selected member states, emphasising that the single telecommunications market is a key foundation of the single economic market.

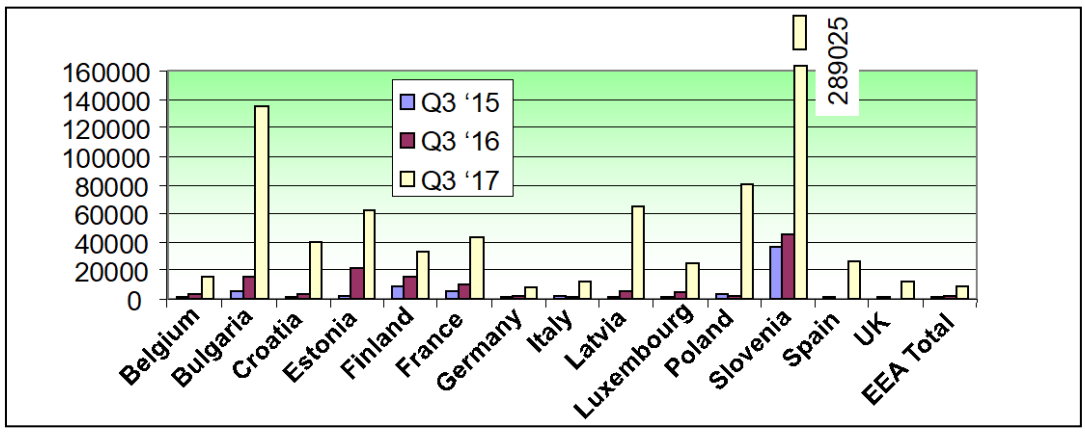
Figure 5: Average Outgoing Voice Minutes per Roaming Subscriber per Month, Q2 v Q3 2017



Source: Authors, based on BEREC, 2018, p. 48.

This effect is shown more clearly in Figure 6, which compares data roaming traffic in Q3 for 2015, 2016 and 2017 for selected member states.

Figure 6: EU Retail Data Roaming Volumes for Q3 2015, 2016, 2017 as a Traffic Index



Source: Authors, based on BEREC, 2018, p.90.

Note: Baseline of Q2, 2012 = 100 (Q2, 2013 for Croatia).

A more detailed examination of the BEREC figures confirms that the abrupt increases in roaming traffic observed in EEA countries in Q3 2017 correlate with the RLAH tariffs being introduced at the start of the vacation season, although BEREC notes that the 2015 update of the roaming regulation also contributed.

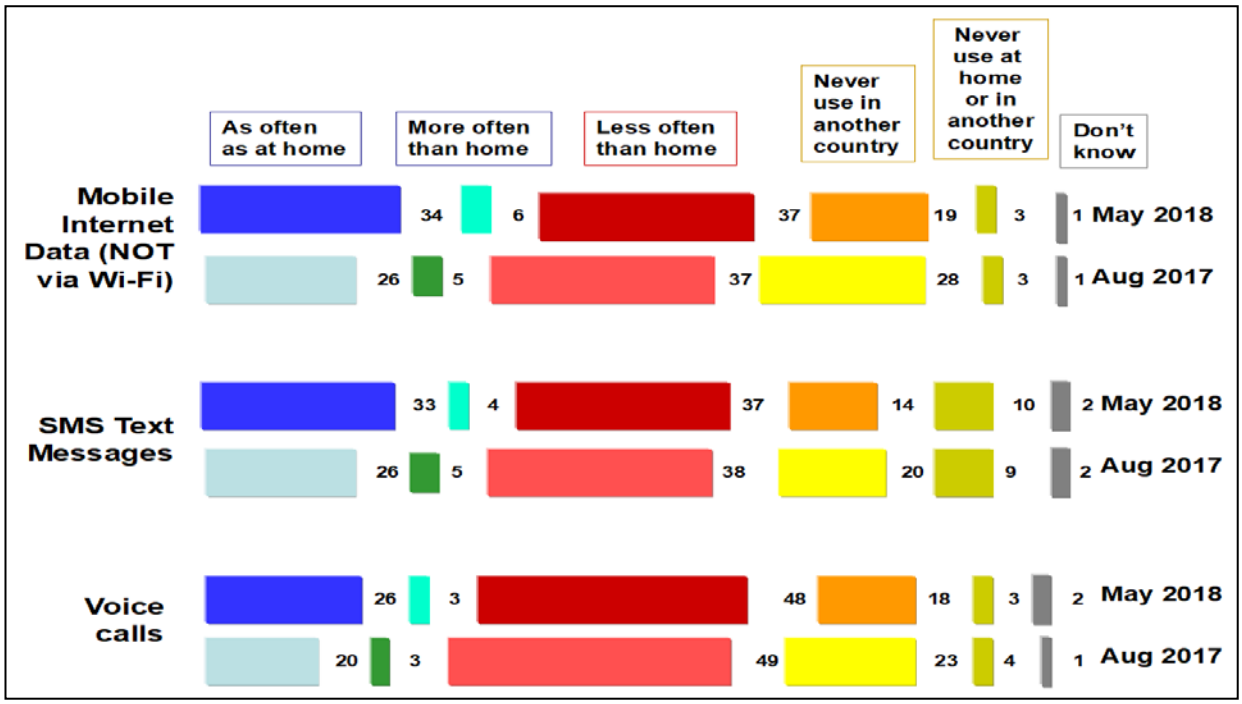
- **Data traffic** growth increased by 148.4% in Q3 2017 v 134.1% in Q2 2017 with respect to the previous quarter. In Q1 2017, the increase with respect to the previous quarter was 13.5% v 19.0% in Q4 2016 and 123.1% in Q3 2016.
- **Voice traffic**, over the same period of Q2 and Q3 2017, the growth of traffic for **outgoing international voice calls** also rose by 78.3% in Q3 2017, compared to a rise of 33.2% in Q2 2017 and 2.9% in Q1 2017, 0.3% in Q4 2016, and 35.8% in Q3 201615. Thus, the quarter to quarter growth of traffic for calls received increased to 44.1% in Q3 2017, compared to 19.2% in Q2 2017, 1.5% in Q1 2017, 0.9% in Q4 2016 and 24.7% in Q3 2016.
- **For SMS,** growth rates found by BEREC were: 92.9% in Q3 2017, 32.7% in Q2 2017, 5.2% in Q1 2017, 27.9% in Q4 2016 and 59.0% in Q3 2016.

2.2. Benefits for Consumers and Business

From the consumer and business perspective, the impact of the regulation has also been largely very positive. A Eurobarometer survey in May 2018, found that on average 62% of respondents in member states (except Romania) were aware that roaming charges had ended on 15 June 2017, although awareness had actually declined by 9% compared to the previous year. The largest declines were seen in Romania (-15%), Denmark (14%) and Italy (-12%). Of those respondents who had travelled in the EU in the year to June 2018, 81% were aware of the abolition of roaming charges (Eurobarometer, 2018). As a consequence, some respondents are now more likely to use their phones abroad as they do at home, compared to 2017, although the majority still use it less or not at all when roaming:

- **Mobile Internet on mobile phone:** an increase of 8% of respondents who accessed Internet services as often as in their country (34% v 26%).
- **Voice calls on MNO service:** an increase of 6% of respondents who use them as often as in their country (26% v 20%).
- **Text messages on MNO service**: an increase of 7% of respondents who used them as often as in their country (33% v 26%).

Figure 7: Use of International Mobile Roaming Services in the EU, May 2018 v August 2017



Source: Eurobarometer, 2018, p 30.

Business users also view the end of roaming charges positively, with a reduction in costs anticipated expected. For instance, the Belgian Association of Digital Leaders (Beltug) surveyed its member companies and found that, as a result of the end of roaming charges (Beltug, 2018):

- Productivity of employees has improved, because they can leave their smartphone switched on, can connect with their corporate networks more frequently, and interact with their company when they are abroad in the EU.
- Companies find it advantageous to select bundles for their employees so that they can use a specified amount of calls, SMS and data at a known price. Fixing a monthly price also facilitates budgeting. The disadvantage of bundles is that when the user exceeds the limits, the prices rise steeply. Thus, it is important to pick appropriate bundles.
- Now that employees are always connected, even when on holiday, an unexpected consequence is that the thresholds of the packages to which a company subscribes are reached more quickly, thereby incurring additional, steep charges from the MNOs.

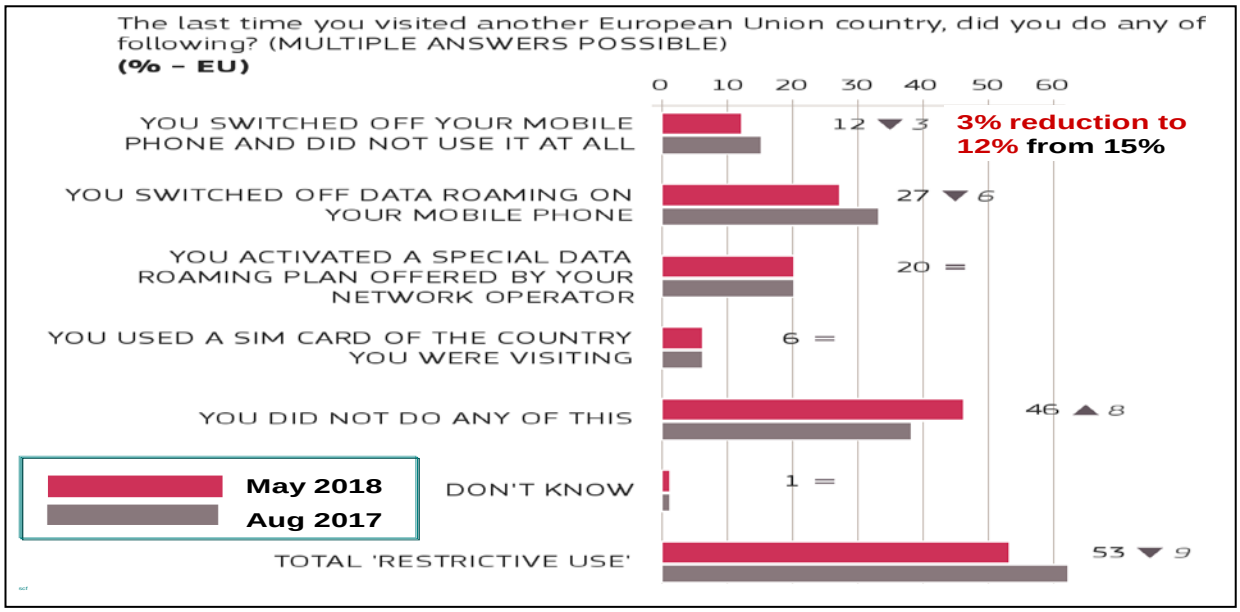
2.3. Silent Roamers Have Reduced but Not Disappeared

According to Eurobarometer (2018), although a majority of respondents still restrict their use of various mobile services when travelling in another EU country, they are now less likely to do so than in 2017**:**

- Overall, 53% of travellers restricted their mobile use in some way the last time they were in another EU country. The most common actions were switching off data roaming on their phone (27%), activating a special data roaming plan offered by their network operator (20%) or switching off their mobile phone and not using it at all (12%).

- Compared to 2017, travellers are now less likely to say they restricted their mobile phone use in some way while travelling in another EU country (-9%), and in particular they are less likely to have switched off data roaming (-6%).
- There has also been a significant decrease in restrictive use compared to respondents who travelled after June 15 in 2017 (-7%).

Figure 8: Survey on Reduction in the Number of Silent Roamers for Various IMR Services



Source: Eurobarometer, 2018.

2.4. Abuse, Misuse and Sustainability Surcharges

2.4.1. Fair Use

The regulation allows MNOs to set limits to the usage of EU roaming services that subscribers can consume to prevent "abusive" or "anomalous" roaming behaviour. As part of their fair use policy, MNOs can monitor their customers' roaming use over a four- month period. If, during this period, the customer has spent more time abroad than at home and roaming usage has exceeded their domestic usage, the MNO may apply a surcharge capped at 3.2 cents per minute of voice call made, 1 cent per SMS, and €6 per GB of data (cap in 2018). However, BEREC reports little evidence of abusive use, or of major actions from MNOs to enforce fair use.

2.4.2. Derogations

MNOs who are able to substantiate to national regulators that they are unable to recover their "actual or projected costs" of providing roaming services can continue to impose sustainability surcharges on their customers for services consumed in the European Union (plus Norway, Liechtenstein, and Iceland). Exemptions like this are referred to as derogations and are seen as temporary measures.

Sixteen NRAs had received applications for sustainability surcharges by August 2017. In total 53 applications were received, with thirty applications being granted. Twelve were still pending a decision

and 11 applications had been refused. Table 1 shows the share of granted applications in each of the countries that had received applications (BEREC, 2017a).

Table 1: MNO Derogations from Roaming at Domestic Rates by August 2017

Country	Applications Received	Applications Granted	Applications Refused	Applications Pending
Austria	3	2	1	0
Belgium	2	1	1	0
Czech Republic	3	0	3	0
Denmark	2	1	1	0
Finland	5	4	0	1
France	12	11	1	0
Lithuania	4	4	0	0
Poland	9	0	0	9
Portugal	1	0	1	0
Slovakia	1	0	1	0
The Netherlands	1	0	1	0
Estonia	3	3	0	0
Romania	1	1	0	0
Spain	2	0	0	2
Sweden	1	0	1	0
Italy	3	3	0	0

Source: BEREC, 2017a.

We might conclude from this that the number of derogations has been relatively small. In most countries, the providers granted derogations had a small market share (BEREC, 2017a). This would tend to indicate that roaming service is actually being provided by MNOs at below cost. BEUC (2017) takes the view that derogations are not necessary because of the various safeguards that the MNOs enjoy, for example, fair use policies.

2.5. Potential Issues that May Affect Effectiveness of the Regulation

Broadly speaking, the 2017 regulation has been implemented smoothly across the EU. The most significant issues that have arisen so far mainly concern the willingness of specific MNOs to fully accept their obligations, for example:

- The Federation of German Consumer Organizations (vzbv), has an ongoing court case against O2 (Telefonica, Germany) concerning the lack of automatic switching to RLAH, as O2 requires customers to send an SMS requesting to switch to a new tariff. The trial hearing started 28 August 2018 (vzbv, 2017).
- Two MNOs in Germany offer a discounted streaming service (StreamOn by Deutsche Telekom and Vodafone Pass by Vodafone Germany) for low-cost mobile Internet access. But these are not supported for roaming under RLAH in another EU Member State. Hence, the NRA (BNetzA) has issued an obligation to follow the regulation. Deutsche Telekom has now brought a legal action against this BNetzA decision.

- Often consumers are not aware that when they are on board a ship, either offshore or on canals or inland waterways within the EU, if a cellular mobile signal is not available, they may inadvertently connect to a mobile network via the ship's own satellite-Internet connection thereby incurring sometimes enormous charges (Telecompaper, 2018).
- MVNOs have a need for roaming untethered SIM cards with permanent or long-term out-of-home member state residence. This type of usage is a typical for Internet of Things (IoT) installations, such as a connected car roaming across the EU. MVNOs offer both national and multicountry connectivity over long periods (longer than four months) and may need to have SIM cards that are not national but organisation dependent. The ITU recognises that the shared or non-geographic Mobile Country Code (MCC) 901 awarded by the ITU is valid, But German MNOs have not accepted this. Thus, BNetzA, ruled in June 2018 that such 901 IMSI codes should be valid (DLA Piper, 2018). BEREC (2018b) has issued a decision on this, supporting use of non-geographic SIM cards especially for IoT applications.

Despite this small number of issues, at the retail level RLAH can be considered a major success for the European consumer and business user.

3. WHOLESALE REGULATION IMPACTS ON IMR MARKET

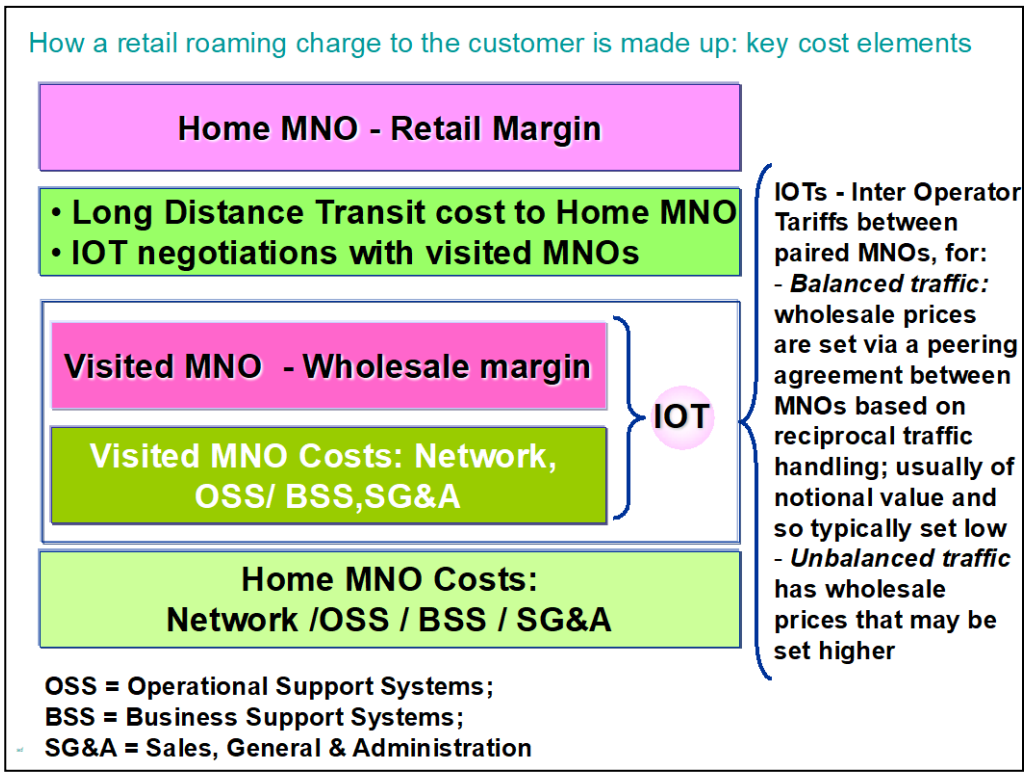
3.1. Defining the Structure of the Wholesale Roaming Market in Europe

The European wholesale market sets the retail IMR tariffs across the EU because wholesale prices are the key dependent variable in their composition. Thus, the level of EU wholesale caps is critical. These caps should be cost-based but should enable operators to make a profit. That appears to be a difficult issue because of the variations in economic returns and costs across Europe. However, there are certain metrics for setting caps that can resolve this. Cost inputs specific to IMR wholesale services include:

- The commercial fees that the host network charges the home network for enabling the home network's visiting subscribers to roam on the host network, as defined in a contractual accord between the two MNOs, known as the Inter-Operator Tariff (IOT).
- Any long-distance transit fees, at wholesale rates, for a separate long distance carrier.
- Commercial incentives that are competitively negotiated, e.g. discounts on volume of traffic passed between operators taking in the balance of the overall direction of traffic.
- Negotiation costs with MNOs on wholesale charges (unless a roaming exchange is used)
- Network operations related cost elements:
  - Home Location Register (HLR) and Visiting Location Register (VLR) operations
  - Fraud prevention measures (e.g. for prepay, the CAMEL platform)
  - Perhaps, if a clearing house for data is used for call data, data clearing house fees
  - Possibly a roaming exchange, if data volumes or minutes are bought through an exchange
  - SMS welcome message servers – welcome messages and pricing on crossing borders.

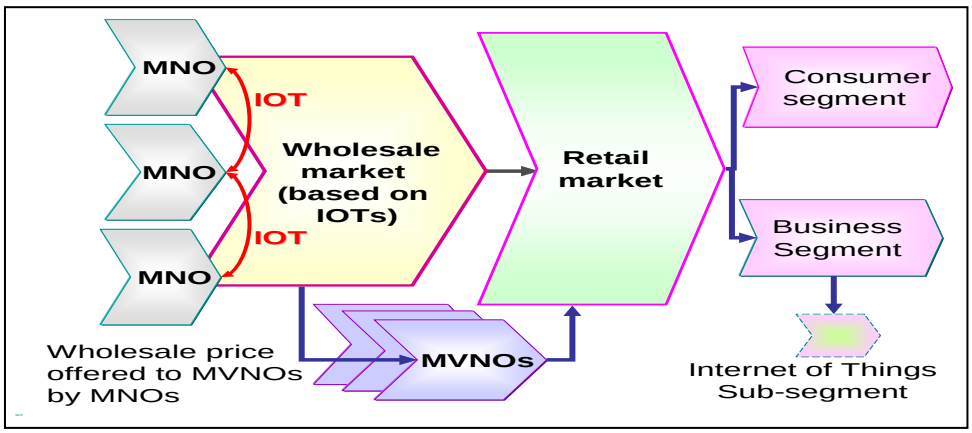
Wholesale charges are the underlying variable cost of the IMR business, as illustrated in Figure 9.

Figure 9: Key Cost Elements in Roaming Charges



The resulting market structure is shown below. MNOs negotiate wholesale prices between themselves, capped by limits imposed by the EC Roaming Regulation, which attempts to ensure that wholesale prices in the IOTs become closer to actual costs.

Figure 10: The Wholesale Market Sets Retail RLAH Prices, Based on Inter-Operator Tariffs (IOTs)



MVNOs depend on their host MNO's wholesale offers for their retail level pricing within their domestic markets.

3.1.1. Inequalities in the Wholesale Market Drive the Risk of Market Failure

Without regulation of wholesale tariffs, wholesale roaming prices in the EU would be higher, as evidenced by unregulated wholesale roaming prices in the EU before the various phases of IMR regulation. The main market failure risks (European Commission, 2016, pp 14-15), which might result in anticompetitive behaviour include:

- **Formation of national oligopolies:** in national wholesale markets, only MNOs are able to offer roaming in the visited market (with three or four MNOs, varying by member state). Among those MNOs, not all may be able to offer a complete range of services, heightening the risk of abuse of Significant Market Power (SMP).
- **Roaming agreements are bilateral in structure:** the main negotiation driver is the amount of inbound and outbound traffic that can be balanced between the operator pair, more than the price agreed for the unbalanced part. For the latter, the regulatory cap can be the limit.
- **Trading imbalances may occur between different sizes of operator:** smaller MNOs, who are not part of a large international mobile group, with smaller traffic volumes, do not generally benefit from wholesale prices lower than the caps. This group includes the MVNOs as they handle no inbound traffic in their home country which can be traded.
- **If MVNOs are excluded from wholesale roaming markets, competition is reduced:** MVNOs are locked out of the market if prevented from negotiating separately from their host MNO.

Thus, the functioning of national wholesale markets can cause prices to rise substantially above estimated costs, a sign of market failure. Note that traffic steering (i.e. the process by which a mobile operator decides which partner their subscribers will use whilst roaming) can only be used to the advantage of the home MNO (but might disadvantage its subscribers on overall price). Note that there

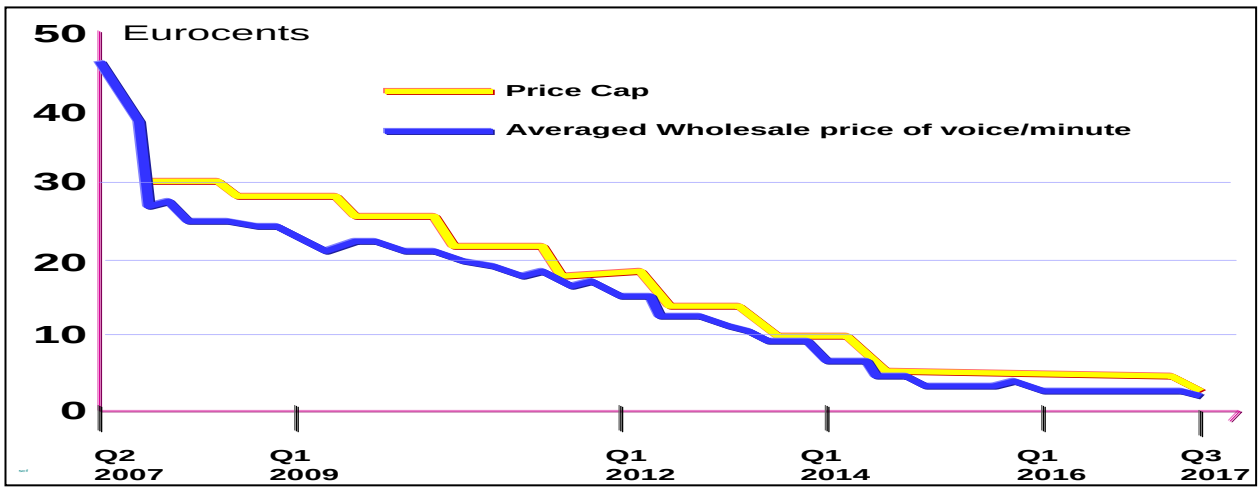
is some transparency here. Article 3 (5) of the Roaming Regulation requires roaming access providers to publish their standard Reference Offers. That Reference Offer should cover all aspects in sufficient detail for wholesale access buyers to understand the conditions of the services (BEREC, 2010; BEREC, 2017b).

3.2. Pricing Effects of Wholesale Regulation for Introduction of RLAH

BEREC compared data wholesale roaming prices for each member state before and after the introduction of the RLAH caps. They found that the averaged EEA price per MB over the year between Q3 2016 and Q3 2017 fell from €c0.99 to €c0.40, which was well under the June 2017 wholesale cap of €c0.77. Even those member states with the highest data prices (i.e. Czech Republic, Cyprus, Slovakia and Slovenia in 2016)) saw significant price reductions to be within the wholesale cap (BEREC, 2018a).

The success of the progressive glide path reductions over the decade from 2007 to 2017 are shown in Figure 11, with the wholesale price per minute for voice falling from nearly €c50 to less than €c5.

Figure 11: Wholesale Voice Prices, Q2 2007-Q3 2017 (€c per minute)



Source: BEREC, 2018.

3.2.1. The Wholesale Market Has Also Conformed to the RLAH Regulation,

According to BEREC's analysis of the wholesale market between April and September 2017, the revised data, voice and SMS and roaming charges between MNOs have been significantly below the regulated average caps following the cap reduction for wholesale tariffs agreed under IOTs.

Table 2: EEA Wholesale Rates Before and After Implementation of the RLAH Regulation

Service Tariffs at Wholesale Level	Q2 2017		Q3 2017	
	Price Cap	EEA Average	Price Cap	EEA Average
Wholesale data (€c/MB)	5	0.57	0.77	0.40
Wholesale voice (€c/minute)	5	2.52	3.2	2.41
Wholesale SMS (€c/SMS)	2	0.68	1	0.55

Source: BEREC, 2018.

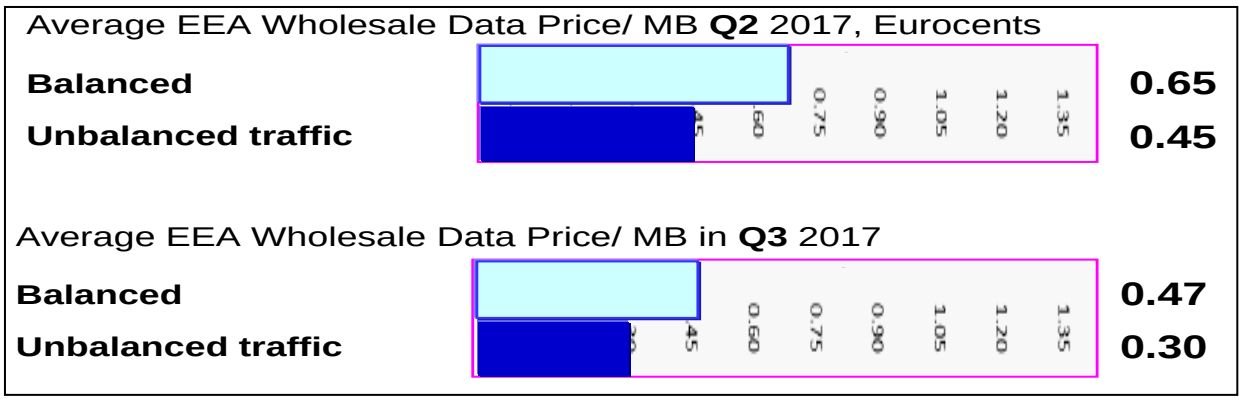
Thus, EEA wholesale average prices for data, voice and SMS are now all under the caps (from a BEREC survey of 159 IMR services providers, MNOs, MVNOs and resellers (BEREC, 2018). As shown in Table 2, the average price for wholesale data service, which in Q2 2017 had already dropped to €c0.57 per MB, fell to €c0.40 in Q3 2017, as the cap reduced from €c5 to €c0.77 per MB. However, the question is – are the data caps correct? As noted, wholesale data has become the key service with the move to OTT, as it embraces all services now – voice and messaging, as well as offering affordable video calling and MMS.

3.2.2. Managing Unbalanced Roaming Communications

In the wholesale roaming market, the majority of deals are reciprocal between home and visited MNOs, so wholesale roaming capacity is largely traded between the same counterparties. Where this trade is intragroup (i.e. an MNO which is part of a larger pan-European or international group with operations in many member states) or traffic is relatively balanced, in practice the unit price is of little consequence as a balanced peering agreement can pertain. So, when both home and visited MNOs are part of a single large group, the cost to the group is not the price used in the exchange of calls, but the cost of handling roaming traffic on behalf of the group. Note that the price paid for balanced traffic is irrelevant to the profits of MNOs, as roaming charges paid are balanced by the identical roaming payment received, so the net payment for balanced traffic is zero. Thus, to maximise their total accounting revenues, the two MNOs may often value the balanced traffic nearer to the *regulated upper limit* of the wholesale price, while still respecting the roaming caps. Benefits come in the presentation of the financial results of the operating group.

Thus, there is an incentive to balance traffic as far as possible (BEREC, 2010) because the nominal declared wholesale price of balanced traffic is irrelevant to the overall margin of the two MNOs. In the absence of wholesale price regulation, each MNO could declare its wholesale price as high as the retail price (i.e. zero retail margin) or as low as the cost of supply of wholesale traffic (i.e. zero wholesale margin) without changing the overall margin (retail plus wholesale) of each MNO. The conclusion is that the wholesale margin could be substantial and that the wholesale market could become uncompetitive. This is significant as its makes the need for wholesale price regulation clear. Also note that traffic steering techniques can give the home operator control over which visited network will carry its traffic, with an inclination for its own group where possible. For overflows, a set of preferred partners can offer backup (in order of preference) for any outstanding traffic, chosen to ensure optimal margins and/or network coverage for roaming service quality. For example, the balanced/unbalanced price differences across the EU for data traffic are shown in Figure 12, averaged across the EEA.

Figure 12: Differences in Balanced and Unbalanced Wholesale Data Traffic, Q2 and Q3 2017



Source: BEREC, 2018.

Consequently, it is only the *residual or unbalanced traffic* which is subject to strong price competition. But for relatively small volumes of residual traffic, the incentive to compete vigorously on price is low, especially for larger operators. For non-intragroup trades, the volume of unbalanced roaming sold may be of much greater commercial significance than the purchase price, as it represents outflows of payments. Thus, if an MNO has an excess of traffic, it seeks the lowest wholesale price for that excess from each MNO in the visited country. The out-of-balance price will tend to be lower if it is competed for by visited MNOs, unless a non-competitive market persists when it may be higher (but is still capped).

The differences between balanced and unbalanced wholesale tariffs in the figure above illustrate this. On average, unbalanced traffic is priced lower in this figure. For wholesale data, the average *balanced* traffic price per MB was €c0.65 in Q2 2017, but €c0.47 in Q3 2017. In sharp contrast, the EEA average price per MB for *unbalanced* traffic was €c0.45 in Q2 2017 and €c0.34 in Q3 2017. For a voice minute, the EEA average balanced wholesale price in Q2 2017 was €c2.70 but €c2.49 in Q3 2017. At that time, the EEA average price per minute for *unbalanced voice traffic* was €c2.18 in Q2 2017 but €c2.27 in Q3 2017 (BEREC, 2018).

3.2.3. Constraints for Permanent Roaming

According to BEREC in its March 2018 report, the majority of responding MNOs had not yet implemented any measures to discourage permanent roaming in their wholesale roaming agreements as fair use policies (FUPs) were ignored. Some explained it as unnecessary, as all usage was charged for. Others even encourage usage through volume or revenue commitments. Only about 20% of responding MNOs had some kind of mechanism in their wholesale roaming agreement to discourage permanent roaming. Also, certain MNOs, may exclude permanent roaming from discounts. Mobile originated calls to countries outside the EEA are excluded from discount rates. This is a concern for large business users that try to negotiate wholesale deals (Beltug, 2018). In essence, the difference between discounted and non-discounted wholesale rates has emerged as a key element for MNOs to control permanent roaming.

On wholesale resale of capacity, a majority of the MNOs responding to BEREC surveys had not yet implemented measures to discourage permanent wholesale roaming by their MVNO and reseller customers (rather than consumer and business users). Some MNOs did not feel the necessity, as all is charged for. Other MNOs actually encourage wholesaler traffic, via volume commitments and revenue commitments in wholesaler contracts. Few MNOs replied with explicit consumption limits.

3.2.4. Permanent Roaming for Machine-to-Machine Communications

MNOs and specialised MVNOs are keen on opening the M2M market segment for major EU vertical industrial users (e.g. automotive, aerospace, logistics, etc). M2M traffic is typically of low data volume, dominated by signalling for process or machine states. This is likely to demand highly reliable infrastructure, with high quality, and perhaps low and standardised latency. BEREC (2016) assessed permanent roaming in relation to the IoT and specifically for M2M and found that a majority of MNOs do not apply specific prices or conditions for M2M traffic at a wholesale level, i.e. the IoT segment is treated much the same as all other data in wholesale contract financial conditions.

Some MNOs expressed their concerns to BEREC that since national networks were dimensioned for domestic SIM cards, a large increase in foreign SIM cards for M2M, on a permanent basis, might produce capacity problems with possible network congestion in visited networks without a fair use policy (FUP). However, whether this is a real issue is open to question because, typically, M2M networks exploit low volume, burst data communications for signalling, rarely measured in GB per session, but perhaps low

kb per signal, for commands or monitoring messages often at slow speed (kbps to Mbps range). Hence, only a small minority of MNOs have special conditions and rates for M2M traffic, e.g. exclusion from discounts. Interestingly, no MNOs with M2M agreements were found to employ an exclusivity of carriage clause for their network, perhaps because that may not be favourable to the M2M segment. Such applications need to select the best network available at any given time (BEREC, 2016). The reliability and mean time before failure (MTBF)/mean time to repair (MTTR) of commercial mobile cellular networks do not always meet the requirements of M2M users and so multiple MNOs are preferred, for failover.

3.3. Competition Effects in the Wholesale Market under RLAH

Retail and wholesale roaming markets are firmly interlinked, since provision of retail roaming is dependent on wholesale access in the visited country. Operators note that RLAH tends to affect two aspects of the bilateral roaming negotiations between two mobile operators:

- It increases wholesale roaming traffic volume because of increased retail roaming demand;
- Equal negotiating power for wholesale roaming agreements will be limited by the balance in volume sent in each direction between the home and visiting MNOs.

Therefore, competition issues may arise when operators have little or no inbound traffic to offset against their own roaming subscribers' traffic (European Commission, 2016). Operators with unbalanced traffic volumes enter negotiations from a weak position inevitably leading to less competitive pricing of wholesale tariffs. Hence, regulation is necessary to protect competition. However, to put these forces into perspective, roaming traffic represents a relatively minor additional fraction on top of overall domestic traffic, one which varies across operators. In the Commission's 2016 Impact Assessment (European Commission, 2016) in most instances, wholesale roaming revenues were found to represent between 1% and 2%, and generally below 4%, of overall domestic retail revenues. In the future, this proportion may rise.

However, there are imbalances (often with a South-North divide) between those member states with a high ratio of inbound traffic compared to outbound traffic, i.e. more visitors to a country than home subscribers leaving it to roam across the EU. This is the result of patterns of tourism and business travel - and increasingly of consumption patterns. Price caps are hence needed to ensure that wholesale roaming markets work competitively for all, both currently, and when satisfying future increased demand stimulated by lowered retail roaming tariffs, following the RLAH success in the retail market (as shown in the preceding chapter).

3.3.1. Is the Wholesale Roaming Market Functioning Effectively?

The overall impact of the retail RLAH obligation on competition dynamics in national wholesale roaming markets is still unclear, because it affects the two main groups of operators differently. First are historic incumbents and operators with a large footprint, generally with large inbound roaming traffic. They argue that the competitive dynamics are effective, witnessed by wholesale market prices often below regulatory caps. A second group of operators, in particular smaller MNOs, MVNOs and those operators with large outbound roaming traffic, and who lack a strong negotiating position for setting IOTs, argue that wholesale prices are at, or close to, current caps. This implies the wholesale offers to them are substantially above the costs of provision. The result is a *Sender/Receiver* divide in perception of the competition effect of RLAH on wholesale roaming markets (European Commission, 2016).

3.3.2. Realistic Wholesale Price Caps are Essential

In the *domestic* national market, wholesale roaming network providers compete to obtain the custom of the national MVNOs and services resellers. That competition may drive down wholesale domestic roaming prices and therefore retail domestic prices. The same could apply to the increase in inbound roaming traffic generated by RLAH, from a visiting MNO. So, the RLAH-triggered increase in roaming traffic at wholesale level is likely to reduce wholesale roaming unit costs, because of economies of scale – but only if competition in the market at wholesale level is active to reveal this.

However, in opposition to greater competition are other forces. Even with several MNOs in each national market, a visiting operator depends on specific MNOs in the visited country due to operational conditions such as coverage and capacity, meaning that switching costs for wholesale roaming services are relatively high. Such factors limit competition in the visited market, making price caps essential. If the visiting operator is small, even with the volume boost from RLAH, it can only offer small volumes relative to those of larger players, or an MVNO. Hence, it finds less competition in the provision of wholesale roaming services. Consequently, effective price regulation to bring *cost-based* wholesale pricing to the fore at the negotiating table is a prerequisite for a fully functioning wholesale market. This is emphasised by the possibility of visited MNOs attempting to recover lost revenue owing to *retail* roaming caps through inflated *wholesale* roaming prices. The willingness of visited MNOs to give discounts could also disappear. Without strong tariff cap regulation, RLAH could exert upward pressure on the wholesale roaming prices currently observed.

3.3.3. Wholesale Issues for MVNOs Means Retail Competition Also Suffers

Since wholesale caps are set high and MVNOs' negotiating power is low, competition suffers in both wholesale and retail markets. MVNOs now represent about 10% of EU SIM cards, and approach 25% of the market in some EU Member States (MVNO Europe, 2018). They offer a wide range of services, ranging from retail consumer markets, to vertical sector specialists, for instance for machine-to-machine (M2M) users, as part of the IoT market as well as retail business users and the public sector. Thus, they enhance wholesale and retail competition. MVNOs can provide market innovations through dedicated sector business models.

As noted, in the domestic market, wholesale tariffs offered to MVNOs in markets where the MNOs compete with each other to attract MVNOs are much lower than for IMR wholesale tariffs. In the wholesale roaming market however, these may be considerable for MVNOs, often being close to the Roaming Regulation cap (€6/GB in 2018) leaving no margin. Thus, if there is international wholesale roaming traffic being carried between MNOs at below this wholesale cap, that is not the tariff offered to MVNOs. Furthermore, MVNOs have no inbound roaming traffic to "trade" in peering relationships: they are unilateral buyers of wholesale roaming volume and/or wholesale roaming resale access (MVNO Europe, 2018). Consequently, despite making significant wholesale purchases, MVNOs have little or no bargaining power, because MNOs do not actively compete for MVNOs' international wholesale roaming traffic. Those MNOs that do respond only offer MVNOs roaming charges close to the price caps. "Light" MVNOs (often discount resellers to the retail market) may not have any possibility of buying from an operator who is other than their host domestic MNO.

But how can any assessment of the suitability of the wholesale cap be made? One approach is to examine the retail domestic tariff as an approximate indicator, which should be cost-based and which is public. Of course, it is only a first indicator, a possible maximum guide. But whether it is closely related to the underlying cost base is unclear, because of the bundling of services. But some useful approximations may be made. In Table 3, the unit price of data services for a large country (France) and a small country (Slovenia) is derived by dividing the overall retail price, corresponding to the entire

billing period, by the total volume of data services included in the bundle. That is the reserve price set by the operator for the data service. Even considering both partial usage of data bundles by customers and the fact that bundles almost always contain unlimited volumes of voice and SMS traffic, retail prices in European markets are well below the current wholesale roaming data cap of €6/GB (excluding VAT), at a minimum, nearly an order of magnitude less.

Table 3: Comparing Retail Domestic Tariffs in Selected Member States (€/GB)

France: Retail Domestic Data Offers		
	With VAT	**Excl. VAT**
SFR 100 GB 4G included in €50 retail/month VAT incl. or €41.7 retail/month VAT excl.[a]	**0.5**	**0.42**
Bouygues 50 GB 4G included in €25 retail/month VAT incl. or €20.83 retail/month VAT excl.[b]	**0.5**	**0.42**
Orange 100 GB 4G included in €75 retail/month VAT incl. or €62.5 retail/month VAT excl.[c]	**0.75**	**0.63**
Free 100 GB included in €20 retail/month VAT incl. or €16.67 retail/month VAT excl.[d]	**0.2**	**0.17**
Slovenia: Retail Domestic Data Offers		
	With VAT	**Excl. VAT**
A1 Svobodni 120 GB included in €41 retail/month VAT incl. or €33.61 retail/month VAT excl.[e]	**0.34**	**0.28**
Telekom Slovenije Dostopni C 100 GB included in €39 retail/month VAT incl. or € 31.97 retail/month VAT excl.[f]	**0.39**	**0.32**
Telemach NAJVEČ 60 GB included in €26 retail/month VAT incl. or €21.31 retail/month VAT excl.[g]	**0.43**	**0.35**
T-2 BREZČASNI L 50 GB included in €19 retail/month VAT incl.;[h] or also €15.57 retail/month VAT excl.[i]	**0.38**	**0.31**

Note: All published tariffs from MNOs, 9 August 2018.

Source: a. SFR, Power Go: https://www.sfr.fr/forfait-mobile/offres/forfait-mobile#sfrintid=HS ; b. Bouygues, B&You: https://www.bouyguestelecom.fr/forfaits-mobiles/sans-engagement; c. Orange, Jet Go: https://boutique.orange.fr/mobile/forfait-jet-100go-sim; d. Free, Forfait free: http://mobile.free.fr/fiche-forfait-free.html; e. Svobodni: https://www.a1.si/narocniski-paketi/paket-dodatni/a1-svobodni; f. Telekom Slovenijek, Dostopni C: https://www.telekom.si/en/offer/postpaid/dostopni-price-plans. g. Telemach, NAJVEČ: https://telemach.si/mobilna-telefonija/narocniski-paketi?tab=nisem-narocnik-fiksnih; h. T-2 offers an unlimited data plan which slows down the connection speed to 2-1 Mbps once the customer reaches 50 GB. i. T-2, BREZČASNI L: https://www.t-2.net/brezcasni-l.

This table points to the current wholesale data cap being well above the cost price. Comparing the current wholesale roaming data cap of €6/GB with ***domestic retail*** prices shows the cap is between 9.5 and 21 times higher than retail levels, while the additional cost of roaming should be less than the retail tariff. If accurate, that would indicate that the EU's current cap is of the order of 10 times the cost price – at a minimum. It signals that the wholesale data glide path forecast in Regulation 2017/920 should be reviewed, since those MVNOs competing with the MNOs in the wholesale market are at a severe disadvantage. MVNOs cannot offer bulk discounts to high volume business customers, or compete

against MNOs in the consumer market. In consequence, the wholesale and retail markets become less competitive because of their absence. Moreover, MVNOs who may use specialist wholesale aggregators (termed sponsored providers) gain no advantage. Such players tend to pass on the MNOs' wholesale data roaming charges, set near the cap.

In consequence, MVNOs enjoy no leverage over price because of their lack of negotiating power with the MNOs in a market where the peering arrangements on balanced data traffic rule while the MVNOs can only offer unbalanced traffic. To reset the scale of wholesale tariffs may require more disclosure of underlying IMR costs to regulators, despite commercial confidentiality issues. Note that wholesale tariff caps should follow technology's march, so that these data caps keep up with market pricing evolution.

3.4. Investment Incentive Effects of International Mobile Roaming

New IoT markets for MVNOs for wholesale mobile roaming are opening. In this market, MVNOs offer international enterprises specialist mobile roaming across the EU, using non-geographic SIM cards. This requires MNO wholesale prices to be limited so they do not exceed the costs of MVNO operations. In consequence, MVNOs are driving vertical sector-based applications:

- Cubic Telecom, Ireland are working with Audi and Qualcomm for EU-wide connected cars. Fiat Chrysler, Jaguar Land Rover and other EU car makers are also using MVNO offerings for their SIM connected vehicles, based on connectivity across multiple networks.
- Aircraft connectivity for maintenance is operated by a highly specialised MVNO, to connect a plane when landed, so Airbus Industries use MVNOs for monitoring and testing across the EU.
- Some EU MVNOs specialise in *global* mobile and Wi-Fi connected consumer and business devices, thus, the Microsoft Surface tablet has a global eSIM for global connectivity.
- Major EU opportunities for MVNOs may also come for M2M/IoT applications on 5G networks so all players should have the same open access, at wholesale level, to assure competition. That implies no restrictions on wholesale access to 5G networking, not being blocked by traditional incumbent operators promising to invest in new infrastructure. Also, it is well to note that effectively the largest MVNOs may now have a greater global coverage than global MNO groups (eg, Orange, Vodafone, etc.) as they can work across many MNO and FNOs.

Naturally, all is not straightforward with the innovative business models that M2M and roaming demand. One example is the German regulatory decision on international SIM cards for data roaming, which are critical as a potential opener of cross-EU IoT initiatives. The case mentioned above in Germany on wholesale access for an MVNO that BNetZA pursued highlights the potential problems to be overcome if the DSM is to flourish.

4. RECOMMENDATIONS

4.1. Harmonisation of MTRs and IOTs

As shown by the much higher international non-EU wholesale roaming prices, the market in general needs adequate wholesale caps to deliver lower prices, which implies that it does not function well structurally. The impact of the retail RLAH obligation on the functioning of the *retail* roaming market has been shown to be a success. However, the wholesale roaming market needs revision of the caps (see section 5.2) for wholesale tariffs to revise the imbalances in the market for MVNOs.

Mobile termination rates between MNOs and FNOs in the domestic market in each Member State set floor prices when calling offnet. For a large majority of operators, even some of those that do not want any modification of the wholesale regulation, there is a still need for a consistent regulation of MTRs throughout the EU (BEREC, 2016). This diversity of situations creates a constraint on further decreasing wholesale caps, as the highest MTRs should remain sufficiently below wholesale voice charges, but may not. One possible solution for a sustainable wholesale RLAH approach throughout the EU could comprise:

- Harmonisation of MTRs across the EU, while ensuring that wholesale tariffs do not fall below costs. This would include assessment of whether transit carriers' charges should be regulated, and verification that regulated termination rates are available across Europe.

Effectively this implies merging wholesale domestic and Europe-wide Inter-Operator Tariffs (IOTs) with MTRs, so that there is a single basis for agreement between operators across the EU. This would ease the problems faced by MVNOs because, as wholesale prices fall, IOT cost prices would also come down as local MTR charges between domestic MNOs would fall for local offnet terminations.

4.2. Improving Existing Regulations

Future modifications to existing regulation should include the following considerations:

- As consumer awareness of RLAH has actually declined since the 2017 roaming regulation was implemented, consideration should be given to a publicity campaign.
- Our analysis indicates that the EU's current wholesale roaming data price cap could be of the order of at least 10 times the cost price. Thus, the glide path forecast in Regulation 2017/920 should be reviewed, so that the wholesale roaming cap for data is in line with costs. An approximate indicator may be set by the average domestic retail price (€/GB) across the EU for bundled data. This should be brought into force in a short timeframe.[1]
- Resetting the level of wholesale tariffs is likely to require disclosure of underlying IMR costs by the MNOs to regulators, perhaps under NDA to assuage the commercial confidentiality issues. Note that wholesale tariff caps should follow technology's march, so that the limits match market pricing evolution.
- Access to 5G networks for IMR for all service providers, including MVNOs is a prerequisite of the next generation of infrastructure for the DSM. Major EU opportunities for MVNOs may come from access to IMR networks for M2M/IoT applications on 5G networks so all players should have the same open access, at wholesale level, to ensure competition. That implies no restrictions on

[1] We understand that the European Commission's interim review of the IMR market scheduled for December 2018 will focus on the retail market and that its review of the wholesale market will only be included in its final report, which is due by the end of 2019.

wholesale access to 5G networking, and specifically, not being blocked by traditional incumbent operators promising to invest in new infrastructure.

Table 4 ranks the recommendations proposed above according to their likely impact.

Table 4: Recommendations Ranked According to Their Likely Impact

Recommendation	Ranking
Promote lowering of the wholesale cap for IMR towards cost-based pricing	1
Enable permanent roaming at a wholesale level for IoT application providers	2
Promote sharing of future 5G networks with open access to all service providers	3
Consider regulation to harmonise/merge MTRs with IOTs	4
Consider a publicity campaign to raise consumer awareness of RLAH	5

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This in-depth analysis was prepared by Policy Department A at the request of the ITRE Committee. It examines the impacts one year after implementation of the EU's Roaming Regulation that introduced *Roam Like at Home* (RLAH), by reviewing both the retail and wholesale markets. The retail roaming market was found to be performing well for most stakeholders. However, in the wholesale market, adjusting the wholesale price cap is necessary so that MVNOs may compete more effectively.

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