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GEOINFORMATION SYSTEM IN TELECOMMUNICATIONS

Macedonian Telecommunications

ABSTRACT

Geoinformation system in Macedonian Telecommunication is formed with an aim to maintain all functions, which have any orientation to spatial data. In the sphere of projecting, development, maintenance and servicing, in the constitution of the technological working in telecommunication, spatial data is presenting a beginning amount of knowledge for the basic solution in those areas.

INTRODUCTION

Modern working in institutions which processing gravitate to spatial data, the implementation of spatial functions perform as correspondent locations in technological systems. Relation, which is opening an important place of the spatial data in integration process, and bigger obligation for their correct, fully and repeatedly dimensioning. Formally ordinance cases but important for the states that don't have covered the functioning of these systems with fundamental standards, on the level of data, platforms, integration and complete implementation.

The formulating of Geoinformation System in Macedonian Telecommunications started before twenty years. That is a period cognizable with conventional philosophy for dimensioning, figuration and distribution of spatial data, from the one side, and not enough presence of new relations and norms with the subjects/participants in the part of verification, management and protection of the spatial content. Unfortunately, these decisions in the time distance are present also today in many institutions in the country, and present one of the notable charges of the processes for correctly transition of existing systems. It is about ununique development concepts for modernizing the technological processing, technologies and methodologies in the sphere of acquisition of the spatial content, which in output give untransparency for interchange, management of the data in wide frames.

Knowing this situations, MT together with the Faculty of construction, formulate an expert team for researching of this phenomena, with an unique goal: establishing of GeoIS with an open opportunity for integration with Telecommunication information system (TIS) and some higher systems on the state level, when the basic condition are created. Of course, in the beginning, in the stage when on the state level there is no understanding for such systems, integrative processes were purely orientated to TIS. Fundamental functions as location components for integration of these two systems, are exposed through the following segments

- Projecting/ development/ maintenance of the infrastructure underground networks
- Service/ integration of the telecommunication services
- Projecting/ development/ maintenance of radio-sidelong relations
- Projecting/ development/ maintenance of mobile telephony

For affirmation of these segments, with high importance is restoration of transparency between different definitions of the data structure, by the feature, quantity and topology, and full respect of the need for integration of user locations with their complex spectrum of needs and services. It is about dynamic categories which cognitions together with their internal and external life cycles need concrete and correct location in systematic working. Besides it was same institution, in the sectors which were advocated these segments, there was an unequal stage not only by the data feature but also in the treatment and prosperity of the process realization on the level of acquisition, presentation, protection and service of the data.

In context with the material that this commission is occupied of, the status of this work is not to dislocate the functions, which by their nature don't belong in the group of spatial management, but to affirm the contact category of spatial data in system control points that are structuring the information for system decision.

0.1. GOALS FOR FORMULATING THE SYSTEM

Formulating of GeoIS in MT has a goal to:
Dimension and integrate the functions from technological working which are gravitating to spatial data
Make an external and internal balance in the quality and quantity of the spatial and attribute data
Make a compatibility and full transparency to the integral system of telecommunications
Provide flexible and modern alignment of the segments from technological working
Provide an opportunity for continuous integration with the systems on the state level
Provide more effective and economical functioning
Arise the market and controlled distribution of the spatial material on the institutional and state level

0.2 STARTING POSTULATES

System realization subjected to the methodological principles, unambiguity concepts the organizational structure of singular and relational data structures. It is from formal interest, the structure of the data classes to be adequate profound how can, in integral way, be avoided:
Redundancy
Incompleteness
Ambiguity

And in the output provide correct/useful

Topological structuring
Appropriate entity structures

These postulates unambiguity affirmed the dimensions of acquisition approaches and objectives for standardization of particular and integral processes, feature and quantity of output data and technological platforms. The intention for sophisticated concentration of entity structures is connected with the basic philosophy of telecommunication working, specializing some practical functions from the exploatation domain:
To determine an optimum route for connexion of new network subscriptor.
To restore and affirm interaction functions for locating the defects in infrastructure network.
To provide stabile algorithms for transfer and integration of existing data and continuity for new data, globalized in the frames of central, subscriptor, infrastructure network and distributive locations to the subscriptor.
To provide technology for formation of terrain model and 3D analyses, alternative solutions by the principles of overhead, zonal, linear and frequency covering with radio signals.

When to these requirements we add the internal and/or external locations for presentation, the process objectives are opened for which the system constitute an objective, unique and optimal informing. With intention to get know the stages and traditions of institution and obtain enough postulates for nomination of strategy, there are made analyses in the following control spots:
Stage, level and mode for acceptance of the existing data material
Investment processes with their dynamic for the period which follows on institutional level
Legend format
Software sustained processes
Adaptation of applicative stages for user and server
Candour for own development of applicative aliment
Domain and expanse of activities
Quantity, dynamics, tradition and location for external and internal streams and their distribution
Functioning in real time with remarkable solidness and/or flexibility of technological components
Useful degree of existing equipment
Set of spatial algorithm components
Degree of educated staff structure for the processes from formulating to fully implementation of the system
Postulates for integration of higher abstractions in internal and external meaning
Existing and announced state and institutional strategies

With no intention to admittance in theoretical aspects for formulating and development of such systems, we would position on institutionalization of the basic goals for system ordinance as carrying objectives in system design:
How to sufficient quantity, qualitative and full data structure
Which functions for real discreatization of phenomena with all life cycles
Subsisting these components in real time
Permanent distribution and servicing of services of the subjects and users
Protection of systematic working through the protection of its basic components
Verification of informing and information constitution

0.2.1 GLOBAL FUNCTIONS

Each segment, in which system should be implemented, opens group of functions for defining principles for database design and system working

Functions in the category formation of DOCUMENTATION

Acquisition of spatial and attribute data
Topological and attribute control and rejection of mistakes in data entering
Maintenance of data
Assistance for 3D processing
Formulating of output documentation
Formulating of global/specific project schemas
Defining of digital keys/symbols for display
History of data

Ô . Processing and working environment for getting function the executing treatment

PC platform - implement the functions orientated to CAD drawings, original data from Total Station, GPS, data from digitalization and registration of attribute data for spatial structures.

WORK STATION platform - transfer of data from PC platform, forming and control of topology, data addition under software GIS platform

Functions in the category SUBSCRIPTOR RELATIONS

Assignment and display of spatial segment by spatial and attribute entities
Optimal connexion under the parameters
Closest distributive point
Optimal distributive point defined by the criteria for distance, free capacity and/or perspective progress of new subscriptor
Administrating region_ central_ operative
Administrative apprehension of documentation by relation request_ working prescription_ connexion_ registration
History of data
Interactive graphic apprehension of preliminary functions

Ô . Processing and working environment for getting function the executing treatment

PS platforms with software GIS platform

Functions in the category SERVICING/MAINTENANCE

Assignment and display of spatial segment by spatial and attribute details
Spatial and attribute questions
Display of physical objectives in installation nets
Location of defects in the net
Statistic for the defects by net elements
Statistic by particular elements in the net
History of data
Interactive graphical apprehension of previous functions

Ô . Processing and working environment for getting function the executing treatment

WORK STATION platforms with software GIS platform
This part of functions is solvable also on PC platforms with PC version of GIS applications or only section of data from the master database distributed on PC.

Û . Function in the category of information VF/RR networks
2D and/or 3D object and network display.
Spatial and attribute questions
Display of physical relations between chosen objects
Display of stages in the network
Simulation of stage in the networks from data to measuring equipage
Acceptance of sensor remote registrations from the measuring places.
Zone/cell/segment of overcastting with radio signal

™. **Processing and working environment for getting function the executing treatment**
PS platforms with software GIS platform

Û . Category of PLANNING/INVESTMENT
Spatial and attribute display of existing net for particular segment
Spatial and attribute display of existing objects of interest
Global development of new networks and objects
Analyze of trends for long-lasting network development
Planning and development of sidelong RR relations
Planning and development of segments with mobile telephony

Ô . Processing and working environment for getting function the executing treatment
PS platforms with software GIS platform

Û . Category of PROJECTING
Display of existing infrastructure nets
Spatial and attribute display of existing objects of interest on network projecting
Projecting new infrastructure networks and objects
Forecast of terrain work
Graphical display and elements for technical documentation
Production of different schemas
Projecting of RR relations

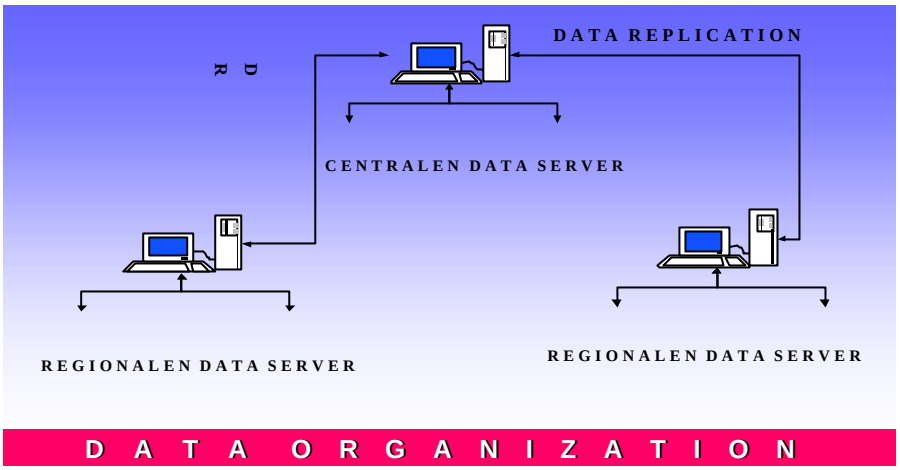
Ô . Processing and working environment for getting function the executing treatment
PS platforms with software GIS platform

⇔. **Category of mutual requirements**
Choosing an area by address/part of address/telephone number/subscriptor name/spatial element
Spatial display of network elements, boundaries of administrative categories, statistical and other data
Statistical analyses and working graphic based on spatial and/or attribute requirements
3D display for network crossing, vertical display, perspective views.
Preparation and drawing of maps with descriptive signs and legends under the conventional norms

Ô . Processing and working environment for getting function the executing treatment
PS platforms with software GIS platform

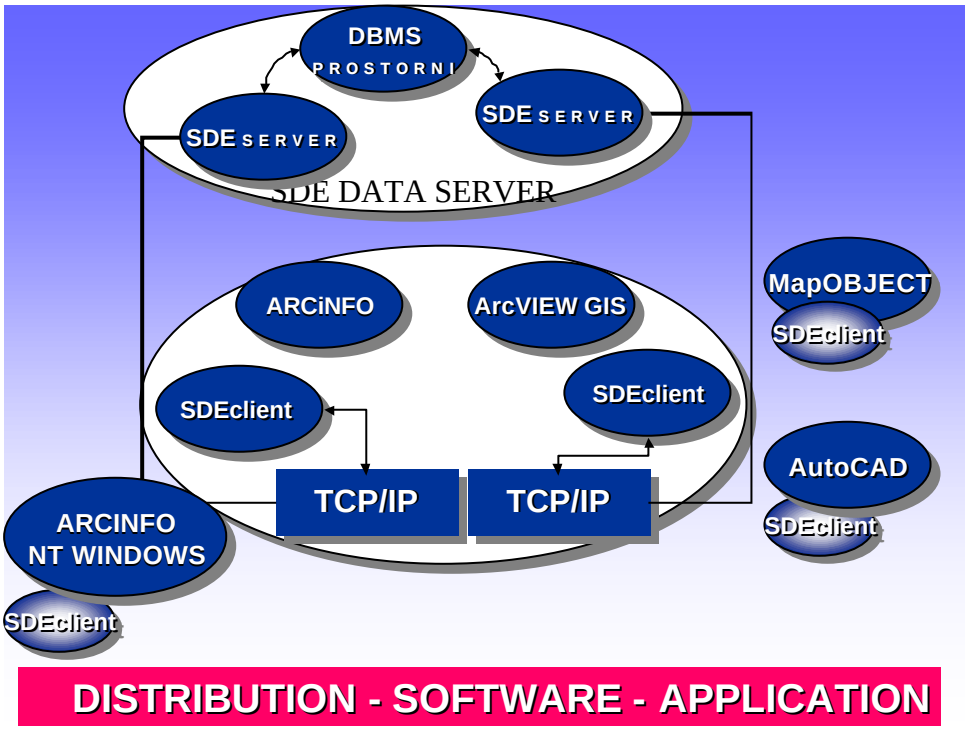
1. ORGANIZATION OF DATA
MT is organized in 14 regional centers. Each center has individual organization of sectors and sections in which should be activated previously affirmed functions. Such an administrative organization means dislocation of the centers from the central office.

The goal is to restore a unique GeoIS on the level of MT and performed careful reconstruction of the stages in each center with full respect of their traditional relations and principle for unique and integrated management, defined design of data structure. The fact that it is about administrative location of centers through the whole country inflicted the principle of regional bases with direct replication of data in the central database on the MT level (description on the following picture).

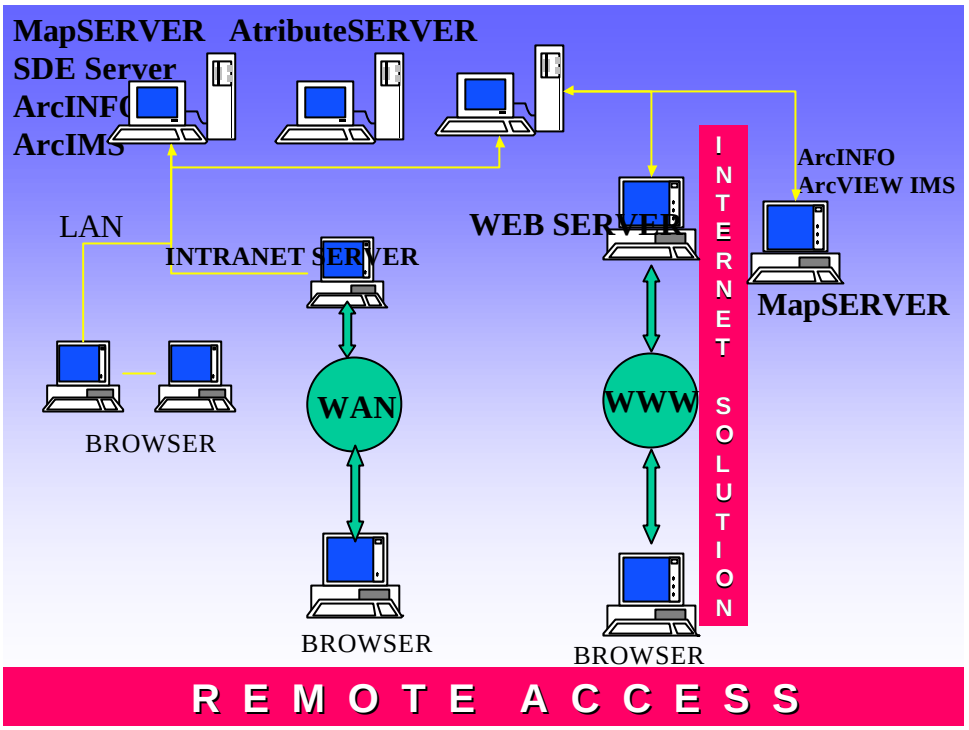


Such principle is looking for assured communication relations between all base components, and for the unique formulating - noticed standards on the data level and technological structuring of the components, but for each center it provides independence in the management as a need for their transparency with the other institutions in the same regional/ state/ administrative segments.

Respecting the existing data concepts in each center, dimensioned and formed with unequal technologies/methodologies and applications, and the principle for integrational functioning of the system, projection for distributive transparency on the level of applications is descripted on the following picture

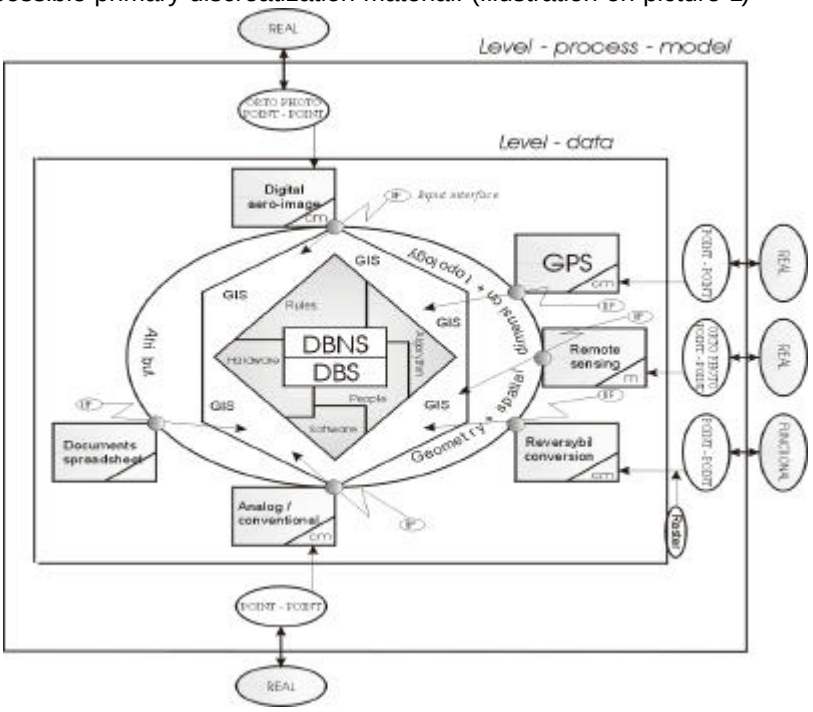


Distributive conception of system recourses with intention to provide controlled access and their effective using, respecting the principles for data organization and fundamental applications from one side and locational concentration of existing resources and traditions for producing of data from the other side, is organized like on the following picture.



2. ACTIVE TECHNOLOGICAL LINES FOR DATA ACQUISITION

The basic data for underground structures, in the country, are purely provided from the state surveying and cadastre for real estate. Their realization is in the domain of State Department of Geodesy (SDG). Using these data in GeoIS meant manifestation of previously defined criteria, which to the distributor inflicted objectives for changing of philosophy in defining, dimensioning and distribution of precisely restored legal and technical norms. With intention to exceed the existing stage, the research team extended with members from SDG. Assuredly that data completeness for underground structures we could provide to the level of usage for telecommunication infrastructure network absolutely in the frames of MT. Yet, for wide distributive utility of these data on the state level, and because of the stage of no existence of any digital spatial content, we had decide to affirm and reference all acquisition methods for the possible primary discreatization material. (Illustration on picture 1)



Picture 1. Acquisition technological lines

3. RESULTS AND CONCLUSIONS

Digital reconstruction for orbital and suborbital image material, existing conventional maps and conversion of real spatial model, is comparatively overtaken for one same spatial segment. Analyses are taken from an aspect of quality of data/figure and economic repayment in that scale.

3.1 RECONSTRUCTION AND EXTRACTION OF ORBITAL AND SUBORBITAL IMAGE MATERIAL

The analyses of these technological methods we made on the area covered with 44 analogue aerophotogrammetric images, namely 36 stereo pairs with a vertical overlapping of 20% and horizontal overlapping of 60%. Scanning of the image material is done with a resolution of 15μm on VEXCEL Imagining 3000. Iterative triangulation process is done with 90 control points, and certain number of tie points, and provides standard deviation of unit weight of 1.37. After generating of stereo pairs, digital model is improved with breaklines, linear elements, defined surfaces and characteristic points.

By this philosophy is produced also a DTM for whole country with spatial data accuracy of 5 meters.

After the definition of strategy for orthorectification, there are produced orthophoto images, their mosaic and orthophoto maps 1:1000. Geometric relations and fitting these products with reversible conversion from existing maps is showed on the following picture.

Activating these digital methods will enable:

Simultaneous activities on several working stations which have installed different modules for different phases from the processes triangulation, forming DTM, production of orthophoto, vectorization, production of thematic maps based on radiometric spectrum/DTM, divers analyses etc.

Getting digital data structure sincere for integration and figuration under the needs of Geoinformation Systems

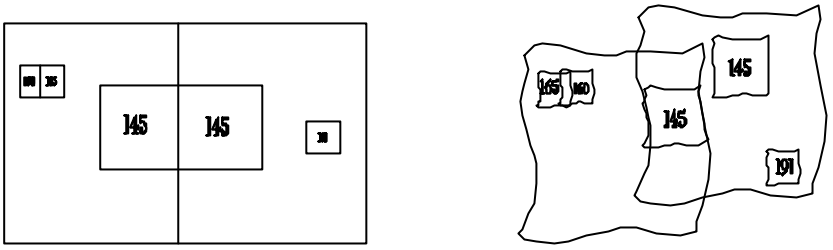
Restitution of digital cartography, which in this moment in the country is not established.

Production of orthophoto, new product comparing with analogue processes, which in this moment in the country has great usage value in the revision of data from the analogue maps and as a background in the spatial planning.

3.2 REVERSIBLE CONVERSION

The problem in the Reversible conversions is in modeling of elements from the "**original**" in their "**images**", resulting with full or partial conformity and/or allocated category of isomorphism. Till the moment of researches stability of algorithm and technology aliment of the processes are closed in the frames of one sheet, and reversibility in tolerance relations, which should provide contact 1:1. Such conversion principles reduce the autonomous of data in the frame of the backing without structuring and/or transferring of defects from/to neighboring tics. That is a problem which requests spatial

modeling of the active and contact sheets, with intention to perform concave / convex stage of sheets and projecting in the plane of table.



3.1 Desirable and practically existing condition of sheets

Model coordinates from the test model, got by digitalization, directly on digitizer and on screen under scanned maps, are transformed in the theoretic coordinate system on the raster model with **affine, polynomial transformation and using collocation**. Model transformation errors are given in the following table.

The results are evident: **equalizing of methodological ways with level of collocation between 30% and 60%**, with average error that, after the rejection of systematic errors, are reduced on 0.05-0.07 mm.

	AFINA		POLINOM		KOLOKACIJA			
	M_y mm	M_x mm	M_y mm	M_x mm	M_y mm	M_{yo} mm	M_y mm	M_{xo} mm
DIGITALIZACIJA	0.075	0.100	0.079	0.107	0.071	0.040	0.075	0.046
SKENI RAWE 1	0.143	0.110	0.070	0.090	0.072	0.053	0.094	0.046
SKENI RAWE 2	0.159	0.127	0.080	0.106	0.126	0.078	0.114	0.080
SKENI RAWE 3	0.297	0.090	0.110	0.101	0.101	0.053	0.081	0.045