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ITU-D STUDY GROUPS

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SECOND MEETING OF STUDY GROUP 1: GENEVA, 2 - 5 SEPTEMBER 2003
SECOND MEETING OF STUDY GROUP 2: GENEVA, 8 - 11 SEPTEMBER 2003

FOR ACTION

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

STUDY GROUP 2

SOURCE: RUSSIAN FEDERATION

TITLE: CASE STUDY ON THE EVOLUTION AND MIGRATION OF 1ST GENERATION NMT450 ANALOGUE MOBILE NETWORKS TO IMT-2000

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Action required:

Participants are invited consider this contribution to the mid-term guidelines.

Abstract:

Case study on evolution and migration of 1ST generation NMT450 analogue mobile networks to IMT-2000.

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In support of the ongoing work of the Rapporteur's Group on ITU-D Question 18/2 regarding evolution and migration strategies for first and second generation systems to IMT-2000, the Russian Federation submits the following case study on the evolution and migration of the Russian NMT450 analogue mobile networks to IMT-2000. This migration is occurring within the 450 MHz frequency band, which, due to its propagation advantages, may be of a particular interest to developing countries and to countries with rural and/or sparsely populated areas.

I. Background on NMT450 Evolution and Migration

NMT (Nordic Mobile Telephone)[1] is a first-generation analogue mobile cellular network standard that was first deployed in 1981 in Scandinavia in 450 and then in 900 MHz band, and later in 12 other Eastern European and CIS countries including Russian Federation in 450 MHz frequency band[2]. NMT450 was a first federal cellular standard deployed in Russia in 1991. Number of users of NMT450 in Russia once reached 1mln is now declining.

In 1998 a need for digital technology for future migration of NMT networks was identified at the NMT MoU Plenary. After studying three different technology options for digitization of the NMT systems, two technologies were selected in 1999 for future evolution of the NMT450 networks: GSM400 and CDMA450. After deployment of two trial GSM400 networks, this evolution path was abandoned by manufacturers who supported it. Between October of 2000 and December of 2002, trials of CDMA450 (also known as IMT-MC-450, or Band Class 5 of IMT-2000 CDMA Multi-Carrier[3]) were conducted by different NMT operators in Russia, Hungary, Romania, Sweden, Georgia and Belarus. Trials have led to successful commercial launches in Romania, Belarus and then in Russia.

II. IMT-MC-450 studies and trial networks

Russian Administration in support of requests from leading NMT450 operators has initiated a study on effective use of 450 MHz frequency band by digital technologies for s smooth migration of NMT450 networks. The studies included studies of NMT network evolution options and implications, EMC and sharing studies of CDMA technology. Studies were carried out by leading Russian scientific research institutes. Studies have shown that IMT-MC-450 is an effective solution for evolution of NMT450 networks in Russia.

In order to practically support the results of theoretical studies trial networks were deployed first in Moscow by Moscow Cellular Communications (December 2001) and then in St.Petersburg by DeltaTelecom. The trials were aimed at testing system coverage and capacity, high-speed packet data capabilities, electro-magnetic compatibility (EMC)/sharing with NMT450 network and other users of the band and adjacent bands, and roaming capability.

The following trial results were reported by operators:

- Single cell radio coverage of up to 50 km;
- Capacity claims proved;

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[1] See Report ITU-R M.742-4, Annex 3 for general description of the NMT standard; See NMTA website http://www.nmtworld.org for more information on NMT450 operators.

[2] Almost all of NMT450 networks operate in the 450-470 MHz frequency band.

[3] See Recommendation ITU-R M.1457-3.

- Approximately 100 kbps average packet data transfer rate (download and upload) achieved in urban environment, in movement;
- Excellent voice quality experienced;
- Roaming successfully tested;
- EMC: two networks, analogue and digital, may coexist in the band, if the guardbands are used at both sides of CDMA carrier.

Based on the studies results and trial network tests IMT-MC-450 was chosen by the Ministry of Telecommunications and Informatics of the Russian Federation as the technology evolution path for existing NMT450 networks in Russia. The IMT-MC-450 standard was adopted as a federal standard in the Russian Federation.

III. IMT-MC-450 Commercial Network Deployments

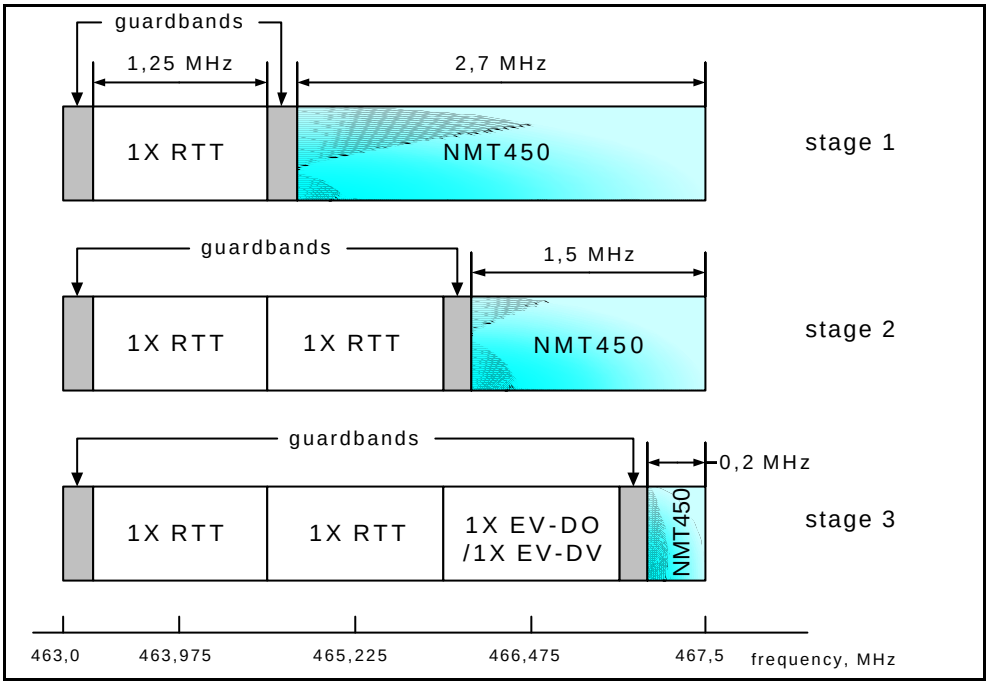
Following the trials and decision of Administration mentioned above, DeltaTelecom deployed a full scale commercial IMT-MC-450 network in Saint Petersburg, Leningradskaya Oblast (Region), and several other regions in north-west of Russia under trademark "SkyLink". Moscow Cellular Communications (MCC) is currently deploying an IMT-MC-450 network in Moscow and Moscow Region to provide services under SkyLink name starting this autumn. There are other NMT450 operators in Russia currently deploying IMT-MC-450 networks in other parts of the country.

A) Stages of IMT-MC-450 Network Deployment

Studies have shown that smooth migration to digital technology in the 450 Mhz band may be performed in several stages, as illustrated in Figure 1. In most cases, the NMT450 operators have limited bandwidth available (2x4.5 MHz on average), which allows usage of three IMT-MC-450 carriers (1,25 MHz each). The need to move from one stage to another may appear at different times in different parts of the network. Traffic demands may greatly vary across the covered territory. Thorough analysis and careful planning should be used to achieve high efficiency and quality.

FIGURE 1

Spectrum usage (BS Tx band) in 3 stages of network evolution.



1) *First stage: initial deployment.* First, a single IMT-MC 1X RTT carrier is introduced. This requires the NMT450 operator to clear 2x1,79 MHz of spectrum used by the analogue NMT system (2x1,25 MHz for the 1x RTT carrier, and 2x2x0,27 MHz for a guardbands between the IMT-MC and analogue narrowband carriers). At this time, the NMT analogue network is still operational and providing service to the customers in parallel with the new IMT-MC system.

2) *Second stage: network growth.* With growth of voice and data traffic in parts of the network, a second IMT-MC 1X RTT carrier can be introduced. This requires the operator to clear an additional 2x1,25 MHz of spectrum used by the analogue NMT system. No guardbands between the IMT-MC carriers is needed. Depending on traffic demand, one IMT-MC carrier can be used mainly for voice, while the second carrier can be used for voice and data. During this stage, NMT analogue subscribers are still being served by the network, but with limited quality due to restricted bandwidth of 1,5 MHz.

3) *Third stage: high demand for data services.* When the data traffic in the network increases substantially and higher bitrates are desirable by end users, a data-optimized carrier – (1xEV-DO) and furthermore 1xEV-DV can be introduced.[4]

B) Commercial IMT-MC-450 Services

When SkyLink began its IMT-MC-450 commercial operations, the cellular mobile radio communications market in St. Petersburg was well developed with nearly 37% penetration and with three competing operators, Megafon and MTS (GSM), and Fora (analogue).

[4] Assuming 2x 4,5 MHz, continued analogue NMT operation is not possible in areas where all three IMT-MC 450 carriers are in use.

SkyLink's objectives for its IMT-MC-450 deployment were to 1) replicate coverage of its analogue NMT network and continue provision of high quality voice services, and 2) provide a variety of new data services to compete with the GPRS services offered by its competitors.

1) Coverage

SkyLink began offering commercial IMT-2000 services over its IMT-MC-450 network in December of 2002. Initially, the network deployment was limited to Saint Petersburg and its nearest suburbs. In order to cover the same geographic area as its analogue NMT system, SkyLink deployed IMT-MC-450 base stations (BTSs) on top of 60 of the 67 existing analogue NMT cell-sites. It was shown that the coverage quality of IMT-MC-450 network is significantly better than that of the analogue NMT system.

2) Services

In addition to providing high-quality voice services, SkyLink is offering the following advanced data services over its IMT-MC-450 network:

- High-speed access to Internet (with data rates up to 153 Kbps) using computers, notebooks and PDAs;
- Access to specialized Web-portals using mobile terminals or PDAs[5]
- E-mail reception and transmission with SMTP/POP3 protocols using mobile terminals or computers;
- Mobile games and specialized applications, such as "Search of objects" with option to receive a city map with the found objects on PDA screen.

When it began providing these services, SkyLink decided to offer three different pricing plans, see Table 1.

TABLE 1

Pricing Plans (Tariffs)	Subscriber's number	Voice minutes included	MBytes of data included	Monthly fee
1	7-digit (local StP numbering area)	Unlimited	75	72 $
2	7-digit (local StP numbering area)	Unlimited	30	60 $
3	10-digit: (8-901+7-dig.)	Unlimited	30	50 $

The duration of voice conversations was not limited, and the cost for data transmissions over the limit is 0,3$ per MByte.

[5] The SkyLink network is developed and constantly modified the Web-portal SkyMobile on which is collected the most important, operatively updated information on user's account, dealers, cash departments, news, exchange rates, weather, help phones etc.

3) Network and service offering expansion

Once it completed its initial network deployment in the St. Petersburg region, SkyLink began to expand its IMT-MC-450 network and services to Leningrad Region. Wireless service penetration in the St Petersburg and Leningrad Region had increased to 45%, with four GSM operators (Megafon, MTS, BeeLine and Tele2), which were offering a variety of services using GPRS, including MMS.

Under these conditions, SkyLink decided to focus its IMT-MC-450 network deployment and service offering in Leningrad Region area where the majority of the population (more than 50%) lives, and to offer a wider variety of higher quality voice and data services.

The new pricing plans included: the Manager Tariff (30$ monthly fee, includes 300 minutes to public telephone network (PTN) numbers and an unlimited number of minutes to mobile phone numbers); and the Special Tariff (exclusively for analogue NMT subscribers that migrate to the IMT-MC-450 network).

The expanded list of data services included: protected access to Intranet (based on VPN); a significantly extended list of services through the Web portal; and preparation for introduction of special platforms of online access to wireless applications using BREW (Binary Runtime for Wireless).

C) Lessons Learned from Commercial IMT-MC-450 Operations

Based on its experience with a commercial IMT-MC-450, SkyLink has made the following observations:

1. Actual capacity and network throughput of the IMT-MC-450 network met declarations made by equipment manufacturers.
2. Electromagnetic compatibility between the analogue NMT and IMT-MC-450 systems was achieved when guardbands were implemented between the analogue and digital carriers.
3. No serious electromagnetic compatibility problems occurred between the IMT-MC-450 system and other wireless systems operating in adjacent frequency bands.
4. The adopted market entry strategy, including tariff plans, was justified:Despite a high entrance fee (> 400 $) there is a steady demand for offered services;
   - More than half of subscribers use data services;
   - Average monthly data traffic volume is approximately 10 Mbytes per subscriber;
   - More than 5% of subscribers have monthly data traffic volumes significantly exceeding the amount included in the pricing plan (30 MBytes per month for pricing plan 1 and 2, see Table 1);
   - Average Revenue Per Subscriber (ARPU) of IMT-MC-450 network is eight times more than the ARPU of analogue NMT450 network;
   - Stable growth of subscriber base of IMT-MC-450 network;
5. The further reduction of analogue NMT subscriber base in 2004 will enable to enter the deployment of a second IMT-MC-450 carrier, that will double the network capacity.

IV. Conclusion

The evolution path for the 1st generation NMT450 analogue mobile networks to IMT-2000 has been explored in Russia by studies and trial networks, and has proved successful by commercial launches in Russia and elsewhere in Eastern Europe.

The use of IMT-MC in the 450 MHz frequency band may serve as an efficient solution not only for NMT450 operators seeking to evolve their networks, but also for new operators interested in providing IMT-2000 services across vast territory with less investment. At the same time experience of rolling out of IMT-MC-450 network in St. Petersburg has shown that the system also allows operators to build IMT-2000 systems in the 450 MHz range in territories with high density of traffic.

The experiences of the NMT operators in the Russian Federation demonstrates that there is a demand for wireless data services and Internet access, particularly as subscribers get used to paying not for session duration, but for information volume. In addition, in the absence of advanced wireline infrastructure, IMT-MC-450 networks provide a unique opportunity to deliver high-speed data services (especially access to the Internet) to subscribers in both urban and rural areas.

In conclusion, the Russian Federation anticipates that the experience of its NMT450 operators in evolving their 1st generation analogue systems to IMT-2000 using IMT-MC-450 will be useful to other countries and operators as they investigate their options for IMT-2000 deployment.

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