Network Alert Management Module for Outage Management System

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Introduction

Canal de Isabel II (CYII), founded in 1851 to provide water to the Spanish capital, now supplies drinking water to 5.5 million people in the region of Madrid through more than 12,000 kilometres of pipes.

In 1992, in order to manage its infrastructures, CYII implanted a geographic information system project called SIGRYD based on the commercial product SICAD from Siemens.

The market evolution and the necessity of new information have lead to the development of a new GIS project called GAUDY based on ESRI technology.

The new system allows us to improve business processes. One of these improvements is the capability of real-time work orders delivery to portable devices.

Alerts and Incidents Management System

SICAD was selected in 1992 as GIS base product, but its performance in map retrieval and queries was really poor, and the license cost was expensive. To solve this problem a new system for map consultation and printing was developed. This software, called SigrydPC, was created in 1994 and based on AutoCad for the mapping and Oracle for alphanumeric data. The architecture of the whole system can be seen in figure 1.

The master data is maintained in SICAD, with some applications to help in these tasks. But most applications are based over the geographical engine SigrydPC. A converter software retrieves the data changed in SICAD to an AutoCad file mosaic in real time.

The most important application based on SigrydPC engine was the Alerts and Incidents Management System (1996-97). This application dealt with customer complaints, telephone alerts and incident resolutions. The application registered element maneuvers and calculated areas affected by service interruptions. Afterwards, it was completed with a module to manage scheduled works on the network. Another application controlled preventive maintenance works over networks components.

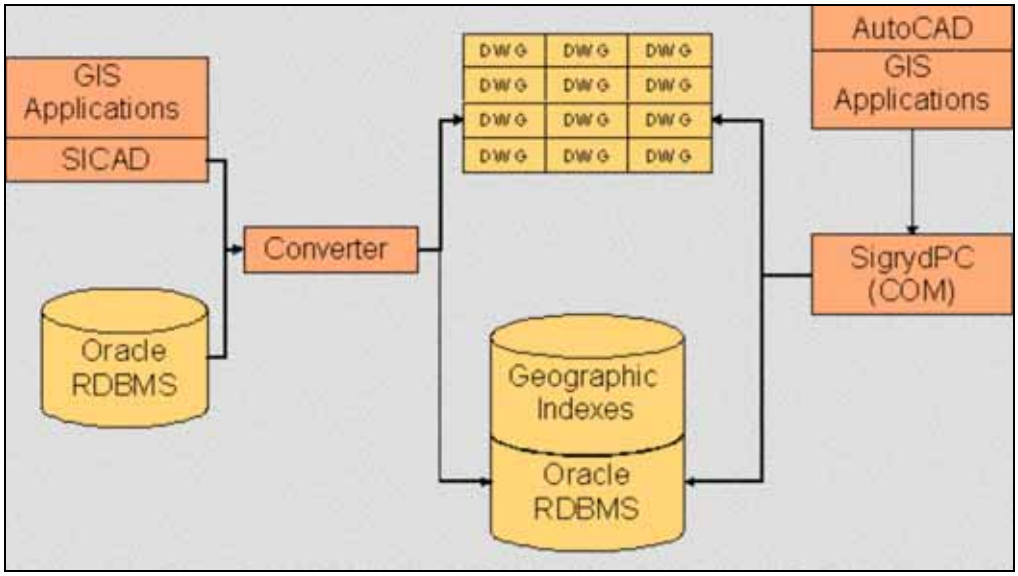


Figure 1. SIGRYD architecture

The GAUDY project substituted this architecture for the ESRI one shown on figure 2. All the applications have been adapted to the new architecture, and have been improved to cover company needs.

Now, the Alerts and Incident Management System is a client/server application made in J2EE (Java 2 Enterprise Edition) architecture. ArcIMS with ArcMap Server extension is used to generate maps. This application deals not only the alerts management and incidents resolution, but also with the scheduled and preventive maintenance works as well. As the incidents and maintenance works are made by the same squads, its management is simplified, thereby reducing information redundancy.

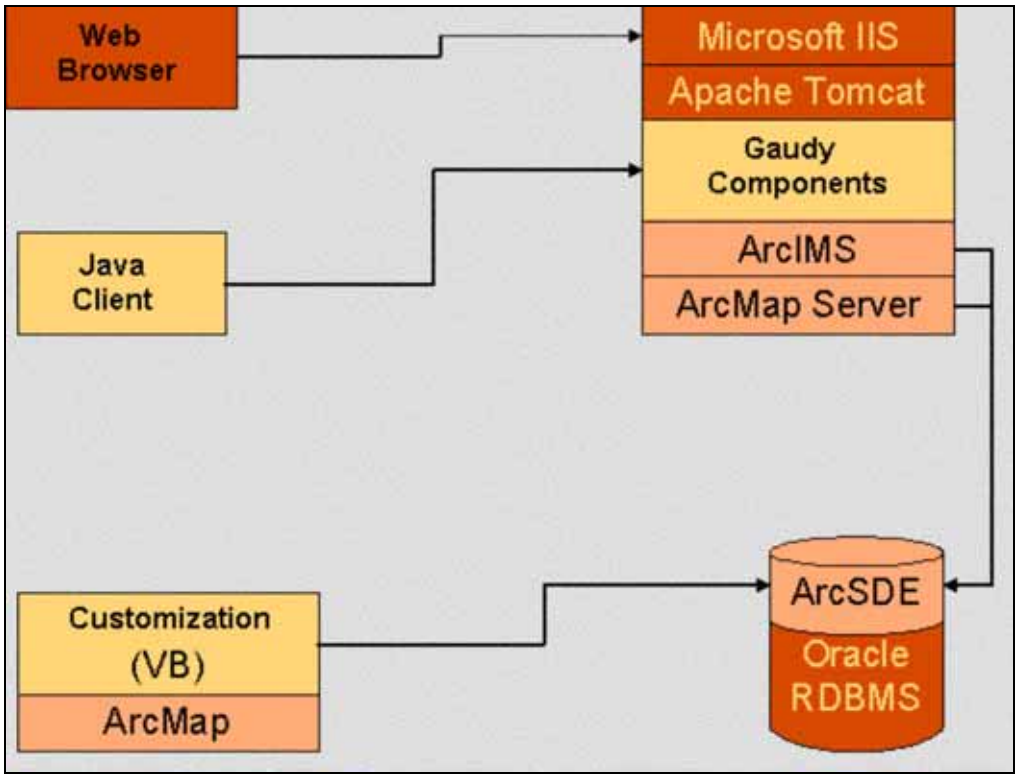


Figure 2. GAUDY architecture

The scope of the application is quite broad, involving several business processes in different company departments:

Customer Relationship

There is a telephone call center where the operators register all the calls and facilitate the information obtained from the system to the clients.

Operators register phone calls on the system, which includes street guides and catalogues of options to validate and classify the information.

The system verifies automatically if the communicated alert is related to previously registered alerts, or if it has to do with a work in progress and gives the existing information to the operator so that he can inform to the client.

When a complaint cannot be associated to other previous alerts or known incidents, the system displays the corresponding area graphically, where the operators can see what is happening on the network (incidents, works in progress or maneuvers). Operators can query, with a simple click of the mouse, any works, existing maneuvers, incidents or alerts and gives the client the information available, or any advise that the supervisor has written down. Later he associates the complaint with the problem or identified work to which presumably caused it.

Incident Management

The Incident control center receives and analyzes alerts. These alerts are grouped when they are likely to have the same source, and the zone centers of operation or other departments involved (Laboratory, Treatment Plants or Insurance) are automatically notified.

Zone centers take action to solve the incidents, and inform the Incidents control center about the progress and estimated resolution time.

Central center supervisors follow the resolution of the anomaly and “close” the incident when the problem is solved.

Scheduled Works Management

The system is also a work scheduler which organizes the tasks flow and distributes them among the squads involved in its completion. These tasks include preventive maintenance, network extension and improvement. Each work order is printed, including a network map and a detailed descrition of the elements.

There are 6 zone centers, and each center schedules its works independently. Foreseen works, element operations and the work in progress tracking can be queried by the rest of the users. Each center consults continuously the lists of its works in course and the scheduled ones for the day, dispatching work orders to the squads.

Work events (start time of a maneuver, difficulties, reestablishment of service, ….) are communicated at the moment by the squads to their zonal center by phone and registered in the system.

At the end of the working day, squads give to each center clerks the course of action report.

Maneuvers control

All the operations made on the distribution network, are registered through the control of maneuvers module. So, the current state and the operation log file of each element is updated continuously and available for querying. This information is really important to identify the origin of a problem and associate complaints to that problem.

Maneuvers can be planned from the same system, for example calculating automatically what valves needs to be closed to isolate a certain conduction in order to replace or repair it. The system indicates also the sections of pipe where the service is interrupted, the most appropriate drainage to use, and the list of clients affected. If the service interruption affects some special clients (hospitals, industries, etc.), the operator is notified in order to communicate the circumstances of the operation to the client.

While the operation is in course, the isolated pipes appear in a different color and the maneuvered valves appear highlighted. The squad in charge of the maneuver will communicate by phone to its zonal center any change on the foreseen plan, that will be updated in the system. Once the maneuver is finished and the network component is restored to its normal state, the end is registered. If by any circumstance some of the elements cannot be restored to its original position, the system will continue displaying the symbol of maneuvered element, until it has returned to its original state.

Incident control center supervises the works development and actions in progress, asking the zone centers for information.

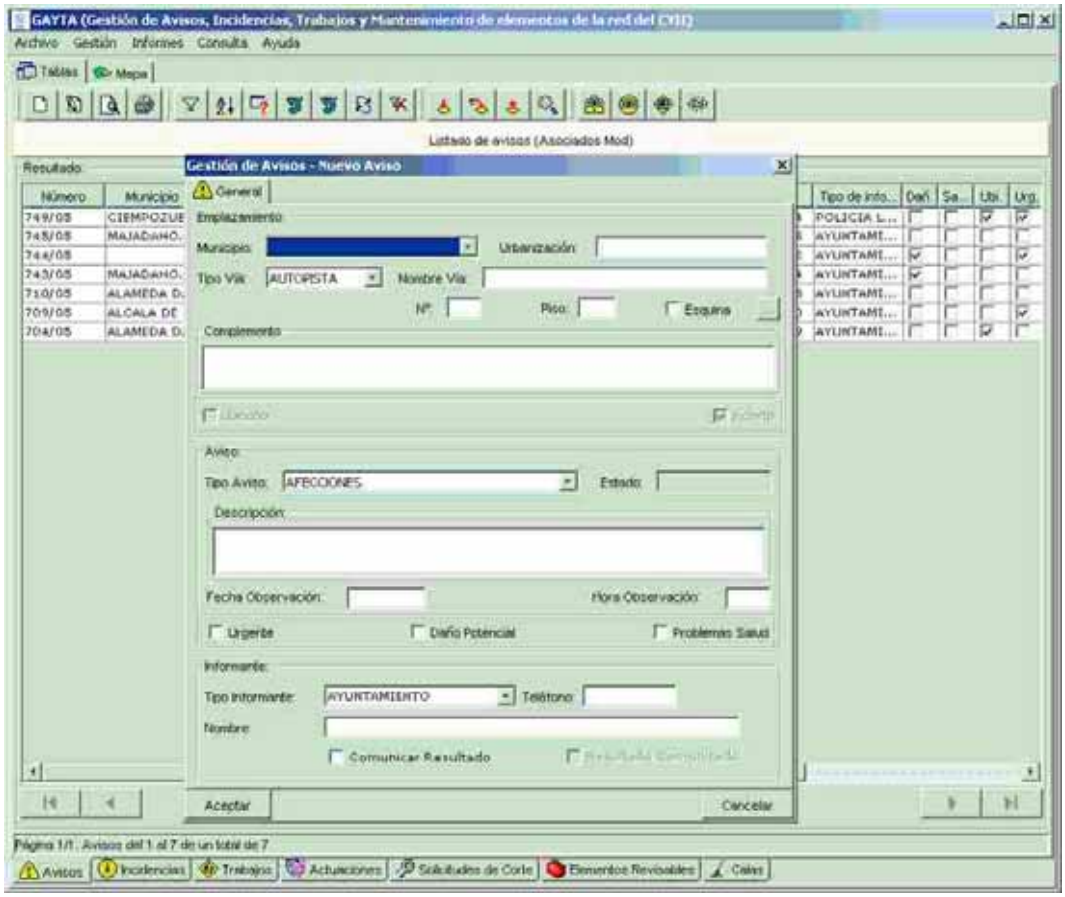
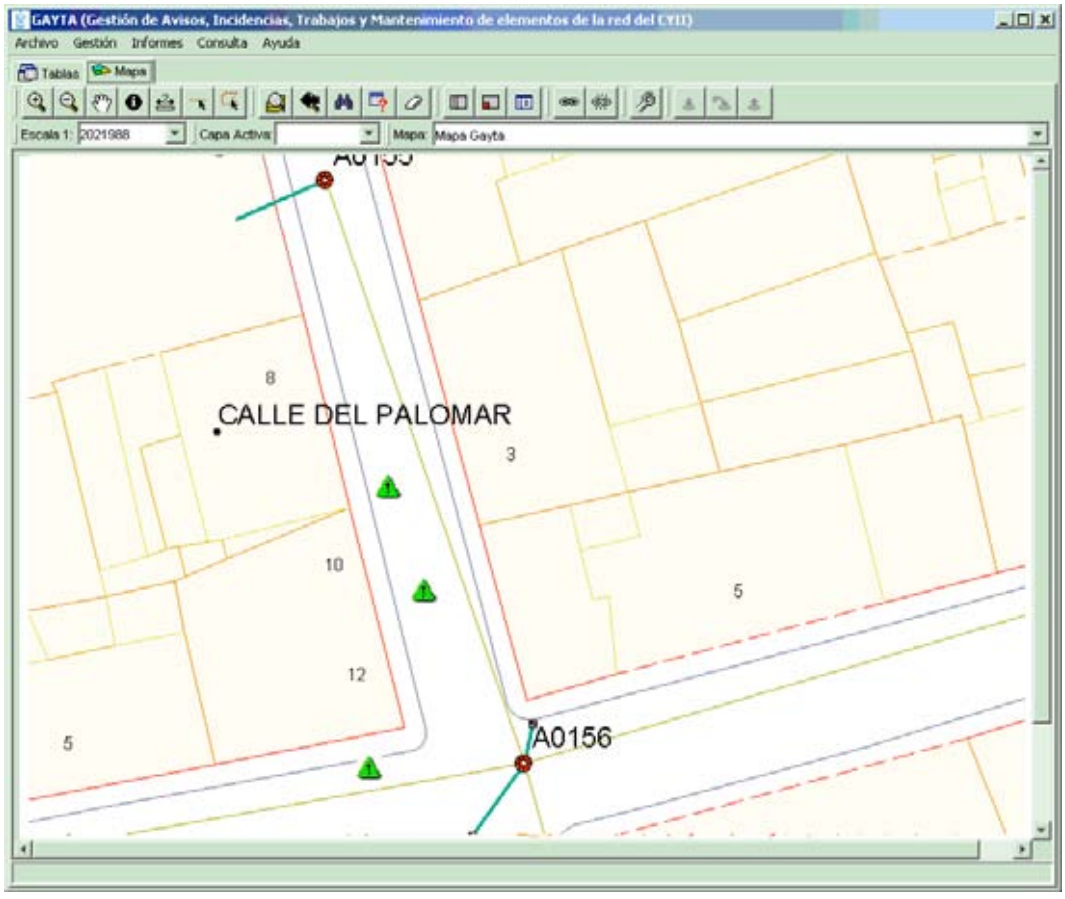


Figure 3 and 4: Alert, Incidents and Works Management application



Real-time Mobile Incidents and Work Orders Management

The current system controls the whole incidents and work orders processes, but there are some drawbacks in the information flow: network squads usually receive information about incidents by phone, and report to the control center by phone too, which sometimes provokes misunderstandings. And sometimes it is difficult to find the location of the elements to maneuver without cartography. A mobile system which organizes network squads daily work will be a major improvement for the corporation.

Mobility experience with Preventive Maintenance

Preventive maintenance was CYII's first experience in mobility. Two applications were developed to manage distribution network preventive maintenance (m-Apyma) and dam preventive maintenance (Goma).

Goma has no need of graphic information associated with work orders, because the geographic area of action is limited. But the distribution network is so wide that one key feature of the system is the geographical information of the network elements to maintain.

Both applications use off-line loading for work orders. In m-Apyma maps of the elements to maintain are loaded simply by generating a new Autocad file for each element centered on the element and copying this file to the mobile computer, which includes Autocad as part of the bundled software.

Although these applications are being used with success by network operators, they have some economic drawbacks: powerful and expensive rougherized laptops are required, and Autocad is needed for mapping operations.

The main problem with this type of application is the distribution of work orders among the laptops. Each terminal contains only the work orders for the working day of a network squad. This information is loaded on the laptops at night from a master computer, through a wireless network, and the results are loaded into the master database the next night, in order to generate the work orders for the next day. But this system is not flexible: scheduled work for the squad cannot be changed "on the fly", due to urgent incidents on the network. These incidents are communicated by mobile phone or radio, and the preventive maintenance is abandoned until the resolution of the incident. This resolution is reported to the incidents service by phone, and are introduced manually on the Alerts and Incidents system.

European Mobile Telecommunications

To transmit real-time information to and from mobile devices, an underlying telecommunication system is needed. There are several choices, and an agreement among coverage, speed and cost must be reached.

CYII owns the trunking radio system of Madrid, used not only by its squads but also by all emergency services, such as fire brigade, ambulances and 112 emergency phone.

This system covers the whole region, but as is designed for voice transport, data transmission speed is only 2400 bps.

Mobile phone companies offer data transmission through different techniques. GSM (Global System for Mobile communications) designed for voice transmission offers circuit switched data transmission at 14,4 kbps. GPRS (General Packet Radio Service) is the packet switched mobile data service available through GSM infrastructure. It provides moderate speed data transfer, by using unused TDMA channels in the GSM network. Each slot allows 14,4 kbps data transmission, and commercial standard uses 4+1 slots (4 slots for download, or 57,6 kbps, and 1 slot for upload, or 14,4 kbps). Coverage is good, over 90% of the region, but voice calls are preferential, and sometimes there are no problems for data transmission.

UMTS (Universal Mobile Telecommunications System) is the 3G mobile communications system launched in Europe. It is a packet service that uses W-CDMA air interface to offer up to 1920 kbps data transfer rates, although at the moment users in the real networks can expect speed up to 384 kbps. Speed is great, but there is only coverage in main towns, as the network is being deployed nowadays. UMTS devices usually are able to use both UMTS and GPRS technologies, depending on the UMTS network coverage.

Mobile application for Management

The system will cover all the daily tasks of network squads. This includes the scheduled work orders, as well as the incidents that will happen during the day. The data for the scheduled work can be loaded before the working day begins. But incidents can occur at any time and the data associated to them must be sent to the mobile device inmediately. As mobile telecommunications network allows us to send data, we can use them to transmit the data to the mobile terminal.

ArcPad was the first idea to organize geographic data. But as incidents can occur in any place at any time, the full data set should be loaded. Mobile device memory is limited by the size of memory card, and there is not enough room for the geographic information needed. So, the geographic information must be generated and sent as part of the incident data.

Developments of Gaudy project includes a graphical web query system. This system, based on ArcIMS services, can be easily consulted by other applications, retrieving alphanumeric information in XML format and maps in PNG or JPEG format. This system can be requested to generate an incident (or scheduled work) area map through HTTP standard web protocol, and this map can be sent to the mobile device as part of the incident data. The mobile application must be capable of sending new requests to the web, in order to navigate, zoom or pan the map, and ask for new map areas. As a matter of fact, the mapping of the main incidents and work orders management system described above is generated in this way (for example, the map shown in figure 4). The mobile application will return information to the main system by sending the reports introduced by operators at real-time.

Figure 5 and 6: Application preview and hardware needed

One key point in this connected solution is the communication issue. GPRS seems to be the best choice nowadays looking at the ratio between transmission speed and coverage. As discussed above, there are areas without coverage, and communication cannot be possible even in areas with coverage, so this fact must be considered.

The mobile application will ask the main system periodically for incidents assigned to it from the control center. The data from the main system will be sent on demand. The feedback information from the mobile device to the main system will be transmitted at real-time, or saved in order to be sent again if there is no communication.