# Unlicensed Spectrum as a Source of Innovation Applicability in the Republic of Kazakhstan

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**Abstract**

Over the past several years both licensed and unlicensed services and devices have enjoyed extensive growth in the wireless marketplace. In some urban areas in the Kazakhstan, the penetration rate of licensed cellular and PCS services is more than 60%. Similarly, the use of unlicensed wireless local area network technologies has grown significantly as these systems have been deployed in homes, offices, and 'hot spots' in restaurants, hotels, public meeting areas, etc. As more services are wirelessly enabled and as technologies continue to evolve, the demand for new spectrum for commercial services will also continue to increase. Thus, the appropriate regulatory models for future spectrum allocations will continue to be debated throughout the wireless industry.

Key words

Unlicensed Spectrum, Republic of Kazakhstan, Alternative Framework

## 1. Introduction

Unlicensed spectrum has two principal advantages. First, because there is no licensing procedure, deployment can be fast and inexpensive. This makes it practical to mass market inexpensive wireless systems for which the cost of a single license would be a significant part of a system's overall deployment cost. Second, unlicensed spectrum is shared. Such sharing is essential for wireless systems that are moved from place to place, like laptop computers that can be connected via a portable wireless local-area network. Unlicensed spectrum has several relevant characteristics: it is in limited supply, technical and end-user competition is momentarily problematic, incompatible technologies are built on specific frequencies, and special interests want to claim and license it as their own resource. Vastly greater public good could be achieved by maintaining or expanding this resource and allowing technology developers to solve some of their current problems.

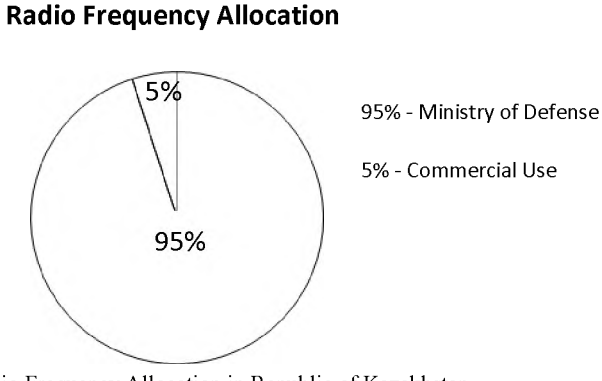


Figure 1. Radio Frequency Allocation in Republic of Kazakhstan

Unlicensed spectrum, available in certain frequencies, is used by several wireless applications including wireless home telephones and home networking. Several different technologies and companies are making use of this free resource. Some technologies

conflict in their implementation and use with other popular technologies; for example, 802.11b networking with 2.4 GHz wireless phones. Many represent business models that are yet to be proven. Some of these approaches (both business models and technologies) are potentially disruptive to the assumptions of the current policy makers.

## 2. Potential and Challenges

It would not be practical to require the owners of a portable device to acquire a license that covers every place they may ever wish the system to operate. Fixed applications that that transmit sporadically or at fluctuating rates can also make more efficient use of unlicensed spectrum; when one is not transmitting, another can. It has been shown that cellular systems could carry significantly more traffic if they shared spectrum dynamically, provided that competing firms are willing to adopt cooperative strategies that serve their common interest. Metropolitan area networks carrying bursty data traffic could expect even greater efficiency gains, if competing networks can be motivated to adopt such techniques.

One serious disadvantage of unlicensed spectrum is the lack of motivation to conserve shared spectrum. All system designs involve a trade-off between competing goals, such as reducing equipment costs while improving reception quality. In licensed spectrum, where the spectrum consumed is the exclusive domain of the end users, conserving spectrum is an important design goal. In unlicensed spectrum, a designer may adopt a *greedy* approach, where the more a device wastes shared spectrum in favor of its own design goals, the more we consider it to be greedy. For example, when Kazakhtelecom began offering unlimited Internet access at a fixed monthly cost, subscribers greatly increased usage. Some would remain logged on for hours when not using the system, to avoid the hassle of reestablishing a connection. Similarly, it is possible to reduce access delays or decrease system cost in unlicensed spectrum with greedy access protocols. If many designers adopt such a strategy, performance could be intolerable for all systems in areas where utilization is high. Consumers would complain bitterly, especially if performance was good when they purchased a given product or service, and then performance degraded over time.

This phenomenon may not seem like a problem at the moment, as there are vast new unlicensed bands with low utilization. However, there is also a proliferation of new unlicensed devices on the horizon. Moreover, given the scarcity of licenses, some companies may use unlicensed spectrum for applications that are actually better suited for licensed spectrum, unless there is some deterrent to doing so. We may see no problems initially, but severe problems as utilization increases. This occurred, for example, with CB radios, which are unlicensed to accommodate their mobility. When utilization was low, there was no problem. When utilization became high, and interference great, many users responded by buying radios with greater transmit power. This reinforced the scarcity, causing even more users to increase their transmit power.

Let's analyze main reasons of less diffusion of internet connectivity among population of Kazakhstan. Consider the current situation there are particular seven factors influencing for spreading of internet service and connectivity among users in the country, figure 2.

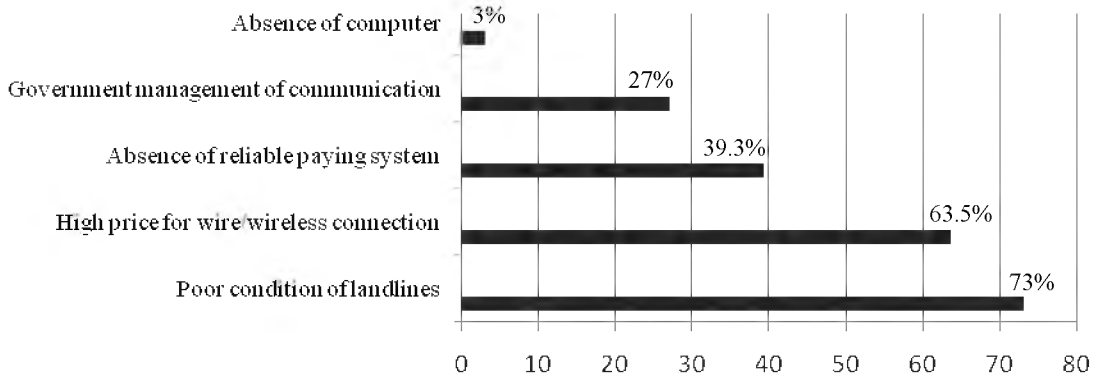


Figure 2. Main reasons, restraining the Internet developing in Kazakhstan.

There is obvious from this figure that one of the important problems existing in Kazakhstan is poor condition of landlines. There are some objective and subjective reasons of this situation:

- Small density of population spread for huge land territory, decentralization of population between rural and urban areas, most attractive cities for improving the quality of service is Almaty city, population of city is 1.5 million people.
- No interest of communication companies in innovation technologies in the way to improve the quality of service, because it's require big amount of finance investments, but it's not cover the risk.
- Monopoly position of regional telecommunication company SC "Kazakhtelecom". Absence of optimal competition doesn't support the developing of telecommunication area, customers are paying to operators – operators are paying to regional monopoly company high price for renting local telecommunication infrastructure.

Information technology, first of all it's the availability of connection to communication infrastructure anywhere anytime, the speed and processing of data transfer between devices and between peoples. The availability and speed is one of the most important factors of our time, compare to another countries Kazakhstan internet provider companies has problems in this area. To solution of existing problems is innovation technologies and wireless connection, optimal utilization of spectrum. Interconnectivity between licensed and unlicensed radio frequency spectrum.

## 3. Applicability in the Republic of Kazakhstan

The radiofrequency spectrum, a limited and valuable resource, is used for all forms of wireless communications, including radio and television broadcast, cellular telephony, telephone radio relay, aeronautical and marine navigation, and satellite command, control, and communications. The radiofrequency spectrum (or simply, the "spectrum") is used to support a wide variety of applications in commerce, government, and interpersonal communications. The growth of telecommunications and information services has led to an ever-increasing demand for spectrum among competing businesses, government agencies, and other groups. Because two or more telecommunications signals occurring simultaneously and in the same location can interfere with each other, the spectrum must be managed to prevent interference. The process of spectrum management includes establishing a regulatory structure, usually within the government, which develops general policies, allocates spectrum, establishes service rules, assigns spectrum to specific users, and enforces the rules that users must follow.

By the potential of using telecommunication market in Kazakhstan can be divided into two groups:

- Markets with increasing demand, its mean specific potential demand for spectrum using, it can be done in big cities (urban areas).
- Markets with not increasing demand (rural areas).

For each specific market its needed individual and origin solution in the way to improve successful implementation. For rural areas following actions can be implemented in the way to improve the quality service of telecommunication:

- Increase the density of segments in population in the way to provide effective competition.
- Segments the possible part of population in the way to provide better service.
- Improve the technical requirements according the geographical situation.
- Diversification.

For urban areas, which has potential to increase the quality and technology service, perspectives of developing is related to effective use of radio frequency and marketing technology of possible customers and their interests. To find how to improve the service which is giving by private companies we have to define weak sides of internet connection.

- Not enough base stations to cover geographically located population, internet provider companies not able to provide the service to all possible customers.
- Not enough internet service realization policy, there is no optimal service for providing wireless access to the internet for customers.

- Poor quality of wireless connection to the internet, it can be realized by disconnections, interference between companies, low speed, roaming service.

In the way to provide solution of existing problem from technical point of view, we can see that many problems exist in interference between different companies and same service. There is two types of wireless connection, licensed and unlicensed.

There are two ways of providing unlicensed devices some protection from interference. One is to keep spectrum utilization low. This could be done by allocating excess spectrum, by imposing strict limitations on transmission power, or by imposing fees on unlicensed devices that are large enough to limit consumer demand.

The alternative is to construct a framework that allows devices to coexist without excessive interference. There are a wide range of choices, which must balance potentially conflicting objectives:

- All devices should have adequate quality of service, where the definition of "adequate" may differ considerably from one application to the next.
- No device should starve, i.e. be blocked from transmission for extended periods. This is a special case of inadequate quality-of-service, but starvation deserves particular attention in an environment where one device may be allowed to transmit indefinitely to the exclusion of others in the band.
- Policies and standards should not inhibit innovation in this rapidly changing field.
- The limited spectrum should be used efficiently, which implies high frequency reuse and some deterrence to wasting spectrum.
- Meeting the imposed rules should not significantly increase device costs.

One promising technique is the adoption of an effective *etiquette*, which places some limitations on when devices can transmit, as well the duration, power, and bandwidth of those transmissions. For example, the unlicensed personal communications services (UPCS) band uses a listen-beforetalk approach, whereby a device is not allowed to transmit until it has detected the band "free" throughout a monitoring period. An effective etiquette would facilitate expansion of applications intended for the band, discourage applications that are not well suited to unlicensed and that would interfere with intended use, and encourage efficient use of the band.

The UPCS etiquette is a good example of an *ineffective* solution. Although it has some advantages, devices operating under the UPCS etiquette can still improve their performance by causing more interference for the neighbors than is necessary. One possible solution is to build explicit incentives into the etiquette. We have proposed imposing a *penalty* on devices which is an increasing function of the spectrum resources consumed. Thus, a device that uses excessive spectrum resources would have a higher penalty than other devices. For example, in a listenbefore-talk etiquette, a device that has transmitted at high power or duration may have a larger monitoring time, a smaller power limit, or a different definition of what constitutes a "free" channel. It has been shown that this approach has great promise in curbing greed.

Just as there are two ways to provide acceptable quality in an unlicensed band, there are two avenues for study. The Agency of Information in the Republic of Kazakhstan should attempt to predict whether utilization will be high in the unlicensed bands between 5 and 6 GHz, at least in some areas or some peak usage hours. This effort would include

1) Prediction of the types of products and services to be offered, and long-term projections of market demand and penetration.

2) For each of the prominent products and services, characterization of their potential access protocols, modulation schemes, power levels and coverage areas, likely locations, and how often they will be used.

3) Determination of how heterogeneous neighboring devices will affect each other's performance, using simulation, experimentation, or a combination of the two.

4) Evaluation of propagation characteristics of signals at 5-6 GHz, indoors and out.

The agency should also seek effective coexistence techniques in case utilization is high. This would require

- Analysis, simulation and experimentation with existing policies.
- Development of new policy.

• Design of access protocols for important applications when operating under the above policies.

## 4. Future Perspectives

In the future, it may be possible that licensees, and licensed systems, may be able to use spectrum that is not directly assigned to a single licensee. Thus, a licensee might be able to have control of unlicensed spectrum or spectrum that has been made available from another licensee. This could be accomplished through arrangements such as secondary markets and spectrum leasing or possibly through some kind of "bandwidth broker" that maintains control of a shared spectrum resource. Furthermore, it may eventually be possible for licensed systems to use additional spectrum in a shared spectrum model while still retaining the benefits inherently available in a licensed cellular system. For example, with the use of fast and accurate positioning technology, it may be possible for multiple base stations operating in close proximity to retain clear channels of communication with their respective mobile users even when using a block of shared spectrum. Additionally, it may eventually be possible for base stations in a cellular network to communicate to each other the detailed information describing the spectrum that each base station is using in terms of frequency, channel codes, signal direction, etc.

The possibility of licensed use of unlicensed spectrum raises many questions in terms of how much spectrum would be made available for this type of use and what wireless technologies would be used. Certainly, the tremendous success of the wireless industry indicates that mobile cellular service is of great value. Millions of users already depend on cellular for both voice and data services. With the coming deployment of 3G services, cellular networks will be able to provide nationwide voice and high-speed data service, clearly meeting the basic communications needs of most persons and businesses (including the need for high speed mobility).

## 5. Conclusion

How the spectrum resources are used and managed, has profound impact on the society, on its prosperity, security, culture, and education. A uniform regulatory environment, the same in each country, is necessary. It would facilitate development of international telecommunication, and will make telecommunication equipment and services less expensive. Moreover, it is a requirement necessary to develop world-wide access to Internet, and further, to the global information infrastructure, especially from sparsely populated regions and for developing countries.

The development of wireless services depends strongly on how the radio spectrum resources are managed. There is growing opinion that the spectrum scarcity is in a great part due to a combined effect of our inadequate approach, inappropriate regulations, simplistic models, tools and methods, and lack of reliable data. Spectrum management (including engineering and monitoring), need to be continuously improved and mechanisms are needed to encourage the rational use and conservation of the spectrum resources. In addition to organizational means, economic mechanisms could be created to encourage conservation of the spectrum resource.

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