

**NEW MODEL USING DSA TECHNIQUES AND COASIAN BARGAINING
AGREEMENTS FOR SPECTRUM MANAGEMENT IN KOSOVO**

by

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In each country spectrum is scarce and expensive and as such it should be treated carefully in terms of efficiency usage. The spectrum can be reallocated, reassigned and resold through agreements between the participants. In some places, interference exists (internal as well as external, i.e., from bordering countries) resulting in inefficient usage of spectrum, not respecting the law of telecommunication, the poor communication, loss of revenue, damage to telecommunication equipment etc. One of these places is Kosovo in GSM spectrum.

In this thesis what we are addressing is how to avoid this problem and bring to participants an AGREEMENT that benefits all. With these kinds of agreements, the interference can be avoided, saving a lot of money and revenue will increase for both parties: unlicensed and licensed mobile operators (including the Government of Kosovo (GK)). On the other hand the positive externalities should happen, such as social cost, economical efficiency, political view and community integration.

Our solution is based on Coase Theory and Problem of Social Cost and on another hand on the situation in Kosovo based on data from TRA of Kosovo and Serbia also data from Mobile Operators from both sides.

TABLE OF CONTENTS

| | |
|--|-----------|
| PREFACE | XI |
| 1.0 INTRODUCTION AND BACKGROUND..... | 1 |
| 1.1 PROBLEM STATEMENT..... | 1 |
| 1.2 SPECTRUM MANAGEMENT - THEORY..... | 4 |
| 1.2.1 Why spectrum needs to be managed..... | 4 |
| 1.2.2 Technology of spectrum allocations | 6 |
| 1.2.3 Spectrum Market..... | 9 |
| 1.2.4 Spectrum property rights | 10 |
| 2.0 KOSOVO | 13 |
| 2.1 KOSOVO SERB ENCLAVES | 15 |
| 2.2 THE MOBILE MARKET IN KOSOVO AFTER 1999 | 16 |
| 2.3 LAW ON TELECOMMUNICATIONS - KOSOVO CASE | 20 |
| 2.4 TELECOMMUNICATION MARKET IN KOSOVO - MOBILE PHONE MARKET | 25 |
| 2.4.1 Overview | 26 |
| 2.4.2 Mobile phone users | 30 |
| 2.4.3 Mobile telephony revenues | 32 |
| 2.4.4 The structure of mobile phone users..... | 33 |

| | |
|--|-----------|
| 2.4.5 Telephone traffic..... | 33 |
| 2.5 TELECOMMUNICATION SECTOR POLICY | 35 |
| 2.6 TELECOMMUNICATION POLICY GOALS | 36 |
| 2.7 MOBILE SERVICE | 37 |
| 2.8 SPECTRUM..... | 38 |
| 3.0 CONSTITUTION, TELECOMMUNICATION LAW AND A BRIEF OVERVIEW OF TELECOMMUNICATION MARKET ANALYSIS OF REPUBLIC OF SERBIA | 41 |
| 3.1 REPUBLIC OF SERBIA: THE CONSTITUTION..... | 41 |
| 3.2 TELECOMMUNICATIONS LAW - SERBIA..... | 44 |
| 3.3 AN OVERVIEW OF TELECOM MARKET IN THE REPUBLIC OF SERBIA IN 2008 AND 2009 | 47 |
| 3.3.1 Overview | 47 |
| 3.3.2 Regulatory Activity..... | 48 |
| 3.3.2.1 Radio-communications | 49 |
| 3.3.2.2 Monitoring and Analysis of the Telecommunications Market..... | 50 |
| 3.3.2.3 Telecom Market Analysis | 51 |
| 3.3.3 BASIC CHARACTERISTICS OF THE TELECOM MARKET IN THE REPUBLIC OF SERBIA..... | 52 |
| 3.3.4 COMPARATIVE ANALYSIS WITH THE SEE COUNTRIES | 55 |
| 3.4 PUBLIC MOBILE TELECOMMUNICATIONS NETWORKS AND SERVICES | 57 |
| 3.5 SOME ADDITIONAL INFORMATION AND ANALYSIS..... | 67 |

| | | |
|------------|---|------------|
| 4.0 | THE CURRENT STATE OF SPECTRUM MANAGEMENT IN KOSOVO..... | 69 |
| 5.0 | SPECTRUM MANAGEMENT AND INTERNATIONAL COORDINATION .. | 72 |
| 5.1 | GENERAL SHARING PRINCIPLE | 72 |
| 6.0 | SPECTRUM MANAGEMENT PROPOSALS FOR KOSOVO..... | 78 |
| 6.1 | PROPOSAL FOR RESOLVING INTERNAL INTERFERENCE | 82 |
| | 6.1.1 MODEL 1 - Internal Problem | 84 |
| 6.2 | EXTERNAL SOLUTION..... | 90 |
| | 6.2.1 Band Sharing | 92 |
| | 6.2.2 Area Sharing | 97 |
| | 6.2.3 Per User Collection | 101 |
| 7.0 | CONCLUSION | 107 |
| | APPENDIX A - KOSOVO..... | 111 |
| | APPENDIX B - LAW ON TELECOMMUNICATIONS IN KOSOVO | 135 |
| | APPENDIX C - RADIO SPECTRUM MANAGEMENT AFTER THE TELECOMMUNICATION REFORM OF 1996 IN GUATEMALA | 142 |
| | BIBLIOGRAPHY | 145 |

LIST OF TABLES

| | |
|---|-----|
| Table 2.1 Number of authorizations / licenses issued by TRA | 27 |
| Table 2.2 Main Indicators Telecommunications Services Market | 28 |
| Table 3.1 Comparative Overview of the Number of Telecom Service Subscribers in the Last 3 years | 51 |
| Table 3.2 Population and GDP in 2009 of SEE countries..... | 55 |
| Table 3.3 Telecom Market Revenue of Republic of Serbia | 56 |
| Table 5.1 Canada/USA states sharing agreement | 74 |
| Table 5.2 Limits of Effective Radiated Power (ERP) Corresponding to Effective Antenna Heights of Base Stations in the Protection Zones and Sharing Zones I and III..... | 75 |
| Table 6.1 Numbers of users per zone | 85 |
| Table 6.2 Total loss from both operators | 86 |
| Table 6.3 Revenue of mobile operator per area -Calculation that Part 1 can harm Part 2 and Part 3 by increasing Tx - Power..... | 99 |
| Table 6.4 Total incoming from user based on nationality..... | 102 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1-1 Spectrum Allocation[61] | 7 |
| Figure 1-2 Typical radiation of energy by a cellular transmitter showing overlap into adjacent channels | 11 |
| Figure 2-1 Kosovo map, demographic view | 15 |
| Figure 2-2 Breakdown of revenues by activity..... | 29 |
| Figure 2-3 Number mobile users: 2007-2010 / III..... | 30 |
| Figure 2-4 Penetration of mobile telephony | 31 |
| Figure 2-5 Mobile market shared in different quarter of years | 31 |
| Figure 2-6 Revenues from mobile telephony | 32 |
| Figure 2-7 Market share of mobile phone based on revenue | 32 |
| Figure 2-8 Division of mobile phone users by way of subscription | 33 |
| Figure 2-9 Outgoing mobile traffic by destination: 2007-III/2010..... | 34 |
| Figure 2-10 Incoming mobile traffic based origin-2010 (in terms of increasing/decreasing per minutes) | 35 |
| Figure 3-1 Republic of Serbia - Basic Facts..... | 53 |
| Figure 3-2 Allocation of Revenues and Investments by Services in 2009..... | 54 |
| Figure 3-3 Mobile Operator Telenor Coverage in 2009 | 59 |

| | |
|--|-----|
| Figure 3-4 Mobile Operator Telenor Coverage in 2008 | 60 |
| Figure 3-5 Mobile Operator MTS Coverage in 2009..... | 61 |
| Figure 3-6 Mobile Operator MTS Coverage in 2008..... | 62 |
| Figure 3-7 Mobile Operator VIP Coverage in 2009 | 63 |
| Figure 3-8 Mobile Operator VIP Coverage in 2009 | 64 |
| Figure 3-9 Total revenue from Mobile Telephony (millions of Euros)..... | 66 |
| Figure 5-1 Sharing Zone USA –Canada..... | 75 |
| Figure 5-2 Map of Guatemala..... | 76 |
| Figure 6-1 Terrain Map of Kosovo with unlicensed coverage by Mobile Operator on Serbs Enclaves..... | 81 |
| Figure 6-2 Rural Vs City Network [58] | 84 |
| Figure 6-3 Interference from Montenegro of GSM operators..... | 91 |
| Figure 6-4 Spectrum Sharing Zones between States - Protected Zones | 94 |
| Figure 6-5 Different Density of Population across the borders..... | 95 |
| Figure 6-6 Common Zones/Areas in terms of Territory/Band/Mobile User..... | 96 |
| Figure 6-7 Protected Zone- with different density of population | 106 |
| <u>Appendix -A</u> Figure 8-1 Kosovo Ethnic Group Poulation..... | 119 |

PREFACE

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I would like also to thank our Dean Myzafere Limani that enables us to be students on University of Pittsburgh - SIS.

I would also like to thank my family for their love and strong support.

This thesis I dedicate to my son **EPIROT**.

1.0 INTRODUCTION AND BACKGROUND

1.1 PROBLEM STATEMENT

Kosovo is the youngest country in the world. It has achieved a measure of independence in 1999, and declared itself an independent state on 17 February 2008. The history of Kosovo is such that several language and religious groups live in enclaves largely separate from the society that surrounds them. Of greatest sensitivity are the so-called Serb enclaves that are home to Serbian speaking Orthodox Christians and are set in a population of Albanian speaking Muslims. The residents of these enclaves do not recognize the sovereignty of Kosovo and identify with Serbia, located to the north of Kosovo. This is most acute in the northern part of Kosovo where the Serbian population density is particularly high, although enclaves are scattered throughout the country. While this has been a concern of the international community and expresses itself in many social challenges, this thesis focuses on the aspects of this situation related to radio frequency management.

Kosovo is relatively small (10.908 km^2)¹ and shares borders with Albania, Montenegro, Serbia and Macedonia. Of particular importance is the GSM infrastructure (900 MHz and 1800

¹ Correct as of this writing, though it should be noted that Kosovo is in negotiation with its neighbors to finally demarc its borders. The outcomes of these negotiations may cause the area of the country to change somewhat.

MHz). Because of the close proximity of neighboring countries, the presence of signals of their national operators can be detected throughout most of Kosovo².

Interference from neighboring countries can be addressed through frequency coordination, but the sensitivities are particularly acute with the Serbian enclaves, who do not recognize the authority of Kosovo's telecoms regulator, the Telecommunications Regulatory Authority (TRA). Because of the isolation of the enclaves and their association with Republic of Serbia, Orthodox churches frequently set up a GSM operator that is not sanctioned by TRA and that homes directly to Serbia. Because Ahtisaari's plan³ gives these enclaves special political and economic status and NATO's Kosovo Force (KFOR) provides active protection to Serbian Orthodox churches, including those located in the enclaves, local (i.e., Kosovars) authorities have limited rights to access to them even they are not sanctioned.

If these operators covered only the enclaves with their service, this might not be a big problem, but radio waves do not honor political boundaries, so these non-sanctioned service providers cover a very large part of the ethnic Albanian Kosovars living in their vicinity.

TRA has confiscated⁴ the equipment of these non-sanctioned operators, which are valued at several million Euros. TRA claims the right to confiscate them because they are not sanctioned and do not have an operating license from them. These unlicensed operators are mainly financed

²This can be detected by searching network operator (mobile) by any of mobile phone.

³ Constitution of Kosovo is based on the Mahtisari Plan:

<http://www.kushtetutakosoves.info/repository/docs/Constitution.of.the.Republic.of.Kosovo.pdf>
<http://www.unosek.org/unosek/en/statusproposal.html>

The Assembly of Kosovo is made up of 120 members. 100 of these are elected directly, while 10 members represent the Serbian minority, 4 the Roma minority and 3 the Bosniak, Montenegrin, Croatian and Hungarian minorities. 2 places are reserved for the Turkish minority and 1 place for Goranci. Serbs have 10 places reserved in the Kosovo Assembly, however this number can be increased if they exceed the threshold of 5%. Around 1,6 million voters will have voting rights at the upcoming elections.

http://www.worldsecuritynetwork.com/showArticle3.cfm?article_id=18482&topicID=32

⁴Illegal/unlicensed operators come mainly from Serbia. Both Serbian and Albanian businessmen are involved in their operation. TRA has called the police forces many times to help it disconnect the unlicensed operators. Much equipment has been confiscated in these operations . See TRA-KOSOVO cases: <http://www.art-ks.org/?cid=2,23,103>

by the Serbian GSM operator⁵. In some cases, equipment is damaged during seizure⁶. When this happens, the unlicensed operator's staff rebuilds their infrastructures as quickly as possible.

Because of these factors, the usage of GSM frequency bands is substantially outside of the control of TRA, which results in interference with and financial loss to the licensed operators (IPKO and VALA). The government of Kosovo does not collect tax revenue from unlicensed operators, which is a further loss. Legally, TRA is obliged to protect licensed operators as well as the state treasury, so they take actions to shut down unlicensed systems. Because of the long, contentious history involving the ethnic Serbs and the ethnic Albanians in Kosovo and because of the UN and NATO engagement in these areas, great attention is paid to protecting the Serbs' minority rights. The privileges enjoyed by the enclaves include forbearance of unpaid utilities fees (electricity, water) and free services (e.g., education, employment, etc.), 10 guaranteed seats in the Kosovo parliament, even if they do not participate in elections. These privileges (which are not shared by ethnic Albanians) are guaranteed until the Serbian community is fully integrated into Kosovo Society⁷. In this thesis, I argue that this privilege should also temporarily be extended to telecommunications services, in particular with regard to frequency management.

From this discussion, it is clear that both the Kosovo government and the unlicensed operators suffer financial losses. The question is whether there is a Pareto superior outcome that is politically feasible in the context of modern Kosovo. This question can address interference

⁵This kind of information we can find on each website: PTK- Vala: <http://www.valamobile.com/index.php?id=505> , TRA : <http://www.art-ks.org/> , even on Serbian Telecommunication Regulator: <http://www.ratel.rs/>

⁶TRA has a right to disconnect any unlicensed operator after it has done all necessary procedures, given by law of Telecommunication of Kosovo. During the damage that can cause to the unlicensed operator TRA is not required to pay compensation.

⁷These privileges are derived from the Mahtisari Plan, as mentioned before: places in parliament given by constitution of Kosovo, tax relief and relief from electricity use payments. Source:, government websites, and electronics - newspapers also on some un-government society. [You need to find at least one specific reference instead of general references like this, even if it is in Albanian].

from the inside (enclaves) or the outside (the neighboring countries: Albania, Montenegro, Macedonia and Serbia).

Since the lawful way of addressing this problem (i.e., disconnecting or confiscating the equipment) does not solve this problem, the question is whether DSA (Dynamic Spectrum Allocation / Assignment), Coasian bargaining, Secondary Users or a kind of MVNO (special functions for enclave) might provide practical frameworks for resolving the conflicts. As for the border problems, two possibilities seem to emerge:

- Fixed allocation - equal to the area of coverage and the amount of frequency band
- Dynamic allocation/assignment if it necessary

1.2 SPECTRUM MANAGEMENT - THEORY

This section provides a brief overview of spectrum management objectives and techniques. This topic has been discussed in some depth by a variety of authors.

1.2.1 Why spectrum needs to be managed

As Cave writes:

Frequencies are used both commercially, notably for mobile communications and broadcasting, and by public sector bodies to support national defense, aviation, the emergency services and so on. As demand grows spectrum needs to be managed to avoid the interference between different users becoming excessive. If users transmit at the same

time, on the same frequency and sufficiently close to each other they will typically cause interference that might render both of their systems unusable. In some cases, “sufficiently close” might be tens or hundreds of miles apart. Even if users transmit on neighboring frequencies, they can still interfere since with practical transmitters signals transmitted on one channel “leak” into adjacent channels, and with practical receiver’s signals in adjacent channels cannot be completely removed from the wanted signal. The key purpose of spectrum management is to maximize the value that society gains from the radio spectrum by allowing as many efficient users as possible while ensuring that the interference between different users remains manageable⁸.

To full this role, the spectrum manager provides each user with the right to transmit on a particular frequency over a particular area, typically in the form of a license. Clearly, the spectrum manager must ensure that the licenses that they distribute do not lead to excessive interference. In practice, this can be a highly challenging task.

At the highest level of management sits the International Telecommunication Union (ITU), a specialized agency of the United Nations. The ITU’s International Radio Regulations allocate the spectrum from 9 kHz to over 275GHz to a range of different uses. In some cases these are quite prescriptive, e.g. “satellite”. In other cases they allow substantial variation, e.g. “fixed or mobile”. The Radio Regulations also set out how countries should coordinate with each other and in the case of global services, such as satellite, provides a mechanism for the assignment of rights to individual users. The ITU conducts the key parts of its business through World Radio Conferences which are typically held every three to four years. These are events attended by thousands of delegates from spectrum managers and users around the globe where potential changes to

⁸Martin Cave –*The Essentials of Spectrum Management*

the Radio Regulations are considered⁹. In some countries, there are multi-national bodies coordinating across a region. For example, this is very much the case within Europe where the European Union (EU) and the Confederation of European Post and Telecommunication Agencies (CEPT) provide further harmonization. Broadly, these bodies can be seen as local versions of the ITU, providing further coordination. Often their coordination is more specific, for example rather than simply designating a band as “mobile”, they might designate it to a specific standard such as “GSM”. Different bodies have differing levels of power. For the CEPT their decisions, like those of the ITU, are non-binding but if a country deviates from them it is expected not to cause interference to its neighbors as a result.

Kosovo’s TRA is also under the auspices of the ITU and complies with CEPT, given the Kosovo’s desire to align with the EU. In some cases they adapt so-called “beauty contests¹⁰” to set up the best practice for telecommunication services.

1.2.2 Technology of spectrum allocations

GSM technologies use a 200kHz channel at the frequency of 900 MHz. The systems are designed to have interference that can be controlled by the operator. Thus, spectrum is regulated by frequency assignment to avoid interference. That is, the spectrum is divided up into

⁹<http://www.itu.int>

¹⁰ In second mobile operator tender “Auction/beauty contest” model in Kosovo means:

- License (basic) price (€20 million) - plus the highest offered bid price (value 30%)
- The extent of coverage and by when the project would be implemented (value 30%)
- Local participation – local partnership and management, planned employment (value 20%)
- Service quality and service range (value 10%)
- Experience in mobile telephony - number of clients, years of experience, number of markets (10%)

discrete parcels of frequency, for example 915–925MHz, and assigned to a particular user. That user then expects that they will be given exclusive use of the band.

This is illustrated in Figure 3.1¹¹, and has been the system on which spectrum management has been based for almost 100 years.

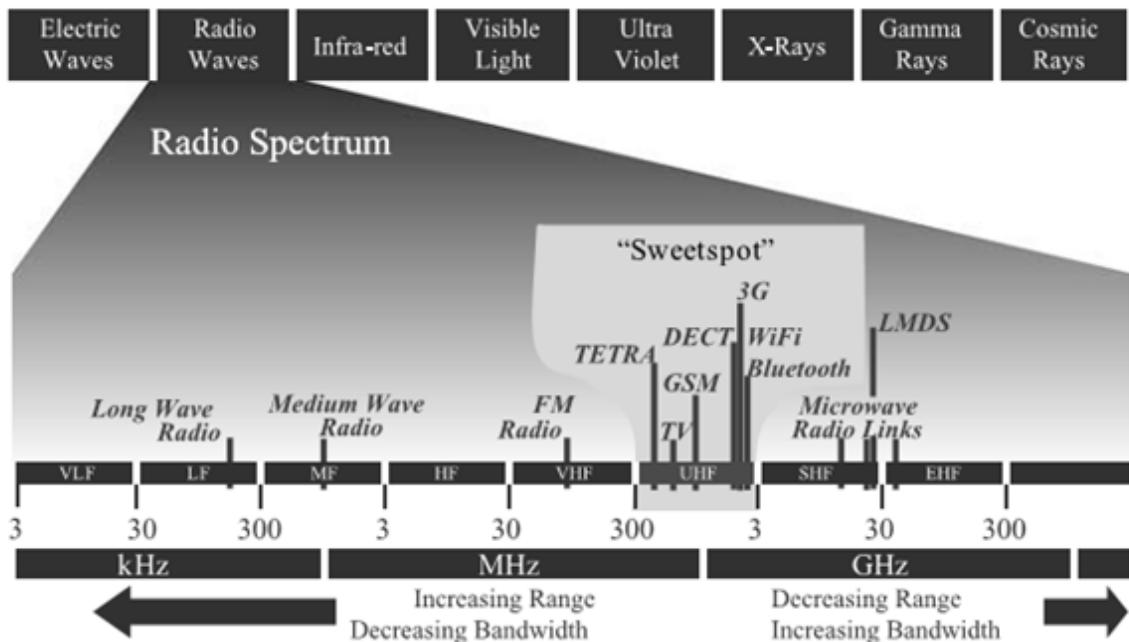


Figure 1-1 Spectrum Allocation[61]

Cognitive and software defined radios are devices which are aware of their surroundings. They can monitor transmissions across a wide bandwidth and note areas of spectrum that appear to be currently unused. They are intelligent enough to adapt their transmissions to the characteristics of the spectrum that they find vacant, using appropriate modulation and coding methods. They can detect when the spectrum is being used by its owner and move to a different band. Perhaps crucially, they can determine the most appropriate access to the spectrum without any central control from a base station.

¹¹ Figure from Cave

. A SDR (Software defined radio) is a device whose entire operation is defined by software. In purest terms this implies that the broadband signal captured by the antenna is digitized by an analogue-to-digital converter and from that point on all signals processing is performed using software. This would be radically different from current radios where filters and mixers are used to select and down-convert small parts of the spectrum prior to its analogue-to-digital conversion.

Many forms of DSA use cognitive radio as part of the system. Cooperative DSA systems, which do not require cognitive radios, need some additional agreement between operator to use the spectrum they want and under what terms (cost/price, time) they agree to operate. Were such an SDR developed, it would have the advantage of being extremely flexible. A software library could contain information about multiple different technologies and new software could be downloaded to the device as technologies changed over time. Having an SDR would make the realization of a cognitive radio much simpler, which is why the terms, rather confusingly, have been used interchangeably.

Within traditional management structures the key types of spectrum access are¹²:

- Exclusive access,in which a user is given a license to transmit on a particular frequency throughout the whole jurisdiction of the regulator (normally a country); no other user is given access to the same spectrum with the exception of unwanted emissions.
- Geographical sharing,in which a user is given an exclusive license but only for part of the country.
- Band sharing, in which different uses are allowed in the same spectrum

¹² From Martin Cave

1.2.3 Spectrum Market

Historically, regulators have assigned frequencies by issuing licenses to specific users for specific purposes – an administrative approach. The administrative approach can also be more or less prescriptive on the details of spectrum use. Often it has involved specifying what equipment a licensee can use and where, and at what power levels it can be used.

Market methods are being employed both at the primary issue of spectrum licenses, when auctions are used and, more significant, by allowing spectrum rights to be bought and sold in the lifetime of a license (trading) and allowing a change of use of the relevant spectrum (sometimes called liberalization).

Trading involves the transfer of spectrum usage rights between parties – either the government or regulator and a public or private licensee (at primary issue), or between two licensees, through so-called secondary, or post-issue, trading.

A secondary market exists in Kosovo but not for solving the problem at hand¹³.

Market failure. Policy aimed at introducing market methods seeks to create markets in which prices are as close to costs as possible and where consumers can choose from a wide range of services. Fully effective competition is usually only possible where there is competing, infrastructures, yet the spectrum-using technology; the markets which they serve and scarcity of radio spectrum create restrictions which often mean that an oligopoly, a market served by a small number of competitors, is the only possible stable outcome.

Highly concentrated markets for spectrum-using services often produce adverse consequences for end users. The worst form of such market failure associated with market power is a monopoly. Anti-competitive behavior, in the form of an “excessive” acquisition of spectrum, can

¹³ Just like MVNO operator

be prevented in different ways by the spectrum regulator, which can set spectrum caps or establish rules that specify how spectrum trading should take place, including prior approval of trades or transfers of spectrum. Equally, a country's competition regulator (if one exists) can attack abuses of power in markets for services which use spectrum, such as broadcasting services.

1.2.4 Spectrum property rights

When considering possible forms for property rights it is worth remembering that the reason for rights is to protect neighbors from interference¹⁴. In this case, neighbors can be both geographical and in frequency terms.

The interference that is most common originates with unlicensed operators. Being unlicensed, the operators avoid any kind of agreement with licensed operators¹⁵.

Agreements can be economic and/or technical. A technical agreement can rely on international standards. Here, the specification for the technology sets out the signals that a given transmitter can emit, and the likely usage defines the density with which transmitters are likely to be deployed. The combination of these two yields the interference that neighbors can expect.

Interference arises from unlicensed transmissions in the same frequency band as well as from other sources. Normally, these are dealt with using public and private enforcement processes. Interference may also come from licensed transmissions in nearby bands or geographies, which spill over into the license holder's band. Interference occurs in all radio systems. When a transmission is made on a specific frequency, the energy transmitted normally

¹⁴ Martin Cave - ESM

¹⁵ Kosovo case

extends across a much broader band. This is shown in Figure 3.4 for GSM where the assigned band extends by 100 kHz each side of the zero point, but emissions continue well beyond this.

The degree to which energy is radiated in neighboring bands can be controlled by

- reducing the system capacity by lowering the transmitted data rate, which narrows the overall pattern of radiated energy, or
- increasing the system costs by employing tighter filtering.

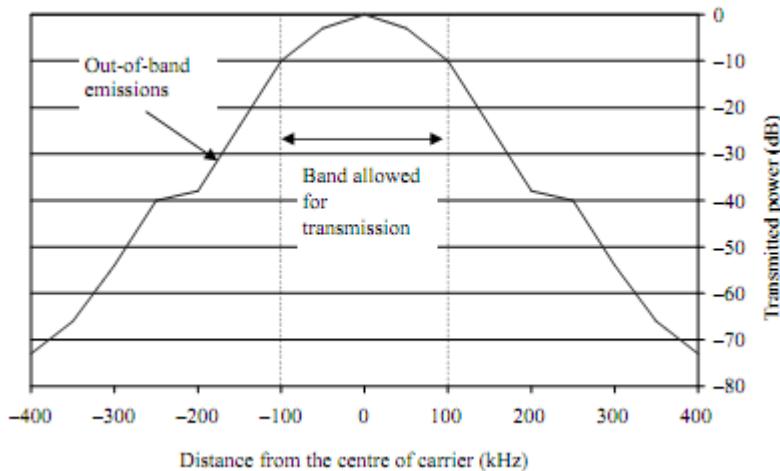


Figure 1-2 Typical radiation of energy by a cellular transmitter showing overlap into adjacent channels

In-band power - a radio receiver, tuned to a particular channel, will also receive signals transmitted in neighboring channels. The neighboring signals will be much reduced in strength by the filters in the receiver, but will not be totally removed.

Another way to reduce interference is DSA because potentially interfering emissions can be avoided through the use of detection and agile radios (for example, cognitive radios). This method leads to use spectrum more efficiently with minor or no interference depending on how they are used. Spectrum efficiency leads to increased income for both licensed and unlicensed operators:

In the case of licensed spectrum, interference can be reduced simply by improving technology or better managing spectrum usage.

2.0 KOSOVO

Kosovo is landlocked and borders Serbia to the north and east, the Republic of Macedonia to the south, Albania to the west, and Montenegro to the northwest. During classical antiquity, the territory roughly corresponding to present-day Kosovo was part of several tribal alliances, including that formed by the Dardania¹⁶.

After the Kosovo War and the 1999 NATO bombing of Yugoslavia, the territory came under the interim administration of the United Nations Mission in Kosovo (UNMIK), most of whose roles were assumed by the European Union Rule of Law Mission in Kosovo (EULEX) in December 2008. In February 2008 individual members of the Assembly of Kosovo (acting in personal capacity and not binding the Assembly itself) declared Kosovo's independence as the Republic of Kosovo. Its independence is recognized by 75 UN member states and the Republic of China (Taiwan). On 8 October 2008, upon request of Serbia, the UN General Assembly adopted a resolution asking the International Court of Justice for an advisory opinion on the issue of Kosovo's declaration of independence. On 22 July 2010, the ICJ ruled that Kosovo's declaration of independence did not violate international law, which its president said contains no "prohibitions on declarations of independence".

¹⁶See more on APPENDIX A

Kosovo represents an important link between central and southern Europe and the Adriatic and Black Seas. Kosovo has an area of 10,908 square km. It lies between latitudes 41° and 44° N, and longitudes 20° and 22° E.

The largest city is Pristina, with an estimated 500,000 inhabitants. The old city of Prizren is towards the south west, with a population of 110,000. Peja/Peć in the west has 70,000 inhabitants with Mitrovica/Kosovska Mitrovica in the north at around 70,000.

North or Northern Kosovo is a region in the northern part of Kosovo with an ethnic Serb majority that functions largely autonomously from the remainder of Kosovo. North Kosovo is by far the largest of the Serb-dominated areas within Kosovo, and unlike the others, directly borders Central Serbia. This has facilitated its ability to govern itself almost completely independently of the Kosovo institutions in a de facto state of partition. Although the Kosovo status process had repeatedly ruled out formalizing this partition as a permanent solution, it has been increasingly mooted amidst continued deadlock.

According to the Kosovo in 2005 Survey of the Statistical Office of Kosovo, Kosovo's total population is estimated between 1.9 and 2.2 million with the following ethnic composition: Albanians 92%, Serbs 4%, Bosniaks and Gorans 2%, Turks 1%, Roma 1%. CIA World Factbook estimates the following ratio: 88% Albanians, 8% Kosovo Serbs and 4% other ethnic groups. According to latest CIA The World Factbook estimated data, as of July 2009, Kosovo's population stands at 1,804,838 persons. It stated that ethnic composition is "Albanians 88%, Serbs 7%, other 5% (Bosniak, Gorani, Roma, Turk, Ashkali, Egyptian, Janjevci - Croats) (2011 - GK is doing registering of population and their economy.

2.1 KOSOVO SERB ENCLAVES

Kosovo Serb Enclaves are the areas of Kosovo where Serbs form a majority, except for North Kosovo. While North Kosovo is connected to the rest of Serbia and mostly functions as a part of it, the enclaves are surrounded with areas of Albanian majority. Those enclaves tend to act as part of Serbia, as they doesn't accept Kosovo Law and do not recognize the Independence of Kosovo. In most of the enclaves, the freedom of movement for Serbs is limited only to the area of the particular enclave but as time passes, they have started to move freely over all territory of Kosova¹⁷.

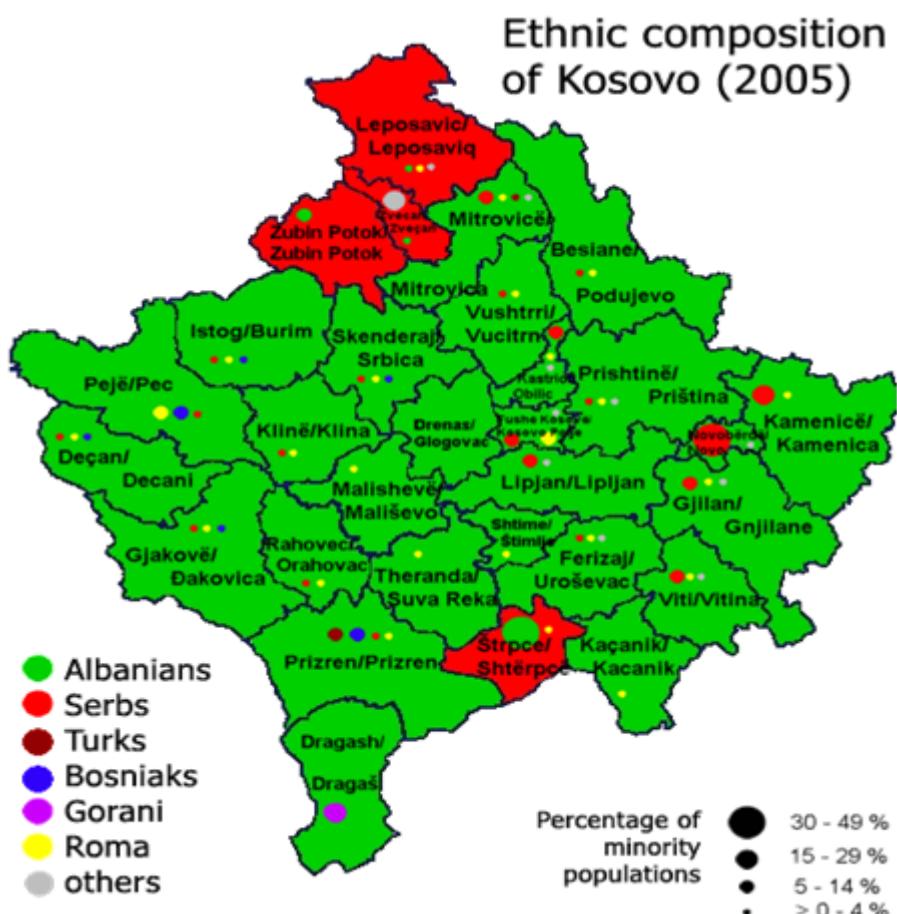


Figure 2-1 Kosovo map, demographic view

¹⁷See more on APPENDIX A

2.2 THE MOBILE MARKET IN KOSOVO AFTER 1999

Based on Appendix A, part 2, and on my experience as ex-employee on TRA-Kosovo, the reality that people in Kosovo face every day in the mobile market can be described as a confused or perhaps more strongly as a mess. Formally, Kosovo has¹⁸ two licensed Mobile Operators: Vala (PTK), which is owned by Government and IPKO, which is majority owned by Slovenia. In addition, there are two MVNO Mobile Operators: Z-Mobile (running on Vala's network) and D3 - Mobile (operating on IPKO). Those MVNO operators have many fewer users compared to VALA and IPKO¹⁹.

In the same space and time there are some unlicensed mobile operators that come from neighbor states like Serbia, Montenegro, Albania and Macedonia. Most of these unlicensed operators come from Serbia. These mobile operators have been available with full capacity in Kosovo territory²⁰ in different period of times.

Other operators that are unlicensed by GK-TRA that interfere comes from Montenegro, Albania and Macedonia²¹. These operators that interfere in terms of spectrum in Territory of Kosovo come from Montenegro, Albania and Macedonia. These mobile operators operate in their own state but they also push their signal into territory of Kosovo without any support from their own states (except for Serbia).

¹⁸More describe on Chapter of Mobile Market Analysis

¹⁹See more detail on chapter of Mobile Market Analysis

²⁰ Some of these unlicensed mobile operators has worked or operate as licensed operators mostly in period of times that TRA doesn't work as regulator.

The period 1999-2004 TRA doesn't exist.

Period 2004 -2006 there has been some actions by TRA resulting in interruption of unlicensed operators.

Period 2006- 2008 TRA does not work well, and on this period these unlicensed operator has been operate without any interruption.

Period 2008-2011 TRA has done the most actions than ever in terms of interrupting unlicensed operators.

²¹Across the borders, without any support from their governments.

At this writing, there is no agreement as to how this interference can be reduced or how these unlicensed operators could become licensed operators, perhaps as MVNOs. The objective of this thesis is to propose some potentially workable alternatives to rationalize the market to policy makers.

Based on reports by TRA²², articles by journalists²³, or publications by telecommunication professionals, it is clear that all parties suffer under the current arrangement:, licensed operators, the Government of Kosovo as well as unlicensed operator (especially those operators comes from Serbia)²⁴.

TRA sometimes causes damage to unlicensed operators when they accidentally damaging base station equipment and installations during their enforcement actions. On April 2010 Mr. Ekrem Hoxha CEO of TRA reported that 26 base stations have been cut off²⁵. Thus, it is clear that unlicensed mobile operators suffer losses due to the present conditions.

On the other hand, licensed operators suffer losses as well. Akan Ismajli, CEO of IPKO, said the two operators' estimated revenue losses were EUR170mn (US\$217mn) per year and that, as well as affecting their profits, there was a significant cost to Kosovo's budget. Also Shyqyri Haxha CEO of PTK (Vala) said that there are millions of Euros per year of losses caused by unlicensed operators. These losses persist even after TRA decommissioned unlicensed operators, because the operators quickly their infrastructure. This kind of problem is also reflected in the politics and relations between the Serbs and Albanians. Remembering that the profit that comes from unlicensed operators, Serbian Kosovars businessmen, Serbian from Serbia

²²TRA website : <http://www.art-ks.org/>

²³Some of them are represent on APPENDIX A- part 2

²⁴ These mobile operators that have Headquarter in Serbia have some BTS inside of territory of Kosovo as we show in Telecom Market Analysis in Serbia chapter

²⁵APPENDIX A - Part 2

businessmen, and Albanian Kosovars businessmen share with each other. It is important to note that the Government is not acting against the Serbians who live in the enclaves but against unlicensed operator that are based there. From these actions taken from GK- TRA, Serbians people lives in enclave many time protest and frustrate.

From words mention above we can seen that here is happening NEGATIVE EXTERNALITIES, that reflect to relation between communities lives in Kosovo even more between nations, Serbs and Albanians with no reason because this problem should solve base on regulation and economy models or in any solution that benefits for both parties.²⁶²⁷

For both Kosovo and Serbia there are legal frameworks that allow for resolving this kind of problem. Both parties are taking radical steps even if they are legal by laws of the Kosovo or Serbian Constitutions. The situation described above calls for middle ground in which all parties will benefit. . This thesis seeks to find a solution using DSA techniques and built on a Coasian bargaining framework.

In recent years (i.e., 2010-2011) two operators who were not licensed by the TRA were operating in Kosovo: MTS and Telenor. These were focused on Serbian enclaves and the surrounding areas, which included Serb and Albanian communities, and counted some 160 000 subscribers. According to the TRA, the average expenditure in the affected regions is about 7 euros/month, so the total revenues per month amounts to approximately 1,120,000 euro/month or EUR

²⁶Like we are trying to solve.

²⁷ Base on my experience, remember that I was Engineer on TRA, when we had taken the actions of interrupting the service of the unlicensed operator, the people that live in Serbs enclave become frustrate or let say “attacked” by Government of Kosovo because they think that just Serbian mobile operator best fit for them. They don’t care even don’t accept Kosovo institution. From most of them (Serbs in enclave) just Serbian mobile operator are acceptable. I remember that time, 2006, one of representative of Serbian enclave Rada Trajkovic has complain for that has done TRA and more than that with help of President of Serbia and foreign minister of Serbian her complain was heard even in UN -New York (in one of session of UN conference). This seams crazy but this had happen.

Base on this reality I tried to explain that this kind of solution should be one step toward decreasing frustrations between Serbs and Albanians in Kosovo and these need special treatment similar with our solution that we are trying to present in this thesis.

13,440,000 per year. These revenues are seen by the TRA-licensed operators as lost revenue and represents approximately 11%²⁸ of the total mobile revenue they report. This amount of revenue comes out every year from the Kosovo market as a result of illegal operation. TRA has not yet found any form approach for recapturing this lost revenue, except for disconnection.

Revenue is not the only concern of TRA-licensed operators. If one of their users inadvertently roams on one of the networks of unlicensed operators, they are not able to control the security of information that passes by these networks, nor are they able to manage the experience of their users, which is a key factor in a competitive market. Further, since unlicensed operators do not participate in TRA's spectrum management processes, planning for the quality of the on-net users is also challenging. TRA (and the government of Kosovo, by extension) is also concerned about protecting their national sovereign rights (which, of course, are not recognized by these operators, whose license originates in Serbia). . Similar concerns exist in the border regions with Macedonia, Albania, Montenegro and, of course, Serbia.

The uncontrolled spectrum usage problem applies to the entire spectrum in areas, including the enclaves and the border area. It is a particular problem for Kosovo because the geographic area of the country is small. Nonetheless, in this paper, only revenue loss from mobile telephony is analyzed, though this lost income may apply to other bands as well.

²⁸During 2010 total revenue of mobile operator was approx. 140 million Euros based on datasheet above.

2.3 LAW ON TELECOMMUNICATIONS - KOSOVO CASE

After Kosovo war 1999, Kosovo was governed by the UN Mission in Kosovo - UNMIK, which set regulations and laws to help the Kosovo Authority rebuild its Institutions. One of these regulations was UNMIK Regulation No. 1999/1 of 25 July 1999, “On the Authority of the Interim Administration in Kosovo,” as amended; and UNMIK Regulation No. 1999/24 of 12 December 1999, “On the Law Applicable in Kosovo,”

To improve the Telecommunications Sector in Kosovo, UNMIK and PSGK established an independent regulatory agency which was responsible for licensing, regulating and supervising the providers of telecommunication services in Kosovo, encouraging the private sector participation and competition in the provision of services, setting standards for all service providers in Kosovo, and, establishing provisions for consumer protection. The TRA guide by law came under Law²⁹ on Telecommunication [59] in Kosovo.

After PSGK³⁰ and all laws necessary to function as a government were established, PSGK under UNMIK created the Ministry of Transport and Telecommunication. Its duties were specified on Law of Telecommunication as described below:

Under Section 3/Authorities and Competencies:

1. The responsibilities for the implementation of telecommunications services in Kosovo shall reside in the following entities:

²⁹http://www.gazetazyrtare.com/e-gov/index.php?option=com_content&task=view&id=170&Itemid=56&lang=en
³⁰Provisional Self-Government in Kosovo

a) The Ministry shall develop policies for the sector, including the development of legislation, and exercising all other powers transferred to it under the Constitutional Framework.

b) The TRA, established as an independent body within the PISG by this Law, shall implement the policies of the PISG and Ministry pursuant to this Law, and all other implementing legislation enacted pursuant thereto.

c) UNMIK, through the SRSG, shall exercise those powers that are reserved to it under the Constitutional Framework, including:

i The authority to manage publicly owned telecommunications assets, including, but not limited to Management of essential PTK assets through the Kosovo Trust Agency KTA in cooperation with the PISG pursuant to UNMIK Regulation 2002/12 on the Establishment of the Kosovo Trust Agency of 13 June 2002;

ii Management of radio frequencies, carried out by the Frequency Management Office FMO. Some specific administrative functions will be implemented by the PISG and the respective independent regulatory body. And

iii The regulation of the broadcast industry, which is currently executed by the Temporary Media Commissioner TMC.

2. The TRA shall coordinate all broadcasting activities with the Temporary Media Commissioner and with other relevant authorities in accordance with the provisions of the Broadcasting Regulation.

3. The TRA assign to service provider and users spectrum resources that are specifically allocated by UNMIK.

4. The TRA shall at its discretion, obtain from service providers and review for compliance with this Law, international contracts involving the provision of Telecommunications Services and equipment between commercial entities active in Kosovo. The TRA shall not conclude any agreements with states and multilateral organizations.

5. the Ministry shall request that the SRSG conclude on behalf of UNMIK agreements with states and multilateral organizations that pertain to the telecommunications sector, as well as all documents pertaining to the SRSG's oversight of international agreements entered into on behalf of UNMIK in the telecommunications sector. As part of the consultative process in these matters, the Ministry may request the right as an interested party to participate in discussions and negotiations conducted by the SRSG with states and multilateral organizations that are intended to result in the conclusion of such agreements³¹.

This is the foundational law for the Telecommunication Sector. Today, FMO and TRA are joined and work together as TRA. TRA is now independent from the Ministry of Transport and Telecommunication (now the Ministry of Economic Development).

Chapter 2 Section 4 of the Law of Telecommunication establishes TRA:

Establishment of the TRA

1. The Telecommunications Regulatory Authority the "TRA" is hereby established as an independent, non-profit body within the Ministry, and shall implement the policies of the PISG and the Ministry pursuant to this Law, and all other implementing legislation enacted pursuant thereto.

³¹Italic letters are copied from law of telecommunication in Kosovo.

2. The TRA shall promote and facilitate the provision of sufficient and satisfactory domestic and international telecommunications services, and other services covered in the broadcasting regulations, provided however, that such promotion and facilitation shall not extent to free of charge services.

3. The TRA shall be governed by this Law, and shall observe the need to promote universal services in accordance with the principles set forth in Chapter 8 of this Law.

4. The TRA is authorized to issue regulations and instruction for the implementation of the present Law.

Based on the law that mention above, TRA is responsible for finding a solution for the problem of unlicensed operators and spurious transmissions from neighboring states. The TRA has the right to proceed, but it seems that the TRA and its engineers prefer the radical solution that is suboptimal for all parties (as discussed above).

Chapter 12 Section 63, 64, 65 of this law (Radio Communications, Spectrum Resource Allocation, Numbering), define clearly the duties of TRA related to Spectrum Resources and other matters that related to it.

1. The radio frequency spectrum is a limited natural resource. Frequency management is a reserved power by the SRSG, which has made a specific quantum or spectrum resources available to the PISG for re-allocation to users and service providers; all provisions pursuant to the allocation of spectrum resources in this Law pertain solely to those spectrum resources made available to the PISG. The TRA shall reallocate to service provides only those spectrum resources that have been made available to it by the SRSG.

2. In order to protect the efficient and non-interfering use of Kosovo's radio spectrum resources and the rights thereof to orbital positions the TRA shall:

- a) Establish a spectrum resource plan to allocate radio frequency bands and/or to assign radio frequencies for use;*
- b) Allocate such radio frequency bands and/or assign radio frequencies for use; and*
- c) Supervise the use thereof.*

3. The TRA's spectrum resource plan shall become effective after SRSG review and approval in writing. All allocations of spectrum resources by the TRA to service providers must be made available to it by the SRSG.

4. the TRA shall maintain all relevant information related to the allocation of spectrum resources, information on the assignment of radio frequencies, and other relevant information required to effectively manage the spectrum resources.

5. With the exception of that information which is related to the requirements of Kosovo security and/or defense, the TRA shall make the information specified in this section publicly available.

Section 64, 65 and some other parts of this law are contained in Appendix B under LAW of TELECOMMUNICATION.

By examining the Telecommunications Law, we build a foundation for understanding the unique situation in Kosovo. I argue that this Law as well as other aspects of Kosovo (market, theory, geography, politics etc,), require a re-thinking on how spectrum might be managed in Kosovo to everyone's benefit. Further, I argue that it is time to take a Coasian perspective and consider investing in technologies such as DSA as a way to a Pareto superior outcome. When I mention

seems old, I have in my mind that in this law is not specified Dynamic Spectrum Allocation as a solution for some special cases.

2.4 TELECOMMUNICATION MARKET IN KOSOVO - MOBILE PHONE MARKET

The link between telecommunications and economic development is well known³². The ITU-D³³ has been evaluating the impact of infrastructure on the development of the information society.

The diversity of modern telecommunications services helps businesses increase productivity by creating more efficient manufacturing and the possibility of coordinating activities within and between businesses, which result in cost reduction. Moreover, the telecommunications industry itself provides a major source of employment, and contributes a significant share to a country's Gross Domestic Product (GDP).

Most countries have found some form of regulation of the telecommunications sector necessary as a way of coordinating shared resources and ensuring reasonable retail prices. TRA has produced a report³⁴ on status of the telecommunications market, which contains the key indicators of market telecommunications. The document was prepared based on data submitted by operators licensed by the TRA that provide mobile, fixed and internet services. Because of data confidentiality, not all indicators reported by the operators are published in this report.

³²<http://www.jstor.org/pss/2677818>

³³<http://www.itu.int/net/ITU-D/index.aspx?category=information&rlink=rhome&lang=en>

³⁴Market analyses : <http://www.art-ks.org/?cid=1,163>

This document is produced quarterly, so licensed operators are required to regularly submit completed questionnaires with the requested to the TRA. This report could be fulfilling with additional statistical information from other alternative operators based on Kosovo market but this kind of information is based on biggest operators in Kosovo.

2.4.1 Overview

The Law on Telecommunications has created the conditions for market liberalization in the country. So far all services have been liberalized telecommunication services including fixed telephony, mobile, Internet, value-added services, etc. Specific actions taken by TRA include:

- Prior authorizations for internet services are released in May 2005 (licensed operators: PTK, IPKO, and KUJTESA net).
- In September 2006 a second license was issued (consortium IPKO / Telecom Sllovenije) to offer fixed telephony services on a national level.
- In the mobile phone market, there are currently two licensed operators (2G): PTK-Vala in the 900MHz band, in 2004, and the consortium IPKO / Sllovenije Telecom / Mobitel (band 900/1800MHz) in 2007.
- The MVNO Framework was approved by TRA in May 2008 and two operators were licensed: Dukagjini Telecommunications (D3mobile), which operates under a commercial agreement with IPKOnet, and Dardafon.net (Zmobile) has an operating agreement with PTK/Vala.

Although all telecommunications services were liberalized, full competition currently exists only in the Internet and mobile telephony services sector, while fixed telephony services are only partially competitive.

During 2010, four (4) enterprises providing telecommunications networks and services were licensed by the TRA the same as were licensed in 2009. In total,

TRA has issued a total of 47 licenses for telecommunication services, which are presented in

Table 4.1. The licenses apply to the following services, all of which are now offered in Kosovo:

- fixed telephony services
- Mobile service
- broadband services
- leased lines services
- Value added services

Table 2.1 Number of authorizations / licenses issued by TRA

| Type of license | Number of licensed operators |
|---|------------------------------|
| Licenses for mobile telecommunications (MNO) | 2 |
| National fixed services license | 3 |
| Internet services license | 13 |
| International telecommunications services license | 5 |
| The license for international telecommunications node and equipment | 5 |
| License Value Added services | 17 |
| License for virtual mobile services (MVNO) | 2 |

Table 2.2 Main Indicators Telecommunications Services Market

| Description | Q3 2010 | Q2 2010 | Change compared to Q2 2010% | Q3 2009 | Change in % compared to Q3 2009 |
|--|--------------|------------|-----------------------------|------------|---------------------------------|
| 1. Number of fixed telephone lines ³⁵ | 289154 | 289154 | - | - | - |
| 2. Number of fixed telephone subscribers | 88716 | 92801 | -4.4 | 84114 | 5.29 |
| 3. Penetration of fixed telephony | 4.48% | 4.4 | 0.08 | 4.46 | 0.02 |
| 4. Number of mobile phone subscribers | 1537164 | 1468002 | 4.71 | 1,297407 | 18 |
| 5. Penetration of mobile telephony % | 74 | 71 | 3.41 | 63 | 18 |
| 6. Number of internet subscribers | 105061 | 104,364 | 0.7 | 136,711 | -23 |
| 7. Number of subscribers to Internet(%) | 5.08 | 5.04 | 0.04 | 6 | -1.52 |
| 8. Revenues (in thousands €) | | | | | |
| From: Fixed Telephony | 4,843,063 | 4,759,074 | 1.76 | 4,870,769 | -0.56 |
| Mobile telephony | 49,543,592. | 41,131,707 | 20 | 48,000,572 | 0.39 |
| Leased lines | 447,069.13 | 395,192.94 | 13.12 | N/a | N/a |
| Access the Internet | 4,169,636.41 | 3682275.72 | 13.23 | N/a | N/a |

35

Table 2.2 contains the recent data for the telecommunications market in Kosovo. Some highlights include:

- During the third quarter of 2010 the number of fixed telephone users decreased, due to the reduction of 4602 users of TK. Number of fixed phone users is estimated to be 88 000, of whom 8 000 IPKO alternative operator.
- While fixed telephony has decreased slightly, mobile telephony and broadband access on the Internet have increased in the number of users.

³⁵ Fixed Telephone lines differ from Fixed Telephone subscriber. While in near past everyone who has telephone lines was approximately subscribers. Now most of fixed telephone lines are unused.

At the end of the third quarter of 2010, the number of mobile phone users increased 3.41% compared with the previous quarter of this year, but was up 18% compared with the third – quarter of the previous year (2009).

- The number of users with broadband Internet access remained essentially steady at about 110 thousand.
- Revenue from telecommunications services for the third quarter of 2010 are €39,325,000.00. The operators of fixed and mobile networks continue to possess the largest market with approximately 90% of revenue across the sector. Mobile operators' revenues are 82.37% of all income market, while fixed operators accounted for 7.7%. The rest of the revenue is from of revenues from Internet services (9.18%), and a tiny fraction (0.74%) from leased lines.

Figure 2.2. shows the division of revenues by activity.

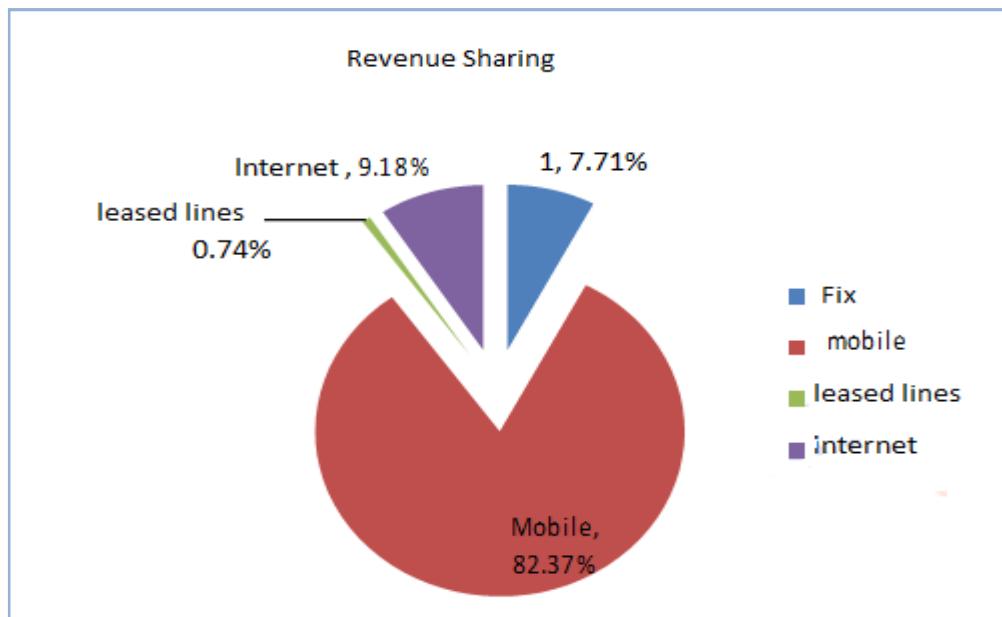


Figure 2-2 Breakdown of revenues by activity

2.4.2 Mobile phone users

As shown in the previous section, mobile telephony has grown significantly in the last year and captures the lion's share of sector revenues. The number of mobile phone users grew by 3.41% while raising the total to 1.5 million users. Mobile operators have reported that in the third quarter (Q3/2010) about 7.000 new users are added to their network. Figure 2.3 shows the growth rate of users from the years 2007 to Q3-2010.

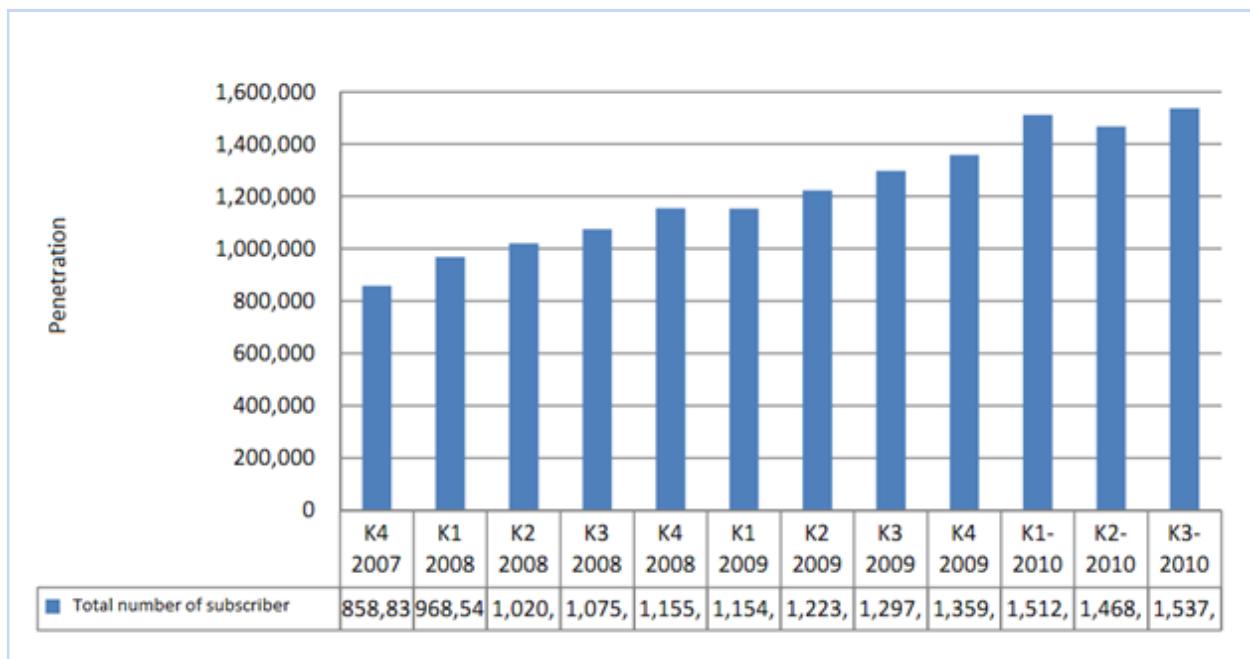


Figure 2-3 Number mobile users: 2007-2010 / III

The penetration rate of mobile phone reached 74.26% by the end of September 2010 , an increase of 11.26% compared to the same period in 2009 (Figure 2.3).

Despite the continuous increase in the number of mobile phone users, the service penetration is low compared to other countries in the region as well as the EU.



Figure 2-4 Penetration of mobile telephony

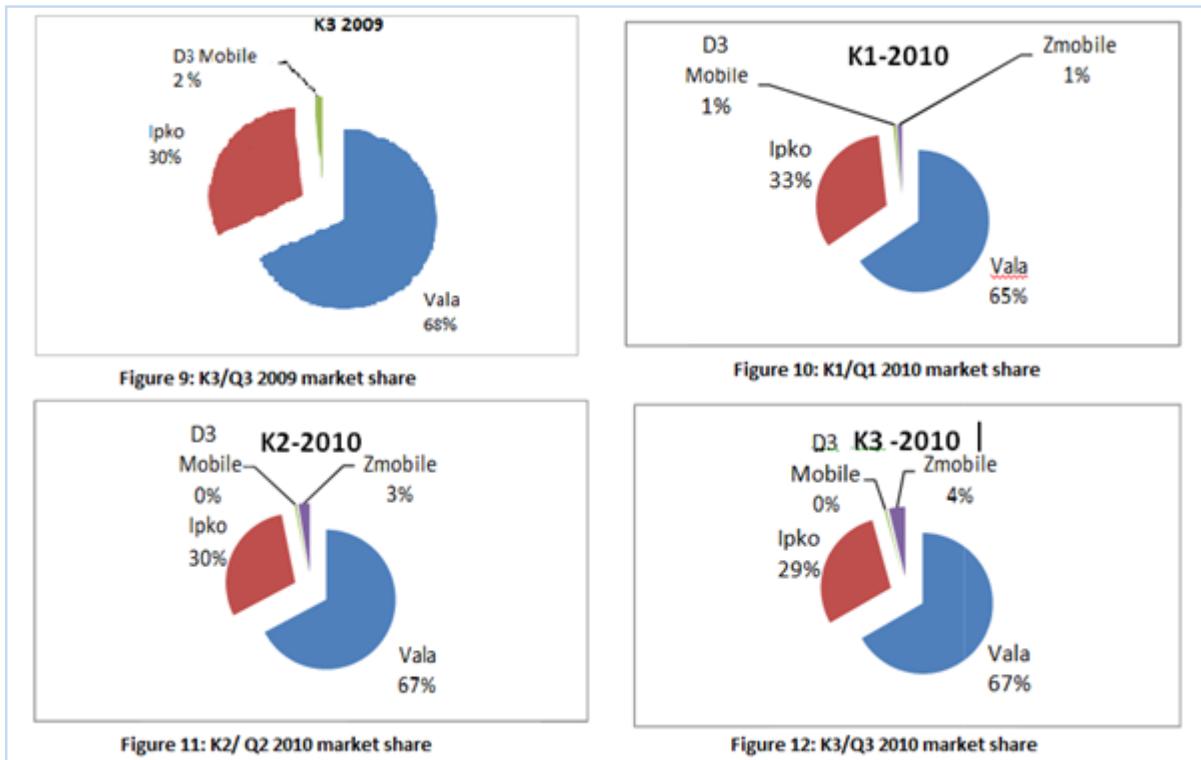


Figure 2-5 Mobile market shared in different quarter of years

2.4.3 Mobile telephony revenues

Total revenues of the four mobile operators in the third quarter of 2010 were 49.5 million euro, which represents an increase of about 20% compared with the previous quarter of this year.

The trend line of the mobile phone revenue can be seen in Figure 2.6 for the period 2007-2010, it can be seen that end of 2008 was the first year of decrease revenue of this market segment.

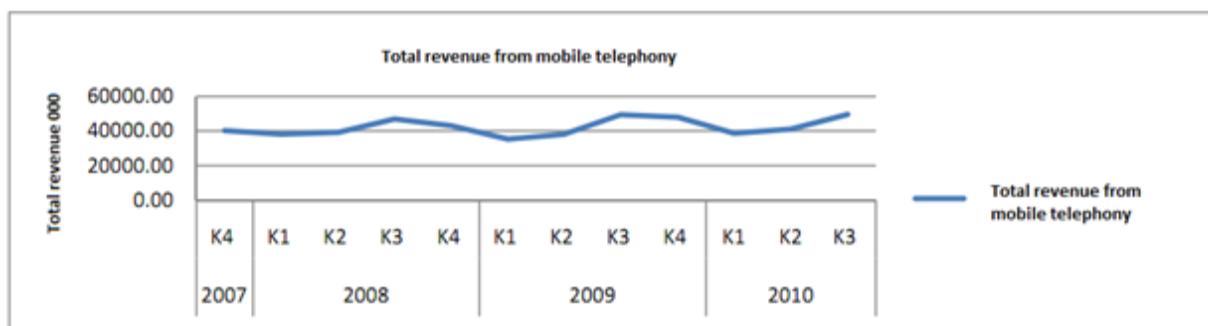


Figure 2-6 Revenues from mobile telephony

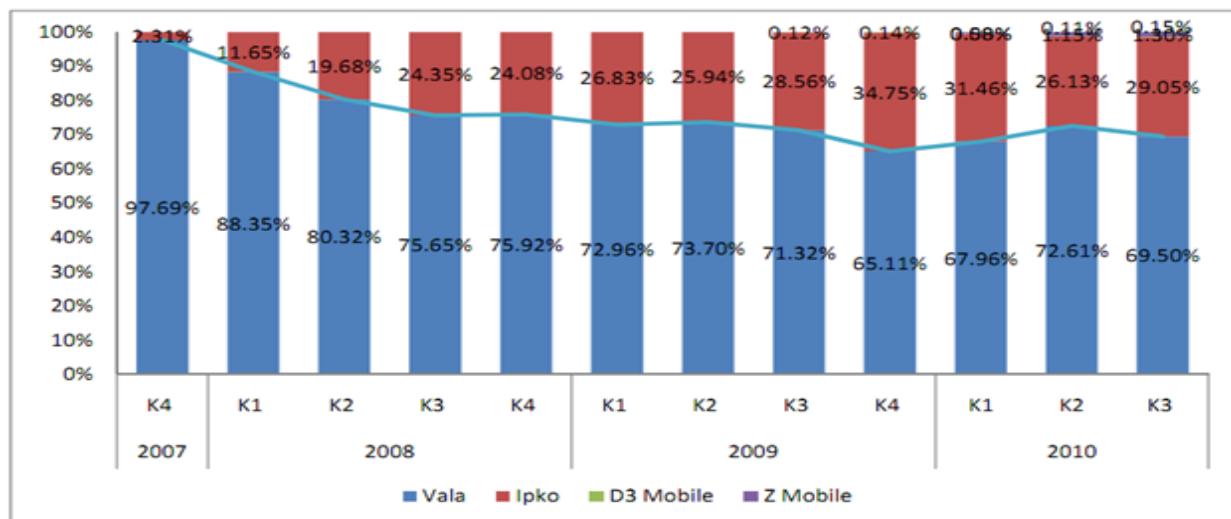


Figure 2-7 Market share of mobile phone based on revenue

2.4.4 The structure of mobile phone users

Structure of mobile telephone users in relations between the users prepaid and contract (postpaid) in the third quarter of 2010 continues to be stable. Number of users with a contract in relation to the total number of users is very low. About 4% of the total numbers of users constitute a contract, while 96% are prepaid users³⁶. Figure 2.7 presents data on the number of mobile phone users, divided into prepaid and postpaid users for the third quarter of 2010.

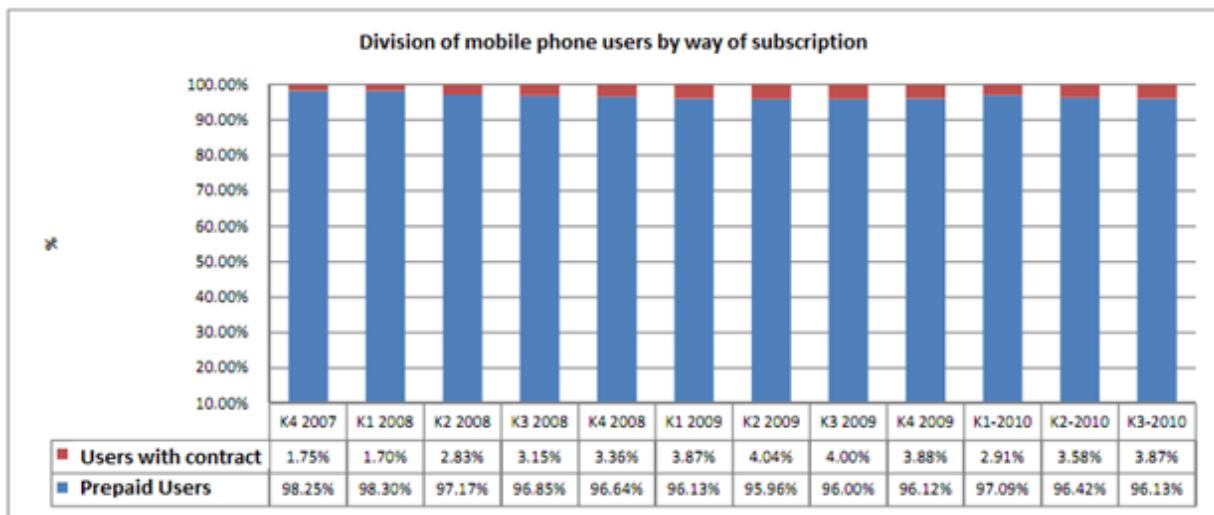


Figure 2-8 Division of mobile phone users by way of subscription

2.4.5 Telephone traffic

Figure 2.8 shows outgoing telephone traffic over time as reported by the two network operators (MNO) and mobile phone service providers (MVNO), broken down by call type:

³⁶ This could be seen quite different of US norms or even EU norms but this happens in Kosovo. Those information was taken from TRA: Telecommunication Market Analysis.

In the third quarter of 2010, mobile networks originated 441.5 mil-minutes, an increase of 32.7% compared to the second quarter, and 21% compared to the third quarter of 2009.

Note that the traffic within the network stayed constant, with 92% of calls originating from mobile phone users.

This amount of traffic within the network appears to have come as a result of multiple offers and tariff programs that offer calling within the groups with very low tariffs, and calls to geographic numbers³⁷ and international calls are a very small part of outgoing calls.

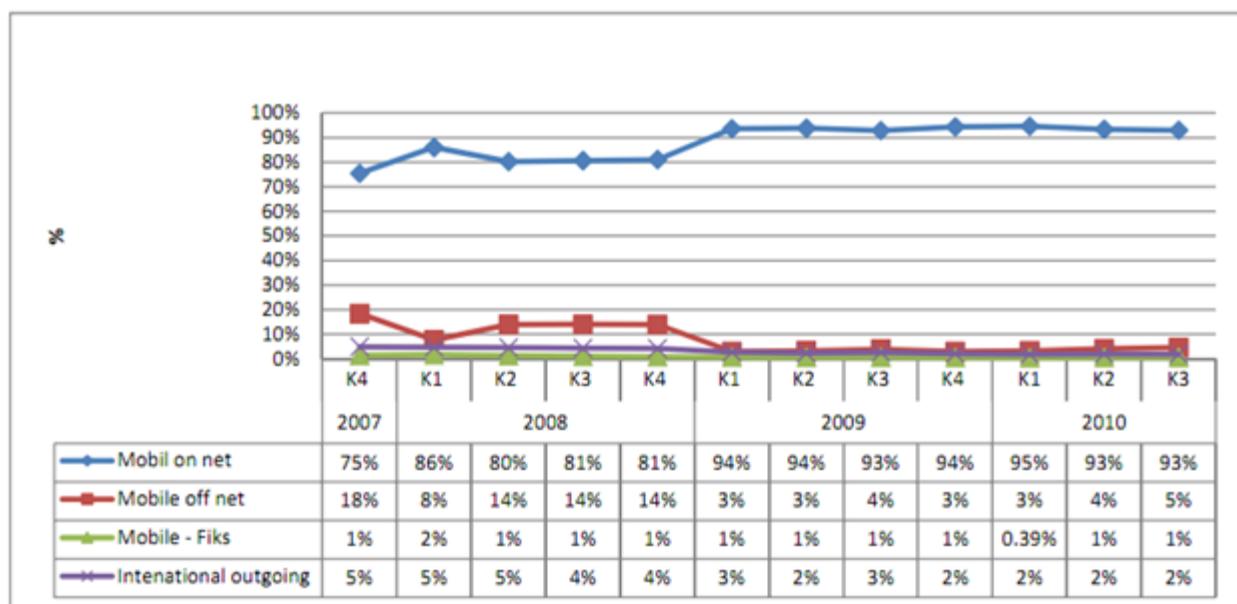


Figure 2-9 Outgoing mobile traffic by destination: 2007-III/2010

Figure 2.9 shows the incoming telephone traffic detail in the networks of the four licensed mobile operators according to the origin of the calls. In the third quarter 2010, traffic on wireless networks reached 107.5 million minutes, which represents an increase of 11% compared with the second quarter of 2010.

³⁷ Geographical number was the numbers that identified town in Kosovo. These numbers was just for fix lines. e.g. +381 38 300 300, here +381 country code fro ex-Yugoslavia now Serbia, 38 stands for Prishtina capital(39 -Peja town, 28 Mitrovica town and so on) and 300 300 stands for subscriber line.

Geographical code is similar to city code but dedicated to fixed lines.

The data presented in Figure 2.10 shows that that the majority of calls are international incoming traffic (over 70%), however, by the end of first quarter, there was a downward trend of these calls, while calls from other mobile networks are increased 55% compared to second quarter 2010 .

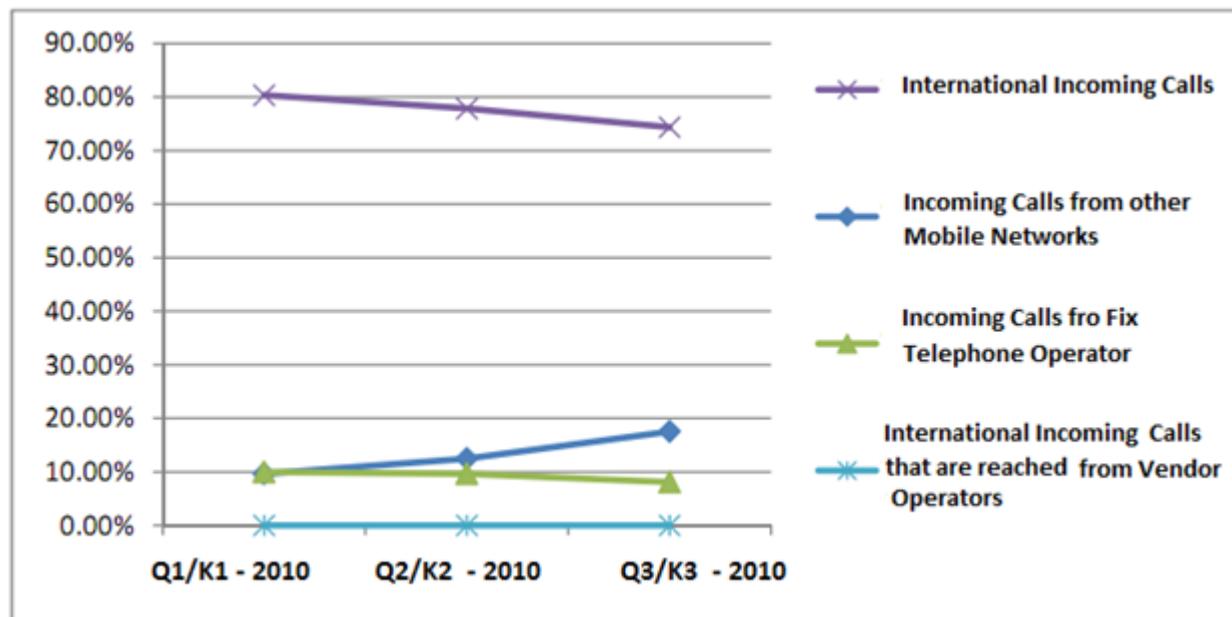


Figure 2-10 Incoming mobile traffic based origin-2010 (in terms of increasing/decreasing per minutes)

2.5 TELECOMMUNICATION SECTOR POLICY

The Vienna Economic Talks – Pristina Meeting was held on 25-26 March 2009 in Grand Hotel Pristina in which the Government of Kosovo - Ministry of Transport and Telecommunication showed its Telecommunication Sector Policy³⁸ and goals for the telecommunication infrastructure. Government of Kosovo has approved this kind of document but also has approved

³⁸<http://www.vienna-economic-forum.com/332.html>

two previous document named National Strategy for Information Society 2006-2012 and eSEE Agenda Plus. On eSEE Agenda Plus is a regional plan that includes participation from Albania, Bosnia & Herzegovina, Croatia, Moldova, Macedonia, Serbia, Montenegro, and Kosovo.

Based on this document we can see that the Kosovo Government was and is ready to be part of region including telecommunication infrastructure. GK has prepared all necessary legal infrastructures in terms of telecommunication strategy.

In the following text we can see the telecommunication policy goal and then we can analyze that to determine if a solution for the unlicensed operator problem (i.e. DSA), is consistent with the Government of Kosova strategy.

2.6 TELECOMMUNICATION POLICY GOALS

Based on the document that GK presented on 26 of March 2009 in the Vienna Economic Talks we can see the following goals.

- Promote market entry;
- Promote competition and a level playing field;
- Achieve Universal Access/services;
- Ensure optimal usage of scarce resources³⁹ ;
- Establish a more effective legal framework for the monitoring and supervision of the sector that facilitates:
 - o efficient and transparent governance,
 - o consumer protection, and

³⁹This point related to our goal of finding final solution, e.g, kind of DSA technique for main purpose of this thesis

- Deployment of new, modern technologies and services to meet user needs.

So from these goals we can see that GK is ready for any solution that fulfills these key criteria above. Usage of scarce resource, efficiency, legal framework, meets user's need, customer protection are all key words that are consistent with the DSA solution

2.7 MOBILE SERVICE

The document mentioned above is related to all telecommunication infrastructure but we are interested, for the purpose of this thesis, on the Mobile services and Spectrum goals.

On the following text we can see the main point related to mobile service that has aggregated from this document:

- All obligations of the PISG⁴⁰ to honor arrangement dictating monopoly supply conditions in the mobile telecommunication sector have ended. The GK⁴¹ affirms the following in respect of mobile services:
- Necessary Scarce Resource, such as electromagnetic spectrum, should be made available, in an economically efficient manner, for the future development of mobile sub-sector as a whole.
- Processes and procedures administered by TRA for the allocation and assignment of radio frequencies for telecommunication network generally, or their reallocation and the migration of assignment when called for, shall be transparent, non-discriminatory and expeditious.

⁴⁰ PISG - Provisional Institutions of Self-Government

⁴¹ GK - Government of Kosova

- One or more individual Mobile Virtual Network Operator (MVNO) licenses may be granted, at the discretion of TRA. Such licenses will permit the provision of mobile services to end users through technical interconnection with, and access to, facilities of exiting holders of mobile services licenses, such that the MVNO can create a separate network identity; assume a significant measure of control with users of services in its own name.
- To the extent further completion on mobile services is introduced the initiative should come from private sector, recognizing that there is a moratorium on the issuance of new mobile licenses until April 2010.
- Thereafter, TRA shall promote and facilitate introduction of #G wireless and Next Generation Mobile Network (NGMN) networks in Kosova and in that regard may issue new licenses for such network to the extent that it determines following analysis that the market will support their sustainability.

So key sentences taken from document mention above, has shown to international and vendor community that GK is ready to fulfill this criteria mention above but a point missing here: solution that proposed here on this thesis.

2.8 SPECTRUM

In the same way we have taken a part of this document related to spectrum and we can see that also spectrum field is treated in same manner like the previous points.

This point taken from that document is:

- The need remains for systematic and consistent approach to issues of spectrum allocation, assignment, monitoring and pricing. Such mechanism should ensure that spectrum resources are made available in a transparent, predictable and economically efficient manner, while at the same time promoting easy of entry of new players and in particular the introduction of wireless broadband technologies. Furthermore, once such mechanism are in place, ongoing attention needs to be given to their maintenance, effects on spectrum users (e.g., coordination of planning and resolution of national and regional issues), and their implications and impact.
- The TRA is directed, as soon as practicable, to conduct a study aimed at producing a rule-making document concerning the most equitable and transparent mechanism for spectrum pricing.
- Consistent with its responsibilities under the Telecommunication Law, the TRA should develop as soon as possible, and to the fullest extent possible, the capability to carry out its spectrum monitoring and enforcement functions, and should be provisioned with appropriate spectrum monitoring equipment for this purpose.

Within the applicable limits of Telecommunication Law, the TRA should develop relationship with counterpart regulatory agencies in the region on matters of cross-border frequency coordination.

- When spectrum duly assigned to operators or other users is either unutilized or underutilized, the TRA may require the operator or user in question to provide written justification for continuing said assignment. In such event, TRA shall review such justification and, should the TRA find that the continued assignment of the spectrum in question to the operator or user in question is not warranted, the TRA may take action to

de-assign the spectrum in question and return it to unassigned spectrum “pool”.

- The TRA shall actively ensure that the national table of frequency allocation and assignments for Kosovo stays in line to the fullest extent practicable with European Common Allocation Table, including updating the table to align the national with the Radio Spectrum Decision (676(2002)EC) and other similar enactment of the European Commission.
- To the extent that the spectrum management and monitoring activities of the TRA require technical assistance and extraordinary capital expenditures, the TRA in coordination with the MTC⁴² shall develop the appropriate and justified funding requests.

This chapter based on the strategy of Government of Kosovo, a review of internal and external document of GK⁴³ and meetings with the main officers of telecommunication policy of Government of Kosovo.

Again, even in this chapter the main purpose was bringing in front of readers the strategy of GK and showing that, this strategy allow us to bring a kind of solution that we will propose.

⁴² Ministry of Transports and Communication

⁴³ Intern document, I have taken permission for particular information - verbal permission

3.0 CONSTITUTION, TELECOMMUNICATION LAW AND A BRIEF OVERVIEW OF TELECOMMUNICATION MARKET ANALYSIS OF REPUBLIC OF SERBIA

After reviewing the Kosovo side in terms of law, telecommunication market, territorial organization, history and independence, it is necessary to provide a complete picture. Serbia does not recognize Kosovo's declaration of independence. In many ways, the different views of the legal status of Kosovo form the basis of the problem.

3.1 REPUBLIC OF SERBIA: THE CONSTITUTION

Let us take some articles from Constitution of Serbia⁴⁴ to learn what they have to offer in explaining the current situation:

Article 1: The Republic of Serbia is a democratic State of all citizens living within it, founded upon the freedoms and rights of man and citizen, the rule of law, and social justice.

Article 2: Sovereignty is vested in all the citizens of the Republic of Serbia. Citizen shall exercise their sovereignty through a referendum, people's initiative, and their freely elected representatives.

⁴⁴For more detail see Constitution of Serbia

Article 3: In the Republic of Serbia everything shall be permitted unless it has been prohibited by the Constitution and law. Guaranteed and recognized by the Constitution are the individual, political, national, economic, social, cultural, and other rights of man and citizen.

Article 4: The territory of the Republic of Serbia is a single whole, no part of which may be alienated. Any change in the boundaries of the Republic of Serbia shall be decided upon by the citizens in a referendum.

Article 5: The Republic of Serbia has a coat of arms, a flag, and a national anthem. The coat of arms, the flag, and the national anthem shall be determined under the procedure provided for amending the Constitution. The capital city of the Republic of Serbia is Belgrade.

Article 6: The Republic of Serbia includes the Autonomous Province of Voivodina and the Autonomous Province of Kosovo and Metohia, these being the forms of territorial autonomy.

As we can see from these three articles above Serbia considers Kosovo as its autonomous province. The articles above mention that “any change of boundaries citizens should decide by referendum”.

Here is one of the main points of problem that we are trying to solve. Serbia believes that it has some sovereign rights to Kosovo but not full rights because Kosovo has some kind of autonomy given by their constitution. Taken from part VI under- Territorial Organization - The Autonomous Province of Voivodina and the Autonomous Province of Kosovo and Metohia, we can see:

Article 108: The autonomous provinces have been formed in accordance with the particular national, historical, cultural, and other characteristics of their areas. Citizens within the autonomous province shall autonomously realize the rights and fulfill the duties established

by the Constitution and law. The territory of an autonomous province shall be determined by law.

Article 109: The autonomous province shall, through its own agencies:

- 1) enact the program of economic, scientific, technological, demographic, regional and social development, development of agriculture and rural areas, in accordance with the development plan of the Republic of Serbia, and shall lay down measures for their implementation;*
- 2) adopt a budget and annual balance sheet;*
- 3) enact decisions and general enactments in accordance with the Constitution and law, to regulate matters affecting the citizens in the autonomous province in the areas of: culture; education; official use of the language and alphabet of the national minority; public information, health and social welfare; child welfare, protection and advancement of environment; urban and country planning; and in other areas established by law;*
- 4) enforce laws, other regulations and general enactments of the Republic of Serbia, whose enforcement has been entrusted to the agencies of the autonomous province, and pass regulations necessary for their enforcement if so provide by the law; see to the execution of provincial decisions and general enactments;*
- 5) establish agencies, organizations and services of the autonomous province, and regulate their organization and work;*
- 6) attend to other business laid down under the Constitution and law, as well as by the statute of the autonomous province.*

The Republic of Serbia may entrust by a law an autonomous province with the performance of specific affairs within its own competences and transfer to it the necessary funds for this purpose. The autonomous province shall collect revenues as laid down by law.

As we can see, the agencies from autonomies province have some independent decision making authority under the Serbian constitution.

3.2 TELECOMMUNICATIONS LAW - SERBIA

Let examine some articles in the Telecommunication Law of Serbia⁴⁵ to help us move forward.

Under II - GENERAL PROVISIONS - Article 3:

The principles governing the regulation of the relations in the telecommunications sector are:

- 1. To provide the conditions for the development of telecommunications in the Republic of Serbia;*
- 2. To protect the interests of the users of telecommunications services;*
- 3. To create conditions to satisfy users' needs for telecommunications services;*
- 4. to promote competition, economy and efficiency in all areas of telecommunications;*
- 5. To ensure the highest possible quality of telecommunications services;*
- 6. To ensure interconnection between telecommunications networks or operators on equal and mutually acceptable terms;*
- 7. To ensure rational and economical use of radio frequency spectrum;*

⁴⁵ For more detail see Telecommunication Law of Serbia

8. To harmonize activities in the telecommunications sector with international standards, best practices and existing technical regulations.

Under Powers of Government Authorities in Telecommunications Sector - Article 5 :

In telecommunications sector, upon the proposal of the ministry responsible for telecommunications (hereinafter Ministry), the Government of the Republic of Serbia (hereinafter Government), which has been prepared with participation of responsible authorities of the Autonomous Region, defines the policy and strategy of telecommunications development in the Republic and adopts the Radio Frequency Bands Allocation Plan.

Both article 3 and article 5 supports our aim toward a solution. In Article 3, each point of that direct or indirect kind of solution for Kosovo case: point 2- *to protect the interests of the users of telecommunications services;*, point 2 - *to create conditions to satisfy users' needs for telecommunications services; and point 4- to promote competition, economy and efficiency in all areas of telecommunications;*

Point 4 also creates the basis for a solution. The law requires the government of Serbia to set policies that promote competition, the economy and efficiency of usage of spectrum⁴⁶, satisfying and protect interest of users, ensuring quality of service and so on. In the following, article 5, is shown that Autonomies Region should be a participating in this solution. So even by this law we have there is an open door to address the problem of unlicensed operators.

Under Part II: REPUBLIC TELECOMMUNICATIONS AGENCY - 1. Legal Status
Establishment Article 7:

⁴⁶Here mention efficiency all areas of telecommunication but part of that is spectrum usage in terms of spectrum usage and ensuring service for customers.

For the purpose of establishing conditions for efficient implementation and promotion of the telecommunications policy in the Republic of Serbia, the Republic Telecommunications Agency (hereinafter Agency) is hereby established as an autonomous and independent public organization exercising its authorities in accordance with this Law and regulations adopted on the basis of this Law. The Agency is an autonomous legal entity and is functionally independent of and not subordinated to any government authority, as well as of any organization and person engaged in operating telecommunications networks and equipment or providing services. In performance of the activities stipulated herein, the Agency shall ensure implementation of the development strategy adopted for the telecommunications sector in the Republic⁴⁷.

In this article above we can see establishing by law of the RSA and granting it responsibility for all kind of policies related to telecommunication. As shown earlier, the same applies to Kosovo. Thus, it seems reasonable that two agencies, one from Kosovo and another from Serbia both have the legal and constitutional basis for finding a solution for the unlicensed operator situation in Kosovo. By law they have the permission as well as the obligation to do that. By law they are kind of independent agency in terms of decision that can bring benefits to all sides. What seems to be missing is the political will to move the idea beyond every day politics.

At this moment that is writing this thesis, international community has required for both part, Kosovo and Serbia to sit down on table and discuss the problems that they should finish.

⁴⁷For more details see : Telecommunication Law of Serbia and Electronic Communication Law

One of those pieces of negotiation is of course telecommunication issues. What kind of final solutions is going to happen, time will show us⁴⁸.

3.3 AN OVERVIEW OF TELECOM MARKET IN THE REPUBLIC OF SERBIA IN 2008 AND 2009

3.3.1 Overview

Pursuant to the Telecommunications Law, the Republic Telecommunication Agency (RATEL) was established as a national regulatory authority (NRA) and an autonomous legal entity with the task of ensuring the efficient enforcement and promotion of the policy set within the telecommunications sector in the Republic of Serbia, aiming at providing the conditions for the implementation of information society and further development of the aforementioned sector.

The establishment of RATEL created the regulatory framework which served as a basis for the upcoming reforms in this sector. From the very beginning of its work, and with the aim of introducing new and quality enhanced services as well as consumer protection, RATEL has directed its activities primarily towards the accomplishment of provisions set out in the Telecommunications Law, regulating the sector based on the principles which would create a free and open market, prevent monopolistic behavior and ensure equal treatment and non-discriminatory status of all market participants⁴⁹.

⁴⁸<http://www.osw.waw.pl/en/publikacje/ceweekly/2011-05-18/relations-between-serbia-and-kosovo-may-become-normalised>

⁴⁹RATEL - Serbian Telecommunication Agency

3.3.2 Regulatory Activity

In performing its regulatory activity during 2009, RATEL adopted and published the following bylaws:

- Rules on radio frequency usage fees (Official Gazette of RS, no. 06/09);
- Decision on the amount of the annual fee for the usage of assigned numbers and addresses from the Numbering Plan (Official Gazette of RS, nos. 16/09 and 23/09);
- Rules on terms and conditions for radio and television program distribution service provision and contents of the authorization (Official Gazette of RS, no. 26/09);
- Instruction on the public bidding procedure for license issuance (Official Gazette of RS, no. 12/09);
- Decision on the provision of call-back service without a special authorization issued by the Republic Telecommunication Agency (Official Gazette of RS, no. 27/09).

Let go some further steps that is interesting for our final solution taken from RATEL:

In accordance with Article 62 of the Law, RATEL prepared Draft Amendments to the Radio Frequency Bands Allocation Plan (Official Gazette of RS, nos. 112/04 and 86/08) which was forwarded to the Ministry of Telecommunications and Information Society (MTIS) for further procedures.

Another part that is necessary taken from Ratel could be this kind of information:

During 2009, RATEL adopted, published and made publicly available on its website, the following instructions and technical requirements:

- Instruction on cable distribution systems designing;
- Technical requirements for cable distribution systems;
- Instruction on base station designing in mobile telephony systems;
- Instruction on drafting project documentation for GSM/UMTS base stations in public mobile telecommunications networks; (and other issues see⁵⁰)

3.3.2.1 Radio-communications

The intensive activities related to the joint work of the Ministry of Culture, the Ministry of telecommunications and Information Society (MTIS), the Republic Broadcasting Agency (RRA) and RATEL on preparing the necessary enactments and the creation of conditions necessary for analogue to digital switchover in radio and television program broadcasting, continued in 2009.

Moreover, during 2009, the following documents related to RF spectrum management were prepared:

- Draft proposal for the new Rules on radio frequency usage fees with the aim of improving the status of radio and TV broadcasters, telecommunications operators as well as other radio frequency spectrum users;
- Drawing-up of Draft Rules on costs for radio station license issuance;
- Draft amendments to the Radio Frequency Bands Allocation Plan;

⁵⁰Telecom Market Republic of Serbia by Republic Telecom Agency of Republic of Serbia - RATEL

- Draft amendments to Frequency/Location Assignment Plan for terrestrial analogue FM and AM broadcasting stations for the Republic of Serbia⁵¹;

In addition to this, the RF spectrum management also included the following activities related to the issuance of radio station licenses, radio frequency coordination and notification and RF spectrum monitoring:

- 8,294 radio station licenses and 370 amateur radio station licenses were issued,
- 1,570 user requests were resolved;
- 611 frequency/location coordination were performed;
- Daily FM and TV broadcast monitoring was performed from the spectrum monitoring centers “Beograd” and “Niš”, as well as the periodic measuring throughout the territory of the Republic of Serbia. The total number of cases processed by radio-emission Controllers reached 1,901

3.3.2.2 Monitoring and Analysis of the Telecommunications Market

In accordance with the 2009 Framework Plan, RATEL carried on with the activities pertinent to the analysis and regulation of the telecommunications market. Since Article 9, point 17 of the Law, stipulates RATEL’s exclusive competencies pertinent to the task of monitoring the developments in the field of telecommunications, gathering information from telecommunications operators and providing information to users, operators and international

⁵¹See more detail on Telecom Market Republic of Serbia by Republic Telecom Agency of Republic of Serbia - RATEL

organizations, the publication “An Overview of Telecom Market in the Republic of Serbia in 2008” represents one of the results of such market analysis.

Comparative overview of the number of main lines of the public fixed telecom network, the penetration rate of the public mobile telecom network as well as the number of Internet and CAT subscribers for 2007, 2008 and 2009, is given in Table 6.1 below.

Table 3.1 Comparative Overview of the Number of Telecom Service Subscribers in the Last 3 years

| Comparative Overview of the Number of Telecom Service Subscribers in the Last 3 Years | | | | | | Source: RATEL |
|---|-----------------------|--------------------|-----------------------|--------------------|-----------------------|--------------------|
| | 2007 | | 2008 | | 2009 | |
| | Number (thousands) | Penetration (%) | Number (thousands) | Penetration (%) | Number (thousands) | Penetration (%) |
| Fixed - lines | 2,854.50 | 38.00 | 3,084.9 | 41.14 | 3,105.7 | 41.42 |
| Mobile - users | 8,452.60 | 112.70 | 9,618.8 | 128.27 | 9,912.3 | 132.20 |
| Internet - subscribers | 1,268.50 | 16.90 | 1,619.7 | 21.60 | 1,705.7 | 22.75 |
| CATV - subscribers | 694.6 | 9.3 | 922.3 | 12 | 1,080.9 | 14.42 |

3.3.2.3 Telecom Market Analysis

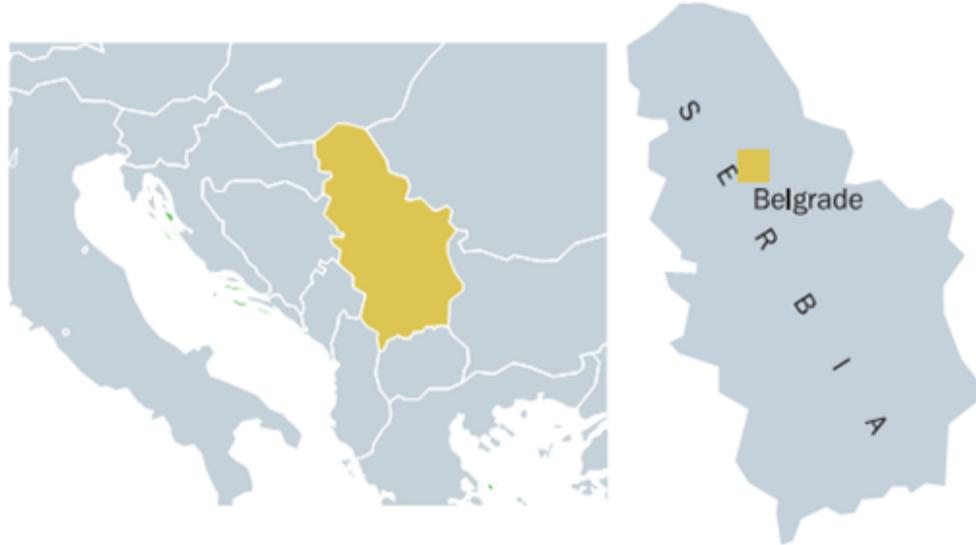
In compliance with the Action Plan for the implementation of the Strategy for the Development of Telecommunications in the Republic of Serbia from 2006 until 2010 adopted by the Ministry of telecommunications and Information Society (MTIS) and pursuant to Articles 9 and 10 of the Law, in 2009 RATEL conducted the first round of the analysis of the following markets:

- Fixed telephony;
- Mobile telephony;
- Interconnection;
- leased lines;
- Internet;
- Radio and TV program distribution.

3.3.3 BASIC CHARACTERISTICS OF THE TELECOM MARKET IN THE REPUBLIC OF SERBIA

According to RATEL's data, the revenues from telecom services in 2009 amounted to 1.51 billion euro. Since the average annual growth rate of the telecom sector revenues in the period from 2005 to 2009 was 13%, this sector is considered to be the most profitable one. The share of telecom sector revenues in GDP was around 4.76% (cf. 4.87% in 2008). The total investments in the telecom sector in 2009 amounted to 288 million euro.

Republic of Serbia - Basic Facts



| Basic Facts | | Source: Statistical Office of the Republic of Serbia and RATEL |
|--|--|--|
| Name | Republic of Serbia | |
| Capital | Belgrade | |
| Area | 88,361 km ² | |
| Population | | |
| (without AP Kosovo and Metohija), 2002 data. | | 7,498,001 |
| Country code: | +381 | |
| Internet domain: | .rs | |
| GDP for 2009 | 2,953.5 billion RSD (estimate) Real annual growth -3% (estimate) | |
| Average net income in 2009 | 31,733 dinars (337.16 euros) Annual growth 0.2% | |
| Fixed penetration: | 41.42 | |
| Mobile penetration: | 132.20 | |
| ISPs: | 199 | |
| Network digitalization rate: | 96.95% | |

Figure 3-1 Republic of Serbia - Basic Facts

Data utilized for the telecom market analysis in the Republic of Serbia were retrieved from the reports submitted by the telecom market participants and refer to the territory of the

Republic of Serbia without the Autonomous Province of Kosovo and Metohija which is under UN administration pursuant to 1244 Security Council Resolution temporarily regulating, inter alia, the competencies of the international civil mission in this territory.

In terms of different services, in 2009, the largest share in the total revenues, approximately 55%, goes to the mobile market, whereas VoIP services with 0.04% represent the smallest share.

Accordingly, investments in the mobile market have the largest share in the total revenues, 52% in 2009, whereas investments in VoIP only 1%. The structure of telecommunications sector revenues is given below (Figure 6.2).

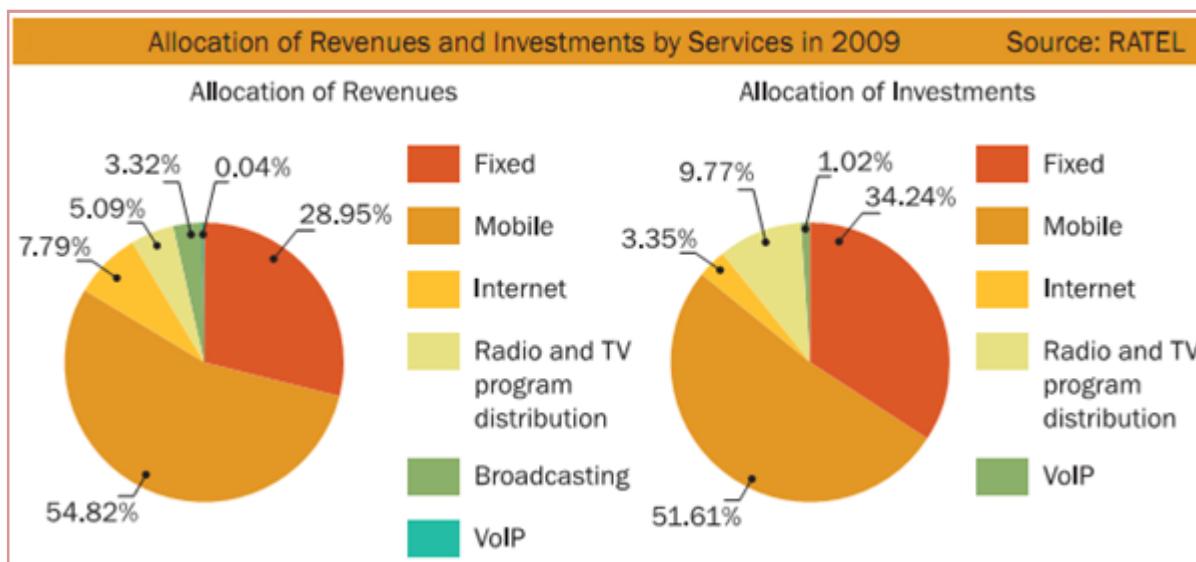


Figure 3-2 Allocation of Revenues and Investments by Services in 2009

It is estimated that the rate of return on investments in the telecom sector amounts to 1.4. The acquisition of Mobi63 by the Norwegian operator Telenor along with the procedure for the mobile telephony license issuance, which was completed by means of an auction (the value of the transaction including additional investments amounted to 1,602 million euro), proved to be the best financial investment, whereas the issuance of the third license to Mobilkom Austria

mobile operator (the value of the transaction and the investments in infrastructure amounted to 570 million euro) represents the largest Greenfield investment in Serbia so far. There are 600,000 employees in the telecom sector and the total value of the sector is estimated to 10 billion euro.

3.3.4 COMPARATIVE ANALYSIS WITH THE SEE COUNTRIES

The countries of the South East Europe include three EU candidate countries - Croatia, Macedonia and Turkey, in addition to four Stabilization and Accession Agreement (SAA) signatory countries— Serbia, Montenegro, Bosnia and Herzegovina and Albania. These countries make up for almost 20% of EU-27 population.

Table 3.2 Population and GDP in 2009 of SEE countries

| Population and GDP in 2009 | | |
|---|-----------------|----------------------|
| International Monetary Fund (IMF) for GDP | Population (mn) | GDP (in bn of euros) |
| Albania | 3.17 | 8.77 |
| Bosnia & Herzegovina | 3.84 | 12.33 |
| Montenegro | 0.62 | 2.96 |
| Croatia | 4.43 | 45.46 |
| Macedonia | 2.05 | 6.65 |
| Serbia | 7.36 | 30.85 |
| Turkey | 70.59 | 442.68 |

Croatia has the biggest GDP per capital (Table 6.2) which amounts to 43% of the average EU-27 GDP, followed by Turkey with the GDP of 30%. The GDP per capita in Serbia and Montenegro amounts to 20% of the EU-27 average.

The value of VAT in these countries remained approximately the same as it had been in the previous year. The highest VAT rate was recorded in Croatia (23%) and Albania (20%), followed by Turkey, Macedonia and Serbia (18%) and finally Bosnia and Herzegovina and Montenegro (17%). The total telecommunications market value in these countries is estimated to 16.4 billion euro, which is an increase of 4% in comparison with 2008. A particular increase was observed within the market segments of Internet, CATV and mobile services. The comparative data on the SEE countries' telecom sector revenues in 2007 and 2008 are given in Table 5 below. The largest share, or as much as 60% of the total telecom market revenues, goes to revenues from mobile telephony, after which follow revenues from fixed telephony, Internet and other services.

The comparative overview of mobile and fixed penetration in the Republic of Serbia (Table 6.3) shows that the number of mobile subscribers in most of the observed countries increased in respect to 2008⁵².

Table 3.3 Telecom Market Revenue of Republic of Serbia

| Telecom Market Revenues (€) | | | |
|--|----------------|----------------|--------------------|
| Source: Enlargement Country Monitoring Report 3 Annex 1 (Cullen International) | | | |
| | 2007 | 2008 | Sector Growth Rate |
| Fixed-line telephony | 5,411,329,183 | 4,709,815,446 | -13% |
| Internet services | 965,443,338 | 1,390,673,088 | 44% |
| Mobile telephony | 9,013,465,423 | 9,950,739,378 | 10% |
| Data communications | 384,632,703 | 437,568,897 | 14% |
| CATV (cable Internet services excluded) | 113,333,302 | 144,899,460 | 28% |
| Total | 15,888,203,949 | 16,429,656,268 | 4% |

⁵²More detail see on Telecom Market Republic of Serbia by Republic Telecom Agency of Republic of Serbia - RATEL

3.4 PUBLIC MOBILE TELECOMMUNICATIONS NETWORKS AND SERVICES

Mobile market in the Republic of Serbia continues with a positive growth trend in 2009 and marks the presence of the following market participants:

- Telecommunications company Telekom Serbia - Mobilna telefonija Srbije MTS, owned by Public company for PTT traffic Serbia (80%) and OTE, Greece (20%) (license replaced on 01.08.2006)
- Telenor Belgrade, 100% owned by Sonoco A/S, Denmark, owned by Telenor ASA, Norway (license issued on 01.09.2006)
- VIP mobile (member of Mobilkom Austria Group), owned by Telekom Austria Group, Austria (license issued on 01.12.2006).

All three operators were granted licenses for public mobile telecommunications networks and public mobile telecommunications network services in accordance with GSM/GSM1800 and UMTS/IMT-2000 standards, issued by RATEL. The licenses were issued for the territory of the Republic of Serbia, for a period of 10 years, which, upon expiration, may be extended for another 10 years without a special request from the operator, provided the requirements under the license are fulfilled.

The Norwegian company Telenor has been present in the Serbian telecom market since 31 July 2006, when, following the successful completion of the bidding procedure, it was issued a license for public mobile telecommunications network and public mobile telecommunications network services in accordance with GSM/GSM1800 and UMTS/IMT-2000 standards. Through this procedure, Telenor also bought the company Mobi63. This has been the biggest direct

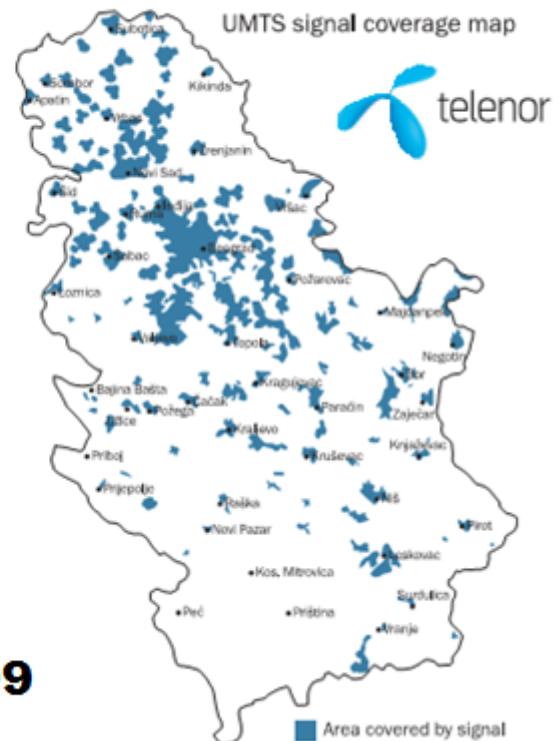
foreign investment in Serbia so far. Telenor, as a member of Telenor Group which operates throughout Europe and Asia, has ownership in thirteen mobile operators, and over 164 million users worldwide. Mobile operators in our neighboring countries, Panon in Hungary and Promonte in Montenegro, are part of this group as well. In 2007 Telenor began with the commercial use of UMTS network enabling video calls and additional services based on high-speed data transmission. In 2009, Telenor built 883 new base stations.

MTS - Mobilna telefonija Srbije, as a branch of the Telecommunications Company Telekom Serbia, was founded in June 1997 and it began to operate through a GSM standard based network in August 1998.

In December 2006, MTS began with the commercial operation of a 3G network with the latest HSDPA technology. During 2008, the operation of the 3G network was intensified. The number of 3G network subscribers rose significantly, from 490 thousand in 2008 to approximately 780 thousand in 2009. In addition to the Serbian market, Telekom Serbia is present as a mobile operator in Republic of Srpska and Montenegro as well.

Mobile operator - Telenor

Source: Telenor Serbia



| Official data | |
|---|-------------------------------|
| Name | Telenor Limited Liability Co. |
| Head office | Belgrade |
| Ownership | 100% Sonofon A/S |
| Number of employees | 1,211 |
| Percentage of territory covered by GSM network signal | 85.2 |
| Percentage of population covered by GSM network signal | 93.66% |
| Percentage of territory covered by UMTS network signal | 17.77% |
| Percentage of population covered by UMTS network signal | 53.14% |
| Number of base stations | 2,703 |

Figure 3-3 Mobile Operator Telenor Coverage in 2009



2008

Official Data

| | |
|---|------------------|
| Name | Telenor d.o.o. |
| Head office | Belgrade |
| Ownership | 100% Sonofon A/S |
| Number of employees | 1205 |
| Percentage of territory covered by GSM network signal | 84.21% |
| Percentage of population covered by GSM network signal | 93.23% |
| Percentage of territory covered by UMTS network signal | 9.85% |
| Percentage of population covered by UMTS network signal | 34.88% |
| Number of base stations | 1820 |

Figure 3-4 Mobile Operator Telenor Coverage in 2008

Comparing Telenor coverage from 2008 to 2009 we can see that, most of coverage in Kosovo territory doesn't exist anymore in 2009. Another issue that is important to point here is

the number of BTS. With red rectangular we point the difference of BTS from 2008, Telenor owned 1,820 and in 2009, Telenor owned 2,703. Telenor has increased number of BTS for more robust signals⁵³.

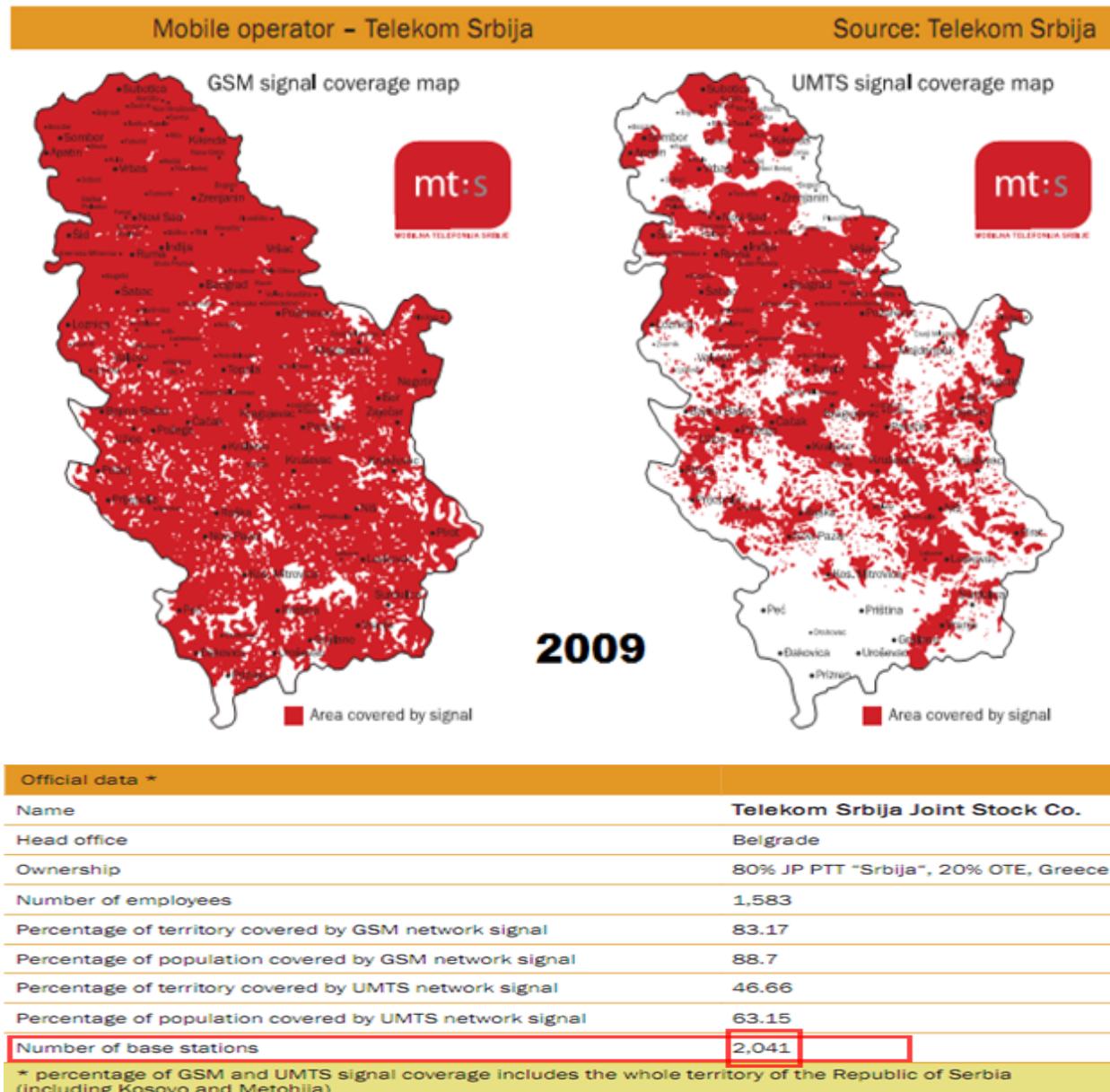
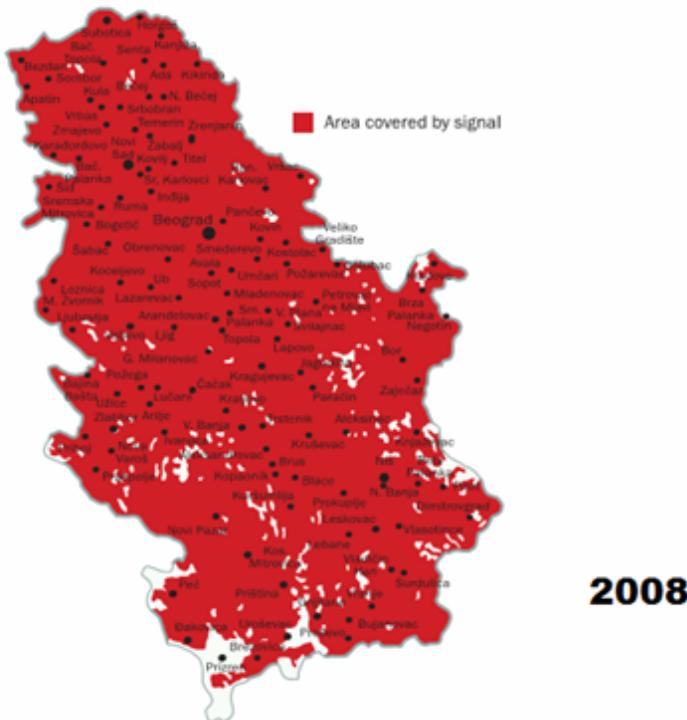


Figure 3-5 Mobile Operator MTS Coverage in 2009

⁵³ Many of this BTS in Kosovo territory was removed from TRA



Official Data

| | |
|---|--|
| Name | Telekom Srbija a.d. |
| Head office | Belgrade |
| Ownership | 80% JP PTT „Srbija“ 20% OTE, Greece |
| Number of employees | 658 |
| Percentage of territory covered by GSM network signal | 87.54% |
| Percentage of population covered by GSM network signal | 92.25% |
| Percentage of territory covered by UMTS network signal | 29.50% |
| Percentage of population covered by UMTS network signal | 55.85% |
| Number of base stations | 1798 |

Figure 3-6 Mobile Operator MTS Coverage in 2008

Compare to Telenor, MTS has more coverage in 2009 remaining from 2008 in territory of Kosovo. Base on some unofficial data, this coverage is shrinking even more in 2010 and 2010. Similar situation we have here in terms of number of BTS. Also MTS has increase number of BTS to robust more signals. Base on this situation we have state or solution in chapter 9.

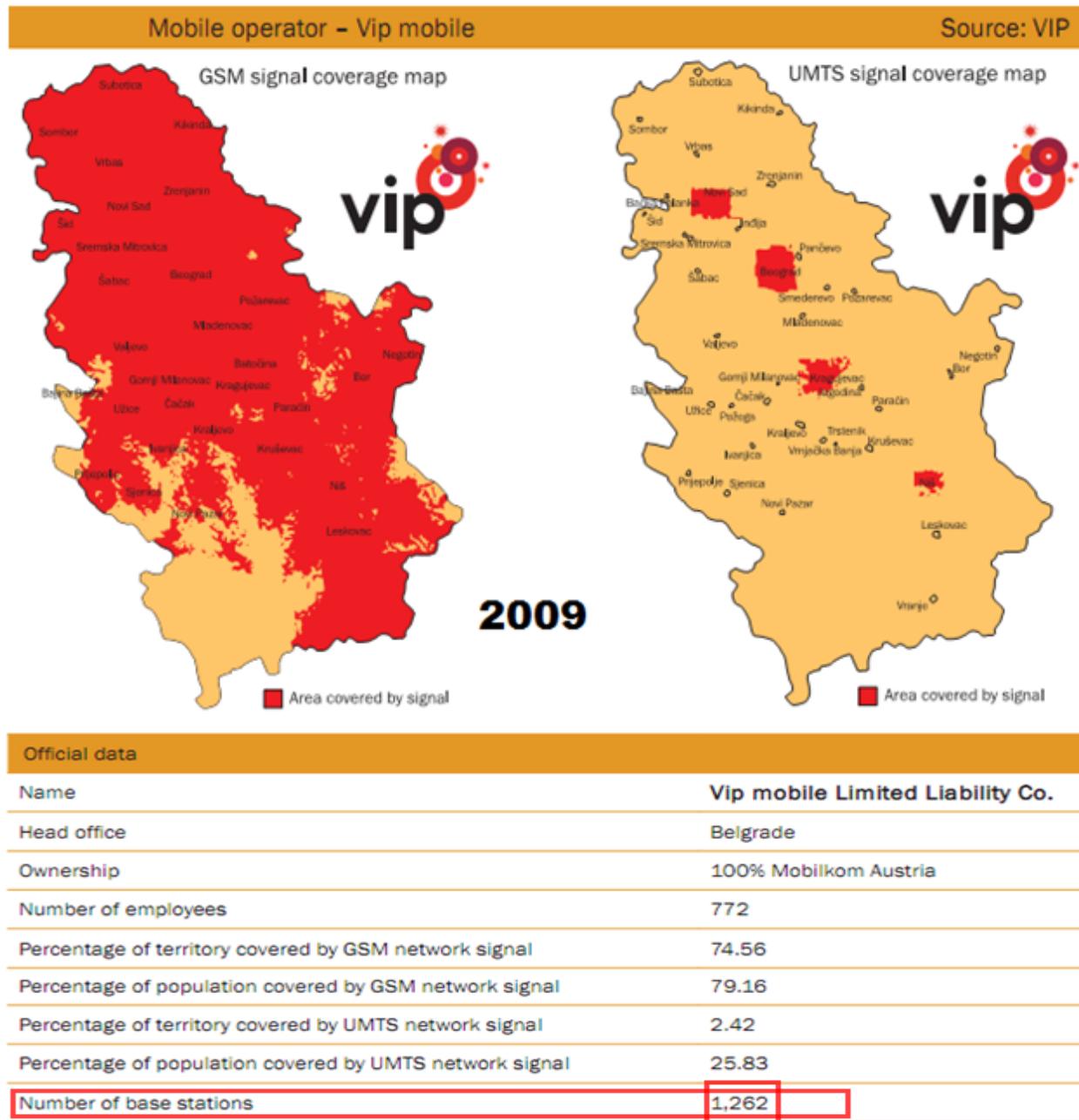
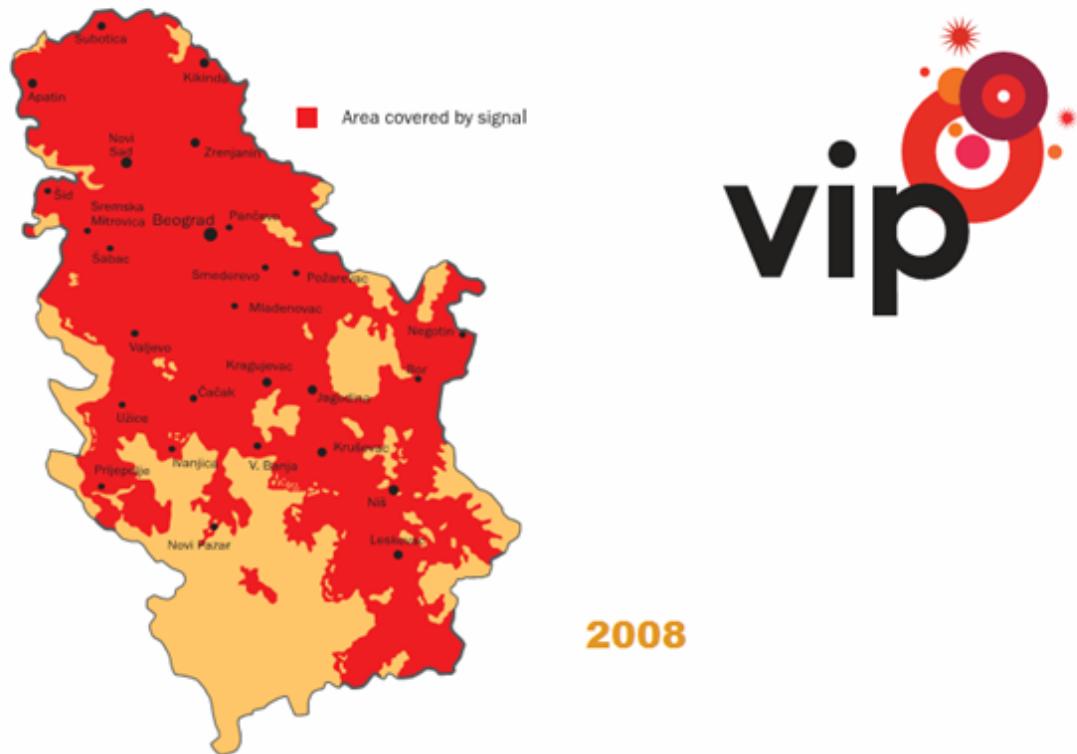


Figure 3-7 Mobile Operator VIP Coverage in 2009

Mobile Operators – Vip mobile

Source: VIP



Official Data

| | |
|---|-----------------------|
| Name | Vip mobile d.o.o |
| Head office | Belgrade |
| Ownership | 100% Mobilkom Austria |
| Number of employees | 613 |
| Percentage of territory covered by GSM network signal | 56.63% |
| Percentage of population covered by GSM network signal | 73.90% |
| Percentage of territory covered by UMTS network signal | 2.42% |
| Percentage of population covered by UMTS network signal | 25.83% |
| Number of base stations | 727 |

Figure 3-8 Mobile Operator VIP Coverage in 2009

VIP - mobile operator as we can see is present just in North of Kosovo. Similar to previous operators, VIP has increase number of BTS to robust signals. As we treated problem in chapter 9 also VIP can be potential competitor for secondary mobile market in Kosovo.

In 2009, Telekom Srbija built 243 new base stations. The third license for mobile operator was granted to Vip mobile, a member of the Mobilkom Austria Group present in eight European countries, including the following countries in the region: Croatia, Bulgaria and Macedonia.

In 2009, VIP mobile significantly increased the percentage of area and population coverage with both GSM and UMTS network signal, having built 535 new base stations.

In addition to 320 million euro paid for the license, during 2008, Mobilkom Austria made considerable investments in the development of infrastructure and hired a large number of professionals, thus making the biggest green field investment in Serbia so far.

The revenues from the mobile network services in 2009 decreased in respect to the previous year and amount to 826.74 million euro. Total investments in the mobile market also exhibit a downward trend in comparison with the previous year and amount to 13.9 billion euro.

However, one should note that the decrease in the revenues from the mobile telephony is, to ascertain extent, a consequence of calculation, i.e. the difference in exchange rates. In 2009, euro had average annual value of approximately 94 dinars, whereas this value was 82 dinars in 2008. In RSD currency, the total revenues from mobile telephony service amounted to 77.8 billion dinars, which in an increase of about 4% in respect to the previous year.

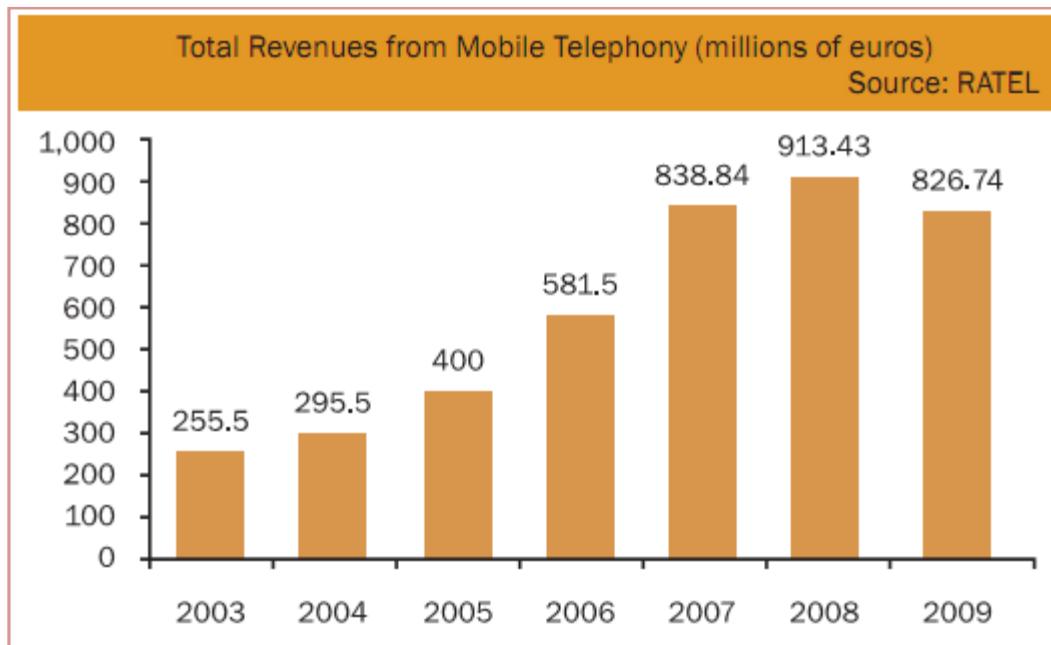


Figure 3-9 Total revenue from Mobile Telephony (millions of Euros)

As one of the temporary measures aimed at diminishing the effects of the World Economic Crisis, the Government of the Republic of Serbia introduced an additional tax rate within the mobile telephony sector on 1 June 2009. The 10% tax applies to all calls, standard SMS and MMS messages, transmission of data and additional services in the country and abroad, whereby this tax is not included in the calculation of VAT. Such a measure resulted in the decelerated growth of the mobile market, even though the operators continued with the effort of trying to win over the users by cutting down on prices and introducing a wide range of new services, such as SMS directory, favorite numbers, money transfer services, services which enable users to buy tickets via mobile phone, downloading music from WAP portals, combination of prepaid and postpaid packages, Facebook profile SMS notification, etc. The

introduction of the 3G network also meant the launch of new services: real time video calls, video streaming, video clips, high- speed Internet, etc⁵⁴.

3.5 SOME ADDITIONAL INFORMATION AND ANALYSIS

All of the information in this chapter was taken from RATEL - Telecommunication Agency of Serbia. In the presentation of this information they performed an analysis of what they have done in the telecommunication sector. For us the interesting part was mobile telephony.

Let us begin our analysis here. It is clear that the Serbian mobile telephone operator always invested in the territory of Kosovo even though TRA of Kosovo has interrupted their services many times. Moreover, they⁵⁵ sometimes damaged and confiscated some of the equipment during the interruption of mobile services. There is no right by Kosovo law to return that equipment back to Serbian Mobile operator because they consider them unlicensed operators. This point we have just seen above by way of shrinking coverage.

As we can see from information above, we have data from two years 2008 and 2009. At the same time we have to explain activity of TRA -Kosovo during these two years (2008/2009). Based on this information and information that we have about Kosovo mobile market we can compare and prove that we said above⁵⁶.

On this presentation, in this chapter, we can see that, map of Serbia has included Kosovo, not just by constitution but also by telecommunication market - mobile market. In Serbian territory there is three Mobile Operators, Telenor, MTS and VIP Mobile Operators.

⁵⁴For more detail see in Telecom Market Republic of Serbia by Republic Telecom Agency of Republic of Serbia - RATEL

⁵⁵ TRA- officers, engineers and staff, responsible for that job

⁵⁶ Serbian mobile operator always invests in Kosovo even their equipment has destroyed many times.

From the map coverage, we can see that Telenor on 2008 has more coverage than 2009. Why this happen? Because of TRA actions! MTS is in the same position. In 2008 has more coverage than 2009. But MTS has not lost a lot of coverage compare to Telenor. This comes from that MTS has more robust structures in terms of human resource that support it. MTS had a strong support from Kosovars non-legal businessmen⁵⁷. This means that their business comes from unlicensed operators and as such their businesses are not registered with the appropriate Kosovo Authority. The Kosovar Authority doesn't accept this situation.

VIP operator has coverage just in North of Kosovo. Authority of Kosovo there is very weak.

Another issue that I want to emphasize here is that, in all conclusion and market analysis that Serbian Government have done through RATEL, Kosovo territory was present in the map of Serbia or as they called Kosovo and Metohija.

However, this information from both sides Kosovo and Serbia in terms of mobile telephony market analysis is very important for this thesis. This brings in front of us another strong argument to clarify the real situation in Kosovo for mobile market and then to facilitate us the way of finding or recommending a right solution for this problem in terms of which solution should be benefits for all “players in the game”, that are mobile operator for both sides Kosovo and Serbia, and the end Government of Kosovo through Telecommunication Regulatory Agency -TRA of Kosovo.

⁵⁷ They could be Serbian Kosovars or Albanian Kosovars.

4.0 THE CURRENT STATE OF SPECTRUM MANAGEMENT IN KOSOVO

At present, there is no agreement with neighboring states on the coordination of frequency bands, resulting in significant interference problems. This is especially pronounced in the mobile radio bands of 900 MHz and 1800 MHz. Because the territory of Kosovo is relatively small (10.908 km²), signals from neighboring operators from the countries of Albania, Montenegro, Serbia and Macedonia can be detected almost everywhere in the territory of Kosovo (Another source of signals in the 800 and 1800MHz bands are transmitters in the Serbian enclaves that are not licensed by TRA). These enclaves have been afforded special political and economic status under Ahtisaari's plan, and their populations maintain stronger relationships with people and businesses in Serbia than Kosovo. Apart from the northern part of Mitrovica, there are a significant number of Serbian enclaves in Kosovo. The Serbian Orthodox churches, new or old (the newly constructed) located in the Serb enclaves, are afforded even greater protection because the religious tolerance in Kosovo is very good and because these churches are protected by KFOR. In many cases, these churches also house the antennas and equipment of the unlicensed operators. Because of the special protections, local authorities have very limited rights to access to them even they are considered illegal. Because of the location of the Serb enclaves, these illegal antennas cover a very large part of Albanian-speaking Kosovars population.

As documented in Appendix, TRA has taken action against these unlicensed operators by confiscating their equipment, valued at several millions of. TRA asserts the right to confiscate them because they consider them to be unlicensed, and therefore illegal, operators. The operators that operate without licenses are mainly financed by the Serbian GSM operator. Every time that TRA inadvertently damages the GSM equipment (BTS and so on) during its disconnection, their staff of the unlicensed operator is able rebuild their infrastructures immediately⁵⁸.

Because of these factors, frequency usage in Kosovo can be said to resemble the “wild west”. This comes at a cost, because the unlicensed operators interfere with the operations of TRA-licensed service providers, who have made capital and operational investments in their systems. These operators (i.e., IPKO and VALA) are recording financial losses as a result. Since they have no enforcement authority, they turn to TRA to resolve the conflict⁵⁹. Due to the accidental damage to the equipment during disconnection, the unlicensed operators also suffer losses. Finally, the Government of Kosova does not collect taxes from the unlicensed operators, resulting in diminished capabilities to address the needs of the country.

Because of the tragic history between the Serbian and Albanian members of the Kosovar communities, the Serbian enclaves have been granted special privileges as a minority community (e.g. non-payment of electricity, water and other administrative services, education, employment, etc., even providing 10 places in the Kosovo Parliament, without the need to participate in elections). These privileges were granted with the hope that this minority will someday integrate to Kosovo society At that point, these privileges will no longer be necessary.

⁵⁸We can see on TRA website: <http://www.art-ks.org/> on news page also in RATEL web page: http://www.ratel.rs/information/news.134.html?article_id=894 -Serbian telecommunication regulatory, part of statistical information are used on chapter 6 of this thesis.

⁵⁹ TRA have authority but can't apply it in whole territory of Kosovo because of political status of Kosovo. TRA tried to find a radical solution. For that till now the problem still exist. The smooth solution should be DSA method, TRA doesn't have courage to do that at least till now(2011).

In this context, it is worth evaluating whether these special privileges should also extend to the field of telecommunications services, especially with regard to frequency management. Given that all parties in this dispute are suffering losses, it is useful to examine how this spectrum management problem might be solved so that a Pareto-superior state might be achieved. There are at least two sub-cases that should be considered: the problem related to the Serbian enclaves and the problem related to adjacent countries.

It is clear that the approach taken in the first case, disconnection of the unlicensed operators, does not achieve this goal. This thesis will consider a Coasian bargaining framework as a strategy for moving forward and evaluate whether some of the dynamic spectrum assignment (DSA) techniques that are emerging might be helpful. Finally, authorizing an MVNO for the Serbian enclaves would have the effect of internalizing the frequency coordination externality and may lead to a Pareto-superior solution if it is politically acceptable.

Kosovo is not unique in being a small country that borders on several other countries (examples include Luxembourg, Moldova, Armenia and Slovenia). It is possible that lessons from these countries could be applied to Kosovo. Typically, solutions to these problems include frequency coordination and careful design of antenna patterns to minimize cross-border interference.

5.0 SPECTRUM MANAGEMENT AND INTERNATIONAL COORDINATION

The starting point of spectrum coordination functions must be fixed spectrum allocation/assignment/access (FSA). Similarly, it is instructive to examine existing spectrum coordination practices among countries with shared borders.

Arrangement F [16] is the arrangement between the Department of Communications of Canada and the Federal Communications Commission of the United States concerning the use of the Band 806 to 890 MHz along the Canada - United States border. This is a useful reference for this work, as it has been for other states around the world in terms of sharing spectrum.

This arrangement between the Department of Communications of Canada (DOC) and the Federal Communications Commission of the United States (FCC), herein referred to as the Agencies, covers the establishment and operation of land mobile radio services operating in the band 806 to 890 MHz along the Canada - United States border.

5.1 GENERAL SHARING PRINCIPLE

The frequency band covered by this arrangement and each of the sub-bands are to be shared on an equal basis along the border, except as otherwise specified.

Sharing Arrangements in the 806-821 MHz and 851-866 MHz Bands

The United States has the unrestricted geographic use of the frequency bands 806.0000 to 809.7500 MHz, 817.2500 to 821.0000 MHz, 851.0000 to 854.7500 MHz and 862.2500 to 866.0000 MHz in the Sharing Zones within the United States.

Canada has the unrestricted geographic use of the frequency bands 809.7500 to 817.2500 MHz and 854.7500 to 862.2500 MHz in the Sharing Zones within Canada.

There are three Sharing Zones:

Sharing Zone I:

This Sharing Zone is the area adjacent to the United States-Canada border East of longitude 121° 30'W and extending a distance of 100 km within either country.

Within this zone, the Agencies may use their allotted portions of spectrum subject to the Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limits of Annex A [16]

Sharing Zone II:

This Sharing Zone is the area adjacent to the United States-Canada border between 121° 30' and 127°W longitude and extending a distance of 140 km within either country. Within this zone, the Agencies may use their allotted portions of spectrum subject to the Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limits of Annex A, Table A2[16].

Sharing Zone III:

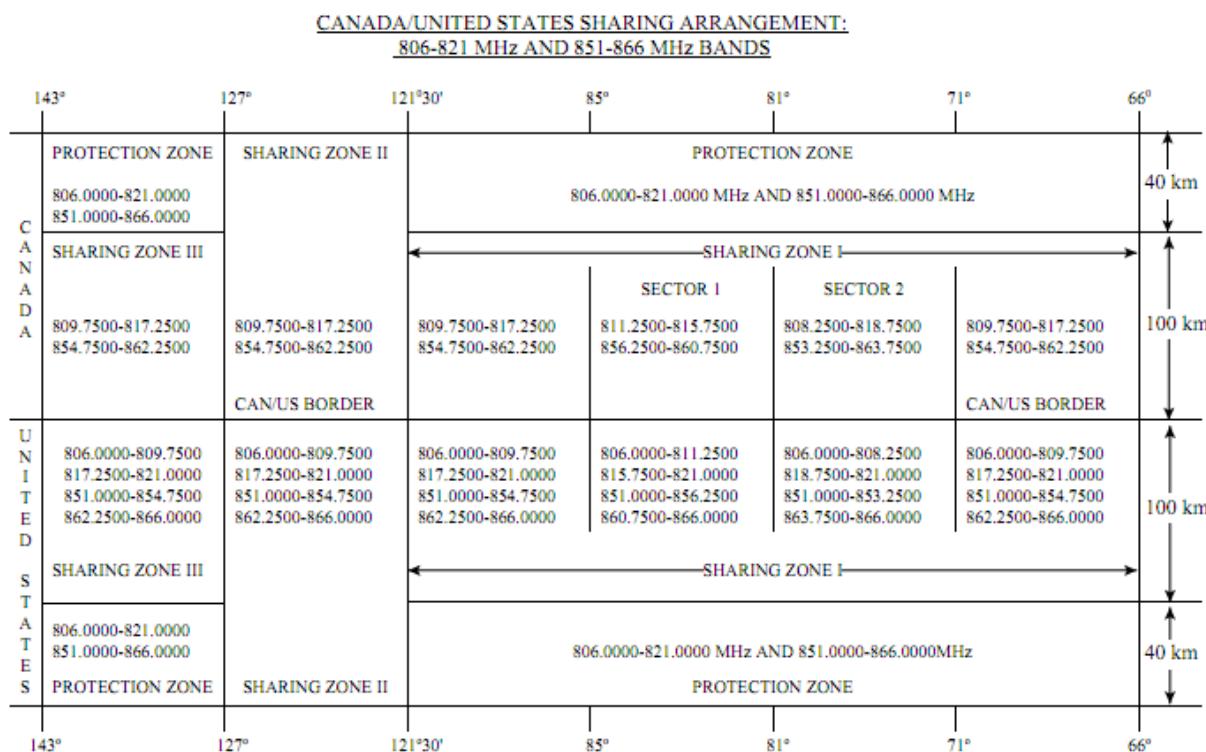
This Sharing Zone is the area adjacent to the Alaska-British Columbia/Yukon Territory border and extending a distance of 100 km within either country. Within this zone, the Agencies may use their allotted portions of spectrum subject to the Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limits of Annex A, Table A1. [16]

Protection Zone:

The Protection Zones are the areas adjacent to Sharing Zones I and III extending from 100 to 140 km away from the United States-Canada border within both countries. There is no Protection Zone associated with Sharing Zone II.

Each Agency has full use of the 806-821 MHz and 851-866 MHz bands within the Protection Zone in their respective country subject to the condition that base stations not exceed the maximum Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limits given in Table 5.2.

Table 5.1 Canada/USA states sharing agreement



- NOTES:
- ALL FREQUENCIES IN MEGAHERTZ
 - PROTECTION ZONES AND SHARING ZONE I AND III SUBJECT TO ANNEX A, TABLE A1 REQUIREMENTS
 - SHARING ZONE II SUBJECT TO ANNEX A, TABLE A2 REQUIREMENTS.

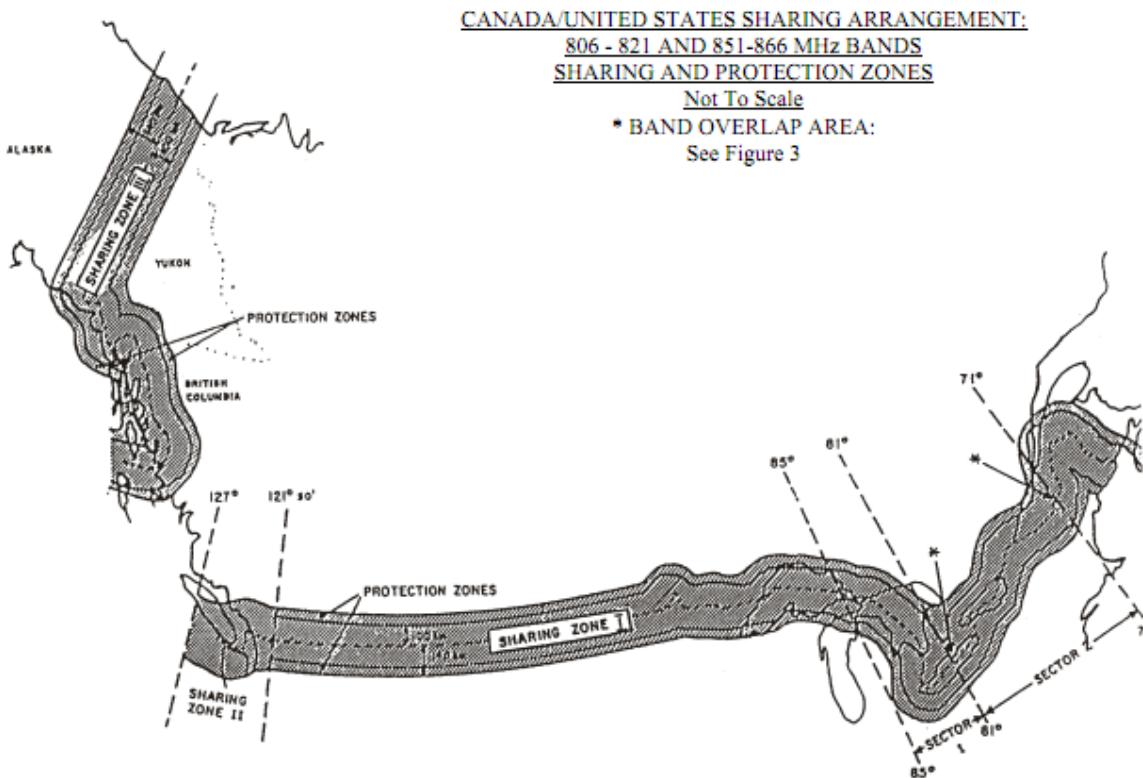


Figure 5-1 Sharing Zone USA –Canada

Table 5.2 Limits of Effective Radiated Power (ERP) Corresponding to Effective Antenna Heights of Base Stations in the Protection Zones and Sharing Zones I and III.

| Effective Antenna Height (EAH) | | ERP |
|--------------------------------|------------|-----------------|
| Metres | Feet | Watts (Maximum) |
| 0-152 | 0-500 | 500 |
| 153-305 | 501-1000 | 125 |
| 306-457 | 1001-1500 | 40 |
| 458-609 | 1501-2000 | 20 |
| 610-762 | 2001-2500 | 10 |
| 763-914 | 2501-3000 | 10 |
| 915-1066 | 3001-3500 | 6 |
| 1067-1219 | 3501-4000 | 5 |
| Above 1219 | Above 4000 | 5 |

The US and Canada are both large countries with few borders, so it would be useful to consider the arrangements of a small country (like Kosovo) with many borders. For this case, we consider Guatemala as documented by the ITU. In terms of territory Guatemala can be similar case to Kosovo, albeit with fewer problems in terms of Spectrum Management.

They use auctions for Mobile Spectrum Band as many countries around the world do. Also they use ITU recommendation as many new countries do.



Figure 5-2 Map of Guatemala

The spectrum allocation and coordination system of Guatemala changed dramatically with the “Ley General de Telecomunicaciones” of 1996. Allocation of radio spectrum evolves from the bottom up. Private action comes first: any person or company, national or foreigner, may request any spectrum band not currently assigned to other users. When conflicts arise caused by interference from signals of adjacent bands and/or inter-modulation distortions private

parties are encouraged to mediate between themselves. If private mediation fails, specific rules are enforced by the telecommunication regulatory body. Additionally, the injured party may sue for damages in existing courts in terms of Radio Spectrum Management after the Telecommunication reform 1996 they have state Títulos de Usufructo de Frecuencias (TUF) that may be leased, sold, subdivided or consolidated for a limited period (fifteen years). In fact, the TUF may be even used as equity exchanged for investment[17].

By using the TUF Guatemala regulatory tries to follow ITU recommendation as many international states do. The TUF was the first step toward ITU recommendation.

The physical TUF is a security paper certificate listing the six following basic variables on the front:

- Frequency band;
- Hours of operation;
- Maximum power transmitted;
- Maximum power emitted at the border of adjacent frequencies;
- Geographic territory;
- Duration of right (beginning and ending).

The independent regulatory body established by the 1996 law, the Superintendencia de Telecomunicaciones (SIT) is responsible for the TUF registry. This computerized database is easily accessible to the public. Anyone may request a copy of the TUF inventory.

Australia, the United Kingdom, and Croatia were also examined from the perspective of spectrum coordination. They all base their practices on ITU recommendations, yet no one faces the problems found in Kosovo.

6.0 SPECTRUM MANAGEMENT PROPOSALS FOR KOSOVO

In the previous chapters, we have examined Kosovo history, the Law of Telecommunication, spectrum theory, the spectrum market of Kosovo and Serbia. In addition, we have examined other problems related to the inefficient usage of spectrum related to the mobile market and have reviewed the literature. Here, we apply these various aspects to spectrum management in Kosovo with particular attention to mobile telephony. The goal of this chapter is to make recommendations for spectrum management in Kosovo.

It seems that all of the countries mentioned above normally carry out their activities within the ITU framework, which leads to bilateral and multi-lateral agreements harmonizing spectrum use across national borders. Some of these international activities include the ITU World Radio Conference (WRC) and related Regional Conferences and Study Groups. Unlike the countries studied in the previous chapter, Kosovo is not yet member of the ITU. Thus, the problem in Kosovo should be temporary; the main objective of this thesis is to find a temporary/transitional solution that will lead to a permanent solution that is beneficial for all parties.

Before modeling our solution for Kosovo case let us review briefly what we have done till now.

In a first chapter we introduced the real situation in Kosovo, then, we've introduced the Law of Telecommunication of Kosovo, which are based ITU recommendations or CEPT standards. Next, we introduced some theory related to Spectrum Management. It is needed to

begin from a basic theory from this field up to advance research till up-to-date to have better picture for addressing the problem that we are treating. Related to basic theory of spectrum management the Martin Cave Book is a useful guide for this field.

In the Fourth chapter we introduce the Kosovo Telecommunication Market. In this chapter, we present some analysis related to the telecommunication market in Kosovo. This analysis relied on analysis that was performed by TRA with some feedback from IPKO and VALA as well as additional sources. The aim of this analysis was to present the telecommunication market in Kosovo. Based on that, we can determine the revenue as well as the loss of income with and without solution proposed here. Base on this analysis on this chapter and on a similar analysis of the Serbian side (chapter 5), we can see clearly that our solution is efficient not just for Kosovo but also for Serbia and the other neighbor states i.e. Albania, Macedonia and Montenegro.

Then, we present Telecommunication Sector Policy. The Government of Kosovo periodically presents its own strategy. This strategy of Government of Kosovo support ITU and CEPT recommendation and as such, was drawing up with cooperation of international community's related to telecommunication standards. Also this strategy support strongly a solution that is efficient and benefit from both parties in an indirect and direct way toward Kosovo case. In this way our solution should have support on solving the problem of Kosovo toward telecommunication issue.

In the same chapter we introduce Constitution, Telecommunication Law and a brief overview of Telecommunication Market of Serbia. As we describe inside this chapter, constitution, telecommunication law allow us this kind of solution. Even though Serbia does not recognize Kosovo as an independent state, it considers it as its part. As a result, through its

Constitution and Telecommunication Law, there is a framework for a solution for Kosovo frequency management problem. Specifically, Articles 108 and 109 of Serbian Constitution define some autonomy in decision making for Kosovo. The data on the telecommunication market that was presented in this chapter shows how the numbers of BTS of some mobile operator were reduced from 2008 to 2009. Based on our analysis in the previous chapter this is known to be the result of TRA actions and not enough support from international communities⁶⁰.

Toward this, our solution suggests better solution than this one actually is.

Let us return to present situation in Kosovo and consider the spectrum usage problem. It is useful to separate the solutions to this problem into (1) Internal - area that is inside the country's borders, where interference comes from internal unlicensed operators and (2) external - interference that comes across national boundaries.

The red points in fig 9.1 represent the main Serb enclaves that have GSM transmitters (BTS or a radio link transmitter to smaller BTS) that can cover most of Kosovo's land area. The chronology of the TRA's interaction with the unlicensed operators was presented in Chapter 2, and Chapter 5 addressed the telecommunication markets in Kosovo. Thus, we can clearly see that there is a huge cost and loss revenue for both sides in the internal frequency coordination problem. As we have state before, Kosovo is independent state and as such GK⁶¹ consider unlicensed operator MTS, Telenor and VIP and some other mobile operator that interfere from outside boundaries, but they still operate and still produce interference until the political problem will close for long time or forever. This operator doesn't apply for license as others done.

⁶⁰ Actions taking by TRA for interrupting services of unlicensed mobile operators

⁶¹ GK - Government of Kosova

TRA have all necessary laws to proceed with finding a solution. It has permission from GK and from internationally communities at least to give a temporary solution (like I will propose) to avoid this essential problem that involve all internationally community even USA.



Figure 6-1 Terrain Map of Kosovo with unlicensed coverage by Mobile Operator on Serbs Enclaves

6.1 PROPOSAL FOR RESOLVING INTERNAL INTERFERENCE

Let us revisit Coasian Bargaining⁶². We considered two different cases: “Crops versus Cattle” or “RuralNet Corp. Vs CityConnect Corp”. Note that Coase also explained the role of positive and negative externalities. Until now we have only seen the negative externalities produced by this problem in Kosovo.

Following Forde and Doyle, let assume that RuralNet **Corp = Serb Enclave operators (MTS, Telenor or VIP)** (each red area of Serbs enclaves has a common manager that we will call Manager A). On another side let**CityConnect Corp. = License Operator (Vala or IPKO)** (which we will call Manager B). So let say we have two “Managers” A and B that cause interference to each other and, at the same time, cause infrastructure damage and lost revenue to each other⁶³. We know that GK supports TRA the operators that have a license through so in this case GK-TRA supports Manager B.

The problem then becomes how “Manager A” can bargain with “Manager B”. As we mentioned before, the Serbian Community has some special rights. Let assume that these rights are listed below that must be considered in the bargaining problem and suggest some preconditions:

- Manager A is free for spectrum assignment fee.
- Manager A doesn't need a license for his territory. (Normally License for GSM cost a lot of money)
- Manager A in cooperation with license operator can lease all necessary equipment to provide cell phone service.

⁶² Forde and Doyle's paper

⁶³ MTS damaged caused by TRA and IPKO damaged caused from some unknown people as reaction of MTS damaged - this was reality

- Manager A can lease land(spectrum) of Manager B for period of time through a bargaining process; in this term Manager A is not bound justto his area (like before).
- Manager A's users should pay taxes to Manager B like all Manager B's users
- Manager A should pay tax on revenue to Manager B (it can be for 1 or 2 years and then no tax revenue till end of transition period)
- Manager A and license operator should communicate with each other to avoid interference. They are free to bargain with each other for any kind business under TRA approval. (They can do MVNO for particular space)

Forde and Doyle examined two cases to develop the experimental methodologies related to the cellular network. Those cases are a California City and a Hoboken NJ, both of which have a high population density so they have a large number of cell phone users.

We have seen that even when there is high demand for cellular service, there are spectrum holes that can be used for secondary service (it can be secondary user or like MVNO user). We can assume that the same in Kosovo because there are fewer users and less demand. There is actually enough room in the GSM band in Kosovo for two more Cellular Network Operators (2 x 900 MHz and 2 x 1800 MHz). We can use an analogy between Kosovo and California and NJ cities for further analysis. The approaches that have been proposed to these cities can also be applied in the Kosovo case. This can be a solution of problem, do bargain as MVNO operators, but let's go deeper with our analysis on models in the following.

It is important to remember that, in the Kosovo case, there is not just technical problem. Instead, we must consider the political, economical, technical and strategic concepts as well when trying to find the best solution for the Kosovo case. Also, the time horizon of the solution (i.e., 5 - 15 years) depends on the political reality.

6.1.1 MODEL 1 - Internal Problem

Considering the Coasian Bargaining procedures, Manager A should start negotiation with Manager B about sharing spectrum around the red zones⁶⁴(fig.1.1).

Each Party should consider revenues and loss during all period of providing service. They should bargain on real business interest and procedures. After they reach agreements they should inform TRA for further procedures⁶⁵.

Let us focus in more detail on the Coasian bargaining analysis. As we know MTS⁶⁶ is present in almost all Serbs enclaves. The same is true for Telenor. Let manager A be for MTS negotiation and Manager B for IPKO⁶⁷.

Let recall the figure from the Forde and Doyle paper:

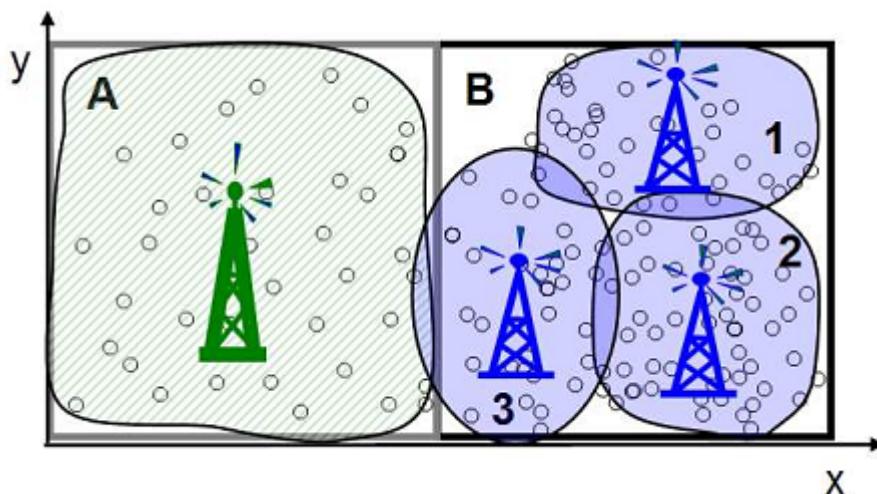


Figure 6-2 Rural Vs City Network [58]

⁶⁴ Red zones = Serbs enclaves

⁶⁵ IPKO has right to have subcontractor to expand its service. Base on that TRA should agree on this potential agreement if this is going to happen.

⁶⁶ Let the MTS mobile operator be a subject of purpose

⁶⁷ IPKO as we mention earlier is second Mobile Operator in Kosovo

Let MTS operates in Zone A and IPKO operate in Zone B. In reality MTS has few users in zone B and IPKO has few users in Zone A. Any of operators can't offer service outside of their zone. For our purpose of this thesis, let us make some numerical assumptions that could be scaled to actual values.

Let MTS have 10 000 users in Zone A. Let IPKO have 30 000 users in Zone B. At the same time let MTS have 2 500 users in Zone B and IPKO have 3 000 users in Zone A.

Table 6.1 Numbers of users per zone

| Zone A | Zone B |
|--------------------------|-------------------|
| 10 000 MTS users | 30 000 IPKO users |
| 2 500 IPKO ⁶⁸ | 3 000 MTS user |

By law⁶⁹, Zone A, zone of Serbs enclave inside of Kosovo belongs to Zone B, to licensed operator, in this case IPKO and, based on that, MTS should be more liberal on bargain procedures.

Let us assume that MTS can collect 5 euro/month/user and IPKO 7 euro/month/user. In the normal condition of operation, MTS collects 50 000 euros/month from zone A and loses 15 000 euros/month from zone B⁷⁰. On the other side IPKO can collect €210 000/month from zone B and loses €17 500/month from Zone A⁷¹.

Let us further assume that, due to interruptions by TRA to MTS, the MTS network is unavailable at least for 2 months per year. If we convert this unavailability to monetary amounts, this works

⁶⁸ If not actual user, they are potential user.

⁶⁹ Spectrum that is used by MTS belongs to IPKO. IPKO has license from TRA.

⁷⁰ Let assume that MTS can't reach zone B, if it will reach the TRA will be aware and interrupt the service. In many cases this was the main reason of interrupting.

⁷¹ Let assume here that IPKO can't install BTS near to Serbs enclave for security reason of damage as in north was happen.

out to $\text{€}100\,000 + \text{€}30\,000^{72}$ (this sum if our solution work) = $\text{€}130\,000$ per year. In the same time damage of the equipment that TRA can cause is around $\text{€}300\,000$ per year. This equipment is confiscated and can't return to MTS base on law that doesn't allow it. In this way if we do simple calculation in terms of how much MTS can collect over a year is:

$$12 \times \text{€}50\,000 = \text{€}600\,000 \text{ total income}$$

$$2 \times \text{€}50\,000 = \text{€}100\,000 \text{ loss from network interruptions for at least two month/year}$$

$\text{€}300\,000$ damage with/or confiscating equipment from TRA

$$\text{€}600\,000 - \text{€}100\,000 - \text{€}300\,000 = \underline{\text{€}200\,000} \text{ per year revenue from MTS}^{73}.$$

Table 6.2 Total loss from both operators

| Euro per year | From MTS | From IPKO |
|---------------------------------------|------------------------------|-----------------------|
| Interrupting | 100 000 | / |
| Damage | 300 000 | / |
| Unable to provide service | 180 000 ⁷⁴ | 210 000 ⁷⁵ |
| Total loss for Mobile Operator | 310 000 | 210 000 |
| / | / | / |
| Total loss from both operators | 520 000 euro per year | |

Recall that in chapter 4, we discussed the telecommunication market survey in Serbia that was done by RATEL. In this, we saw the reduced number of BTS in the territory of Kosovo.

⁷² $3000 \times 5 \times 2$ (month)

⁷³ This could be negative externalities

⁷⁴ $3\,000 \text{ user} \times 5 \text{ euro/month} = 15\,000 / \text{month} = 180\,000 \text{ per year from Zone B}$

⁷⁵ $2\,500 \text{ user} \times 7 \text{ euro/month} = 17\,500 / \text{month} = 21\,000 \text{ per year from Zone A}$

Other negative externalities could be that people living here often may not have a connection through mobile phone, which has economic costs and can increase the frustrations between the communities.

Let us calculate the total loss for both zones A and B in this scenario.

We should remember that in this scenario GK also suffers losses from uncollected value add taxes(16 % in Kosovo), which is another negative externality.

Further considerations include the maintenance costs for. Let assume that MTS spends €100 000 per year for its network, including human resource, BTS maintenance and so on. So the final pure revenue for MTS is €100 000 /year, on which MTS does not pay VAT to GK through TRA.

On analyze above we have seen that it benefit to have Coase bargaining. It will benefit also if we thin on DSA approach, as we know these radios doesn't exist yet

If this agreement that we explained above ("Coasian Bargaining")happens, the MTS will have the following situation. Based on table 9.1, the total MTS users will become 13 000(10 000 from Zone A and 3 00 from Zone B). From this we can do simple calculation: $13\ 000 \times 5$ euros/month = $65\ 000 / month = 780\ 000$ euros/year. Let assume that this business will be legal from the perspective of GK⁷⁶ and 16% of this amount will go to GK as Value AddedTax. The amount of 16% of 780 000 is 124 800 euro /year. Another tax is related to profits that we'll assume is 10%, or €78 000 / month. Let assume that X%⁷⁷ of the €780 000 belongs to IPKO for offering cooperation with MTS via a negotiated agreement. On the other side based on this

⁷⁶ This can happen in a way that IPKO is free to join with any operator in band that he received license. It is able to receive any service from company as a supporting. IPKO should just to respect the license agreement.

⁷⁷ This X% let it be as variable number that we should calculate under which value MTS should accept the DSA , cooperative sharing with IPKO.

agreement IPKO will have another 2 500 user in Zone A; in terms of income this means €2500 x 7/ month = €17 500/month = €210 000/year.

Now based on calculation above, let us do some analysis.. First let us find the upper and lower bounds of **factor X** so that MTS management would accept the agreement with IPKO. In another words, let us find the **factor X** value that benefits MTS:

Total income: €780 000/year

Tax Value Added 16 % : €124 800/year

Total another TAX⁷⁸ - 10%: €78 000/year

Spectrum usage from MTS that belongs to IPKO⁷⁹(or amount of money that IPKO will accept to cooperate with MTS) is **factor X**: X%

€780 000 - €124 800 - €78 000 = €577 200 - This amount is total incoming after paying taxes.

Let find X:

€577 200 - X = €200 000⁸⁰ = €377 200 euro/year

$$\frac{X\%}{100} = \frac{377 200}{780 000} \xrightarrow{\text{yields}} X(\%) = \frac{377 200}{780 000} * 100\% = 48.35^{81}\%$$

Thus, we havefind that X%: **0 ≤ X < 48.35**.Based on Coasian Bargaining, MTS benefitsfrom reaching this agreement as long as X is in this range.

The MTS operator tries to keep X as low as possible, similarly, IPKO tries to get it as high as possible. In this case **factor X** we can name as a Coasian Bargaining factor that is a key factor for establishing an agreement.

⁷⁸ Tax in Profit and related to it, maintenance of selling point etc ... (without BTS maintenance and other issues related to network)

⁷⁹ Here IPKO is doing kind of reselling frequency band.

⁸⁰ This amount is total income in a scenario without agreement.

⁸¹ This % is per year of total incoming per year

Even if MTS will pay nothing to IPKO ($X=0$), this still benefits IPKO because IPKO has additional users and revenue (€210 000 per year in Zone A).

On the other side, IPKO can pay MTS up to €200 000⁸² per year. IPKO should offer mobile service to the users of Zone A with the same price as MTS has done⁸³. In this way IPKO's benefit is €10 000 /year with no interference from MTS; on the other side, MTS has €200 000 total income, so it⁸⁴ can save €100 000 /year from BTS maintenance of and other issues related to their network.⁸⁵

This analysis shows that, based on a model of the current situation, that both parties can benefit if this agreement is reached.

The analysis above has treated just one Serbian Enclave. In Kosovo there is more than one, and the northern part of Kosovo is totally ungoverned by Kosovo Institutions. This model should also work also for the other enclaves and for Northern Kosovo.

For internal solution we focused just on Coase Bargaining. Other modes of sharing, such as using DSA technologies, could work as well, but this is not the main focus of this Thesis. Nonetheless, we have presented a brief discussion of this in an Appendix.

The model that we described above could be accepted by GK because it will produce positive externalities for them as well as the operators in the Serbian enclaves.⁸⁶ Another positive externality is the increased income for the GK budget. The number of IPKO user will increase and the other income factors calculated above in terms of amount of money will increase the GK budget. This could be a step more toward a normalized situation in Kosovo.

⁸² Remember that this amount is total amount that MTS can collect from Zone A

⁸³ Here was assumed that if user will spend 7 euro per month if not then IPKO can offer MTS less than 200 000 euro per year

⁸⁴ MTS

⁸⁵ Also that equipment can sell or release to IPKO operator.

⁸⁶ After some years this situation should be normalized and all people should move freely not just in territory of Kosovo but in whole Europe. This solution should be just for this period that has affected from 1999.

In terms of technical issues this model should work also with DSA techniques based on cooperative sharing with setting up PU and SU based on strategy mention above and as treated on appendix X. Here as we mention earlier should be a common database with a common MAC to avoid contention in terms of total incoming per user (MTS or IPKO). This field could be more related to software design than network design⁸⁷.

If the database will robust with strong software design⁸⁸ having a common MAC, in common areas could involve more than two operators i.e. MTS, Telenor, and IPKO. How does it work? Same manner as previous model but here we will have Primary Users, Secondary user and Third Users. This point is not the purpose of this thesis as such we are not going further

Another model that is treated her is MVNO model as a solution but is not the main object of this thesis. This model is presented on Appendix X.

6.2 EXTERNAL SOLUTION

As we have seen in the introduction or in first chapter of this thesis, the total area of Kosovo is 10, 908 km². It is quite small area compared to how a BTS cover under many electromagnetic propagation models.

Let's do a simple calculation. Total area of Kosovo is roughly $10.000\text{km}^2 = 100 \text{ km} \times 100\text{km}$. In another hand in GSM, a BTS can reachdiameter **35km** whereas in CDMA a BTS can reach a distance of **110 km**. This range can increase by increasing the transmition power level above the normal level. This can happen in state boundaries, for example in high mountains

⁸⁷ For more detain see Appendix how does Primary and Secondary Users work in Cellular Network.

⁸⁸ it is not big deal to do that

where few people live. Because of that, almost the entire territory of Kosovo has interference from neighboring states.

TERRAIN MAP OF KOSOVO

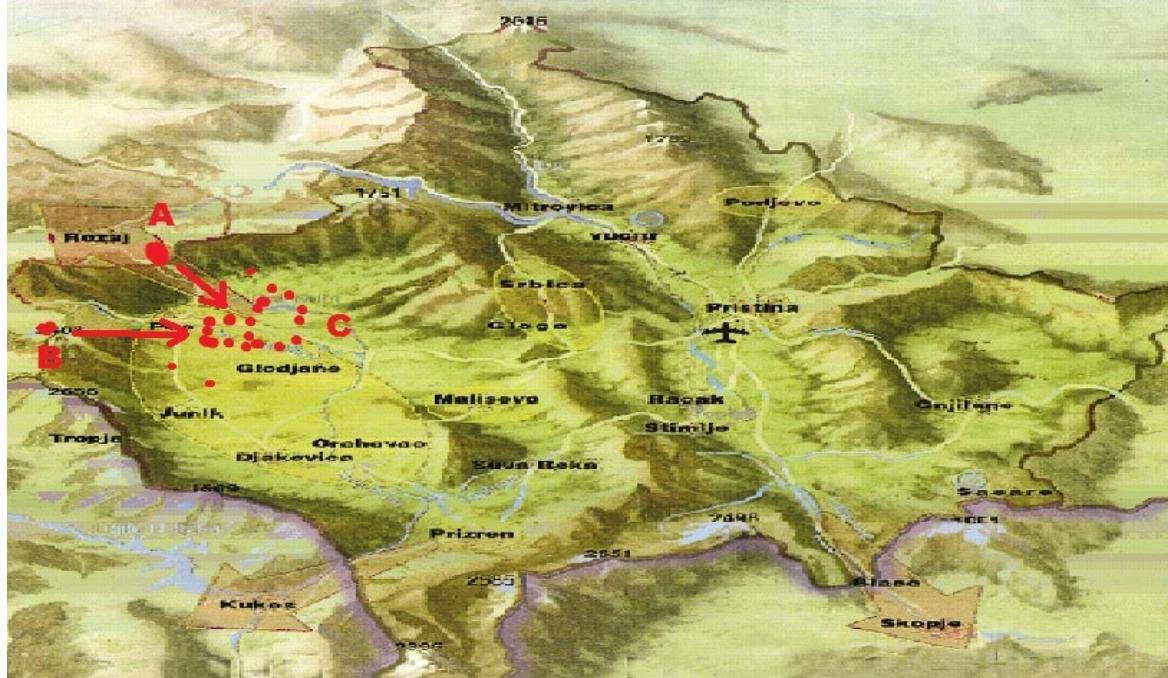


Figure 6-3 Interference from Montenegro of GSM operators

In fig 6.3 demonstrates what happens in Kosovo, and it is by no means the only one.

In the case presented in figure above, the interference comes from Montenegro and occurs in area between the towns of Peja, Klina and Gjakova. The presence of interference can be sensed by every user by simply searching for a network provider. Similar problems (in different regions) are found in the border areas with Albania, Serbia and Macedonia.

The question is how we can solve this problem in a way that is beneficial for both parties (partners across the borders). Keep in mind that each party should respect territory of each other in terms of spectrum usage.

Fig.6.4 shows the Kosovo map with different zones that are needed to support spectrum coordination in border areas. There are two different kinds of zones: ZONE A (area between three states) and ZONE B (area between two states) that must be addressed.

In this section, we will present a solution based on: Band Sharing, Areas Sharing and Per User Collection⁸⁹. These model are presented below and are based on the models of international cooperation described above.

6.2.1 Band Sharing

Let us begin with some general definitions” Let the 900MHz GSM have two different bands:

BAND A and **BAND B**. In the same manner 1800 MHz GSM has two different bands: **BAND C** and **BAND D**.

In **ZONE A** (each area) that is indicated by a red circle, there should exist three SUB-BANDs that belong to a full band. For example, in ZONE A, there should exist this sub bands: BAND A1, BAND A2 and BAND A3. So in general there are these SUB-BANDS:

For the frequency band 900MHz: **BAND A1, BAND A2 and BAND A3**

BAND B1, BAND B2 and BAND B3

BAND A1 = BAND A2 = BAND A3 and BAND B1 = BAND B2 = BAND B3

For the frequency band 1800MHz: **BAND C1, BAND C2 and BAND C3**

BAND D1, BAND D2 and BAND D3

BAND C1 = BAND C2 = BAND C3 and BAND D1 = BAND D2 = BAND D3⁹⁰

⁸⁹ Using Coasian Bargaining as in Internal Solution

⁹⁰ A similar solution but not the same is present on “ SPECTRUM MANAGEMENT AND INTERNATIONAL COORDINATION” chapter

Let assume that IPKO belong BAND A of GSM 900 MHz and VALA Band B of GSM 900MHz . Let assume that in Zone A -area 1 IPKO belong just **BAND A1** and VALA belong **BAND B1** . In the same manner we assume that let in Zone A, MTEL belongs **BAND A2** and AMC belong **BAND A3**

The radius of red circle R should be set in that manner that all parties (three states involved) should agree on. This radius should be set after economical and political analysis. We assume that this radius is 2 KM.

In ZONE B. indicated by the green line/boundaries, there should exist two SUB-BANDS. So in general there are these SUB-BANDS:

For frequency band 900MHz: **BAND A1** and **BAND A2**

BAND B1 and **BAND B2**

BAND A1 = BAND A2 and BAND B1 = BAND B2

For frequency band 1800MHz: **BAND C1** and **BAND C2**

BAND D1 and **BAND D2**

BAND C1 = BAND C2 and BAND D1 = BAND D2

The distance “D” between the green lines should be equal from the borders between the states. How much this distance will be depend on agreement between the states involve on areas on ZONE B. We assume that this distance should be 4 KM (2 km on each part) for the purpose of this analysis.

Let assume that “Vala” (a licensed cell operator) has BAND A (at 900 MHz) and “Ipko” (a licensed cell operator) has BAND B and in near future **Operator X** will have Band C (at 1800MHz) and **Operator Y** will have BAND D (at 1800MHz).

Now let us consider the areas in ZONE A. In these areas, the spectrum should be shared equally in three parts. The coverage area should be the same if possible, if not there should be a compensation. If, let say, “Vala” Mobile Operator has a full band of Band A, then in ZONE A it will have one third of a band, or A1. Likewise, in ZONE B there are two sub-bands; in this case , “Vala” Mobile Operator will have a half band of A or Band A1

We can use the agreement between USA and CANADA describe briefly in anearlier chapter as a reference to establish the details. The same parameters that have been used there can adopt in Kosovo case in terms of areas and electromagnetic waves propagations including an antenna dimensions and power transmissions.



Figure 6-4 Spectrum Sharing Zones between States - Protected Zones

Now let zoom in on the Kosovo Map and focus on fig.6.5 and 6.6. We are seeing **ZONE**

A - area 1:

Here, the states Albania, Montenegro and Kosovo meet. If we think more deeply about this situation, we must ask: which is the most efficient spectrum sharing for this zone? How about if the population density differs across the borders? In fig 6.5 is illustrated as Part 1, Part 2 and Part 3. How about that in those parts the demand of the service differ from each other? Those three parties are in different states.

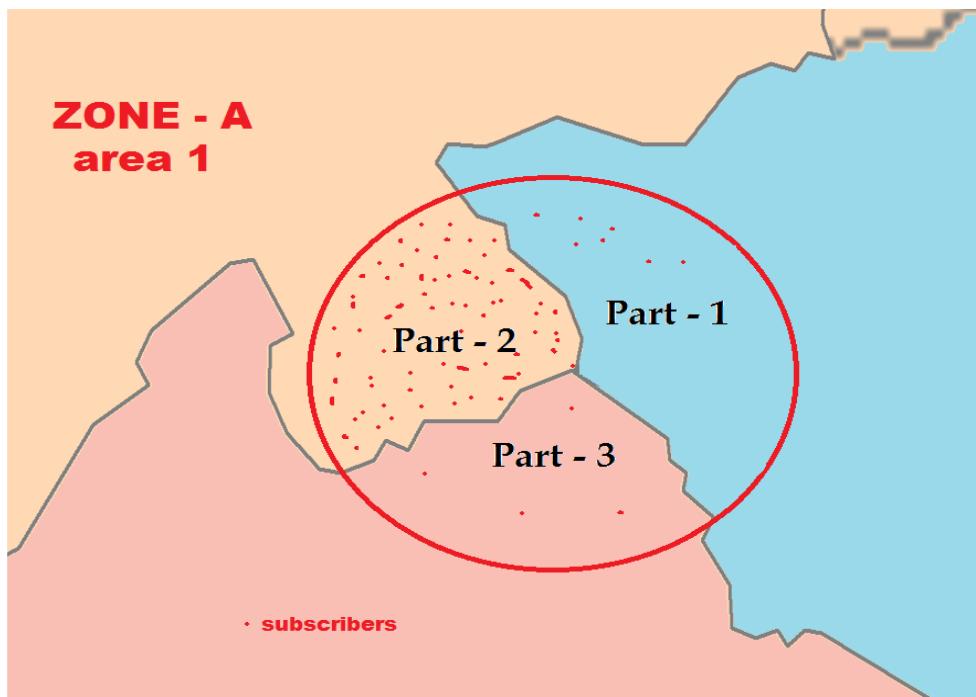


Figure 6-5 Different Density of Population across the borders

With this problem definition mention above we are going to the same case that previous we had mention above as the **Internal Solution**, with some minor differences. Here we should consider again DSA and the Coasian Bargaining procedure as in Appendix X.

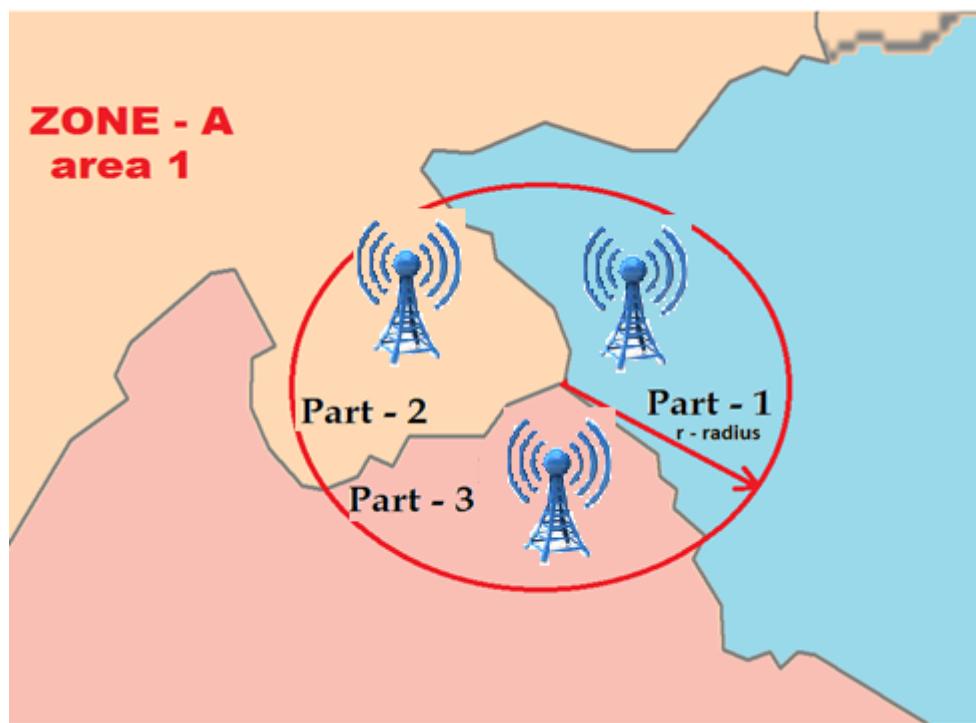


Figure 6-6 Common Zones/Areas in terms of Territory/Band/Mobile User

The similar case we have between borders: (1) Kosovo, Albania and Macedonia (2) Kosovo, Macedonia and Serbia (3) Kosovo, Montenegro and Serbia.

Before we start explaining what is the best solution for this situation we should consider another occurrence.

Suppose that a majority Albanian community lives in Part 1, Part 2 and Part 3 (in other areas, this might be a majority Serbian community). Each member of this community has regular daily relations with, say, KOSOVO (Part 1).

Let assume that the people that live in Part 1 has gone to Prishtina to study and they have permanently relocated, but they still have relatives in, say, Part 2 or Part 3 (this is close to reality). Which is the most efficient sharing between Parts (1,2 and 3) in this circumstance? If

they pass their zone of mobile operators they will pay high as roaming user. (as we know is high fee).

6.2.2 Area Sharing

Let us assume that each Part (1,2and 3) has a BTS. Let us use the same framework as we used in the Internal Solution: Let us assume that in this Zone A - area 1 as we state IPKO has a third of band of 900 MHz. In the same manner let assume that M:TEL⁹¹ own a third band of 900MHz and AMC⁹²(the mobile operator from Albania) another third band of 900 MHz. Let us further assume that in these three parts (1,2 and 3), the majority of the communities are Albanians who have family relationships with each other. As a such the demand of IPKO service for all this parts is higher compared to AMC and M:TEL networks.

We assumption here that each HLV of Part 1 - IPKO, Part 2 - M:TEL and Part 3 - AMC should exchange their database only from BTSs comes from the parts present in fig.9.6. This related to trust total incoming and as such this related to factor X that decide for agreement.

This approach is based⁹³ on the same principles that underlie typical MVNO⁹⁴arrangements and as such should be supportive of an agreement between these Mobile operators. This agreement should include these features:

- Users in Part 2- M:TEL and Part 3- AMC can use the Mobile Network in Part 1 - IPKO in inside the territory of Kosovo as secondary user; in that way they can be an MVNO User of IPKO Mobile Operator. We assume that only users that live in

⁹¹<http://www.mtel.me/>

⁹²<http://www.amc.al/>

⁹³ Also base on respecting the TAS agreement

⁹⁴ See Appendix X

part 2 and part 3 can be MVNO users of IPKO. The reciprocity should work and this can be benefit for both parties.

- Fee that will be charged to these users should be the same as with other MVNO users belong to same Mobile Operator.

Let return to fig 6.6 again. Here we have the same situation as in fig. 6.7 and 6.9. First of all each part should respect the agreement achieved through bargaining. This kind of the dialog should be based “TAS⁹⁵ or TUF⁹⁶” ideas, taking business strategy into account. Each party should see which configuration has more revenue and which is more efficient.

Let's be more specific on this point: In Zone A's areas, each part (let say Part 1,2 and 3) should be as equal as possible in terms⁹⁷ of m^2 . In this zone, let say Zone A area 1, each operator⁹⁸ should own strictly a third of band spectrum as we described above. The radius of red circle of Zone A should be set in accordance with three states, in this case Kosovo, Albania and Montenegro. We propose that radius should be no more than 2-4 km. Beyond these boundaries, penalties should be set if the regulatory agencies of each states find that this rule is not respected in practice. About the technical terms this should be set similar to USA-CANADA agreement as we explained in chapter 8 but it has to be adapted to size of the territory of Kosovo and the rule mention above.

Up to this point, we assumed that each part (Part 1 , Part 2 and Part 3) owned a third Band of the 900 MHz spectrum of BAND A i.e. IPKO has **BAND A1**. We assumed that the penalties should be set when the operator is exceeding these bands.

⁹⁵ A TAS package describes an exclusive package of spectrum rights in terms of time, space and frequency

⁹⁶Títulos de Usufructo de Frecuencias (TUF) - see Appendix C

⁹⁷ Ares that belongs to each states -best calculation is flat area. Flat area is how we take picture from satellite and that picture separate qually

⁹⁸ In this zone, Zone A Kosovo belong a third of each spectrum in this case a GSM spectrum.

In the same manner, we could imagine an alternative formulation in which we assume territories instead of bands. Let assume that IPKO has all BAND A in Part 1. If IPKO harms Part 2 or interferes with any other band, penalties should be assessed to IPKO. In this case instead of bands, we are speaking now in terms of areas.

In fig. 6.6 let us assume that IPKO from Part 1 harms M:TEL from Part 2 and AMC from Part 3 by producing interference⁹⁹. Let us assume that all this Part (1,2, and 3) have majority Albanian populations (like in Kosovo). Here the highest demand will come toward Kosovo Mobile Operator (i.e IPKO).

Table 6.3 Revenue of mobile operator per area -Calculation that Part 1 can harm Part 2 and Part 3 by increasing Tx - Power

| Power Transmitting in W of PART 1 - IPKO | Area Loss m ² | Revenue- 20euro/m ² | Area Loss | Revenue- 30euro/m ² |
|--|--------------------------|-----------------------------------|--------------|-----------------------------------|
| Parameters | N | Y | M | Z |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 500 | 10000 | 500 | 15000 |
| 3 | 1500 | 30000 | 1500 | 45000 |
| 4 | 2200 | 44000 | 2200 | 66000 |
| 5 | 3500 | 70000 | 3500 | 105000 |
| 6 | 5000 | 100000 | 5000 | 150000 |
| | Square meter | Euro € | Square meter | Euro € |
| Revenue per operator in Part 2 is 20€/month and Part 3 is 30€/month | | | | |
| Revenue - mean the incomes per that area served by previous operator | | | | |

⁹⁹ In reality Part 2 and Part 3 are producing interference on Part 1, but I am trying to give an example of an idea how this problem can be solved.

In table 6.3, for instance, we have all case assumed that Part 1 - IPKO can harm Part 2-M:TEL and Part 3-AMC. In the table we see that, Part 2 - M:TEL can earn 20€/month/m², and Part 3-AMC can earn 30€/month/m². If Part 1-IPKO harms Part 2 -M-TEL let say, the penalties should be considered. If Part 1-IPKO produces interference and cover around 500 m² of Part 2-M:TEL¹⁰⁰ and 1500m² of Part 3-AMC the penalties from the authority¹⁰¹ should charge IPKO of Part 1. In this case IPKO will pay for damages that it causes to the other parts. Base on table 6.3 this amount is €10 000 that IPKO have to pay M:TEL and another €45 000 IPKO have to pay AMC from Part 3. The total penalties that IPKO has to pay to the damaged operators is €10,000 +€45,000 = €55,000 per month.

Base on the table and model that we proposed, we have an analogous situation to the one described by Forde et.al [5]. They suggest, based on Coasian Bargaining, a beneficial way for operators to act.

Let us be more specific. In the example above, IPKO¹⁰²causes interference in 500m² area of M:TEL¹⁰³ band and around 1 500 m² of AMC¹⁰⁴ band. In this example, the total area outside of Part 1 (that belongs to IPKO), IPKO is covering around 2 000 m² more. For this unlicensed coverage IPKO will have to pay as penalties €55 000 per month. What about if IPKO is able to collect from this 2 000 m², say,€65 000 /month. In this case, IPKO would be better off paying€55 000 to M:TEL and AMC. At the same time this also benefits AMC and MTEL. If M:TEL and AMC would lease area to IPKO for a combined €55 000, then they could save even more because they save that amount of money goes for the maintenance and operations of the

¹⁰⁰ In terms of M:TEL band of 900 MHz

¹⁰¹ This authority should establish altogether IPKO, MTS and MTEL. This authority sholut monitor if any of mobile operator is breaking down the agreement and then penalties should charge to that mobile that is braking down the agreement. The agreement should include this terms including penalties, TAS specification, factor X as we explained before and so on

¹⁰² Part 1

¹⁰³ Part 2

¹⁰⁴ Part 3

BTSs of area of Part 2 and area of Part 3. This bargain procedure should happen between mobile operator involved on this areas Part (1,2 and 3) through supply/demand or bid/demand model. AMC and MTEL could even lease to IPKO its own BTSs.

Let us find a general formula for this solution. Let the area loss of Part 2 – MTEL - be noted as “N” and its Revenue as “Y”. In the same manner let the area loss of Part 3 be noted as “M” and revenue its revenue as “Z”. So IPKO can benefit by causing harm and paying penalties toward M:TEL and AMC for any value, say ”W” that satisfies the equation $W > Y + Z$ toward the area that IPKO harms. The value W is the income that IPKO will collect by harming the area that belongs to Part 2 (€Y revenues) and Part 3 (€Z revenues)¹⁰⁵.

6.2.3 Per User Collection

Another solution that we are going to give here is based on the Internal Solution, i.e., the number of users that each mobile operator of each Part (1,2 and 3)Has.

Let consider again Zone A- area 1 and follow the same process as above for the other Zones. As before, we assume that the majority of the population in this zone is from the Albanian community.

This model is based on users and is building on revenues that that mobile operators can collect from users. In contrast, the previous models were based on spectrum and territory, respectively.

In practice, most users in the Balkan¹⁰⁶ countries hold (at least) two SIM cards, which is the assumption we are taking here also. Based on this, we can compute the table below.

¹⁰⁵ $0 < N < 5\,000$, $0 < M < 5\,000$, $0 < Y < 100\,000$, $0 < Z < 150\,000$

¹⁰⁶ <http://en.wikipedia.org/wiki/Balkans>

Table 6.4 Total incoming from user based on nationality

| Number of user base on nationality | Part 1 - Mobile Network: IPKO | | Part 2 - Mobile Network : M:TEL | | Part 3 - Mobile Network : AMC | | Total ¹⁰⁷ | Totalx1.2 ¹⁰⁸ |
|---|-------------------------------|-----------------|---------------------------------|-----------------------|-------------------------------|-----------------|----------------------|--------------------------|
| ////////// | Users | Money Collected | Users | Money Collected | Users | Money Collected | | |
| Albanians ¹⁰⁹ | 3 000 | 21 000 | 1500 | 9 000 | 2500 | 12 500 | 42 500 | 45 550 |
| Serbs | 0 | 0 | 50 | 300 | 10 | 50 | | |
| Montenegro's | 0 | 0 | 30 | 180 | 5 | 25 | | |
| Bosnians | 200 | 1 400 | 30 | 180 | 25 | 125 | | |
| Romanians | 5 | 35 | 0 | 0 | 20 | 100 | | |
| Total ¹¹⁰ | | 22 435 | | 9660 | | 12 800 | | |
| Total - kos ¹¹¹ | | | | 10 800 ¹¹² | | 13 750 | | |
| Amount of money that users spent per month ¹¹³ | 7 euro/month | | 6 euro/moth | | 5 euro/moth | | | |

Based these assumptions, we can see that the Albanian community will spent more money per month for mobile communication. In this way, IPKO(Kosovo mobile operator) will collect more money per user compare to other mobile operators (M:TEL and AMC). Most of these expenditures in this area are for connections to Kosovo users, even from Albania. In this case, a user from Part 2¹¹⁴(M:TEL)calling a user from Part1 (IPKO)does so at a higher international rate. If users that live in Part 2 (MTEL) and Part 3 (AMC) will have lower pricesto call Part 1 (IPKO-users), these users that are majority Albanians community will spend more money /month. We assume that this increase factor should multiply by factor be 1.2 or

¹⁰⁷ Total money spend by user base on nationality

¹⁰⁸ $21\ 000 + 9000*1.2 + 12\ 500 *1.1 = 21\ 000 + 10\ 800 + 13\ 750 = 45\ 550$. Factor 1.2 from Montenegro compare from factor 1.1 from Albania tell us that, people living in Montenegro has more probably to live in Kosovo than people comes from Albania.

¹⁰⁹ All Albanians that live in Montenegro, and even many in Albania, have more relationships with people in Kosovo than to people in Albania and Montenegro

¹¹⁰ Total amount of money that Mobile operator can collect in its own area-zone i.e M:TEL from Part 2.

¹¹¹ Total amount supposing that IPKO will collect from this user that becomes IPKO users. Factor 1.2 will follow user from part 2 and factor 1.1 will follow user from Part 3.

¹¹² $9000*1.2=10800$, this serve just to Albanian community where IPKO has interes.

¹¹³ These amounts of money that users spend per month are taken from internal analysis of TRA - Kosovo.

¹¹⁴ From Montenegro

1.1^{115} . What does this mean? Having a normal price per call inside same mobile operator instead of international call (roaming call that is known for high rate of price/call), users will spend more credits/money per month and that with increasing factor we assume at least will be multiplying factor 1.1 or 1.2. So if I spend €5/month, living in Montenegro and most of friends I have in Kosovo in this way calling from MTS to IPKO and instead of that If I have same operator, much more cheaper price/call I will have so this means that as I assume, I will spend $\text{€}5(1.1)/\text{month} = \text{€}5.5/\text{month}$. In this way I will call from IPKO to IPKO

Let's do some simple calculation here: We assumed factor 1.2 or 1.1, this mean that user of Part 2 and Part 3 will spend more¹¹⁶ if the same user have price per call roughly as same users as in inside Part 1. Here I am seeing two scenarios:

First Scenario: IPKO benefits if it harms Part 2 and Part 3 operators and pays penalties to MTEL(Part2) of €9,660 per month and to AMC (Part3) of €12,800 per month. IPKO has calculated that it will collect from Part 2, $\text{€}9000 * 1.2 = \text{€}10,800/\text{month}$ and from Part 3 $\text{€}12,500 * 1.1 = \text{€}13,750/\text{month}$. Now let do another calculation here in terms of how much money IPKO can earn from an agreement with M:TEL and AMC:

From M:TEL:

$$\text{€}10800 - \text{€}9660 = \text{€}1140/\text{month}$$

From AMC:

$$\text{€}13750 - \text{€}12800 = \text{€}950/\text{month}$$

Let us define $\alpha = \text{€}1140/\text{month}$ and $\beta = \text{€}950/\text{month}$.

¹¹⁵ (Base on Table 9.2). If Albanian users spends 9 000 per month in Montenegro - Part2 from M:TEL mobile operator then $9000 * 1.2 = 10800$

¹¹⁶ Just Albanians community

If $\alpha > 0$ and/or $\beta > 0$ then the Part 1 carrier can bargaining, over the size of the penalty, harm Part 2 and Part 3 and pay the penalties and still profit. At the same time, MTEL and AMC could reduce their operations, saving money from maintenance of their BTS in Part 2 and Part 3 and still earn the penalty.

As Coase has explained in this paper[2], IPKO would benefit in terms of social cost even for low values of α and β (even $\alpha = 0$ and $\beta=0$) . This mean that IPKO user will benefit having a cheaper communication with their relatives and will improve the public image of IPKO as nurturing the Albanian community¹¹⁷.

At further distances from the border region, this strategy should be discouraged through higher penalties. The harming region should be just Part 1, 2 and 3. Out of this region should be cleared in terms of interference(harming). This is what we suggest for this stage¹¹⁸.

Remember that in Part 2 and Part 3 harms should be allowed by MTEL and AMC. If a bargain can't be reached the harm should be stopped. Also remember that, in reality, the Montenegro operator (M:TEL) is interfering around 10 000 m²of Kosovo territory and does not currently pay penalties to any of Kosovo's mobile operator of Kosovo or TRA. If MTEL creates interference in such a large area and has few users in that area the penalties so it doesn't benefit them to interfere. Without an agreement, the interference that comes from Montenegro and the other states will continue unabated.

Based on analysis that we have done above the operator should set up the agreement between them (IPKO, M:TEL and AMC). The main incentive should be the revenue that they will have on this agreement. Each operator should select such agreement that benefits more for

¹¹⁷ Same can happen to north of Kosovo to Serbian Community

¹¹⁸ Out of the regions Part 1, Part 2 and Part 3 each mobile operators should respect the agreement between borders sharing as explained in SPECTRUM MANAGEMENT AND INTERNATIONAL COORDINATION chapter.

them. These benefits come from the point that how they agree to share users, area of spectrum that's benefit more for them. This analysis is done to see that they will collect more money with agreement base on analysis above than without agreement. Also the penalties should be part of agreement but it can't be the main incentive as the revenue is. Persuade of bargain procedures in another challenge point that is based on respect on agreements and it is related to practible procedures that is not scope of this thesis.

I believe that this kind of agreement should work because has strong incentive like revenue with this agreement. All partners will benefit. Also if they decide to don't respect this kind of agreement after they set-up, they will not have any benefit not just in terms of revenue but also in terms of international cooperation. They will show how they are serious to make business on international scope. There are some duties that neighbor state should respect.¹¹⁹

Or, at simplest way, without any analysis, without any business view, without any cooperation, each part respect TAS or TUF conditions and Fixed Spectrum Allocation for their regions. Respect ZONE A and ZONE B, respect radius of circle and final respect third band of ZONE A or half band of ZONE B.

In fig 9.7 we have the same case like previous but here are just two parts. The condition should similar as previous example with three parts on Zone A.

¹¹⁹ This challenge should be seen after the agreement will set up but the probability to don't work this agreement is too low. Normally this agreement should have another third part as a guarantee.

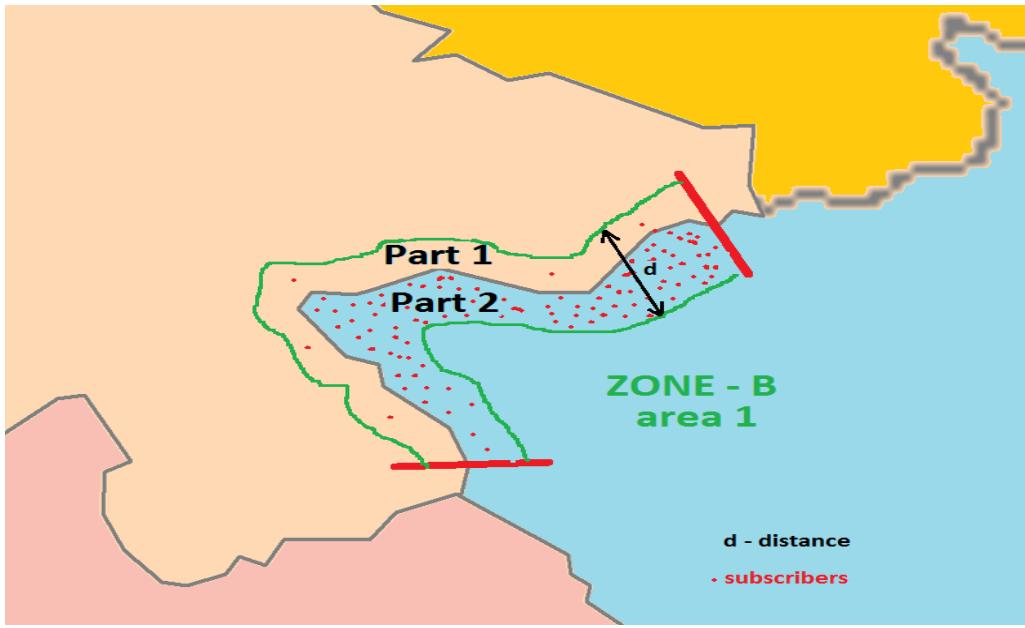


Figure 6-7 Protected Zone- with different density of population

7.0 CONCLUSION

The Kosovo is the youngest state in the world. It has declared independence from Serbia in 17 February 2008, though Serbia does not recognize this. . As a result, the Telecommunication Market in Kosovo faces some unique challenges. In particular, disputed mobile service providers are operating in some Serbs enclaves, creating challenges for the Government of Kosovo to manage the spectrum. Based on our data, tens of millions of Euros per year are being lost by the stakeholders (the Government of Kosovo, licensed and unlicensed mobile operators). Beyond this, the social cost is that some people who live in enclaves do not always have the services of a mobile operator.

We reviewed the analyses done by the regulatory agencies in Kosovo and Serbia. We have also reviewed the telecommunication laws and their policy strategies for these two governments. This analysis has shown that a legal foundation for the resolution of this problem seems to exist.

Regarding external interference, we reviewed the cooperation in several example countries. Based on these research and theory there are clearly technical solutions to this problem that have succeeded elsewhere that could be adopted by the parties surrounding Kosovo.

People living in Kosovo have become increasingly frustrated with this problem. Policymakers have not offered a solution to this problem, and the indirect costs (damage of unlicensed mobile operators and interference in Kosovo) is growing.

This thesis has offered a solution to this problem that will benefit every stakeholder. We have also shown that every participant has a strong incentive to participate in this agreement because of the private and social benefits. Our solution is based on Coase Bargaining theory. We believe that our solution will work in practice but could benefit from a third party guarantee¹²⁰.

We have argued that this solution has numerous positive externalities, such as the reduction of social cost, economic efficiency, and integration of all communities in Kosovo.

Social cost: All users who live in Zone A, Zone B and the Red Zone should have lower communications cost compared to the current situation. *Economic efficiency:* Some internal operator considered unlicensed before agreement, they will operate by having a good revenue with no interruptions anymore by Telecommunication Regulatory Authority. Their users will have lower costs per call-minute. Other operators, licensed operator considered before agreement will have more revenue inside the Red Area because they will have no interference from unlicensed operator consider before agreement. Also, the Government will see a revenue increase from the tax on the profit from the Mobile Operators¹²¹.

Political view: It will be a positive outcome if a significant and visible problem is solved. It could help improve the relations between the ethnic Albanians Serbs who live in

¹²⁰ Could be international community

¹²¹ From License Mobile Operator, Red Zones Operator and from Zone A and Zone B

Kosovo as well as in Serbia. The future of these two states lies in the European Union, and there is no reason to have this kind of problem.

Integration: This is based on the concept that every person should feel him/her self equal with others. By extension, all people should be treated equally by every kind of service that is available.

As we have seen through this thesis our solution base on analysis and data that we have collected is focused on an economically sound solution for efficient spectrum management. This is not a political solution but it can be a good place to start negotiation for achieving a politically feasible solution in this region for this problem. We have mentioned also the benefits that will achieve with this solution in political terms although this was not the topic of this thesis.

Another point that I would like to make here regards the mobile network technology. The operators in Kosovo have currently deployed 2.5G GSM mobile networks.. We therefore focused on an economical solution based on this technical platform.. Second generation has GPRS for data that in practice offers data rates around 40kbps. It can be used this channel for setting up DSA platform. This service should be enough for DSA solution or if this doesn't work , band of GPRS wouldn't be enough, then we will set up FIX spectrum allocation- FSA. We have thought to use GPRS band of 2.5G for our solution. These need to upgrade a special (based on our demand) software application for GSM network. While this is not the main focus of thesis, we mention it just as an idea how it should be implemented and leave it for future work.

If this solution will work on 2.5G - GSM, in 3G and 4G this will be much easier. For instance in 3G there is HSPA up to 168Mbps downlink and 22Mbps uplink. This will be more than enough to use this band for setting up any DSA platform solution.

About 4G/LTE generation, there is some application that supports DSA or something like that.

Basically LTE is DSA network. LTE use spectrum with high level of efficiency.

We are not focused how our solution will work in detail because first should achieve the agreement then we will begin to implement it in terms of technical issues including software application that will need to achieve DSA technique or Cooperative and Non-Cooperative Sharing.

8.0 APPENDIX A - KOSOVO

8.1 KOSOVO OVERVIEW

Kosovo (Albanian: Kosovë, Kosova; Serbian: Косово, Kosovo) is a disputed territory following the collapse of Yugoslavia. The partially recognized Republic of Kosovo (Albanian: Republika e Kosovës; Serbian: Република Косово, Republika Kosovo), a self-declared independent state, has de facto control over most of the territory, with North Kosovo being the largest Kosovo Serb enclave. Serbia does not recognize the unilateral secession of Kosovo and considers it a United Nations-governed entity within its sovereign territory, the Autonomous Province of Kosovo and Metohija (Serbian: Аутономна Покрајина Косово и Метохија, Autonomna Pokrajina Kosovo i Metohija), according to the 2006 Constitution of Serbia.

8.1.1 Background

Kosovo is landlocked and borders Serbia north and eastward, the Republic of Macedonia to the south, Albania to the west and Montenegro to the northwest (the latter three recognise it as independent). The largest city and the capital of Kosovo is Prishtina (alternatively spelled Pristina or Priština), while other cities include Peja , Prizren, Gjakova, and Mitrovica

During classical antiquity, the territory roughly corresponding to present-day Kosovo was part of several tribal alliances, including that formed by the Dardani. Upon conquest, the Romans dissolved existing tribal alliances and re-integrated communities centered on Roman civitates¹²² as part of the Roman province of Moesia Superior. Subdivisions in Late Roman times created the region of "Dardania". After the collapse of Roman control, the region was contested between Avars¹²³, Sklavenes and Byzantines, and later between the Byzantines, Bulgarians and Serbs.

Dardania is one of the tribes of Illyria, predecessor of Albanian.

In June 1878, the breathtaking city of Prizren saw the establishment of the League of Prizren, an Albanian cultural and political movement for autonomy and eventual independence from Ottoman rule. Whereas Albania declared independence in 1912, Kosovo – which had briefly liberated itself from the crumbling Ottoman rule – was invaded that same year by Serbia, whose long decades of rule were resisted by the overwhelmingly ethnic Albanian population of Kosovo. The people of Kosovo were used to active resistance – they had done the same against Roman and Ottoman rule after all Kosovo was the last of the seven nations to emerge out of Yugoslavia

¹²²In the history of the Roman Empire, the Latin term civitas (plural civitates) referred to the condition of Roman citizenship

¹²³http://en.wikipedia.org/wiki/Eurasian_Avars,
http://www.hyperhistory.com/online_n2/civil_n2/histscript4_n2/avars.html

in the wake of Serbia's four bloody wars of aggression against fellow federal entities – Slovenia, Croatia, Bosnia-Herzegovina and Kosovo – in the 1990s.

After the Kosovo War and the 1999 NATO bombing of Yugoslavia, the territory came under the interim administration of the United Nations Mission in Kosovo (UNMIK), most of whose roles were assumed by the European Union Rule of Law Mission in Kosovo (EULEX) in December 2008. In February 2008 individual members of the Assembly of Kosovo (acting in personal capacity and not binding the Assembly itself) declared Kosovo's independence as the Republic of Kosovo. Its independence is recognized by 75 UN member states and the Republic of China (Taiwan). On 8 October 2008, upon request of Serbia, the UN General Assembly adopted a resolution asking the International Court of Justice for an advisory opinion on the issue of Kosovo's declaration of independence. On 22 July 2010, the ICJ ruled that Kosovo's declaration of independence did not violate international law, which its president said contains no "prohibitions on declarations of independence".

The region currently known as "Kosovo" became an administrative region in 1946, as the Autonomous Province of Kosovo and Metohija. In 1974, the compositional "Kosovo and Metohija" was reduced to simple "Kosovo" in the name of the Socialist Autonomous Province of Kosovo in Yugoslavia, but in 1990 was renamed back to Autonomous Province of Kosovo and Metohija

The entire region is commonly referred to in English simply as Kosovo and in Albanian as Kosova or Kosovë ("indefinite" form, [kɔ'sɔ:v]). In Serbian, a distinction is made between the eastern and western areas; the term Kosovo (Kocobo) is used for the eastern part, while the western part is called Metohija. In Albanian western part mean ''Rafshi i Dukagjinit'' - Plain of Dukagjini. But whole territory know as KOSOVA.

8.1.2 Kosovo War

In 1995 the Dayton Agreement ended the Bosnian War, drawing considerable international attention. However, despite the hopes of Kosovar Albanians, the situation in Kosovo remained largely unaddressed by the international community, and by 1996 the Kosovo Liberation Army (KLA), an ethnic Albanian guerilla group, had prevailed over the non-violent resistance movement and had started offering armed resistance to Serbian and Yugoslav security forces, resulting in early stages of the Kosovo War.

By 1998, as the violence had worsened and displaced scores of Albanians, Western interest had increased. The Serbian authorities were compelled to sign a ceasefire and partial retreat, monitored by OSCE observers according to an agreement negotiated by Richard Holbrooke. However, the ceasefire did not hold and fighting resumed in December 1998. The Račak massacre in January 1999 in particular brought new international attention to the conflict. Within weeks, a multilateral international conference was convened and by March had prepared a draft agreement known as the Rambouillet Accords, calling for restoration of Kosovo's autonomy and deployment of NATO peacekeeping forces. The Serbian party found the terms unacceptable and refused to sign the draft.

Between March 24 and June 10, 1999, NATO intervened by bombing Yugoslavia aimed to force Milošević to withdraw his forces from Kosovo. This military action was not authorized by the Security Council of the United Nations and was therefore contrary to the provisions of the

United Nations Charter. Combined with continued skirmishes between Albanian guerrillas and Yugoslav forces the conflict resulted in a further massive displacement of population in Kosovo. UN administration period

On June 10, 1999, the UN Security Council passed UN Security Council Resolution 1244, which placed Kosovo under transitional UN administration (UNMIK) and authorized KFOR, a NATO-led peacekeeping force. Resolution 1244 provided that Kosovo would have autonomy within the Federal Republic of Yugoslavia, and affirmed the territorial integrity of Yugoslavia, which has been legally succeeded by the Republic of Serbia.

Some around 200,000, representing the majority of the Serb population, left when the Serbian forces left. Many displaced Serbs are afraid to return to their homes, even with UNMIK protection, specially the people who was involved in crimes in Kosovo. Around 120,000-150,000 Serbs remain(most of them return) in Kosovo, but are subject to ongoing harassment due to fear for their safety.

In February 2007, Ahtisaari delivered a draft status settlement proposal to leaders in Belgrade and Pristina, the basis for a draft UN Security Council Resolution which proposes 'supervised independence' for the province. A draft resolution, backed by the United States, the United Kingdom and other European members of the Security Council, was presented and rewritten four times to try to accommodate Russian concerns that such a resolution would undermine the principle of state sovereignty.

8.1.3 Declaration of Independence

Republic of Kosovo declared independence on 17 February 2008 and over the following days, a number of states(the United States, Turkey, Albania, Austria, Croatia, Germany, Italy, France, the United Kingdom, the Republic of China (Taiwan), Australia, Poland and others) announced their recognition, despite protests by Russia and others in the UN. Currently, 75 UN states recognize the independence of Kosovo and it has become a member country of the IMF and World Bank as the Republic of Kosovo.

The UN Security Council remains divided on the question (as of 4 July 2008)¹²⁴ . Of the five members with veto power, USA, UK, and France recognized the declaration of independence, and the People's Republic of China has expressed concern, while Russia considers it unlicensed. As of May 2010, no member-country of CIS, CSTO or SCO has recognized Kosovo as independent. Kosovo has not made a formal application for UN membership yet in view of a possible veto from Russia and China.

On 8 October 2008, the UN General Assembly resolved to request the International Court of Justice to render an advisory opinion on the legality of Kosovo's declaration of independence from Serbia. The advisory opinion, which is legally non-binding but had been expected to carry "moral" weight, was rendered on 22 July 2010, holding that Kosovo's declaration of independence was not in violation of international law.

As of 9 October 2008, all of Kosovo's immediate neighbor states except Serbia have recognized the declaration of independence. Montenegro and Macedonia announced their recognition of Kosovo on 9 October 2008. Albania, Croatia, Bulgaria and Hungary have also recognized the independence of Kosovo.

¹²⁴This remain same even now on 2011

8.1.4 Geography

Kosovo represents an important link between central and southern Europe and the Adriatic and Black Seas. Kosovo has an area of 10,908 square km. It lies between latitudes 41° and 44° N, and longitudes 20° and 22° E.

The largest cities are Pristina, the capital, with an estimated 500,000 inhabitants. The old city of Prizren is towards the south west, with a population of 110,000. Peja/Peć in the west has 70,000 inhabitants with Mitrovica/Kosovska Mitrovica in the north at around 70,000.

North or Northern Kosovo is a region in the northern part of Kosovo with an ethnic Serb majority that functions largely autonomously from the remainder of Kosovo. Ibër/Ibarian Kolashin, a toponym that pre-dates the political partition, is also used to refer to the area. North Kosovo is by far the largest of the Serb-dominated areas within Kosovo, and unlike the others, directly borders Central Serbia. This has facilitated its ability to govern itself almost completely independently of the Kosovo institutions in a de facto state of partition. Although the Kosovo status process had repeatedly ruled out formalizing this partition as a permanent solution, it has been increasingly mooted amidst continued deadlock.

8.1.5 Demographic

According to the Kosovo in 2005 Survey of the Statistical Office of Kosovo, Kosovo's total population is estimated between 1.9 and 2.2 million with the following ethnic composition:

Albanians 92%, Serbs 4%, Bosniaks and Gorans 2%, Turks 1%, Roma 1%. CIA World Factbook estimates the following ratio: 88% Albanians, 8% Kosovo Serbs and 4% other ethnic groups. According to latest CIA The World Factbook estimated data, as of July 2009, Kosovo's population stands at 1,804,838 persons. It stated that ethnic composition is "Albanians 88%, Serbs 7%, other 5% (Bosniak, Gorani, Roma, Turk, Ashkali, Egyptian, Janjevci - Croats) (2011 - GOK is doing registering of population and their economy)

8.1.6 Relations between Albanian and Serb communities

The relations between Kosovo's ethnic Albanian and Serb populations have been hostile since the rise of nationalism in the Balkans during the 19th century, rivalry which became strong after Serbia gained Kosovo from the Ottoman Empire in 1912 and after Albania became independent in the same year. During the Ottoman period however, Serbs and Albanians within Kosovo enjoyed good-neighbourly relations, working together to oppose foreign meddling in the territory on many occasions. During the Tito-era of communist rule in Yugoslavia, the ethnic Albanian and Serb populations of Kosovo were strongly irreconcilable with sociological studies during the Tito-era indicating that ethnic Albanian and Serb peoples in Kosovo rarely accepted each other as neighbors or friends and few held interethnic marriages. Ethnic prejudices, stereotypes and mutual distrust between ethnic Albanians and Serbs have remained common for decades. The level of intolerance and separation between the ethnic Albanian and Serb communities during the Tito-period was reported by sociologists to be worse than that of Croat and Serb communities in Yugoslavia which also had tensions but held some closer relations between each other.

8.1.7 Kosovo Serbs Enclaves

Kosovo Serb Enclaves are the areas of Kosovo where Serbs form a majority, except for North Kosovo. While North Kosovo is connected to the rest of Serbia and mostly functions as a part of it, the enclaves are surrounded with areas of Albanian majority. Those enclave tend to be part of Serbia, they doesn't accept Kosovo Law, more than that they don't recognize Independence of Kosovo. In most of the enclaves, the freedom of movement for Serbs is limited only to the area of the particular enclave but passing the time they have start to move freely over all territory of Kosova.

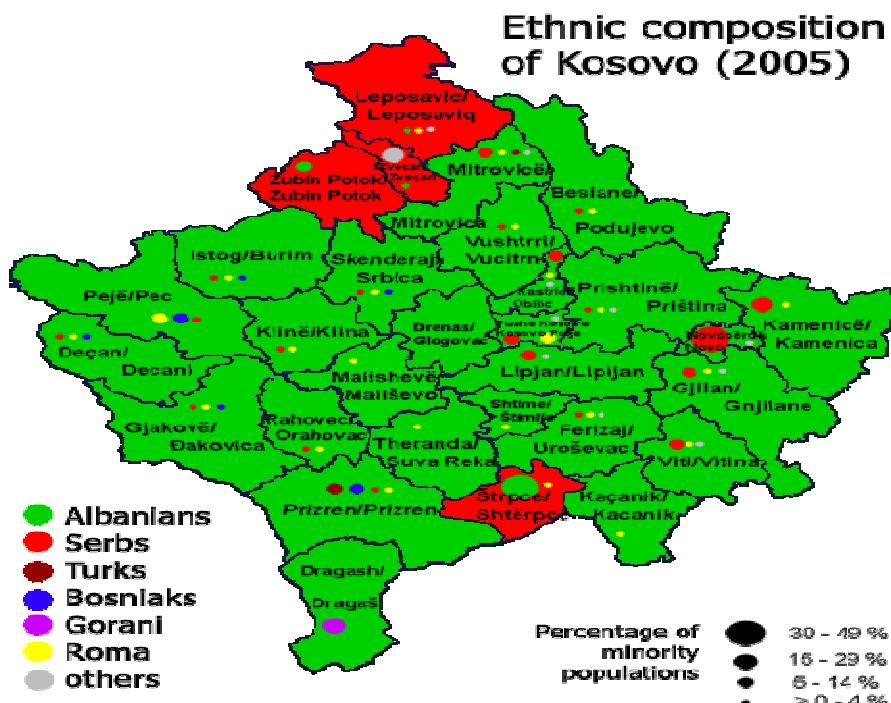


Figure 8-1 Kosovo Ethnic Group Poulation

8.1.8 Mitrovica

Mitrovica /Kosovska Mitrovica (Albanian; Mitrovicë or Mitrovica, Serbian: Косовска Митровица or Kosovska Mitrovica; Turkish: Mitroviça), is a city and municipality in northern Kosovo. It is the administrative centre of the homonymous district.

Since the end of the Kosovo War of 1999 it has been divided between an ethnic-Albanian-majority south and an ethnic-Serb-majority north (the whole city, however, has an Albanian majority). Its northern part is the de facto capital of the Serb enclave of North Kosovo. In the aftermath of the war, the town became a symbol of Kosovo's ethnic divisions. Mitrovica became the focus for ethnic clashes between the two communities, exacerbated by the presence of nationalist extremists on both sides. The bridges linking the two sides of the town were guarded by armed groups determined to prevent incursions by the other side. Because of the tense situation in the town, KFOR troops and the UNMIK police were stationed there in large numbers to head off trouble. However, violence and harassment was often directed against members of the "wrong" ethnic community on both sides of the river, necessitating the presence of troops and police checkpoints around individual areas of the city and even in front of individual buildings.

On March 17, 2004, the drowning of an Albanian child in the river prompted major ethnic violence in the town and a Serbian teenager was killed. Demonstrations by thousands of angry Albanians and Serbs mobilized to stop them crossing the river degenerated into rioting and gunfire, leaving at least eight Albanians dead and at least 300 injured. The bloodshed sparked off the worst unrest in Kosovo seen since the end of the 1999 war.

8.2 CHRONOLOGY OF MOBILE AND TELECOMMUNICATION INFRASTRUCTURE AND LEGISLATURE PROBLEM IN KOSOVO - JOURNALIST AND PROFESSIONAL VIEW AFTER 1999 TILL NOWADAYS

8.2.1 Kosovo: PTK threatens unlicensed mobile operators with court [55]

29.05.2006, 10:08

Prishtinë, May 29, 2006 - The Post and Telecom of Kosovo (PTK) together with Monaco Telecom and Cable and Wireless, has sent a letter last week to all unlicensed mobile telephony operators in Kosovo asking them to halt their transmission, or they will face the court. A copy of this letter was sent to UNMIK Chief Jessen-Petersen, the Government of Kosovo and the Telecommunications Regulatory Authority (TRA).

"The PTK has verified that you are operating unlicensedly in Kosovo, where the only licensed operator is the PTK," the letter reads. "We have made surveys and we know precisely how you have increased the antenna transmission power in order to transmit waves within the territory of Kosovo."

The PTK has verified that these unlicensed operators have a higher signal power than allowed by European regulations for transmission. "The PTK has requested them to halt their unlicensed operations or they will face legal procedures and the PTK shall request compensation for the losses caused to the PTK," said the source.

There are six unlicensed operators in Kosovo: Mobtel and Telekom Serbia, Mobimak and Kosmofon from Macedonia, Promonte from Montenegro and the AMC from Albania.

8.2.2 Kosovo regulator to switch off unlicensed mobile networks [56]

Friday 20 October 2006

All unlicensed mobile phone operators in Kosovo, other than Telenor in Serbian regions, will be turned off, said telecommunications regulatory chairman Anton Berisha to daily newspaper Lajm. He explained that the body, the KTA, had received an announcement from UNMIK that the agency has the right to block all unlicensed mobile communication operators' equipment in the region. Nevertheless, he said, Telenor's equipment in Serbian communities cannot be touched. The agency has prepared a plan of action and has contacted municipal governments and relevant ministries, and will begin a united action to shut down off all of the unlicensed operators in the region. According to the KTA's estimates, the unlicensed work of mobile telephone companies has cost the Kosovo budget at least EUR 100 million since 1999. Along with Telenor, the Mobilna Telefonija Srbije network is also available in the region.

8.2.3 Unlicensed operators continue to cause damage to Vala [54]

23.2.2007

More than 40 percent of the frequency range of Vala, the only legal mobile operator in Kosovo, is used by Mobile Telephony of Serbia (MTS). According to the Post and Telekom of Kosovo (PTK) experts, at this moment MTS is using 37 channels.

The PTK officials say the Telecommunications Regulatory Authority (TRA) is not stopping the MTS unlicensed operators on the territory of Kosovo, and that in fact MTS is slowly expanding its network in Mitrovica, Pristina, Prizren and Pec.

“This proves that TRA's activities on removing the unlicensed operators' antennas were only a media show, and not a real initiative”, said Aferdita Qurkagjiu from PTK.

8.2.4 Vala And iPKO Want Action On Foreign Operators [53]

Serbia - Mobile - Feb 26 2009

Kosovo's incumbent fixed-line operator PTK and owner of mobile operator Vala, has criticised the Telecommunications Regulatory Agency (TRA) for failing to eliminate 'unlicensed' mobile operators in Kosovo. PTK alleges Serbia's MTS, Albania's AMC, Montenegro's Promonte and Macedonia's Mobimak (T-Mobile Macedonia) and Cosmofon are among the perpetrators.

PTK has said it has experienced technical problems due to the interference of unlicensed mobile operators and that until the problem is sorted there 'can be no appropriate liberalisation of the telecommunications market, fair competition and service quality.' According to BalkanInsight the unlicensed operators have an estimated 150,000 customers, which would account for almost 10% of Kosovo's mobile subscriber base. The online news source also states that Akan Ismajli, the general director of iPKO (Kosovo's second mobile operator) has dismissed the TRA's claims there is no legal recourse to eliminate the bogus operators.

PTK has invited the TRA and the government to take steps to eradicate the unlicensed operators which it claims have increased their network coverage from year to year. Ismajli says their antennas and base stations are not concealed but clearly visible and that, given the Constitution of the Republic of Kosovo, there is no reason that PTK and iPKO should be hampered by unlicensed operators. BalkanInsight also reports that Ismajli said the two operators' estimated losses were EUR170mn (US\$217mn) per year and that, as well as affecting their profits, there was a significant cost to Kosovo's budget.

The operators will be hoping their accusations create waves within Kosovo's government and regulator. They have intimated that the continued presence of unlicensed operators is an attack on Kosovo's sovereignty in a region where political tensions have remained since the war. The suggestion that Kosovo's budget is losing out to operators from foreign countries will be weightier in today's uncertain economic climate and could spur the government into action. There was also a possible implicit accusation that the 150,000 customers who are subscribed to the unlicensed operators should be more patriotic. Finally, there was a warning to the regulator that its attempts to liberalise the mobile market further will be impeded if the unlicensed operators issue is not resolved.

The legality of the other operators is further complicated by Serbia not recognising the secession of Kosovo. Nevertheless, as long as the foreign operators are providing services in Kosovo, PTK and iPKO will see their profits dented and be less incentivised to aid the liberalisation and development of Kosovo's mobile market.

8.2.5 Kosovo cuts off Serbian mobile phone providers, Belgrade protests [58]

Apr 23, 2010

Pristina, Kosovo/Belgrade - Kosovan authorities said Friday that they have shut down unlicensed Serbian mobile phone installations in their country.

The Telecommunications Regulatory Authority said in a statement that it 'has taken action preventing unauthorized unlicensed activity of non-licensed operators, who have extended their network within the territory of Kosovo.'

Serbian mobile phone operators had continued extending their services in northern and central Kosovo via installations set up before the 1999 war, which ended with NATO ousting Serbian security forces from the country to stop ethnic bloodshed.

The mainly Albanian Kosovo declared independence from Serbia in 2008.

The shutdown affected users of Serbian mobile providers in central Kosovo, Belgrade media reported.

The Serbian government condemned the measure as a 'new attempt at isolating Serbs' who remain in Kosovo.

Though the United States and the majority of European Union nations recognize Kosovo, Belgrade continues refusing to even acknowledge it. Serbia insists that Kosovo is its territory and

has made it a policy not to communicate with Pristina over any issue.

Serbia also encourages Serbs in their enclaves, especially in the northern part of Kosovo, to resist the central Pristina authorities.

8.2.6 Kosovo disables Serb cell phone towers before sale [55]

Mon Apr 26, 2010

PRISTINA, April 26 (Reuters) - In a bid to make its state-owned telecoms company more attractive for privatization, Kosovo has removed most unlicensed cell phone transmitters owned by operators from neighboring Serbia, officials said on Monday.

Kosovo officials say they were losing around 200,000 potential consumers because of Serbian providers operating transmitters in Serb enclaves in Kosovo.

"We have cut off 26 stations and only two remain to be removed later," said Ekrem Hoxha, head of Telecommunication Regulatory Authority. "The signal is either eliminated or it is too weak."

The three-day action against unlicensed cell phone towers comes ahead of Kosovo's plans to privatise its national post and telecoms company (PTK) by August or September.

The crackdown prompted protests from the 120,000-strong ethnic Serb community and the government in Belgrade which is opposed to Kosovo's independence.

Serbia's President Boris Tadic described the move as "violations of human rights" and said he will seek to restore the connections. "The Serbian population is ... in jeopardy, they have no communications, no telephones, they cannot call for help," he said.

Kosovo's state-owned telecoms company said it is distributing free SIM cards for consumers left without service.

About 2,000 Kosovo Serbs rallied against the move in the Gracanica enclave just outside capital Pristina on Monday.

Hoxha said authorities will launch similar actions if they detect new signals from unlicensed operators.

Kosovo, a country of two million, has no country code as it is not a member of the United Nations and its International Telecommunications Union (ITU). International calls currently go through Monaco, Serbia and Slovenia.

Kosovo is recognised by 66 countries, including the United States and most EU member states, but not by Serbia, nor its ally Russia.

So far, the government in Pristina has issued two mobile licences, one to state telecom and the other to Telekom Slovenije (TLSG.LJ). The government is currently considering whether to invite bidders for another license.

Both Kosovo cell phone operators have said that some of their transmitters were damaged in explosions over the past three days in predominantly ethnic Serb northern areas where the Pristina government has no authority.

"This is a positive signal for investors who would want to buy telecoms, but Kosovo has to show that these (Serbian) operators will not start working again," said Safet Gerxhaliu, an economist for the Kosovo Chamber of Commerce

8.2.7 Serbs protest against Kosovo communication blackout [51]

April 27, 2010

In estimated 3,000 Serbs, angered that their mobile phones had gone dead, protested on Monday in the Serb enclave of Gracanica, outside of Pristina, against the actions of Kosovo officials to disable mobile phone networks from Serbia, reported the Serbian news agency Tanjug.

Over the weekend, the Kosovo Telecommunications Regulatory Authority reportedly removed or damaged more than 20 repeater stations owned by two Belgrade-based mobile operators Telekom Srbija and Telenor. In an official statement, the authorities said it had taken action against "unauthorized unlicensed activity of non- licensed operators, who have extended their network within the territory of Kosovo."

Symbolically, the protest was led by ambulances, to underscore the fact that emergency services to the 100,000 Serbs south of the Ibar River, which divides the Serb-dominated north of Kosovo from the ethnic Albanian majority, have been left without communication.

Protesters said the actions were tantamount to blackmailing them to integrate into a state they do not recognize. Kosovo declared independence in 2008 and Serbia is challenging the legality of this act before the International Court of Justice.

8.2.8 Kosovo Serbs Protest over Cut Phone Lines [57]

27 APR 2010

Some 3,000 Kosovo Serbs staged a protest in the Serb enclave of Gracanica on Monday, after base stations of Serbian telecommunications operators were disabled in central Kosovo. Meanwhile, Kosovo's Telecommunications Regulatory Authority has said that its operation to remove Serbian-licensed masts has ended.

The Kosovo Serb protesters yesterday called on the international community to react and stop the Kosovo government from prohibiting them from using the phone services of Serbian mobile operators.

With banners saying: "Blind, Mute, Deaf" and "No Network, Why?" the protestors, who started gathering at noon with a rally on the main street in Gracanica, have announced that similar gatherings are expected to be held every day until the Serbian mobile phone services are re-activated.

Ahead of the crowd of protesters were ambulances apparently intended to symbolise that communication with such emergency services cannot exist without properly functioning phones.

More than 20 base stations of Serbian telecommunications operators in central Kosovo were disabled by workers of Kosovo's Telecommunications Regulatory Body and special units of the Kosovo police on Friday and Saturday in a move that angered Belgrade and Kosovo Serbs.

In a statement, Kosovo's Telecommunications Regulatory Authority, TRA, revealed that it had disabled 26 mobile masts in 22 locations across Kosovo.

The publicly owned Post Telecom of Kosovo has said that it has supplied more than 2,500 sim cards for its Vala mobile phone operator to Serb enclaves for free and is working with

Monaco Telecom, which provides the network, to offer affordable prices between Vala and Serbian numbers.

Vala said that as a result of this, traffic on the network has risen by 4.5 per cent compared to the last weekend.

“We have noticed that there is great interest among the young residents of the Serb community to be supplied with Vala sim cards, which makes us feel good and encourages us to further enhance our services, especially during an emergency situation like this,” said Shyqyri Haxha, CEO of the PTK.

He added that fixed phone lines and the Internet have also been disrupted in Serb enclaves as in some areas these had been provided through the masts and not lines.

“Since the antennas of unlicensed operators have been removed and disconnected from the system, there was an emergency need to connect these customers to a different system, namely in our system, in order to provide fixed telephony services and internet, therefore, we have done it successfully,” said Haxha.

PTK said that in Serb-majority Strpce, in southern Kosovo, an optical cable was damaged on Saturday but was fixed immediately.

“PTK, as a state commercial company, does not deal with politics but it provides services to the citizens of Kosovo without distinction,” added Haxha. “In this case, we are also offering our services to the Serbian citizens.

“None of the Serbian community members living in enclaves can now complain of having no services. All that is necessary for them to do is to help us in order for us to help them.”

In a statement, the TRA said: "Any deployment of telecommunication equipment without prior permission of the TRA will be considered unlicensed and will be treated as such."

Serbia, meanwhile, has vowed to do everything it can to re-activate the services of the Serbian-based operators.

Speaking at a press conference on Monday, Serbian Prime Minister Mirko Cvetkovic said that the government will do "literally everything" short of using force to help the Serbs in Kosovo.

"This is a very serious problem that we are facing and we will do our best to help these people," the prime minister said.

Serbian President Boris Tadic has said that the country would begin an international effort and demand immediate action from international institutions to re-activate the services.

Beta news agency learned from its sources in the EU that EULEX finds that the move of Kosovo authorities may not have been well executed, and the mission understands the importance of communication for the Serb population, but it also believes that some mobile phone transmitters were not legally there.

EULEX spokesperson Irina Gudeljevic said that the EU rule of law mission supports any action of the Kosovo Telecommunications Regulatory Agency that is directed against, as she put it, unlicensed mobile phone operators.

Gudeljevic noted previously that "Kosovo Telecommunications Regulatory Agency is an independent body, and the EU mission is not familiar with its plans related to the north of Kosovo, where the signals of Serbian mobile operators are now functioning properly".

The state secretary at the Ministry for Kosovo and Metohija, Oliver Ivanovic, said that EULEX representatives deny involvement in the action, but the Serbian concern is that EULEX, as he put it, supports the move.

In what appeared to be a retaliatory move following the action by Kosovo's Telecommunications Regulatory Authority, three masts used by Kosovo-based mobile operators were blown up in the north of Kosovo over the weekend.

8.2.9 Full telephone communications restored to Serb enclaves in Kosovo[49]

12 may 2010

BELGRADE, May 11 (Xinhua) -- After 19 days without a mobile telephone signal, the Telekom Srbija network has been restored to the 100,000 Serbs living in isolated enclaves in Kosovo, reported the Serbian news agency Tanjug on Tuesday.

The mobile telephone provider has not, however, disclosed how it has managed to restore service to the Serbs who live south of the Ibar River; service was not disrupted in the Serb-dominated north.

On April 23, the Kosovo Telecommunications Regulatory Authority, claiming that Telekom and Telenor, the two Belgrade-based mobile service providers to Kosovo, were "unauthorized unlicensed, non- licensed operators," subsequently disabled or damaged over 20 repeater and base stations on Kosovo territory.

Serbian officials condemned the move, saying it was part of strategy of forced assimilation, and that only the United Nations mission on Kosovo (UNMIK) was competent to regulate telecommunications according to the Security Council Resolution 1244.

A number of retaliatory attacks on the property of Kosovo mobile phone operators ensued.

On Monday, Serbian Minister for Kosovo and Metohija Goran Bogdanovic said his ministry and the telecommunications companies were trying to resolve the problem peacefully.

8.2.10 Telecommunications Regulatory Authority of Kosovo Cuts Cables and Removes Equipment Belonging to Serbian-Owned Telecom Mobile Operator[48]

September 27, 2010

Telecommunications Regulatory Authority of Kosovo cut cables and removed equipment belonging to Serbian-owned Telecom mobile operator in the Serb enclaves in central and eastern Kosovo. The move came only a few days after Serbia and Kosovo agreed to launch as soon as possible a dialogue about all outstanding issues under European Union auspices.

A Serbian Telecom official said some 80,000 out of 120,000 Serbs living in Kosovo were left without the signal, the Belgrade-based Beta news agency reported. Serbia's minister for Kosovo, Goran Bogdanovic, said It shows Pristina hasn't given up "unilateral moves and violence" and is creating an "atmosphere of fear" and isolating Serbs "at the moment when we expect negotiations on all problems, including the telecommunications one,"

Kosovo unilaterally declared independence from Serbia in February 2008 and has been recognized as an independent country by 70 states, including the U.S and 22 out of 27 members of the EU. Serbia has rejected the move and still considers Kosovo its southern province.

Telecommunications Regulatory Authority of Kosovo cut cables and removed equipment belonging to Serbian-owned Telecom mobile operator in the Serb enclaves in central and eastern Kosovo. The move came only a few days after Serbia and Kosovo agreed to launch as soon as possible a dialogue about all outstanding issues under European Union auspices.

8.2.11 Kosovo-Serbia Talks: Moving Forward? “Practical problems”: what are we talking about? [50]

MAR 22, 2011

Of critical interest for both countries, the Kosovo-Serbia talks will aim at improving regional cooperation, increasing the freedom of movement, and strengthening the rule of law. But before tackling touchier issues, both delegations agreed to focus on easy topics and try to solve the nuts-and-bolts problems that have arisen since the 1999 conflict. Longstanding issues in the areas of documentation, transportation, commerce, and telecommunications have so far made everyday life in Kosovo very difficult for Albanians and Serbs alike.

9.0 APPENDIX B - LAW ON TELECOMMUNICATIONS IN KOSOVO

9.1 LAW ON TELECOMMUNICATIONS IN KOSOVO- PARTICULAR

Taking into account UNMIK Regulation No. 1999/1 of 25 July 1999, “On the Authority of the Interim Administration in Kosovo,” as amended; and UNMIK Regulation No. 1999/24 of 12 December 1999, “On the Law Applicable in Kosovo,” as amended; and

On the basis of the authority granted by United Nations Interim Administration on Kosovo UNMIK Regulation No. 2001/9 of 15 May 2001, “On a Constitutional Framework for Provisional Self-Government in Kosovo,” especially Sections 5.1h, 5.7, 9.1.1, 9.1.26a, 9.3.3, and 11.2 thereof;

Recognizing the need to improve the Telecommunications Sector in Kosovo by: establishing an independent regulatory agency responsible for licensing, regulating and supervising the providers of telecommunication services in Kosovo; encouraging the private sector participation and competition in the provision of services; setting standards for all service providers in Kosovo, and, establishing provisions for consumer protection:

...

Section 3

9.1.1 Authorities and Competencies

1. The responsibilities for the implementation of telecommunications services in Kosovo shall reside in the following entities:
 - a) the Ministry shall develop policies for the sector, including the development of legislation, and exercising all other powers transferred to it under the Constitutional Framework.
 - b) the TRA, established as an independent body within the PISG by this Law, shall implement the policies of the PISG and Ministry pursuant to this Law, and all other implementing legislation enacted pursuant thereto.
 - c) UNMIK, through the SRSG, shall exercise those powers that are reserved to it under the Constitutional Framework, including:
 - i The authority to manage publicly owned telecommunications assets, including, but not limited to Management of essential PTK assets through the Kosovo Trust Agency KTA in cooperation with the PISG pursuant to UNMIK Regulation 2002/12 on the Establishment of the Kosovo Trust Agency of 13 June 2002;
 - ii Management of radio frequencies, carried out by the Frequency Management Office FMO. Some specific administrative functions will be implemented by the PISG and the respective independent regulatory body. And
 - iii The regulation of the broadcast industry, which is currently executed by the Temporary Media Commissioner TMC.

2. The TRA shall coordinate all broadcasting activities with the Temporary Media Commissioner and with other relevant authorities in accordance with the provisions of the Broadcasting Regulation.

3. The TRA assign to service provider and users spectrum resources that are specifically allocated by UNMIK.

4. The TRA shall at its discretion, obtain from service providers and review for compliance with this Law, international contracts involving the provision of Telecommunications Services and equipment between commercial entities active in Kosovo. The TRA shall not conclude any agreements with states and multilateral organizations.

5. The Ministry shall request that the SRSG conclude on behalf of UNMIK agreements with states and multilateral organizations that pertain to the telecommunications sector, as well as all documents pertaining to the SRSG's oversight of international agreements entered into on behalf of UNMIK in the telecommunications sector. As part of the consultative process in these matters, the Ministry may request the right as an interested party to participate in discussions and negotiations conducted by the SRSG with states and multilateral organizations that are intended to result in the conclusion of such agreements.

Chapter 2

Telecommunications Regulatory Authority “TRA”

[...]

Section 4

9.1.2 Establishment of the TRA

1. The Telecommunications Regulatory Authority the “TRA” is hereby established as an independent, non-profit body within the Ministry, and shall implement the policies of the PISG and the Ministry pursuant to this Law, and all other implementing legislation enacted pursuant thereto.
2. The TRA shall promote and facilitate the provision of sufficient and satisfactory domestic and international telecommunications services, and other services covered in the broadcasting regulations, provided however, that such promotion and facilitation shall not extent to free or charge services.
3. The TRA shall be governed by this Law, and shall observe the need to promote universal services in accordance with the principles set forth in Chapter 8 of this Law.
4. The TRA is authorized to issue regulations and instruction for the implementation of the present Law.

...

Chapter 12

Radio Communications, Spectrum Resource Allocation, Numbering

Plan for Telecommunication Services

Section 63

9.1.3 Management of the Radio Frequency Spectrum

1.The radio frequency spectrum is a limited natural resource. Frequency management is a reserved power by the SRSG, which has made a specific quantum or spectrum resources available to the PISG for re-allocation to users and service providers; all provisions pursuant to the allocation of spectrum resources in this Law pertain solely to those spectrum resources made available to the PISG. The TRA shall reallocate to service providers only those spectrum resources that have been made available to it by the SRSG.

2.In order to protect the efficient and non-interfering use of Kosovo's radio spectrum resources and the rights thereof to orbital positions the TRA shall:

- a establish a spectrum resource plan to allocate radio frequency bands and/or to assign radio frequencies for use;
- b allocate such radio frequency bands and/or assign radio frequencies for use; and
- c supervise the use thereof

3.The TRA's spectrum resource plan shall become effective after SRSG review and approval in writing. All allocations of spectrum resources by the TRA to service providers must be made available to it by the SRSG.

4.The TRA shall maintain all relevant information related to the allocation of spectrum resources, information on the assignment of radio frequencies, and other relevant information required to effectively manage the spectrum resources.

5.With the exception of that information which is related to the requirements of Kosovo security and/or defense, the TRA shall make the information specified in this section publicly available.

9.1.4 Plan for Allocating Spectrum Resources

- 1.In its plan to allocate spectrum resources and radio frequency bands, the TRA shall define the radio frequencies or radio frequency bands intended for allocation for individual radio communications and among individual groups of users and shall set out the conditions upon which radio frequencies may be used.
- 2.Not later than fifteen 15 days after the approval by the SRSG, the TRA in coordination and with the assistance of the SRSG, shall make publicly available its spectrum resource plan which shall conform to domestic and international laws and UNMIK Regulations binding in Kosovo. The plan shall take into account the requirements of Kosovo security, defense and emergencies, and the need to protect against natural and other disasters.
- 3.On the basis of the spectrum resource plan, the TRA shall report to the SRSG on all regional frequencies and the extent to which they are occupied.

Section 65

Plans of Radio Frequency Use

- 1.The spectrum resource plan shall set out in detail the use of radio frequencies within the radio frequency bands intended for individual services by the plan for allocating radio frequencies and radio frequency bands, and shall set out the conditions of use therefor.
- 2.The TRA shall administer the plan described in this section.

Section 66

Existing Users of Radio Frequencies

1. Not later than sixty 60 days after the entry into force of this Law, the TRA shall notify in writing all existing users of spectrum resources whose allocations fall within the spectrum resource plan authorized by the SRSG, of the provisions of this Chapter. All existing holders of frequency spectrum allocation authorization shall retain the right of use granted by UNMIK for the full term, provided that they:

- a) are legal entities properly registered as an individual or business entity in Kosovo;
- b) comply with all General Terms and Conditions applicable to the right to use spectrum; and,
- c) pay the applicable spectrum resource right to use fees.

10.0 APPENDIX C - RADIO SPECTRUM MANAGEMENT AFTER THE TELECOMMUNICATION REFORM OF 1996 IN GUATEMALA¹²⁵

The spectrum allocation system of Guatemala changed dramatically with the “Ley General de Telecomunicaciones” of 1996. Allocation of radio spectrum evolves from the bottom up. Private action comes first: any person or company, national or foreigner, may request any spectrum band not currently assigned to other users. When conflicts arise — caused by interference from signals of adjacent bands and/or intermodulation distortions — private parties are encouraged to mediate between themselves. If private mediation fails, specific rules are enforced by the telecommunication regulatory body. Additionally, the injured party may sue for damages in existing courts.

From the perspective of the theory of economics of property rights, the most salient feature of the spectrum reform is the creation of usufruct titles in lieu of Constitutional restraint. In the Guatemalan Civil Code, the usufruct carries the right to use and enjoy the property of another to the extent that such use and enjoyment does not destroy or diminish its essential substance.

The 1996 law specifically states that the Títulos de Usufructo de Frecuencias (TUF) may be leased, sold, subdivided or consolidated for a limited period (fifteen years). In fact, the TUF

¹²⁵<http://www.itu.int/osg/spu/ni/spectrum/guat-rsm.pdf>

may be evennused as equity exchanged for investment. The usufruct term can be extended for an additional 15

years by a simple request at no cost to the bearer, and so on. The electromagnetic waves are infinitely reusable and are not “destroyed or diminished” after being used. Therefore, in all practical matters, the TUFs are the closest approximation to private property rights in radio spectrum that the Guatemalan law allows. Regulation is limited to interfering emissions and reserved bands.

The physical TUF is a security paper certificate listing the six following basic variables on the

front:

- frequency band;
- hours of operation;
- maximum power transmitted;
- maximum power emitted at the border of adjacent frequencies;
- geographic territory;
- duration of right (beginning and ending).

The back of the TUF is for endorsements which are required whenever the instrument is beingnegotiated for property transfer. The independent regulatory body established by the 1996 law, the Superintendencia de Telecomunicaciones (SIT) is responsible for the TUF registry. This computerized database is easily accessible to the public. Anyone may request a copy of the TUF inventory.

The adjudication process contained in article 61 of the law is quite simple and has been implemented in practice as follows:

- An interested party surveys existing spectrum use in the spectrum registry of SIT.
- The party applies to SIT for the right to use a frequency band as specified in the application form.

- The application is evaluated by SIT which deems it accepted, incomplete, or rejected.

SIT is required, by law, to answer in 3 days or less. Grounds for rejection include technical interference, request of reserved or radio amateur bands. Reserved bands are for government use only.

- If the application is accepted, public notice is issued. Parties objecting the new use file formal complaints. Grounds for opposition are limited to technical interference.
- Complaints are quickly adjudicated via binding arbitration. The adjudication process cannot exceed 10 days.
- Other interested parties are allowed to file competing claims to requested spectrum rights.
 - If no competing claims are filed, then the petitioner directly receives rights without auction gratis.
 - If competing claims filed, then SIT must schedule an auction 35 days after the end of the opposition period.

BIBLIOGRAPHY

- [1] Misook Kim , “Cognitive Radio and Interference Management” Working Paper, pp 1-8,[On-line], Available: <http://www.docstoc.com/docs/56520448/Cognitive-Radio-and-Interference-Management> -
- [2] Ronald H. Coase (1960, Octomber) “The Problem of Social Cost” The Journal of Law and Economics,[On-line], Volume III, Available:
<http://heinonline.org/HOL/LandingPage?collection=journals&handle=hein.journals/jlecono3&div=2&id=&page=>, pp 1-28-
- [3] R. H. Coase,(1937, November) “The Nature of the Firm,” Economica,[On-line], New Series, vol. 4, no. 16,Avalible:
<http://msuweb.montclair.edu/~lebelp/PSC643IntPolEcon/CoaseNatFirmEc1937.pdf> pp, 386-405 .
- [4] Simon Haykin, Cognitive Radio: Brain-Empowered Wireless Communications, Life Fellow, IEEE - Matt Yu, EE360 Presentation, February 15th 2012[On-line], available: <http://www.stanford.edu/class/ee360/lectures/matt.pdf>,
- [5] Timothy K. Forde & Linda E. Doyle(2007, Arill) , “Exclusivity, Externalities & Easements: Dynamic Spectrum Access and Coasean Bargaining” [On-line] [New Frontiers in Dynamic Spectrum Access Networks, 2007. DySPAN 2007. 2nd IEEE International Symposium on](http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=4221510&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F4221461%2F4221462%2F04221510.pdf%3Farnumber%3D4221510), Vol 48, pp 303 – 315 Available:
<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=4221510&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F4221461%2F4221462%2F04221510.pdf%3Farnumber%3D4221510>.
- [6] Daniel Willkomm,Sridhar Machiraju, „Jean Bolot,, Adam Wolisz, (2008,Octomber), Primary Users in Cellular Networks: A Large-scale Measurement Study –[On-line], 3rd IEEE International Symposium of New Frontiers in Dynamic Spectrum Access Networks 2008 – DySPAN 2008 Chicago, IL, 2008, Available: http://www.tkn.tu-berlin.de/fileadmin/fg112/Papers/dyspan08_measurement-study.pdf, Tech 4.
- [7] Theodoros Kamakaris & Radhika Iyer - Stevens Institute of Technology & Milind M. Buddhikot (2005, November), “A Case for Coordinated Dynamic Spectrum Access in Cellular Network”,[On-line] in Proc, First International Conference on

- Dynamic Spectrum Access Networks, DySPAM 2005, Baltimore, USA, Available: <http://www.bell-labs.com/user/mbuddhikot/psdocs/SpectrumMeasurements-DyspanMilind.pdf>
- [8] Sooksan Panichpapiboon and Jon M. Pela (2003, June), “Providing Secondary Access in a Cellular Network”, INTERNATIONAL CONFERENCE ON WIRELESS NETWORKS (ICWN), JUNE 2003, [On-line], Available: <http://www.kmitl.ac.th/~kpsooksa/document/icwn03.pdf>
- [9] Martin BH Weiss, Mohammed Al-Tamaimi , Liu Cui, “Dynamic Geospatial Spectrum Modelling: Taxonomy, Options and Consequences” , The 38th Research Conference on Communication, Information and Internet Policy , October, 2010, [On-line], Available: http://d-scholarship.pitt.edu/5811/1/Weiss_TPRC_2010_revision_2.pdf
- [10] Carlos E. Caicedo, Martin B.H. Weiss, “The Viability of Spectrum Trading Markets”, [New Frontiers in Dynamic Spectrum, April, 2010 IEEE Symposium on](#), pp 1 – 10,[On-line],Available : http://www.academia.edu/2743424/The_viability_of_spectrum_trading_markets
- [11] Martin B.H. Weiss, Simon Delaere, William H. Lehr, “Sensing as a Service: An Exploration into Practical Implementations of DSA”, [New Frontiers in Dynamic Spectrum, 2010 IEEE Symposium on](#), pp, 1-8, Institute of Electrical and Electronics Engineers, [On-line], Available: <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=5457829>
- [12] Martin B.H. Weiss William H. Lehr, “Market Based Approaches for Dynamic Spectrum Assignment”, Working Paper, School of information Science, December 2009,[On-line], Available: http://d-scholarship.pitt.edu/2824/1/JSAC_Weiss_and_Lehr.pdf
- [13] Saman T. Zargar, Martin B. H. Weiss, Carlos E. Caicedo, , and James B. D. Joshi, “Security in Dynamic Spectrum Access Systems: A Survey”, Working Paper, School of information Science, December 2009,[On-line], Available:http://d-scholarship.pitt.edu/2823/1/SecurityInDSASystems_A_Survey_JSAC.pdf
- [14] Zeljko Tabakovic, Sonja Grgic, Mislav Grgic , “Dynamic Spectrum Access in Cognitive Radio”, [On-line], 51st International Symposium ELMAR-2009, September 2009, Zadar, Croatia, Available: http://www.vcl.fer.hr/papers_pdf/Dynamic%20Spectrum%20Access%20in%20Cognitive%20Radio.pdf
- [15] J. Nasreddine, J. Pérez-Romero, O. Sallent, R. Agustí, “A Primary Spectrum Management Solution Facilitating Secondary Usage Exploitation”, Spanish Research Council under COGNOS grant (ref. TEC2007-60985), [On-line]Dept. Signal Theory and Communications, Universitat Politècnica de Catalunya (UPC) c/ Jordi Girona, 1-3, Campus Nord, Barcelona, 08034, Spain, Available: <http://jad.nasreddine.com/frames/ICT08.pdf>

- [16] Industry Canada, Spectrum Management and Telecommunications, Federal Communications Commission of the United States of America (FCC), Arrangement F - Arrangement Between the Department of Communication of Canada and the Federal Communications Commission of the United States Concerning the use of the Band 806 to 890 MHz along the Canada - United States borders , [On-line], Available: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10069.html>
- [17] ITU , Radio Spectrum Management, “Spectrum Management for a Converging World: Case Study on Guantemala”[On-line], Available:<http://www.itu.int/osg/spu/ni/spectrum/guat-rsm.pdf> -
- [18] ITU , Radio Spectrum Management, “Spectrum Management for a Converging World: Case Study on United Kingdom”[On-line], Available:<http://www.itu.int/osg/spu/ni/spectrum/UK-RSM.pdf>
- [19] ITU , Radio Spectrum Management, “Spectrum Management for a Converging World: Case Study on Australia”,[On-line], Available: <http://www.itu.int/osg/spu/ni/spectrum/UK-RSM.pdf> - ITU
- [20] Spectrum Management of Cognitive Radio Networks - Kwang-Cheng Chen and Ramjee Prasad - 2009 John Wiley & Sons, Ltd
- [21] -Ehsan Pasandshanjani , Babak H. Khalaj, “Primary- Secondary Interaction Modeling in Cellular Cognitive Radio Networks: A Game - Theoretic Approach” Communications, IET, . [Online]. 6(10), pp. 1212-1219 Available:<http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6261626&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F4105970%2F6261617%2F06261626.pdf%3Farnumber%3D6261626>
- [22] Arnon Tonmukayakul,Martin B. H. Weiss , “A study of secondary spectrum use using agent-based computational economics”, Journal Netnomics, [Online]. 9(2), pp. 125-151. October 2008, Available:<http://dl.acm.org/citation.cfm?id=1531270>
- [23] Yao Xie, Benjamin Armbruster and Yinyu Ye, “Dynamic Spectrum Management With the Competitive Market Model” Working Paper, Available: http://www.stanford.edu/~yyye/DSM_ieee.pdf
- [24] - Hitao Zheng,: , Lili Cao, Device Centric Spectrum Management, Working Paper, Available: <http://www.cs.ucsb.edu/~htzheng/publications/pdfs/simplerule.pdf>,
- [25] R. Menon, R. M. Buehrer, and J. H. Reed, “Outage Probability Based Comparison of Underlay and Overlay Spectrum Sharing Techniques,” Proc. IEEE DySPAN 2005, Nov. 2005, pp. 101-9.
- [26] X. Liu and W. Wang, “On the characteristics of spectrum-agile communications networks,” in Proc. First IEEE International Symposium on New Frontiers in

Dynamic Spectrum Access Networks. (DySPAN 2005), Baltimore, Maryland, U.S.A., November 2005, pp. 214 – 223

- [27] W. Gardner and C. Spooner, "Signal interception: performance advantages of cyclic-feature detectors," IEEE Transactions on Communications, vol. 40, no. 1, pp. 149–159, 1992.
- [28] N. Shankar Sai, C. Cordeiro, and K. Challapali, "Spectrum agile radios: utilization and sensing architectures," in Proceedings of the First IEEE International Symposium on New Frontiers in Dynamic Spectrum Access Networks. DySPAN 2005., pp. 160 – 169, November 2005 W. Webb,
- [29] "The Role of Economic techniques in Spectrum Management," IEEE Communications Magazine, vol. 4, no. 3, March 1998
- [30] S. De Vany, R. D. Eckert, C. J. Meyers, D. J. O'Hara, and R. C. Scott, "A Property System for Market Allocation of the Electromagnetic Spectrum: A Legal-Economic-Engineering Study," Stanford Law Review, vol. 21, no. 6, June 1969.
- [31] R. Coase, "The Federal Communications Commission," Journal of Law and Economics, vol. 2, pp. 1–40, October 1959.
- [32] W. Horne, "Adaptive Spectrum Access: Using the Full Spectrum Space," Working Paper, Available: <http://radar.det.unifi.it/radar/prin2007/Adaptive-Spectrum-Horne.pdf>, 2003.
- [33] R. T'onjes: "DSA and Re-configurability Requirements", Presentation at 2nd European Colloquium on Reconfigurable Radio, Athens, 20-22. June 2002.
- [34] P. Leaves, et al., "A Time-Adaptive Dynamic Spectrum Allocation Scheme for a Converged Cellular and Broadcast System" , IEE Radio Spectrum Conference, United Kingdom, Oct 2002.
- [35] W. Lehr et al., "Software Radio: Implication for Wireless Services, Industry Structure, and Public Policy," Prepared for TPRC, Alexandria, VA, Sept. 2002.
- [36] D. J. Schafer, "Wide Area Adaptive Spectrum Applications," MITRE Corporation Reston, VA.
- [37] Al Daoud, M. Alanyali, and D. Starobinski, "Secondary pricing of spectrum in cellular CDMA networks," in Proceedings of the 2nd IEEE International Symposium on New Frontiers in Dynamic Spectrum Access Networks (DySPAN 2007), 2007, pp. 535–542.
- [38] Youping Zhao, Bin Le, and Jeffrey H. Reed, "Network Support: The Radio Environment Map," in Cognitive Radio Technology, Bruce A. Fette, Ed.: Academic Press, 2009, ch. 11, pp. 325-366.

- [39] Martin BH Weiss, "Secondary use of spectrum: a survey of the issues," Info, vol. 8, no. 2, pp. 74-82, 2006.
- [40] J.M. Chapin and W.H. Lehr, "The Path to Market Success for Dynamic Spectrum Access Technology," IEEE Communications Magazine, vol. 45, no. 5, pp. 96-103, May 2007.
- [41] J.M. Chapin and Lehr W.H., "Time-limited leases in radio systems," IEEE Communications Magazine, vol. 45, no. 6, pp. 76-82, June 2007.
- [42] W.H. Lehr and N. Jesuale, "Public Safety Radios Must Pool Spectrum," IEEE Communications Magazine, vol. 47, no. 3, pp. 103-109, March 2009.
- [43] Jon M. Peña and Sooksan Panichpapiboon, "Real time secondary markets for spectrum," Telecommunications Policy, vol. 28, pp. 603-618, 2004.
- [44] Arnon Tonmukayakul, "An Agent-Based Model for Secondary Use of Radio Spectrum," University of Pittsburgh, Pittsburgh PA, PhD Dissertation 2007.
- [45] Radio Spectrum Management - Module 5 of ICT Regulation Toolkit - ITU - www.ictregulationtoolkit.org - Croatia Case
- [46] Sun Yunlong, Full telephone communications restored to Serb enclaves in Kosovo, http://news.xinhuanet.com/english2010/sci/2010-05/12/c_13288854.htm, 2010-05-12 07:05:20
- [47] Loic Poulain, Kosovo-Serbia Talks: Moving Forward?,
<http://csis.org/blog/kosovo-serbia-talks-moving-forward>, Mar 22, 2011,
- [48] Zhang Qian,Serbs protest against Kosovo communication blackout,<http://english.peopledaily.com.cn/6964603.html>, 11:03, April 27, 2010
- [49] ECIKS ,**Kosovo: PTK threatens illegal mobile operators with court**,
http://www.eciks.org/english/lajme.php?action=total_news&main_id=407, 29.05.2006, 10:08
- [50] BMI,Vala And iPKO Want Action On Foreign Operators,
<http://store.businessmonitor.com/article/238009>, Serbia – Mobile Feb 26 2009
- [51] PressCut, Illegal operators continue to cause damage to Vala,
<http://www.limun.hr/en/main.aspx?id=122026&Page=1374>, 23.2.2007
- [52] Reuters, Kosovo disables Serb cell phone towers before sale,
<http://in.reuters.com/article/2010/04/26/kosovo-telecoms-idINBYT63194220100426>, Mon Apr 26, 2010 9:54pm IST

- [53] Telecompaper, Kosovo regulator to switch off illegal mobile networks,<http://www.telecompaper.com/news/kosovo-regulator-to-switch-off-unlicensed-mobile-networks>, Friday 20 October 2006 | 08:31 CET | News
- [54] Bojana Barlovac , Kosovo Serbs Protest over Cut Phone Lines, <http://www.balkaninsight.com/en/article/kosovo-serbs-protest-over-cut-phone-lines>, 27, Aprill, 2010
- [55] Europe News , Kosovo cuts off Serbian mobile phone providers, Belgrade protests, http://www.monstersandcritics.com/news/europe/news/article_1550573.php/Kosovo-cuts-off-Serbian-mobile-phone-providers-Belgrade-protests, Apr 23, 2010, 18:10 GMT
- [56] Official Gazette, LAW ON TELECOMMUNICATIONS , http://www.gazetazyrtare.com/e-gov/index.php?option=com_content&task=view&id=170&Itemid=56&lang=en
- [57] Martin Cave, Essentials of Modern Spectrum Management, Cambridge UK, Cambridge University Press 2007, pp 11-29,85-104
- [58] Forde, T.K., Doyle, L.E., “Exclusivity, Externalities & Easements: Dynamic Spectrum Access and Coasean Bargaining”, [New Frontiers in Dynamic Spectrum Access Networks, 2007. DySPAN 2007. 2nd IEEE International Symposium on](#), Dublin, Ireland, April 2007, pp. 303-315