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Roaming

Technology, Case Studies, Economics and Applications

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1. ΠΕΡΙΛΗΨΗ

Η εργασία που ακολουθεί έγινε στα πλαίσια του μαθήματος «Τεχνολογίες Τηλεπικοινωνιών και Δικτύων», του Β' εξαμήνου του διατμηματικού μεταπτυχιακού προγράμματος στα Πληροφοριακά Συστήματα του Πανεπιστημίου Μακεδονίας.

Στο πρώτο κεφάλαιο αναλύεται ο όρος *roaming*, που αποτελεί και το αντικείμενο της συγκεκριμένης εργασίας. Αναφέρονται ορισμοί από πολλές διαφορετικές πηγές ενώ δίνονται και κάποιες μορφές *roaming*.

Στη συνέχεια προσεγγίζεται ο τρόπος λειτουργίας του *roaming*, σε γενικές γραμμές και χωρίς να απαιτούνται ιδιαίτερα εξειδικευμένες γνώσεις τηλεπικοινωνιών και δικτύων για την κατανόησή του.

Ακολουθεί το κεφάλαιο όπου αναφέρεται το κόστος της χρήσης της υπηρεσίας του *roaming* ανά τον κόσμο, ενώ δίνονται και συγκριτικά παραδείγματα από διάφορες χώρες της Ευρώπης, με τη χρήση πινάκων και γραφημάτων.

Τέλος παραθέτονται και ορισμένα *case studies* από εταιρίες κινητής τηλεφωνίας που παρέχουν υπηρεσίες *roaming* στην Ελλάδα.

Θα πρέπει εδώ να σημειωθεί πως το *roaming* βρίσκεται υπό ανάπτυξη ειδικά στην Ελλάδα και εξαιτίας αυτού δε βρέθηκε κανένα σχετικό βιβλίο από όπου θα μπορούσαν να ληφθούν πληροφορίες για το θέμα, οπότε η εργασία βασίστηκε αποκλειστικά σε πηγές μέσω του διαδικτύου.

2. SUMMARY

The following project is a part of the course “Telecommunications and Networking Technologies”, taught during the second semester of the interdepartmental postgraduate Master in Information Systems of University of Macedonia.

In the first chapter the term roaming, which is the subject of this particular project, is being analyzed at length. Not only definitions by a variety of different sources are given, but also certain types of roaming are mentioned.

Afterwards the way of operation roaming is being approached, in general terms, without any specialised knowledge of telecommunications and networks required for its comprehension.

The next chapter consists of the cost of the usage of roaming services around the world. Some comparative examples from various countries of Europe are being given also, with the usage of tables and graphs.

Finally, certain case studies are being given and they examine cell network companies in Greece that provide roaming services.

Due to the fact that roaming is still under growth, especially in Greece, no relative book was found so as to obtain more information about the subject. Therefore, this work is based exclusively on sources via the Internet.

3. DEFINITION

Roaming is a general term in wireless telecommunications that refers to the extending of connectivity service in a location that is different from the home location where the service was registered. Roaming occurs when a subscriber of one wireless service provider uses the facilities of another wireless service provider. This second provider has no direct pre-existing financial or service agreement with this subscriber to send or receive information. A device will usually indicate when it is roaming. The quintessential example of "roaming" is the case of cellular phone when a phone is in a location where its wireless service provider does not provide coverage (for example, another country). In some cases, roaming occurs in a phone's designated home area when it transmits via a different provider's tower (sometimes at a higher price). This is likely to occur when the service provider's signal is too weak or if the volume of callers is too high. In order for a mobile device to use a different carrier's service, the phone's service provider must have a roaming agreement.

Additionally, roaming can be referred to as a service offered by most cellular service providers, allowing users to use their phone even if they are not in their home coverage area. In general, using a phone while roaming incurs additional fees, though some service providers offer national roaming for free on some service plans. When a phone is in a roaming area, it usually displays an indicator light or logo.

Furthermore, roaming service can be defined as the ability to get access to the Internet when away from home at the price of a local call or at a charge considerably less than the regular long-distance charges. For example, if you normally get access to the Internet from an access provider in Athens and are travelling to Hong Kong, you can call a designated access provider in Hong Kong. Instead of paying long distance charges to your local provider in Athens, you pay the local phone connection charge in Hong Kong and possibly a modest additional charge for the service. In some cases, roaming occurs in a phone's designated home area when it transmits via a different provider's tower (sometimes at a higher price). This is likely to occur when the service provider's signal is too weak or if the volume of callers is too high. In order for a mobile device to use a different carrier's service, the phone's service provider must have a roaming agreement with that carrier.

Roaming is also defined as the ability for a cellular customer to automatically make & receive voice calls, send & receive data, or access other services when travelling outside the geographical coverage area of the home network, by means of using a visited network. Roaming is technically supported by mobility management, authentication and billing procedures. Establishing roaming between network operators is based on - and the commercial terms are contained in - Roaming Agreements. If the visited network is in the same country as the home network, this is known as National Roaming. If the visited network is outside the home country, this is known as International Roaming (the term Global Roaming has also been used). If the visited network operates on a different technical standard than the home network, this is known as Inter-standard roaming.

GSM Roaming, which involves roaming between GSM networks, offers the convenience of a single number, a single bill and a single phone with worldwide access to over 210 countries. The convenience of GSM Roaming has been a key driver behind the global success of the GSM Platform. Network, Services and Roaming information are continually updated to reflect the evolving situation worldwide. Interactive coverage maps, updated quarterly, allow you to navigate to see where exactly you can use your phone.

Some of the most common types of roaming are given below:

- **Regional roaming:** This type of roaming refers to the ability of moving from one region to another region inside national coverage of the mobile operator. Initially, operators often made commercial offers restricted to a region (sometimes to a town). Due to the success of GSM and the decrease in cost, regional roaming is rarely offered to clients except in nations with wide geographic areas like the USA, Russia, India, etc., in which there are a number of regional operators.
- **National roaming:** It refers to the ability to move from one mobile operator to another in the same country. For commercial and license reasons, this type of roaming is not allowed unless under very specific circumstances and under regulatory scrutiny. This has often taken place when a new company is assigned a mobile telephony license, to create a more competitive market by allowing the new entrant to offer coverage comparable to that of established operators (by requiring the existing operators to allow roaming while the new entrant has time to build up its own network).
- **International roaming:** This type of roaming refers to the ability to move to a foreign service provider's network. It is, consequently, of particular interest to international tourists and business travellers. Broadly speaking, international roaming is easiest using the GSM standard, as it is used by over 80% of the world's mobile operators. However, even then, there may be problems, since countries have allocated different frequency bands for GSM communications.
- **Inter-standards roaming:** It refers to the ability to move seamlessly between mobile networks of different technologies. Since mobile communication technologies have evolved independently across continents, there is significant challenge in achieving seamless roaming across these technologies. Typically, these technologies were implemented in accordance with technological standards laid down by different industry bodies and hence the name. A number of the standards making industry bodies have come together to define and achieve interoperability between the technologies as a means to achieve inter-standards roaming. This is currently an ongoing effort.

4. THE ROAMING PROCESS – HOW DOES IT WORK?

Roaming service is made possible through Internet Service Providers (ISPs) who have cooperative agreements to grant each others customers local access to the Internet. So you need to check with your operator that your mobile subscription allows you to use your phone abroad and which services are available in your destination country. A simple phone call is all that is normally required. You should also check that your operator has a 'roaming agreement' with an operator in the country that you are visiting. Your operator will be able to provide a list of all of the countries you can roam to. Finally, you should check that your mobile phone supports the radio frequency employed in that region of the world. GSM services are provided in a number of bands (e.g. 850, 900, 1800 and 1900 MHz). Most modern phones are multi-band, but travellers from Europe to North America, for example, should check that their phones will operate in the 850 and/or 1900 MHz bands. The details of the roaming process differ among types of cellular networks, but in general, the process resembles the following:

1. The Internet user must already subscribe to an ISP that offers roaming service arrangements.
2. Assuming the ISP does, the user can determine a cooperating ISP in a city to which the user is travelling. . If there is no roaming agreement between the two networks, maintenance of service is impossible, and service is denied by the visited network.
3. In the travel location, the user can call the local ISP's designated phone number through the computer modem, entering information during login that will identify the user's home ISP.
4. The "foreign" ISP will contact the ISP and determine that the user is a valid user. The visited network requests service information (including whether or not the mobile should be allowed to roam) about the roaming device using its IMSI number (International Mobile Subscriber Identity number is a unique number, associated with all GSM and Universal Mobile Telecommunication Systems (UMTS) network mobile phone users).
5. The "foreign" ISP will grant the user access to the Internet. The user will be able to access e-mail from the home mail server.
6. The user will be charged at local phone rates. In addition, depending on the particular service arrangement, the home ISP may levy an additional hourly usage charge or a monthly charge in case the service is used during that month.

If a call is made to a roaming mobile, the public telephone network routes the call to the phone's registered service provider, who then must route it to the visited network. That network must then provide an internal temporary phone number to the mobile. Once this number is defined, the home network forwards the incoming call to the temporary phone number, which terminates at the host network and is forwarded to the mobile. In order that a subscriber is able to "latch" on to a visited network, a roaming agreement needs to be in place between the visited network and the home network. This agreement is established after a series of testing processes called IREG and TADIG. While the IREG testing is to test the proper functioning of the

established communication links, the TADIG testing is to check the billability of the calls. The usage by a subscriber in a visited network is captured in a file called the TAP (Transferred Account Procedure) and is transferred to the home network. The TAP/CIBER files are rated as per the tariffs charged by the visited operator. The home operator then bills these calls to its subscribers and may charge a mark-up/tax applicable locally.

5. ROAMING CHARGES -THE EUROPEAN COMMISSION’S ROLE

When you crossed the border, you started 'roaming' on a mobile phone network in the Destination Country. This “Host Operator” will now handle at least part of every call you make and receive. Rather than sending you a separate bill, the Host Operator charges your Home Operator, using a wholesale rate they arranged between themselves. Your Home Operator then passes this expense on to you in your next bill. This retail charge is likely to be greater than the wholesale rate they were charged. There are almost certainly several Operators in the Destination Country, but you were probably transferred to one Host Operator automatically (you may have received a 'welcome SMS'), because operators across Europe have set up roaming arrangements.

In general, international roaming charges are much more expensive than normal domestic charges and they are generally higher on pre-pay tariffs. You should contact your mobile provider to compare their pre-pay and post-paid roaming rates, and consider switching to a post-paid contract, particularly if you travel often. Using text messages can be a useful way of reducing the impact of high international roaming rates, although sending multiple text messages may not work out cheaper than making a single call. Nevertheless, charges for sending a text message whilst abroad are still generally higher than for domestic text messaging; although usually there is no charge for receiving text messages whilst abroad. Regarding charges for international data roaming services such as 3G, customers should know that they may be able to access data services - via GPRS or 3G, for example - whilst roaming abroad. These services may be charged by volume or duration with minimum charges applying.

While these differences can be partly explained by the different cost structures, the European Regulators Group has pointed out that these cost differences often do not clearly justify the level of the retail charges. One of the reasons for the high level of charges may be that most consumers do not frequently use their mobile phone when abroad, so roaming charges do not play an important role in their choice of telephone operator. The current European Commission initiative will increase both the transparency of charges and the pressure on mobile operators to offer their customers competitive roaming charges. Many consumers are not aware that, unlike at home, they are charged for receiving a call when travelling abroad. They are charged because their home operator incurs additional costs as a result of their travelling abroad – for instance more complex network interconnection services because the operator does not own a network abroad. The overall costs of the call are split between the caller and the roaming customer, so the person receiving the call also pays an additional charge. While charges for receiving a call are generally less than those for making a call abroad, it is worth checking these charges out with your operator.

When you roam, airtime rates are typically much higher than your plan rate, and you may even be getting your service from a different carrier. In addition to your roaming rate, long-distance charges and--in some cases--further usage fees may apply as well. Fortunately, all carriers have created rate plans that offer large home areas, sometimes as large as the whole country. These plans may include long distance as well, and while they are initially more costly than local usage plans, you won't end up paying a lot in roaming fees and roaming long-distance charges. Rules that govern long-distance and roaming charges can be confusing. If you go with a regional or local plan that does not include standardized long distance, you need to understand how you'll be billed. This means reading the plan's terms and conditions carefully. The basic issue is that if you make a long-distance call, and your plan does not include free long distance, you'll incur long-distance charges. The long-distance rate may depend on your carrier, your rate plan, where you are when you place the call, and where you're calling. Note that these charges do not include additional airtime costs. You will still be using your quota of monthly minutes, or paying per-minute airtime costs in addition to long-distance charges. This is also generally true for plans that provide for a consistent per-minute long-distance charge.

It's a fact that very high international mobile "roaming" charges currently affect 147 million EU citizens (37 million tourists and 110 million business customers). As a result, the European Commission has identified that the high prices paid by consumers for international roaming services are a matter of concern, and has established the EU Regulation on roaming, that allows citizens travelling within the EU to communicate across borders at affordable and transparent prices. The usage of roaming is relatively low among European citizens and especially for occasional travellers. At present, only a minority of all mobile customers makes use of roaming services despite overall EU mobile penetration of above 90%. The proposed regulation will ensure that people who normally avoid using their mobile phone abroad will now be able to experience more benefits of mobile communications. It is expected that consumers will be paying around €4.4 billion less for their calls abroad.

The industry has taken considerable time to respond to threats of regulation with packages which purport to bring about decreases in roaming prices. The larger operators such as Vodafone, T-Mobile, Telefonica Moviles Espana, O2, Orange and TIM have all announced different packages aimed at introducing key benefits to consumers. Some also included the wholesale aspect or offered inbound and outbound fixed fees across all EU Member States. The Commission welcomed moves by these operators but unfortunately, the benefits do not go far enough in providing consumers with a similar experience to that which they get at national level, which is the over-riding objective of the EU regulation. Few of the offers have tackled one of the major problems of roaming, the excessive charges for receiving calls. This is unfortunate since operators make huge margins from received calls and flat rates for receiving calls at the same price as for making them only aggravates the problem. Therefore, the Commission decided that action was required.

The regulation consists of the following:

- Prices paid for international roaming when travelling within the European Union will not be unjustifiably higher than the charges for calls paid within the user’s country.
- Consumers will benefit from lower prices for making calls in the visited country, back home or to any other EU Member State.
- Consumers will make considerable savings when receiving calls.
- Prices operators charge each other (wholesale charges) will be considerably lower than what they are today. This ensures all operators will be in a position to offer lower retail tariffs.
- Transparency of roaming charges for consumers will be enhanced. Mobile operators will be required to provide customers with full information on applicable roaming charges when subscriptions are taken out and to update consumers regularly about these charges. Consumers can ask for information on roaming charges free of charge either via SMS or voice call.
- National regulators will also be tasked to monitor closely the development of roaming charges for SMS and multi-media message services (MMS).

As a result, packages have helped to make roaming more affordable but as the Eurobarometer Report indicates, the majority of Europeans state the high cost of roaming as is the reason why they are less likely to use the mobile phone when abroad. There were also a few positive developments in some Member States where prices of standard tariffs have gone down. This is, however, not enough to ensure that European citizens are not penalised for crossing borders.

People are already trying to find ways to reduce or even eliminate the cost of roaming services.

6. SAMPLE TARIFFS FOR TRAVELLERS FROM GREECE TO UK, PORTUGAL, CYPRUS, ITALY AND FRANCE

Sample tariffs are given assuming the consumer is calling home, making a four-minute post-paid voice call. All prices are given in Euros, for the time period of September 2006, including tariffs provided for up to six different Host Operators in the destination country.

Your Operator	Roaming In The United Kingdom					
	3	O2	Orange	T-Mobile	Virgin Mobile	Vodafone
Cosmote	4.77 €	4.77 €	4.77 €	4.77 €	--	4.77 €
Q Telecom	--	--	4.38 €	--	--	4.14 €
TIM	4.77 €	4.77 €	4.77 €	4.77 €	--	4.77 €
Vodafone	--	5.00 €	5.00 €	5.00 €	--	4.44 €

Your Operator	Roaming In Portugal		
	Optimus	TMN	Vodafone
Cosmote	4.77 €	4.77 €	4.77 €
Q Telecom	4.60 €	--	--
TIM	4.77 €	4.77 €	4.77 €
Vodafone	6.96 €	6.96 €	4.60 €

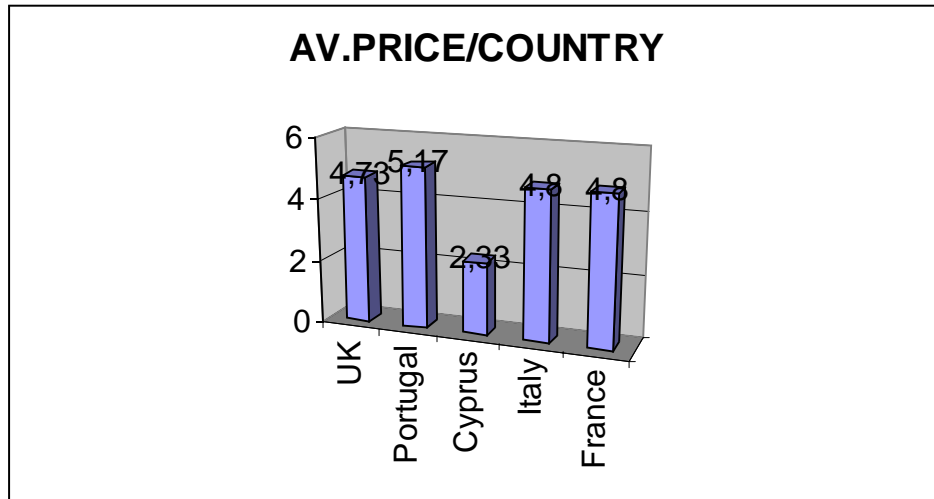
Your Operator	Roaming In Cyprus	
	Areeba	Cytamobile
Cosmote	1.92 €	1.92 €
Q Telecom	0.94 €	0.94 €
TIM	4.77 €	4.77 €
Vodafone	1.80 €	1.56 €

Your Operator	Roaming In Italy				
	3	H3G	TIM	Vodafone Omnitel	Wind
Cosmote	--	--	4.77 €	4.77 €	4.77 €
Q Telecom	--	--	4.80 €	5.28 €	4.42 €
TIM	--	--	4.77 €	4.77 €	4.77 €
Vodafone	--	--	5.00 €	4.44 €	5.00 €

Your Operator	Roaming In France		
	Bouygues	Orange	SFR
Cosmote	4.77 €	4.77 €	4.77 €
Q Telecom	4.77 €	--	4.94 €
TIM	4.77 €	4.77 €	4.77 €
Vodafone	5.00 €	5.00 €	4.44 €

AVERAGE PRICES

UK	4,73
Portugal	5,17
Cyprus	2,33
Italy	4,8
France	4,8



As we can see from the tables and the chart above, Portugal is the country with the highest prices while Cyprus is the cheapest one in international roaming charges.

7. CASE STUDIES FROM GREEK CELLNETWORK PROVIDERS: VODAFONE, TIM, COSMOTE, Q-TELECOM

• **The Vodafone Passport Service**

By using the service mentioned above, you can call home when travelling abroad at almost the same rate you pay at home - plus a small connection fee for each call.

So when you phone home on Vodafone from a Vodafone network almost anywhere in Europe, you'll know what each call is costing. The same goes for receiving calls. You'll only pay the same small connection fee for each call you take, no matter how long you talk.



You can call from all below countries using Vodafone Passport by selecting the equivalent network.

Country	Network	Country	Network
Albania	Vodafone Albania	Malta	Vodafone Malta
Australia	Vodafone Australia	Netherlands	Vodafone Netherlands
Belgium	Proximus (Belgacom)	New Zealand	Vodafone New Zealand
Czech Republic	Oskar	Portugal	Vodafone Portugal
France	SFR	Romania	Connex
Germany	Vodafone Germany	Spain	Vodafone Spain
Hungary	Vodafone Hungary	Sweden	Vodafone Sweden
Ireland	Vodafone Ireland	Switzerland	Swisscom
Italy	Vodafone Italy	UK	Vodafone UK
Japan	Vodafone KK	-	-

The calling charges of this service are given below and, as we can see, they are advantageous prices for frequent travellers.

Available Retail Tariffs Plans	€ 0,2356
Old Vodafone 60 not available	€ 0,2142
Business Tariffs Plans with 80 minutes free time	€ 0,1999
Business Tariffs Plans with 150 minutes free time	€ 0,1928
Business Tariffs Plans with 300 minutes free time	€ 0,1856
Business Tariffs Plans with 540 minutes free time	€ 0,1785

- **TIM roaming services**

International Roaming service enables you to connect abroad with any network TIM cooperates with, and use your mobile phone. TIM also provides to all 3G users with the ability to use 3G services abroad and also perform Video Calls. All TIM Post paid (having enabled GPRS) customers can have continuous access in WAP and Internet services as well as send MMS using their mobile even if they are abroad.

While you travel abroad and you receive an incoming call, you are being charged according to your tariff plan, the international cost towards the country you are hosted. In case the foreign network charges extra for the incoming calls, this charge appears in your bill including 20% mark up.



When you travel by ship in international waters (Adriatic Sea, Atlantic Ocean, Baltic Sea, North Sea, Mediterranean Sea, Caribbean Sea etc.) there is a possibility of getting connected with networks via Satellite. The charge in this case follows Satellite charging principles for both incoming and outgoing calls. When you call from abroad, send and receive SMS or you use GPRS/MMS service you are being charged according to the tables below:

		CALL DESTINATION						
		Call setup: 0,238	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
CALL ORIGIN	Zone 1		0,0199	0,0297	0,0417	0,0595	0,0833	0,2380
	Zone 2		0,0297	0,0297	0,0417	0,0595	0,0833	0,2380
	Zone 3		0,0357	0,0297	0,0417	0,0595	0,0833	0,2380
	Zone 4		0,0595	0,0595	0,0595	0,0595	0,0833	0,2380

- **Roaming services for contract plans, WHAT’S UP and GPRS in COSMOTE**

COSMOTE has been offering the roaming service since the first day of its operation, in anticipation of its travelling subscriber’s modern needs. Today, COSMOTE covers all five continents and continues to increase the number of collaborating countries and networks at an accelerating pace. The roaming service is available in 165 countries and 340 networks. If you are abroad you can still communicate with any telephone in Greece or any country where COSMOTE has a roaming partner agreement and you are within that network's coverage. COSMOTE also provides Roaming Service to San Marino and Vatican City via TIM Italia and Omnitel, Monaco via France Telecom SFR and Bouygues.



Also COSMOTE offers GPRS roaming service available in 68 countries and 118 networks.

WHAT'S UP is finally offering its customers roaming service, that enables all WHAT'S UP holders, old and new alike, to send and receive SMS and to receive calls in 165 countries and 340 networks all over the world automatically and with no any extra procedures. With WHAT'S UP roaming you can receive calls and short messages. WHAT'S UP roaming has the following features:

- Incoming calls won't be diverted to your personal Voice Mail when your phone is engaged or when you don't answer the call
- If your account balance is not enough to get a call, connection is terminated before you get the call.

• **Q-TELECOM'S INTERNATIONAL ROAMING SERVICE**

International Roaming service is available for Q1 and Q Business1 subscribers. For the time being the service is not provided to QCard1 owners. International roaming allows you to:

- make and receive international and local calls.
- Send and receive short messages (SMS).
- Retrieve voice messages stored in your personal voice mail box, by calling +30699-555 1333 from any phone.

All mobile operators that have roaming agreements with Q-TELECOM internationally provide the above services.

Based on the General Terms and Conditions for the Provision of Q-Telecom Telecommunication Services, Q-Telecom may ask the subscriber who wishes to

activate the International Roaming service to provide an up to €500, deposit, in case the subscriber does not pay his monthly bill automatically by credit card.



Q-TELECOM is continuously expanding the international roaming agreements with mobile operators and countries. Mobile Telephony price listing for Q subscribers is given below:

NUMBER PORTABILITY SERVICE BY Q-TELECOM	Q card1 With Q change Without Monthly Bill
Q change - NUMBER PORTABILITY CONNECTION PACK WITH Q card1 INITIAL FREE AIRTIME	€ 19 € 1
NEW SUBSCRIPTION TO Q-TELECOM	Q card1 Without Monthly Bill
Q card1 CONNECTION PACK INITIAL FREE AIRTIME USAGE REWARD	€ 11 € 3 -
Q TO Q CALLS 0+Sec	€ 0,0020/sec
NATIONAL CALLS 0+Sec	€ 0,0061/sec
SHORT MESSAGE SERVICE (SMS) (To Greek Mobile Networks)	€ 0,0680
SHORT MESSAGE SERVICE (SMS) (To Foreign Mobile Networks)	€ 0,0680
MULTIMEDIA MESSAGE SERVICE (MMS) (To Greek Mobile Networks) ³	€ 0,4000
VOICE MAIL (MESSAGE RETRIEVAL) CALL FORWARDING SERVICE	0,0046 €/sec
CALLER LINE IDENTIFICATION (CLI) Q- who called	NATIONAL RATES FREE
(MISSED CALLS SERVICE) INTERNATIONAL CALLS	FREE
<u>ZONE 1</u>	1+Sec € 0,0071/sec
<u>ZONE 2</u>	€ 0,0077/sec
<u>ZONE 3</u>	€ 0,0089/sec
<u>ZONE 4</u>	€ 0,0095/sec
<u>ZONE 5</u>	€ 0,0107/sec
<u>ZONE 6</u>	€ 0,0119/sec
<u>ZONE 7</u>	€ 0,1012/sec
ZONE 8 - 25 EASTERN EUROPEAN COUNTRIES	€ 0,0061/sec

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