Effectiveness of Traffic Direction Techniques in Mobile International Roaming and Implications for Market Definition

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Abstract: This paper describes the techniques adopted to date by mobile operators to direct the traffic of their roaming customers abroad to specific and preferred foreign networks, and analyzes its effects from a regulatory point of view. It introduces some criteria, including a Traffic Steering Index, that allow regulators to assess whether, in a pair of mobile operators from two different countries, one adopts effective direction techniques to the other's network. Furthermore, the paper proposes a methodology for evaluating the share of roaming traffic that is effectively directed to a specified network by a given group of foreign operators, and hence a measure of a realistic direction efficiency. Finally, it briefly examines how the use of such technical methodologies could be employed in the definition of the markets related to international roaming, particularly when considering a market of captive traffic, namely traffic internalised between operators from different countries belonging to the same group/alliance.
Key words: international roaming, traffic steering, captive markets, electronic communications.

The regulation of mobile international roaming over the last years has been a top issue on the agendas of European regulators of the electronic communications sector, and of the EU Commission. Both the first Commission's Sector Inquiry (EU Commission, 2000), and the ERG [1] Common Position on the definition and analysis of the markets for wholesale international roaming [2] (WIR) (ERG, 2005) concluded that international

[1] The ERG (European Regulators Group) is the group formed by the National Regulatory Authorities (NRAs) of the EU countries, including, as observers, the Authorities of the accession countries and those of EEA (European Economic Area), with 35 members to date. This Group, instituted by a Commission's Decision within the sector regulatory framework, is mainly devoted to the harmonisation of the application of EU regulation.

[2] The WIR Common Position is based on a joint project carried out by a group of NRAs chaired by the Italian regulator AGCOM.

roaming retail tariffs had to be considered, in general terms, relatively high [3], to the detriment of consumers and the development of the service in the EU internal market.

The ERG WIR Common Position (2005) is a reference framework for NRAs in the EU, in their proceedures of defining and analysing the relevant market, according to the provisions of the sector specific regulatory framework [4]. By the end of 2006 only Finland and Italy (AGCOM, 2006) had concluded the formal proceedure for the wholesale international roaming market, with the publication of a final decision. Only very few other European NRAs made any progress with such a procedure, while others preferred to postpone these activities in view of the Commission proposal of direct regulation of tariffs (see below). The outcome of these first market analyses shows that, despite the competition problems and adverse effects on consumers identified by NRAs, the tools provided by the current regulatory framework do not allow them, in this specific case, to take effective and decisive action to address these problems and ensure that end users fully receive the benefits of regulation.

At the end of 2005 the ERG informed the Commission that, apart some initiatives taken to increase transparency, the regulatory framework was not sufficient to incisively address market problems, and that a higher level EU action was deemed necessary. The Commission subsequently announced its intention to introduce direct price regulation, both at a wholesale and retail level [5]. The ERG contributed actively to this process by formalising two responses (in the form of ERG Common Positions [6]) at the consultations launched by the Commission, which also had some influence over the final proposal. A draft was filed by the Commission to the EU Parliament and Council on July 12th 2006 and now awaits the completion of the co-decision approval phase. The proposal is expected to take effect by summer 2007.

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[3] In this context the issue of "high prices" is not to be seen as implying the excessive pricing concept of competition law. So far only the Commission, in 2 specific cases that are still open - in 2004 in the UK and in 2005 in Germany - has notified MNOs of such alleged specific abuse.

[4] Market n. 17, Wholesale International Roaming, is in the list of the 18 markets susceptible to *ex ante* regulation according to the EU sector regulation framework. See EU Commission (2003).

[5] The Commission launched a consultation on the regulation project, divided in 2 phases, in 2006, see EU Commission (2006).

[6] For the two ERG Common Positions, of March 28th 2006 and May 11th 2006, see ERG (2006).

This paper aims to discuss a central topic in the international roaming market functioning, namely the adoption by mobile operators of techniques for directing the roaming traffic generated by their own customers roaming abroad to specific foreign networks, and the effectiveness of such techniques. This paper mainly adopts a technical point of view, however it will also briefly discuss the regulatory implications, particularly those related to markets definition. The objective of the article is twofold: on the one hand it suggests appropriate tools for regulators to analyse national roaming markets [7], and on the other it highlights some regulatory issues meriting further reflection, starting with the observations recently made by the Commission in its comment letter (EU Commission, 2006b) to the notification ex art. 7 Framework Directive (Framework Directive, 2002) of the Italian market decision regarding the possible introduction of a roaming captive market.

■ International roaming definitions

International roaming services allow customers of a home mobile network operator (MNO) *H* [8], to make (and receive) calls, and use other mobile services when they travel abroad and can be registered on the network of a local visited operator *V* [9]. When a customer of *H* makes a call while registered on the network of V, s/he will pay a retail tariff to *H* (the own national operator), while, at a wholesale level, operator *V* issues a bill called IOT (Inter Operator Tariff) for use of its network in the name of *H*.

The main subject of this paper is so-called Traffic Direction (or Traffic Steering). By this notion we mean the ability of operator *H* to let its own customers, travelling in a visited country, register on the network of a chosen (by *H*) specific operator V and to make and receive calls on this network

[7] The permanence of the wholesale international roaming market in the recommended list of markets susceptible to *ex ante* regulation is still under consideration, within the Review 2006 of the sector specific regulatory framework (see the Commission public consultation (EU Commission, 2006c) on the draft review of the Recommendation on relevant products and service markets). However, NRAs are duty-bound to monitor the electronic communications markets in any case and where they suspect the existence of competition problems they could identify, define and analyse the markets most appropriate to national circumstances.

[8] We suppose *H* to be one of the N mobile operators in the Home Country HC.

[9] We also assume *V* to be one of the M mobile operators in the Visited Country VC.

while abroad. Traffic direction is then a technical occurrence that is undergone by MNOs, under the control of foreign operators.

We will use the wording "inbound roaming" to represent the traffic generated [10] by customers of a home operator on the network of a visited operator, from the point of view of the visited operator (namely the operator that actually manages the calls). That means, for example, that the originated inbound roaming represents the calls made by the customers of the home operator in the visited operator's network, observed by the latter.

The word "outbound", on the contrary, is related to the traffic generated by customers of a home operator onto the network of a visited operator, from the point of view of the home operator. From this it follows that the inbound roaming of *V* in the VC, with respect to a given operator *H* from HC, matches the outbound roaming of *H* on *V* [11].

There is also a fundamental difference between "inbound roaming" and "outbound roaming" when it comes to market definition. In fact, operator *V* builds up its wholesale product to be sold to *H* on the basis of its inbound roaming. Inbound roaming therefore characterises the national market of wholesale international roaming. Outbound roaming, on the contrary, is used by an operator to charge its own customers retail tarifs. Outbound roaming is consequently related to an eventual national retail market.

For further details on these aspects of market functioning and definitions it is advisable to consult the aforementioned ERG WIR Common Position (ERG, 2005) or the Italian AGCOM decision (AGCOM, 2006). Very briefly, in these analyses, the national market for wholesale international roaming has been defined based on the originated traffic of inbound roaming, jointly on all mobile networks in a given country, for mobile services including voice and SMS, on the whole national geographical territory. A retail market for international roaming has not yet been defined.

One of the fundamental characteristics of international roaming that led to the aforementioned market definition for WIR was the adoption and effectiveness of traffic steering technologies by mobile operators. The issue was actually whether the traffic of a given home operator is steerable or not.

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[10] With the word "generated" we usually intend both calls originated and calls received. As we will see later, for the market definition only originated calls may have significance.

[11] In theory at least. Some differences might be experienced and could depend on the different ways and procedures whereby traffic data are stored in the information systems of MNOs.

When traffic cannot be directed, then it should end up divided more or less randomly amongst the networks of the visited country [12]. In this case it is reasonable that the national wholesale market could be segmented into as many markets as the number of national networks. Consequently, each operator could be considered a monopolist in its own market/network, as for national terminated mobile traffic [13].

This approach was indeed adopted by the Commission in the 2 Statements of Objection issued to O2 and Vodafone in the United Kingdom in 2004 and to T-Mobile and Vodafone in Germany in 2005. These Statements constituted an infringement procedure for alleged abuse of dominant position on the basis of article 82 of the Treaty. The period when the abuse took place ranged, depending on the actual case, from around the end of 1997 to around the end of 2003. The absence or negligibility of traffic direction was assumed during this period.

In these two cases, the aforementioned definition of the wholesale market on the basis of each national network was, of course, without prejudice for the assessment NRAs had to make pursuant to the provisions of the sector regulatory framework. To this end it is worth noting that NRAs are duty-bound to analyse their national markets from a forward-looking perspective; hence, they have to observe relevant phenomena and assess their future impact, rather then to take stock of given and unmodifiable data and circumstances pertaining to the past. The ERG WIR Common Position (ERG, 2005) which, on the contrary, suggested defining a single national market, irrespective of the operators' networks, was not taken for granted when the ERG working group started the project.

One of the main reasons behind this new market definition, commonly accepted in national market analyses to date, was the initial assessment of MNOs starting to use effective traffic direction techniques. Wherever there is a proof that foreign operators have adopted such a tecnique, then the national market should not be segmented into each single network. In fact, traffic can be theoretically moved in a relatively simple way from one operator to another in the visited country, so there is a degree of substitutability between national networks [14].

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[12] Precisely, on all the networks the home operator has bilateral roaming agreements in place with (in practice, almost always all).

[13] See market n. 16 in the list of the Commission's relevant markets (EU Commission, 2003).

[14] The adoption of traffic directing techniques and the existence of groups/alliances between operators, able to employ those techniques on a large scale, have fundamental consequences

From the mobile operators' perspective, the use of traffic direction technologies is deemed fundamental not only for the internalisation of traffic within groups or alliances [15], but also in order to increase relative volume shares with operators that, for example, offer discounts on nominal wholesale prices. Generally the discount agreements foresee different levels for different volume thresholds, as this acts as an incentive to concentrate the traffic towards specific foreign operators.

Annex 1 offers a brief description of technologies that operators can adopt in order to effectively direct their (customers') roaming traffic to specific preferred networks, with a short qualitative discussion of their relative efficiency.

■ Roaming traffic direction

In this chapter we examine the issue of traffic direction from the point of view of measurement, discussing the issues surrounding the actual implementation of the relevant technologies by mobile operators and the efficiency that results.

The first question that needs to be answered is how to show that operator H actually directs its (customers') traffic to V's network, and that any eventual substantial share would not be a random effect or the result of V‘s better coverage in the visited country? [16] The discussion of traffic direction technologies in annex 1 shows that no single technology can achieve 100% efficiency at the moment. So a second question could be how can we make a reasonable estimation of the actual obtained efficiency?

The following example should enable us to understand these issues more thoroughly; let's suppose that Vodafone UK [17] generates, through its

for the assessment of dominance as well. This is not, however, a matter for discussion in the present paper.

15 To date the Vodafone Group covers the largest number of EU countries with 11 directly owned subsidiary operators, and other countries with affiliated operators; while partner operators are present in many of the remaining EU countries. There are also 2 relevant alliances: Starmap, with operators in around 10 countries, and Freemove, with operators in around 15 countries. Another important group enjoying fast development is H3G, with operators in 6 countries to date.

16 V could, for example, be the historical incumbent with the best network.

17 We use the names of existing operators as examples for illustrative purposes only.

own customers, 100,000 minutes of voice calls originated in Italy, and that 80,000 of these calls are carried by Vodafone Italy's network. Can we claim, without a doubt, that Vodafone UK is actually adopting traffic steering for the benefit of Vodafone Italy? Since there are 4 mobile networks with national coverage in Italy, if the traffic were randomly distributed, we should observe 25% of it on Vodafone IT's network (i.e. 25.000 minutes) [18]. In this specific example one may suspect that Vodafone UK is actually playing with traffic direction, but we would prefer to have a criterion to assess this situation with greater certainty. As for efficiency, can we state that the direction efficiency of Vodafone UK (on Vodafone IT) is 80%? Can we state without any doubt that ALL traffic of Vodafone UK observed on Vodafone IT is actually directed? Further analysis would also seem necessary to clarify these points.

In order to state that traffic direction is effective, we should at least verify that two conditions are satisfied: firstly, the will (technical implementation) of the home operator, and secondly, whether this will is realised in practice. Taking into consideration the discussion regarding the traffic direction technologies in annex 1, it is possible to state that:

- Not every SIM or every handset is compatible with any direction technique; meaning that customers can sometimes still register with networks different to those preferred (by the home operator), more or less randomly, even in presence of direction techniques.
- Customers can manually register with networks different from those preferred by the home operator [19].
- Every network can have coverage problems, even on a temporary basis, meaning that in cases of a gap in the preferred network, customers will be registered on a different network.
- Every network can experience capacity problems or temporary unavailabilities, meaning that a customer registered on a preferred network could experience, unpredictably, the saturation or technical unavailability of this network; hence s/he could be forced, in an automatic or manual way, to switch registration.

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[18] Should 3G-only networks be excluded, based on the hypothesis that all the Vodafone UK 100,000 traffic minutes are GSM only, the percentage would raise to 33%.

[19] Even if the operator employs Managed Roaming together with Enhanced Preferred Roaming (see annex 1), there may be a minimum time threshold during which the end user could make, or receive, a call on a different network than the preferred one.

From these considerations it follows that:

- There is some traffic that the home network wishes to direct onto a specific visited network and that, when direction fails, will end up being carried (reasonably in a way that is either random or depending on the relative coverage) by other networks in the visited country.
- There is some traffic that the home network cannot intrinsically direct onto the preferred visited network, that will nevertheless end up being carried by this same network.

Going back to the example of Vodafone UK, let's assume: a) that Vodafone UK also sends traffic to a third country, for example Malta, where only 2 operators are active; one, say, Vodafone MT, being the historically settled operator, with complete coverage of the territory and the best radio signal in the entry ports, the other with a lower grade coverage; b) that 80% of Vodafone UK traffic in Malta ends up carried by the Vodafone MT's network; c) that a Vodafone UK competitor, say T-Mobile UK, has a relevant share of its traffic in Malta, for example 70%, on the same Vodafone MT's network, with a claimed absence of any traffic direction technique to this network. It could then be argued that traffic from Vodafone UK could also be carried by Vodafone MT to a far more independent degree than the specific use of traffic direction would imply. Hence, the "regulatory" efficiency of direction might be lower than the *prima facie* assumption.

A thorough assessment of possible adjustments to make to the observed traffic in order to evaluate the real efficiency of the direction itself seems necessary not only as an academic discussion, but also in the context of the aforementioned comments made by the Commission regarding possible different wholesale international roaming market definitions. The Commission, in fact, seems to argue about the possibility of extrapolating the so-called captive component from the WIR market, namely [20] the inbound roaming traffic share coming from operators belonging to the same Group of the observed operator(s).

In the following two sections we will, respectively, try to answer the two questions raised regarding traffic steering: namely, how to assess whether a foreign operator is actually employing traffic direction techniques to a given operator, and what is a fair share of the directed traffic to consider in order to

[20] However a definition of a captive market of international roaming, from a regulatory point of view, has not yet been formally formulated. It should be a variant of an international self-supply.

evaluate the relative efficiency (and consequently the eventual captive share).

■ Traffic steering indicators

In this section we try to devise a criterion to assess the effective ability of an MNO of a Home Country, *H*, to direct the traffic of its own customers roaming in a foreign Visited Country, to the network of a specific preferred visited operator *V*.

A first indicator that could be employed is the relative "market share" of traffic directed to the visited operator's network *V* by *H*, with respect to all traffic of H in VC. We take the point of view of H, so we use the outbound traffic data of *H* in the visited country VC.

It is then possible to evaluate the Outbound Market Share of *H* to *V*, (OMS), better expressed as a percentage. If this share is high, then this could be an indication that H is actually employing direction techniques to V. Yet it is debatable how high this share should be in order to be considered a reliable indicator of a real ability to direct traffic.

A first comparison could be made with the value 1/M, expressed as a percentage as well. This value should represent the expected traffic share if all traffic from HC were directed in a perfectly random way on all the operators in VC [21]. Therefore if OMS >> 1/M this could lead to a good presumption of the effective ability of directing by *H*. For example, with M=3, 1/M would be 33%; then if the market share OMS of outbound traffic of H on V is, say, 60% (the other 40% being carried by other MNOs in VC), then the criterion seems satisfied.

However, the shares of traffic carried by *V* coming from other MNOs of HC than *H* could also be high as well, raising doubts as to the conclusions reached. Furthermore, this test is not generally able to capture newly born relations (for redirection), particularly with regard to operators that have recently entered the market. The problem in these cases is that the measure can be biased by external factors such as, *inter alia*, the relative coverage of

[21] Those networks inherently able to carry far less traffic than other operators, such as regional operators, new entrants with limited coverage or with emerging technologies, etc., could be excluded from the evaluation of M.

operators in the VC and their ability to cover top sites with better signals than their competitors.

For these reasons the OMS indicator should be complemented by at least one other quantitative indicator, able to capture the relative ability to direct traffic of *H* to *V* with respect to the average ability of all operators in the HC to send traffic to the same operator *V*.

This indicator, that we shall call Traffic Steering Index [22] (TSI), is defined as the ratio of two ratios: the first is the share of traffic of *H* carried by *V* over all traffic of *H* in VC, and the second is the share of all traffic coming from HC carried by *V* over all traffic coming from HC in VC.

This indicator is equal to 1, when the ability (or inability) of *H* to direct traffic to *V* is equal exactly to the average ability of any MNO in HC (including *H* [23]) to direct their customers to V; therefore, in this case, even a high OMS would not show other than a "natural" direction.

A TSI value less than 1 (say by 15-20%) could be a reasonable evidence that *H* customers are somehow deviated away from *V*. Conversely a TSI value far greater than 1 (say 10-15% or more), would seem good proof that the customers of *H* are directed to V more than on the average (and random) case, particularly, but not necessarily, if associated with a high relative OMS market share. The evidence would be almost definitive whenever all the TSI values of H evaluated with the other operators in VC different from *V* are less than 1 [24].

In order to make a sound assessment of the ability of *H* to direct the traffic of its roaming customers to *V*, it would be advisable to observe the two specified indicators, OMS [25] and TSI, dynamically over more than one time

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[22] This indicator was introduced by the author, in the context of the aforementioned ERG joint project on WIR in 2005, which he chaired. Formulas for calculating both OMS and TSI in general, and examples of using these indicators in real traffic cases and cross country analyses, have been also devised.

[23] It is debatable whether the traffic of the customers of H itself should be excluded when evaluating the denominator of the fraction; however this would arguably lead to more scattered TSI values, making it more difficult to draw conclusions in some instances.

[24] Some care must be taken in assessing TSI when OMS approaches 100%. However, a more detailed discussion of this issue lies beyond the scope of this paper.

[25] Evaluating OMS requires the use of data (better of traffic volumes) of outbound originated roaming, for the relevant service (say the voice call), provided by operator H. It is also possible to use the inbound originated roaming data provided by the operator V, by calculating, in this

period (usually a year to smooth out seasonality effects). Whenever both increase, for example, the presumption of an effective adoption of traffic directing techniques grows as well. Observing the trend in the two indicators for multiple periods, and for all the relevant M operators in VC, could definitely help to overcome possible uncertainties in rare, yet theoretically possible, critical cases.

The suggested quantitative analysis should be complemented by all the known qualitative information, such as partnership/alliance relations, discount agreements, technological developments, lifetime of handsets, consolidation time of the MNOs, network coverage, entry port coverage, quality of offered services, etc., that may underpin quantitative analysis conclusions and lead to the best informed judgment.

■ Captive traffic evaluation

After devising a criterion for assessing the effectiveness of traffic direction, we need to answer the second question regarding the amount of directed traffic that can actually be classified as captive, and hence the real efficiency of direction.

In other words, after having shown, as far as possible, that an operator *H* effectively employs traffic directing techniques to an operator *V*, it is important to assess whether it is necessary to introduce an adjustment to the observed traffic (of *H* on *V*) to evaluate the traffic really directed and the amount of such a correction.

Assuming that a non zero share of *H* traffic in VC is carried by operators different from *V*, this means that *H*, that by definition implements directing techniques to *V*, is not able to control a certain portion of its own customers' traffic. It is questionable whether such traffic could actually be considered contestable. The issue then becomes whether, following, for example, a decrease in the (wholesale) prices of a competitor, such traffic could be readily moved to a new operator(s). It is reasonable to assume that since *H* is not able to direct such traffic to *V*'s network (yet is supposedly willing), then it will not be able to direct this traffic to the network of any other given

case, the inbound market share IMS. Some algebraic relations could be devised between the two market shares.

operator, whether willing or not. Furthermore, V's competitors in VC might try to attract portions of this traffic, for example by targeted investments in coverage or advertisement. It is then arguable which market the traffic in question belongs to: to the contestable market, the so called merchant market, or not? [26]

In any case, it should be reasonable to propose the exclusion of the non steerable traffic share carried by *V* from the captive market of *V* itself. In fact, in principle, the non steerable traffic is distributed onto all the networks of VC, including the operator *V* itself. That's why an adjustment of the captive traffic of *V* might be necessary.

As a first technical step in this matter, given the traffic in the visited country of the competitors of *H*, we can try to assess, for operators that do not employ traffic direction to the same operator *V*, what is their average market share with *V*. This indicator could be considered a measure of the attraction ability of *V* for non steered or non steerable traffic. Let *AI[V]* be this ability (Attraction Index, measured in percentage points, related to operator *V*).

A good measure of AI[V] could be devised by considering operators, not necessarily from a single home country, that do not employ directing techniques with any operators in VC, thus avoiding any polarisation effect. The average market share found for *V*, evaluated over a sufficient number of operators [27], is a reasonable assessment of the attraction ability of *V* [28].

It is advisable to adopt the estimation tool for AI[V] more suitable for the specific case under evaluation [29], taking into account that the amount of the traffic adjustment should decrease in any case as long as the direction techniques improve.

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[26] For example, it could form a third segment, conceptually different from captive and merchant, that we could refer to as random.

[27] It could be enough to gather data for 5-6 significant operators from a couple of different countries.

[28] To estimate such an indicator, we could even use the simple average 1/M (substantially implying that the attractor of non steerable traffic is only based on random effects), or, at the other end, we could make the estimation more detailed by weighting it with the coverage and network quality of *V* with respect to other operators in VC.

[29] In our discussions so far we have assumed that any mobile operator has roaming agreements in place with any counterpart in a given country, but this is not always the case. We could have, for example, a measured direction of 100%, even in the absence of any adoption of traffic steering techniques and/or group/alliances partnerships, whenever the operator *H* has only a single roaming agreement in place with *V** in the Visited Country.

The AI[V] parameter could then be used to adjust IT[V,H], the inbound traffic, that measures the amount (not the share) of the observed traffic of *H* on *V*, in order to obtain the final *ICT[V,H]*, the inbound captive traffic, the real captive traffic of *V* from *H* [30] (that might be one of its Group partners, and that by definition employs effective direction to *V*).

Once ICT[V,H] is evaluated, the traffic steering "regulatory" efficiency of *H* on *V* immediately follows as the ratio between ICT[V,H] and all the traffic of *H* in VC.

An example will be useful to better understand these concepts. Going back to the Vodafone UK case with 80,000 minutes of traffic observed on Vodafone IT, let's assume that the Vodafone IT attractor is 33% (equal to the random distribution over the 3 Italian GSM networks) [31]. Since 20;000 minutes end up being carried by 2 other networks in Italy, the share of traffic that can be reasonably considered as not being actually directed by Vodafone UK and that is, however, carried by Vodafone IT is equal to 0,33*20,000/0.66, that is 10,000 minutes. It thus follows that the captive traffic of Vodafone IT with respect to Vodafone UK is ICT[Vodafone IT, Vodafone UK] = 80,000 – 10,000 = 70,000 minutes. The efficiency of direction could finally be measured by 70,000/100,000, i.e. 70% (versus a result of 80% produced by the first glance evaluation). Similar results can be derived using real traffic data.

■ Regulatory implications

In the previous sections we showed that, given any two mobile operators of two different countries, it is possible to answer the question whether one effectively employs traffic steering on the other, and, in this case, to estimate the really directed traffic and the "regulatory" efficiency of direction. These topics have been discussed from a technical perspective, but it is worth highlighting some resulting issues from a regulatory/economic point of view.

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[30] Some methodologies and formulas have been devised to calculate *AI* and *ICT* to be used in general cases.

[31] Actually Vodafone IT might have a higher attractor, being a well-established operator renowned for its wide coverage. We also assume that Vodafone UK has roaming agreements in place with the other 2 Italian GSM operators, which actually carry part of its traffic.

In theory, by subtracting from each visited country operator's inbound traffic the captive share related to its group operators, the result would be a distinct market, so-called merchant, which should represent the contestable traffic by the operators of the same country, supposedly in competition with each other. The captive traffic seems to be, on the contrary, withdrawn from competition, due to the fact that the foreign operators purposely direct this traffic onto specific networks with whose operators they enjoy close links, and hence is not subject to the same competition constraints. As said, this paper does not intend to explore the concept of captive markets in the Commission's practice [32] and in the Court of Justice jurisprudence [33], and only highlights the following issues related to the international roaming case.

Firstly, it may be appropriate to introduce a sound criterion for devising which operators should be considered when it comes to the definition of a given operator's (and later a national) captive market. A first possible definition would imply that, given a visited operator (under examination), only the foreign operators that belong to the same Group should be considered. "Belonging to the same Group" would assume the existence of a parent company with a controlling stake over the considered operators, or alternatively, with at least a minority stake in every operator under scrutiny. The latter seems the more widely accepted definition to date. Another variant of this definition could be obtained by considering other softer forms of control (i.e. dominant influence).

Secondly, it is arguable whether, in addition to the participation in a defined group, participation in a given alliance should also be considered. In this case, the relevant question is whether the simple voluntary participation in an alliance of companies with commercial objectives (and mutually advantageous agreements) is sound enough to imply a reciprocal captive market [34]. Further extending this reasoning, we might also consider the operators that, while not reciprocally belonging to a group or alliance, nevertheless have wholesale discount agreements in place, based on volume thresholds, and thus have a reciprocal incentive to direct traffic onto each other's network. This case can also be examined in the concurrent presence of group/alliance partnerships.

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[32] See for example the Case *COMP/M.2314 – BASF/Eurodiol/Pantochim*.

[33] See for example the Cases T-310/01 *Schneider Electric vs Commission* (2002) ECR II-4071 and T-221/95 *Endemol vs Commission* (1999) ECR II-1299.

[34] From the evidence gathered so far, the Commission would seem to believe that this is not the case.

Once the basic criteria for the definition of the captive market have been established, it should be appropriate to apply the effective direction test to all (foreign) operators included in the definition, to get a clear picture of the real situation. The normal scenario would be that group partners do employ directing techniques to a given operator under scrutiny. It could, however, be the case [35] that a certain company (operator), even belonging to the same group, does not employ any traffic steering mechanism to the scrutinized operator [36], thus raising the question whether the related traffic should be included at all in the relevant captive segment or not.

As a further issue, after assessing the ability of the chosen group of foreign operators to employ traffic direction techniques, we should then be able to assess the amount of traffic share to be considered captive, and, consequently, decide how to define the merchant market. The captive market could simply be the sum of inbound roaming traffic coming from operators belonging to the same group of each operator considered [37]. However, as shown in this paper, it may also be appropriate, depending on the judgment of the regulator, firstly to include only the group operators that effectively adopt traffic direction [38] and, secondly, to introduce the adjustment described in the previous section for the traffic of each relevant operator [39].

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[35] Examples of this have been experienced in real markets.

[36] Because the group recently purchased this operator or because it employs old network technologies, for instance.

[37] Or otherwise according to the chosen definition for the "belonging to the same group" issue.

[38] This traffic would, in fact, be carried by the operator under scrutiny in the end without any real desire on the part of the home operator and is not supposed to be easily movable following a change in pricing policies. Furthermore, traffic from the same home operator carried by the local competitors of the visited operator would, instead, contribute to the merchant segment.

[39] It should then be assessed whether it is necessary to include the adjusted (what we earlier called random) traffic share in one of the other segments or to consider it a distinct segment (as mentioned in the section on captive traffic evaluation), eventually negligible. The captive traffic of V would consist of the WIR traffic coming from operators in the same group/alliance and definitely directed, while the random traffic of the same operator V would consist of the traffic, coming from the same operators, that could be considered as not steered; the merchant traffic would then amount to the rest of the traffic carried by V. At a visited country level, the contestable traffic would be the sum of the merchant traffic of its individual operators. Only this would be the traffic potentially available to be directed in the short term to different operators as a result of a change in wholesale pricing policy. Under these hypotheses the random traffic could not be assimilated to the merchant because it was not ultimately controlled by the home operators. On a country level, it is distributed rather randomly on all the visited networks. It is a sort of core segment that remains observable as long as the directing techniques do not reach 100% efficiency.

The attention to punctual details in this assessment is deemed important when considering that the correct quantification of the complement merchant market, and the measure of the appropriate shares, could be fundamental in judging potential dominant positions in this new defined market.

After the above analyses regarding the most appropriate market definitions to adopt and the calculation of the shares, regulators may also find it necessary to proceed with a standard assessment of the competition level in the defined markets, particularly the merchant market. They may also want to tackle the question of whether individual visited operators in their own captive market should be considered monopolist. Finally, regulators, where they have found any dominant position, also need to identify and evaluate the effective extent of the eventual remedies to be applied.

Whatever the choices made by regulators regarding the issues we raised, this paper hopefully provides the tools to evaluate the real operators' behaviour and the eventual relevant national specificities to consider, as to the traffic direction issue, and so it should help to proceed towards better informed and comprehensive decisions. In particular, these decisions could also be needed for markets of products excluded by current common market definitions to date, such as MMS and other data services [40].

As for future steps, the Commission, with the regulation proposal currently under approval at EU political level, seems to be taking very direct action in order to achieve the objective of reducing the retail tariffs of international roaming for end users within a relatively short time. However, even EU direct regulation will not last forever [41]. In the longer term different solutions might be explored to direct this market to function in a more competitive manner. For example, regulators could look at the market from new and different perspectives, that foresee a radically different structure of the market, whose functioning has been always been mainly taken for granted to date. For example, a regulatory approach that foresees more flexibility for operators in defining and marketing retail offers directly to the customers of foreign operators could be considered. This approach may ensure a structural change able to address the root of the problems in this interesting yet tangled market.

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[40] Furthermore, one of the amendments to the aforementioned Commission's draft proposal of international roaming regulation under approval foresees the obligation to monitor whether traffic steering techniques are used to the disadvantage of customers for member states.

[41] Current discussions are for a sunset clause of around three years.

Annex 1 - Technologies for international roaming traffic direction.

There follows a brief description and discussion of the technologies most commonly employed by mobile operators to direct their customers' roaming traffic to specific preferred foreign networks.

Preferred Network List

When a mobile customer switches his/her handset on for the first time in a foreign country, the handset will search first for its home network (namely the national home operator) stored in the SIM card, then the last network where the handset was registered on. Failing to find both, it will then start a search for an available network among those listed in the Preferred Network List, a list of operators stored in the same SIM card. Failing again to find any network in the list, it will finally randomly select one network among all those whose signal is present (above a given floor level).

The Preferred Network List stored in the SIM can then be considered a method, generally the first employed by operators, to direct traffic. It is evident that the efficiency of any choice based on the preferred list is relatively low, due to the fact that the first choice of the handset, apart from the home network, is the network that it was registered on the last time it was used. It may be that, should the network(s) in the list not cover the specific place where the user switches the handset on, registration will take place in a random way. This new choice will then be retained on subsequent occasions when the user switches the handset on. The same applies whenever the handset looses coverage while roaming.

Another reason for its low efficiency is that the operators in the preferred list are stored in a rather static way, compared with the market dynamics where many changes in alliances and grouping take place over time. This means that an operator could remain in the list even if it is no longer "preferred" by the home operator. Conversely, a new operator in the relevant group/alliance may not the chance to make it onto the list very quickly.

For these reasons, operators put some effort into finding methods for updating the preferred list in the past. However, particularly with the advent of GSM developments, preferred list maintenance became rather problematic, normally requiring a physical swap of the customer's SIM, which was an expensive and long task.

Another limitation of the preferred list technique, is the finite dimension of the SIM memory, that cannot contain more than a given number of networks, for example, with the most common SIM types around 50. This makes it unfeasible to include more than a couple of networks for the most roamed 25 countries, or more than 50 networks in total in any case.

SIM-Toolkit/OTA

The introduction of SIM Toolkit technologies (a software SIM management technique), together with OTA (Over The Air, a SIM remote management tool), was a big step forward for traffic direction, because it allowed the updating of SIM content, including the preferred list, by means of automated procedures. However, this technique is not completely satisfactory: as discussed earlier. In fact, if the handset is tuned into a "non-preferred" network, this network is retained for any subsequent

registration until the handset is moved (or switched on) in an area where that network does not have, even temporarily, coverage, and, at the same time, there is at least one preferred network active. So even if this technique was a step forward for traffic direction, the efficiency of the process can still be improved.

Bearing in mind our discussion of the handset registration mechanism, it is reasonable to assume that coverage investments at the main entry ports in a given country were, and still are, a key traffic direction technique themselves.

Assisted roaming

A handset with the assisted roaming feature is able to automatically register with a network in the preferred list when switched on, irrespective of the last registered network. This means that, within the appropriate coverage area, assisted roaming directs the handset towards the preferred network(s) when it is switched on. Assisted roaming is consequently a handset feature and can be used in conjunction with the SIM Toolkit/OTA.

The assisted roaming feature is a further step forward for the efficiency of traffic directing techniques, but handset compliance must be ensured. Therefore mobile operators cannot have total control over the effective diffusion of this feature among their customers.

Managed roaming

Recently a new set of technologies have been introduced in the market, generally referred to as managed roaming. This feature allows the handset to undertake the same process of assisted roaming, with the addition that any attempt to register with a non preferred network is initially denied and the handset tries to register with a preferred one. This feature has the added value, compared with assisted roaming, of not depending on the handset type or SIM, and is network dependent instead.

Yet managed roaming technologies allow, depending on the network configuration, customers to manually select a network (although this procedure is generally unknown to most users) and to register temporarily with a backup network, where any preferred one is unavailable, under operator control.

GSM 1999 EPR

If a mobile handset is compliant with the "GSM Release 99 Enhanced Preferred Roaming (EPR)" standard, when it happens to register with a non preferred network (for example, by backup or manual override), then the handset will periodically search for a network in the preferred list, and register with it whenever available. The home operator can define the period of search. The EPR feature can complement any managed roaming solution.

Other technologies

There are further functionalities, more or less attributable to the Traffic Direction category, such as HLR blocking/barring, that make it possible to directly deny any registration to a given network. By means of such features the operator can prevent its customers from registering with a non-preferred network by configuring their HLR (Home Location Register, the national database with customer profiles). The use of such techniques, at least in the past, was questioned as a potential infringement of

the GSMA (GSM Association) code of conduct. However, in practice, these technologies do not differ that much from managed roaming.

As shown in this overview of traffic directing technologies, there is ample choice for mobile operators to enable their customers' traffic to be carried by a preferred network. Since the relative efficiency of the various technologies is variable, the best result from an operator perspective can be achieved by using many such technologies in a complementary way.

Annex 2 – Acronyms

ERG	European Regulators Group
EU	European Union
HC	Home Country
HLR	Home Location Register
IOT	Inter Operator Tariff
MMS	Mobile Multimedia Service
MNO	Mobile Network Operator
NRA	National Regulatory Authority
SIM	Subscriber Identity Module
VC	Visited Country
WIR	Wholesale International Roaming

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