

Information systems studying

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JUSTIFICATION OF PERSPECTIVES DIRECTIONS OF UPGRADING RADIOCOMMUNICATION SYSTEMS OF ARMED FORCES UKRAINE

Aim. In the article explore issues and directions of the innovative approach to the development of automated complexes and radio communication facilities for special purposes. During the research it was determined that the effectiveness of the military radio communication system would be improved by facilities of modernization of the latest facilities of radio communication of foreign production or by improving the existing system of military radiocommunication. Presented directions and features of leading research and development works for the improvement and development of channels and systems of military radio communication, the creation of nodes and centers of radio communication, automated complexes and radio communication of special purpose were presented. Was given generalized approach to the construction of the system of automated radio communication, antenna-hardware complexes, software and hardware complexes of radio prediction and planning of use of radio frequency resource. **Conclusions.** According to the results of the conducted researches, conceptual decisions about the system engineering and technological reconfiguration of the existing radio communication system are proposed, which will allow to work in the automated radio networks as part of the radio centers of information and telecommunication units; to unify the facilities and complexes of radio communication with facilities of communication and automation, to provide counter work with the equipment of the old park, as well as to construct a fundamentally new radio communication system with the ability to calculate the planning and forecasting of the radio frequency resource.

Keywords: complex and device of radio communication, antenna-device complex of adaptive radio communication, systems radioprediction and planning radio frequency resource.

Formulation of problem

Analysis of recent research and publications.

Improving radio communications have special significance in connection with number of issues that appeared during antiterrorist operation (ATO).

Base of improvement existing radio system should make automated transceiver two-way radio systems and field stationary radio centers of new generation developed on new element base with advanced technology radioaccess that enable creation of sophisticated and flexible structures.

Research perspectives of development of radio communications systems conducted to ensure sustainable, reliable and timely information to different users bring in conditions of natural and artificial destabilizing factors, which is actual scientific task.

Scientific and technological task of research should be resolved within framework of concept of a unified automated digital communication system (UADCS) special purpose, which based on reference model of open systems interconnection OSI (open systems interconnection basic reference model) and modern telecommunication technologies based on using radio with programmable parameters (SDR - Software Defined Radio).

Objective of article is scientific justification for choosing directions of radio communication systems of special purpose taking into account existing and future approaches to construction of radio and reconfigurable automated systems.

Systems of military radio communication should provide the necessary information resource of users for

the purpose of their integration into information-control systems of the armed forces, as shown in fig. 1 for the US armed forces. According to recommendations MSE-R for radio with programmable parameters (SDR) include transmitter and/or receiver, which use technology of using software install or change working frequency settings, including in particular frequency range, modulation type or output power except changing operating parameters used in normal course of pre-work preset radio unit, according to particular specification or standard system [1].

Main directions of research, which conducted at creating automated digital radio system:

complex approach in creation, implementation and operation advanced networks, radio systems and radio communications;

realization technology design, which provide, finally, networking, radio channels and radio communications systems that operate consistently in conditions of different kinds of destabilizing factors;

perform not only traditional requirements of creation "set" of technical devices, combined in some information and control network and implementation of main objectives for which creates radio network or radio communication - namely, ensuring reliable, noise-immune, secured and continuous radio 'communication;

development and implementation methods of structural and parametric synthesis channels, receiving, transmitting antenna and hardware adaptive radio communication systems and equipment for radio centers;



Fig. 1. Structure of the combined information and control system

development and implementation of technology providing necessary tactical and technical characteristics at all stages of life cycle of networks, channels, systems and radio communications.

Task solution

1. Systems (channels) radio communication

Main directions of research in field of radio communications shall including development of principles of construction special purpose radio systems using different levels to ensure structural stability of wireless communication networks to action of enemy countermeasures (REW) and devices of destruction through:

combination of direct and switched radio low and medium lengths that enable transmission of information to bypass nodes have failed and radio lines because of weapons, REW and violation of propagation;

integrated using radio spectrum in HF, UHF bands, which allows to organize radio using different propagation mechanisms - with HF reflection from ionosphere - UHF with display of sporadic layer in conditions of undisturbed environment and terrestrial waves in HF, UHF bands.

Achieving immunity, security and capacity of networks and channels should be based on:

multiparameter adaptation of organization, maintenance and restoration of wireless communication (frequency, speed and transmission

mode, spatial orientation of directional diagrams resettlement (antenna feeders antenna-feeder devices);

compensation of powerful natural and intentional interference, and preventing their emission of radio devices;

packing information and dynamic routing packets of information based load and driving conditions [5, 6];

optimal combination of direct and error correction procedures supplementary request ARQ (Automatic Repetition Query) during transmission using effective methods of coding [5, 11];

radio control connectivity and quality radiolines based on cognitive radio (using probing and test signals predicting propagation conditions, employment and evaluation frequency range of signal-interference environment;

Using digital methods for forming and processing of promising optimal signal-code designs that provide high-speed data, without compromising noise immunity parameters [5, 6];

functional independence of radio communication networks of external synchronization (navigation systems) for autonomous functioning in defeat these systems using efficient algorithms entry and support of high-matching-based generators.

While creating radio systems must be provided to develop tactical and technical requirements for radio systems for various purposes, operating in difficult conditions-interference environment, including action REW, which include:

wide requirements for construction and deployment territorial networks, channels and wireless communication systems, including general characteristics and quality indicators of networks and channels;

specifications interoperability of radio communications transport networks, access networks, services, communication services, automated control system of communication, information security and systems (logistics, power supply, network clock synchronization, numbering and addressing), providing taking into account implementation of operational requirements imposed by customer.

Simulation of networks and channels radiocommunication study principles of design and development methods for their implementation should include:

description and typical networking scheme, the complex of radio communication units of various ranks;

complex issues of information security and protection of wireless communication networks of technical devices intelligence;

proposals for uniform joints, protocols and interfaces of network elements network radio.

comparative performance assessment schemes (options) of radio communication;

assessment of probability-time characteristics would bring networks and radio communication channels in terms of destabilizing factors;

development of programs and methods of bench and field tests to verify that parameters of (complex) radio communication requirements of tactical-technical task (TTT) in their development.

2. Creating units and radio communication centers

Implementation of the transition from traditional building radio unit, main task of which was to set pairing devices interconnected via communication devices, to develop promising equipment which incorporates wide functions.

Main directions of research in field of radio communication units and centers should include development of principles of construction of radio centers for various purposes in order to:

Modular building unified radio centers of various ranks, something provide increasing functionality by breeding standard modules;

group using radio in place of their existing assignment radio direction;

digitally automated topology formation and reconfiguration of radio networks;

shuttle spaced elements distributed radio centers based on standard interfaces and advanced telecommunication technologies;

ensure transition of interaction in diverse joints (for data lines and for line management) in unified solution based on one of sheets Ethernet that will greatly simplify task combination of hardware and

transfer it from area of software and hardware solutions in area of software problems while increasing it's flexibility and scalability [2-6].

3. Complex and radio communications devices

Main areas of research in field of radio communications systems and should include development of principles of construction radio devices for various purposes in order to:

establishment of receiving, transmitting, antenna and hardware systems and radio frequency systems support;

building complex and radio communications systems based on concept of SDR (Software Defined Radio) and SCR (Software Cognitive Radio), which allow lifecycle framework to develop hardware device functionality and efficient using radio frequency spectrum through improved software that provides different, including new algorithms;

creating complex and radio communications systems, which provide software and hardware platform performance networks, wireless communication features of physical, data link and network levels and management of networks - and transport, session representative and applied levels.

Main tasks that must be addressed in course of research in creating systems and radio communications as part of functions of physical layer are:

formation and spectral energy efficient signals, including signals with extended range ("fast" and "slow" pseudo-restructuring operating frequency) noise signals and their combinations;

provide necessary energy potential of radio channels by varying frequency, speed and power transfer, including by drafting capacity in transmission antenna and hardware;

implementation of spatial configuration diagram orientation of receiving antenna and hardware from direct sources of interference, drawing power transmission antenna and hardware in space;

providing spatial and polarization compensation is not deliberate and intentional interference, and their radiation transmitting means [3, 4,9].

Main scientific and technological challenges in creating systems and radio communications in functions of link layer are:

frequency control and energy resources (adaptation speed, power transmission diagram form directional antennas);

implementation of noise-immune coding signals based on the two-level coding and application turbo coding;

providing multiple access to common time-frequency resource network based on code and the time-frequency separation.

Main objectives of research in creating systems and radio communications as part of functions of network include:

providing connections to network elements of transport network unified automated communications network;

implementation of necessary safety information exchange official radio communications network management procedures on basis of adaptation, routing and signal noise immunity;

integrated management of time-frequency and network energy resources based on active and passive analysis of signal-interference environment, using results of long-term forecasting and operational conditions for radio.

4. Antenna-device complexes

Development of antenna-device complex, which enable noise-immune receiving information simultaneously on multiple frequencies operating range of specified number of geographically distributed correspondents based on formation of controlled spatial diagram orientation specific forms of implementation required values of sensitivity to electromagnetic field, survivability and reliability in terms of different kinds of destabilizing factors [4-8].

5. Software-device complexes of radio prediction and planning radio frequency resource

While creating software-device complex of radio prediction and using frequency resources should focus on design:

automated networks operating radio prediction;

models of calculating characteristics of wave propagation in HF range, including using results of probing the ionosphere;

dynamic models of action natural and intentional interference;

software and methodological support for long-term, short-term and operational radio predictable range of usable frequency;

evaluation of statistical parameters obstacle levels in real time.

Was made comparative assessment interference environment in several lists of frequencies from issuing recommendations about frequency with the lowest noise level, and quality control admission on single operating frequency to desired mode.

Implementing radio dispatching functions in information and telecommunication communication centers in appointment operating frequency of radio communications, including:

visual inspection of whole list of backup frequencies in their current state;

frequency assignment reporter considering its usable range of frequencies on current time and noise level;

returning frequency (group of frequency) reserve list;

control radio season transition from one to another;

receiving of given frequency-time program control and marker signals;

receiving and processing results of determine frequency bands usable on their basis for using comparison of noise levels at different frequencies.

Feature software-device complex of radio prediction and planning radio frequency resource, which developed:

providing early assessment and operational characteristics of radio propagation and-interference environment;

recommendations for appointment operating frequencies, as optimal in terms of propagation and minimum level of noise;

planning using radio frequency resource information and telecommunication nodes of communication;

placement equipment should be not result in addition to capital expenditures;

ensuring continuous monitoring and continuous interference environment in several lists of frequencies;

providing automated control over allocation of frequency resources;

delivery in real-time recommendations of choosing operating frequencies on several criterial;

simultaneous using several data stations probing ionosphere.

Ensuring sustainability of channels and radio communications systems:

develop models assess stability of radio communication channels, radio wave propagation characteristics and interference different parts of wavelengths;

study ways and technical solutions to ensure the stability of the antenna feeder devices and protection electronic equipment from electromagnetic radiation of natural and artificial;

development requirements for protection radio equipment and antenna-feeder devices from electromagnetic radiation of natural and artificial:

selection (based on current regulatory and technical documents and literature), analysis and forming initial data on parameters of electromagnetic radiation of natural and artificial origin to develop requirements for safety equipment of radio and antenna-feeder devices from electromagnetic radiation according to the requirements for resistance (survivability) objects using;

development of tactical-technical task on creation equipment of protection radio devices and antenna-feeder devices from electromagnetic radiation of natural and artificial origin.

Assess the stability of settlement radio and antenna-feeder devices to electromagnetic radiation of natural and artificial accordance with their development (without equipment protection against electromagnetic radiation and their use):

calculation of estimates of expected parameters of voltage, current and energy induced in the antenna feeder devices and paths electromagnetic radiation of natural and artificial;

making estimated assessment of stability of radio, antenna and feeder protection equipment and the action of voltage, current and energy that in paths of aerial devices and feeders electromagnetic radiation of natural and artificial;

develop proposals on building schemes equipment protection against electromagnetic radiation of natural and artificial and experimental verification of radio parameters (selection of components used in equipment protection against electromagnetic radiation, allowing for the construction of reception and transmission channels of radio and antenna-feeder and the expected parameters of reduced voltage, current and energy);

develop proposals on building schemes equipment protection against electromagnetic radiation;

experimental verification of conformity of radio parameters (coefficient transmission, coefficient creeping wave amplitude-frequency and phase-frequency characteristics in operating frequency range) of individual units that make up equipment protection against electromagnetic radiation protection equipment and whole set of their development requirements. Development of programs and methods of bench and field tests to verify that parameters of equipment protection against electromagnetic radiation of natural and artificial requirements of tactical-technical task in their development: development of programs and methods of bench and field tests to verify that the parameters of the equipment protection against electromagnetic radiation requirements of TOR their development;

develop programs and methods of bench testing and field verification to ensure necessary resistance to electromagnetic radiation transmit and receiving radio tract;

justification required storage of specific types of control-measure equipment for making bench testing and field equipment protection against electromagnetic radiation;

justification required storage of specific types of control-measure equipment for bench testing and field verification to ensure necessary resistance to electromagnetic radiation transmit and receive radio tract.

Conclusion

In article directions of scientifically based systems (networks, channels), units and centers of radio communication, antenna and hardware, and also recommendations for creating software-device complex of radio prediction and planning of radio frequency resource.

Proposed solutions for system integrators and technology reconfiguration of existing radio system allow to:

1. Ensure working in automated radio networks consisting of stationary radio centers of information and telecommunication units and field information and telecommunications nodes, while providing automatic maintenance provider.

2. Unify devices and complex of radio communication with devices of communications and automation.

3. Ensure common (counter) work with old fleet of radio as stationary and field communication centers of command and control;

4. Ensure functioning and management of receiving and transmitting systems directly from device and remotely.

5. To provide automatic retransmission signal according to the address on choosing optimal correspondent of radio waves passing.

6. Build radically new, distributed type and technologically flexible automated system of radio communications.

Future research should consider development of hybrid information technology to improve efficiency of military radio communications systems.

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Обґрунтування перспективних напрямків розвитку системи радіозв'язку Збройних Сил України

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Мета. У статті досліджуються питання та напрямку інноваційного підходу до розвитку автоматизованих комплексів і засобів радіозв'язку спеціального призначення. У ході проведених досліджень визначено, що підвищити ефективність системи військового радіозв'язку можливо шляхом переоснащення новітніми засобами радіозв'язку закордонного виробництва або проведенням удосконалення існуючої системи військового радіозв'язку. Представлені напрямки й особливості проведення науково-дослідних і дослідно-конструкторських робіт з удосконалення та розробки каналів і систем військового радіозв'язку, створення вузлів і центрів радіозв'язку, автоматизованих комплексів і засобів радіозв'язку спеціального призначення. Наведений узагальнений підхід до побудови системи автоматизованого радіозв'язку, антенно-апаратних комплексів, програмно-апаратних комплексів радіопрогнозування та планування використання радіочастотного ресурсу. **Висновки.** За підсумками проведених досліджень запропоновані концептуальні рішення по системотехнічній та технологічній реконфігурації існуючої системи радіозв'язку, які дозволять забезпечити роботу в автоматизованих радіомережах у складі радіоцентрів інформаційно-телекомунікаційних вузлів; уніфікувати засоби та комплекси радіозв'язку з засобами зв'язку та автоматизації, забезпечити зустрічну роботу з апаратурою старого парку, а також побудувати принципово нову систему радіозв'язку з можливістю розрахунків планування та прогнозування радіочастотного ресурсу.

Ключові слова: комплекси й засоби радіозв'язку, антенно-апаратні комплекси адаптивного радіозв'язку, комплекси радіопрогнозування та планування використання радіочастотного ресурсу.

Обоснование перспективных направлений развития системы радиосвязи Вооруженных сил Украины

Р.Н. Животовский, С.Н. Петрук

Цель. В статье исследуются вопросы и направления инновационного подхода к развитию автоматизированных комплексов и средств радиосвязи специального назначения. В ходе проведенных исследований определено, что повысит эффективность системы военной радиосвязи возможно путём переоборудования новейшими средствами радиосвязи зарубежного производства либо проведением усовершенствования существующей системы военной радиосвязи. Представлены направления и особенности проведения научно-исследовательских и опытно-конструкторских работ по усовершенствованию и разработке каналов и систем военной радиосвязи, создания узлов и центров радиосвязи, автоматизированных комплексов и средств радиосвязи специального назначения. Приведен обобщенный подход к построению системы автоматизированной радиосвязи, антенно-апаратных комплексов, программно-апаратных комплексов радиопрогнозирования и планирования использования радиочастотного ресурса. **Выводы.** По итогам проведённых исследований предложены концептуальные решения по системотехнической и технологической реконфигурации существующей системы радиосвязи, которые позволят обеспечить работу в автоматизированных радиосетях в составе радиоцентров информационно-телекоммуникационных узлов; унифицировать средства и комплексы радиосвязи со средствами связи и автоматизации, обеспечить встречную работу с апаратурой старого парка, а также построить принципиально новую систему радиосвязи с возможностью расчёта планирования и прогнозирования радиочастотного ресурса.

Ключевые слова: комплексы и средства радиосвязи, антенно-апаратные комплексы адаптивного радиосвязи, комплексы радиопрогнозирования и планирования использования радиочастотного ресурса.