Body of European Regulators for Electronic Communications

BEREC

BoR (12) 68

ROAMING REGULATION - CHOICE OF DECOUPLING METHOD

A consultation to assist BEREC in preparing advice to the Commission on its forthcoming Implementing Act

June 2012

Introduction

The Roaming Regulation provides in Article 4 a right to all end-users to choose (from 1 July 2014) a provider of international roaming services different from the provider of domestic services (without any contractual penalty for existing customers as a consequence of a switch of provider). This right applies to services which the end-user consumes while abroad within the EU. The process is known as decoupling or separate sale of roaming services.

Article 5 defines the right of “alternative providers” (ARPs) to request the services and facilities necessary to offer separate regulated roaming services to the customers of any provider. It also sets out explicitly that local provision of data services by a visited network operator is to be one of the chosen methods of decoupling. Although the regulation provides criteria to be followed to implement the facilities to be provided by domestic providers, the detailed rules and specific technical solutions for the implementation of these facilities are not defined in the regulation.

It is the responsibility of the Commission, after obtaining an Opinion from BEREC and taking account of the views of the Member States expressed in COCOM, to prepare an “Implementing Act” which sets out more explicitly than the Regulation the detailed rules and specific technical solution/s that would meet the criteria defined in the regulation. The Regulation also envisages that BEREC may issue “guidance” on implementation. The precise boundary between Implementing Act and BEREC guidance is not defined in legislation and will need to be worked out in the coming months. BEREC expects that, in broad terms, the Implementing Act will set out the choices of decoupling method and the main implementation principles while the BEREC guidance should set out any complementary detail. In that way, a reasonable degree of legal certainty should be provided to the market players while leaving flexibility to update the detail in the light of experience and market evolution.

To assist the Commission, BEREC has therefore prepared this document which provides the Commission with an assessment of the pros and cons of the different possible decoupling solutions. It seeks views from stakeholders about its assessment and about the production of guidance in due course. This document is not the required formal BEREC Opinion which will be prepared following consultation in the light of the Commission’s draft Implementing Act. However, this document provides a basis for production of the BEREC Opinion in due course.

Consultation

BEREC invites comments from stakeholders on any of the issues presented in this document not later than 10 August. A parallel consultation is taking place on draft BEREC Guidelines on wholesale roaming access under Article 3 of the Regulation. BEREC intends to hold a public workshop on both consultations on 19 July.

Following the close of the public consultation, BEREC expects to provide the Commission with advice on its draft Implementing Act in September.

Summary assessment

The full analysis supporting the summary assessment below is set out in Annexes 2 and 3 dealing with the technical implementation issues and competition issues. Annex 1 summarises the obligations which appear to be required in the Implementing Act in order to facilitate implementation of, respectively, Single IMSI-based and LBO-based decoupling.

BEREC has consistently taken a cautious view about the scale of the benefits likely to be delivered to end users as a consequence of decoupling. In particular, these were expressed both in the BEREC "Report"[1] of December 2010 and the BEREC Analysis[2] of August 2011. In short, BEREC considered that while the policy of decoupling represents a clear attempt to stimulate much more intense retail competition for the benefit of end users, there are no guarantees that it will work well in practice. The reasons for caution identified by BEREC in its earlier papers remain equally valid today.

Nevertheless, the legislators decided that decoupling (and provision of local data services in particular) should be introduced. Under these circumstances, BEREC has therefore considered which methods of decoupling provide a reasonable prospect of delivering competition benefits sufficient to justify the implementation costs. In particular, it would be inappropriate to implement a costly solution in the absence of guarantees of significant competition benefits.

In line with this approach, BEREC recommendations for decoupling are set out below. These are based on the technical and competition assessments in the attached Annexes and on its view of the obligations which will need to be covered by the Implementing Act (and summarised in the attached Table).

Local Break-out (LBO)

This is the term used to refer to local provision of data services by a visited network operator. It is not currently practical to extend this local provision of services to voice and SMS services. As noted above, it is a compulsory element of the chosen decoupling solution. There are a number of ways this can be implemented. The most basic form appears to require users to change handset settings to configure the service. Since this form of LBO will deter a number of users, it may not lead to a mass-market solution. However, for users of data roaming who have the confidence to change the settings it may nevertheless provide for much better deals While BEREC has not been able to provide precise quantification of the implementation costs (leaving aside those investments required to be made by the LBO providers for the effective marketing and delivery of the service), it believes that they are very low for the domestic provider.

While the LBO providers can take some steps to ameliorate the customer experience, further enhancements would require a co-operative development effort and standardisation by all network operators, the costs of which remain unclear and which probably cannot be completed by July 2014. BEREC takes the view that it would be unwise to rely on the availability of such a solution (of unclear implementation cost) by July 2014.

[1] BoR (10) 58 BEREC Report on International Mobile Roaming Regulation
[2] BoR (11) 46 BEREC Analysis of the European Commission's Proposal for a Regulation on Roaming COM(2011)402 of 6 July 2011

For these reasons, BEREC recommends the introduction of the basic version of LBO in July 2014.

Since LBO only stimulates competition in the short term in the case of data roaming, there is a presumption in favour of the introduction of an additional decoupling method to provide for competition in voice and SMS roaming. In the long run, when traditional voice services are replaced by services based on data transmission, additional decoupling methods might no longer be necessary. However the timing of such developments is uncertain.

BEREC does not see any basis in the Regulation to enforce any rights for MVNOs and resellers to gain access to networks for the purpose of offering LBO. This interpretation arises from the definition of wholesale roaming access. Such agreements might nevertheless be reached through commercial negotiation.

Q1. Do stakeholders agree that the basic version of LBO should be introduced in July 2014? What are the elements that may hinder or facilitate the diffusion?

Q2. Should co-operative efforts be made to develop a more user-friendly version of LBO for subsequent evolution? What kind of efforts would be most productive? Could you provide any cost estimations for the development of user-friendly interfaces? Can BEREC assist with this process?

Q3. Are there any measures which BEREC could consider to facilitate the ability of MVNOs and resellers to offer LBO? If so, can you provide clear evidence on the technical feasibility and the costs which would arise from such measures?

Dual IMSI

While LBO requires the customer to choose a specific foreign network for the delivery of data services during his visit, the other decoupling methods envisage an ongoing relationship between the end user and an ARP probably, but not necessarily, based in the end-user's home country. The first of these given serious consideration was "dual IMSI".

However, few if any are seriously considering dual IMSI today. BEREC considers that significant development and standardisation activity would be necessary for implementation. We do not believe this could be completed in practice in time for implementation in July 2014. While precise cost estimates remain elusive, any reasonable guess at implementation costs leads to a figure which (assuming recovery, one way or another, through charges to consumers) imposes a significant overhead on retail prices.

For these reasons, BEREC recommends that dual IMSI should not be implemented in July 2014. However, we propose that BEREC will closely follow technical advances on dual and virtual IMSI in order to reassess in the medium and long term if these type of decoupling methods may evolve to a cost-effective solution for the promotion of effective competition for international roaming services.

Q4. Do you agree that Dual IMSI should not be implemented in July 2014?

Single IMSI / Single IMSI +

This family of solutions has been proposed so as to provide a cheaper method of decoupling than dual IMSI. The most basic version is a "pure resale" option. The more sophisticated Single IMSI+ versions allow ARPs to steer traffic to their own choice of visited network or to benefit from their own roaming agreements and/or wholesale discounts they have negotiated.

Implementation of one of the Single IMSI+ variants could be justified only if there were confidence that the incremental competition benefits would be commensurate with the costs. BEREC has made considerable efforts to seek advice from stakeholders as to the additional cost (by comparison with the cost of the basic version) of implementing one of the more complex variants. Despite these efforts, BEREC has been unable to establish so far whether or not there is a method of delivering traffic steering at reasonable cost by July 2014. Information given by MNOs so far has given no clear consensus on the ease and cost of implementation.

Unless clear evidence is presented by the deadline to this consultation on the actual cost and ease of realizing access to traffic steering by 1 July 2014 BEREC would not consider it appropriate to recommend implementation of a Single IMSI+ variant.

Q5. Can you provide clear evidence on the feasibility and the costs which would be involved in making access to traffic steering possible (within the normal limits of steering technology) via Single IMSI + by 1 July 2014. (Any information you provide will be treated by BEREC as commercially sensitive, if you prefer).

Furthermore it is unclear that the incremental competition benefits arising from implementation Single IMSI + (by comparison with those arising from Single IMSI) are significant enough to justify the extra implementation costs. This is because the retail margin available to all retail providers will (by July 2014) dwarf the additional margin available to those able to take account of good wholesale roaming agreements (for example, with additional volume discounts) especially for voice and SMS.

However, if wholesale costs fall as a consequence of large expected increases in volumes and retail prices also fall below the price cap, Single IMSI + has potential to deliver material competition benefits for data roaming. But the timing and extent of such benefits is unclear.

Q6. What is your view of the difference in incremental competition benefits achievable, as between implementation of Single IMSI and Single IMSI +? Please provide as much justification as possible for your view.

Finally, there are some legal issues which cloud Single IMSI + which need to be addressed by the Commission. In particular, it would seem to be necessary for the "decoupler" to impose on the access provider the choice of visited network operator for unregulated roaming services (e.g. calls to the USA) when customers are roaming in Europe. More certainty on these points would be necessary before proceeding with implementation.

In the meantime, BEREC considers that there are no implementation bottlenecks to be cleared for Single IMSI. Implementation costs are very low for those MNOs which already host MVNOs or resellers on their network, as technical issues for supporting ARPs are similar to the ones for supporting domestic MNOs. The rapid growth of domestic MVNOs in many EU member states supported by different MNOs and the corresponding experience accumulated in providing host support for MVNOs leads BEREC to the view that costs will not be unduly high for MNOs not already supporting domestic MVNOs.

In summary, BEREC recommends that a version of the Single IMSI family is implemented as a complement to LBO. Assuming satisfactory resolution by the Commission of the above-mentioned legal points, the choice between basic Single IMSI and a variant of Single IMSI + should depend on the responses to the consultation. The information needed to finalise the assessment relates to whether or not Single IMSI + can be implemented effectively:

(a) Everywhere in the EU.
(b) By July 2014.
(c) At reasonable incremental implementation cost (over and above the implementation cost for basic Single IMSI), taking into account the expected extent of the competition benefits.

In the absence of convincing evidence on all these points, only basic Single IMSI would be a viable option.

Q7. Do you agree that a version of the Single IMSI family should be implemented in July 2014? Which elements are key to a successful implementation?

Q8. If steering is not implemented, do you consider that it would nevertheless be practical to implement systems which would allow decoupling providers to have an option to settle wholesale roaming charges directly with the visited network, on the basis of their own wholesale roaming agreements, as opposed to reliance on a roaming resale agreement with the end user's home network? If practical, please estimate the cost (if applicable) to your company of implementing such systems changes. Please also assess the competition benefits which you would foresee.

Q9. Do you consider that there could be further enhancements to Single IMSI +, beyond the ones considered in this paper? (including elements that could simplify implementation and increase feasibility)? Please comment on the additional implementation costs and competition benefits.

Obligations necessary for effective implementation of decoupling

BEREC considers that various obligations should be included in the Implementing Act in order to promote effective implementation of decoupling. These are listed in Annex 1.

Q10. Do you agree that the obligations listed in Annex 1 are necessary?

Q11. Are there any additional necessary obligations or are there obligations that should not be included?

Further developments

In principle, it would be possible at any stage to update the Guidelines to provide for an evolutionary development of either LBO or Single IMSI(+). Depending on how the Implementing Act is drafted, a change may however require a revision to that Act. This needs further discussion with the Commission services.

However, the impact of decoupling and the best choice of decoupling method will in any case need to be considered as part of the Commission's Review of the Regulation, required by 2016. At that stage, all the existing options (and any which have emerged in the meantime) can be reconsidered in the light of the state of the market at the time.

Q12. Do you have any comments concerning future evolution of the decoupling methods?

Q13. Do you have any other comments?

Annex 1

TABLE – IMPACT OF OBLIGATIONS TO BE IMPOSED TO FACILITATE SINGLE IMSI AND LBO DECOUPLING

SINGLE IMSI	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Support for customers provision	Compulsory	Low for host MNOs supporting MVNOs
Basic support for ARP billing (post-paid customers): TAPs and CDRs	Compulsory	Low for host MNOs supporting MVNOs
Basic support for ARP billing (pre-paid customers): On-Line Charging Systems interconnection	Compulsory	Medium
Support for billshock measures: SMS sending, data service cut-off when reaching consumer limit	Compulsory	Medium
Complete post-paid billing support for ARPs	Not strictly necessarily to act as an ARP. Commercial agreements or reasonable prices	Low for host MNOs supporting light MVNOs

LBO	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Universal APN in domestic HLR	Compulsory	Low
No network barring for LBO customers (except for justified reasons)	Compulsory	Low (on the basis that barring will not be practiced at all). Appears technically impractical at present to prevent barring for LBO customers but allow barring for other customers
Obligation to conclude roaming agreements at request of visited country operator	Compulsory	Same as any other roaming agreement.
Facilitate network discovery and selection for LBO selection	Not needed for basic LBO – can be negotiated commercially.	Medium/High
For MNOs in visited country, to act as host provider for MVNOs and resellers	To be subjected to commercial agreements	Burden for visited provider, not for domestic provider.

Annex 2

BEREC Technical Analysis of the alternatives for supporting retail decoupling structural measures

May, 2012

Contents

1 Executive Summary

This Annex analyses existing alternatives that can theoretically be used to implement the decoupling provision considered in articles 4 and 5 of the Proposal for a regulation of the European Parliament and the Council on roaming on public mobile communications network within the European Union for the period 2012-2022.

The analysis clarifies the potential obligations to be imposed on mobile operators, as well as assessing feasibility, complexity and burden imposed for operators when implementing the decoupling measure applying this to each alternative.

Four alternatives are analysed. LBO (Local Break Out) consists of local data provision by the visited network, maintaining provision of voice and SMS by the domestic provider. The alternative labelled "single IMSI" consists of maintaining the traditional communications flow architecture for international roaming in the communication between domestic and visited operators, while allowing for resale of the retail service by the alternative roaming provider (ARP) which receives CDR information in order to be able to charge consumers, in a similar way as MVNOs act in the domestic market. "Single IMSI+" is a further refinement of "single IMSI" allowing ARPs to leverage their coverage footprint across the EU and their own roaming agreements. Finally, "dual IMSI" consists of the use of dual IMSI SIM cards (one IMSI for domestic use corresponding to the domestic operator, and another IMSI associated with the ARP to be used when the consumer is in a foreign country).

With respect to LBO, the analysis shows that a simple and basic LBO decoupling solution can be implemented in a straightforward way, minimizing the burden for domestic operators, and facilitating LBO-based offers for visited operators. Unfortunately, this basic LBO implementation may not cover all the communications services such as corporate VPNs, but normal internet service for most consumers can be supported by this basic LBO implementation. LBO is considered as an alternative adequate to enable visited operators to compete with domestic providers, probably complemented with other solution(s).

"Single IMSI" is technically feasible and the technology is mature enough to be reasonably sure that by July 2014 it can be implemented by operators to allow decoupling by ARPs. In fact, the facilities and technical issues involved for both domestic providers and ARPs are very similar to the challenges for implementing an existing MVNO to host MNO relationship. Single IMSI is an alternative especially well suited for MVNOs, resellers and companies having adequate distribution channels for travellers (for example, airlines, travel agencies, etc).

For "Single IMSI+" the document analyses several architectures that can be applied to allow ARPs leveraging own operator footprints and roaming agreement. Although some them are feasible from the point of view of implementation of information flows, steering per customer in the domestic network (needed to provide an effective implementation of single IMSI+) is an issue for which BEREC has not identified a single clear technical solution yet. Single IMSI+ would be an interesting alternative for large groups in the EU that could leverage their coverage advantages, as well as low wholesale prices derived from volume negotiations throughout the EU.

Finally, the implementation of "dual IMSI" has been also assessed. The analysis shows that dual IMSI implementation involves several challenging issues where there is no assurance that they will be

solved by 2014. Terminal locking practices, incoming calls management and time needed to provision the service are the key problems to solve in order toimplement dual IMSI in the short term.

The most adequate alternatives from the technical point of view in terms of feasibility and complexity are single IMSI and a basic LBO implementation. This analysis is focused on technical issues and does not enter on competition issues as these are analysed in another associated BEREC document.

The Annex also includes a preliminary analysis on obligations to be imposed (in general to domestic operators) to enable the use of each alternative. This section will be used as an input for drafting BEREC opinion on article 5.

2 Objectives of the Annex

This Annex is focused on the analysis of the different solutions under consideration to implement the "decoupling" regulatory measure for a technical perspective. The analysis presented in the Annex aims to identify the main technical issues involved in implementing each decoupling alternative, and perform an assessment on the feasibility and complexity of implementing each of them in the short (July 2014) and long term. The final objective of the Annex is to draw initial conclusions and recommendation when selecting the most appropriate solution/s to implement the decoupling measure. The present analysis was done by BEREC experts from different NRAs. It is built upon discussions and feedback obtained from different stakeholders who kindly collaborated with BEREC to address and identify the technical issues for each alternative solution. However, the views expressed in the Annex represent BEREC's views and the conclusions drawn in the Annex should not be considered as the result of a consensus among BEREC and operators.

It is important to remark that this is an evolving analysis, the present initial version being a first insight on the issues to be addressed. More analysis is needed to reach solid and definitive conclusions. Hence, BEREC will maintain more interactions with stakeholders along time in order to reassure the conclusions and allow for as much consensus as possible on the technical analysis on the implications for operators for each decoupling measure. Current technical evolution, especially evolution towards LTE, will also imply periodic update of the present analysis, as well as potential identification of new different decoupling solutions along the time.

3 The decoupling measure

Decoupling measure obligations are defined in articles 4 and 5 of the EC proposal for a regulation on roaming on public mobile communications networks within the Union[3]. As stated in these articles, home providers shall enable their subscribers to access regulated voice, SMS and data roaming services of any interconnected Alternative Roaming Provider (onwards, ARP) from 1 July 2014. The main objective of this measure is to allow consumers to use domestic mobile services from one provider and separate roaming services in the EU offered by an ARP while keeping the same mobile number. Additionally, neither domestic nor roaming providers shall prevent customers from

[3] ec.europa.eu/information_society/activities/roaming/docs/roaming_recast11.pdf

accessing regulated data roaming services provided directly on a visited network by an alternative roaming provider.

Regulated roaming services to be offered by the ARP are to be directly billed by the ARP, and should provide in general the same functionality and quality as traditional roaming services provided by the domestic provider. Regulation is focused on the 'Union-wide roaming' that means the use of a mobile device by a roaming customer to make or receive intra-Union calls, to send or receive intra-Union SMS messages, or to use packet switched data communications, while in a Member State other than that in which the network of the domestic provider is located, by means of arrangements between the home network operator and the visited network operator.

In particular, regulation identifies the 'roaming customer' that is a customer of a roaming provider of regulated roaming services, by means of a terrestrial public mobile communications network located in the European Union, whose contract or arrangement with his roaming provider permits Union-wide roaming.

Regulated roaming services include regulated roaming call, regulated roaming SMS message and regulated data roaming service. Regulated roaming call means a mobile voice telephony call made by a roaming customer, originating on a visited network and terminating on a public communications network within the Union or received by a roaming customer, originating on a public communications network within the Union and terminating on a visited network.

Regulated roaming SMS message means an SMS message sent by a roaming customer, originating on a visited network and terminating on a public communications network within the Union or received by a roaming customer, originating on a public communications network within the Union and terminating on a visited network. Regulated data roaming service means a roaming service enabling the use of packet switched data communications by a roaming customer by means of his mobile device while it is connected to a visited network. A regulated data roaming service does not include the transmission or receipt of regulated roaming calls or SMS messages, but does include the transmission and receipt of MMS messages.

As defined in the adopted Regulation, in order to ensure consistent and simultaneous implementation across the Union of the separate sale of regulated retail roaming services, the Commission shall, by means of implementing acts and after having consulted BEREC, adopt, by 1 January 2013, detailed rules on the information obligations laid down in Article 4(4) and on a technical solution for the implementation of the facilities referred to in paragraph 1 of this Article. Those implementing acts shall be adopted in acccordance with the examination procedure referred to in Article 5a(2), and shall apply from 1 July 2014.

The provisions to be considered in the EC implementing acts will define obligations for domestic providers along the EU. These obligations will not apply to operators outside the EU providing wholesale services to support retail roaming services. Operators entitled by national regulation to provide mobile services in any country of the EU will be also entitled to use the decoupling measures considered in article 5 in order to supply alternative international roaming services to EU citizens and visitors.

4 Description of the alternatives considered

This section includes the description of the different technical solutions considered by BEREC as candidates to support the decoupling measure for the 'Union-wide roaming'.

In short, the dual IMSI solution corresponds to the one initially identified by the EC and BEREC as the by default decoupling measure using a different IMSI for domestic and roaming services in the same card. The single IMSI solution corresponds to the decoupling proposal introduced by some operators as a simple one based on wholesale roaming provision by the domestic operator. Single IMSI+ is a further enhancement studied by BEREC in order to allow alternative roaming operators to leverage their roaming agreements and footprint in the EU. Lastly, LBO consists on retail roaming data service provided directly by a visited operator using the 3GPP defined functionality named "Local Break-Out". In the next sections each alternative is described in more detail.

4.1 Local Break-Out

The Local Break-Out (LBO) model consists of local provision of retail data services by the visited network, with no intervention of the home provider in data services supply except for SIM Card authentication. This is combined with retail SMS and voice supplied by the home operator in the same way that traditional roaming works. This solution is supported by the "Local Break Out" option included in the 3GPP standards that allow for local provision of data services, diverting data traffic to the visited network. Although the "Local Break Out" option was initially designed to optimize data traffic management when roaming, LBO can also be used by the visited operator to act as an ARP for Internet access and other data services, providing and billing them directly to consumers.

When a customer decides to opt for a visited network to provide directly retail data services, she/he must contract the service with the selected visited operator and select manually the visited network in the terminal. The contract may be done in several ways, from traditional mechanisms used for contracting mobile services (selling points, internet based contract or whatever) to the use of prepaid scratch cards sending the code via SMS or introducing it in an initial captive portal in a similar way that Wi-Fi services are commercialized. Probably, mechanisms based on simple and direct prepaid models as the use of a scratch card will be used by visited operators in order to make convenient and easy contract procedures for occasional customers roaming temporarily in the country.

The provisioning process for LBO implies configuring the terminal with a common APN named "EUInternet" to allow data services provisioned by the visited network. From the operational point of view, APN configuration in the terminal may be facilitated in some cases by specific mobile apps developed by ARP or resellers.

Once the consumer selects a visited network for roaming in the terminal, the visited operator checks whether the consumer has an active LBO contract. If this is not the case, international roaming is provided in the traditional way with the home operator providing and billing all roaming services. If the consumer has contracted data roaming with the visited provider, the visited provider network interacts with the HLR from the domestic provider to authenticate the SIM Card. The HLR will grant permission to use the "EUInternet" APN and its IP address will be resolved in the DNS in the visited

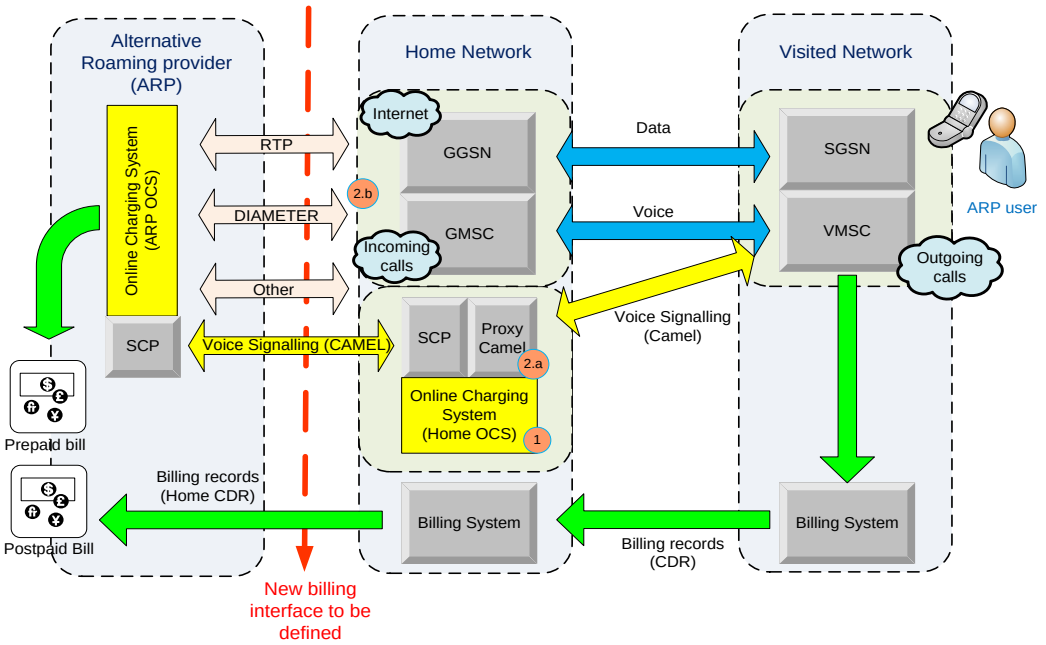
network (see section 5.1.1 for more detail). From that moment all internet access requests will be provided and billed by the visited network.

When the consumer comes back home, moves to another country where LBO will not be used, or decides to use traditional roaming data services, original (domestic) APNs must be restored (either manually or by an application in the terminal) to the original ones used by the domestic provider in order to allow local data use in the home country and/or provide traditional roaming service.

While using LBO for data services, voice and SMS would continue to use the roaming services of the home network supported by the LBO provider network, and would be billed by the home network as usual. On the other hand, retail billing for data services would depend on consumer contractual agreements with the visited network provider and/or on consumer choice. This might encourage more attractive retail data prices, as the local network could gain not only additional retail data traffic but also wholesale voice and SMS roaming traffic.

4.2 Single IMSI

The single IMSI solution has much in common with the hosting resale model implemented in different national scenarios. For this to be possible, the ARP must sign agreements with each domestic operator providing domestic services for its potential consumers. This solution can be used by all kind of operators: mobile network operators as well as MVNO or mobile resellers. The basic call flow procedure is mainly identical as if the service was offered by the home operator. The main differences appear in the billing interface as it is shown in the next picture.



Identified solutions (not mutually exclusive):
1) ARP using a reseller model: The ARP enters the prepaid tariffs directly in the OCS of the Home Network.
2) ARP with own OCS:
2.a) The Home network redirects the Camel signalling to the SCP (Signalling Control Point) via a Proxy Camel (only for voice). The data tariffs must be still entered in the OCS of the Home Network.
2.b) The ARP OCS is directly connected to the network elements of the home network (SCP for voice, SMSC for SMS, GGSN for data) via a Real Time Protocol (Diameter or other propietary protocol).

Figure 1: Call flow procedures for single IMSI

Depending on the type of infrastructure deployed by the ARP, they will enjoy more or less flexibility to provide a major range of different tariffs to its customers:

1) If few or no billing infrastructure deployed. This option resembles to the already existing mobile reselling model in the national scenarios where the reseller provisions to the host the customer profile and the tariff portfolio. The home operator should be informed about the ARP customer credit and tariffs in order to interact accordingly: i) cutting the service when no more credit available, ii) sending the SMS that contains tariff information when trespassing a border, iii) sending the alert SMS when reaching 80% of maximum data consumption and iv) cutting the service when reaching 100%.

2) ARPs deploying own billing infrastructure. In this case the home operator forwards the billing information to the alternative roaming provider in order that the latter could have a better control of his customers (tariffs and credit) and comply with the regulatory requirements (informative SMS). Two modalities are identified:

    a. Billing signalling (CAMEL) is forwarded to the network elements of the ARP. It is not supposed to be the best solution because it does not allow data service if the supported CAMEL version precedes phase III.

    b. The Online Charging System of the ARP is directly connected to the elements of the domestic provider (GGSN, GMSC, etc.) or directly to the domestic OCS. Some real time protocol like Diameter must be used.

Some of the latter two alternatives will likely be chosen by the current MVNO with deployed infrastructure as well as MNOs acting as an ARP. Nevertheless, for this to be possible it would be necessary to define a new interface between domestic provider and ARP over which billing information can be exchanged, both in real time (OCS interconnection) for prepaid customers and also periodically over specific time intervals (monthly CDR consolidation) for post-paid customers.

4.3 Single IMSI+

The Single IMSI+ solution is proposed as an enhancement to Single IMSI, building certain additional functionalities on the requirements described above. The solution aims to allow the roaming provider to set up its own roaming agreements with visited networks. Therefore the ARP needs to be able to select the preferred visited network to be used by its customer.

The simplest implementation could be through the use of settings in the HLR to actually bar non-preferred networks. When entering a foreign country the handset selects the best available visited network which is not barred. This solution, however, is not considered adequate. The reason is that the selection of the visited network can be greatly affected by the steering systems of the domestic MNO that try to send the customer to the non-barred network preferred by the domestic MNO. The ARP can restrict the list of allowed networks so that only a single network is allowed for roaming. However, this would degrade the roaming experience of the customer. Furthermore, the regulation protects any visited country operator who wants to offer LBO from being blocked by the ARP. This could restrict the ARP's option of using the list of allowed PLMNs for roaming to steer its customers.

Two methods have been identified to achieve some measure of these specifications; the Single IMSI+ Standard and the Single IMSI+ Light implementations. To make both of these primary implementation methods for decoupling possible the following must be provided as a minimum.:

- A mechanism by which the ARP is able to bill its customers for roaming services
- The ARP must have control over the steering and barring of the roaming customers' traffic.

Per implementation method additional requirements are needed

Single IMSI+ Standard

Next figure shows the conceptual architecture of the Single IMSI+ Standard ARP CAMEL decoupling implementation method showing the type of information, signalling, and traffic that is exchanged between the three parties involved.

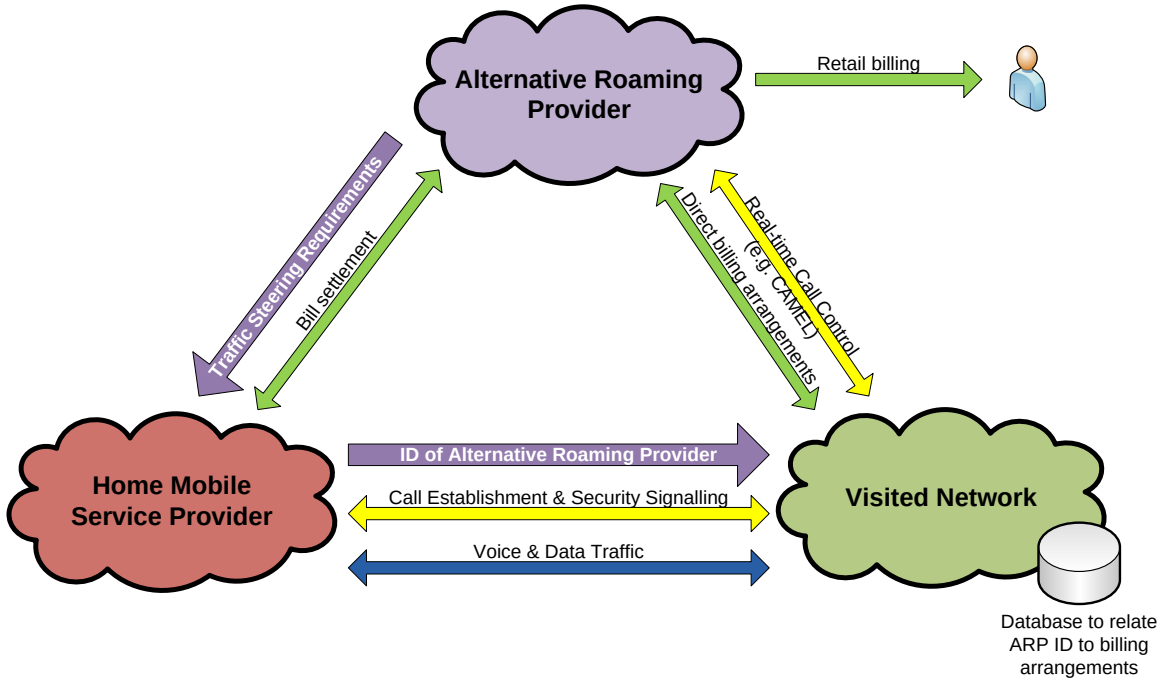


Figure 2: Conceptual diagram of Single IMSI+ Standard ARP CAMEL

When the customer is roaming, the Home MNO provides the ID of the ARP to the Visited network. This allows the Visited Network to charge directly the ARP according to the agreed billing arrangements, without the interference of the Home MNO. In this way, the ARP is able to bill its customers directly. Current standards do not allow a separate ARP ID to be provided. The proposed method for identification of the ARP is by using a Service Control Point (SCP) address. This SCP address must be sent by the Home MNO and points to the infrastructure of the ARP.

The Home MNO facilitates the signalling required for user authentication, registration, and service establishment, as well as the delivery of voice and data traffic. An alternative real-time call control interface is set between the Visited network and the ARP. The purpose of this interface is to allow

the ARP to authorise or bar services depending on the user's account status, bill-shock prevention caps, or other commercial arrangements. The real-time call control interface could be implemented using CAMEL. However, there are several limitations that render this solution inadequate. For example, technical challenges exist for data and incoming voice control and billing. Later in this Annex these technical challenges will be addressed (chapter 2)

Additionally, the ARP provides its traffic steering preferences to the Home MNO which has the responsibility of steering the customer to the preferred visited network. The Home MNO is likely to charge the ARP for the services they provide. A separate wholesale billing arrangement is therefore required between the ARP and the Home MNO.

Some stakeholders have mentioned the possibility to bypass the need of implementing CAMEL by the ARP[4], upgrading CAMEL interfaces used in the Home MNO's and/or the Visited MNO's. However in this variation the ARP still needs to be identified in order to setup a signalling path between Visited MNO and ARP to control and monitor services. The next figure describes the established relationships between the three parties involved

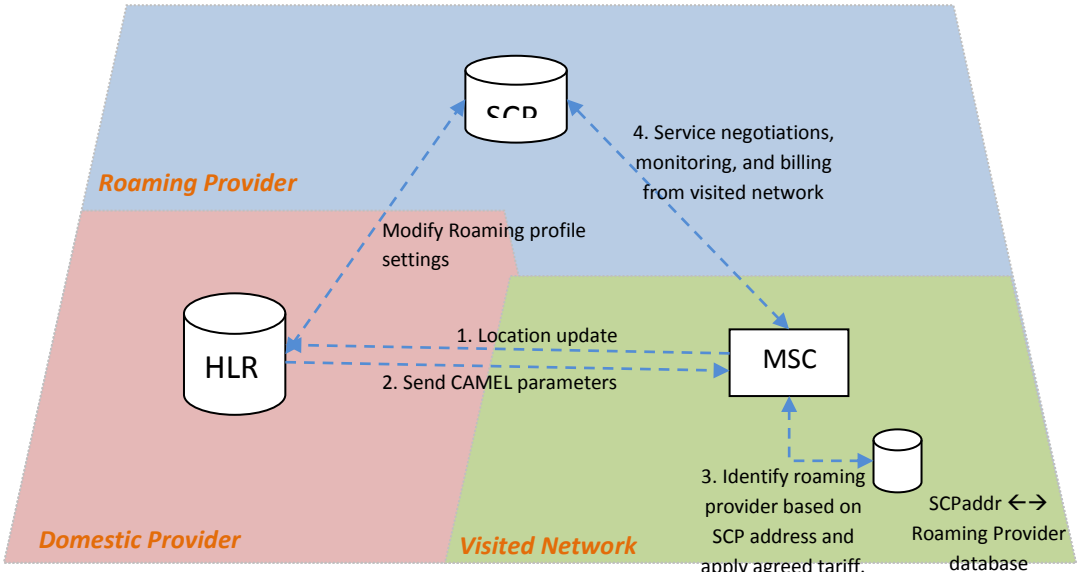


Figure 3: variation of implementation method Single IMSI+ Standard bypassing the need for an ARP to implement CAMEL

The removal of the need of Implementing CAMEL for the ARP makes the ARP more dependent on the Home MNO.

Single IMSI+ Light (tri-directional discount settlement)

The conceptual architecture of the Single IMSI+ Light decoupling implementation method removes the need for an ARP to implement CAMEL and to be identified, in real-time, by the visited network. This method is purely based on discount settlement where the ARP negotiates itis own discount

[4]CAMEL phase II is the most commonly deployed version of CAMEL. Implementing a new CAMEL Interface and/or upgrading to CAMEL phase III is not considered an appropriate option, particularly as CAMEL is not compatible with future network architectures (LTE).

schemes on existing roaming agreements between the Visited MNO and the Home MNO. There are two variations: discount settlement is done by (i) the visited MNO or by (ii) the Home MNO.

The procedures in both variations become increasingly complex when the negotiation on discounts for volumes attributed to the ARP affects the discounts that should be given to the Home MNO. In this case, the Visited network should seek reimbursement from the Home MNO, which should then affect the billing between the Home MNO and the ARP.

Furthermore, both variations of the Single IMSI+ Light solution requires some way of reconciling the volumes attributed to the different providers and a level of trust between the three players. There is therefore a risk that it can lead to increased number of discount/volume disputes.

Single IMSI+ Light - Visited MNO

Figure 4 shows the conceptual architecture of the Single IMSI+ Visited MNO decoupling implementation method, showing the type of information, signalling, and traffic that is exchanged between the three parties involved.

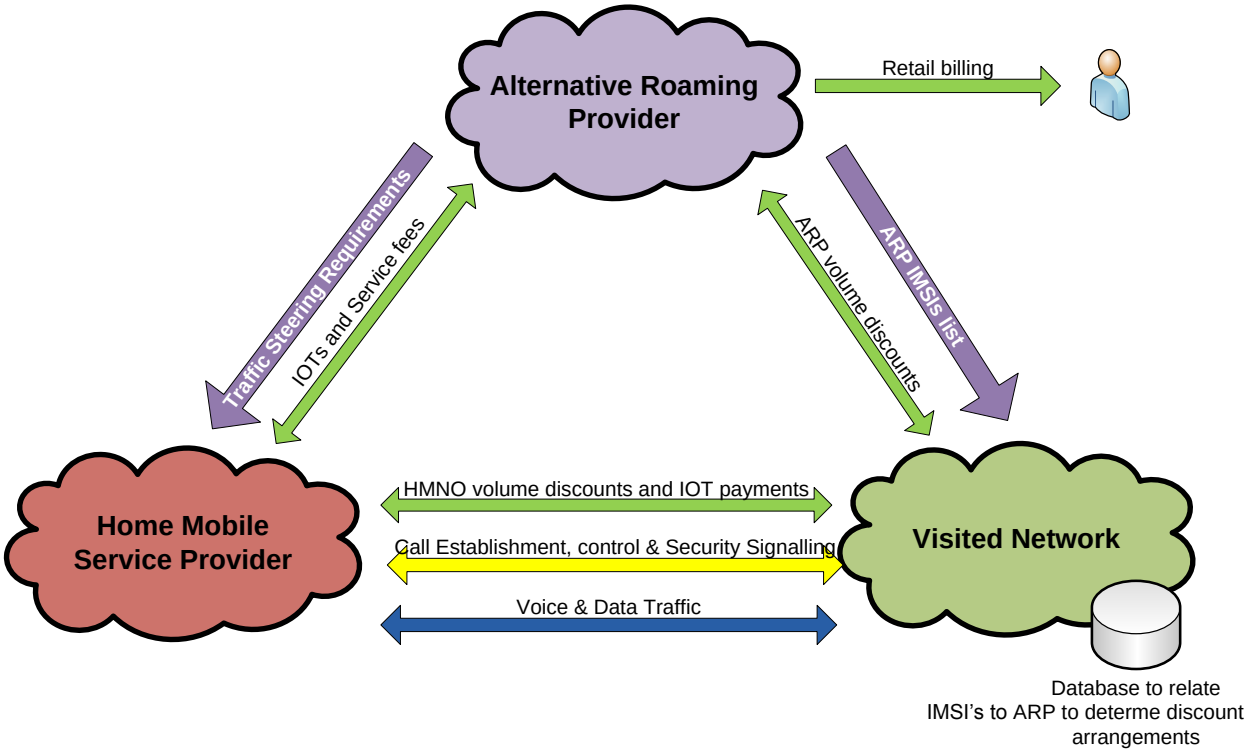


Figure 4: Alternative implementation of Single IMSI+ Light Visited MNO based on discount settlements by the visited Network

Since the Visited Network has to arrange the discount settlement, it must able distinguish between the traffic generated from the ARP customers and that of the Home MNO customers. Based on the total roaming volumes received from the Home MNO, the Visited MNO applies the agreed discounts and charges the Home MNO appropriately. The Home MNO, passes the wholesale charges corresponding to the ARP customers to the ARP. Having received the corresponding CDRs from the Home MNO, the ARP sends a list of IMSIs and the associated call records to the Visited MNO. This list can be a sub-range of available IMSI's of the Home MNO associated to the ARP when customers roam. This list only needs an update when the available ranges expand or decrease. For customers

switching from Home MNO to ARP for roaming, however, the Home MNO must change their IMSI into one out of the reserved sub-range.

Instead of using an IMSI-number out of the sub-range IMSI's of the ARP for the customer, the ARP can also use the IMSI-number of the customer which was provided by the Home MNO. However since the customer base of the ARP changes a lot, the database to relate IMSI's to the ARP must be updated constantly, perhaps as much as at least once a day.

Based on the charging agreements between the visited network and the ARP, the visited network returns to the ARP the amount corresponding to the volume discounts they should have given them.

Single IMSI+ Light Home MNO

Figure 5 shows the conceptual architecture of the Single IMSI+ Home MNO decoupling implementation method, showing the type of information, signalling, and traffic that is exchanged between the three parties involved.

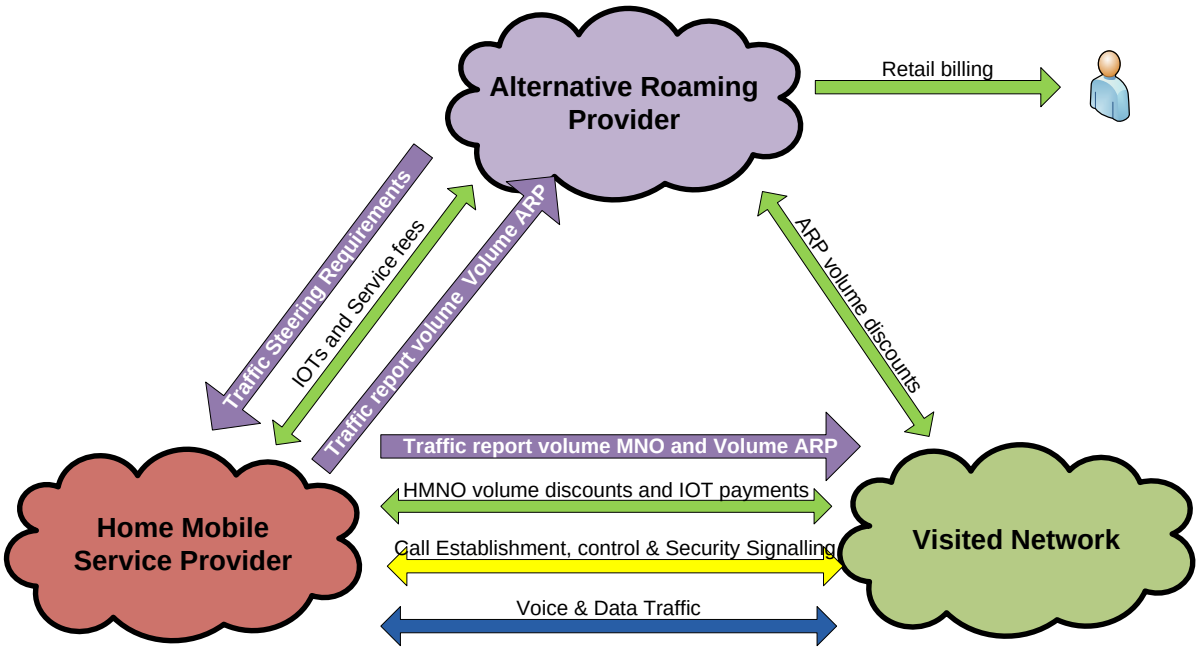


Figure 5: Alternative implementation of Single IMSI+ Light Home MNO based on discount settlements by the Home MNO

In this variation the Visited MNO does not need to know if an IMSI belongs to the ARP or the Home MNO. The visited Network receives traffic reports from the home MNO to allow the split of volume discounts accordingly. The ARP receives a traffic report from the Home MNO to be able to bill its customers. Based on the total roaming volumes and Traffic report received from the Home MNO the visited network applies the agreed discounts to Both Home MNO and ARP and charges the Home MNO appropriately. The Home MNO charges the ARP appropriately for the wholesale costs.

4.4 Dual IMSI

Dual IMSI refers to a solution based on a single UICC module (SIM Card) containing two or more totally independent (U)SIM applications each with its own security framework, one managed by the

Home MNO and the other(s) by the ARP. The home IMSI is used in the subscriber's home country and the international IMSI is used when roaming abroad. Existing solutions are able to switch from one IMSI to another automatically depending on the location, although these procedures are not standardized.

As can be seen in the next figure, under the dual IMSI model, when the customer is in the home country, the local IMSI is used and the domestic HLR is used for user authentication and profile. When the customer is roaming in any other EU country, the second IMSI is used in the terminal and international roaming is provided in the visited country as if the ARP was the domestic operator (HLR from the ARP is used for user authentication and profile, and visited networks provide wholesale service to the ARP and not the domestic provider). Interaction is needed in any case between domestic provider and ARP to manage incoming calls.

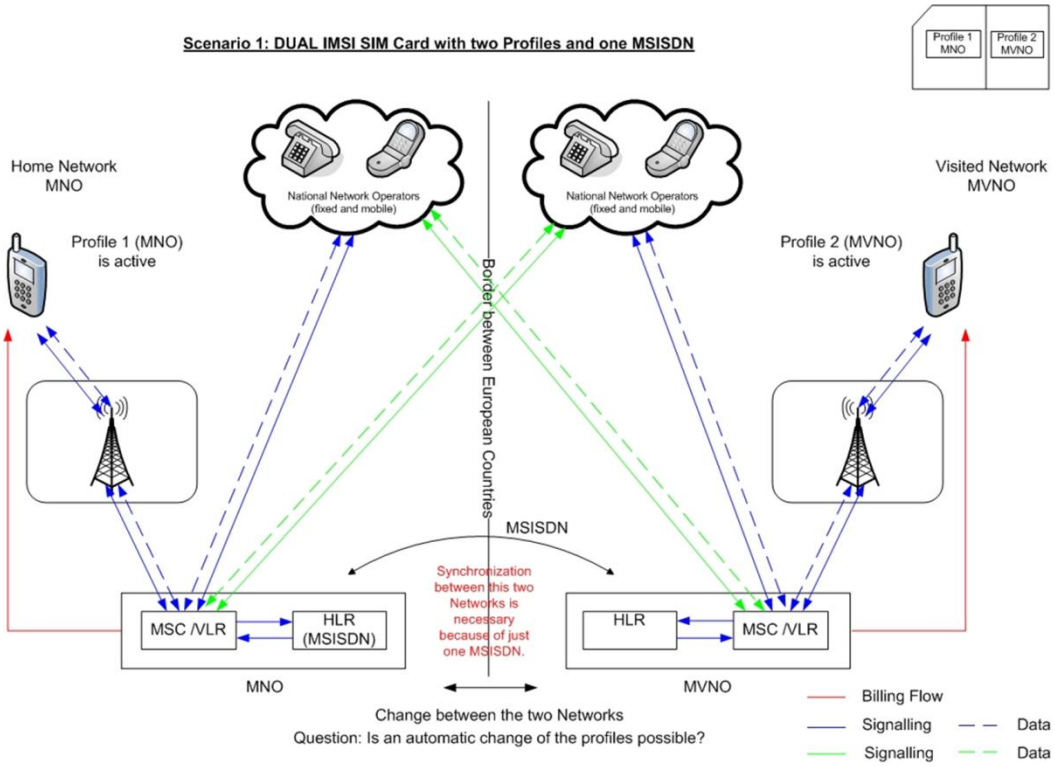


Figure 6: Dual IMSI Model

Theoretically, Dual IMSI is the best engineering solution representing a complete decoupling of roaming. The fact that the solution requires IMSI changes by maintaining the same telephone number, implying specific challenges regarding security, logistics, IMSI update and number portability (there are several number portability solutions in the EU countries), that will be analysed in the next chapter.

It may be questionable if the dual IMSI proposed solutions have a chance to evolve in the new generation networks architecture. Nevertheless, it is believed that some mobile operators will use dual-IMSI cards in a so called virtual Roaming Hub environment to get worldwide coverage quickly.

5 Technical challenges for each alternative

This section includes BEREC initial assessment on the issues involved for each alternative that may imply limitations in the roaming service provided by the ARP, potential obstacles for its implementation in the existing situation for technology, need to standardize new non-existing protocol enhancements, or additional developments (both in IT systems or in Network Elements) for any type of actor participating in the provision of alternative roaming services.

For each issue, the present analysis includes a brief description of the problem identified, possible solutions identified to overcome the problem, assessment of feasibility of implementation for July 2014 and level of complexity implied in the potential solutions to address the issue.

5.1 Local Break-Out

5.1.1 APNs management (terminal and HLR)

In order to facilitate a seamless unbundling experience for the customer when the service is offered by different ARPs in different European countries and/or the same Provider/Group in different countries/networks, and to simplify the adoption of specific settings at the HLR, we propose the use of a common "EUInternet" APN across all EU networks falling within the regulation.

The provision of this new EUInternet APN must be done only once in the HLRs, enabling the VPAA flag (Visited PLMN Address Allowed) in order to allow use of the data gateways (GGSN) of visited network for this APN. Every time a customer contracts the LBO data service when abroad, this new standardized APN must be configured in the terminal. In the same way, when the customer comes back home or travels to a third country, the original APNs must be restored. All other APNs (if any) belonging to the subscriber profile in the HLR have to be maintained the same (i.e. as before decoupling).

It seems feasible that the provision and the restoration of the APN could be assisted by some application designed for that purpose. This application should overwrite the old APN (after saving it in the phone internal memory) and when it detects that the user has moved on to another country, the stored APNs could be restored from the internal memory in a transparent for the customer way. This involves a certain degree of collaboration by the user but, on the other hand, no major changes are required in the home network. Applications for management of APNs in the terminal already exist, at least for Android terminals, and it is expected that specific applications for LBO use will be developed and distributed by LBO operators.

It must be pointed out that while the APN update process could also be assisted by the home network via OTA (over the air) commands sent by the home operator in order to reduce the user interaction, the effectiveness of the OTA commands cannot be guaranteed as OTA interactions depend on the terminal and possibly require some action by the user. At the same time, this solution may require a major investment in the OTA systems of the home network since the home network should be aware of the customer’s status (whether they have selected a specific ARP or not, and which country they are in), and send the OTA commands accordingly.

5.1.2 Steering and roaming agreements

In order to allow all MNOs in the visited country to use LBO, home providers should be obliged to conclude a roaming agreement with any MNO in Europe requesting it. It can be a direct relation or indirect if the MNO is present in a roaming hub (the visited country could conclude a roaming agreement with the hub). In general, this consists of the obligation for home providers to negotiate a roaming agreement with the visited operator based on the reference offer to be published by mobile operators as defined in article 3. Even having reached a roaming agreement, domestic operators are able to bar the use of specific visited networks defining it in the HLR or configuring accordingly their steering systems. This may be required sense in certain situations where there are billing disagreements, temporary reduction in the grade of service or any other situation advising not to use a specific visited network. However, If LBO is to be supported and all visited networks are to be entitled to offer local data services, barring could not be used as a strategic tool to forbid the use of LBO by visited providers and only in clearly justified reasons such as breach of wholesale contract, domestic providers should be allowed to bar LBO providers.

To assist the discovery of potential LBO roaming providers, the HMNO could provide a SIM Card Application (preferable OTA updatable) able to present customer the available networks. This could also support potential ARP last minute roaming offers. A drawback is that SIM Toolkit applications may not be used for all kinds of terminals and a hypothetical obligation to provide this kind of applications could not be enforced for all terminals.

In its simplest form LBO provision involves consumer manual selection of the visited network[5]. This means that terminal manufacturers should clearly indicate the procedure to select network when in roaming, and how to update/change APN.

Other options may also exist, such as the redirection of the customer to a landing page that lists all the available LBO options in the visited country and information on how to choose any of them.

5.1.3 Blackberry services

BlackBerry devices depend on one of two different proprietary alternative solutions from RIM in order to establish a data connection. The solutions are called BlackBerry Internet Solution (BIS) and BlackBerry Enterprise Solution (BES), with the latter mainly used for business services, as the name implies. The main differences between these are that BES requires a locally installed server that provides a selection of services for the employees. These include amongst others: policy, messaging, synchronisation and security services. Another important difference is that BES requires a connection from the terminal to the HMNO through a VPN tunnel, in order to access the local, corporate enterprise servers.

If neither BIS nor BES are set up/configured by the user of a BlackBerry device, he/she will only have access to voice and SMS – no data can enter or leave the device (including MMS).Likewise, the

[5] It is possible that visited network selection can be automated in some mobile operating systems via the same application updating APNs for LBO use. However, as now, BEREC has not found evidence on the availability of application programmatic interface (APIs) for network selection. In any case, it is not discarded that future evolution of mobile Operating Systems will allow for this automation of network selection, making it easier and more transparent for consumers the use of LBO-based offers.

mobile network which a BlackBerry device is connected to must also contain at least one instance of a BlackBerry infrastructure. This is mandatory for HMNO (domestic network), Roaming Enabler's network (such as a roaming hub network), or any visited network. Each BlackBerry device has a unique identifier called BlackBerry PIN. This number lets the network understand that the terminal should be connected to the local BlackBerry infrastructure.

Each visited network must have an instance of a BlackBerry infrastructure OR the visited network must be connected to a Roaming Enabler that provides it. Currently, BIS is available in more than 300 networks, distributed in close to 100 countries. There is no indication that LBO, if implemented by July 2014, should impose any significant problem for BlackBerry Internet consumers using BIS. However, for BlackBerry users with a mandatory connection to their corporate servers (BES) there are issues and restrictions concerning the use of LBO. The current, standard solution for BES does not allow establishment of the VPN tunnel from an LBO-enabled terminal to the enterprise servers. These customers must use the APN from the domestic provider and use the roaming services for Blackberry supplied by the domestic provider, being charged by the domestic provider for the use of these services under the conditions for traditional roaming.

So, as a conclusion, LBO could work for blackberry customers supported by BIS (typically residential customers), but not for BES based customers (typically business customers).

5.1.4 MMS and VPN Services

MMS

MMS is a non-real-time delivery service, much like SMS or email. The service utilises a store-and-forward usage model. The message is stored on the terminating operator's servers, where additional content adaption may take place. The destination terminal/user collects the content by reading a URL pointer in an SMS, and then uses a WAP or HTTP-capable browser to display the message. Depending on implementation, MMS messages are typically transported over IP and presented on an appropriate viewer application (WAP/HTTP browser, picture viewer, or dedicated MMS viewer).

To secure a homogenous experience for users whether they are roaming or not, the HMNO must be able to reach the subscriber with the previously mentioned SMS containing the URL pointer. Without this notification, MMS would not be delivered. The terminal is configured with a special MMS-APN that points to MMS servers in the home network. The terminal must then use the GRX-network or Internet to fetch the content. If the user wants to send outgoing MMS directly through the visited network, the MMS-APN in the terminal must be updated.

At present stage, there seems not to be a single, agreed method for running MMS services provided directly by the visited network operator through a LBO solution.

However, for MMS services, consumers can use the APN from the domestic provider and use the roaming services supplied by the domestic provider. The customer will then be charged by the domestic provider under the conditions for traditional roaming. Also, it is possible for the consumer to login to a MMS via a web browser e.g. using LBO provided internet access in order to retrieve and send consumer MMSs.

MMS alone should not be considered a show-stopper for a possible implementation of LBO by July 2014. As noted, the service can be supported by the domestic provider/HMNO in the same way that

voice and SMS. In general, there is a decline in MMS usage that it is being substituted by e-mail, social networks, or specialised Over The Top (OTT) applications.

VPN Services

VPN services are often provided using VPN clients that create a virtual secure tunnel to the enterprise's network over public networks. However, some organisations choose to physically connect to the Home operator's network, providing a secure link to the operator's GGSN, or even their own GGSN installation, in order to achieve a higher level of securityVPN solutions that are strongly connected with the HMNO (due to specific Service Level Agreement with the customer), and may suffer if they are routed into Internet through the local GGSN. The HMNO then has little or no control over the QoS provided to the running VPN-instance. This can lead to a less than optimal experience for the subscriber.

To combine VPN with LBO, the corporate customer must establish tunnels from their VPN-server to the GGSN of the visited network. Unless the customer connects to a Roaming Enabler (RE), there can be a challenge with scaling.

Use of private addresses from the corporate network and into the terminal will, under most circumstances, not be a problem, since they run on top of the already established connection.

SLA-based VPNs should be established directly between HMNO and visited network, instead of going through the Internet. This will enable the HMNO to fulfil any SLA obligations towards the customers, but at the same time the customer will be outside of any LBO solution.

So in general, it is foreseen that corporate customers will not get involved on establishing tunnels from the VPN-server to LBO providers and for the LBO providers it would not be a scalable solution just for occasional use when corporate customers roam in their networks.

5.1.5 Loss of roaming coverage

There are several different ways LBO can be implemented. In its simplest form, the customer has to manually select the network providing the LBO by overriding the mobile device's automatic network selection. This procedure may significantly differ between mobile devices. It is possible that the home network provides information to the customer on how to manually select a network through, for example, a landing page where customers are redirected if they wish to enable LBO.

Once the visited network is manually selected, the home provider cannot steer the customer to any other network and the mobile device will not attempt to register to any other network available. This raises the potential problem that if the customer is in a non-spot area of the LBO provider, the mobile will not select a different network that may be available and the customer will stay without service, until the automatic network selection is re-enabled by the consumer in the mobile. At the same time, it will not be possible for the home network to remotely change any settings, or provide guidance to the customer. This situation could lead to a deterioration of the roaming experience as currently established where roaming customers have virtually ubiquitous service.

As mentioned above we believe that this problem can only occur when LBO is implemented using manual network selection. We expect, however, that in the future smartphone applications will soon

emerge to facilitate LBO. These applications could be smart enough to steer the mobile to a different network when there is no coverage from the LBO provider if the consumer selects this behaviour, as well as reconnect the LBO provider when the terminal is again in its coverage.

5.1.6 MVNO competition

LBO is a solution to be applied by Visited Network MNOs using their own network infrastructure to provide local data services. However, it is technically possible to support MVNOs using LBO capabilities from a visited provider in a similar way that is done for local MVNOs using a host provider in the domestic market.

In that case, visited networks would have to route the traffic to the appropriate node (e.g. MVNO GGSN) in the case of full MVNOs or enable the MVNO to act as "reseller" of the roaming retail offer, leveraging on their domestic connection with the MNO. This would imply the development of specific interfaces between visited networks and MVNOs.

Another issue that should be solved is the way that consumers opt for the MVNO LBO service. MVNOs are not seen as separate networks in the user terminal, and consumers should select manually the host LBO provider (that should be informed by the MVNO to the consumer). When connecting, the host LBO provider should show a first captive portal allowing consumers to select among different providers of local data services supported by the specific visited network, and allow consumers to select one of them. The use of a unique APN for all ARPs makes the discrimination among MNO LBO service and MVNO LBO service more challenging, as DNS address resolution cannot directly distinguish among the different providers.

So, in the case that LBO support for MVNOs by Visited Networks would be technically possible, it would imply a series of developments to be done by visited operators. These developments could be agreed between MVNOs and MNOs in a similar way that is done for domestic MVNOs. However, it is not clear whether these developments could be imposed as an obligation to visited networks, as the obligations for decoupling are restricted in the regulation to domestic providers.

So, in conclusion, MVNOs could potentially use LBO capabilities of visited MNOs under a commercial agreement to offer LBO service, but there seems to be no legal base to impose obligations for MNOs to support this kind of agreement.

5.2 Single IMSI

5.2.1 Implementation of alternative roaming provider tariffs in the domestic prepaid systems

The single IMSI solution does not impose great technical challenges at either the signalling level or the configuration of the HLR, as consumers from the ARP use the same IMSI that is used in domestic communications. Also, in the Visited Network everything works the same way as if the domestic provider would be supplying the retail service.

However, some adaptations must be done at the billing level to support ARP-specific tariffs and customer provisioning. For prepaid, there could be two alternatives:

1) Reseller model: The ARP informs the home operator of its retail tariffs and it is the home operator who is in charge of controlling the available prepaid credit before cutting the service or comply with the regulatory obligations on behalf the ARP (provision of SMS with tariff information when abroad or disconnection of the data service when the maximum data consumption level is reached).

2) Online Charging System interconnection model (OCS model): In this case, the ARP has its own OCS in order to control their prepaid customers. It corresponds to the case of the MNOs and full MVNOs. Depending on the existing infrastructure (availability of an SCP, Signalling Control Point) and the protocols used to transmit the signalling information (CAMEL, DIAMETER, or other proprietary protocols), the ARP could control both voice and data tariffs (if DIAMETER or CAMEL beyond phase III are available) or only the voice tariffs (if CAMEL phase II and some SCP equipment is available). This solution provides greater flexibility in setting more differentiated tariffs, but requires the development of real time signalling interconnection between operators. Unlike the previous solution, the ARP could be responsible to comply with the regulatory obligations.

For post-paid services, through the home CDR the ARP is able to prepare and send the retail bill to their customer in a monthly basis. There are no major issues except of that related to the prevention of bill-shock (informing when some data consumption is reached or even cutting the service). There are also two alternatives:

1) Reseller model: The ARP informs the home operator of its data retail tariffs and it is the home operator who is in charge of controlling the maximum data consumption in order to send the SMS or even cut the service when necessary.

2) Self-compliance with regulatory obligation: The Domestic provider informs the ARP about the customer data consumption in a frequency greater than monthly and enough to allow the compliance of the regulatory obligations. It implies that the ARP is in charge to check if some action must be performed, in which case the ARP would send the corresponding alarm to the Domestic operator that would trigger the SMS/cut the service.

5.3 Single IMSI+

5.3.1 Selection of the preferred visited MNO and Steering capabilities for Alternative roaming provider

The first important requirement would be giving ARPs the ability to bar unwanted Visited MNO's, except when a customer of the ARP wants to use the LBO service of a certain Visited MNO. According to the regulation, network barring should be removed for customers that use LBO on this network. There are two methods of ensuring this. Never bar networks that offer LBO, which is easy to implement but puts very much pressure on steering control by the ARP, or to only unbar LBO network when the LBO network has requested to remove barring for certain customers. This involves a real time connection between LBO provider and Home MNO to update the barring settings in HLR. This might be developed commercially in due time but is not foreseen before 1 July 2014.

Under this second method, when the ARP wants to provision a new customer, the barring of potential visited networks in the HLR settings needs to be removed. Unbarring has to be performed at a per-IMSI level in the HLR. This involves at least an administrative form of access and in the most advanced version an automated form of access. It is presently unknown what the impact of automated access (real-time or near-real-time) would be, or whether the HLR has the capacity to bar and unbar networks at a per-IMSI level.

A second important requirement for a solution of Single IMSI+ variations is to allow the ARP to steer its customers to the preferred Visited MNO(s). Our analysis showed that this capability has to be facilitated through the domestic provider.

Lack of the ability for the ARP to steer its customers' traffic would significantly undermine its ability to negotiate interesting roaming agreements and or better volume discounts and thus compete with the Home MNO for retail roaming services. This is because traffic steering allows the MNOs to maximise their margins (or to minimise their wholesale roaming costs) by steering their customers to the visited networks that offer the larger (often volume-based) discounts.

BEREC analysis shows that, under the suggested implementations variations of Single IMSI+ Standard and Single IMSI+ Light, the ARP may only have limited control over the steering of the roaming customer due to different steering systems or lack of steering systems in Home MNO. Traffic steering mechanisms are proprietary and custom built. Some steering systems define a steering policy per IMSI, while in other cases the steering policy is defined as a wider network policy. The goal of both systems is the same, namely to hit volume targets by distributing the total roaming customer base across different networks according to the applied policy. To prevent changing of IMSIs and information on SIM cards (associated with sub IMSI range steering) an overall implementation in Home MNO's of a steering policy per IMSI system is required. It seems that some MNOs already have this ability, although they do not apply it in this context. Most MNOs, however, would have to buy new steering systems, activate licenses, or adapt existing ones. MNO's have acknowledged that per IMSI steering systems are available in the market. At this moment, it is unknown if these systems could be used for ARP steering preferences. So far, it is known that these systems do not work with unlimited profiles. So an ARP having access to such a steering system could perhaps only use one steering profile for all its customers. Using more profiles might impede business of Home MNO too much and/or limit the access possibilities of other Home MNO's

Furthermore the steering systems are not scaled up to handle in (almost) real time big numbers of steering policy changes. A reasonable provisioning time (changing policy per IMSI) is necessary

The access to the steering system i.e. changing the steering policy of the Home MNO of a certain IMSI into the steering policy of the ARP for new customers of ARP can be done automatically or through administrative procedures. For automation the ARP would need to implement an appropriate interface, based on proprietary protocols, with the Home MNO to supply its new customers to his steering policy.

To allow the easy introduction of ARPs, traffic steering interfaces need to be standardised. Standardisation, however, might easily take 2 to 3 years. At the same time, it is quite uncertain what the role of steering systems is going to be in an LTE environment and whether the developed standards would need to be replaced in the future.

Conclusion

There might be a reasonably fast implementable solution to these barring and steering settings to make customer steering work for variations of the Single IMSI+. However there is a need to study further the impact of such solutions.: the impact of different forms (administrative or automated) of access to HLR barring settings and the impact of access (automated or administrative) to the per IMSI steering systems. The ability for the ARP to steer its customers to the preferred network is of paramount importance as it differentiates the Single IMSI+ from the Single IMSI solution. It is very worthwhile to study during consultation if access to barring and steering systems are feasible for July 2014.

Overall, any solution to these problems requires the cooperation of the ARP and the Home MNO and is considered to be mildly complex (Single IMSI+ Light variations) to very complex (Single IMSI+ Standard variations). The visited network is not affected by access to steering and barring systems.

5.3.2 Implementation of alternative roaming provider in the domestic prepaid systems

All Single IMSI+ variations

First of all, the same issues identified for single IMSI retail billing, apply also for the Single IMSI+ solutions. Additionally, we must consider the following issues.

With the Single IMSI+ Light variations the Visited MNO does not have a roaming agreement with the ARP but only a discount agreement. The customer is identified as a customer of the Home MNO (using the IMSI). From there, there are two options:

- The Visited MNO contacts the Home MNO's IN platform for billing purposes. In this case, the Home MNO's IN must have a connection with the billing platform of the ARP. The billing platform will subtract the credit that corresponds to the agreed wholesale price at which the ARP purchases roaming from the Home MNO.

- The Visited MNO contacts directly the IN platform of the ARP. In this case, there is no requirement for an interface between the H-MNO's IN and the ARP's billing platform. It is unclear at this stage whether the Visited MNO's network can contact the ARP's IN if there is no roaming agreement (and interconnection) in place.

A possible issue that may rise is to define a mechanism through which the Home-MNO can impose "conveyance charges" to the ARP, if the EC decides that such a charge is justified.

Conclusion

If an appropriate implementation is proposed and supported by the industry, it may be possible to implement a Single IMSI+ Light variation by July 2014. The implementation cost will mostly fall on the ARP and the Home MNO. The ARP needs to implement its own IN platform and provide the interconnection (Single IMSI+ Standard variations). Iin some cases, when ARP's cannot implement an own pre-paid system, they might not be able to offer pre-paid roaming services without using third party billing (the use of the prepaid system of the home MNO) (Single IMSI+ Light variations).

5.3.3 CAMEL-based solution not functional for incoming calls

Single IMSI+ Standard ARP CAMEL

The CAMEL interface terminates at the Visited MSC only for Mobile Originate (MO) calls. Mobile Terminated (MT) calls are instead controlled by the Gateway MSC of the Home MNO.

Consequently, the Visited MNO will not be able to extract the ID of the ARP using information in the CAMEL signalling for MT calls.

This has the consequence for the Single IMSI+ variations which depend on a CAMEL implementation that Home MNOs cannot decouple incoming (MT) calls without further implementation measures.

For this case of incoming calls, a possible solution is that the visited network maintains an association between the IMSI of the roaming customer and the SCP address. This association can be established during the location registration procedure. When the visited MSC issues the CDR for an incoming call, it compares the IMSI of the called party (roaming customer) against the database and addresses the CDR to the respective ARP (if one is defined). The Gateway MSC of the Home MNO also needs to establish a CAMEL connection with the ARP's SCP so that the ARP can control the call.

To implement this solution the visited MSC (and the respective VLR) needs to fully decode the roaming customer's IMSI. This increases the number of digits that need to be analysed from 5 to 15, expanding significantly the size of the VLR database.

5.3.4 Support for Data decoupling

Single IMSI+ Standard variations

CAMEL phase II, which is the version of CAMEL that is most widely adopted, does not support data services. This means that the network element in the visited network that takes care of the data service and billing is not aware of the SCP address which corresponds to the roaming provider and cannot differentiate between the roaming and domestic providers for data services.

We are not aware of a readily available solution to this problem. It has been considered to use the APN, but this is a parameter that needs to be updated on the handset. While APN can indeed be updated using OTA signalling, successful update cannot be guaranteed when the customer is roaming. For example it is possible that the customer will reject the update, while other technical complications may also occur. Furthermore, OTA changes of APNs is not standardized and has yet to be developed.

While there is no firm solution proposed we are unable to confirm whether data decoupling can be supported with a Single IMSI+ Standard with CAMEL implementation. It seems, however, that data decoupling will not be supported without further, complicated, implementations.

It's quite possible this problem cannot be solved for 1st of July 2014. Single IMSI+ standard with CAMEL support therefore does not seem feasible. However, this is not an issue for Single IMSI+ light.

5.3.5 Imposition of wholesale provider by the ARP for non-regulated calls

Under any single IMSI+ solution, the ARP would be selecting the wholesale provider for all calls done by their customers. This selection of wholesale provider (visited network to be used for the consumer) would also apply to non-regulated calls that are not necessarily required to be provided by the ARP. An example of non-regulated calls would be SMSs sent or calls made to a consumer in the USA or Japan.

Technically, it is not possible to use a different visited network for regulated and unregulated calls. This means that if the ARP is able to steer its traffic to its preferred visited network, the home network would be obliged to use this network (that may not be its preferred one) to provide non-regulated services. This potential problem affects just non-regulated calls that are a small part of the total roaming calls and roaming services in general. However, it is a regulatory issue that should be

solved –out of the scope of this document- before selecting single IMSI+ as one of the alternative decoupling options.

5.4 Dual IMSI

5.4.1 APNs update in the terminal

Basically, under the dual IMSI solution, it is mandatory that every time a customer visits another country new APNs must be inserted in the terminal. When the consumer comes back home, the original APNs must be restored. The APNs need to be switched from H-MNO APNs to ARP APNs for roaming and then back when the customer is in the home country. Two general approaches are possible:

- The first approach would be to change the APNs directly on the device while roaming. This could be done manually by the user or via OTA tools, such as configuration messages – which may not be supported by all devices.
- The second approach would be to redirect the APNs in the ARPs' network gateways, so device settings do not need to be changed, but still the correct APNs are being used. This approach is seamless for the user, since no user interaction is necessary (a notification could still be sent).

The main challenge with APNs is that there are different types of data traffic. Operators are offering IP-based services, such as the existing MMS, BlackBerry, VPN services and the emerging RCS and VoLTE services. While these services are IP-based, they require routing over the H-MNO network and do not work directly over the "open Internet", i.e. a unified APN. The key question is whether these services will be provided by the H-MNO or the ARP while roaming, which could significantly affect the overall user experience.

It seems feasible that the provision and the restoration of the APN could be assisted by some application designed for that purpose. This application should overwrite the old APN (after saving it in the phone internal memory) and when it detects that the user has come back, the stored APNs could be restored from the internal memory in a transparent way.

Also, as the ARP controls the user from the beginning, it depends on this operator to decide if it is worth to invest in an OTA system in order to update the APN in the terminal in a transparent way.

5.4.2 Terminal blocking by domestic provider

It is common practice for MNOs to lock subsidised terminals to some specific IMSI range or PLMN values, at least for a few months (depending on each country), or until the phone subsidy is repaid by their customer. A device that is locked at the IMSI ranges of the domestic provider may not be usable when the ARP's IMSI is used by the SIM Application.

According to GSMA, a device is usually either completely open to use on any network ("unlocked") or it is locked to accept only SIM Cards within a certain IMSI range or specific IMSI. This can be country lock (MCC), network lock (MCC+MNC) or even subscriber lock (MCC+MNC+MSIN). Within the framework of current standards, it is not possible to lock the device onto two networks..

Therefore an HMNO-locked device could not use an ARP's IMSI, unless it is unlocked. A differentiated solution of enabling devices to be locked to two or more networks requires complex changes of standards and on all devices, on which this should be enabled. The overall timelines for this could be in the 4-5 year range; at least 2-3 years for standardisation plus several years for device vendors to implement and make available in large numbers. Finally, consumers would need to replace their devices to enable this solution, or carry out a complicated firmware upgrade procedure.

The simplest solution would perhaps be to unlock the device when the customer wishes to use an ARP, potentially incurring some cost for the customer to cover the terminal subsidy. Some alternative solutions are listed below. However, each of the envisaged options has potential problems.

- IMSI of the ARP is taken from a dedicated IMSI range that belongs to a home MNO. This would require some co-ordination between providers and potentially some industry guidelines. In this case, no changes on the current device configuration are required.
- IMSI of the ARP is taken from a dedicated IMSI range allocated by the NRA to be used only for roaming purposes so that a unique MCC+MNC is shared by all ARPs of one country. In this case, new devices on the market will not be locked for the new IMSI ranges allocated to this purpose. Very scalable, but inter-operator billing impacts.
- IMSI of the ARP is taken from a dedicated IMSI range allocated by the NRA to be used only for roaming separation purposes and assigned exclusively by the NRA to that specific RP/TRE. In this case a unique MCC+MNC will be assigned to each RP/TRE in a way that avoids inter-operator billing impacts. In this case, new devices on the market will not be locked for the new IMSI ranges allocated to this purpose. This solution is not scalable, but has no inter-operator billing impacts.
- IMSI of the ARP is a sub-range of its existing IMSI range to provide domestic services. The range would be communicated to all other operators so that the new devices can contain that range and avoid the locking effect. Very scalable and no inter-operator billing impacts. Requires that the RP/TRE already has IMSI.

A common problem in all the above options is that the ARP can use the roaming IMSI range to attract customers with locked devices in the domestic market.

In the case that dual IMSI is to be used as a decoupling solution, a research on availability of IMSI ranges for ARP use and terminal blocking practices should be carried out.

5.4.3 Blackberry services

The situation for blackberry services is similar with the situation for LBO. In general, ARPs will be able to access/provide blackberry services for the consumer, except for corporate blackberry services connected by a secure tunnel directly to the domestic provider.

5.4.4 Other specific services (VPNs, etc.)

The situation for other specific services as VPNs is also similar with the situation for LBO. Specific services provided by the domestic operator needing specific resources from the domestic infrastructure or secure tunnels with corporative networks could not in general be provided by the ARP.

5.4.5 IMSI update through OTA

In the case of the dual IMSI approach, updating the IMSI for roaming using OTA signalling is possible, according to the latest information we have received from the industry. This can be done by implementing appropriate server and control platform in the network. Some companies have already ideas and suggestions for a security framework. Assuming that the security framework can be developed, Dual IMSI based applications are able to manage SIM card updates over the air and modify the contents of SIM cards via the gateway of the OTA platform. The gateway of the OTA platform processes the update or the synchronization to the SIM card as far as the mobile phone complies with the latest standards. Furthermore, the SIM card must have the required logic installed to manage the 2 IMSI's controlled over the network. This implies that the SIM card must be changed at least once.

The relevant standards are not under the GSM Association's control, so no guarantees can be given that reassure successful standardization outcome. The relevant standardisation bodies to normalise IMSI updates for customers changing to other ARP without changing physically the SIM card are 3GPP, ETSI and others. Based on other standard processes that the GSM Association has followed, it is conceivable that OTA SIM update mechanisms, including a full set of security features, could be standardised within 2-3 years, but there is no assurance for this standardization in this time frame. There may already be proprietary solutions available today, for example embedded SIM cards used in machine-to-machine communication applications. Interoperability, however, is not given with these solutions, so they are not applicable for end-user devices without further standardisation. However it is important to note, that decoupling the physical SIM from the logical authentication mechanisms by enabling OTA updating bears high security risks, which could result in hacked SIM cards and increased fraudulent behaviour and could cause significant damage to operators and customers.

5.4.6 Incoming calls management

The issue with routing of terminating calls and SMS to an ARP customer arises from the fact that consumers keep their MSISDN numbers unchanged when roaming. This means that a terminated call will automatically be routed to a G-MSC (gateway switching centre) in a HMNO's network. Similarly, for terminating SMS the MAP Send Routing Info query for SMS would also hit the National Service provider's signalling network.

If a user is roaming in the EU, the HMNO would not, with current network architectures, have enough location information for the secondary IMSI to allow the routing of those sessions to this user.

The HMNO and the ARP's networks may get alignment on the roaming status of the customer so that the HMNO can retrieve sufficient routing information to route the call successfully. At present time however, there are no existing standard or non-standard solutions to make that alignment work.

A Dual IMSI solution inevitably means that two HLRs are involved, one for domestic services with the HMNO, the other for roaming services via the ARP. While incoming call forwarding may even be possible using the existing signalling and roaming standards, the picture becomes more complex when looking into the details, especially for SMS. According to existing procedures, SMS are transported over the signalling system. The SMSC of the originating network identifies the terminating network through the MSISDN. If the customer is served by the ARP, the MSISDN will point to the domestic provider's HLR which will not be aware of the location of the customer These issues can be resolves with new HLR-to-HLR communication mechanisms, which require changes to existing CSS7 and SMSC. Once the new HLR-HLR communication is standardised, it can take time for vendors to make the relevant changes to their products. The time depends largely on the complexity of the solution and global demand for the new features. Furthermore, depending on the actual implementation, European operators (~130) may have to replace some of their existing equipment to support the new SMS management standard for ARPs across Europe, perhaps taking another 6 months to 1 year.

An alternative solution could be to define an ARP-specific MSRN at the HMNO's HLR which points to an SMS router at the ARP's network. The SMS router would then query the ARP's HLR for the correct MSRN of the roaming user. This solution, however, requires that the domestic IMSI is known to the ARP, or the ARP's IMSI is known to the domestic provider. The IMSI is among a number of parameters that MNOs keep secret for security purposes. We would not expect MNOs to agree in sharing this information.

5.5 Issues common to all alternatives

5.5.1 Number portability procedures

One relevant aspect to be considered when analysing decoupling solutions is the implications of number portability practices on roaming services provided by ARPs. Number portability is already a reality along all Europe and consumers can change HMNO at any time maintaining their mobile number.

In an ideal world, roaming services provided by an ARP should not be affected by a change on the domestic provider supplying national services. However, all decoupling alternatives need some kind of collaboration from the domestic provider and in practice; roaming services provided by an ARP will be affected by a change in the domestic provider.

In the case of single IMSI and single IMSI+, the retail roaming service is really provided by the domestic provider and when the consumer changes domestic provider, roaming services provided by the ARP will not be available except that the new domestic provider gives the same support than the old domestic provider. This cannot be in general assured, as the agreements and interconnection between ARP and domestic provider takes time to be put in effect and the time allowed for number portability is very short (typically a single day).

In the case of dual IMSI, in order to use the ARP services when changing domestic provider, consumers would have to receive a new dual IMSI and also some arrangements to manage incoming calls should be established between the domestic provider and the ARP.

Lastly, in the case of LBO, when the LBO provider has roaming agreements with both, the old and the new domestic provider, changing the domestic provider should be transparent for occasional access by the consumer using the LBO provider. In any case, the set of potential LBO providers available in the visited country will depend on the agreements between visited provider and each domestic provider. In the case that all MNOs establish roaming agreements with all MNOs in visited countries, no impact at all would be derived from changing domestic provider. However, as roaming agreements are not by default established among all providers, and LBO service can only be provided when there is a roaming agreement between HMNO and the LBO provider, sometimes it may happen that when customer switch to a different domestic provider, the set of LBO providers available for use when travelling may change.

As a conclusion, number portability affects the ARP, in the case of single IMSI, single IMSI+ and dual IMSI, as the customer loses the service provided by the ARP. It is not simple to consider adaptations for number portability procedures, as the time to perform the portability is too short and each country have different procedures to be considered. In any case, it could be considered at least the notification to the ARP about the change of domestic provider, in order to allow them to offer re-contracting roaming services as soon as possible. It would imply some not so complex adaptations in national portability procedures.

For LBO, number portability can imply that the variety of LBO providers change when porting the number to a different domestic provider. In the case that the LBO provider (visited network) has established roaming agreements with both domestic provider, number portability will not affect LBO provision.

5.5.2 Legal interception

Legal interception implications is a relevant issue when considering decoupling measures, as not all communications can be directly intercepted by the domestic provider. This is a sensible issue for security organizations and government, and any solution implying technical limitations on legal interception as it is now, would be an additional problem that could be considered as a blocking one by governments.

In general, single IMSI and single IMSI+ do not impose any additional relevant burden for legal interception when roaming, as incoming calls, SMSs and data traffic is managed by the domestic provider.

In the case of dual IMSI, domestic provider has access only to incoming calls. SMS and data traffic must be intercepted in the ARP network. This means that security forces must be able to identify the ARP and contact with the corresponding ARP to intercept roaming traffic. This makes interception a bit more complex, as an additional actor is implied, and domestic provider should be prepared to supply to security forces which ARP the customer is currently using (domestic provider already knows, as he has to provide dual IMSI SIM cards). The situation would be more complex when the ARP is an operator from other country (as it may happen) and in this case, security forces would have to comply with the legal framework from other country.

Lastly, for LBO, data services are directly provided by the ARP and it does not traverse domestic data network. Although SMS and voice services can be intercepted as usual in traditional roaming, security forces should address the LBO provider (located in other country and in general with a different regulatory framework for interception). So, for data services the situation is similar to WiFi services provided in the visited countries: consumers have a contract with a different provider in a foreign country and –as it happens to other services as banking or travelling contracted in other EU country, collaboration from the service provider with security forces must be performed under different rules than the national ones.

As a conclusion, legal interception procedures are not affected under the single IMSI and single IMSI+ model. Under the dual IMSI model an additional provider is involved in the legal interception (under a different legal framework if a foreign operator). In the case of LBO data services are directly provided by a foreign operator using a different legal framework, imposing similar challenges than existing for WiFi use.

5.6 Conclusions

In the next tables a summary of the analysis on the different technical challenges for each alternative is shown.

Table 2: Summary of technical challenges analysis for LBO

Issue	Proposed solution	Feasible for 2014	Complexity
APNs (HLR)	Include the Universal APN for ARP use in the HLR enabling the Visited PLMN AddressAllowed flag.	Yes	Low
APNs (terminal)	Define a common unique APN to be used for Internet access by all LBO providers. APNs will be configured manually or when possible assisted by terminal applications managing APNs configuration.	Yes	Low
Steering and barring	Obligation not to bar any visited network for consumers using LBO	Yes	Low if barring is not applied at all for the LBO provider. Medium/high if barring is limited to LBO consumers.
Roaming agreements	Obligation to reach a roaming agreement to provide LBO based services when requested by the VMNO	Yes	Low
ARPs discovery and selection	Can be done manually, but better user experience if visited operator delivers applications to help consumers in network selection and APNs management.	Yes	Medium
Blackberry services	Use of LBO provider blackberry server except for secured corporate servers (otherwise, it is still possible to use	Yes	Low

	domestic APNs and service)		
MMS services	No single stand-out solution in the visited network (it is recommended to use domestic APNs and/or Internet access to MMS)	No for ARP provision. Yes for domestic provider provision	-
VPN services	No single stand-out solution in the visited network (it is recommended to use domestic APNs and service)	No	-
MVNOs acting as ARPs	Subjected to commercial agreements between MVNOs and visited MNO supporting LBO (if possible).	Not clear	High if possible

Table 2: Summary of technical challenges analysis for Single IMSI

Issue	**Proposed solution**	**Feasible for 2014**	**Complexity**
Cut-off limit for post-paid	Coordination between Domestic and ARP to follow data consumption	Yes	Low/Medium
Implementation of ARP tariffs in domestic OCSs	Similar to light MVNO support	Yes	Low (especially for MNOs hosting MVNOs)
ARP OCS-Domestic operator connection	Development to be done to support this improvement (based on the use of DIAMETER)	Yes	Low/Medium

Table 3: Summary of technical challenges analysis for Single IMSI+

Issues for Single IMSI + Standard variations	**Proposed solution**	**Feasible for 2014**	**Complexity**	**Need further study**
Steering mechanism for ARP customers	No solution without standardization	Not clear	Medium/high (if possible) Needs further study	Yes
Billing support for ARPs (prepaid)	No clear solution identified for ARP Visited Network interaction. Even if there is interaction through CAMEL interface or monitoring traffic by signaling billing of incoming calls and data keeps very complex-It could be done using domestic provider as an intermediary, but several issues to be solved	Not clear	High if possible	Yes

Incoming calls and data decoupling	Incoming calls can be solved by implementing CAMEL in ARP Network. Data decoupling stays problematic	Not clear	High if possible	yes
Issues for Single IMSI + Light variations	**Proposed solution**	**Feasible for 2014**	**Complexity**	**Need further study**
Steering and barring mechanism for ARP customers	Not yet confirmed solution for per single IMSI steering, Administrative provisioning procedures are possible in short term.	May be possible for 2014	Low for buying of the shelf steering solutions and administrative provisioning to high when automation of provisioning is needed/wanted	Yes, especially regarding costs
Billing support for ARPs (prepaid)	ARP's are dependent on home MNO or Visited MNO. Several issues, mainly trust issues need to be solved	Yes	Low if possible usage prepaid system Home MNO to medium to high if own prepaid platform has to be implemented	Little if prepaid systems Home MNO are being used, further more it's very much like Single IMSI except for negotiating own discount arrangements.

Table 4: Summary of technical challenges analysis for Dual IMSI

	Proposed solution	**Feasible for 2014**	**Complexity**
APNs update in the terminal	Can be supported by OTA update (not perfect) or by a Smartphone application	Yes	Low
Terminal blocking	Several possible solutions	Not clear	Medium/high
Blackberry services	Use of blackberry server in the ARP (not valid to secured access to corporate RIM servers)	Yes	Low (for non-secured access)
Other services (VPNs)	No solution identified, except deploying secure tunnels between ARP and corporate clients (not feasible in general)	No	-
IMSI update OTA	No solution identified by now. IMSI update via OTA is not allowed as now by operators	Not clear	Not a question of complexity, but of agreement in GSMA. Need to check evolution along time
Incoming calls management	Need standardization, but can be done	Not clear	Low, but needs standardization

6 Implications of each alternative

This section is devoted to identify the needs of standardizations and implementation of new functionalities for each alternative in each type of actor (domestic provider, host provider in the case of MVNOs, visited networks and alternative roaming providers).

6.1 Local Break-Out (LBO)

6.1.1 Need to standardize new features (signalling, billing, security framework)

- A unique universal APN to be used by all ARPs should be defined.

6.1.2 Adaptations to be implemented in the networks (HMNO, VMNO, ARP, host MNOs)

- HMNO:
    - Provision in the HLR for the universal APN (activating the flag VPAA -Visited PLMN Access Allowed- for the specific APN EUInternet)
    - Avoid barring visited network for their LBO customers. The mechanism to be applied to avoid barring for LBO providers can be left to domestic providers. It can be as simple as not to apply barring at all for visited networks using LBO or to apply it only for LBO customers

6.1.3 Adaptations to be implemented in billing systems (domestic, visited, ARP, host MNOs)

- HMNO do not need to adapt billing systems.
- VMNOs using LBO must be able to perform billing retail for LBO customers. No need to adapt wholesale billing for voice and SMS.

6.1.4 Type of actors allowed to act as Alternative Roaming Provider (MNOs, Full MVNOs, and/or Light MVNOs)

- MNOs with a roaming agreement with the domestic operators and MVNOs and other resellers reaching an agreement with LBO provider to resell local data services in the case that it would be technically possible to support LBO-based MVNOs.

6.2 Single IMSI

6.2.1 Need to standardize new features (signalling, billing, security framework)

- HMNO:
    - Postpaid interface: For sending the information related to the customer activity (CDR – Call Detai Record and TAP -Transferred Account Procedure) and also control the maximum customer data consumption.
    - For ARPs using their own prepaid billing system, interconnection of the OCS (Online Charging Systems) or otherwise the ARP OCS with the network elements of the domestic operator (GGSN, GMSC, etc.).

6.2.2 Adaptations to be implemented in the networks (HMNO, visited, ARP, host MNOs)

- Nothing to be done

6.2.3 Adaptations to be implemented in billing systems (HMNO, VMNO, ARP, host MNOs)

- HMNO: Ability to manage a variety of different new retail tariffs from ARP implying adaptations in the billing, mediation and provisioning systems in order to bill ARP consumers. Utilization of DIAMETER protocol in order to allow prepaid data tariffs to be controlled by the ARP
- VMNO: No adaptations.
- ARP: In the case that the ARP prefers to manage the billing by their own, the system must be built. It implies utilization of DIAMETER protocol in order to allow prepaid data tariffs to be controlled by the ARP.
- Host MNOs: Nothing

6.2.4 Type of actors allowed to act as Alternative Roaming Provider

- MNO, Full MVNO,
- Light MVNO, and other actors not already involved in the mobile business acting as resellers.

6.3 Single IMSI+

6.3.1 Need to standardize new features (signalling, billing, security framework)

The analysis shows that there are two possible interfaces relating to the billing platform that will need to be defined when using Single IMSI+ Standard; an interface between the billing platforms of the ARP and the H-MNO and / or an interface between the H-MNO's IN and the ARP's billing system.

In principle these interfaces could be based on proprietary protocols. However, if the measure proves as advisable, standardization of the interfaces will help the quicker and less costly adoption of the system.

For Single IMSI+ light it seems logical (less impact on Visited MNO) to arrange the settlement of discounts by the Home MNO. Billing settlement between Home MNO and Visited MNO will largely be the same as under the current (normal) roaming arrangements. Except that the Home MNO has to make traffic reports (identifying which traffic belonged to ARP and which to Home MNO) and the visited MNO has to accept them to calculate the discounts for both the ARP and the home MNO. These interfaces could be arranged by administrative procedures. If automated it doesn't involve real-time systems and impact would be fairly low compared to real-time procedures in billing-systems.

In addition, for each Single IMSI+ solution an interface is needed between the traffic steering entity and HLR PLMN settings of the HMNO and the ARP if the EC decides to mandate the provision of a traffic steering mechanism to be implemented. This can be a very difficult interface to standardize as traffic steering systems are not standardised.

Finally, there may be a requirement to modify the TAP messages. Such messages are modified on a bi-annual basis as new features are regularly added. We believe therefore that any such addition will be easy and quick to implement. The contribution of GSMA in assisting and endorsing common agreements by operators in this issue would be important in this respect.

6.3.2 Adaptations to be implemented in the networks (domestic, visited, ARP, host MNOs)

The following adaptations are required for the implementation of the Single IMSI+ Standard solution:

- **HMNO:** The H-MNO has to support the CAMEL protocol phase II as a minimum. Depending on the implementation approach it may need to implement an interface between its IN or billing system and the ARP's billing system. Finally, depending on demand from other CPs to connect as ARPs the HLR may need to be upgraded to overcome capacity limitations.

- **ARP:** Depending on the implementation approach, the ARP has to build its own IN and billing platforms. It may also need to have its own interconnections with roaming networks.

- **VMNO:** The V-MNO also has to support the CAMEL phase II protocol as a minimum. It further needs to build database facilities to allow the identification of the ARP from the SCP address. This database has to be linked to each MSC/VLR.

6.3.3 Adaptations to be implemented in billing systems (domestic, visited, ARP, host MNOs)

It is unclear whether any changes have to be made to the billing system other than already defined i.e. discount settlement

6.3.4 Type of actors allowed to act as Alternative Roaming Provider (MNOs, Full MVNOs, and/or Light MVNOs)

Any mobile service provider can act as an ARP.

6.4 Dual IMSI

6.4.1 Need to standardize new features (signalling, billing, security framework)

In order to use these decoupling alternatives, the new features for billing, signalling and security should to be standardized. Concerning the IMSI issue, the standardisation process may be pushed by M2M procedures. A regular standardisation process involving 3GPP and ETSI takes about 2-3 years or even more depending on complexity. Bellow some examples of issues to be standardized:

- Standardization of switch IMSI in a multi-IMSI
    - Some applets already exist, for example the one used by BICS, but none is standardized
- Standardization of SIM update OTA (IMSI, secure profile)
    - Same as previous, OTA update is possible for some SIM characteristics', but nothing is standardize
- Standardization of specific signalling flows between the domestic and ARP networks
    - In order for the domestic provider and the ARP to know where the customer is located, some specific links must be provided between the two operators. It only seems that they must interconnect and interact but the GSM/UMTS standard should be compliant with this use.
- Standardization of new network components used for traffic signalling
    - Traffic signalling in a dual IMSI environment requires additional signalling operations especially for SMS
- Standardization of HLR / HLR interface

- The HLR of the roaming provider needs to communicate with the HLR of the domestic provider to indicate that the user is roaming and change the traffic routing accordingly. This requires new HLR to HLR communication mechanism in the existing CSS7 and SMSC

- Standardization regarding terminal blocking

  - With current standards, it is not possible to lock the device onto two networks only as mentioned in chapter 5.4.2. Therefore an HMNO-locked device could not use an ARP's IMSI, unless it is unlocked. A differentiated solution of enabling devices to be locked to two or more networks requires complex changes of standards and on all devices, on which this should be enabled. The overall timelines for this could be in the 4-5 year range; at least 2-3 years for standardisation plus several years for device vendors to implement and make available in large numbers. Finally, consumers would need to replace their devices to enable this solution.

- Standardization IMSI update in real time

  - The full extent of changes to enable dual IMSI is not totally clear and would certainly require a detailed feasibility study before any conclusions can be reached of necessary changes to existing standards.

6.4.2 Adaptations to be implemented in the networks (HMNO, VMNO, ARP, host MNOs)

Given that the solutions are not entirely defined today in the case of dual IMSI, it is not clear where the adaptations have to be implemented. However, as mentioned in the previous chapters, the following points summarize the issues to be considered: Additional HLR has to be implemented in the ARP (in order to manage incoming calls) as mentioned in previous chapters.

- Changes in the Terminal

  - In the use case of Dual IMSI, the switch should a priori be seamless for the user because having two IMSI will enable the visited network, who has a wholesale contract with the ARP to connect itself to the corresponding IMSI and all the network or terminal configurations are done automatically via signalling on HLR inter links, SS7 links or OTA. Nevertheless, depending of terminal used by the customer, some of them will request a manual intervention, especially for data if the APN cannot be automatically changed.

  - The question of terminal locking in the Dual IMSI case is related to the question of the IMSI. Indeed, each MNO can lock their terminal to some specific IMSI range, at least for a few months (depending on each country).

  - APN update must be performed in the terminal in a transparent way

- SIM card change (logistic for card distribution)

The SIM card will at least need to be changed the first time a consumer opts for an ARP. For the following changes it depends if there is a TRE or not, and if not if there is dedicated "slot" on the SIM in order to implement a new IMSI, with the new RP features, via OTA. Today's use of OTA is only for IMSI update but no secure profile, although this could evolve if specific standardisation becomes reality. Since that at least the first time SIM card must be physically changed when a consumer switch to an ARP, the time to deliver a new SIM card depends on the logistics of the SIM card provider. Dual IMSI SIM cards could be kept on stock in shops, so a customer could walk away with the new SIM card immediately. The potentially high number of combinations of Dual IMSI SIM cards (number of HMNO x number of ARP), however, could cause significant stock keeping cost (cost of the SIMs as working capital, storage space) for some operators. In this case a more centralised stock keeping with posting of the SIM may be chosen by some suppliers. This would typically take several days (depending on postal service), unless the operator runs out of stock for a specific SIM card combination. Therefore SIM card distribution could take between immediate to several days to arrive from a distributor or warehouse to the customer. The time may also depend on the business model of the HMNO/SIM card provider.

- OTA Dual IMSI update mechanism OTA SIM update mechanisms including a full set of security features to be implemented in order to allow IMSI updates for consumers changing to other ARP without changing physically the SIM card.

BlackBerry issue

- Full supported for Post-paid customers
- Prepaid implementation under finalization with RIM

6.4.3 Adaptations to be implemented in billing systems (domestic, visited, ARP, host MNOs)

Need for roaming agreements among operators

HMNOs must to sign an agreement with the ARP enabling this actor to sell retail roaming to its customers, but no specific needs for roaming agreement between the HMNO and the MVNO.

This specific roaming agreement will nevertheless be needed between the ARP and the visited network. If a roaming enabler is used by the ARP, it could simplify technical aspects because in that case the ARP do not necessarily need to have network element and this could increase competition coming from any kind of undertakings.

Billing system

The main adaptation will have to be done in the billing, provisioning, HLR and other network elements that deal with authentication.

Indeed, as the customer will have two bills, because of two contracts, there will be a need to implement the customer features on different elements. Network element of each network, HMNO and VMNO will need to open the IMSI to interconnection and consider as "ok" the MNC corresponding to those IMSI.

6.4.4 Type of actors allowed to act as Alternative Roaming Provider (MNOs, Full MVNOs, and/or Light MVNOs)

Any MNO of full MVNO using their own IMSI can use dual IMSI for acting as an ARP. Light MVNOs could also use dual IMSI solutions supported by a roaming enabler using ther own IMSI for ARP use.

6.5 Conclusions

The following tables summarize conclusions about which kind of actors (MNOs, Full MVNOs and light MVNOs/resellers) can use each decoupling alternative, as well as main technical implications for each alternative.

Table 5: Summary of stakeholders that would act as an Alternative Roaming Provider

	LBO	**Single IMSI**	**Single IMSI+ Standard variations**	**Single IMSI+ Light variations**	**Dual IMSI**
MNOs	Yes (Visited Networks)	Yes	Yes	Yes	Yes
Light MVNOs /Resellers	Not clear	Yes	No	Yes	Yes if they use a roaming enabler
Full MVNO	Not clear	Yes	Yes	Yes	Yes if they use a roaming enabler

Table 6: Summary of Technical implications for each alternative

LBO	**Description**	**Complexity**
Standardization	Unique APN	Low
Adaptation in networks	Universal APN in the host HLR (Domestic provider)	Low
	Avoid barring for LBO customers (HMNO)	Low if barring is not allowed. To be study if barring is not to be allowed only for LBO customers
Adaptations in billing and other support systems	Support for MVNOs acting as ARPs (VMNOs) under commercial agreement	Similar to domestic MVNOs support

SINGLE IMSI	**Description**	**Complexity**
Standardization	No need to standardization	
Adaptation in networks	No need to adapt networks	Low
Adaptations in billing and other support systems	Cut-off limit for post-paid customers	Not high, but depends on the architecture of the billing system of the domestic

		network
	Support of ARP prepaid tariffs	Low for HMNOs acting as MVNOs in domestic services
	Support of using the ARP Online Charging Systems.	Not high, but depends on the architecture of the billing system of the domestic network
SINGLE IMSI+ standard variations	**Description**	**Complexity**
Standardization	Interconnection of billing systems , access to steering and barring systems	Medium for interconnection of billing systems to very complex if access to steering and barring should be automated
Adaptation in networks	Steering by the ARP	To be studied
Adaptations in billing and other support systems	Support of Visited-ARP communication to allow for prepaid control	Not solved and complex if can be solved.
	Support of wholesale billing between ARP and visited country operators	Needs at least a CAMEL implementation
SINGLE IMSI+ LIGHT variations	**Description**	**Complexity**
Standardization	Discount settlement methods, access to pre-paid billing systems , access to steering systems	Low to Medium depending on level of automation, prepaid access is complex to very complex.
Adaptation in networks	Steering by the ARP potentially possible by implementing steering per IMSI and allowing access to barring system in the HLR	To be studied.
Adaptations in billing and other support systems	Support of Home MNO to allow for prepaid control	Not solved and complex if can be solved.
	Support of discount settlements	Low
DUAL IMSI	**Description**	**Complexity**
Standardization	Incoming calls management	Low
	IMSI OTA Update	Not clear
Adaptation in networks	Terminal blocking	Medium/high
Adaptations in billing and other support systems	Support of VMNO-ARP communication to allow for prepaid control	Not solved and complex if can be solved.
	Support of whole billing between ARP and visited country operators	Not clear

7 Regulatory obligations for each alternative

This section includes a preliminary analysis on the potential obligations that could/should be imposed in order to enable the use of each decoupling alternative.

7.1 Local Break-Out (LBO)

7.1.1 Domestic provider

- Provision in the HLR for the universal APN (activating the flag VPAA -Visited PLMN Access Allowed- for the specific APN EUInternet)
- Avoid barring visited network for their LBO customers.
- Allow all MNOs in the visited country to use LBO: home providers should be obligated to conclude a roaming agreement with any MNO in Europe requesting it in order to provide LBO based services. It can be a direct relation or indirect if the MNO is present in a roaming hub (the visited country could conclude a roaming agreement with the hub).

7.1.2 Visited network provider

- No obligations to be imposed.

7.2 Single IMSI

7.2.1 Domestic provider

Three new interfaces must be implemented:

- Provision interface: It corresponds to the basic communication interface between operators in order to provide network element addresses, customer information (prepaid, post-paid, tariff, among others), billing portfolio, etc.
- Post-paid interface: For sending the information related to the customer activity (TAP - Transferred Account Procedure) and the host wholesale billing information (Host CDR – Home Call Detail Records). In case the Home operator doesn't know about the ARP tariffs or maximum data cap selected by their users, this interface must be able to communicate especial events related to the compliance with the regulatory burden (for example, sending SMS when reaching 80% of data cap). Otherwise, the home operator should incorporate the customer information in their billing system in order to decide by itself when the SMS should be sent.
- Prepaid interface: Real time protocol interface used to interchange on line events. At least, the interface must accept DIAMETER protocol and any other that could be agreed.

Alternatively, in order to facilitate those ARP without billing infrastructure to enter the roaming market, the home operators should be capable to implement a reduced prepaid tariff portfolio in their own billing systems upon request of an ARP (at least one tariff profile by ARP).

7.2.2 Host provider in the case of MVNOs

- No obligations to be imposed.

7.2.3 Visited network provider

- No obligations to be imposed.

7.3 Single IMSI+

7.3.1 Domestic provider/host provider

- All the obligations to be imposed under single IMSI apply also for single IMSI+
- Obligation to allow the ARP to offer roaming services to its customers based on a single IMSI+ Standard or Light solution with access to HLR barring settings and steering per IMSI system
- Obligation to provide the appropriate (interconnection) arrangements within reasonable time and with regard to provisioning, traffic transport, monitoring and/or billing at reasonable cost to the ARP, upon request in case of single IMSI+ Standard or Light
- Obligation to provide wholesale roaming to the ARP at regulated prices in case of Single IMSI+ Standard or Light
- Obligation to make discount reports and send them to visited network and ARP in single IMSI+ Light

7.3.2 Visited network provider

- No extra obligations

7.4 Dual IMSI

7.4.1 Domestic provider

- Enable the use of Dual IMSI on its network
- Unlock the terminals for the IMSI of the ARP
- Interconnect and interact with the ARP for incoming calls.
- Include the universal APN/s for ARPs in the HLR.

7.4.2 Host provider in the case of MVNOs

It depends if the MVNO is a light or full MVNO.

- If a full MVNO, none, but the full-MVNO must be compliant with 7.4.1
- If a light MVNO, same obligations as in 7.4.1(except for the terminals)

7.4.3 Visited network provider

- No obligations to be imposed

7.5 Summary on the set of obligations for each alternative

LBO	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Universal APN in domestic HLR	Compulsory	Low
No network barring for LBO customers (except for justified reasons)	Compulsory	Low for no barring at all. Not possible for not barring just LBO customers
Obligation to conclude roaming agreements at request of visited country operator	Compulsory	Same as any other roaming agreement.
Facilitate network discovery and selection for LBO selection	Not needed for basic LBO.	Medium/High
For MNOs in visited country, to act as host provider for MVNOs and resellers (if technically possible)	To be subjected to commercial agreements	Burden for visited provider, not for domestic provider.

SINGLE IMSI	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Support for customers provision	Compulsory	Low for host MNOs supporting MVNOs
Basic support for ARP billing (post-paid customers): TAPs and CDRs	Compulsory	Low for host MNOs supporting MVNOs
Basic support for ARP billing (pre-paid customers): On-Line Charging Systems interconnection	Compulsory	Medium
Support for billshock measures: SMS sending, data service cut-off when reaching consume limit	Compulsory	Medium
Complete post-paid billing support for ARPs	Not strictly necessarily to act as an ARP. Commercial agreements or	Low for host MNOs supporting light MVNOs

	reasonable prices	

SINGLE IMSI + (all variations)	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Allow steering and barring (except for LBO customers) to be decided by the ARP for its customers	Compulsory	No solution confirmed yet, Steering per IMSI needs to be further studied (complexity low/medium in case of administrative procedures for access)
Support of Visited MNO - ARP communication to allow for prepaid control	Compulsory	Same as Single IMSI
Support of wholesale billing between ARP and visited MNO	To be subjected to commercial agreements	Nothing if it is a direct relation between ARP and MVNO. Medium if it is to be done via domestic provider participation

DUAL IMSI	**Assessment on the need to impose the obligation**	**Complexity for domestic provider**
Incoming calls management	Compulsory	Low, but not standardized
Terminal blocking	Compulsory	Medium/high, need to assess feasibility
IMSI update via OTA	Highly advisable	Not clear, it is more a question of agreement in GSMA

8 Conclusions

8.1 Local Break-Out (LBO)

A simplified implementation for LBO is likely to be available in July 2014 and implementation costs should not be, in our first initial qualitative assessment, too high for domestic operators. The most simplified implementation would imply the following limitations:

- Consumers should select the LBO provider using manual network selection in the terminal (or using a software application in the terminal when possible) each time the consumer connects to the LBO provider when he is not steered to the LBO provider by the domestic provider.
- Although Internet access services would be available and residential customers of the blackberry services can be also provided by the ARP (not available for those services needing a direct connection between the domestic network and any enterprise Blackberry server), MMS services and other specific services implying tunnelling between the domestic provider and companies (as it is the case for some VPNs services) would not be provided by the ARP. If the consumer needs to use MMS, he can still access this service through traditional roaming services and being charged by the HMNO or use an internet-based interface.

The obligations that must be enforced for this most simplified implementation regarding implementations to be done, will be reduced to the use of a universal APN[6] for ARPs to be implemented in all HLRs as well as terminals and enable VPAA (Visited PLMN Access Allowed) flag for this APN in HLR in order to permit IP access in all possible European visited networks. In general, this obligation is considered as a low complexity implementation feasible to be implemented for July 2014.

Under this model, APNs should be updated in the terminal to include the universal APN, but for terminals allowing APN management by applications (e.g. Android terminals), it can be done by an App provided by the LBO provider.

In the case that LBO is to be implemented, it would be also necessary to include a provision to not allow the barring of any visited network for LBO customers (implied in any case in the regulation). Domestic operators can decide on the mechanism to be applied: not barring networks at all, not barring networks notifying using LBO (being these two the simplest measure to implement from a technical viewpoint) or not to bar visited network used just for LBO consumers (in this case there could be a need to inform domestic providers about LBO consumers in real time).

Any MNO having a roaming agreement with a domestic provider would qualify for acting as a LBO ARP. Through commercial negotiations, if technically possible, MVNOs and other actors reselling services from the MNO could provide LBO supported by the MNO infrastructure.

In order to allow all MNOs to act as LBO ARP, the regulation should include provisions not to deny roaming agreements at the request of the visited provider who expresses an interest to use LBO.

[6] Changes likely to include DNS Modifications

8.2 Single IMSI

Single IMSI is the simplest solution covering all regulated services from a technical point of view. As the IMSI and roaming service in the network is provided by the domestic provider, visited networks work as usual, the terminal does not need to use different APNs or adapt network selection, and the mechanisms for interaction between HMNO and ARP are somewhat similar to the existing MVNO-host MNO relation in use today in domestic markets.

In order to enable its implementation, the implications and obligations are limited to domestic network support for the ARP in terms of billing and pre-pay management.

The easiest way is to implement the ARP tariffs in the Domestic provider billing system with the ARP acting as a service reseller.

For operators willing to use their own billing systems (MNO or most of the full MVNO), some obligations should be imposed to the domestic operator:

- Post-paid consumers: Supporting CDRs transmission to the ARP in order to allow the ARP to charge their customers.
- Pre-paid consumers: New interface between operators OCS to allow sending requests to cut service when the limit is reached (pre paid platform standardised API and agreed interconnection)

The challenges to implement these features are similar to the ones for MVNO support by host provider in the domestic market, and in principle, similar mechanisms should be implement. It is far from simple in any case to estimate costs for domestic provider support as it depends on IT systems adaptations and it would be much easier for operators acting now as a host operator for MVNOs. In any case, the already existing variety of MVNOs in many EU countries supported by different MNOs acting as hosts, points to consider that these type of adaptations in the IT systems are proven and its application for single IMSI based decoupling can be not too costly for MNOs not already supporting MVNOs.

8.3 Single IMSI+

The introduction of improvements on the single IMSI solution to allow ARPs to leverage their own footprints and roaming agreements is, unfortunately, not trivial based on the information and analysis done by now, more information on per IMSI steering and access to such systems is needed to asses an implementation for July 2014 is feasible.

The main issue deals with steering: steering preferences per customer is not always supported in home networks and steering profiles are usually defined in a separate, proprietary, network entity. Although steering per IMSI is commercially available the impact to upgrade networks not having this capability is still unknown. The feasibility for implementation before july 2014 needs to be studied.

Access to barring and steering settings is of paramount importance for Single IMSI+ solutions to work.

Also, there is the problem on controlling consumer use by the ARP. As described in the analysis, a direct communication between the visited network and the ARP is not easy to be implemented, and the mechanism for billing should be in line with the one defined for single IMSI. Additional features are required to support wholesale billing differentiation between Domestic and Visited and ARP and Visited network (including some kind of interaction at a wholesale billing level to account for discounts to be applied for the ARP), CAMEL phase II, which is the version of CAMEL that is most widely adopted, does not support data services. This means that the network element in the visited network that takes care of the data service and billing is not aware of the SCP address which corresponds to the roaming provider and cannot differentiate between the roaming and domestic providers. And therefore Single IMSI+ standard based on CAMEL doesn't seem to be feasible before July 2014. This issue with CAMEL is not a blocking factor for Single IMSI+ light.

Considering this situation, the current analysis done shows that a single IMSI+ standard solution is not likely to be available for July 2014. Further analysis is needed on steering issues to be sure that it is possible to support a complete ARP steering mechanism which would make Single IMSI+ light feasible. .

From a competition viewpoint, it can make sense to analyse a simplified version with discout agreements, if a solution for steering and billing is identified (in principle, although possible, it would not be simple). In any case, it would impose Quality of prepaid customer experience drawbacks and ARPs would not be able to leverage all possible benefits.

Finally, there are some legal issues related to the selection of the wholesale provider by the ARP for non-regulated calls that can be supplied by the domestic operator which cloud Single IMSI +. These can probably be resolved. But these are not for BEREC to resolve. Certainty on this point would be necessary before proceeding with implementation.

8.4 Dual IMSI

Dual IMSI has the attractiveness of being "clean" in the sense that when using the ARP IMSI, except for managing incoming calls, the domestic provider is not involved on traffic management, relation with visited networks, etc, and the ARP is much more autonomous than in the other solutions.

However, there are several issues not solved to be considered when implementing this alternative. As explained in the text, the issue with terminal locking needs further study. There are several possible solutions to overcome terminal locking problems, there will be a need to check IMSI ranges available in all countries for the ARPs use, and existing policy for unlocking terminals can be an issue in any transitory period - while the terminals base are completely renewed including the IMSIs to be used by ARPs so as not to be locked. A questionnaire is to be sent to all NRA on handset locking regulation and IMSI ranges availability to check the situation.

In the case that the terminal locking issue is resolved, an obligation for domestic providers should be imposed in order to send incoming calls to the ARP, and allow a complete roaming experience by the consumer. This is not an issue standardized in existing 3GPP specifications, it does not look to be

complex to implement, and there are existing non-standard implementations used by roaming hubs and MNOs based on dual IMSI solutions.

Another relevant issue is the question of change of the IMSI card when changing the roaming provider. Although an obligation can be imposed to use dual IMSI SIM cards from a certain moment (assuming an additional cost for operators, although probably an small additional cost due existing replacement cycles and economics of scale), as over the air transmission of IMSI to update SIM cards is not standardized nor allowed by the GSMA use cases provided to ETSI due to security reasons. There is an on-going discussion on different fora about the implementation of this feature (not only for roaming, but also for embedded & M2M). Also, one operator has told BEREC that it is likely that OTA update for IMSIs will be available for July 2014. However, it cannot be assure that this issue will be solved for July 2014, and further evaluation is required to address any security issues for operators.

In the case that OTA update for IMSIs will not be available in the short term, dual IMSI implementation would impose a significant delay for switching time (3-4 days or a week) to allow SIM card change. This is far from the switching time under discussion for the regulation (2 or 3 working days in the EC proposal and 1 day in the EP amendments) and would raise barriers for consumers for changing ARP provider. Even in the case that OTA IMSI update is solved, the first time a consumer opts for an ARP, the SIM card must be physically changed to a dual IMSI card.

Considering this situation, as now, it cannot be assured that Dual IMSI will be workable for July 2014. If the situation with terminal locking can be solved and incoming calls management standardized, Dual IMSI could work, but it cannot be assure that switching time could be reduced to 1 day except where clear advances are made on IMSI OTA update standardization and an obligation is imposed to deliver new SIM cards using dual IMSIs. Even in this case, consumers using old single IMSI cards, except that they are to be compulsory changed by dual IMSI cards, will not be entitled to switch provider in one day.

8.5 Overall conclusions

The technical analysis shows that LBO and single IMSI are the most promising solutions from a technical point of view in the short term. The issues implied and complexity identified in their implementation show that both are feasible and can be implemented at a reasonable cost by July 2014. Single IMSI is based on mechanisms similar to the ones used by host providers for MVNOs, and it should be feasible to adapt these mechanisms for ARPs use. Although LBO in its most simple implementation has some limitations, it can support a basic internet access service, and consumer experience should be reasonable.

It is not possible to reasonably assess Dual IMSI solutions implementation as feasible for implementation by July 2014. Although it is possible that some of the pending issues will be solved in the next years and as of now more analysis is needed. ,. Its main strength is weakened. due to the long switching time due to the need for SIM card changes this limits the potential appeal for dual IMSI, and more interaction with industry is needed to be able to assess when this potential problem might be solved in the medium-long term.

Single IMSI+ standard is in general a complex solution, the Single IMSI+ Light option seems easier to implement but it is not clear that the steering issue can be resolved. More interaction with GSMA and other stakeholders is needed to be able to assess when this potential problem can be solved before 1st July 2014.

The present analysis is limited to technical issues regarding feasibility and complexity and does not include competition implications for each alternative that are addressed in Annex 3.

Annex 3:

Competition analysis of decoupling solutions

Contents

As noted in the Technical Annex 2, there are a number of decoupling solutions to consider. The question for BEREC was whether these decoupling solutions would actually have an impact on competition in the roaming market so as to reach the targets set out by the Commission, i.e. bring international roaming prices down to domestic levels. Much lower roaming prices that will remain at those levels in the long-run will only be achieved if competitive pressure in the roaming market can be increased. This is typically induced by a certain amount and diversity of market players, low barriers to market entry, equal access to essential wholesale services etc. – i.e. basically a level playing field.

In this regard BEREC's analysis follows a set of criteria measuring the competitive impact of each solution at retail and wholesale level. The impact on roaming prices is assessed separately as the public is particularly aware of retail roaming prices, which have been much higher than prices of domestic mobile services. BEREC's analysis also considers the potential impact of innovation on competition in the roaming market (dynamic efficiency).

1 General remarks

Any structural solution to impact competition in the roaming markets and increase competitive pressure can only succeed, if new entrants get incentives to seek wholesale roaming access or invest in their own infrastructure (large operators and LBO providers using their infrastructure) and as a result offer retail roaming services. The chance of gaining profits typically works as an incentive for market entry.

For present roaming providers - especially MNO - the question is whether they would have an incentive to compete at all in international roaming services. One incentive could be the prospect of market entry by new players or established players in national markets. If the prospects of market entry were uncertain, particularly domestic MNO would not be motivated to compete against each other. Market performance in the domestic and international roaming markets shows that there has not been much competitive pressure so far and prices for mobile services are higher than for fixed services – except in a few Member States, where prices for domestic mobile services are quite low. It is therefore likely that MNO are not willing to cannibalize their existing revenues by starting a price war. They may not expect traffic volume growth to be sufficient to offset price reductions. Furthermore declining absolute margins between wholesale and retail rates (partially due to the built-in glidepath in the caps) as well as expectations of growth in "roam-like-at-home-offers" may be considered to be add uncertainty to the prospect of market entry.

Competitive pressure could therefore be largely driven by MVNO and resellers rather than by MNO, particularly if single IMSI+ or single IMSI were implemented. MNO will certainly react to market structure changes and adapt their roaming offers. It is possible that some MNOs will initiate some competition with LBO. But it seems rather unlikely that they will be the driving force behind competitive pressure that will bring prices down.

On the other hand small MNO could expect extra profits by offering local data services to roamers. As they typically attract smaller wholesale roaming revenue due to much less traffic than large MNO, offering local retail data services to roamers will generate revenue at retail level. They will also produce some new wholesale voice and SMS revenue they could not make before. But even for large MNO there is extra revenue to be gained particularly from offering local data services as they could increase retail data roaming revenue from heavy data roamers. On the other hand these operators have a greater turnover to lose.

In light of this it makes sense for decoupling to be rather simple and fairly cheap to implement so as not to discourage market entry. High implementation costs make it difficult particularly for small MNO to implement decoupling.

2 Retail level

The decoupling solution is supposed to primarily target the retail level. It is therefore crucial that the options proposed directly impact competition at retail level. In principle, this should lead to increased consumer take-up due to decreasing retail roaming prices. (However, significant changes in voice and SMS roaming volumes are not expected; volumes of these services have shown very little sensitivity to significant price reductions over the last few years.) In a competitive market consumers would be offered a diversified supply of roaming services and would have a choice of several market players. Apart from those classic economic criteria BEREC also investigated whether the proposed decoupling solutions were consumer friendly as to enable consumers to easily handle the decoupling options.

2.1 Typical customer

Looking at the demand side typical customers actually making use of decoupling are likely to be price-sensitive and moderate to heavy users of roaming services. Since modern smartphone users tend to consume significant and growing volumes of data, the target group will tend to increase over time and will include not only business travellers but also holidaymakers and consumers living near an international border. LBO will however mainly target high data users and is also a good alternative for customers travelling for short periods.

2.2 Choice of alternative roaming providers

2.2.1 Looking at the supply side (i.e. which provider would be able to be an alternative provider) the widest choice for consumers would likely be offered if dual IMSI or single IMSI+ were implemented. These two options would allow all types of mobile operators (i.e. MNO, full MVNO, and light MVNO when supported by a roaming enabler) to enter the roaming market. However dual IMSI is reported to be quite costly to implement compared to the other alternatives. Dual IMSI and standard single IMSI+ are especially well fitted for transnational groups as those could use their footprint to compete.

2.2.2 The lighter variants for single IMSI+ and single IMSI seem more likely to appeal to MVNO and resellers. Transnational and large MNO may be disinclined to enter the market if they cannot leverage their own footprint or get good deals on roaming agreements, as they will have concerns about damage to their brand arising from problems which are the responsibility of another MNO. Nevertheless this option could theoretically be used by MNO as well.

Light single IMSI+ would also allow large and transnational operators to leverage their own coverage footprints and better deals for wholesale access using their bargaining power.

2.2.3 Typical LBO players are likely to be MNO in the visited country or (assuming commercial agreement) MVNO acting as middlemen/ aggregators as long as they have the right to use a mobile network in the visited country.

2.3 Consumer friendliness

In terms of consumer friendliness of each decoupling option BEREC looked at the *selection process, switching time and any action required from customers*.

2.3.1 The *selection process* in each case requires that the customer would need to select an alternative roaming provider – either prior to travelling or upon arrival in the visited country, the latter only applying to LBO due to shorter time to provision needed.

2.3.2 When it comes to *convenience* dual IMSI turns out to be potentially the most inconvenient solution. Consumers would need to change the SIM card if those cannot handle two IMSI (which we can expect for most SIM cards that are currently used) or if profiles cannot be changed automatically via over-the-air (OTA) programming. Consumers would as well need to change the APN (Access Point Name = host name that is used to define the terminal's access to the network and is usually configured in the handset and the HLR). The APN must either be changed manually or could be automated in some cases by an application in the terminal and/or OTA programming. Note that OTA programming can only be managed by the domestic MNO to reconfigure the APN once customers return to their domestic network. It also does not work for all terminals. Methods of manually changing APN could differ depending on the type of handset. Furthermore it would take several of days (approx. 4-5 days) to switch to the chosen alternative roaming provider, unless switching is possible using OTA programming.

2.3.3 Single IMSI+ and single IMSI are both quite convenient to handle as customers could keep their SIM card and the APN settings, and switching would only take one day.

2.3.4 LBO can to some extent also considered to be rather customer-unfriendly if being implemented in its basic version, which may require a manual change of the APN for terminals that do not support applications for managing APN. As set out above OTA programming can only be managed by the domestic MNO. If the need to make manual changes to handset settings deters customers, the effect of LBO on retail competition may be limited.

Customers are mostly expected to select a LBO provider upon arrival in the visited country, for example as a consequence of advertising during the journey or at the point of entry. Or else a roaming contract with a visited network could cover all future visits to that country. The burden of selecting a local provider could be lessened when using an aggregator or middleman for roaming services as one operator for several EU countries. In terms of switching time LBO would only take minutes to switch to an alternative provider for data services.

2.4 Consumer protection

With regard to consumer protection rights, customers are subject to differing legal standards if roaming services are provided by an operator outside their home country. This is true for all decoupling options and will be most apparent with the LBO solution. Note that this is similar to how WiFi is currently used by travellers.

3 Wholesale level

BEREC is interested in increasing wholesale competition primarily for two reasons. First, material strengthening of wholesale competition would usually be expected to feed through, at least to some extent to the retail level, bringing better choice, quality and prices to end

users. Second, if wholesale competition were to become more effective, it would be possible to remove or reduce wholesale regulation. Therefore BEREC considers it necessary to analyze the impact of all decoupling solutions on competition at wholesale level.

3.1 Connection to visited network

BEREC first looked at how the connection to the visited network would actually work and how *wholesale roaming agreements* would actually look like with regard to the decoupling options.

3.1.1 In a dual IMSI world technically the alternative roaming provider uses their own IMSI on the SIM card, which allows the visited network to identify the alternative roaming provider whenever its subscribers roam. In commercial terms alternative roaming providers have a wholesale roaming agreement with the visited MNO.

This is common for MNO. Additionally full MVNO using their own network code will have the right to settle their own wholesale roaming agreements with visited networks. Discounts on wholesale rates will depend on traffic volumes that full MVNO receive from their host MNO derived from its billing records.

Light MVNO and resellers will use wholesale roaming agreements that were settled between host MNO and visited networks. These are typically wholesale resale roaming agreements. Full MVNO - particularly the small ones – may prefer to settle for resale agreements as well in order to save transaction costs.

3.1.2 Similar to dual IMSI, the single IMSI+ option also enables alternative roaming providers to directly contract own wholesale roaming agreements with visited networks and/or negotiate discounts with the visited networks for traffic steering.

A lighter version of the single IMSI+ option allows alternative roaming providers to negotiate own discount arrangements with visited MNO that already have roaming agreements with their host MNO. This limits wholesale competition in a way that alternative roaming providers would not be able to negotiate completely new roaming agreements, which include their own wholesale tariffs and discounts.

3.1.3 The single IMSI solution allows similar wholesale arrangements like light single IMSI+. Here the alternative roaming provider has a wholesale resale agreement with the host MNO and the host MNO in return contracts roaming minutes with all the visited network. This model allows access to wholesale resale roaming services of the host MNO but leaves aside any wholesale negotiations on prices between alternative roaming provider and visited MNO.

3.1.4 With LBO the visited network is the roaming provider for data services. An addendum to the wholesale roaming agreement with the host MNO on signalling (allowing customers to use LBO) will be necessary.

3.1.5 In case the visited network is chosen to be the alternative roaming provider – i.e. also for roaming voice and SMS - a standard wholesale roaming agreement with the host MNO is also required for voice and SMS traffic as both services will run on the visited network. This will alter the current wholesale relationship.

3.2 Ladder of investment

3.2.1 In terms of climbing the ladder of investment it is clear that the dual IMSI option claims the highest efforts. Alternative roaming providers would need to technically provision possibilities to transfer a second profile on the SIM card and manage all necessary procedures so as to enable roaming services. MVNO that are not full MVNO may have to build their own signalling infrastructure in order to being able to better extract and thus profit from dual IMSI.

3.2.2 Single IMSI+ entails high (but lower than dual IMSI) to medium investment, largely depending on the choice between the standard single IMSI+ solution and a light single IMSI+ solution. The standard single IMS+ solution gives more control over consumers and wholesale costs as the alternative roaming provider can negotiate its own roaming agreements and leverage their own footprint.

3.2.3 Single IMSI involves the least effort for alternative roaming providers. They would just resale wholesale roaming services. This option is similar to integrating domestic MVNO into the host network.

3.2.4 Providing local data services can be seen as already staying on the higher step of the ladder of investment as the own network is used and no wholesale roaming service is required here for data services. LBO providers will presumably invest in their network to make LBO usage more consumer–friendly. Home MNO will as well make similar investments to facilitate return of their customers to the host network after roaming. With evolution of voice and SMS to LTE networks it is possible that in the future these services may also be offered locally to roamers. LBO can be the only solution that does not imply complex and indirect roaming relations between the retail and wholesale level, giving the right signals for infrastructure investment.

3.3 Impact on wholesale competition

The impact on wholesale competition and on wholesale roaming agreements will vary to some extent, according to which option is chosen although the magnitude of the impact cannot currently be assessed.

3.3.1 Dual IMSI would be expected to have the largest effect on competition. It allows market entry by MNO, full MVNO and light MVNO/SP. There will presumably be the same number of MNO that have the same set of wholesale roaming agreements. Additionally there may be ARPs seeking direct wholesale roaming access, in particular negotiating wholesale roaming prices with visited MNO, allowing them to become more independent from MNO. In the long-run this may outweigh the short-term benefits of cheaper wholesale resale agreements. MVNO may also enter the market to operate as a trusted roaming enabler for light MVNO, allowing them to access more countries.

As the number of purchasers would tend to increase while the number of sellers remains constant, one could think that bargaining power will shift in the direction of the vendors of roaming traffic. This would be the case if we expect roaming traffic volume to remain constant. In practice, while voice and SMS roaming volumes seem reasonably stable, roaming data volumes have increased very fast and are expected to continue to show significant growth. Increasing data volumes could increase purchasers' bargaining power. However, this effect will be limited by the tendency of the large groups to try to balance their traffic with other groups across Europe as a whole and by the fact that, for the moment,

voice revenues dominate data revenues. The current level of wholesale roaming data caps gives plenty of room to compete although, by 2014, the margin between costs and wholesale caps will be much lower.

It is possible that large groups and other transnational operators are the ones to benefit most, which could lead to wholesale traffic mostly being internalized by large transnational groups. If this puts competitive pressure at retail level, we would expect retail roaming prices to fall.

Light MVNO and SP will have to use their wholesale access agreements with the host MNO or use a roaming enabler. They are unlikely to contribute to increasing competitive pressure in the wholesale market.

In total the number and diversity of market players negotiating direct access rather than relying on resale is expected to rise.

3.3.2 Single IMSI+ standard version is likely to generate a similar impact on competition like dual IMSI. This may happen if alternative roaming providers seek direct roaming access agreements although it seems costly to negotiate roaming agreements with several networks especially in the face of limited economies of scale as it is the case for smaller-scale players. But even if wholesale resale access seems to be even cheaper for alternative roaming providers, they still may want to conclude own wholesale roaming contracts with visited networks as this makes them more independent. Moreover wholesale prices could be lowered due to increased bargaining power. Full MVNO could expand via domestic services as soon as they have gained a significant number of customers (backward induction). As noted above ARPs may nevertheless rely on resale agreements instead.

Small players are expected to yield more roaming traffic, as retail data consumption will rise, which could impact bargaining power.

3.3.3 Basic Single IMSI cannot realistically change competition at wholesale level. It allows MVNO and SP to access wholesale resale roaming agreements. Note however that wholesale resale agreements entail different prices than wholesale agreements settled between MNO. Actors negotiating wholesale roaming agreements will likely still be the same, i.e. MNO. Hence these wholesale resale agreements are not expected to have a significant impact on competition in the market for wholesale roaming tariffs (roaming agreements). Also under single IMSI, alternative roaming providers cannot decide on the operator to provide wholesale resale access but will have to use the one chosen by the host MNO. Furthermore domestic MVNO will select their host MNO mainly based on domestic wholesale rates rather than on roaming rates as the latter makes up a much smaller amount in terms of traffic volume and revenue. Unlike standard single IMSI+ or dual IMSI full MVNO may not be willing to contract with visited networks here, so that they will not be able to exert competitive pressure.

Although barriers to the wholesale market are low BEREC does not expect that many MNO would use the single IMSI or the light version of the single IMSI+ option. They would not want to use other MNO's wholesale roaming agreement or transfer their bargaining power to another MNO. Nevertheless small MNO could be interested to use single IMSI or a light implementation of single IMSI+, because their bargaining power is already weaker due to less roaming traffic. They possibly could make the same deals with a resale agreement or discount agreements as if they negotiated themselves and thus save transaction costs.

3.3.4 Any of the structural solutions combined with LBO will impact wholesale agreements and bargaining powers. Wholesale data traffic will be taken out of the wholesale roaming market and rather be promoted as local data services at the retail level. This may affect bargaining powers of MNO depending on whether both sides (purchaser and vendor) engage in offering local data services aside from just offering wholesale roaming traffic. Incentives for market entry by alternative roaming providers may be lowered if data traffic is mostly covered by LBO providers, and in the same way, incentives for LBO providers may be also affected by market entry using other alternatives.

MNO offering local data services will be able to bargain wholesale roaming prices with alternative roaming providers and host MNO, keeping their wholesale tariffs for roaming voice and SMS services at cap level. This would be a doubtful strategy for LBO operators which already have material wholesale inbound roaming business as it could induce the home providers to change their steering preferences in light of high roaming voice and SMS prices in such a way the visited network captures less normal roaming traffic. But this will depend on who offers LBO. Disruptive small operators do not at present generally attract that much wholesale roaming traffic.

BEREC does not expect that most transnational groups will initially be interested in offering LBO, unless it became necessary to respond to an initiative by a smaller player. Large MNOs will be reluctant to start a price war and cannibalize their wholesale deals. Even so, LBO may be attractive for special applications such as video, and in limiting the impact from Wifi networks.

The possibility for MVNO to offer LBO might be negotiated commercially but does not appear to be enforceable under the Regulation.

3.3.5 Consumer conduct could affect market entry at wholesale level and thus impact wholesale competition. If consumers are reluctant to opt for a LBO provider once they have chosen an alternative roaming provider there will be less pressure on the decrease of wholesale data prices. On the other hand if roamers mainly go for local data services pressure on wholesale data prices will increase and an increased data consumption in conjunction with much LBO usage leads to declining single IMSI turnover. There will also be a pressure on retail data prices for alternative roaming providers and domestic providers.

4 Impact on roaming prices

This chapter explains how retail and wholesale roaming prices will change due to implementation of decoupling. Here the lowest price that could be achieved is of special interest – the lowest price meaning roaming prices approaching prices of domestic mobile services.

4.1 Retail roaming prices

We first consider the lowest possible prices which can be achieved while still operating profitably.

4.1.1 For dual IMSI, retail roaming tariffs approaching domestic levels are possible to be reached by large MNO particularly, in countries with currently high retail domestic tariffs. Unlike large groups small MNO and full MVNO will not be able to internalize wholesale costs with dual IMSI, so that their retail tariffs will depend on their wholesale deals. Only if those attract a large amount of customers could they gain some bargaining power to negotiate

good wholesale deals with large MNO, which could then be passed on to the retail level. For ARPs using wholesale resale roaming agreements the lowest price to be achieved are wholesale resale prices plus a mark-up for retail costs (e.g. acquisition costs).

4.1.2 The single IMSI+ options are likely to generate a similar outcome. Here again the lowest price which could be achieved by small MNO will depend on their bargaining power, which again will depend on the amount of subscribers.

With a standard single IMSI+ option an alternative provider could be lucky to get a competitive roaming agreement with a visited network, which is seeking roaming traffic it previously did not get.

In a light single IMSI+ world alternative roaming providers are completely bound by existing roaming agreements and their only bargaining power is the amount of subscribers in order to get a better discount agreement. So for full and light MVNO/SP the lowest price to get is the wholesale resale price (of agreements between host and visited MNO) minus a discount (which light single IMSI+ allows them to negotiate) plus a mark-up for retail costs.

4.1.3 The lowest price which could be achieved with the single IMSI option is the wholesale resale cap plus a mark-up for retail costs. As wholesale prices fall nearer to domestic costs in accordance with regulation, near-domestic prices can be achieved for a greater range of countries over all single and dual IMSI options.

4.1.4 Combining any of the structural solutions with LBO, the lowest prices that MNO could offer for LBO services are similar to domestic retail prices in the visited country for prepaid customers. Costs to provide local data services depend on the domestic costs (much lower than typical wholesale roaming charges) as well as on customer acquisition costs.

Retail prices of alternative roaming providers on voice and SMS depend on their wholesale resale roaming agreements with their host MNO (in the single IMSI case) or on the wholesale roaming/discount agreements with the LBO provider (with single IMSI+ options). Here voice and SMS are assumed to being provided by the visited network, which needs to have a wholesale roaming agreement with the host MNO.

4.1.5 However, the levels identified above are theoretical. In practice, whether these levels are achieved or approached depends on the intensity of the competition. On the basis of the general analysis at the beginning of this Annex, competition is likely to be driven by new entrants rather than established players. From this perspective, market entry is more likely for the options where cost of entry is cheapest.

Another factor driving price reductions is the available retail margin. By 2014, when decoupling will be introduced, the margin will be more or less the same between single IMSI, single IMSI + and dual IMSI. Although the latter two allow those with good wholesale agreements to benefit from an additional margin, this addition cannot be much greater than 10% of the minimum margin available (i.e. under pure resale agreements). Therefore, on balance, there must be doubt as to whether dual IMSI would generate additional competition benefits commensurate with the additional implementation cost which is generally considered to be very significant. Moreover, the additional margin available from single IMSI+ over single IMSI may not translate into significantly more intense competition. It would depend on whether the market players able to negotiate wholesale prices below the resale price chose to pass on the cost reductions to consumers or not.

4.2 Wholesale roaming prices

Wholesale roaming prices will decline as the wholesale price caps include a glidepath. In addition the question was whether the decoupling solutions could induce competition in the wholesale market to actually impact wholesale roaming prices.

Large volume increases may put additional pressure on wholesale prices. Smaller players who were previously unable to offer enough traffic to expect a discount below the regulated cap may find themselves more able to do so. This would apply not only to MNOs but (in the context of Dual IMSI or Single IMSI +) ARPs who will choose to negotiate their own direct access agreements. BEREC does not expect that large MNOs will see a commercial case for lowering wholesale prices to an extent so as to start a price war. As noted above, it is unlikely that voice or SMS volumes will change sufficiently to have any real impact on prices.

If retail prices fall below the retail cap (for example as a consequence of the success of LBO), this increases the pressure on wholesale prices in general. In addition, it increases the incentives for ARPs to seek their own direct access agreements. In this scenario, (wholesale and retail data roaming prices well below their respective caps), single IMSI + and dual IMSI have the potential to deliver material additional price reductions at the wholesale level. But it seems rather unlikely that either could stimulate significant reductions by themselves.

For these reasons, BEREC considers that the question of wholesale competition is unlikely to be the most significant factor in making the choice between Single IMSI / Single IMSI + / Dual IMSI.

5 Incentive for service and tariff innovation

In terms of dynamic competition BEREC considered potential incentives for operators to innovate and undertake new investment to improve services and network quality. Generally innovation is perceived to increase competitive pressure among market players, because it promotes product and price differentiation, thus allowing to subdividing markets and in the end can push retail prices down. Any developments undertaken at wholesale level can be passed on to the retail level.

5.1 Dual IMSI is most likely to support tariff and services innovation particularly for MNO and full MVNO. They do not depend on roaming agreements of their host MNO, which compete with them at retail level. This autonomy theoretically allows them to redesign agreements at wholesale and retail level.

5.2 The outcome regarding tariff innovation is similar for standard single IMSI+, which enables MNO and full MVNO to leverage their wholesale roaming agreements with visited networks as well.

5.3 Single IMSI and light Single IMSI+ only offer low if no incentive to innovate at all since alternative roaming providers complete wholesale resale roaming agreements with their host MNO or discount agreements with roaming partners of the host MNO. As a result host MNO will have to undertake any innovation first and pass it on in their wholesale resale agreements for alternative roaming providers to also take part.

A light single IMSI+ option may be an incentive for operators to innovate and convert to a standard single IMSI+ solution.

5.4 LBO itself will presumably provide an incentive for local data services providers to innovate, as retail providers are in this case the ones owning the network that support the

services. Generally we can expect new innovative data offers, particularly in light of growing retail data consumption and a lower cost base. There is a chance that operators further develop LBO thus technically advancing it and improving technical applications for customers. This will lead to improving QoS and consumer experience. As a consequence LBO could be much easier to handle and thus will be more appealing to customers. Note that these possibilities are already available to large multi-national undertakings.

Hence any of the single IMSI+ or single IMSI options combined with LBO will most likely promote innovation, though with single IMSI it may seem difficult for alternative roaming providers to compete with data offers that are priced near “roam-like-at-home” offers in the face of wholesale resale or discount agreements.

6 Effectiveness of decoupling

BEREC understands that price caps in the roaming market are to be removed in the long term. For this to happen the decoupling solutions and the wholesale access obligations are supposedly to work effectively so as to establish sustainable competition in the roaming market.

6.1 Wholesale regulation necessary?

6.1.1 It should be a pre-requisite of removal of wholesale regulation that prices will be and remain at a competitive level, assessed taking into account the costs of provision. As noted above, decoupling may under some circumstances contribute to this but is unlikely to drive it.

6.1.2 At present, for dual IMSI it seems unclear whether decoupling will lead to material beneficial change in the structure of the wholesale roaming market to the extent that wholesale regulation could be withdrawn, even beyond 2016. But as set out above market structure may change if full MVNO take the chance to settle for their own wholesale roaming agreements as well as trusted roaming enablers. Possibly new niche operators such as pan-European providers may also find it interesting to enter the roaming market. In the face of sufficient market entry wholesale regulation may not be necessary in the long-run. Small players with lower countervailing power may still need some regulation.

6.1.3 Even if in the future it were possible to remove wholesale price caps, it is likely that for single IMSI+ variants technical obligations at wholesale level will have to persist to ensure that wholesale agreements continue to work.

6.1.4 For single IMSI wholesale regulation will have to be maintained both for wholesale inbound roaming and wholesale resale roaming. Otherwise MNO can set wholesale resale charges above the caps. Consequently competition will always depend on the regulated wholesale resale prices for decoupling.

6.1.5 Local data offers from visited networks could in principle exert sufficient competitive pressure on alternative roaming providers and on MNO, so that wholesale regulation for data services may be obsolete in the long-run. This will however depend on whether there are sufficient local data offers to actually put pressure on roaming services.

Competition in the market for local data services itself does not depend on wholesale roaming data regulation as prices for local data services are not based on wholesale roaming charges.

For roaming voice and SMS services regulation would still be needed until overall implementation of LTE perhaps changes the order of things.

6.2 Retail regulation necessary?

Retail regulation will presumably not be required with neither decoupling solutions if competition succeeds in lowering market prices. Only with LBO roaming voice and SMS may demand regulation until these services will be directly provided in the data part under control of the consumer. BEREC however has doubts that sustainable competition will in fact emerge so as to put an end to retail regulation.

7 Conclusion

This chapter shortly summarizes the main advantages and drawbacks of each structural solution and makes a recommendation on which option to be implemented.

7.1 Main advantages

7.1.1 Dual IMSI potentially has the largest impact on competition from MNOs. It produces competitors to face MNO, which will not have to demand wholesale resale roaming agreements and thus will not depend on wholesale resale price caps of host MNO. Operators with the best wholesale inbound roaming price could target the roaming market and create a downward pressure on prices. Dual IMSI is rather an option suitable for large groups that enjoy good wholesale deals and have large transnational footprints. However, as noted above, we do not expect in practice that competition through decoupling will be driven by the large groups.

7.1.2 Standard single IMSI+ can be adapted to a range of operators ranging from large groups leveraging their footprints to larger ARPs. A similar outcome to dual IMSI could be expected with standard single IMSI+.[7]

7.1.3 Single IMSI and light Single IMSI+ allow different types of providers to offer alternative roaming services. New entrants are granted access to roaming markets and drive retail prices toward wholesale caps. It is fairly simple to implement and particularly serves the needs of MVNO and resellers. Nonetheless large MNO are not expected to make use of this option, as they cannot leverage their transnational footprints nor roaming agreements, but only small MNO.

7.1.4 LBO is a technology which can be adopted today already. Operators compete whilst using their own network, providing incentives to investment in infrastructure, which could again technically improve the solution. Local data offers put competitive pressure on retail offers of visited networks and alternative roaming providers. The expected price reductions are not conditioned by the caps.

7.2 Main drawbacks

7.2.1 Dual IMSI gives rise to some major drawbacks that BEREC cannot ignore. Stakeholders report uncertain implementation costs that are assumed to be much higher than for all other options as well as a long timeframe for implementing dual IMSI. Additional costs are expected with the need to change SIM cards of those subscribers that opt for an alternative roaming provider. Regarding MVNOs and resellers, a decoupling obligation will

[7] Light Single IMSI+ is only slightly better than single IMSI since traffic steering is limited to non-existing and only discount agreements can be negotiated.

have to be imposed on host MNO or the alternative roaming provider has to use a roaming enabler if MVNO and reseller want to use dual IMSI.

7.2.2 Standard single IMSI+ entails complex implementing procedures as well. BEREC expects, amongst other problems, limitations with regard to steering, on which stakeholders have differing views. Some regard steering as a tool that already works, some say that it will need constant management. Stakeholders also disagree on how much it will cost to implement steering and the effort that it takes. It is also unclear who should recover these costs.

7.2.3 Unlike dual IMSI and standard single IMSI+ does, single IMSI purely provide resale of wholesale roaming services. It is clear that this will require maintaining wholesale caps. MNO cannot use their own wholesale roaming agreements if they want to use single IMSI and therefore cannot use their own footprint in visited networks.

7.2.4 LBO currently does not cover roaming voice and SMS. In order to keep implementation costs low customers would need to manually select the visited network. Subscribers that demand local data services could distort the wholesale roaming market for voice and SMS. Visited networks that offer local data services could also provide voice and SMS services to roamers. Alternative roaming providers using other structural solutions compete with visited networks providing LBO and the potential market for both types of actors must be shared among them, making it less profitable than when using a unique structural solution. If an alternative roaming provider loses its customers to an LBO provider it may not offer roaming in the country/ies that the LBO provider is operating. This possibility will increase to the same degree when switching from voice and SMS to data.

On the other hand, single IMSI could also weaken LBO as both options target the same market. LBO providers may not be able to place good offers for retail voice and SMS, because – unlike local data – they do not control wholesale prices for voice and SMS. Alternative roaming providers offering roaming services via single IMSI can leverage their brand and target their existing customers. Moreover entry costs could be lower for alternative roaming providers if LBO requires significant advertising to generate consumer awareness of local data offers.

Note however that single IMSI and LBO are different measures allowing different market players to compete.

7.3 Conclusion with regard to achieve significant price reductions below the cap

BEREC investigated whether each option was able to achieve the caps proposed in the Regulation. Generally we can assume that if operators actually compete for roaming customers, it is likely that prices will fall below the caps.

7.3.1 Dual IMSI could in principle decrease roaming prices well below the caps. The question remains whether this can be achieved during the timeframe set out in the Regulation as it could require more time to deploy. Particularly standardization may take quite a long time thus delaying implementation of dual IMSI and the delay on getting alternative roaming provider service due to the need of changing the SIM card can undermine consumer eagerness to opt out for an ARP. Moreover, large groups (who are the biggest beneficiaries of dual IMSI) may not be the drivers of competition.

7.3.2 Standard single IMSI+ will presumably generate a similar outcome like dual IMSI if there were no technical restrictions such as traffic steering.

7.3.3 If alternative roaming providers were not able to steer traffic standard single IMSI+ produces the same result just like single IMSI and light single IMSI+. Both light single IMSI+ and single IMSI are moderately likely to lower prices to cap level, but this will not happen in an instant. As said before the effect on competition is rather modest if not uncertain, so prices decrease due to declining price caps rather than due to competitive pressure. But implementation costs are low enough to justify an attempt to implement single IMSI or light single IMSI+.

7.3.4 LBO is likely to deliver lower caps for data roaming in those countries where it is offered. However a spill-over-effect on non-LBO prices may be rather limited in the as local data services - so it currently seems - only appeal at the moment to a fairly small segment of users. Moreover it may not be available everywhere. It is at least moderately likely to achieve lower prices to suit the price caps but probably only for heavy data roaming users. If providers of LBO find ways to make signing up to local data services easy and painless the positive effect may be more universal. It should be also considered that roaming data services is a growing market.