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PROBLEMS OF DIGITALIZING MILITARY COMMUNICATION NETWORKS AND WAYS OF SOLVING THEM

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At present significant part of military cable networks is built on the basis of dedicated (allocated to subscribers) analogue communication channels which are their own and leased from the United Telecommunication Network (UTN) of Russia. Own channels of the Ministry of Defense are mostly used in the central zone and in the communication networks of separate units and formations of the Armed Forces. Channels and streams in trunk-lines as a rule are leased from Rostelecom and Electrosviaz JSC. Special bridged taps are established between network nodes of UTN and military network nodes. They are used to bring leased channels straight to the consumers. The vast majority of bridged taps of the Ministry of Defense is built on the basis of MKSB-type copper cables and K-60P and P-306 analogue transmission systems (ATS).

At the same time, there are the following main disadvantages of the existing cable networks: morale and physical ageing of the equipment, reduction of its reliability (service life of transmission systems of practically all bridged taps is over) and, as a result, voice-frequency channels feature high inconsistency of parameters and deviations from normal parameters; absence of united network system of automated control of communications; significant power consumption of old-fashioned communication means; big number of personnel required to maintain the equipment; high mass and dimensions parameters of analogue equipment.

All these make the modernization of the existing cable communications lines of the Ministry of Defense on the basis of their full-scale transition to digital processing, transmission and switching of the information extremely necessary.

Besides development of information and control systems stipulates growing number of new users as well as necessity to enlarge channel resource in the interest of the existing users of the communication networks. Thus it becomes necessary to combine local computing networks of headquarters into united informational-and-computing

network, organize non-secured and secured documents turnout by means of electronic mail, create video-surveillance and video-communication systems, etc. Automatization of the telephone communications also requires two-three time increase of channel resource in information directions. Low traffic-handling capacity, reliability and quality of analogue channels don't allow cable networks meet growing requirements of consumers. At the same time, digital networks provide nearly unlimited traffic-handling capacity, high quality and reliability of channels, their automatic back-up and connection.

Analysis of the tendencies of subscribers networks development in the communication system of the Armed Forces demonstrates permanent total and specific growth in volumes of subscribers that are digital by their physical nature. To transmit traffic of such systems via analogue channels it requires additional transformations (modulation and demodulation) that affect the rapidness, reliability and quality of information exchange. At the same time, modern digital technologies of transforming and transmitting analogue signals (e.g. voice) have positive influence on the quality of voice communications.

Technical and economic policy pursued by communications operators and Rostelecom and Electrosviaz JSC first of all, is aimed at the accelerated development of digital trunk-line network of UTN of the Russian Federation and deactivation of existing analogue networks. It is only the requirement to provide special consumers with cable communications that prevents operators from quitting maintenance of out-of-date analogue equipment. As result of this unlike digital network the existing analogue network is not modernized and updated. It brings to the permanent loss of quality performances of channels leased in the interest of information exchange of the Armed Forces with general growth in quality level and quantity of offered communication services. Charges for leasing the channels have a permanent tendency to make digital ones cheaper and analogue ones more expensive. If only in 2000 leasing of digital 64 kbit/sec channel from Rostelecom JSC was 2.3 times as expensive as voice channels already in 2004 it became one and a half to two times as cheap as it. The difference will be more significant when leasing data links with higher speed.

With these and other factors taken into account the Office of the Chief of Communications has started full-scale works on preparing and performing step-by-step transition of communication system of the Armed Forces of the Russian Federation to employment of digital means and link of communications. To develop unified scientifically and economically reasonable approach to the conducted digitalization several regulating documents were elaborated and approved. The main documents are the following: "Concept of transferring communication systems of the Armed Forces of the Russian Federation to digital data transmission and switching," "Special-purpose comprehensive program of step-by-step transfer of the primary communication network of the Armed Forces of the Russian Federation to digital telecommunications equipment," "Program of transferring secondary communication networks of the Armed Forces of the Russian Federation, other units and formations to digital equipment of data processing and rendering services."

When carrying out full-scale digitalization of communication networks necessity of providing communications continuity at all stages of modernization cannot be disregarded. Digital communications system is not created at once in the "deserted" place

it shall be upgraded in parallel with the existing analogue systems with step-by-step transfer of customers to the digital telecommunication equipment.

At the same time, regardless to the recent tendency of increasing expenditures on military equipment procurement the Ministry of defense is not capable of financing such high-priced projects as simultaneous replacement of copper cable trunk links with fiber-optic communication lines (FOCL) and additional leasing of high-speed digital channels in the interest of all existing and perspective users.

That is why use of so-called "money-saving" technologies can become one of the ways to perform digitalization. First of all it is "digitization" of existing cable bridging taps using xDSL technology (it is dozens of times as money-saving as creation of FOCL), as well as use of flexible digital channels multiplexers, which provide more efficient (more than twice) use of traffic-handling capacity of leased channels. Besides, number of digital channels can be built-up by means of using xDSL equipment operating on free pairs of existing cable trunk links without affecting ATS operation.

Success of carried out activities to digitize communication networks will depend much on correct selection of telecommunications equipment with specific requirement of the military communication systems taken into account.

- Firstly, it is informational and technical security. This requirement means that the used equipment should be manufactured domestically and should contain complete set of operating and design documentation in accordance with GOST (State Standard). Software should have fully open source code and be certified by authorized bodies.
- Secondly, it is unification of digital equipment and control systems. Ideally the whole spectrum of telecommunication equipment for various communication networks should be manufactured by one development contractor and have united distributed control system. This will make it possible to increase efficiency of technical maintenance and operational control of communications, to decrease expenses on personnel training, purchase of SPT&A, etc. But in practice each branch of the Armed Forces has its own ordering and expert organizations, its own existing cooperation of developers. In this situation the way out may be in creation of new materiel on the principles of "open systems" with use of standard algorithms and protocols, which provide possibility of joint operation and united control principles.
- Thirdly, developer should provide its personnel with access to the secured facilities to perform warranty and post-warranty maintenance of the delivered equipment;
- At last, fourthly, design and operational characteristics of equipment should comply with the protection level of the facility where it is used.

In accordance with expertise performed relative to these and a number of other criteria the Chief of Communications of the Armed Forces of the Russian Federation has compiled a "List of dual-purpose communications equipment used and planned to be used in the Armed Forces of the Russian Federation." The document is approved by the Chief of the General Staff of the Armed Forces of the Russian Federation and Deputy Minister of Information and Communications of Russia. The list includes equipment of a

number of domestic manufacturers of telecommunication equipment. These are EZAN FGUP, NATEX NTTs, NPP Novel-IL JSC, Morion JSC and others, in particular.

Telecommunication equipment of the above-mentioned companies in general meets the requirements of military communication specialists and is at approximately the same level in technical performances.

But at the same time, it's necessary to point out that equipment of the Megatrans family manufactured by the NATEX group is the most favorable for works with copper cable.

The author of the present article personally participated in several comparison tests of xDSL equipment of various manufacturers at facilities of the Ministry of Defense and states superiority of the Megatrans-3 modems in operation reliability, range of contact and the least impact on K-60P ATS operating simultaneously with it.

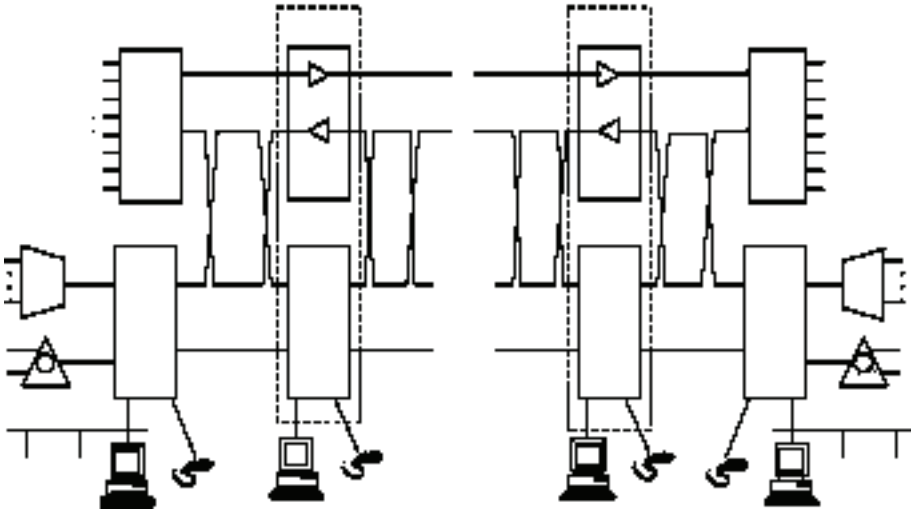
New generation of the Megatrans-4 digital transmission system (DTS) provides synchronized bit transfer rate up to 4608 kbit/sec via free physical pairs of copper cable at a distance of up to 270 km and supports 14 remotely-fed regenerative repeaters. Such unique performances were achieved owing to unbalanced self-adaptive multiposition modulation with adjustable level (with use of TS-RAM and G.shdsl.bis, ITU-T 991.2 standards) and system of analogue processing and correction of the signal, which had been developed and patented by the company. Thanks to the latter installation of the Megatrans equipment doesn't require individual tuning for type and quality of the cable, length of segment, etc. That was confirmed by the tests performed on the real cable trunk line of the Ministry of Defense with specialists of the 4 TsNII MO (Central scientific research institute of the Ministry of Defense) participated.

The most important feature of the Megatrans-4 termination equipment is the presence of two built-in N interfaces (G.703 2 Mbit/sec) and one Ethernet 10/100BaseT. Thanks to support of G.704 standard and TDM+Ethernet technology any variants of distributing traffic handling capacities of the digital path between all three interfaces is acceptable and correspondingly between various TDM and IP users. It provides a series of unique possibilities.

- Firstly, connection of communications control complexes directly to DTS via Ethernet interface bypassing channel-forming multiplexer, thus making it possible to perform maintenance of the latter without a risk of loosing control over the network.
- Secondly, unification of modern private automatic telephone exchanges (ATE) directly in a separate E1 channel without using channel and switching resources of multiplexers.
- Thirdly, unification of computers at various communication master stations and control centers of the formation into united virtual local area network (VLAN) without additional cost because thanks to presence of Ethernet bridge in all modems and regenerative repeaters Megatrans-4 DTS constitutes Ethernet switchboard distributed for hundreds of kilometers.

Example of organization of digital bridging tap on the basis of the Megatrans-4 equipment operating in one cable together with K-60P ATS is given in the Figure.

Regenerative repeaters are located at nonserviced repeater stations (NRS). Depending on the customer's requirements and status of the cable trunk line transmission rate may vary within the range from 200 to 4616 kbit/sec with 64 kbit/sec intervals. It is possible to increase the length of the regeneration part at lower rates of transmission. Thus, in 2002 experimental operation of the Megatrans DTS was carried out at one of the bridging taps of the Ministry of Defense. It provided stable operation at a rate of 400 kbit/sec for the distance of 37 km without using regenerative repeaters, additional pairing and balancing.



Organization of the Digital Bridging Tap on the Basis of the Megatrans-4 Equipment

Besides digital copper cable transmission systems NATEX manufactures practically the whole spectrum of digital telecommunication equipment required to modernize the existing communication networks and create new ones: FOCL transmission systems, multiplexers and switchboards of digital-synchronous and digital-plesiochronous hierarchy of all levels, microwave-link systems and equipment of wide-band radio access. The manufactured equipment supports both traditional for military communication networks TDM technologies and rapidly developing in the world market IP networks as well as their various compositions (TDM over IP, TDM+Ethernet, VoIP, etc.).

It is worth mentioning that efficiency of any telecommunication equipment depends not only on quality of operation of separate elements but also on the presence of the developed administrative system. With this in mind the "NATEX" Group of companies has developed an integral control system FlexGainView. It is an open system, i.e. it can support equipment manufactured by the third parties and its modules can be adapted into other control systems built on the basis of modern standards. SNMP-agents and MIB-files of the FlexGainView system are fully compatible with HP-Open View and SNMPc Castle Rock used in the world recognized control environments. Software operates in Windows and Unix systems and meets the increased requirements of reliability and safety. It is certified by the Ministry of Communications of Russia. Here are the following functions of the control system: graphic display of controlled network

elements on a united map of devices, load of terrain map; detailed presentation of status of the selected device with possibility of applying SNMP-commands to the device; device boards failure alarms and notification (color, sound, E-mail, SMS through e-mail); registration of network events in the logbook of current and happened events with a possibility to compile trend-report on the preset events; simulation of malfunctions; tuning of routes between terminals; control of emergency situations happening in the data transmission channels; control of protection systems and many others.

Selection of the equipment for every specific case, its installation and adjustment at the customer's sites is performed by the specialists of the Natex Spets-telecom company, which have all required regulating documents and appropriate level of security clearance.

The enterprise analyzes tendencies in developing domestic and foreign telecommunication network technologies, participates in research and experimental development, elaborates proposals on use of serially manufactured products in the communication networks of the special consumers, provide development, manufacture and delivery of communication means and software complying with special requirements to the security ministries and structures. Military representatives of the Ministry of Defense oversee the quality of performed works.

Natex Spetstelecom conducts special inspections and analysis of the manufactured equipment. It passed through Quality Management certification in the Military Register voluntary certification system. It has got FSB license on performance of works related to use of information considered to be a state secret.

On the basis of results of work of the Commission controlling quality of domestic telecommunication equipment created in accordance with the decision of the Chief of the General Staff of the Armed Forces of the Russian Federation the whole spectrum of products was recommended for employment in the networks of the Armed Forces of the Russian Federation.

Employment of equipment manufactured by the NATEX Group of companies will make it possible to use advanced and perspective technologies in the special communications networks, raise operation efficiency, survivability and information security of the existing communication system and to provide modernization of the communication system of the Armed Forces of the Russian Federation in a short space of time.