Heterogeneous Networks Management System
having GIS and Web Based Interfaces

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Abstract

Paper describes particularities of architecture of wide area telecommunications management network (TMN) and system (TMS) RomTMN HD that are developed by specialists from Technical University of Moldova and Systemcomputer Ltd. for Direction of Telecommunications of Romtelecom (Hunedoara County, Romania). Core modules of RomTMN HD are implemented on the base of original geoinformation model of telecommunications systems. The architecture of TMN and TMS is based on M series of ITU-T Recommendations and uses modern concepts of implementation of distributed objects management like DCOM - Distributed Component Object Model, WBEM - Web Based Enterprise Management and GIS - Geoinformation Systems. RomTMN HD being automated and integrated management system is capable to improve all complex set of processes of coordination of resources necessary for supervision, monitor, projection, simulation, generation, implementation, analysis, measurement and test of telecommunications networks in order to warranty to end users high level of services, at adequate price and optimal distribution of capacities.

1. Management of telecommunications objects

Main trends of modern information systems progress can be denoted as having well-defined orientation toward stable increasing of the degree of system's complexity, of the intensity of systems interaction and co-operation using information exchange channels and telecommunications interfaces, and of degree of human-machine interface naturalization (visualization). Modern TMN and TMS must be based on visual management technologies: they must be able to deal visually with a wide range of telecommunication systems beginning from simple local area networks and ending with global Intellectual Networks, Internet and wide area virtual private corporate networks. One of possible way to implement visualization paradigm consists in integration of TMN with geoinformation systems.

Telecommunications system of Romania consists of a set of distributed equipment, interconnected by cable links that provides solutions for reliable transportation of information between customers of telecommunications services. Telecommunications networks of Romania represent typical examples of heterogeneous structures, having a mixture of different switching, multiplexing and concentration techniques. It is very important to create an integral management system capable to deal with information technologies objects distributed over large geographic areas. National and regional telecommunications operators must manage available resources using standard procedures. This will results in increasing of the potential and quality of telecommunications services, and in decreasing of non-justified payments. Consequently the perspective to shift toward using new generation of intelligent networks will be open. The hierarchy of management systems can be divided into a sequence of 4 layers in correspondence with goals of services (fig. 1).

First layer L1 is oriented for implementation of network elements (NE) management functions using own internal agents or external agents built as Q-Adaptors (QA). Second layer L2 is used for management of networks resources as a result of controls gotten from layer L3 from services management or from fault messages analysis gotten from agents of layer L1. The activity from layer L2 results in modifications of performance, capacity and topology and other parameters of networks under management. Third layer L3 disposes to users all the spectrum of own and external telecommunications services. Fourth layer L4 deal with strategic plans in development and using of telecommunication resources and services.
2. Objects under management in Hunedoara county (Romania)

Hunedoara County owns a complex set of telecommunications resources of national and regional level. Geographic position of County in Romania is shown on fig.2.

- Transmission system (TS), having transport channels and channel-level operation equipment:
  - fiber optics national backbones BB1, BB3: 288 km;
  - regional rings of fiber optics TIM1, TIM2: 157 km;
  - STM16 (Philips), STM4 (Philips, Fujitsu), STM1 (Alcatel);
  - PDH (Alcatel, Ericsson);
  - Symmetric cables: 680 km;
  - Analog circuits: 1066 (33%);
  - Fiber optics cable: 360 km;
  - Digital circuits: 2170 (66%).

- Switching systems (SS), formed from Exchanges, satellites, hand switched operator assisted nodes, local distribution systems having integral capacity of 89900 units and 71500 connected lines:
  - 30 analog exchanges (“Pentaconta” - 9, “Topex” - 3, “Pentomat” - 18), 25800 served units;
  - 8 hand switched exchanges, 1700 served units.

3. RomTMN HD system architecture

The management system for such complex set of telecommunications objects is hierarchical having four level of management. Automated and integrated management system is capable to improve all ensemble of processes of coordination of resources necessary for supervision, monitor, projection, simulation, generation, implementation, analysis, measurement and test telecommunications networks in order to warranty to end users high level of services, at adequate price and optimal distribution of capacities. The structure of RomTMN HD, a new Regional TMS for Hunedoara County, developed
during 1999-2001 is based on generic model of TMN recommended in ITU-T standards of series M (fig. 4).

RomTMN HD includes next components:
- LDCN and WDCN are Local and Wide Area Digital Communications Networks.
- OS are Operations Systems
- WS are workstations
- MD are Mediation Devices
- NE are Network Elements (and Q-Adapters)
- PAX are Public Automated Exchanges
- FD and AN TS are Fibre Digital and Analogue Transmission Systems

Objects under management are equipped by monitor and management agents mounted on NE and connected to OS and WS via LDCN or WDCN. Data transport is made using Distributed Component Objects Model (DCOM). WDCN has star-ended linear fibre optic 155 Mbps ATM backbone (fig.5).

Software of Rom TMN HD is distributed over LDCN and WDCN servers, databases and workstations and has also hierarchical GIS-enabled structure shown on fig. 6:
- **TMNC** is TMN Software of County level
- **TMNT** is TMN Software of Territory level
- **TMNL** is TMN Software of Locality level

System software is based on MS Windows 2000 OS platform, MS SQL Server database systems, ASP/Delphi programming environment and MapInfo/MapX GIS.

Most kinds of information are available via Intranet Web services, that implements WBEM (Web Based Enterprise Management) paradigm. Internal structure of TMN software system can be presented on abstract level, shown on fig. 8.
Figures 9 to 12 illustrate samples gotten as screenshots from main management services, that are implemented as ASP and ActiveX components, used inside of Intranet Server web-pages and containing next generic management services:

- Configuration management;
- Performance management;
- Fault management;
- Account management; and
- Security management.

The interaction of thin (IE-based) clients with web server uses SOAP technology that gives the possibility to introduce MS dotNET solutions into project future development.

4. Conclusion

DCOM and WBEM based Telecommunications Management system with Interactive Geoinformation sub-systems incorporated into TMN architecture gives the possibility to significantly increase integral efficiency and spatial accuracy of management procedures. Networks under management configuration and current state monitoring become spatially "natural" for managers. They can easily browse inside managed object space. GIS also provides good possibilities for networks topology optimisation and future planning.

5. References