A&QT-R 2002 (THETA 13)
2002 IEEE-TTTC International Conference on Automation, Quality and Testing, Robotics
May 23 - 25, 2002, Cluj-Napoca, Romania

Architecture of Fault Management Subsystem of RomTMN H Telecommunications Management System

V.Ciclicci[1], I.O.Muntean[2], T.Budura-Rusu[2], V.Sidorenco[3], S.Dolenco[1], S.Pustovalov[1], R.Dorogan[1], R.Albu[1], C.Cazac[1], V.Maslo[1], G.Eremei[1]

[1]*Systemcomputer S.R.L. Decebal 99, Chisinau, MD2038,Moldova,Republic of*
[2]*Romtelecom S.A., DTC Hunedoara, Iuliu Maniu,2, Deva, 2700, Romania*
[3]*Technical University of Moldova, Stefan cel Mare, 168, Chisinau, MD2004, Moldova,Rep. of*

Abstract. Paper describes particularities of architecture and of implementation of Fault Management Subsystem of RomTMN H Telecommunications Management System, based on concepts of Distributed Agents, Web Based Enterprise Management principles, Active Server Pages and Dynamic Geographical Information web publishing.

Key words. telecommunications fault management, distributed agents

1. INTRODUCTION

The problem of right model of system architecture choice is one of the most acute problems of practical implementation of Nation- or County-level distributed Telecommunications Management Networks (TMN) from the strategic, technical and economic points of view. Fast and fruitful development of Internet technologies had generated the concept of WBEM (Web Based Enterprise Management) that provides possibility to use interactive dynamic web publishing systems for effective distant monitor, test, verify and diagnose of complex distributed objects under management. Most important contribution to the development of above mentioned capabilities were done by specialists from DMTF (Distributed Management Task Forces), IETF (Internet Engineering Task Forces) and W3C (The World Wide Web Consortium) [1,2,3].

WBEM technique based on HTTP protocol permits to use standard web-browser as main client program that only must be able to understand common set of XML/DHTML (and optionally – Java) languages. Being extended over mobile applications, there is a need also to provide WML (Wireless Markup Language) compatibility as well. Server side facilities can be realized using ASP (Active Server Pages) or ASP.NET techniques having CGI gateways to distributed databases, agents, managers and mediator services of TMN, accessed via corporate Data Communications Network (DCN) .

Practical realization of RomTMN H project [4] for Management Center of the Romtelecom's Department of Telecommunications of Hunedoara County had demonstrated high efficiency of using of WBEM as technological platform for management of telecommunications objects widely distributed geographically. RomTMN H project were also enhanced by incorporated Geoinformation System (GIS)

that provides mechanisms of dynamic publishing of thematic maps of distributed objects under supervision and management (http://www.syscom.md).

The object under management of RomTMN H represents a mixture of telecommunications components that belongs to one of next categories: Inside Plant (IP) or Outside Plant (OP). The objects of IP are concentrated geographically and are mainly placed inside corporate buildings containing exchange and multiplexing equipment.

The rest of telecommunications equipment belongs to geographically distributed elements of OP: cabling systems, distribution systems, trunk amplifiers, power supplies, regenerators et.al. The majority of elements of OP from Hunedoara County Department of Romtelecom are placed inside unattended nodes that must be carefully monitored from the County Telecommunications Management Center (CTMC) placed in Deva City.

2. THE ARCHITECTURE OF FAULTS MANAGEMENT SERVICE

Faults management service is one of five most important services, realized by RomTMN H (configuration, security, performance and account managements are the other services).

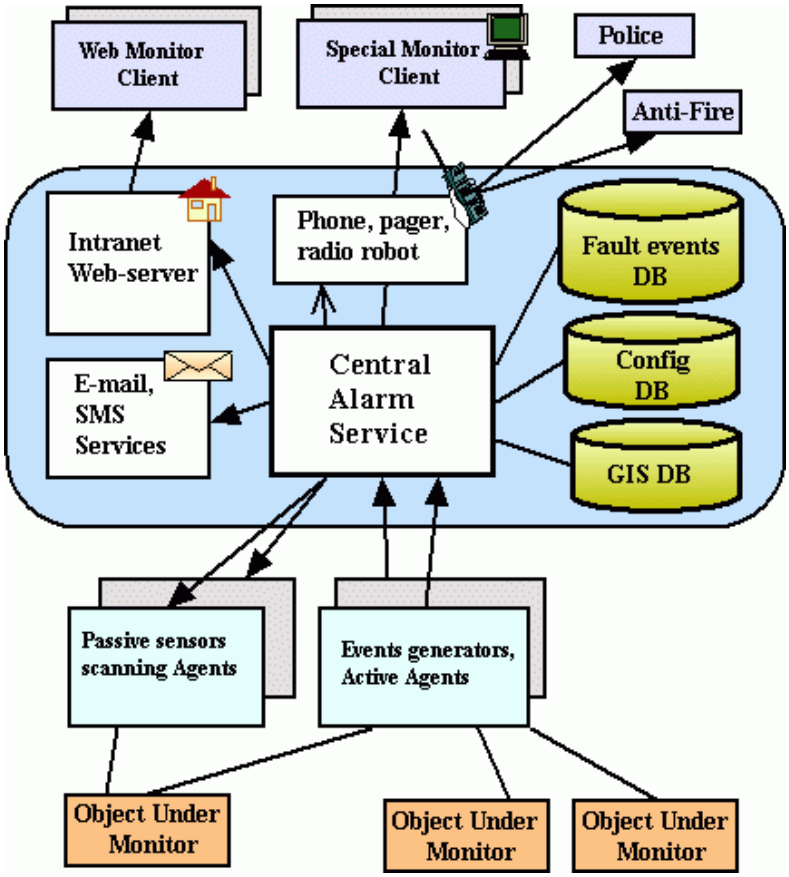

Figure 1. General logical architecture of faults management service.

This service integrates alert information flows, generated by monitor agents placed inside Network Elements (NE) or Q-Adaptors (QA) of the components of OP and informs persons on duty from CTMC about their current state and faults history.

General logical architecture of faults management service is presented on fig.1, and

of physical level – on fig.2.

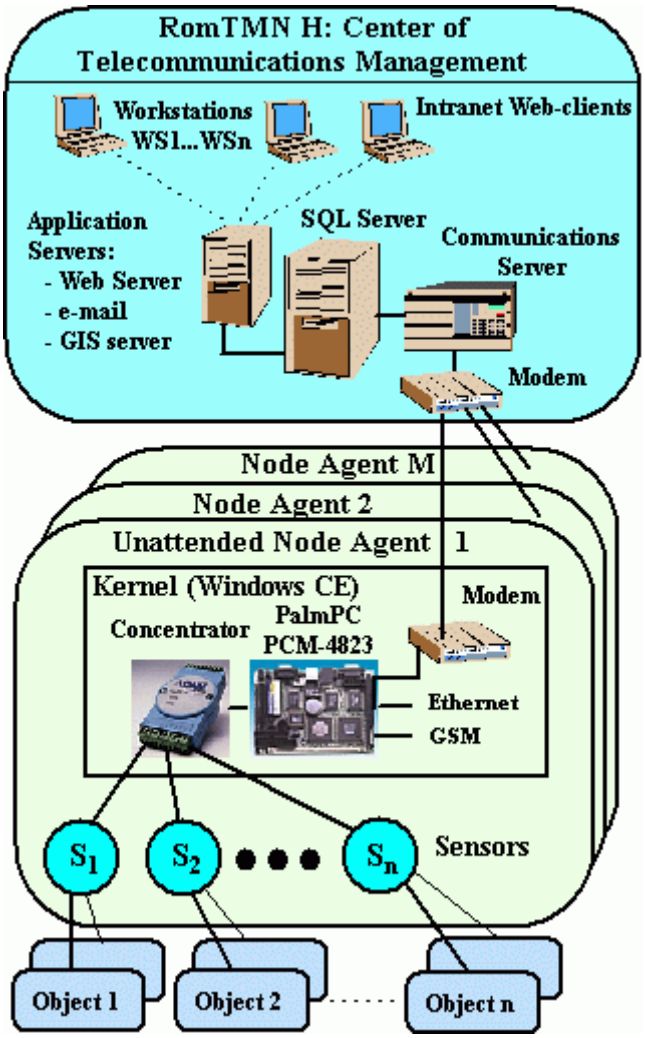

Figure 2. Physical components of architecture of faults management service.

Every network node included into distant faults supervision must be equipped with smart Node Agent, capable to support operations of distant monitor of geographically distributed complex objects. All network nodes can be divided into next categories:

- Served nodes (placed mostly on IP objects)
- Unattended nodes (placed mostly on OP objects)

The kernel of served Node Agent is based on common PC connected to appropriate Ethernet segment of corporate LAN DCN. The kernel of unattended node is based on industrial PalmPC/Biscuit PCM-4823 PC (Advantech) having Pentium-compatible processor, DiscOnChip storage, RS-232/485 serial port adapters, Ethernet port, internal modem and running Windows CE v.3.0. applications. The RS-485 port is used to communicate with ADAM-4053 smart hub alert signals concentrator, collected from a set of sensors $\{S\} = <S_1, S_2, \ldots S_n>$, are distributed over devices under management (fig.3) retrieving a wide spectrum of fault and security signals (events) like:

- Carrier pilot signal level (both on primary and secondary groups of channels)
- Cable integrity supervision

- DC Power Supply battery state; 220 V AC Power Supply lines state
- Door open, intrusion and movement detection
- Fire and smoke alerts, water flooding detection
- Values of different counters registration

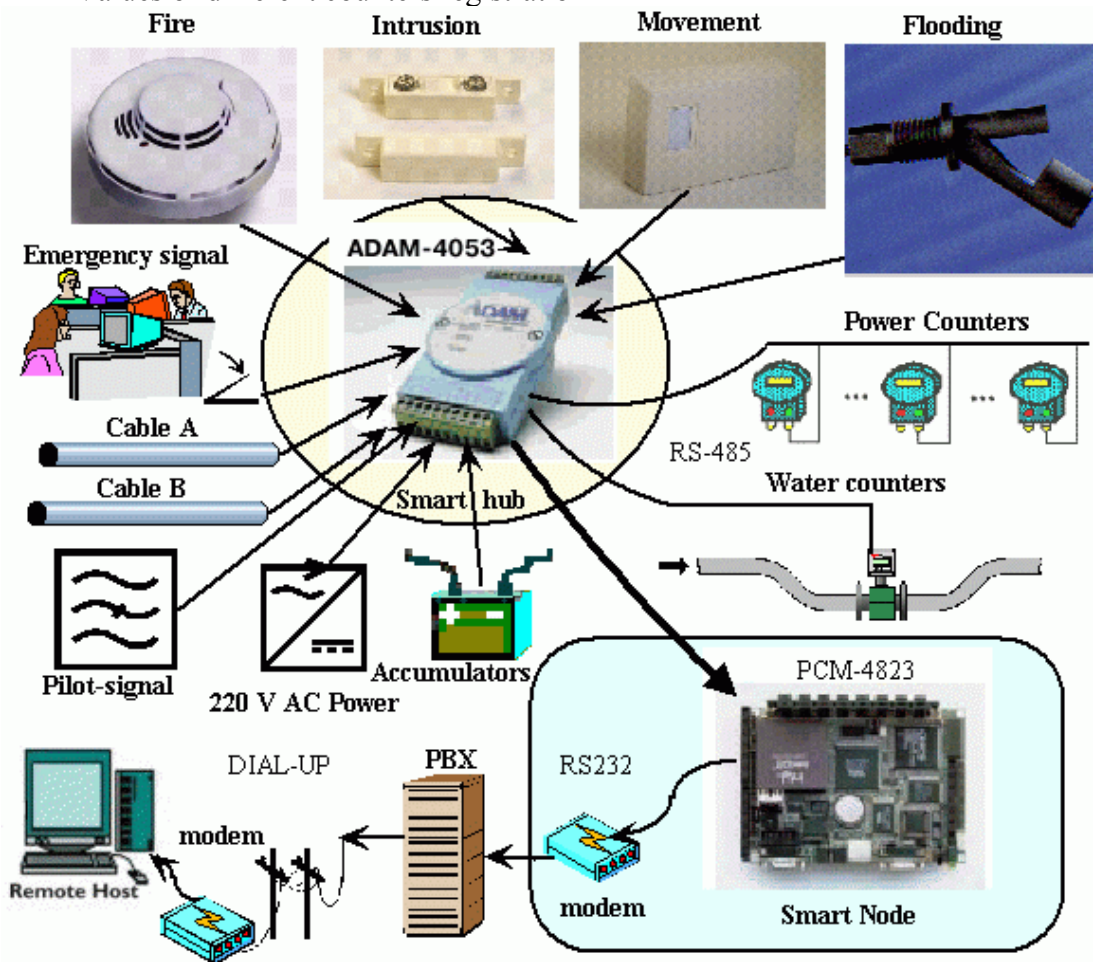

Figure 3. The set **{S}** of sensors

The set of ADAM 4000 series of devices performs primary data acquisition, filtering, normalization, buffering and sending them to remote host of central office. Every ADAM 4053 device is individually addressed via remote configuration procedure.

Primary fault alert messages generated by sensors are collected in real time by Node Agent computers (Smart Node equipment) and are transmitted toward Fault evens history SQL database storage of CTMC. The **ADAM's Scan** software package made by Systemcomputer has three-tier components: client, intermediate and server components. The client tier contains configuration, test and measurement agents working in Windows CE operating system environment. The intermediate tier uses DCOM technique for primary data collection, processing and storing to remote SQL database via appropriate link (modem, LAN, GSM SMS channel). Server components contains a set of MS SQL Server database tables, that are accessed by specialized Work Station end-user software and are dynamically web-published using ASP technology of Microsoft IIS 5.0 - Internet Information Server.

Central Alarm Service is the core of Fault Management Subsystem of RomTMN H

that can be configured to generate and distribute a wide range of alert messages as a consequence of registered primary fault events via a number of alternative ways:

- special TMN interfaces of Work Stations; GIS enhanced WBEM web pages
- e-mail, pager, SMS messages sent to configured clients
- multimedia (robotic phone voice) messages

The configuration facility of Central Alarm Service gives the possibility to establish:

- The address of e-mail server, SMS, pager gateway servers used for sending messages and distribution listserv facilities. Configuration and content of e-mail and other predefined messages.
- Conditions for sending alerts in case of critical time outs in the protocols of agents' activity monitor faults discovering (keep-alive service).
- Lists of monitored objects and parametric profiles for each of them, including real-space geographic positions.

GIS support subsystem of Central Alarm Service uses MapInfo Professional and MapX GIS software for dynamic web-publishing of multilevel thematic electronic maps that contains telecommunications objects under supervision and management, configured by Configuration Management subsystem of RomTMN H system. The hierarchy of maps includes World, Europe, Romania, Hunedoara County and localities levels of presentation (fig.4).

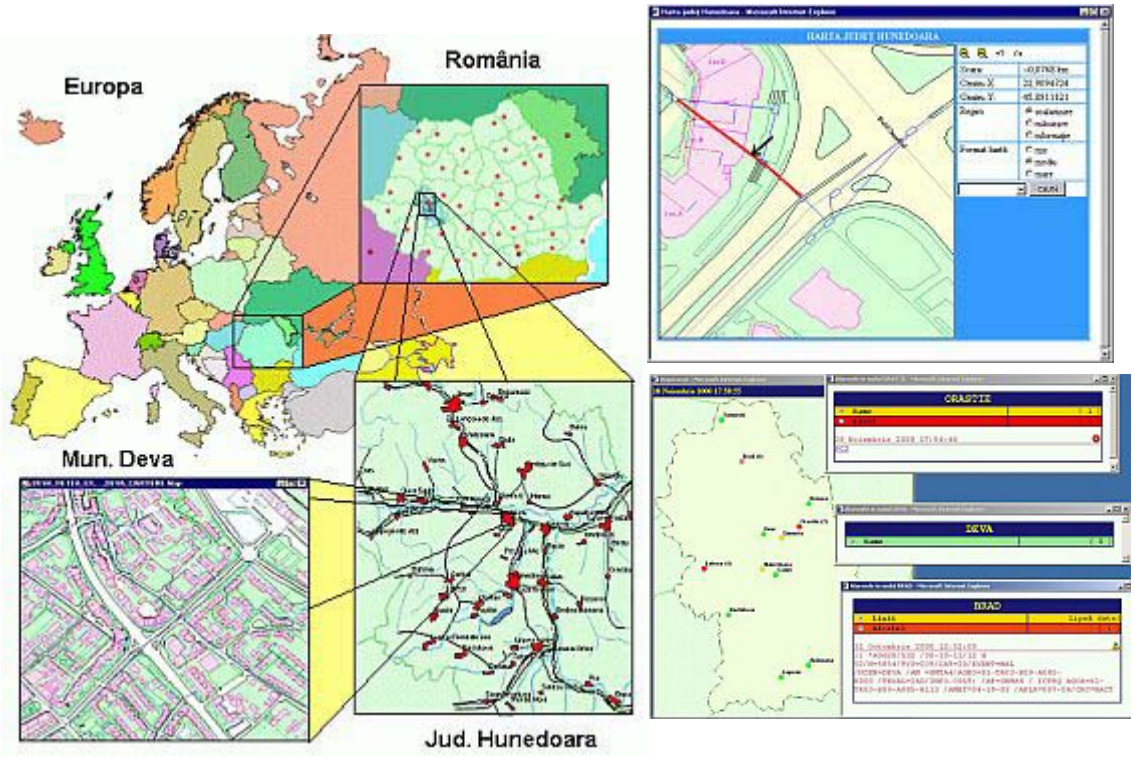

Figure 4. Hierarchical system of electronic maps. Samples of alerts on map

Every object under management is identified by its uncial ID, by NetNode ID and its geographical position (**Coord.X,**. **Coord.Y**). Registered users can use electronic maps for observing both current states and history of alerts retrieved from monitoring agents. Every alert event is registered into database and produces a Monitoring Chart, which contains geographic locality, category, data and time of event registration, the message

sent to responsible services, their reaction on (acknowledged, solved, put out of services, reconfigurations started etc.). For example, the procedures of determining of cables integrity can emphasize the cable segment in trouble by changing color of respective map object (fig.4). End users can access web interface of Central Alarm Service via usual web browser from any work station placed in the County-level Corporate DCN or even from Internet, after getting registered credentials from Security subsystem of RomTMN H system and configuring Virtual Private Network services. The visualization is made via dynamic pages publishing having such interactive facilities like **Pan, Zoom-In, Zoom-Out, Center, Measure** etc. (fig. 4, 5).

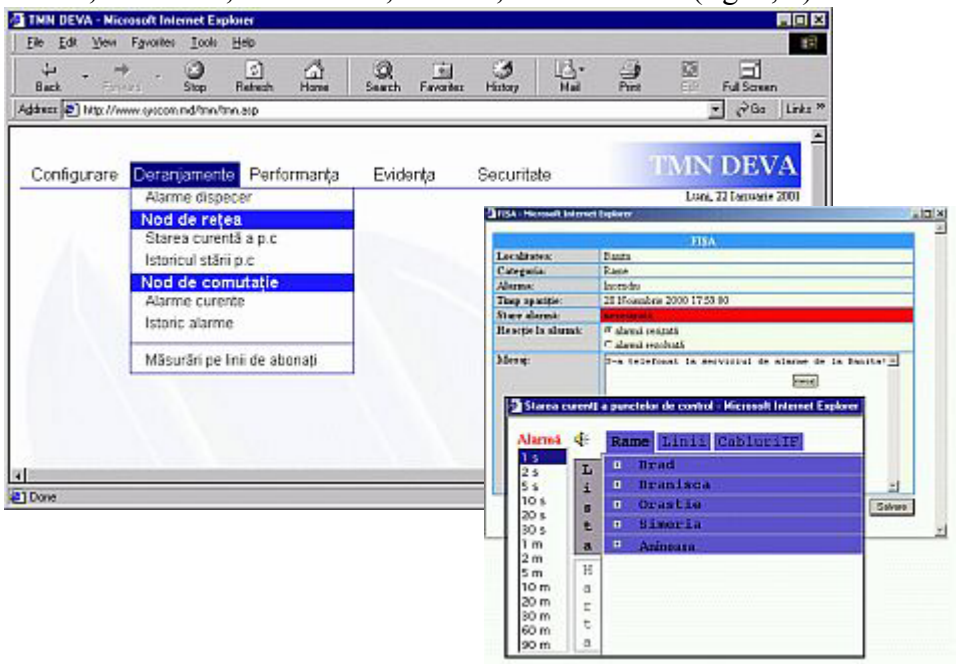

Figure 5. WBEM interface of Central Alarm Service

3. CONCLUSION

Implementation and practical using of Fault Management Subsystem of RomTMN H system had strongly demonstrated the capacity of modern information technologies to effectively monitor and manage telecommunications objects distributed over large geographical area using GIS enhanced WBEM techniques. In near future authors are planning to use next generation of web-publishing facilities based on XML and GeoVRML languages (http://www.geovrml.org).

4. REFERENCES

[1] Distributed Management Task Forces. http://www.dmtf.org/wbem/index.html
[2] The Internet Engineering Task Forces. http://www.ietf.org/
[3] The World Wide Web Consortium. http://www.w3c.org/
[4] Ciclicci V.V., Muntean I.O., Budura-Rusu T., Sidorenco V., Dolenco S.I., Dorogan R. Pustovalov S. Sistem regional de management complex al telecomunicațiilor județului Hunedoara. International Informatization Academy. *Acta Academia*. Chişinau: Evrica, 2000. P. 315-328.