

Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies

BACHELOR THESIS

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Analysis of International Mobile Roaming and the European International Roaming Regulation

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v Praze dne 15.5.2008

Vojtěch Bartoš

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Název práce: Analýza mezinárodního mobilního roamingu a Evropské regulace mezinárodního roamingu

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Abstrakt: Tato práce analyzuje současnou situaci mezinárodního mobilního roamingu. Nejdříve zkoumá nákladovou strukturu a komentuje všechny složky z různých úhlů pohledu, aby tak vybudovala základ pro náležité odvození nákladově založené regulace. Dále navrhuje různá nápravná opatření, jelikož jak trh velkoobchodních roamingových služeb, tak i kontroverzní maloobchodní trh roamingových služeb byly shledány Evropskou komisí jako nekonkurenční. Konečně práce komentuje současný regulační rámec Evropské komise. Navrhuje opatrnost při použití koncepce evropského domácího trhu a varuje před přílišným omezením zisku malých operátorů za současného regulačního rámce.

Klíčová slova: mobilní telekomunikace, roaming, regulace, Evropská komise

JEL klasifikace: F53, K20, L13, L51, L96

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Abstract: This thesis analyzes the current situation of the international mobile roaming. It shows the costs structure and discusses all the categories from various points of view as an introductory background for a proper derivation of a cost based regulation. Further it proposes certain remedies as both the markets of wholesale and controversial retail roaming services were found uncompetitive by the European Commission. Finally it gives few comments on the current European Commission regulation. It proposes caution while dealing on the level of European Home Market and warns of profit squeeze for smaller operators under current regulatory framework.

Keywords: Mobile telecommunications, Roaming, Regulation, European Commission

JEL classification: F53, K20, L13, L51, L96

Abbreviations

- ARPU - Average Revenue per User
- CAMEL - Customized Application for Mobile Enhanced Logic
- CTU - Czech Telecommunications Office
- EC - European Commission
- EEA - European Economic Area
- EU - European Union
- GSM - Global System for Mobile communications
- GSMA - GSM Association
- GSM MoU - The GSM Memorandum of Understanding
- IMCO - European Parliament's Committee on Internal Market and Consumer Protection
- INTUG - International Telecommunications Users Group
- ITRE - European Parliament's committee on Industry, Research and Energy
- IOT - Inter Operator Tariff
- MNO - Mobile Network Operator (usually referred simply as *operator*)
- MTR - Mobile Termination Rate
- NRA - National Regulatory Authority
- SIM - Subscriber Identity Module
- STIRA - Standard Terms of Roaming Agreements

Chapter 1

Introduction

The year 2007 and date of June 27th represents a milestone of cross-border mobile communication inside European Union (EU). Commissionaire for Information Society and Media of the European Commission (EC) Viviane Reding succesfully finished the procedure leading to roaming regulation in the EU. The regulation has been ratified by that day and since June 30th all mobile operators in the member states are obliged to offer a Eurotariff with criteria specified in the regulation (EC) No 717/2007. The battle against mobile operators has been brought to an end and the consumers are now given the "*freedom to roam.*" ¹

The discussion on roaming regulations was hot especially during the last two years since the first public consultations organized by the EC on February 20th 2006. The reactions of mobile operators were at first rather negative, opposing any regulation proposal and stressing the competitiveness of the market. In the later phase of the consultations, as the regulations seemed more and more inevitable, they put forward their own proposals on market adjustments.

In fact, the first proposal to regulate roaming prices is dated already June 1999 when the first sector inquiry into mobile roaming prices was launched by GSM Association. Regulation of roaming prices was initiated by concerns of end-users of either international or national roaming raised to the EC and

¹Says Viviane Reding on her webpage – see:

http://ec.europa.eu/commission_barroso/reding/.

these led to an INTUG report in 1999. The report showed that roaming prices were in some cases many times higher than the prices of non-roamed calls. The results were alarming and the above mentioned sector inquiry started.

The reason for the creation of the EC's regulation proposal from July 2006 was thus evident. Market of mobile roaming was found uncompetitive and the high prices caused by the lack of competitiveness were worsening the effort of unifying Europe as a single market. The treatment had to be based on a regulatory basis compatible with the Article 95 of the EC Treaty, because the cross-border bi- or multilateral agreements could not be regulated by National Regulatory Authorities (NRAs).

Specificity of international roaming is, besides, in its great technological intensity. The fixed costs are very high as well as is the uncertainty of the investments success. The simple cost based pricing as under perfect competition is thus undesirable for the operators.

Another problem is the different importance of roaming to consumers on one hand and to operators on the other. While the former use roaming mostly only as a supplementary and marginal product, the later are highly dependent on roaming revenues that make up to 5%-10% of mobile operators total revenues. The low elasticity leads towards higher prices of the services. The effective pricing under such conditions in a multi-product firm² is called Ramsey-Boiteux pricing as we will learn further in the text.

Moreover the regulatory approach must be treated very carefully as there is no equivalent in the history of regulation and competition law. The reader might argue that similar regulations have been carried out already many times – e.g. in railways, airlines or telecommunications. She can argue that all the mentioned sectors have both the high fixed costs and a cross-border nature. However, the roaming market needs to be much more technologically endowed. Its billing, for instance, needs to be realized instantly and effectively in very low values, but in large amounts. This makes it different from the two mentioned markets - airlines and railways.

²And mobile telecommunication companies – operators – offer many services ranging from mobile phone sales to voice and data services provision.

The reader can further argue that fixed line international calls are billed similarly. However, she does not realize the fact, that roaming differs from international calls in the way that roaming subscriber takes his home device registered by the home operator to the foreign country. The billing and user network registration is thus done over the border which makes it a totally different – and more expensive – service.

Aim of this work is to inform the reader about the problems and specifics of the international mobile roaming, its costs and lack of competitiveness and later to show what impact may be expected from the ratified regulation by the EC from July 2007. We examine both the proposed version from June 2006 and the ratified one and argue why certain steps were proposed at the beginning and why some were later modified or completely replaced.

In chapter 2 we will discuss roaming from the economic sight. First we will introduce the basics of mobile communications and its technicalities with main stress on roaming. Then we will introduce our method of estimation of wholesale and retail roaming cost while considering various aspects contributing to roaming cost structure such as new technologies or organization structures.

Further in chapter 3 we will deal with regulatory approach and the theoretical background of the European international roaming regulation. We will discuss what are roaming markets – i.e. wholesale and retail – and why are these considered uncompetitive. We will propose some remedies leading to improvement of competitiveness within the markets.

Chapter 4 will give an overview of main documents related to the international roaming regulation. We will put the main stress on the roaming regulation proposal from June 2006 (EC , 2006a). We will emphasize the effects of the proposal on operators of different sizes and different conditions. Later, we will show how the regulation was finally approved, what was remedied and what possible perils may the regulation bring in the future.

Chapter 5 brings conclusions.

Chapter 2

Technical aspects of roaming and Basic terms

In this chapter we will start with some basics of mobile telecommunications. Later we will concentrate on the international mobile roaming. We will give a few comments on the background of the service and further we will describe both the wholesale and retail markets with all its problems. We will try to set basics for estimation of wholesale costs under various scenarios of international roaming calls. In the retail part we will discuss the the pricing schemes of international mobile roaming and the difficulties of the latest trend: the flat-rate pricing. At the end of the chapter we will show the specific costs of roaming in more detail.

2.1 Mobile Communications

Since 1983, when the first cell phones of the first generation (1G) were introduced, the cellular telephony made a great progress. From the suitcase telephones, excessive prices and insufficient network coverage to the recent hand-helds of the size of a credit card and network coverage almost on all places of the planet, even in the poorest parts of it.

The wireless telecommunications have drastically changed the behavior of people and led to great economic advantages. The Economist (2008a) calls it the most important and most successful technology introduced in the emerg-

ing economies that helped to significant boost of these economies. In the western world, however, the effect is similar. The industry creates new workplaces mainly in the human-capital intensive positions and thus adds to the worlds productivity.

Consumers demand more and more sophisticated technologies ranging from data transfers, internet banking to even controls of home devices through their mobile phones. The business side does not keep them waiting.

In the EU countries the penetration has already exceeded 100% and the revenues are great. There is an ever greater pressure on more usage of the mobile phones behind the borderline of the home country of subscribers since the Europeans tend to travel more. Either if travelling for vacation or for business purposes. Such demands can be fulfilled by roaming services offered by the Mobile Network Operators (MNOs).

2.2 International Mobile Roaming

Roaming is generally a term used in the wireless telecommunications and stands for widening of the range of communication connectivity into another than a home location - the place, where the telecommunication service is registered. In the following we will understand the term *roaming* for the international roaming in mobile telecommunications. That means the case, when the cell phone is located outside the area covered by the network to which the user is subscribed. The other possibility would be a term *national roaming* which is not of our interest. We will set only the basics and refer to relevant sources later.

Let us consider a person travelling from home country A to a foreign country B where the home operator A^O does not have his own network coverage in the area of country B . However there is an operator B^O in the country B who has a roaming agreement with operator A^O . Mobile phone of the traveller will be connected to the B^O network (He usually has a choice to choose from various networks, either manually or automatically.) and the B^O will handle all operations needed. Such service is called roaming.

2.2.1 GSM Association

All mobile operators from the EU countries are members of the GSM Association (GSMA). The goal of GSMA from its foundation in 1987 is standardization of mobile services. The association stands as a promoter of an unified technology that enables users that their mobile devices are working worldwide and that the users are accessible all over the globe. Therefore the straightforward goal of the GSMA is to maintain roaming and promote unified and nondiscriminatory agreements.

The GSMA represents more than 700 operators in 218 countries of the world which makes GSM *Family of Technologies* a largest group in the field of mobile telecommunications.¹

The roaming agreement in GSM networks (which we will consider in the whole further text as roaming in all European countries is determined by European GSM interconnection process) is given in the GSM Memorandum of Understanding (MoU) providing a general basis for establishment of international roaming, the general terms called Standard International Roaming Agreement (STIRA) and on the Inter Operator Tariff (IOT) developed by GSMA. The agreements are usually reciprocal. That means, that operators agree on reciprocal conditions of provision of roaming services. This is, however, not always the case.

2.2.2 Standard Terms of Roaming Agreement

The STIRA framework bounds the MNO's to apply nondiscriminatory tariffs to all operators. It is a general framework including technical and financial details on the roaming services offered to the partner operator.

What is being criticized in some papers - e.g. Stumpf (2001) - is rigidity of STIRA towards Mobile Virtual Network Operators (MVNO) as these are excluded from STIRA altogether. We will discuss the effect of this exclusion

¹GSMA has already exceeded the "magic line" of 2.5 billion subscribers according to GSM Brochure (2008) and www.gsmworld.com website. Another cellular bearer technologies (such as UMTS, mainly in the USA), however, do not even make up to 300 million subscribers.

later in the text in chapter 3.

2.2.3 Inter Operator Tariffs

GSMA launched a new version of wholesale pricing unit in 1999 called IOT which is the core of a wholesale pricing system. The system works well due to transparent policy of GSM allowing interested public (meaning mostly foreign MNO's) to see the IOT setting of each and every foreign operator (who is a member of MoU) through GSM Infocentre.² Naturally the IOT's of home country competing operators are not visible as it would harm pricing policies of the operators and would be contrary to competition law as it would allow cartel agreements etc. This rule is though not so strict these days as cross-border mergers occur ever more often. The foreign branches are thus able to convey these figures to the home-located MNO's. However, the harm of STIRA framework is a possibility to apply discounts on IOT's which are confidential and are not to be shared with other MNO's. These tariff exceptions are the main concern to the price inequalities. Such worries are mentioned in more papers dedicated to the topic of roaming regulation. Let us mention at least Stumpf (2001) and Lupi, Maneti (2006).

The dataset called TAP3 is the latest version of databases recording used roaming services. The database contains data on each call that can be later billed upon agreed price from IOT. The call records must contain all the necessary information. The dimensions of the dataset are according to Stumpf (2001):

- Destination - domestic or international
- Time of day - peak or off-peak
- Time unit - 10 seconds / 30 seconds / 1 minute or other
- Type of terminated network - fixed or mobile

²Accessible online for registered users or possible applicants for signing up at: <https://infocentre.gsm.org/>.

- and may include a set-up fee for each call

There are even IOT settings for SMS or other data services, but as our text is dealing with voice services only, we will not go to any more detail than mentioning the existence.

It is worth of noting here that the IOT is only charged to the home network by a visiting network when the subscriber of the former makes a call. If the same subscriber receives a call while being connected to the visited country network the IOT is not charged (ARCEP , 2006). We will show why later in this chapter.

Moreover it is very important that the reader understands that the IOTs are not the costs of wholesale services as it may be even sometimes confused and that there may be not even any correlation between the two terms. Later in the text we will show that there is a lack of pass-through of lower wholesale costs to consumers. This is mostly caused by leaving IOT rates high even if underlying costs are falling.

2.3 Wholesale international roaming services

Wholesale roaming services are services among operators from the home network (in the home country) and from the visited network (in the foreign country). These allow subscribers of the home network to use the services of their mobile telephones in the visited network. Strictly speaking, the range of services is currently, the same as if calling in the home country. Further many operators try to maximize the coverage by contracting in many countries (and operators there). Thus subscribers are not limited by the border, can use the same SIM card, same mobile phone and can use the same services as they are used to at home.

In this section we will deal with the technology that enables roaming. Then we will try to estimate the costs of the wholesale roaming services as well as we will inform about some recent technologies or possibilities for MNOs to reduce their wholesale costs of roaming.

2.3.1 GSM Network Architecture

The architecture of GSM networks is built on very sophisticated technologies, but its design is rather easy for understanding. We will need to know the basics of the architecture to understand the underlying costs of various roaming services. The supplementary visual scheme is given in figure 2.1.

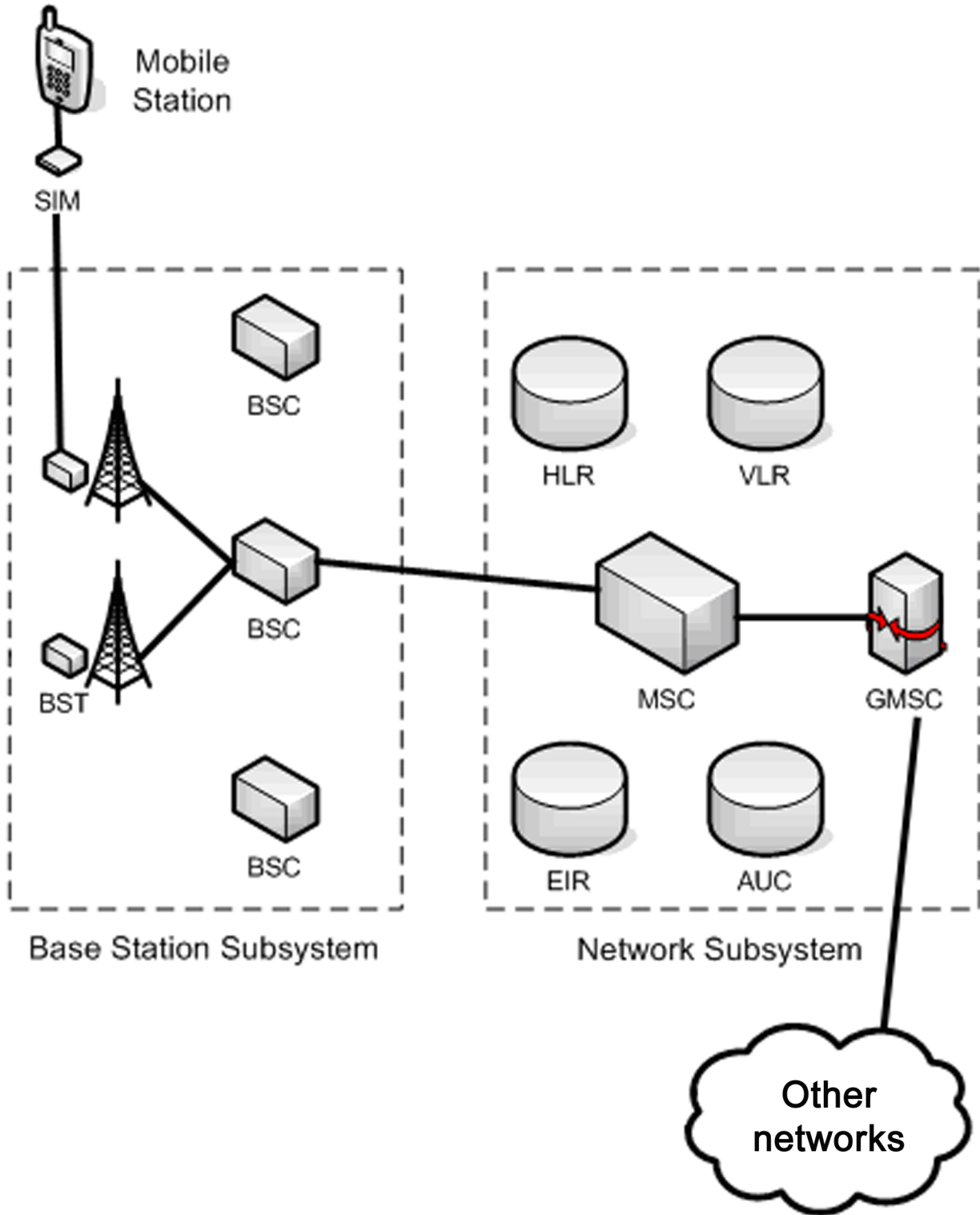
The first unit in the architecture is the Mobile Station (MS) which is your and any other mobile phone. This unit connects over the air to the Base Station Subsystem (BSS) which is mostly known as the antennas quite everywhere in the landscape. These are Base Transceiver Stations (BTS) communicating further with Base Station Controller (BSC). BSC is the most robust and sophisticated element within the BSS. It handles usually from 10 to 100 BTSs and collects data and transfers voice channel from the MS. The identification data are located on MS Subscriber Identity Module (SIM) card. The card contains the International Mobile Subscriber Identity (IMSI) which is further recognized, located and billed if some service is requested.³

The further circuit of GSM architecture is the Network Switching Subsystem (NSS). The core of this subsystem is the Mobile Switching Center (MSC). The main function is switching the calls to desired mobile phones or fixed stations. The basic idea behind the currently very smart technology is the telephone exchange that used to switch calls manually as we can remember from older movies. However, MSC maintains the switching between mobile phones and fixed telephones, as well as it supports the mobile phones mobility management.

Further the NSS contains Home Location Register (HLR), a database containing details of each mobile phone subscriber of the concrete GSM network; Visitor Location Register (VLR) is a temporary database of subscribers who are roaming into the area operated by the concrete GSM network. The VLR stores all necessary information about the roaming subscriber - e.g. her allowed services, her phone number (or MSISDN), her HLR address. There are many more services within the core GSM network but we will mention only

³The IMSI is different from the mobile phone number that we are calling. The mobile phone number is stored in a MSISDN.

Figure 2.1: GSM Architecture



source: Falch, Henten, Tadayoni (2007)

the Billing Centre (BC) that is responsible for generating a bill for all subscribers registered not only in the HLR but even in VLR, thus generating a bill to a roaming customer or better to her home network.

2.3.2 Scenarios of roaming services

In the previous subsection we have informed the reader about technicalities of mobile communications with regard to roaming. We give an example of possible roaming scenarios on an example of a Czech tourist traveling to Germany for his summer holidays. We can think of four different scenarios of roaming calls.

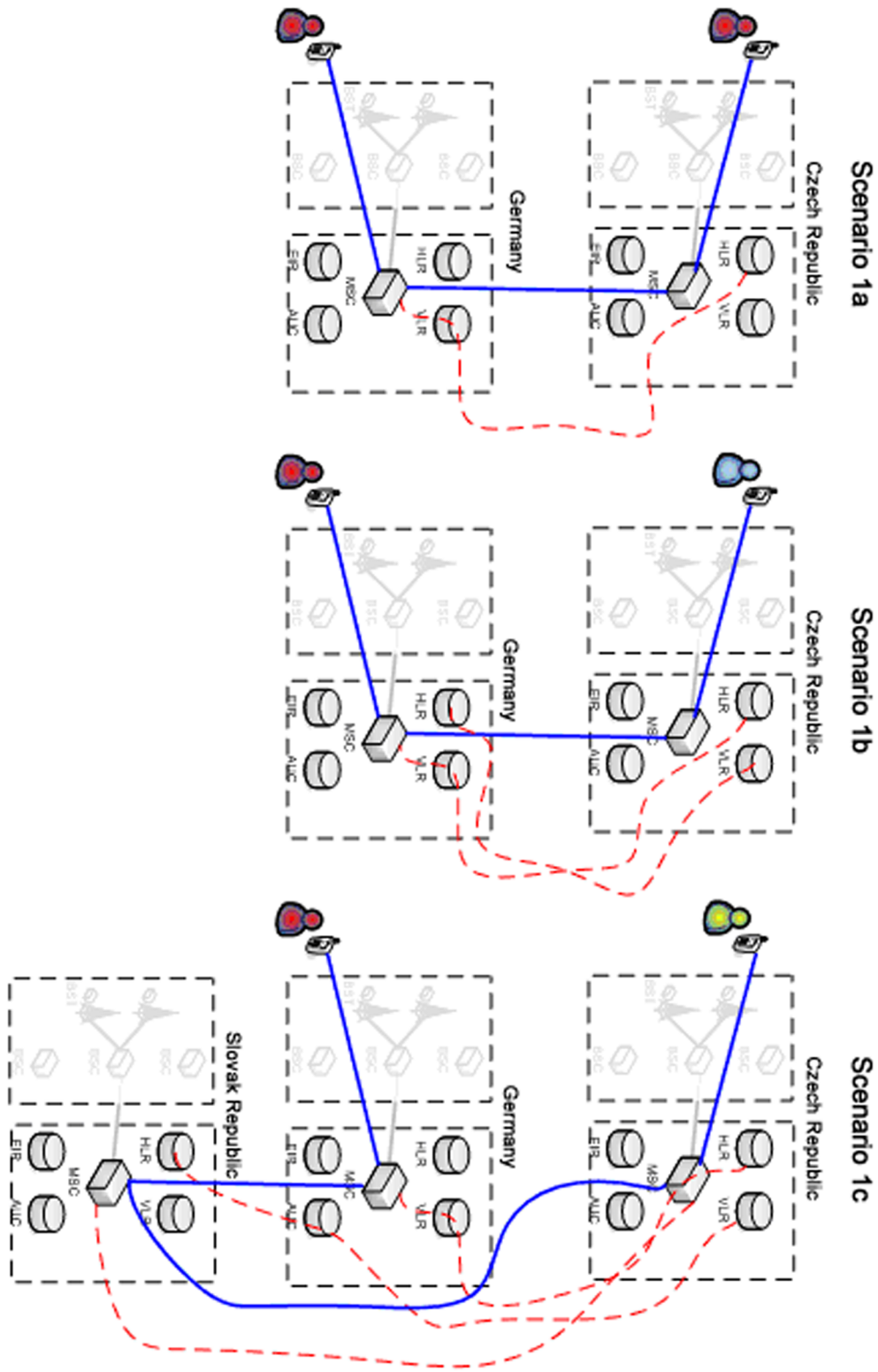
1. Calling home from the visited country
2. Calling within the visited country
3. Calling to other than home or visited country
4. Receiving a call

Bellow we will deal with all scenarios in more detail. We will think of what services are used for each scenario to be later able to derive the underlying costs of wholesale roaming services. We know that cost of each call consists of mobile origination (*MO*), mobile or fixed termination (*MT*, respectivel *FT*), international transfer costs (*IT*) and roaming specific costs (*RSC*). We assume that mobile origination has the same cost base as the mobile termination, thus we further denote both *MO* and *MT* only as $2 \cdot MT$. Some more details to this assumption will be given further in the text. To *RSC* we dedicate an individual section later in this chapter as the topic is rather demanding and controversial as we will see later, especially in chapter 4.

Calling home from the visited country We can further divide this scenario to three more subsections.

1a) Czech tourist calls from Germany to the Czech Republic to a Czech subscriber — This means that the origination begins in Czech Republic.

Figure 2.2: Roaming technologies - Calling home from the visited country



source: Falch, Henten, Tadayoni (2007)

There is one origination, one transit and one termination (either mobile or fixed – depending on what the user in the Czech Republic uses, further in the scenarios by termination we will mean either fixed or mobile termination). Mathematically we derive:

$$C_{1a} = 2 \cdot MT + RSC + IT \quad (2.1)$$

1b) Czech tourist calls from Germany to the Czech Republic to a German subscriber — The call originates in Germany. VLR in the Czech Republic requests info from HLR in Germany. There is thus one origination, one transit, extra signalling between the countries and one termination. Mathematically:

$$C_{1b} = 2 \cdot MT + RSC + IT \quad (2.2)$$

1c) Czech tourist calls from Germany to the Czech Republic to a Slovak subscriber — The call is originated in Slovakia. VLR in the Czech Republic requests info from HLR in Slovakia. There is one origination, transfer from Germany to Slovakia, transfer from Slovakia to the Czech Republic and one termination. Thus we derive:⁴

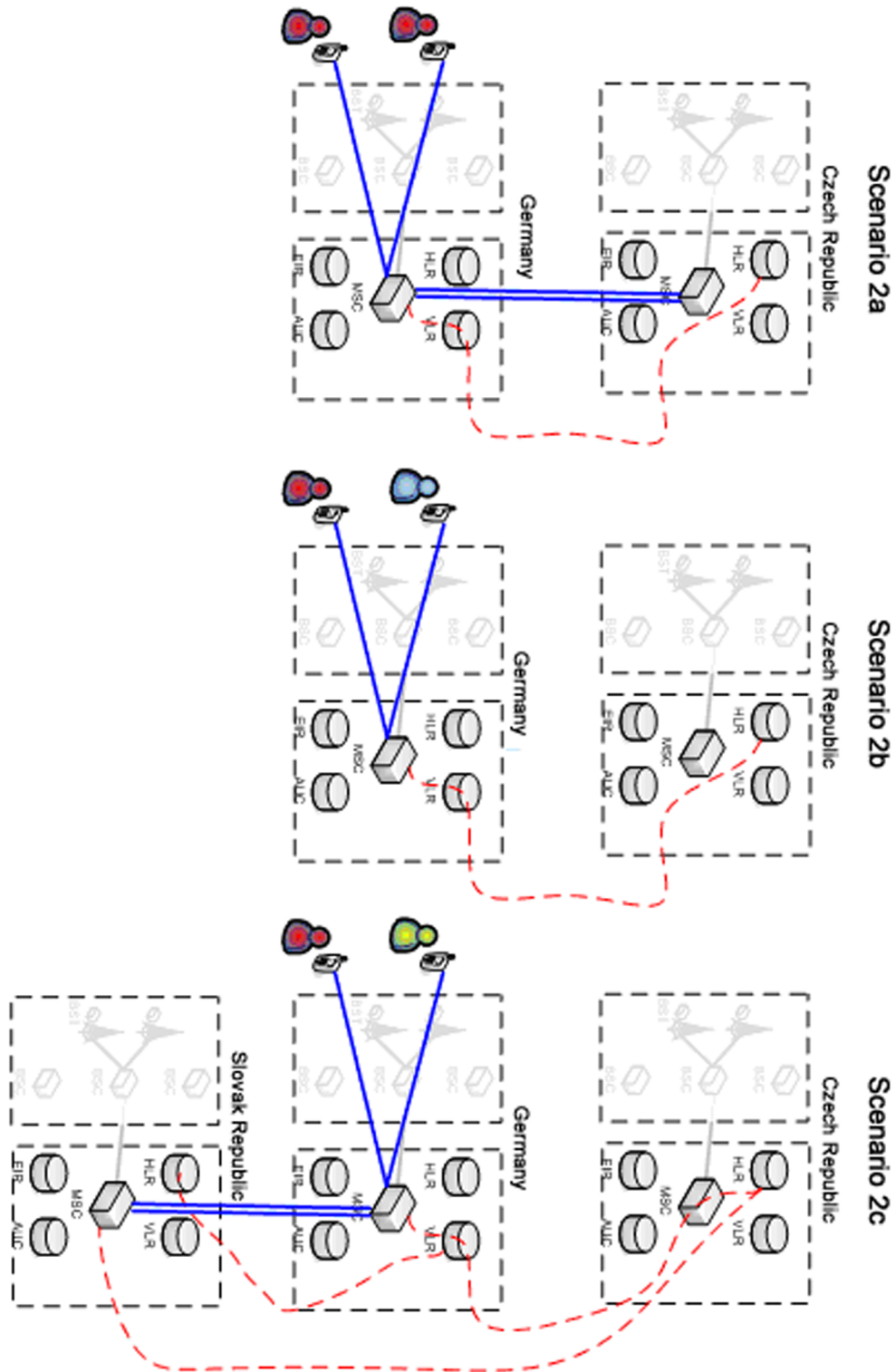
$$C_{1c} = 2 \cdot MT + 2 \cdot RSC + 2 \cdot IT \quad (2.3)$$

Calling within the visited country

2a) Czech tourist in Germany calls to a Czech subscriber in Germany — Usually the call is set-up and switched in the Czech Republic. Thus it requires two transfers from both subscribers. However, Falch, Henten, Tadayoni (2007) add that such so called *tromboning* may be bypassed by certain technologies that allow handling of such calls as this one within the visited country. Yet this requires beside additional technology contracts between operators. This is so costly that for most operators this

⁴In scenarios 1c and 2c we expect higher RSC because of more complicated call handling. Falch, Henten, Tadayoni (2007) confirm our statement.

Figure 2.3: Roaming technologies - Calling within the visited country



source: Falch, Henten, Tadayoni (2007)

method is rather unprofitable. We would better further count with one origination, one termination and two transfers or mathematically:

$$C_{2a} = 2 \cdot MT + RSC + 2 \cdot IT \quad (2.4)$$

2b) Czech tourist in Germany calls to a German subscriber in Germany —

The call is originated in Germany as well as switching is. Still there is some signalling between Germany and the Czech Republic because of billing. We assume VLR in Germany has already received information from the Czech HLR. There is thus one origination and one termination or mathematically:

$$C_{2b} = 2 \cdot MT + RSC \quad (2.5)$$

2c) Czech tourist in Germany calls to a Slovak subscriber in Germany —

The call is originated in Slovakia. This needs one transfer. The call is switched to the Czech Republic and this requires additional transfer. Thus we can expect the same results as in scenario 2a. The same holds true for the technology bypassing *tromboning*. Again, we have one origination, two transfers and one termination. Moreover, additional signalling is required between the Czech operator and the Slovak one. Mathematically we derive:

$$C_{2c} = 2 \cdot MT + 2 \cdot RSC + 2 \cdot IT \quad (2.6)$$

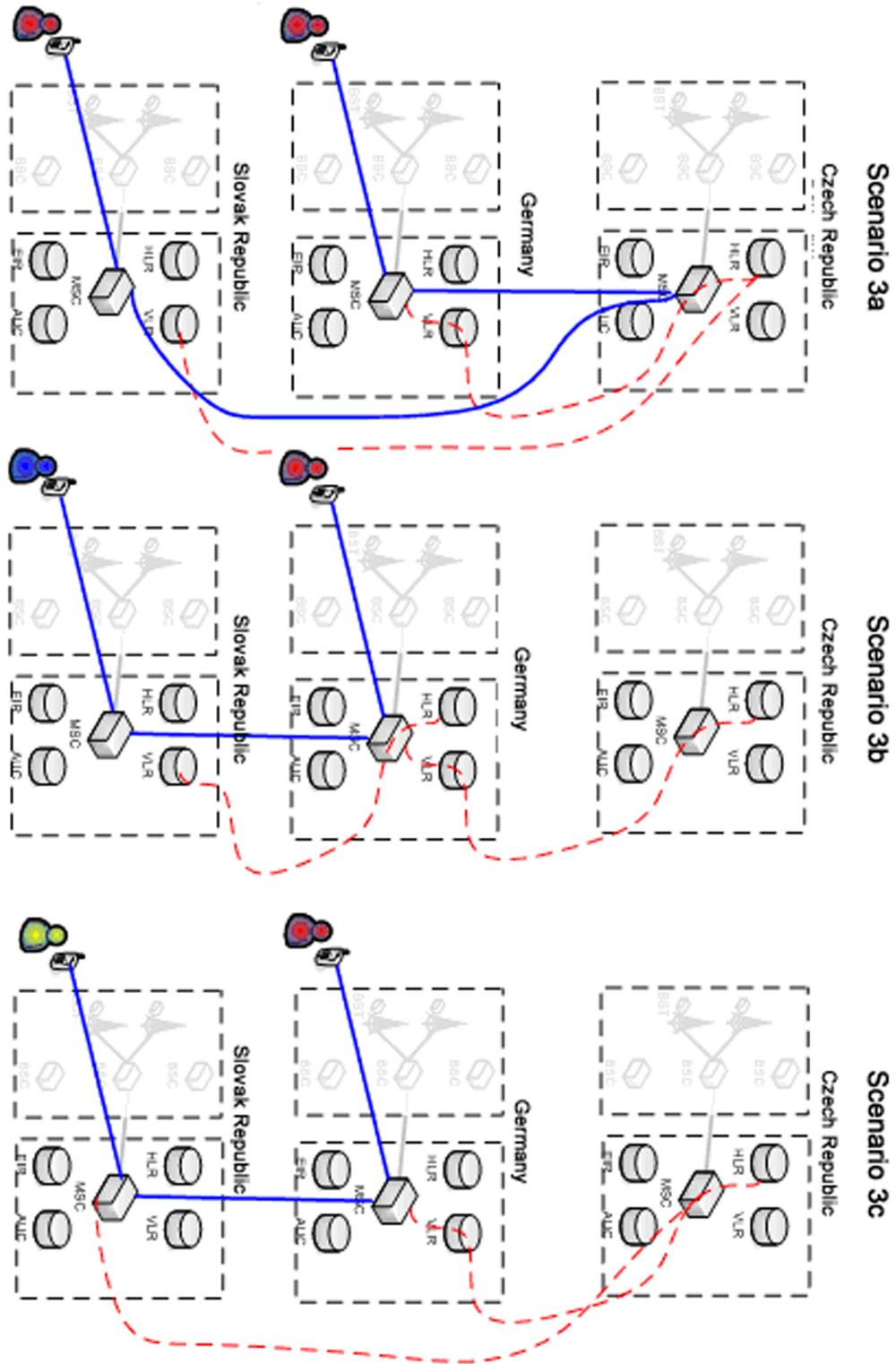
Calling to other than home or visited country

3a) Czech tourist in Germany calls to a Czech subscriber in Slovakia —

The call is switched and set-up in the Czech Republic. There needs to be additional transit to the one from Germany to the Czech Republic from the Czech Republic to Slovakia. We have one origination, two transfers and one termination. We derive:

$$C_{3a} = 2 \cdot MT + RSC + 2 \cdot IT \quad (2.7)$$

Figure 2.4: Roaming technologies - Calling to other than home or visited country



source: Falch, Henten, Tadayoni (2007)

3b) Czech tourist in Germany calls to a German subscriber in Slovakia —

The call is originated in Germany where it is switched. Thus we have only one transfer, one origination and one termination. Mathematically:

$$C_{3b} = 2 \cdot MT + RSC + IT \quad (2.8)$$

3c) Czech tourist in Germany calls to a Slovak subscriber in Slovakia —

The same situation as 3b, only here the call is set-up and switched in Slovakia. We have one origination, one termination and a transfer or mathematically:

$$C_{3c} = 2 \cdot MT + RSC + IT \quad (2.9)$$

Receiving a call The call differs from all above mentioned scenarios: the receiving party is not charged the origination charge which is paid by the calling party. Thus if we consider all scenarios above and subtract the origination charge we receive the cost of receiving a call. Or:⁵

$$C_4 = RSC + IT \quad (2.10)$$

2.3.3 Wholesale roaming services cost estimates

In the previous subsection we have shown the technicalities of setting up a call. We will need this background in following chapters⁶ to estimate the average wholesale costs of roaming. This is necessary if we wish to bring the market to the competitive state by the regulation rules. The regulation should be cost-based, which means we are trying to draw the market nearer to the perfect competition.

From the scenarios proposed we see that the main cost difference is between calling from the visited network, or the outbound roaming, and the inbound roaming, which means receiving a call. As we will see in the next section the difference is visible even in the retail side.

⁵In this scenario we include only costs that are to be paid by the receiving party. The calling party pays off $2 \cdot MT$.

⁶See chapter 4.

The scenarios of the outbound roaming differ mainly in signalling and international transfer costs. As we will see later these are not significant and thus the costs of the outbound services are approximately the same within the network.

2.4 Retail international roaming services

Most important to end users of roaming services are the retail prices. These are basically derived as a percentage mark up (handling charge) on wholesale prices (BEUC , 2006). The range varies from 10% to 35% according to Stumpf (2001). Moreover the mark up varies from country to country but within the country it is usually being equal for all operators. The prices are thus directly derived from the wholesale rates. We will show, however, that there is lack of pass-through from lower wholesale costs to the retail prices as the IOTs (wholesale prices) remain very high.

The paper by Lupi, Maneti (2006) shows the difference between retail prices of roaming originated, outbound roaming, on which IOTs are applied, and roaming terminated calls, inbound roaming, on which IOTs are not applied as, we have discussed in the previous section. See table 2.1.

In their paper Lupi, Maneti (2006) talk of the great difference between the two services as of a proof that IOTs are being set unjustifiably high. This assumption is rather incorrect. Anyway, we can see that the difference is caused mainly by the differences in costs of the wholesale services. We cannot say much about the IOTs if we give no insight in underlying costs of the operators. This was shown in the previous section while talking about possible scenarios of roaming voice services. We will discuss later in the chapter 4 the costs of both inbound and outbound roaming in real figures and we will show why there is space for regulation but we will not base it on assumption of Lupi, Maneti (2006).

We now know there is a difference between retail prices of inbound and outbound roaming. The main concerns of the EC while proposing a regulation were though the differences of prices between the operators. In the section

Table 2.1: Sample prices for 4 minute inbound and outbound calls (euros)

Home country	Visited country	Placing	Receiving	$\Delta\%$
		a call	a call	
Austria (A1)	Estonia (Elisa)	6.4	2	+ 220 %
Belgium (Mobistar)	Italy (TIM)	4.4	2	+ 120 %
Denmark (Sonofon)	France (Orange)	4.97	1.88	+ 164.4 %
Finland (Mobistar)	Italy (TIM)	4.4	2	+ 120 %
France (Bouygues)	Spain (Amena)	6	1.88	+ 219.1 %
Germany (Vodafone)	France (Orange)	5.1	2.36	+ 116.1 %
Italy (Wind)	UK (O2)	4	1.4	+ 185.7 %
The Netherlands (KPN)	Finland (Finnet)	5.52	2.76	+ 100 %
Spain (Movistar)	Ireland (Meteor)	3.32	2	+ 66 %
UK (Orange)	Portugal (Optimus)	4.7	1.76	+ 167 %

source: Lupi, Maneti (2006)

dedicated to specific costs of roaming in this chapter and later in chapter 4 we will show how the different specific costs may cause the higher prices of roaming retail services. What is, however, strange is that the differences are very high even within the countries where the mobile operators face the same specific conditions. There is one explanation: if the operators have greater number of subscribers, the very high fixed costs – which are specific for mobile communications – are transferred to lower marginal costs. Even this assumption does not hold for all operators as we can find differences even between operators with almost equal number of subscribers (EC , 2006b).

The next concern of the EC was the low transparency of roaming pricing schemes. The prices were in some cases not even published, though some progress was made in the past years by GSM Europe, an European branch of GSMA. Its aim was to simplify the access of consumers to roaming rates and to information on operators in foreign countries. Therefore it developed its Code of Conduct in 2001.⁷ The document is obligatory for the operators and proposes to inform consumers at least about the prices of calls and SMS. The operators should do so via informative SMS, on their websites and by print-

⁷See: http://www.gsmworld.com/gsm europe/position_papers/ovum_coc291002.pdf

ing leaflets that are free for consumers on the retail outlets or at border points. The operators that agree to the terms of the Code of Conduct are published annually as one can see at the website in the footnote.

The transparency has greatly improved since. The ERG report shows that in its report on International Roaming Retail Tariff Transparency. The survey of 54 operators of whom 31 were signees⁸ to Code of Conduct of the GSMA has shown quite satisfactory figures. Four fifths of all operators surveyed published information about main roaming services such as call prices⁹ and prices of SMS. Even the other services were published by more than a half of the operators. (ERG , 2005).

The awareness of consumers was improved even with introduction of flat-rate tariffs. To these we give a special subsection further in the text.

However, as we will see later, the EC was not pleased with current state of transparency in pricing for the consumers as well as with the level of retail prices. There is no common framework to which operators are bound to subscribe. The aim of the EC regulation proposal is thus clear. The Code of Conduct of the GSMA was though a step in the correct direction.

2.4.1 Problems with flat-rate pricing

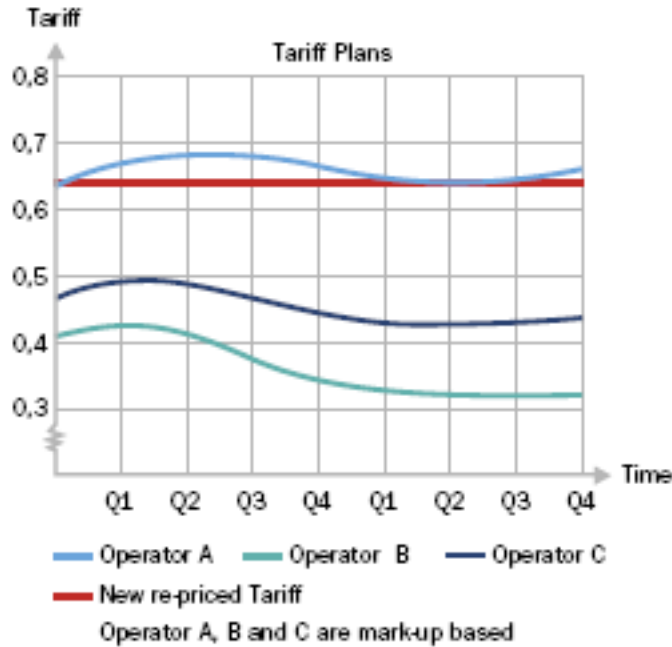
As we have said the operators tend to introduce simplified pricing schemes in form of flat-rate tariffs. These tariffs have a common price for one or more countries disregard the operator selected. Such pricing mechanism is advantageous because of the simplification for the subscriber. He does not have to search for the least expensive network in the foreign country.

Yet, as we will discuss in the section devoted to traffic redirection in chapter 3, the concern in the past was that there is no guarantee that customers roam on the network with lowest IOT (Stumpf , 2001). With the introduction of SIM Application Toolkit the problem was mostly solved. What was not solved was the lack of pass-through from wholesale savings to consumers. To this topic

⁸The rate of signees of Code of Conduct to all European operators corresponds to true state of signees in the EU.

⁹This includes calls received and calls made to both fixed and mobile networks.

Figure 2.5: Flat-rate tariff setting – Mach Repricing



source: MACH (2006)

we give some notes in the next subsection.

The non-flat-rate prices are set as an IOT rate with a given mark-up. The flat-rate tariff is set on an average IOT and does not change over time with changes in concrete IOTs (MACH, 2006). This may be rather transparent, but may lead to price increase in some cases which may even decrease the consumer surplus if prices are not based on exactly weighted average price. If we take a look at the figure 2.5, although it is only a model situation, we can make a picture of how the pricing may come about.

Let us show the assertion on a following example. We have two foreign operators in two different countries, let us say Germany and Estonia and a home network, e.g. T-Mobile CZ. T-Mobile CZ has bilateral agreements with both operators. Germany is often visited by the Czech nationals while Estonia is visited only seldom. Operator from Germany may thus offer T-Mobile a volume discount and has lower IOT. We put q_{ee} , p_{ee} as a volume of minutes, respectively IOTs, from Estonia to T-Mobile CZ. Further q_{de} , p_{de} as a volume of

minutes, respectively IOTs, from Germany to T-Mobile CZ. The flat-rate tariff price is p_{flat} . Further we assume that the elasticity of demand is equal 0 and thus consumers will not change their behavior even with significant changes in price. This assumption is rather stringent, but as we show in this thesis, the demand elasticity for roaming services is very low. We now show three different scenarios of setting up a flat-rate tariff:

Weighted average — If we count a weighted average of the roaming usage the consumers remain the same, rates for Germany will rise only slightly and rates for Estonia will drop significantly. T-Mobile will gain no additional revenues. Mathematically we can derive:

$$p_{flat} = \frac{p_{ee} \cdot q_{ee} + p_{de} \cdot q_{de}}{q_{ee} + q_{de}} \quad (2.11)$$

Mean — If we count a mean of the IOT rates the consumer surplus drops, rates for Germany will rise by the same figure as the rates will fall for Estonia. T-Mobile will gain additional revenues. Again we derive:

$$p_{flat} = \frac{p_{ee} \cdot q_{ee} + p_{de} \cdot q_{de}}{2} \quad (2.12)$$

Maximum IOT — This is an extreme case. T-Mobile may choose to select as a benchmark the highest IOT - Estonian one. In this case there is a radical increase in rates for Germany, no change in rates for Estonia, consumer surplus is reduced radically and T-Mobile gains great revenues. This means:

$$p_{flat} = \max\{p_{ee}; p_{de}\} = p_{ee} \quad (2.13)$$

Unfortunately there is no paper comparing the rates before and after the introduction of a flat-rate tariff. We can only assume that the rates are set above the weighted average as the operators usually set their rates for a longer period of time¹⁰ while they are not aware in advance of the exact volumes for each contracted networks and the levels of IOTs. There is thus a cost for the transparent pricing.

¹⁰As the rate is published to the consumer it cannot be updated too often. Either because of menu-costs (Expensive print of brochures, leaflets and other marketing products.) or simply because of the consumer psychology.

2.4.2 Lack of pass-through from wholesale savings to consumers

The concern of the EC is that there is lack of pass through from wholesale cost savings to the consumer in the form of lower retail prices. In the chapter 3 we will show some technical improvements – such as traffic redirection – and other possibilities leading to wholesale cost reductions. As there is such potential it is clear that wholesale costs are falling as there is no reason why costs should rise.¹¹

Still we can see that roaming prices remain rather stable over the time or are rising in some cases (CTU , 2006; EC , 2006b). This is due to low elasticity of demand for roaming services. Mobile operators are said to structure their pricing according to the Ramsey-Boiteux pricing¹² rule. This rule suggests that *“services in more inelastic demand should bear higher mark-ups over their attributable cost in raising funds to cover common costs”* (Ewers Consult , 2007). As roaming is rather inelastic the mark-ups remain high and there is scope for regulation. The low elasticity of demand will be discussed more in chapter 3.

2.5 Roaming specific costs

As we are speaking of excessive prices of roaming we need to examine the cost structure as a whole. We have already discussed various technical aspects but we have never included any detailed figures. Thus it would be appropriate to describe even the costs of purchasing and maintaining of the technologies required for roaming only as well as technologies used for roaming. There were at least two studies (AT Kearney , 2007; ITRE , 2006) that showed some methodology for estimating such costs.

¹¹Except for marginal things such as increase in labor cost. Such effect would result in costs increase in older labor-intensive industries but not in modern mobile telecommunications which are mostly capital-intensive.

¹²Boiteux (1956) applied the rule of mark-up setting as an inverse proportion to price elasticity of demand discovered by Ramsey (1927) to natural monopolies. However, Frank Ramsey was studying optimal taxation.

Table 2.2: CapEx and OpEx for a medium-sized operator (10 million subscribers) estimated by ITRE (2006)

Cost item (maximum cost case for all calls)	Order of CapEx in euros	Order of Annual OpEx in euros
Additional network capacity	5m (or 1m/yr, 5yrs)	10 m
Electronic Data Interchange system for TAP files	2m	2m
CAMEL for home network	15m	3m
Rating engine enhancement	5m	5m
Interconnect billing system	7m	10m
Extra customer care	5m	10m
Wholesale termination charges	2m	25m (0.08euro/min, 150m x2min calls)
Wholesale international transit charges	1m	20m (0.05euro/min, 150m x2min calls)
International wholesale accounting for TAP files, invoices etc	1m	3m
Increased fraud risk as detection delay with periodic invoicing	10m	10m

source ITRE (2006)

The ITRE (2006) report has proposed a set of 10 categories that contribute to the costs of roaming services. See table 2.2.¹³

As we can see some categories are used by other services as well, rather than by roaming only. AT Kearney (2007), that uses ITRE CapEx and OpEx estimates in its methodology, excludes such categories completely. The excluded categories are Rating engine enhancement, Extra customer care and Increased fraud risk as detection delay with periodic invoicing as these are considered as a part of common retail costs that are "shared accross number of services." The other two excluded categories are linked to the other part of wholesale costs than roaming specific costs. These are wholesale termination charges and wholesale international transit charges. We can identify with both

¹³The table assumes 5% of 10m subscribers roam, with 1 call/day, i.e. approximately 150m calls/year of 2 minutes (OECD average).

Table 2.3: CapEx and OpEx estimates by ITRE (2006) - trimmed by AT Kearney

Cost item (maximum cost case for all calls)	Order of CapEx in euros	Order of Annual OpEx in euros
Additional network capacity	5m	10 m
Electronic Data Interchange system for TAP files	2m	2m
CAMEL for home network	15m	3m
Interconnect billing system	7m	10m
International wholesale accounting for TAP files, invoices etc	1m	3m
Total	30m	28m

source: AT Kearney (2007)

of these assumptions as we have already talked about these categories in our section about scenarios of wholesale roaming costs (not including the specific costs of roaming) and in the section of retail roaming services aforementioned in this chapter.

Let us now familiarize us with the methodology proposed by AT Kearney (2007) as this seems more theoretically based than the similar methodology by ITRE (2006).

We have already mentioned the exclusion of some of the categories proposed by AT Kearney (2007). We thus continue only with following subset in table 2.3.

We include already annualized CapEx so that the outcome of both CapEx and OpEx are representative. The annual rates have been computed using the assumption that Weighted Average Cost of Capital (WACC) is 13% which differs only slightly from ITRE (2006) proposal with WACC equal to 15%.

Moreover the asset life expectancy was prolonged in the AT Kearney (2007) methodology as it was based on average asset life assumptions used by regulatory authorities from the UK, The Netherlands and Australia. We could have observed, there are almost no differences among the regulatory authorities and thus we consider the estimates reasonable. However, it is noteworthy

that ITRE expects the life expectancy lower (5 years for each category). We can only make a guess that ITREs' assumption is based on fact that the new technologies occur very quickly and because of that the older equipment remains either incompatible or simply outfashioned.

Let us now give few comments on the ITRE selection of a 10 million subscribers (or medium sized) network. One can wonder why did both ITRE and AT Kearney choose as a benchmark an operator which is larger than 75% of the operators from our sample in the number of subscribers. See our sample of operators in Appendix A. ITRE mentions that there is more spending on large networks as it spends more on expensive technologies such as CAMEL¹⁴ while smaller operators acquire only less technologically advanced technologies such as web based real time billing for prepaid users. Moreover the smaller operators usually choose other parties (either third party billing specialist or to the roaming partner operator) to maintain the billing for them. Swan (2003) adds that billing system is one of the most expensive and thus we can see why some smaller operators may choose to rely on billing services of other parties.

Still the costs remain high for the small operators even if considering the paragraph above. We expect that per-minute prices remain significantly higher for the lowest 25% of operators from our sample – e.g. operators with approximately 2.5 million subscribers. This is because if we had had counted the CapEx and OpEx costs as a quarter of the original estimate of 10 million subscriber network, the volume of minutes, however, drops four times as well and so the underlying roaming specific costs would remain the same as the costs of the network considered in ITRE or AT Kearney papers. The proportional decrease in costs is not to be expected because of high fixed costs and further low additional per-unit (here subscriber or better one minute of roaming call) costs in the whole mobile telecommunications market and the great scope for economies of scale. Had the costs decreased proportionally it would contradict the assumption.

However, the AT Kearney (2007) paper concludes that specific costs of

¹⁴Robust technology for real time billing for prepaid users.

roaming are to be estimated at least at 7 eurocents per minute. As we do not have any exact data on the costs of smaller operators we need to take the AT Kearney estimate as a correct value of roaming specific costs as it states the most reasonable methodology behind the figure. Our concern about undervalued costs of smaller operators remain.

Chapter 3

Theory & competitiveness

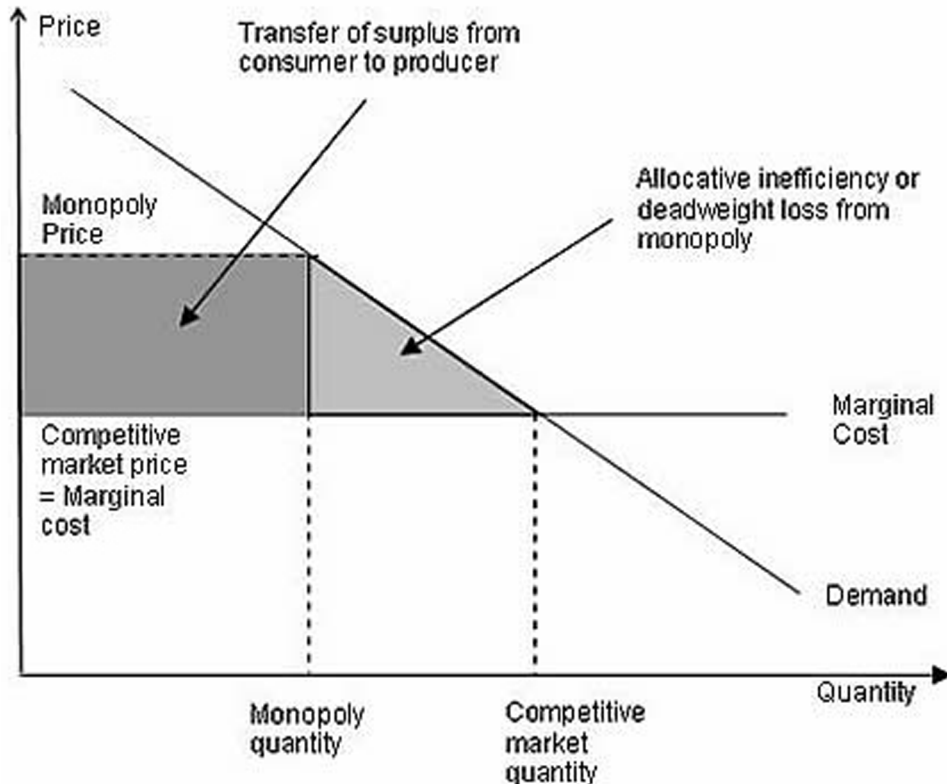
*"If it moves, tax it.
If it still moves, regulate it.
If it stops moving, subsidize it."*
Ronald Reagan

In the previous chapter we have shown a complexity of the roaming market mainly in economic terms. This chapter will deal with the economics from the regulatory side of view and will show the main features of competitiveness and competitiveness violation in the market. As we could have noticed, the specificity of the market is obvious mainly due to its contracting among competitors, the low elasticity of demand for roaming services both from business and from private subscribers, cross-border overlap that ties hands of NRAs and naturally the specifics of the whole mobile telecommunications that, because of scarcity of spectrum and huge sunk costs, leads in most countries to forming of MNO Significant Market Powers (SMPs).

In this chapter we will introduce basics of regulatory economics. We will start with a brief introduction of competition and show why excessive pricing emerges and why is such pricing damaging the market that, if remedied properly, could prove greater efficiency.

Then we will deal with the roaming regulation. First the use of price cap that has been chosen by the EC as a best tool for remedy of it is problem with excessive prices will be discussed. Then we will survey the current competition policy of the EC based on the document from 1997 and as well about

Figure 3.1: Monopoly price setting and deadweight loss



source: <http://www.med.govt.nz/>

the new regulation of telecommunications from 2002. That will serve as a base for the definition of relevant markets of wholesale and retail roaming services that are subjected to the current international roaming regulation.

3.1 Theory of regulation

Monopolies are often formed in fields such as railways, power industry or telecommunications. These branches face increasing returns to scale as they have great fixed costs and (especially last two) low operational costs. The regulatory theory and praxis has shown that breaking the monopoly is not always desirable in these cases as the firms may maintain services provided

with lower costs than if many smaller firms were present (Varian , 2005), pp. 435-437. However, the pricing policies of above mentioned firms are, if unregulated, causing welfare losses and are Pareto-ineffective.¹

Monopolist maximizes his profits if marginal costs equal marginal revenues. In this case the producer surplus is maximized. In figure 3.1 we show the monopolistic pricing in detail. However, in this case we deal only with single-product monopoly. As we have said, the case of roaming and mobile telecommunications has to be treated as a multiple-product market where prices are being set according to Ramsey-Boiteux rule (Ewers Consult , 2007). We will show what problems may this difference bring further in the text. In the next section we will continue along with remedial actions that bring the uncompetitive market to competitive state.

3.2 Price cap regulation

Price cap was first introduced in 1983 by Stephen Littlechild in his Regulation of British telecommunications (Littlechild , 1983) and is now a standard in regulating network industries, especially telecoms. The former most common Rate-of-Return regulation² is being abandoned because of several problems as discussed in King (1998):

1. It weakens incentives for cost efficiency.
2. For a multi-product firm where only some products are regulated, Rate-of-Return regulation involves arbitrary allocations of cost and assets.
3. It is difficult to set an appropriate Rate-of-Return for the regulated firm.

As we will discuss the first two points later in the text, let us examine the third problem. Usually the regulators have a chance to look only at the historic

¹Note that Pareto-effectivity is that one individual cannot be better off without having other individual worse off.

²Rate-of-Return regulation as described in Averch, Johnson (1962): *"If the rate of return, computed as the ratio of net revenue to the value of plant and equipment (the rate base), is judged to be excessive, pressure is brought to bear on the firm to reduce prices. If the rate is considered to be too low, the firm is permitted to increase prices."*

data from the balance sheet to set the Rate-of-Return base. Such data cannot completely forecast future situation within the market and thus cannot be considered as good estimators of current market price and state. Moreover, the annual Rate-of-Return can only be easily estimated by the embedded cost of preferred stock³ and bonds (or more generally by debt obtained capital). The cost of own capital is more controversial and difficult to estimate (Lamdin , 2003). Therefore the Rate-of-Return regulation is hard to monitor and hard to set for the future periods.

In the next paragraphs we describe the price cap and its adoption as a substitute of Rate-of-Return regulation and as well we will give some comments on another two above mentioned problems.

The known price cap expression is:

$$CPI - X \tag{3.1}$$

Where *CPI* is consumer price index⁴ that is independent of firms' behavior and thus is an exogenous factor in the expression. *X*, however, is factor reflecting potential cost savings due to technological improvements, economies of scale and other factors. The prices are thus adjusted according to current level of consumer price index subtracting *X*.

Alexander, Irwin (1996) argue, that price cap is being used more commonly due to thought stronger incentives to be efficient. This holds true as price cap is set and known in advance and remains unchanged (Except for changes dependent on the expression 3.1.) as long as until the revision that is usually proposed after 5 years. Firms may thus raise profits by cutting costs down. This is impossible with the Rate-of-Return regulation as the Rate-of-Return regulation gives only a fixed percentage mark-up above costs of investment and gives no premiums to firms lowering their costs. Moreover, there is evidence that such regulation may lead to excessive capital expenditures to enable to increase revenues as these are derived from the costs of capital.

³*Cost of preferred stock* = $\frac{\text{Total Annual Preferred Dividends}}{\text{Proceeds from the Issuance of Preferred Stock}}$
 see: http://edocket.access.gpo.gov/cfr_2005/octqtr/pdf/47cfr65.304.pdf

⁴In the original text Littlechild uses *RPI* which is British Retail Price Index.

This behavior is called Averch-Johnson effect.⁵ The effect leads exactly to the contrary than what we expect from the behavior under perfect competition. Averch, Johnson (1962) have concluded in their paper two main aspects of the Rate-of-Return regulatory bias:

1. *"The firm does not equate marginal rates of factor substitution to the ratio of factor costs; therefore the firm operates inefficiently in the sense that (social) cost is not minimized at the output it selects."*
2. *"The firm has an incentive to expand into other regulated markets, even if it operates at a (long-run) loss in these markets; therefore, it may drive out other firms, or discourage their entry into these other markets, even though the competing firms may be lowercost producers."*

To show the difference between price-cap and Rate-of-Return regulations more precisely let us consider an example of a telecom company that is subject to a regulation. In the first case the firm is subject to Rate-of-Return regulation and is allowed profits of 10% on CapEx. As any profit-maximizing firm, the operator may have an incentive to acquire additional capital (only up to some

⁵The Averch-Johnson effect shows that a regulated profit maximizing firm under the rate-of-return regulation may set its inputs ineffectively, biased towards higher capital expenditures. Thus its costs are not minimized, as a less expensive combination of capital and labor could have been chosen to maintain the current level of outcome. This is given by the restriction on return on capital that cannot exceed the allowed rate of return. Averch and Johnson show it on a static model of 3 inputs. The firm thus maximizes profit:

$$\Pi = R(K, L, F) - rK - wL - gF \quad (3.2)$$

Where $R(K, L, F)$ is a function of revenue, K, L, F are quantities of capital, labor and fuel and r, w, g are its prices. The constraint on capital, while having s as the rate of return allowed by the regulatory agency, is:

$$R(K, L, F) - wL - gF \leq sK, \quad s > r \quad (3.3)$$

If we solve the Lagrange equation given the restriction from equation 3.3 we will see that the marginal rate of technical substitution between capital and labor is less than the factor ratio. That means that the firm uses more capital than it would be needed for costs minimization. For outcomes and for proof see Averch, Johnson (1962).

level, naturally) so that it is allowed higher profits. This behavior is irrational at the first sight.

In the other case the operator is being regulated by a price cap of 0.5 euros / minute call. The profits may vary during the time given the usual profit function:

$$\pi = p \cdot Q - C \cdot Q \quad (3.4)$$

That means that profit of the firm equals its total revenues minus total costs. In this equation p is only restricted from above and there is no lower bound. Regulators thus leave space for natural profit maximization under minimized expenditures on additional capital. Incentive for the firm under price cap regulation will be to reduce costs either by new billing schemes or by investing into cost saving technologies which is more desirable than the possible wasting under the Rate-of-Return regulation.

The operator subjected to a price cap regulation is, moreover, much easier to monitor. The respecting of prices is expected to be controlled even by the competitors as the wholesale prices are known to them and the retail prices are known even publicly.

The Rate-of-Return regulation is on the other hand much harder to monitor. The estimation of capital expenditures on the regulated market is rather a time consuming activity.

Alexander, Irwin (1996) show moreover that the optimal price for the first period is then usually derived by the Rate-of-Return method – we will show that in chapter 4. Thus even in the price cap method there is partially included the Rate-of-Return method. The positive impact on efficiency however remains as mentioned in the paragraph above as the Rate-of-Return is used only as a starting position for cost estimation and later is abandoned to leave free space to firms profit maximization.

3.3 Relevant Markets

In this section we will be dealing with relevant markets and their definitions. Properly defined relevant markets are the cornerstones of every regulation as

it specifies the area that is subjected to regulation. First we need to specify the meaning of the market from the regulatory point of view as it differs from economic definition of market of neo-classic economists as were Cournot (1838)⁶ or Marshall (1890)⁷. (Massey , 2000)

The economic market gives us only information on how the price is linked to a described product and its geographical area. This definition, however, gives us no clue how to find out whether the market is competitive or not. Hence the definition of the market, that may be subject to regulatory issues, need to be:

"A market is any product or group of products and any geographical area in which collective action by all firms would result in a profit maximizing price that significantly exceeds the competitive price." NERA (1992) as in de Streel (2003)

Exact definition of relevant market is the Achilles' heel of competition policy. There are many theoretical approaches of defining a relevant market. Unfortunately neither of the approaches can be applied universally to any regulatory case. Each case has to be treated with great level of understanding and patience.

The EC has codified its approach towards relevant market definition in its Notice on relevant markets (EC , 1997). The approach defines the two dimensions as of economic market - i.e. physical and geographical dimensions of the markets. The difference is that the main stress is put in how the market in these dimensions is competitive or is not. For telecommunications the code was further specified by the new Regulatory Framework from 2002 (EC

⁶Cournot (1838): *"Economists understand by the term market, not any particular market place in which things are bought and sold, but the whole of any region in which buyers and sellers are in such free intercourse with one another that the prices of the same goods tend to equality easily and quickly."*

⁷Marshall agrees with Cournot (1838) and adds: *"Thus the more nearly perfect a market is, the stronger is the tendency for the same price to be paid for the same thing at the same time in all parts of the market: but of course if the market is large, allowance must be made for the expense of delivering the goods to different purchasers; each of whom must be supposed to pay in addition to the market price a special charge on account of delivery."*

, 2002). There are three main criteria for selecting of core markets that may be subject to possible regulation in the framework. These criteria are:

1. High entry barriers
2. Dynamic state of competitiveness behind entry barriers
3. Absence of ex-ante regulation

These criteria are investigated by NRAs in particular member states and are under obligation to the Framework Directive passed on ERG.

The Access Directive, Articles 9-13, of the EC proposes certain wholesale remedies such as transparency, non-discrimination, accounting separation, access and price control and cost accounting. The retail remedies are listed in the Universal Service Directive that proposes in the Articles 17-19 e.g. a prohibition of excessive pricing, undue price discrimination or unreasonable bundling of services (Cawley , 2004). We will see later in the text how these remedies are applied in the roaming regulation and we will give some comments on how the regulatory framework may have been composed to fulfill the remedies better.

Now we have at least a brief insight into how relevant markets are studied. In the next subsections we will discuss the concrete relevant markets that are subject to the roaming regulation. As we have already said, there are two relevant markets that need to be investigated as the roaming regulation considers both wholesale and retail price caps. We will start with the well defined wholesale roaming market and later we will continue with questionable retail market.

3.3.1 Wholesale international roaming market

The wholesale market is defined in ECs directive 2002/21/EC (EC , 2002) on a common regulatory framework for electronic communications networks and services (Framework Directive). The exact wording in Commissions Recommendation 2003/311/EC on relevant product and service markets within the

electronic communications sector susceptible to ex ante regulation in accordance with the Framework Directive of the definition is as follows: "*The wholesale national market for international roaming on public mobile networks.*" We thus see that the definition applies to wholesale market only.

We define the relevant market according to the paragraph above by its physical and geographical characteristics. Where by geographical range we further understand the whole coverage of all European operators (As all MNOs have agreements with all other MNOs subjected to the Regulation.). Physical characteristics are given by the GSMA STIRA as it was defined in chapter 2. The wholesale roaming agreements of all operators are arranged on the basis of STIRA and thus the wholesale international roaming market in the area of the EU and the EEA is a narrow market of operators subscribed to GSMA STIRA.

Hrubý in his lectures adds even the time range that may be important as well. As the examination was carried out in the past years means that the uncompetitiveness of the market is a current problem, was not present in the past as the technology of mobile roaming simply did not exist and may not occur in the near future. This may be because of technological change within the market or by discovery of a new technology that may serve as a substitute to current mobile roaming.

3.3.2 Retail international roaming market

On the other hand the retail roaming market is not recognized and thus not properly defined as there probably is not any specified retail roaming market. The retail prices are set up in the form of bundles that differ from operator to operator and even every operator usually promotes more than one bundle to match the customer needs. These bundles include either roaming services only (Sets prices for voice calls for specific areas, SMS prices and data prices and in the recent time occurred even a monthly lump sum rate for roaming services in the USA.) or can be a part of a wider bundle with prices ranging from all common domestic services to specific prices such as roaming.

One can wonder how it is possible to maintain the regulated retail price

of the voice roaming services on the levels quoted by EC while other parts of the bundle remain unchanged. Answer to this question is possibly given in the text of the regulation, though the basis of the thought behind it is rather wobbly. In the next paragraph we will discuss why.

3.3.3 Cross-Subsidies

One would usually expect that cross-subsidies – or commonly called as a *waterbed effect* – occur if there is only a part of bundle regulated while other remains unregulated. By cross subsidies we understand transferring the prices from one sector to another within a market, in this case a bundle, to maintain or raise revenues (Ralph , 1992). As there are no tools that take this fact into account we can only assume that the EC intends to avoid cross-subsidies by threatening the operators by possible future regulation dealing with other parts of the roaming services. The warning for operators could be found in the final text of the regulation in Article 11:

"No later than [on] 30 December 2008 [...] the Commission shall evaluate in particular whether the objectives of this Regulation have been achieved. In its report the Commission shall review developments in wholesale and retail charges for the provision to roaming customers of voice and data communication services, including SMS⁸ and MMS, and shall, if appropriate, include recommendations regarding the need to regulate these services" (EC , 2007).

The aim of this article can thus be explained as a way of preventing the cross-subsidies to occur. We could have learned how strong the effect of regulatory threats may be while observing the roaming price drops and roaming tariff simplifications in the period of past few years when the first mentions of roaming regulation arose. Naturally there are many other examples of positive impact of regulatory threats as in Haucap, Heimeshoff, Uhde (2005) who call it threat-based regulation.

⁸Though it is rather strange that SMS is mentioned as a part of data communication services as it does not come under this category.

Yet we mentioned that cross-subsidies may occur not only on the fields highlighted in the Article 11 but as well in all other fields included in the bundle (Provided that the bundle services exceed the mentioned fields.) or, moreover, in the whole pricing set-up of the operator as such. However, to measure such pricing politics would be rather demanding topic and as this thesis does not set itself a task this particular thing we shall leave further contemplations upon the reader. We will have to make do with that, that above mentioned may occur and that if the operators' revenues taken from roaming voice services will be missing in operators' investment plans, we can be quite sure to observe some price increases in other fields of activity.

Let us propose at least one possible scenario not to leave the reader in complete confusion. If we assume that cross-subsidies may occur, there is a scope for suspicion that regular customers may loose as their costs will rise on account of not that frequent customers using roaming services. The cross-subsidy shall not have any greater impact as the raise of prices in fields with significantly larger demand - e.g. home network voice services, domestic MMS, subsidised mobile phone sales etc. – will not need to be high. Still costs of the much larger consumer group may rise under such scenario while consumer surplus remains the same. The last part of sentence naturally holds true only under assumption that the operator does not want to raise its revenues but only wants to preserve the revenues gained prior the regulation. However there may be many other scenarios where we can only guess as there is no enough space in this thesis for complete survey of this problem as mentioned above.

3.4 Causes of uncompetitiveness in the mobile telecommunications, especially roaming market

From the text above we could have seen some indications why the market of international roaming is not in a competitive state. In this section we will discuss the main aspects speaking against the competitive state - scarcity of the spectrum, high fixed costs of mobile operators and low elasticity of demand

for retail roaming services.

3.4.1 Scarcity of spectrum

The number of frequencies that can be allocated to operators to be able to run a network is rather limited. Therefore there are usually only between 2 and 4 MNOs in each country. In the Appendix A we have calculated that average number of operators in European Union is 3.3. Thus the scarcity of spectrum leads to limited number of players in the market which causes entry barrier. This is one of the 3 criteria mentioned in the Regulatory Framework from 2002 (EC , 2002) for selecting a market that should be subjected to ex-ante regulation. The small number of entrants is usually considered as a main problem of competitiveness. However, as we will mention in the next section, the possible remedy is the introduction of virtual operators or MVNOs. We will discuss their effect on competitiveness further.

3.4.2 Fixed costs of mobile operators

The next thing that disrupts the competitiveness on the roaming market and even on the whole market of mobile telecommunications are the huge fixed costs that MNOs are forced to spend before they can launch the network and start offering its services to the customer. What distinguishes mobile telecommunications from e.g. manufacturing plant (We can have high fixed costs in manufacturing plants as well.) is its insecurity in the future of the technology and its usage by end-users. As the investment into a new technology is split between CapEx and OpEx, we need to say, that if project fails, CapEx is a sunk cost, while OpEx is being paid only up to the end of the project.

The insecure future of investment is being observed due to great amount of occurrences of new technologies and fast applications of these to the market. Each technology brings some new service that need to create its own demand. As the demand is being created over the time, operators can never be sure of success of the technology and thus cannot be sure about the return of investment.

Moreover Haucap (2003) shows that the higher are the fixed costs, the lower is the number of entrants in the market. Thus even if there is enough possibilities of spectrum allocation, the market would not be competitive in this way either. The equation on which this assumption is based is as follows:

$$m = \frac{1}{F} \cdot \sum_{j=1}^n (p_j - c_j) q_j(p_j) \quad (3.5)$$

By m we understand the number of firms, F is the level of fixed costs needed to the entry to the market. Further p_j and c_j are expected price and cost for service j ; $j = 1 \dots n$ and $q_j(p_j)$ is expected demand for the service at price p_j .

3.4.3 Low elasticity of demand for roaming services

Roaming services are offered only as a part of the whole bundle of MNO services. According to ITRE (2006) it makes up to 5% of all the services used. Its use is thus only marginal and new subscribers do not usually choose their network with major emphasis to roaming prices.

We can say that if the operator raises price of a roaming call, there will not be as great decrease in number of subscribers as perhaps if there were an increase in prices of domestic calls, i.e. the retail roaming market is inelastic in price.

In the previous chapter we have already noted the Ramsey-Boiteux pricing rule that suggest that services with more inelastic demand should bear higher mark-ups over their attributable cost in raising funds to cover common costs.

Haucap (2003) concludes that the Ramsey-Boiteux pricing is the optimal way of pricing for unregulated telecommunications company. The high fixed costs of the infrastructure and the risk of investment in new and costly technologies as discussed in subsections above incur such pricing structure. Moreover, the paper argues that regulatory attempts trying to bring the market more to the perfect competition state, thus equalize the prices with costs, may be very disruptive for the whole mobile telecommunications market.

3.5 Prospects for improving competition in international roaming

There are several ideas discussing what could be done for international roaming market to bring it more towards perfect competition state. We will discuss both technological and operational approaches that are proposed and can be already encountered.

3.5.1 Traffic redirection

We have already mentioned that there are agreements between operators setting the IOT tariffs. However, the IOTs may differ not only from country to country but even from operator to operator. In the early years of mobile communication the operators needed to insert a list of networks to the SIM cards of the subscribers where they preferred networks with lowest IOT tariffs. The list was activated if a subscriber entered the foreign network and had his phone set to the automatic network selection. However, the tariffs changed over time while the list remained unchanged.

The problem with subscribers with outdated list of networks was partly solved by introduction of *smart SIM cards* in 2003. The card uses a SIM Application Toolkit, that with over-the-air programming of the SIM card allows the device to switch to the network with lowest IOT. This clever application recognizes not just the current position in average IOT pricing, but can redirect in real time if perhaps one operator uses different peak and off-peak IOTs while the other does not and the conditions change suddenly. Even the list of preferred networks in the mobile phone is updated via SIM Application Toolkit over-the-air programming. Visited network operators are not dependent on random distribution of customers anymore as they were in the times of rigid and unupdated networks lists (ARCEP , 2006). Now they are having an incentive to offer IOT discounts to receive their preferred network status.

The new technology of over-the-air programming thus cause better terms for both operators and customers. Customers usually benefit from lower pri-

ces⁹ as IOTs are being discounted and operators benefit from easier negotiating positions.

The manual selection of a network may be rather harmful for operators using SIM Application Toolkit, because consumers are not aware of IOTs. By selecting a network with higher IOT the consumer does not know about the underlying costs of the operator (his rates are independent from IOT) but the costs of the MNO may rise if network with higher IOT is selected. We can thus expect at least an incentive of operators to pass through the prices to the subscribers in the ordinal way. That means that best rates will be offered to the subscribers calling via a network with lowest IOT if flat-rate is not present. That would secure the operators cost minimization as aware subscribers would select the most advantageous network.

What happens if operator sets a flat-rate tariff and subscribers of the network prefer manual selection of the network? Let us consider a hypothetical situation when there are two operators in the country – *A* and *B*. Operator *A* has $IOT_A = 1$ while $IOT_B = 10$. The home operator offers a flat rate tariff for the country and all roaming consumers (population shall be $P = 1$) from the home network decide to select their network manually. The distribution of network selection is uniform because people are completely unaware of real costs for the operator. Further assumption is that both networks cover the same area. Their costs remain the same while selecting of either *A* or *B*. However for operator the costs differ dramatically:

Manual selection — Under manual selection would the costs for operator be derived as:

$$C = 0.5P \cdot IOT_A + 0.5P \cdot IOT_B = 5.5 \quad (3.6)$$

Automatic selection — While under automatic selection via SIM Application Toolkit or possible other technology the costs in this case would be significantly lower as we derive:

$$C = \arg \min\{IOT_A; IOT_B\} \cdot P = 1 \quad (3.7)$$

⁹Still we have to be cautious as we will mention in the next section that there is a problem with passing of lower wholesale costs through to the subscriber.

Now we can clearly see the impact of unaware consumer decision to select network manually. Costs rise and as operators do not subsidy consumers we shall expect later on rising prices.¹⁰

3.5.2 Vertical Integration

There is an interesting model by Kumar, Hämmäinen (2004). The authors show a model of costs of wholesale roaming according to the number of roaming agreements per operator. This is a special case of vertical integration in the sector if we consider that forming of alliances is in roaming sector not only broadening (horizontal) integration, but in the terms of evaluation even a vertical integration. This holds true because some former agreements done on bilateral base shift towards alliance agreements which reduce the transaction costs of MNO's done on basis of inter-alliance contract. The alliance further negotiates with the outside world as a unit, thus has a greater power in contracting. The lower transaction costs occur due to lower ammount of agreements within the alliance, which means less expensive negotiating and less updating of the whole set of bilateral agreements. The paper gives us 3 possible ways of agreement forming in the roaming market. From the unintegrated *Bilateral case*, partly integrated *Clustered case* to the fully integrated *Centralized case*.

Prior to commenting the 3 cases, it is important to mention the assumptions of the Kumar-Hämmäinen model:

1. Every mobile network has the same number of roaming subscribers.
2. Every network supports the same average number of interoperable services.
3. A network is a part of one and only one cluster
4. Only one agreement is needed for an operator to be part of a cluster.

¹⁰e.g. as it was shown in the pricing schemes for flat-rate tariffs in subsection 2.4.1.

5. Members of a cluster can make one or more bilateral agreements with those not included in the cluster.
6. The roaming Average Revenue Per User (ARPU) parameter includes revenue from both mobile originated (MO) and mobile terminated (MT) services.
7. The transaction costs include CapEx and OpEx.

Where by bilateral roaming model we understand the agreement between two operators, by clustered model we assume that two or more operators form an alliance and finally by centralized roaming model we understand that there is a non-partisan organization administering all the operators in the market.

Bilateral case — Let us begin with the first case. This can be applied on Czech MNO Paegas from the 1990s. The operator was not a part of any international alliance and all roaming agreements had to be done on bilateral basis. This has cost a lot of money on IOT's negotiation and gave it a worse position in the bargaining as the operator was only of minor importance. Both of these had to project to the higher roaming costs due to bargaining costs and worse wholesale conditions (prices) which subsequently led to higher roaming prices.

Clustered case — In 2003 the great alliance FreeMove is formed by Orange SA, Teliasonera, TIM and T-Mobile - the important players on the market. As this is a form of a cluster, we can use it as an example of the second case. In Europe, the FreeMove members make up to 90% of the coverage of mobile using population. According to the assumptions of the model the costs of the members decrease with lower need of contracting and IOT updating within the alliance. In the ideal case there is only one agreement signed before entering the alliance by which the MNOs pledge to respect the agreed conditions.

Centralized case — The third case is only hypothetical and has not occurred in the real world yet. There may be some authority that manages all the

agreements in one centre and therefore every operator needs one and only one agreement with this authority that enables it to intermediate the roaming services in all other operators networks. This case represents naturally lowest costs as the contracting is minimized to one agreement at all.

We can thus observe that forming of certain clusters, or alliances as mentioned, can lead towards decrease of costs of wholesale roaming services that can be further translated to lower tariffs for end-users, depending on the elasticity of demand.¹¹ Vodafone passport, a flat-rate international roaming tariff offered to Vodafone subscribers, could be considered as a fine example. The company has built a brand worldwide and due to common strategy and co-operation it could offer a bundle with significantly reduced prices for the subscribers.¹²

We need to add that the prices of Vodafone Passport (and even of some other operators or alliance bundles) is for certain calls significantly less expensive than the rates of the regulated Eurotariff by the EC (2007). See the table 3.1.

3.5.3 MVNOs and roaming

As we have said, the small number of players – caused either by barriers to entry, by high fixed costs on infrastructure or by scarcity of spectrum – may cause uncompetitive state in the market of international roaming.¹³ Higher number of players could thus bring competitive state to this market.

Much hope was put into the Mobile Virtual Network Operators (MVNOs) (OECD , 2007; Stumpf , 2001). The MVNOs are operators without allocated spectrum thus their infrastructure costs are minimal. The only infrastructure

¹¹Though the elasticity of demand for retail roaming services was considered very low in the section above.

¹²See e.g.: <http://www.abroad.vodafone.co.uk/index.cfm?do=cost.passport>

¹³We assume that in highly price-elastic markets such as non roamed calls a competitive state exists even with small number of players in the market. This is, besides, in accord with Ramsey-Boiteux pricing principle.

Table 3.1: Comparison of Eurotariff and Vodafone Passport per minute prices in euros (without VAT)

Minutes	Calls made		Calls received	
	Vodafone Passport	Eurotariff	Vodafone Passport	Eurotariff
1	1.04	0.49	0.81	0.24
2	1.26	0.98	0.81	0.48
3	1.49	1.47	0.81	0.72
4	1.72	1.96	0.81	0.96
5	1.95	2.45	0.81	1.20
6	2.18	2.94	0.81	1.44
7	2.40	3.43	0.81	1.68
8	2.63	3.92	0.81	1.92
9	2.86	4.41	0.81	2.16
10	3.09	4.90	0.81	2.40

source: EC (2007), www.vodafone.co.uk

is the switching centre, HLR and an authentication centre. MVNOs have their own mobile network code, so that they can be recognized by other mobile networks and – for roaming most important – they can be registered by VLRs of the MNOs.

Yet, as mentioned already in the previous chapter, they cannot sign up to STIRA and cannot offer their own IOT tariffs to other operators. Their roaming agreements need to be contracted via MNOs and thus the number of players in the market remains unchanged. However fair the prices may be as supervised by the national regulators, this problem will need to be solved by GSMA in the near future. Our belief is that if MVNOs have an access to providing their own roaming agreements, the pressure on lower prices may rise. There is though a great problem with setting the accurate rules for international roaming offered by MVNOs as they are only resellers of services offered by MNOs. We propose that discounts on volume purchases may be arranged within three party agreements of both MNOs and a MVNO.

Chapter 4

International roaming regulation

A little introduction to the details of roaming regulation was given already in the chapter 1. The paragraphs in the next section will study the history and the text of the final regulation in more details. We will first inform the reader about the events preceding the regulation and then we will briefly introduce the final regulation.

Finally we will proceed with the proposal of the regulation from June 2006 which will be a base for our theoretical thoughts on the possible regulatory approach. We will further discuss and compare the final text of the regulation.

4.1 History of the regulation proposal

Year 2006 was a last drop for Commissioner Viviane Reding in watching the *unaffordably* high prices of the European operators roaming services. Since 2006 she has launched the official program which should lead towards the regulatory strategy for the European-wide roaming market. Such intention is based on the Eurobarometer survey (Eurobarometer , 2006) made especially for the occasion which showed the unsatisfiedness of the customers with high prices on the market and what more, on another study that showed shocking outcome pointing out the drastic differences between prices of roaming services among different European states and operators.

The misbalance is in contradiction to the unification of the European market proposed by the Lisbon strategy and should be therefore remedied by any

possibilities. The main objective was to set the unified rules for the international roaming services and grant the *reasonable* prices both on wholesale and retail levels. Such thing should – according to official press release of the EC on Viviane Reding’s web page – increase the volume of users of roaming service, boost the international communication and subsequently help to broader mobility across Europe. The last mentioned was only a consumer part explanation, on the other hand there should be a profit to the operators alone. Say, mostly to the smaller ones by tying the hands of biggest operators (For the European market we consider as dominant operators Vodafone, T-Mobile, Telefónica O₂, Orange and Tim.¹) and leave more space for negotiations on the wholesale prices – though only by implementing the wholesale or retail price cap.

The second reason for setting up the regulation proposal and subsequent regulatory legislative was to simplify the tariffs and make the price lists of Europe-wide operators more transparent. As mentioned above there were drastic differences among the individual operators across Europe in their roaming pricing policies. The proposed regulation should help to improve the competitiveness on the market and therefore to push the prices as low as to the level of *manufacturing* costs and take away the profits of the (dominant) operators. As when dealing any regulation there was a lot of space for never-ending dialogues on both sides – the Commission on one side and national operators on the other. To avoid most of the main conflicts the Commission decided to consult the proposal in two rounds of consultations with not just the operators, but even the NRAs² and the European Consumers’ Organization (BEUC)³ and the European Regulation Group (ERG).

As we go along the time, we can find the seed of the regulatory proposal of Viviane Reding in the sector investigation of the national and international roaming services. This further led to opening the proceeding by some of the

¹See our comments on vertical integration in chapter 3. We stress out the better bargaining positions for greater players in and lower contracting costs for operators with cross-border affiliates. Both holds true for the wholesale roaming market.

²Czech Republic represented by Czech Telecommunication Office (CTU)

³From French Bureau Européen des Unions de Consommateurs, <http://www.beuc.org>.

British and German operators for breaking the Article 82 of the EC Treaty.⁴

International roaming was also recognized as an issue for potential *ex ante* regulation at the time of the adoption of the 2002 regulatory framework for electronic communications (Framework directive), through the identification of the wholesale national market for international roaming on public mobile networks in the Commission's Recommendation of 11 February 2003 on Relevant Product and Service Markets within the electronic communications sector (EC , 2003). In May 2005 the ERG noted that the very high prices of roaming were not based on any rational reason and the operator mark-ups seemed unjustified. This was the last drop as described at the beginning of this section. Viviane Reding launched her campaign against the high prices of roaming as a part of i2010 program, the European Information Society for Growth and Employment initiative. The program is based on the EU's Lisbon goals and among others promotes the priority of "*creating an open and competitive single market for information society and media services within the EU.*"⁵

The initiative had therefore a legal and ideological support and work was about to begin. At first came the warning for consumers on July 11th 2005. As "*the holiday season approached the peak all over Europe*"⁶ Commission had released a warning campaign for customers on costs of roaming services. In the press release the Commission pledges to aim its effort to examination of non-transparent pricing of the roaming services.

Shortly after the holiday season was over, on October 4th 2005, the official website was presented. The site was created with an intention to serve not just as an informative portal for curious visitors and consumers but even as something that could be described as *two-sides of a gun* effect. This gun was created for the barehanded customers, to open their eyes and last but not least to see, that somebody is already solving their problem. (Eurobarometer , 2006)

Secondly as an executor's sword on the neck of mobile phone operators

⁴Article 82 of the EC Treaty: "*Any abuse by one or more undertakings of a dominant position within the common market or in a substantial part of it shall be prohibited as incompatible with the common market in so far as it may affect trade between Member States.*"

⁵See: http://ec.europa.eu/commission_barroso/reding/

⁶Again, Viviane Reding on her web page.

accused of overpricing the cross-border services meant to be the first warning and a simple way for the voluntary self-regulation establishment. The comparison to a weapon is incorporated even in the press release from October th 2005 where Viviane Reding says that "*only a well-informed consumer is a well-armed consumer.*" Already the first results revealed startling variations in roaming charges.

The first mentioned point called over as a *gun for barehanded customers* was carried out spontaneously and, well, was not that important as the second one. The self-regulation could have been seen in some cases during 2005 and 2006 and was summed up even on the Viviane Reding's webpage as a first step towards the success in pressing down the prices.

The warning has still not been heard as much as necessary, according to the press release of Viviane Reding on March 28th 2006. The prices of roaming remained in average the same and in some cases have even risen. Commission has therefore escaped the plan of self-regulation in roaming market and invited the involved parties to public consultations. The first round was launched on February 20th 2006 and finished on March 22th 2006. Already on March 28th was introduced the first regulation proposal draft. The second round was launched after the presentation of the proposal and took place from April 3rd 2006 to May 12th 2006. In the enhanced proposal from July 12th 2006 were for the first time presented concrete methodology.

According to the press release from July 12th 2006 the regulation could have come into effect by summer 2007 which actually happened. Prior to the description of the final regulation we will talk more about the ratification process that started in March 15th 2007.

Telecommunications ministers agreed in principle, that roaming prices must be capped at the level of 0.50 euros per minute for calling home. The rate was not far from the commissions proposal. On April 12th 2007 the European Parliament's industry, research and energy committee, which is the lead committee on roaming, voted for backing the proposal, though with even lesser rates than proposed. The suggested rate was set as low as 0.40 euros per minute while calling home. On May 15th a compromise between German presidency

Table 4.1: Eurotariff maximum per minute charge in euros (without VAT)

Eurotariff maximum price	August 30th 2007	August 30th 2008	August 30th 2009
Calls made	0.49	0.46	0.43
Calls received	0.24	0.22	0.19

source: website of Viviane Reding

and members of European Parliament (MEP's) was reached. Their main difference of opinion was in the rates of price caps. These were arranged at rate of 0.49 euros for the first year and 0.46 and 0.43 euros in following two years for the minute rates of calling home. Only 8 days thereafter the European parliament accepted the regulation proposal in the form of the compromise deal. Final step was done by Telecommunications ministers forming Telecoms council who adopted the regulation informally already on June 7th 2007 and officially on June 27th 2007. The horse trade with figures however remains unclear as most of the documents do not include even a simple calculations of their proposals. See the figures in table 4.1.

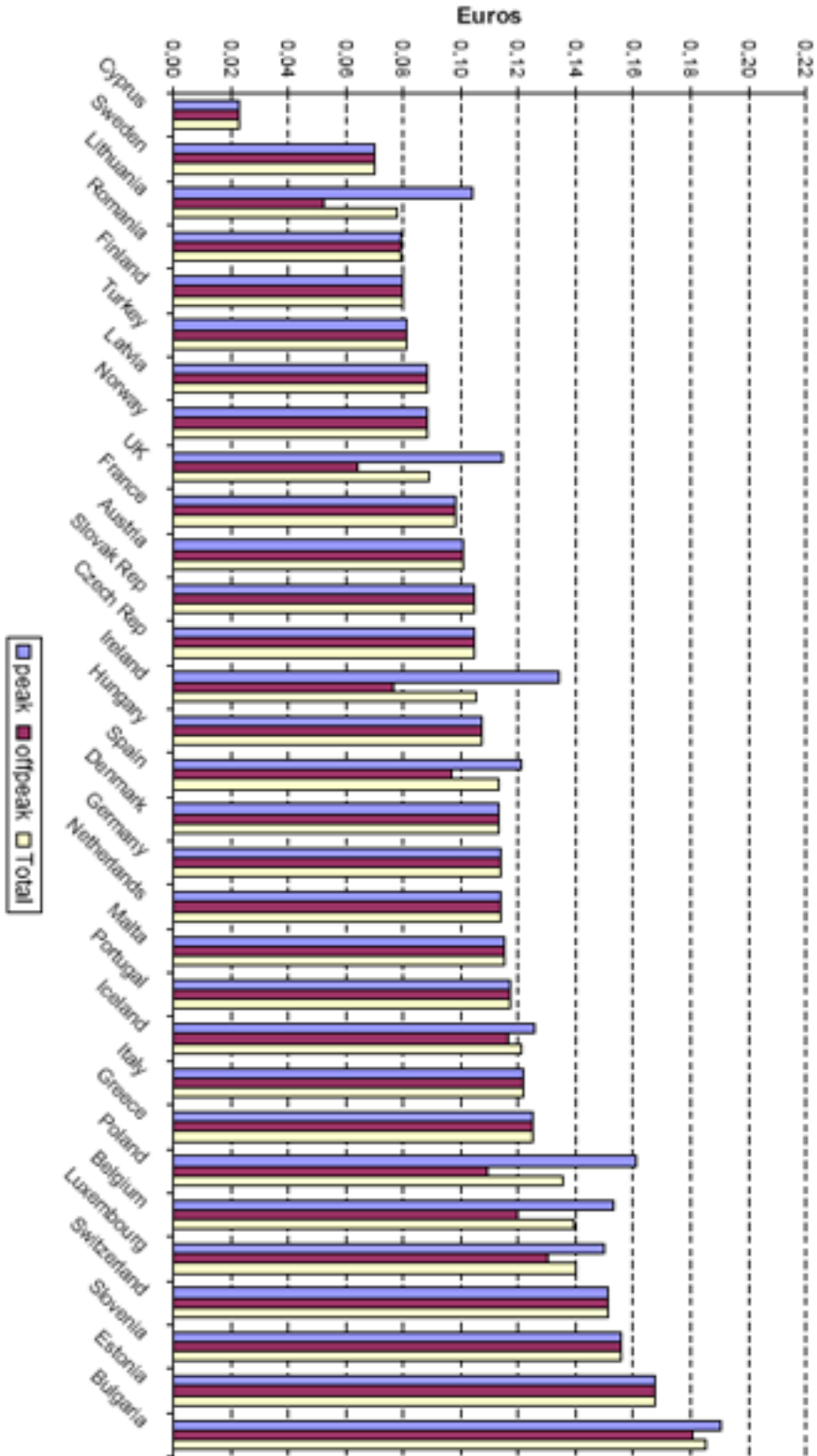
4.2 Wholesale international roaming regulation

The first proposal from June 12th 2006 introduced the wholesale price cap, i.e. the IOT price cap, based on the average per-minute EU MTR. This rate is determined as a weighted average of the national MTRs at peak rate, where by weights we understand the total numbers of subscribers in the country divided by total number of subscribers EU-wide. Mathematically we can write:

$$MTR_{EU} = \sum_{i=1}^{27} \frac{C_i}{Pop} \cdot MTR_i \quad (4.1)$$

Where MTR_{EU} will be further denoted in the text as average MTR, C_i is equal to number of subscribers in i^{th} country of the EU while MTR_i is the average termination rate in the i^{th} country and Pop is the whole EU-wide subscribers

Figure 4.1: European MTR rates, 2006 data



source: ERG (2006)

population. Obviously:

$$\sum_{i=1}^{27} \frac{C_i}{Pop} = 1 \quad (4.2)$$

The average MTR evaluates approximately to 11.4 eurocents. This amount is equal to price of average termination rates in Netherlands. However the prices still differ greatly among the EU states: termination rates in Poland are 16.7 eurocents (not to mention the fresh EU member, Bulgaria, with 18.6 eurocents) while in Cyprus the rates were only 2.3 eurocents. The Czech Republic with its 10.4 eurocents places slightly below the average. These figures are taken from original document by ERG from July 1st 2006.⁷

The selection of termination rates as a benchmark for maximum price limits of wholesale roaming rates is not reasoned in the proposal in the (EC , 2006a), Annex II. Economical justification is to be found in Falch, Henten, Tadayoni (2007). The paper shows that a justification for the selection of MTR exists because of the cost structure of roaming. That is simply divided into categories as mobile origination, international roaming transfer costs and mobile or fixed line termination rates. Moreover we usually add roaming specific costs as it was shown in chapter 2.

Since the termination rates add up to a half of the wholesale roaming costs it is the best way to select it as a benchmark for the price cap. Moreover the termination rates were subjected to regulations on national basis that gather termination rates on behalf of the EC. The market of termination rates is defined as a Relevant Market 16 in the Framework Directive (2002/22/EC) EC (2002) as "*voice call termination on individual mobile networks.*" As it has been regulated in every country the rates are known to the NRAs and subsequently to ERG as we show in Appendix B. These rates may according to Falch, Henten, Tadayoni (2007) serve as a proxy for the second greatest part of costs - mobile origination rate. The origination rates are known only to some NRAs since in most of the countries the market of mobile origination (Market 15) has been found competitive and there was no pressure from the EC on data collection.

We can say that the costs of mobile origination are almost the same as the

⁷See: http://www.erg.eu.int/doc/publications/erg_06_%2059_mtr_update_snapshot.pdf

Table 4.2: Roaming call cost estimates using scenarios from subsection 2.3.2 and data from table 4.3 in eurocents

Scenario	Using AT Kearney estimates	Using Copenhagen Economics estimates	Equations
1a	23.28	28.28	$2 \cdot MTR + IT + RSC$
1b	25.28	30.28	$2 \cdot MTR + 2 \cdot IT + RSC$
1c	29.28	39.28	$2 \cdot MTR + 2 \cdot IT + 2 \cdot RSC$
2a	27.28	32.28	$2 \cdot MTR + 2 \cdot IT + RSC$
2b	23.28	28.28	$2 \cdot MTR + RSC$
2c	29.28	39.28	$2 \cdot MTR + 2 \cdot IT + 2 \cdot RSC$
3a	27.28	32.28	$2 \cdot MTR + 2 \cdot IT + RSC$
3b	25.28	30.28	$2 \cdot MTR + IT + RSC$
3c	25.28	30.28	$2 \cdot MTR + IT + RSC$
Simple average	26.17	32.28	

source: own calculations, Falch, Henten, Tadayoni (2007), Juvelund, Karlsen, Olesen (2007), AT Kearney (2007)

costs of mobile termination. However, as the Market 15 was found competitive we may expect the rates to be cost based and therefore lower or equal to termination rates. The termination rates, on the other hand, are being subject to regulation in most of the countries and thus we can expect only prices approaching the cost based prices as the regulation almost certainly cannot secure absolute competitiveness.

The EC has proposed the limit of $1xMTR_{EU}$ for receiving a call, $2xMTR_{EU}$ for calling within a visited country and $3xMTR_{EU}$ for calling home. According to schemes from the section on possible scenarios of roaming usage in chapter 2 we derive the approximate costs estimates of operators in table 4.2 and compare it with the limits proposed by EC in its regulation proposal. Unfortunately the data on proportions of the scenario volumes in minutes are confidential and thus we need to substitute the more precise method of weighted average by a calculation of simple average.

To the comparison we use the costs estimated by two independent consul-

Table 4.3: Wholesale cost estimates by various subjects in eurocents

Components	CE Estimates	ATK Estimates
Origination cost	12.34	12.34
Transit costs	2.00	2.00
Roaming Specific Costs	2.00	7.00 / 8.00
Blended Termination Rate	8.94	8.94
Total Wholesale IOT	25.28	30.28 / 31.28

source: Juvelund, Karlsen, Olesen (2007), AT Kearney (2007)

tancies - Copenhagen Economics (Juvelund, Karlsen, Olesen , 2007) and AT Kearney (2007). These two agencies have released their comments on the proposal. Copenhagen Economics on behalf of the Committee on Internal Market and Consumer Protection (IMCO) after the release of ECs roaming regulation proposal and AT Kearney as a reaction on Copenhagen Economics' paper on behalf of GSMA. We may speculate that the truth lies somewhere in the middle as the former works for consumer-biased institution and thus would try to reduce the figures as consumers would benefit more from lower prices. On the other hand, the later is producer-biased as GSMA is favouring the operators. Validation of this assumption could be found e.g. on the web pages of Commissioner Viviane Reding in documents from the first consultation round.

In the table 4.3 we can clearly see the main difference of both papers. AT Kearney emphasises Roaming Specific Costs. These costs were already commented in chapter 2 and regards to these comments we can trust the outcomes of AT Kearney. The basics for this statement are to be found in the reference above. Thus we shall expect the average per-minute costs of wholesale services to be at around 30 eurocents⁸. However, this assumption cannot be confirmed as any hard data are on confidential basis only and thus unavailable.

Both reports state the same figures for international roaming transfer costs as these vary only slightly between 1 to 2.5 eurocents (Juvelund, Karlsen, Ole-

⁸Compare with table 4.2, estimate was reduced under assumptions, that RSCs cannot be, in scenarios concerned, figured in fully twice ($2 \cdot RSC$). Moreover, we assume even slightly lower prices of RSC as discussed in the text.

sen , 2007). The real figures are part of the IOT tariffs which are confidential, but the figures were given at least to the Commission. Copenhagen discussed with selected operators who confirmed the rate of 2 eurocents as a *"high estimate for weighted average international transit costs."* Prices for less busy routes may be higher as Copenhagen Economics ads.

We need to add a comment on the fourth row in the table 4.3. The figure of 8.938 eurocents has been computed as a weighted average of average mobile and fixed termination rates. The weights are 30% for fixed termination and 70% for mobile termination as these values are cited by Copenhagen Economics as being estimated during the discussions with various operators on confidential basis. Again the data cannot be verified. The latest fixed and mobile termination rates are appended in Appendix B. These do not vary significantly from the figures from 2006 on which data in table 4.3 were computed and on which we will be further referring. Moreover, the mobile termination rate with which is being computed on the fourth row is not the average MTR value as in the regulation proposal from 2006, but it is a 75th percentile. Why it is so we shall show in the subsection.

4.2.1 Problems with wholesale regulation

In this subsection we need to ask several questions regarding the regulation proposal from June 2006. The benchmark of average per-minute MTR was chosen without any reasoning as we have mentioned in the previous section. Is it thus the best instrument for the regulation? Or is it the 75th percentile as proposed by Copenhagen Economics? As we have noted already in chapter 2, there are cost differences among countries where either geographical or social aspects influence the costs. Is the proposal considering all these differences as it wants to regulate on European Home Market Approach? We shall answer these questions further in this section.

Should MTR be set as a benchmark for the wholesale price cap? We have said in the previous section, that mobile termination rate is a good benchmark as it is easily accessible through NRAs or ERG. The data on termination rates

are known and it is as well known, that it contributes significantly to wholesale roaming costs. Such rating based on multiples is thus easily calculated and can be effectively supervised with almost no additional costs either for regulators or for operators.

Yet if we take into account the real costs of MNOs we have shown that costs may vary exactly in the controversial fifth row of table 4.3 where Copenhagen Economics argues for low Roaming Specific Costs while AT Kearney argues on basis of its own calculations and of calculations of ITRE (2006) that operators in some countries may be disadvantaged because of their higher costs on specific technologies.

First these may include operators in countries with favorite holiday locations where the costs for technologies on extended traffic must be paid even during low season while the capacity is excessively high, thus uneconomic. The other aspects are the geographic ones. By these we mean mountainous or sparsely populated countries or significant areas. These need to be covered with much higher costs. On the other hand, sparsely populated areas do not require advanced technologies and thus the prices may be not that excessive or in some cases the prices may not differ from normally populated areas (ITRE , 2006) - e.g. the ones we know from the Czech Republic.

The next questionable category is a small MNO. With great fixed costs of technologies with great CapEx and OpEx values the marginal costs grow for small operators as we know from basic economic theory of economies of scale.

If we compare mobile termination rates to mobile origination rates, the other major part of the wholesale roaming costs structure, we can observe that termination rates are significantly higher. This is as we said because of lack of competitiveness on the termination market that is regulated on the one hand but on the other the regulation itself is not able to bring the price as low as to competitive cost-based pricing (Falch, Henten, Tadayoni , 2007). Even because of that the setting of average MTR as a benchmark and price caps are multiples of average MTR it can be said, that the $2xMTR_{EU}$ for roaming within a visited country or $3xMTR_{EU}$ for calling to home country or to third country is well above the costs of the MNO. We may only think of two things. Are

not the price caps too high in some cases leaving still a great amount of revenues to some operators operating in ideal conditions? Are not the operators in nonideal areas too disadvantaged due to their initial conditions?

Is it good to regulate the peak or average termination rates? Or something else? The EC has proposed to regulate the average of the average national MTR. However there are significant differences in some countries between peak and off-peak rates, see figure 4.1. The average termination rates are currently being computed as an arithmetic mean. Thus there is not any visible contribution of both peak and off-peak rates to the revenues of the operators. Naturally the contribution in the peak time is higher as the traffic is higher. We therefore propose to count national averages with more precise methods using perhaps weighted average instead of arithmetic mean. As weights we propose percentage of traffic in both peak and off-peak times. We need to admit that such calculations would mean higher burden for NRAs.

Naturally as we have noted that the traffic in peak time is higher, the average termination rates calculated using weighted average would be higher than these in figure 4.1. Therefore the EU average MTR would increase and the proposed price caps would rise consequently.

Still the selection of average termination rates – even these based on arithmetic mean, however flawed these may be – may be understandable. The significant difference in peak and off-peak rates could be observed only by 5 countries⁹ whose contribution is not that significant in the total calculation of average MTR.

Yet after draft calculations based on assumption that peak time traffic is 75% of total traffic and counting only with selected countries (as in the footnote below) with significant differences between peak and off-peak rates, we have learned that the weighted average approach can make up to 0.4 eurocents more to the current average MTR. Falch, Henten, Tadayoni (2007) suppose that the use of average rates instead of peak or other possible rates has

⁹These countries are according to figure 4.1 Lithuania, UK, Ireland, Denmark and Slovenia. Total weight of these countries is according to table in Appendix B 0.168 (own calculations).

"only limited impact on the level of roaming charges." Even Copenhagen Economics in its report propose the use of average termination rates.

The advantage of selection of average instead of peak rates is in addition securing that there will not be any fraud observed in operators' peak / off-peak rates setting as the regulators in all cases of the termination charges regulate the average, not the peak or other rates. Had the national termination rates been selected as the peak rates, there may appear intentional rise of peak rates while maintaining the average levels at current (regulated) levels by reduction of off-peak rates. Again we may only recommend the considering of regulation based on weighted average and not on the basis of arithmetic mean. This would solve even the problem of possible fraud discussed above.

Is it better to set the price cap as a multiple of average SMP operator MTR or as a 75th percentile of SMP operator MTR? Copenhagen Economics in its paper has proposed contrary to the EC to select a cap not as the EU average of national average MTR but a 75th percentile of national average MTR. This is due to Copenhagen Economics' finding that wholesale costs may *"vary significantly between operators due to circumstances outside their influence."* We have already mentioned the possible variables affecting the costs in the paragraphs above. Therefore we may think that selection of 75th percentile of the average national MTR may be the best way to ensure that at least most of the operators would be in any case able to cover their costs. The use of 75th percentile may add up approximately 2 eurocents to the proposed average MTR as calculated in the ECs proposal.

Still the operators with highest termination rates - e.g. Poland – may face problems as the rate selected on basis of the 75th percentile is still much lower than the average termination rates in these countries. However this suspicion is rather speculative and we will better tend to think that the wholesale roaming costs of these operators are still below the proposed cap as we have shown that termination rates make up to most significant part of the wholesale roaming costs structure and thus its multiples (proposed by the EC as a benchmark) exceed in most cases the real costs.

Nevertheless the suspicion that some operators may be disadvantaged in comparison to other just due to the above quoted "*circumstances outside their influence*" remains. By these operators we may expect the highest level of cross subsidies. We have mentioned reasons already in chapter 3.

On the other hand Falch, Henten, Tadayoni (2007) note that "*75th percentile based calculation will take rates further away from a most efficient operator approach which is the traditional basis for cost calculations*".

The paradox in the answer given to the question above, where we first conclude that some operators may not even cover their costs under the current price caps while others will have the gap too wide and thus will not be pressed toward effective costs based pricing, will be explained in the paragraph below.

Should there be the same MTR for all countries within the Community?

We should seem to be able to give a straight answer almost immediately. The application of the European Home Market Approach is understandable as the EC wishes the same conditions for consumers EU-wide. Still, as we have shown, the differences in costs may be great among operators. Thus, to behave economically, the best way to achieve most effective outcome would be to treat each case individually. Only so we could minimize the excessive profits of individual operators and achieve effective pricing policies on a cost based principle as economic theory say.

The scenario above is possible only in a dreamland of economic theory. As we can never say how high the true costs of roaming really are we need to rely on at least averages of cost estimates based on empirical studies of many subjects in the market. So we can derive the figures as it is shown perhaps in report of Copenhagen Economics or AT Kearney.

Moreover, had it been possible to treat each case individually there would be a great pressure of lobby groups for opt-outs for operators or the operators would simply adjust data to show higher costs. We are quite convinced that in a firm with such a complicated infrastructure such thing is possible.

Brief summary of own comments on Wholesale regulation

Positive:

- **European Home Market Approach:** Under EHMA the whole regulation is easy to monitor and gives no space for lobbying.
- **75th percentile MTR:** May be beneficial for smaller operators as it raises the maximal wholesale price. Their costs are usually greater than costs of bigger operators.
- **Regulating average MTR:** Easy to monitor, brings down wholesale price.

Negative:

- **European Home Market Approach:** Individual approach would be better as it would not harm certain operators with higher costs caused by natural conditions.
- **75th percentile MTR:** No cost based regulation as it brings too wide gap for big operators with lower costs.
- **Regulating average MTR:** More precise method may be to use weighted average for peak and offpeak rates.
- **Call types:** Different rates for calling home, within a country or to another country is unnecessary. Compare costs in table 4.2.

Table 4.4: Accepted wholesale IOT caps in euros

Date	Price
August 30th 2007	0.30
August 30th 2008	0.28
August 30th 2009	0.26

source: EC (2007)

4.2.2 Accepted wholesale regulation

The proposal for regulation from June 2006 has undergone a great change after series of consultations. The final version from July 2007 proposes following caps on wholesale prices.

As we can see the MTR-based regulation is replaced by price-cap on average wholesale roaming rates given at 30 eurocents for the first year, decreasing annually by 2 eurocents. Article 3, paragraph 3 of the final regulation says the average wholesale price is to be counted by division of total wholesale revenues by total volume of wholesale roaming minutes sold for provision of wholesale roaming calls within the Community by given operator within the twelve months period. This holds good for each pair of operators. It is noteworthy that the wholesale regulation deals only with roaming originated calls (calling home, within a visited country or to another country) while it does not regulate the received calls. We have said that the received calls are not subjected to IOT payments and thus the deleting of such cap is welcomed. The retail regulation is sufficient for the receiving calls scenario as we can observe in table 4.2.

The figure of 30 eurocents for average roaming rate corresponds to AT Kearney (2007) proposal and as well to our estimates.¹⁰ The IOTs set at such rate should cover all underlying costs of roaming. We do not find any mention on EU-wide average MTR in the text, yet the inspiration by the proposal of the regulation and following comments from various consultancies is clear. In the previous section we have noted that the MTR is an appropriate benchmark for

¹⁰Compare again with table 4.2.

wholesale roaming cost estimates.

We have already led discussions on whether and how would the smaller operators be harmed. IMCO is concerned by the effect on small operators that it wants to include the special clause into the regulation: *"The Commission shall analyse the effects of this Regulation on the competitive situation of smaller, independent or newly started operators."*¹¹

What is further questionable is the impact of the annual decrease in average wholesale price to 28, respectively 26 eurocents. We have noted that the costs for a medium sized operator are slightly exceeding 30 eurocents if counting with AT Kearney Roaming Specific Costs estimates. Thus we may expect that in the following years some operators may show losses in the wholesale roaming market. The final regulation trusts most likely to Juvelund, Karlsen, Olesen (2007) whose cost estimates are lower due to lower estimates of Roaming Specific Costs (2 eurocents). Yet, our position here remains unchanged.

We need to hope in technological advantages. These would need to be made soon to be able to cut costs of the operators to the necessary levels. The example of such solution may be the third-party billing for smaller operators as discussed in the previous chapter.

However, the revenues of the smaller operators will rise due to better bargaining position under the new regulatory framework. The IOTs were set 'unjustifiably' high as mentioned, and this held true especially in the case of smaller operators. These would thus benefit from lower rates paid for the regulated IOTs while purchasing wholesale roaming services from foreign operators. This assumption is rational as we have talked about the discounting policies in IOT setting. The discounts are applied only to purchasers of big volumes while the small operators usually purchase only small volumes. The IOT may thus be set nondiscriminatory, but still may penalize the small players.

¹¹Room document, Working Party on Telecommunications and Information Society, on 23 March 2007

4.3 Retail international roaming regulation

The main problem of most of the critics of the regulation proposal from June 2006 is the retail price regulation (e.g. Tsyganok , 2005). For retail roaming market the EC proposes a cap of 130% above the maximum wholesale rate for the call. $1 \times \text{MTR}_{EU}$ for receiving a call, $2 \times \text{MTR}_{EU}$ for calling within a country and $3 \times \text{MTR}_{EU}$ for calling home. The retail regulation is implemented because of lack of trust in wholesale reductions pass through to the consumers (i.e. retail prices). The authors of Impact assessment (EC , 2006b) argue in the same way. The mark-up is implemented to retail services only. The wholesale services are already allowed a mark-up through regulated MTR as we have discussed above.

The mistrust is mainly due to the specifics of roaming markets where one firm is retail reseller of wholesale services from other country operator on the one hand and on the other is at the same time a wholesale supplier to the operators in other countries. Thus the demand for wholesale services is determined by consumers from the other country while the retail services demand is set by operator's own customers.

Usually the retail cap is not implemented solely because the big firms may set wholesale prices artificially high to push smaller firms out of the markets by permanent losses. The wholesale cap would not be, as mentioned above, efficient as the EC proclaims. Only the combination as proposed may bring positive effect to consumers within the EU while maintaining "reasonable" profits even to minor operators (EC , 2006b). We have already argued that this may not be true as some operators with specific conditions may not even cover their costs under the wholesale cap. The retail cap has been selected as a "rational mark-up" to the wholesale price without any other proper examination of retail costs (EC , 2007).

By retail costs we mean mostly the costs of marketing and customer handling. These costs account to retail services only. As we have said there is no such thing as a single relevant market for international roaming. There is only a bundle of services which are promoted by the operator as a whole

and thus marketing costs are spread out among many more services such as data services, home voice services, discounted handsets and all the services mentioned as a part of the bundle anywhere in the text.

Further we shall discuss the 3 different approaches proposed by Copenhagen Economics, AT Kearney, and ERG. Copenhagen Economics promoted single absolute mark-up, AT Kearney proposed Earnings before Interest and Taxation (EBIT) capping, and the wholesale regulation only with wait and see proposal on retail regulation was championed by ERG. We shall discuss their reasoning and finally we will give our own proposals towards effective retail regulation in this specific case.

4.3.1 Copenhagen Economics comments

Copenhagen Economics in its survey promotes higher costs on marketing and other (marginal) retail costs. According to their study the retail mark-up should not be extrapolated from percentage mark-up but should be set as an absolute figure. The optimal cap estimated by AT Kearney is set at rate of 14 eurocents. This has been derived from its survey on 19 operators who provided their confidential information to the company. The figure is derived as a multiple of total expenditures on marketing and retail services times the proportion of roaming in the total bundle of services. See exact methodology in Juvelund, Karlsen, Olesen (2007), pg. 35.

Copenhagen Economics argues in favor of this approach not only because of insufficient mark-ups proposed by EC in the regulation proposal. Its main contribution is seen in decrease of the range between the end-user price for receiving a call and the end-user price for calling home. These would range between approximately 15 and 45 eurocents under EC proposal while under Copenhagen Economics study it would range *only* from approximately 26 to 51 eurocents.¹²

Copenhagen Economics argues that under the conditions proposed by EC there will be much greater tendency towards switching from calling home

¹²Own calculations using data from Juvelund, Karlsen, Olesen (2007) and EC (2006a).

from visited network to receiving calls as it would be significantly more favorable. How high the difference between prices proposed by Copenhagen Economics may be, the same gap was in average roaming tariff before any regulation. Thus it is clear that under such conditions there will not be any switching from callers to receivers as it would be possible under the ECs proposal.

However, we may think of elasticities again. The gap between prices was high enough even before the regulation as we have already mentioned. The difference between the prices is 1/2 which is rather a great figure.

Had there been at least any slight sign of indifference among users between calling or receiving the switching towards cheaper option would certainly occur. We may still attribute this effect to the lack of awareness on roaming tariff schemes. The next and perhaps more crucial thing why switching does not occur is the trouble with agreeing on calling between the caller and the receiver. Let us imagine a businessman writing SMS or Email to important client at home to call him at 12:00 to reduce costs of the businessman. What is more imaginable is a situation of holidaymaker agreeing on such strategy with his wife or friends at home. Still even in this situation the statistics give us no significant correlation between price differences of calling/receiving and usage of both services (Eurobarometer , 2006).¹³ We may not consider the switching between these two services as a threat under any reasonable conditions and thus this concern of Copenhagen Economics is rather mistaken.

According to Copenhagen Economics we can derive the share of roaming in the retail services costs using some unit that translates the whole range of services – roaming included – according to its share in volume in the whole bundle. Copenhagen Economics proposes to use voice minutes as such benchmark. This assumption speaks rather for using of common absolute benchmark for all roaming services as whole. Yet every category of roaming voice services – e.g. receiving a call, calling within a country or calling home or

¹³We can agree with The Economist (2008b) that the Eurobarometer may often be misleading, however the figures still give at least some evidence. Official figures on roaming minute volumes by the operators are unfortunately on confidential base only.

Table 4.5: EBIT margins for mobile operators using AT Kearney ECB data

EBIT margins for mobile operators based on 2005 data	EBIT (%)
Average margin	21.9%
50 th percentile margin	26.5%
75 th percentile margin	31.4%

source: AT Kearney (2007)

to another than the visited country – has different wholesale costs and this should be reflected even into the retail prices. And this reflection should be done proportionally as we would expect. If the price of wholesale service is 1 euro for one type of service and 2 for another while assuming the same elasticity of demand for both services, the relative retail mark-up should be set equally – let us say 30%. This holds true for the Ramsey-Boiteux pricing as described above and thus it holds true for non-regulated mobile operators’ price setting as it was discussed above in the section dealing with Ramsey-Boiteux pricing. Percentage mark-up seems to be in accord with such assumption. We shall discuss the details of percentage mark-up in the next sub-section.

4.3.2 AT Kearney comments

AT Kearney proposes in line with CEs proposal from June 2006 a percentage mark-up to retail services. Yet the study argues that there was incorrect methodology used in the proposal as it used EBIT margins of the whole telecommunications industry and did not bother to try to extract the data for EBIT of mobile industry only. AT Kearney uses its European Cost Benchmarking database of confidential data on cost and revenue from sample of 19 operators. The figures for EBIT under 3 different approaches are derived by AT Kearney are shown in table 4.5.

AT Kearney concludes that the proposal by EC is workable even if not based on proper methodology.

The outcomes of AT Kearney are according to our thoughts premature.

Even though the range of the database covers operators of all types, as far as we can expect according to own research on 51 operators¹⁴ from groups mentioned by AT Kearney on details of their ECB database on which are their findings based, not all details were considered. We speak especially of retail costs as mentioned in the subsection above. Copenhagen Economics has calculated average retail costs of operators in various segments from the data given by AT Kearney. The costs are presented in this text in table 4.6. The outcomes speak very much against the results of AT Kearney and its proposal of capping with a percentage mark-up of 30%. As the average retail cost per traffic minute for all European operators reaches as high as 10.2 eurocents the cap would not even cover the costs of most of the operators. Let us count the mark-ups according to the proposal and we will receive figures as 3 eurocents for receiving a call, 7 eurocents for calling within a visited country and 10 eurocents for calling home or to other than the visited country.

The fear of Copenhagen Economics and others is that the cap may hurt especially the small operators. The main concern is that per minute costs grow with less traffic while the level of costs remains roughly the same among the operators within the nation. The market is of the same breadth and expenditures for marketing and advertising are thus mostly equal in the fierce competitive market of mobile telecommunications. Yet the outcome gives us data showing smaller difference than we expected. The inverse proportion¹⁵ does not describe the shape of the curve correctly as the costs differ only in 20% among small and medium operators, and big operators.

What is further interesting is the great difference among retail costs of Western and Eastern Europe. The average costs in Eastern Europe are assessed to 7.35 eurocents which is far below western European average that can be ex-

¹⁴See complete data in Appendix A

¹⁵In this case we expected the costs to fall inversely proportional to the volume of traffic which we have substituted by the number of subscribers for the sake of simplicity not taking into account differences in trends among different countries because of assumption that all operators face the same trends within the country of their origin itself where the competition fight takes place. Thus again the proportion will remain the same within the country.

Table 4.6: Average retail costs per traffic minute, various segments in eurocents

Operator segment	Weighted average of retail costs per traffic minute eurocents/minute
Across all 19 operators in the sample	10.20
Large Western European operators	10.09
Small and medium Western European operators	12.15
Eastern European operators	7.35

source: AT Kearney (2006) as in Juvelund, Karlsen, Olesen (2007)

pected to be around 11 eurocents.¹⁶ In the Eastern Europe the operators can rely on cheaper labor force which means lower costs.

With respect to the data of Copenhagen Economics based on database of AT Kearney we disagree with the studies proclaiming that the burden of the retail regulation under the terms of the EC proposal from June 2006 will fall onto the shoulders of small operators with expected higher retail costs. Yes, the reasoning is clear but the data do not confirm it. Yet the data confirm that the burden will fall onto shoulders of all operators almost equally and that in such manner that most of the operators will not be able to contribute to the retail costs in the proportion expected from the roaming revenues. Should the conditions change for the operators in the way EC proposes while pricing policies in other parts of the mobile communications market remain the same, we can expect a profit squeeze by some operators. Thus we can be sure that the *waterbed effect* (or cross-subsidies) would emerge under such conditions.

Moreover we can argue that the data from the AT Kearney ECB database may have been flawed by some effect affecting only the single year 2005 from which the database is collected. The retail costs may have differed from other years averages because of some special campaign. In 2005 the marketing costs

¹⁶Neither the exact figure nor the exact weights are given in the Copenhagen Economics study thus we can only guess. The figure is thus only an estimate.

have been affected by promoting new handsets with digital cameras or with included MP3 players. Such technology with a great economic potential for operators does not occur every year. We thus have to expect different costs for different years.

We would propose to collect data from the wider time-range to make sure that the data are not biased by single year outlier. Last but not least we have to point out that the outlier would not be solely one operator. It would be the market as a whole – speaking on Europe-wide range – as the mobile communications market is highly competitive and similarly technologically advanced in all EU countries. The operators usually promote the whole bundles of services as mentioned above. Thus their campaigns usually target similar products at the same time as the competitors do.¹⁷ The almost uniform timing is given by great level and pace of innovativeness in the market. Therefore we can expect that the data for given year may be affected by some time-specific event.

The study of AT Kearney proposed a percentage mark-up. We can see that retail costs are higher than the mark-up and thus the proposal in such level is inappropriate. We can accept the percentage mark-up only if the costs from the table 4.6 were calculated properly for each scenario of receiving a call, calling within a country or calling home or to another country. We can expect much higher figures than above mentioned 3, 7 and 10 eurocents. This would create a great disproportion between the calling scenarios which we discussed in the previous subsection. Our outcome was that we will not expect any switching between receiving and calling under greater difference between the prices. As the ECs primary wish was to completely abolish the price for receiving a call under assumption of *calling party pays* we can at least be in favor of percentage mark-up. The absurdity of abolishment of price for receiving a call was discussed above. We can only remind that even receiving a means using roaming specific utilities and international transfers which means costs for the operator.

¹⁷For a reader with doubts about the validity of this assumption we refer him to websites of various operators. The similarities in the advertising campaigns are obvious.

4.3.3 ERG comments

ERG proposed to *wait and see* with implementing of the retail regulation. Its objective was to wait whether the market competition and regulatory threat will not make the work. As we have mentioned, the falling wholesale prices were usually not passed through to consumers in form of lower retail prices. This sunrise clause approach is rather desirable if only the regulatory threat had not been present for so long. The suggestion of ERG was released in March 2006 and the EC had a long time for observing the behavior of mobile operators until July 2007 when the final version of the regulation was adopted. Had this thesis been released two years earlier we had had agreed with ERG if no deep enough study had been led through. However, time has shown that certain regulation was needed as prices were really not passed through to consumers enough.

It is noteworthy that many operators decreased their retail prices until the adoption of the regulation.¹⁸ This was not the case of all operators, however, significant differences were still present. We thus keep to our proposal of retail price cap in form of the percentage mark-up as proposed in the previous subsection.

4.3.4 Accepted retail regulation

The approach to regulating the retail roaming prices has changed as dramatically as the wholesale one. The figures for retail roaming prices accepted in the final regulation are included in the table 4.7.

We can now see, that the EC has changed its approach of 30% mark-up on wholesale costs and has accepted the approach of nominal price cap as on the wholesale level. The categories remain unchanged and thus the EC regulates both incoming and outgoing calls. Same rates are applied on calling to home country or to another than visited country and calling within the visited country as in the wholesale cap. The inspiration and justification can be found in

¹⁸See e.g. ECs website on roaming regulation:

http://ec.europa.eu/information_society/activities/roaming/roaming_regulation/index_en.htm

Brief summary of own comments on Retail regulation

Positive:

- **Fixed mark-up:** Setting a fixed mark-up of 14 eurocents/min. may easily cover the retail costs even of smaller operators.
- **Percentage mark-up:** Percentage mark-up offers proportional pricing and thus prevents switching of demand. Moreover is in accord with Ramsey-Boiteux pricing.
- **Wait and see:** No disruption in the roaming market. Waiting for new technologies or simply for new conditions that may bring the market to competitive state may be worth considering. Market solution is always better than regulatory one.

Negative:

- **Fixed mark-up:** Disproportional pricing caused by fixed 14 eurocents mark-up may cause undesirable switching in demand and is not in accord with Ramsey-Boiteux pricing
- **Percentage mark-up:** May be difficult to set a proper mark-up that covers all retail costs.
- **Wait and see:** For too long the market was not moving towards competitive state.

Table 4.7: Accepted retail caps in euros (without VAT)

Date	Calls made	Calls received
August 30th 2007	0.49	0.24
August 30th 2008	0.46	0.22
August 30th 2009	0.43	0.19

source: EC (2007)

Juvelund, Karlsen, Olesen (2007). We've already discussed the reasoning for single tariff for outgoing calls in the section on wholesale regulation.

In previous subsections we have also calculated the approximate costs of retail services and total costs of receiving a call. These include Roaming Specific Costs (approximately 7 to 8 eurocents)¹⁹, International Transit (approximately 2 eurocents)²⁰ and roaming retail costs (approximately 10.20 eurocents)²¹. In table 4.8 we show the mark-ups on wholesale costs for incoming calls and on wholesale IOT cap on outgoing calls while in one case we include the retail costs and in the other we exclude it to see the difference.

According to the figures in the table we can see that without retail costs (10.20 eurocents) we can observe mark-ups for both incoming and outgoing calls even exceeding the original version of 30%. The retail costs are, though, indisputable part of total costs. While calculating with the inclusion of this additional item, we obtain different figures. The incoming call mark-up in the third year is even negative. Moreover, as for wholesale costs for outgoing calls we do not consider the estimated costs, but the IOT cap from the final regulation text only. If calculating the same table with our estimates, the figures would be lower even in the case of outgoing calls. See the verification in the section dealing with wholesale regulation.

We can conclude that the regulation is rather strict for the specific groups of operators such as operators disadvantaged by geographical conditions or

¹⁹See table 4.3 or Juvelund, Karlsen, Olesen (2007)

²⁰See table 4.3 or AT Kearney (2007)

²¹See table 4.6; We calculate with the average cost for European Operators as whole, not within the different segments stated in the table.

Table 4.8: Retail mark-ups, accepted regulation, in euros

Retail costs not included				
Date	Incoming calls		Outgoing calls	
	Nominal	Percentage	Nominal	Percentage
August 30th 2007	0.15	62.50%	0.19	38.78%
August 30th 2008	0.13	59.09%	0.18	39.13%
August 30th 2009	0.10	52.63%	0.17	39.53%

Included Retail Costs (10.20 eurocents)				
Date	Incoming calls		Outgoing calls	
	Nominal	Percentage	Nominal	Percentage
August 30th 2007	0.03	11.88%	0.07	13.98%
August 30th 2008	0.01	3.86%	0.06	12.72%
August 30th 2009	-0.02	-11.32%	0.05	11.28%

source: own calculations

smaller operators. Their costs should even exceed the promoted costs in our calculations and thus the regulation may menace these groups and their revenues. The other groups (e.g. large operators) may not be that much disadvantaged and we again refer the reader to the comparison of Eurotariff and e.g. Vodafone Passport where the rates are even lower than the regulated ones.²²

In the table 4.9 we add the differences between prices for incoming and outgoing calls. We have worried that the different proportion of prices for dif-

²²See table 3.1.

Table 4.9: Differences between incoming and outgoing call rates

Date	Price in	Price in	Absolute	Percentage
	euros for	euros for	difference	
	calls made	calls received	in euros	difference
August 30th 2007	0.49	0.24	0.25	48.98%
August 30th 2008	0.46	0.22	0.24	47.83%
August 30th 2009	0.43	0.19	0.24	44.19%

source: own calculations

ferent types of calls may skew the demand more towards one or another type. The absolute differences have stayed approximately same, yet, the percentage differences matter. The intent of regulation is not to modify the demand of consumers, but only to lower the prices. Above we have led the discussion whether the services can be treated as substitutes or not and concluded that the services are substitutes only to a certain level. Still, we warn that the disproportion may lead to switching in demand. The remedy is to be found in proportional pricing for both types of calls.

4.4 Transparency in international roaming pricing

The regulation proposal and the final regulatory framework did not omit the part that improves pricing transparency of roaming. The regulatory text includes Article 7, *Transparency of retail charges*. We have proposed already in the chapter 2 that additional information may bring the market closer to competitive state.

Yet, the European Commission wishes to increase awareness of roaming tariffs in two ways, not just by the above mentioned Article 7. The other way is by simplification of tariff schemes incorporated already in the mere existence of the Eurotariff. We have discussed the problems of flat-rate tariffs already in chapter 2 and thus we need to add any more details.

The economical impact of this regulation is naturally not that controversial as the intervention into retail and wholesale prices. Most of the operators usually inform customers by informative SMS while entering into the foreign network. The Commission thus urges the operators just to alter these informative SMSs and to establish a phone line where consumers can get a free voice information about roaming tariffs. As well, such consumer voice service is generally available by most of the operators and thus incurs no significant additional costs.

We thus agree with this part of the regulation without any remarks. The transparency rules may be likened to e.g. safety instructions or information on food label. Such regulation as well reduces the information asymmetry and

is thus desirable as it may bring the market towards more competitive state. The effects of information asymmetry were studied e.g. by Stigler (1961) and his outcomes coincide with our statement. Textbooks of basic microeconomics present the existence of information asymmetry as well as a barrier for perfect competition (Gravelle, Rees , 2004), pp. 362-374.

Chapter 5

Conclusions

In the previous pages we have given a few comments to the regulatory effort of the EC to regulate roaming charges. We have put the main stress into the analysis of the cost structure of roaming. These are usually divided into 4 categories. These are mobile origination, mobile termination, international transfers and roaming specific costs.

We have vindicated that the selection of the mobile termination rate (MTR) as a benchmark for the price cap was correct and justifiable. MTRs are being already regulated in most countries and thus the rates are already known. That means also lower costs for supervision of the regulation. Moreover, the MTR is a good indicator of mobile origination rate (MO) as these are considered to have a similar cost base. The selection of average MTR is unclear, however, as there are significant differences among the European countries.¹ We have concluded that the regulated MTR gives a fair mark-up to medium and big operators so that they do not suffer from profit squeeze. On the other hand, we point out, that the smaller operators may not be able to cover their costs under the current price cap. Even though the final regulatory framework does not mention MTR, its inspiration is clear.

The second concern of this thesis were the roaming specific costs (RSC). These were calculated in different ways. We have shown some arguments why the RSCs are substantially higher than the rate with which the original EC proposal methodology calculated. Moreover, we have again shown the dis-

¹See Appendix B.

proportion of RSCs among countries, which may incur another threat of profit squeeze for certain types of operators. This disproportion is mostly caused by geographical and geological conditions. Besides, we have shown that the concerns, that smaller operators may have significantly higher RSCs than the bigger ones, are not reasonable as the smaller operators can usually use less expensive technologies. We must admit that certain differences exist.

The smaller operators may improve their endangered situation as described above by better bargaining position on Inter Operator Tariffs (IOTs) since the big operators are now limited in their wholesale prices. We have mentioned that the big operators usually abused the bilateral agreements on IOTs simply by overcharging IOTs while bargaining discounts. In such position were the smaller operators naturally handicapped.

The third main issue has been the retail price cap. In chapter 3 we have shown that there is no precisely defined retail roaming market as retail roaming services are usually sold in greater bundles containing products going . Still, we have indicated that the use of retail price cap is rational as the pass through of wholesale savings is not secured due to low elasticity of demand for retail roaming services. Yet, neither the proposed, nor the accepted cap can fully secure the coverage of retail costs especially of smaller operators in Western European countries.

As the retail caps of the accepted regulatory framework are not proportional for incoming/outgoing calls during the whole period of 3 years² we warn of unnecessary and undesired change in consumer demand for these services as a consequence.

We have further shown that mobile operators usually set their prices according to the Ramsey-Boiteux pricing scheme. We are quite convinced, that cross-subsidies (*waterbed effect*) may occur under the regulation. The threats to regulate other than voice services in the international roaming may solve only a part of the problem. The retail services are sold in bundles including not only roaming services, but many more ranging from home voice or data services to sales of discounted handsets.

²Note that the price caps are adjusted to given level every year.

Additionally we have given certain proposals how the markets of roaming may improve without any need of regulation. The model of Kumar, Hämmäinen (2004) indicates how the vertical integration of operators may increase competitiveness. In the same manner may some new rules for IOT contracting by MVNOs help to boost competitiveness. In the text we propose how could this be possibly done.

This text thus concludes that in the current situation the regulation is a tenable measure. The final regulation has been designed reasonably in contrast with the regulation proposal from June 12th 2006. The present regulatory framework now contains most of the remarks from different papers written on this topic. However, mentioned problems must be monitored so that the market can evolve freely without significant distortions. And more, the regulation should be terminated as soon as the new technologies, that may be able to bring the roaming market more towards the competitive state, are available and competitive.

Bibliography

- 2008, [GSM Brochure, 2008]. GSM Association's handbook 2008, GSMA. Available at: http://www.gsmworld.com/documents/gsm_brochure.pdf (accessed May 15th 2008).
- 2008, [The Economist, 2008a]. The Economist: The limits of leapfrogging, February 7th 2008. Available at: <http://www.economist.com/> (accessed May 15th 2008).
- 2008, [The Economist, 2008b]. The Economist: Ask a silly question, February 21st 2008. Available at: <http://www.economist.com/> (accessed May 15th 2008).
- 2007, [AT Kearney, 2007]. AT Kearney, International Roaming Regulation: Comments on the Copenhagen Economics "Study on Roaming" published in February 2007, AT Kearney.
- 2007, [EC, 2007]. Regulation (EC) No 717/2007 of the European Parliament and of the Council of 27 June 2007 on roaming on public mobile telephone networks within the Community and amending Directive 2002/21/EC, OJ L 171, June 29th 2007, p. 32-40, Brussels
- 2007, [Ewers Consult, 2007]. Ewers Consult: Mobile Call Termination Charges, Ewers Consult GmbH, Bochum. Available at: http://www.ewers-consult.com/pdf/files/mobil_en.pdf (accessed May 15th 2008).
- 2007, [OECD, 2007]. OECD: Communications survey, Organization for Economic Co-operation and Development, Paris.

- 2006, [ARCEP, 2006]. ARCEP: Public consultation on the wholesale markets for access and call origination on public mobile networks 10.01.2006 - 21.02.2006, Autorité de Régulation des Communications électroniques et des Postes, Paris. Available at: <http://www.arcep.fr/fileadmin/reprise/publications/c-publique/consultang-roaming-100106.pdf> (accessed May 15th 2008).
- 2006, [BEUC, 2006]. BEUC: International Roaming Tariffs - Commission's consultation, BEUC/128/2006, Bureau Européen des Unions de Consommateurs, Brussels. Available at: http://ec.europa.eu/information_society/activities/roaming/docs/comments/beuc.pdf (accessed May 15th 2008).
- 2006, [CTU, 2006]. CTU Relevant market analysis - Market 17, Czech Telecommunication Office, Prague. Available at: <http://www.ctu.cz/> (accessed May 15th 2008).
- 2006, [EC, 2006a]. Proposal for a Regulation of the European Parliament and of the Council on roaming on public mobile networks within the Community and amending Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services, COM(2006) 382 final, July 12th 2006, Brussels.
- 2006, [EC, 2006b]. Commission Staff Working Paper - Impact Assessment of policy options in relation to a Commission proposal for a Regulation of the European Parliament and of the Council on roaming on public mobile networks within the Community, SEC(2006) 925, July 12th 2006, Brussels.
- 2006, [Eurobarometer, 2006]. European Opinion Research Group: Special Eurobarometer survey no 269. Available at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_269_en.pdf (accessed May 15th 2008).
- 2006, [MACH, 2006]. MACH: Re-pricing, MACH. Available at: http://www.mach.com/about/publications/publications/MACH_Re-pricing.pdf (accessed May 15th 2008).

2005, [ERG, 2005]. ERG Project Team on International Roaming Retail Tariff Transparency, European Regulators Group. Available at: http://www.erg.eu.int/doc/publications/erg_05_43rev1_irr_ttransparency.pdf (accessed May 15th 2008).

2003, [EC, 2003]. Commission Recommendation 2003/311/EC of 11 February 2003 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communication networks and services, OJ C(2003) 497, February 11th 2003, Brussels.

2002, [EC, 2002]. Commission Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive), OJ L 108 (2002), April 24th 2002, p.33, Brussels.

1997, [EC, 1997]. Commission Notice on the definition of the relevant market for the purposes of Community competition law, OJ C372/5 (1997), December 9th 1997, Brussels.

1992, [NERA, 1992]. NERA: Market definition in UK Competition Policy, UK Office of Fair Trading Research Paper no. 1, National Economic Research Associates (NERA).

ALEXANDER, I., IRWIN, T., 1996. Private Sector Development Department, World Bank. Available at: <http://rru.worldbank.org/Documents/PublicPolicyJournal/087irwin.pdf> (accessed May 15th 2008).

AVERCH, H., JOHNSON, L.L., 1962. Behavior of the Firm under Regulatory Constraint, *American Economic Review* 52, 1052-1069.

BOITEAUX, M., 1956. Sur la gestion des Monopoles Publics astreints a l'équilibre budgétaire, *Econometrica*, Vol. 24, No. 1 (Jan., 1956), pp. 22-40 - translated to english as: BOITEAUX, M., 1971. On the Management of Public

- Monopolies Subject to Budgetary Constraints, *Journal of Economic Theory* 3, 1971, pp. 219-240.
- CAWLEY, R. A., 2004. The new approach to economic regulation in the electronic communications sector in Europe: the application of regulatory remedies, *Journal of Network Industries* 5, pp. 3-21.
- COURNOT, A.A., 1838. *Recherches sur les Principes Mathematiques de la Theorie des Richesse*, translated by N.T. Bacon, (1927), New York: Macmillan.
- FALCH, M., HENTEN, A., TADAYONI, R., 2007. Regulation of international roaming charges the way to cost based prices?, 18th European Regional ITS Conference Paper, Istanbul, DRAFT.
- GRAVELLE, H., REES, R., 2004. *Microeconomics*, 3. ed., Financial Times Prentice Hall, Munich.
- HAUCAP, J., 2003. *The Economics of Mobile Telephone Regulation*, Diskussionspapiere der Fächergruppe Volkswirtschaftslehre no. 4, Helmut-Schmidt-Universität, Hamburg.
- HAUCAP, J., HEIMESHOFF, U., UHDE, A., 2005. Credible Threats as an Instrument of Regulation for Network Industries, forthcoming in: WELFENS, P. (ed.), *Regulatory Changes, Innovations and Investment Dynamics in the Digital World Economy*, Springer: Berlin 2006, Available at: <http://ssrn.com/abstract=890107> (accessed May 15th 2008).
- JERVELUND, C., KARLSEN, S., OLESEN, H. B., 2007. *Study on Roaming: An Assessment of the Commission Proposal on Roaming*, Copenhagen Economics study, Copenhagen.
- KING, S., 1998. Principles of Price Cap Regulation, in *Infrastructure Regulation and Market Reform: Principles and Practice*, Australian Competition and Consumer Commission (ACCC) and the Public Utility Research Centre (PURC), Canberra.

- KUMAR, K. R. R., HÄMMÄINEN, H., 2004. Assessing the Value of Roaming over Mobile Networks, In International Telecommunications Society Biennial Conference.
- LAMDIN, D. J., 2003. Cost of Equity Uncertainty and Rate of Return Regulation: Implications of New Developments in Financial Economics, University of Maryland, Baltimore. Available at: <http://ssrn.com/abstract=416581> (accessed May 15th 2008).
- LESCOP, D., 2008. Regulating International Roaming Charges: Why Less When More Is Possible?, *Journal of Communications and Strategies* no. 66, pp. 159-166.
- LITTLECHILD, S., 1983. Regulation of British telecommunications, London: Her Majesty's Stationery Office.
- LUPI, P., MANETTI, F. M., 2006. Roaming in the Woods of Regulation: Public Intervention vs. Firms Cooperation in the Wholesale International Roaming Market, "Marco Fanno" Working Paper no. 19, Dipartimento di Scienze Economiche "Marco Fanno", Padova.
- MASSEY, P., 2000. Market definition and market power in competition analysis: Some practical Issues, *The Economic and Social Review*, 4, pp. 309-328.
- MARSHALL, A., 1890. Principles of Economics, London: Macmillan.
- PALMIGIANO, A. et al., 2002. Technical Issues on Roaming: Transparency, Technical Aspects and Data Overview related to the Proposed Regulation on Roaming, IP/A/ITRE/FWC/2006-087/Lot2/SC1, European Parliament's committee on Industry, Research and Energy (ITRE), Brussels.
- RALPH, E., 1992. Cross-subsidy: A Novice's Guide to the Arcane, EKconomics LLC Paper, Baltimore. Available at: <http://www.ekonomicsllc.com/Ralph1992Cross-subsidy.pdf> (accessed May 15th 2008).

RAMSEY, F. P., 1927. A Contribution to the Theory of Taxation, *The Economic Journal*, Vol. 37, No. 145 (Mar., 1927), pp. 47-61.

SALSAS, R., KOBOLDT, C., 2002. Roaming Free? Roaming Network Selection and Inter- Operator Tariffs, *Dot.Econ Working Paper*, London.

STIGLER, G. J. 1961. The Economics of Information, *The Journal of Political Economy*, Vol. 69, No. 3 (Jun., 1961), pp. 213-225.

DE STREEL, A., 2003. Market Definitions in the New European Regulatory Framework for Electronic Communications, *Info* 5, 27-47.

STUMPF, U., 2001. Prospects for Improving Competition in Mobile Roaming, *WIK GmbH*, 2001.

SWAN, M., 2003. Total cost of charging and billing: CapEx and OpEx, unpublished paper. Available at: <http://www.netlab.tkk.fi/opetus/s38041/k05/swan.pdf> (accessed May 15th 2008).

TSYGANOK, L., 2005. Is there competition in the markets for International Roaming Services, unpublished ECARES Paper. Available at: <http://www.ecare.ulb.ac.be/ecare/people/doc/tsyganok/telecommunication.pdf> (accessed May 15th 2008).

VARIAN, H. R., 2005. *Intermediate Microeconomics*, 7. ed., W.W. Norton & Company, New York.

Appendix A

Sample of European MNOs

Table A.1: Sample of European mobile operators

Country	Group	Subscribers	
		(millions)	Market share
Italy	Telecom Italia	35.3	54.1%
Germany	Vodafone	30.8	41.5%
Germany	T-Mobile	30.7	37.0%
France	Orange	23.4	45.0%
Spain	Telefonica	22.4	54.4%
Italy	Vodafone	21	32.2%
United Kingdom	Telefonica	17.9	28.8%
United Kingdom	Vodafone	17.1	27.5%
United Kingdom	T-Mobile	16.7	24.0%
United Kingdom	Orange	15.3	21.8%
Spain	Vodafone	14.9	36.2%
Poland	Orange	12.5	34.3%
Germany	Telefonica	12.1	16.3%
Poland	T-Mobile	11.9	34.0%
Spain	Orange	11.1	24.0%
The Netherlands	KPN	9.1	59.4%
France	Bouygues	8.7	18.8%
Romania	Vodafone	8	45.9%
Romania	Orange	8	46.0%
Greece	Vodafone	5	50.6%
Czech Republic	Telefonica	4.9	45.3%
Czech Republic	T-Mobile	4.8	41.0%

Portugal	Vodafone	4.7	41.8%
Greece	Cosmote	4.6	38.0%
Sweden	Telia Sonera	4.6	46.0%
Belgium	Belgacom	4.3	45.0%
Hungary	T-Mobile	4.3	46.0%
The Netherlands	Vodafone	3.9	25.5%
Austria	Telekom Austria	3.8	40.0%
Bulgaria	Cosmote	3.3	40.0%
Austria	T-Mobile	3.2	36.0%
Belgium	Mobistar	3.2	33.0%
Hungary	Telenor	3.1	34.0%
Slovakia	Orange	2.7	55.0%
Czech Republic	Vodafone	2.5	23.1%
Finland	Elisa	2.5	48.1%
The Netherlands	T-Mobile	2.5	15.0%
Finland	Telia Sonera	2.4	42.0%
Hungary	Vodafone	2.2	24.2%
Ireland	Vodafone	2.2	54.6%
Lithuania	Telia Sonera	2.1	48.0%
Slovakia	T-Mobile	2.1	45.0%
Ireland	Telefonica	1.6	39.7%
Sweden	Telenor	1.6	17.0%
Denmark	Telenor	1.4	24.0%
Romania	Cosmote	1.2	7.0%
Denmark	Telia Sonera	1.1	20.0%
Ireland	Eircom	0.9	22.3%
Estonia	Telia Sonera	0.8	47.0%
Latvia	Telia Sonera	0.8	43.0%
Slovakia	Telefonica	0.5	11.6%
Malta	Vodafone	0.2	61.7%
Total		415.9	

source: own calculations, operators websites, NRAs

Table A.2: European countries, aggregated data on mobile telecommunications, 2006 data

Country	Population (millions)	Operators studied	Penetration rate	Prepaid share	Postpaid share
Austria	8.3	2	99%	28%	72%
Belgium	10.5	2	83%	64%	36%
Bulgaria	7.7	1	78%	68%	32%
Cyprus	0.8	0	99%	57%	43%
Czech Republic	10.3	3	105%	71%	29%
Denmark	5.4	2	96%	19%	81%
Estonia	1.3	1	104%	36%	64%
Finland	5.3	2	98%	3%	97%
France	60.9	2	76%	35%	65%
Germany	82.5	3	90%	50%	50%
Greece	11.1	2	89%	60%	40%
Hungary	10.1	3	90%	69%	31%
Ireland	4.2	3	96%	75%	25%
Italy	58.8	2	111%	84%	16%
Latvia	2.3	1	79%	61%	39%
Lithuania	3.4	1	117%	65%	35%
Luxembourg	0.5	0	150%	43%	57%
Malta	0.4	1	81%	100%	0%
Netherlands	16.3	3	94%	57%	43%
Poland	38.1	2	71%	60%	40%
Portugal	10.6	1	106%	82%	18%
Romania	21.6	3	81%	xxx	xxx
Slovakia	5.4	3	80%	56%	44%
Slovenia	2	0	90%	44%	56%
Spain	43.8	3	94%	50%	50%
Sweden	9	2	101%	52%	48%
United Kingdom	60.4	4	103%	66%	34%

source: own calculations, operators websites, NRAs, ERG

Appendix B

Average termination rates in Europe

Table B.1: Average termination rates in Europe

Country	MTR (euros)	Active subscribers (millions)	Weight	Contribution to average MTR, eurocents per minute
Austria	0.101	8.2	0.018 ¹	0.182
Belgium	0.153	8.7	0.019	0.292
Bulgaria	0.19	7.4	0.016	0.307
Cyprus	0.023	0.7	0.002	0.003
Czech Republic	0.105	10.8	0.024	0.248
Denmark	0.113	5.2	0.011	0.129
Estonia	0.167	1.4	0.003	0.051
Finland	0.08	5.1	0.011	0.089
France	0.098	46.1	0.101	0.992
Germany	0.114	76.1	0.167	1.901
Greece	0.125	9.9	0.022	0.271
Hungary	0.107	9.1	0.02	0.214
Ireland	0.134	4	0.009	0.118
Italy	0.122	65.1	0.143	1.742
Latvia	0.088	1.8	0.004	0.035
Lithuania	0.104	4	0.009	0.092
Luxembourg	0.15	0.7	0.002	0.023
Malta	0.115	0.3	0.001	0.008
Netherlands	0.114	15.4	0.034	0.385

¹Weight of a country is computed as a number of subscribers in the country divided by a total number of subscribers in the EU. $w_i = \frac{SUB_i}{SUB_{EU}}$; $i = 1, \dots, 27$; $\frac{\sum_{i=1}^{27} SUB_i}{SUB_{EU}} = 1$

Poland	0.161	27.1	0.059	0.958
Portugal	0.117	11.1	0.024	0.285
Romania	0.079	20.6	0.045	0.357
Slovakia	0.105	4.3	0.009	0.099
Slovenia	0.156	1.8	0.004	0.062
Spain	0.121	40.4	0.089	1.072
Sweden	0.07	9.1	0.02	0.14
United Kingdom	0.0115	61.6	0.135	1.55
Total		445.9	1	11.6

source: Juvelund, Karlsen, Olesen (2007)

Appendix C

Exchange rates

Table C.1: Exchange rates for services paid for in currencies other than the euro

Currency	Rate Units per euro
Bulgarian lev	1.9558 ¹
Cypriot pound	0.5837 ²
Czech crown	28.718
Danish crown	7.4422
Estonian crown	15.6466
British pound sterling	0.674
Hungarian forint	246.15
Lithuanian litas	3.4528
Latvian lats	0.6963
Maltese pound	0.4293 ³
Polish złoty	3.7677
Romanian leu	3.134
Swedish crown	9.2525
Slovakian crown	33.635

source: European Central Bank (ECB)

¹The reference rates were posted by the ECB on June 29th, 2007.

²in euro from 2008

³in euro from 2008