

Emergency Management Information System: Case Study

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Abstract— The nature and complexity of emergency management has grown significantly in the past decade. Along with this growth, there is an even greater growth in technological solutions and aids. Computers have been used for emergency planning, regulatory compliance, response to disaster situations, and recovery. Even application forms for disaster assistance have become electronic instruments. This paper provides the procedure of computer technology used in emergency management. The Emergency Management Information System (EMIS) in Saudi Red Crescent Commission (SRCC) is a consolidated Computer Aided Dispatch (CAD) system that combines emergency centres, and medical dispatch services with modern Geographical Information System (GIS) real-time services (such as address verification, automatic vehicle location, automatic vehicle recommendation and routing, map displays) and online GIS updating to enhance emergency response. EMIS operates out of Regional Dispatch Centers which are communicating with responders via radios and mobile data computers in emergency vehicles.

Implementation of EMIS provides an integratable, scalable emergency management system to support emergency responders

Keywords— Emergency Management Information System, GIS

I. INTRODUCTION

Emergency Management Information System (EMIS) is a computer database for disaster response that provides graphical, real-time information to responders. The purpose of the paper is to focus on how to implement the most recent technologies to improve the performance of the Emergency Life Cycle (ELC). Disasters pose many obstacles for integrating and coordinating emergency operations, especially when essential emergency management staffs are prevented from reaching designated emergency operations centres.

EMIS Project was recently designed to supply, install and operate the contracted EMIS for Saudi Red Crescent commission (SRCC). The goal of this project is to build a reliable, scalable and full connectivity infrastructure. Besides this, project will apply intelligent decision support system in order to enhance business processes and workflows. The project will include ;(1) a complete computerized incident command system; (2) a computerized system for Electronic Patient Care Reporting (ePCR), (3) a monitoring system in the central operation room.

The paper is organized as following. Section II describes the main components of the projects. Section III describes the GIS services provided within the projects. We then present the performance measures used, in section IV. Finally, further steps are discussed in conclusions.

II. EMIS DESCRIPTION

In this section, the main components of EMIS are outlined. In fact, EMIS is based on technologies and tools that are widely available, such as servers, Microsoft® Operating System (OS), Oracle Database Management System (DBMS), Geographical Information Systems (GIS), Network Analyst, and Tracking Analyst.

EMIS has four main integrated system components; infrastructure, application, data and training as shown in Figure 1. These components are briefly described in the following subsections.

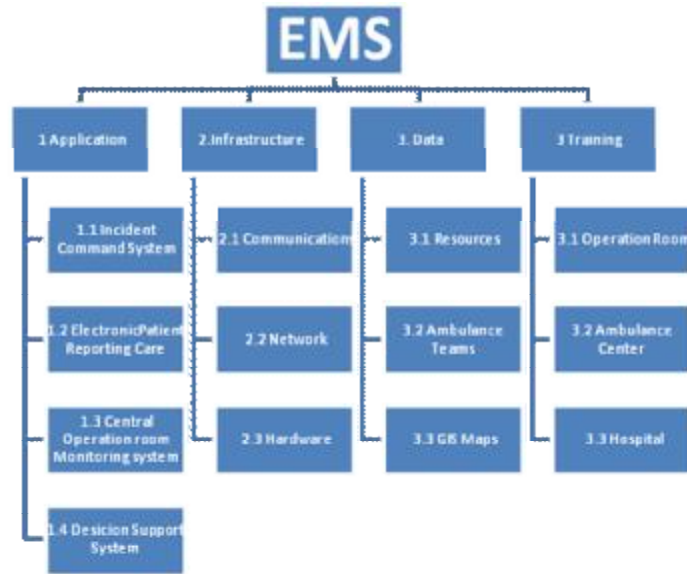


Figure 1: Project components

A. Infrastructure

EMIS is an integrated solution for enhancing the performance of emergency life cycle over the whole area of a country. For this reason it must contain a well established infrastructure of communication lines and networking to facilitate its major role. Infrastructure component consists of many parts as illustrated in Figure 2.

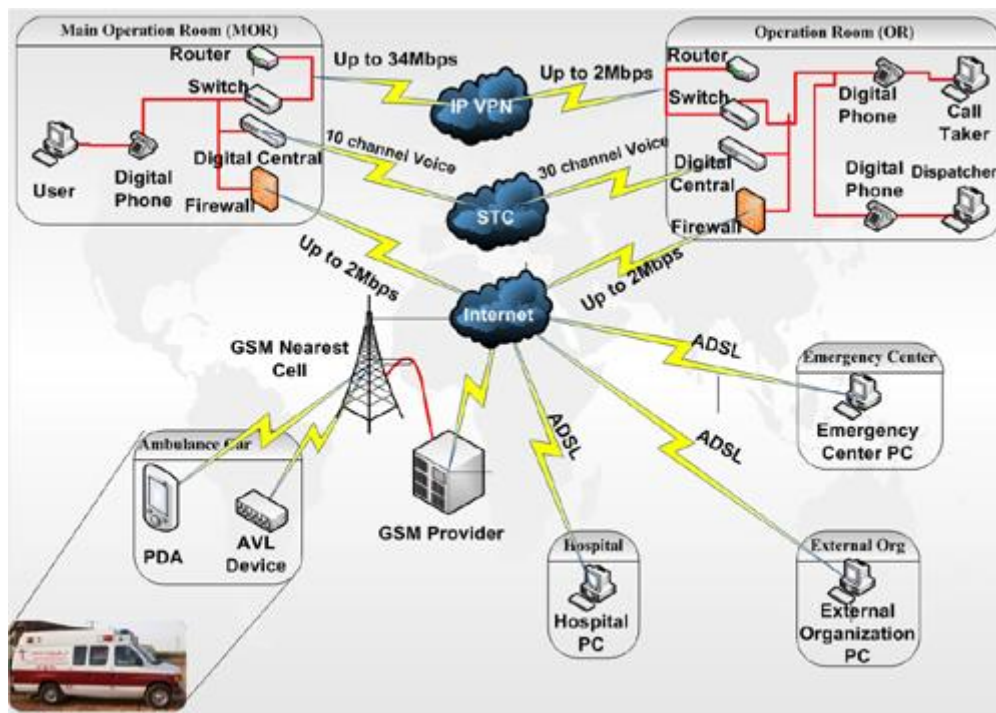


Figure 2: Type of communications being implemented

1) *Communications:* In this integrated solution there are several levels of communications; first level has the telephones and PCs that are connected to a digital central where ANI and ALI features have been activated. PDAs are connected to the same operation room through General packet radio service (GPRS). The second level is the communication between all rooms and the central operation room through the internet connection but is being designed to support the Virtual Private Network (VPN).

2) *Hardware:* The base layer consists of several types for hardware that helps the system to perform in a stability way, hardware used:

- Servers: there are three Servers, two for a Database and GIS and the other for ALI that acts as a firewall and installed on it a Linux based firewall (PFSense) and is connected to the King Abdul-Aziz City for Science and Technology (KACST) servers.
- Call Receiver: in system each Call and dispatcher has own PCs that can use all features on it like ANI , AVL, Database Management System (DMS).
- Switches: each operation room consists of one switch to connect all devices existed to local network like Pcs servers, router, and printers.
- Digital Central: all land lines in each operation room is connected with a special type of digital central that had been integrated with the EMIS and provide many features like ANI , ALI , Interactive Voice Response (IVR) .
- Routers: each room has one router that is responsible for getting access to the internet connection and establishes the IP VPN connection.
- Plasma Screens

3) *Network*: Figure 3 shows a sample of connection types in Al Riyadh operation room. The operation room consists of a portion containing the receivers and some glass rooms containing the dispatchers all these are connected through cable networks with a switch that is connected to the router to access the internet. In addition, the server room which contains servers one for handling information and one works as a backup system and the other one to handle Caller Position

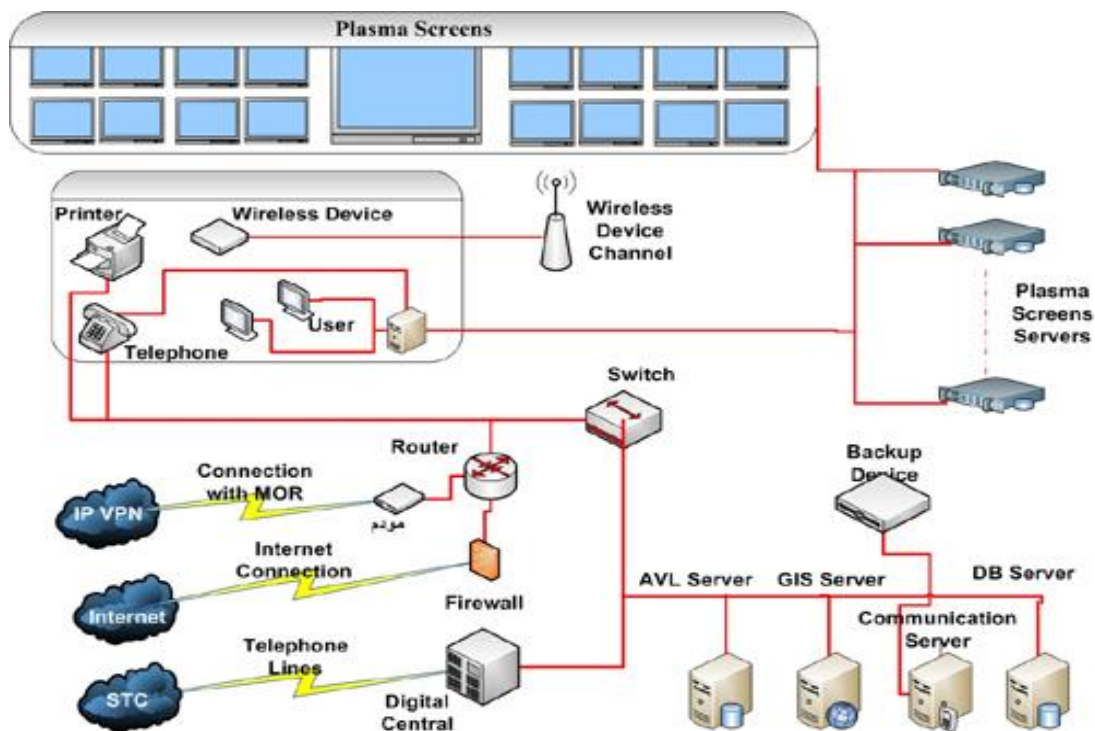


FIGURE 3: Sample of connection in Al Riyadh

B. Data

In huge projects, handling data is a very heavy procedure because it contains a lot of information and affects on the results of the project. EMIS includes and collects information from 17 operation room and its employees these information contains the full employee information, the emergency centers associated to each operation room, all dispatch channels and all list in the application must be entered. The information of all ambulances teams in each emergency centers with the employees and car information have been added. Global Positioning System (GPS) devices, GIS Maps are added to all cars so that it helps us in calculating shortest path for all these reasons

C. Training:

The idea of changing way of work is refused by employees, so there must be a way for how to present this new idea to the normal end user because this role is the real success for any project.

D. Application:

The last part of this project is to implement this new technology so that the user can utilize all available features. The main features are:

1) *Incident Command system* :This part contains the call taker which receives the call on the application through the integration with the digital central and can identify the number whether it has been used before or already in the system through the Automatic Number Identification (ANI) also it can identify automatically the caller location thorough the Automatic Location Identification (ALI).Another item in this part is the Computer Aided Dispatch (CAD) who get all the incident information being entered by the Call Taker and have the enough information assign the suitable ambulance unit through the Automatic Election of ambulance unit. Also he can notify the position of each ambulance vehicle through the automatic Vehicle Tracking (AVL) which is being done as a graphical real time tracking by Geographical Information System (GIS), so by this way he can know the status of each ambulance unit whether it finished the case or still in the incident place of in the emergency center so he can choose it or choose another unit, this role also send all this information to the rescuer in the field who is using a special Mobile Computer called Portable Digital Assistant (PDA) to receive all this information and sends all medical and personal information being entered to the Operation room, with also some features like shortest path and voice guidance ...etc.

2) *Electronic Patient Care Reporting (EPCR)*: This part is independent software to enhance the capacity for field personnel inside of emergency response vehicles, improving response unit communication with dispatch centres, and enabling First Responder Field Incident Reporting capabilities. The rescuer using PDA can input medical information and personal information of the patient through a graphical user interface (see figure ..) in conjunction with some related modules used to facilitate and enhance the services being delivered to the patient as shortest path from its place to the incident place and from the incident place to the hospital with a voice guidance all this is being introduced on a GIS map, also election for the nearest hospital according to the specialization and position. Above that all step being done the rescuer has the option to confirm its timing so the person in the operation room can always know the status of this unit, and all action being done on the PDA has signature and confirming to know who is responsible for this item. PDA also is working by a technique called Occasionally Connected System (OCS) that it have its local Database also so if the GPRS connection is down right now it wont make a problem you ll be able top complete your work and save it and as soon as the connection returns the OCS system will transfer automatically the data to the operation room server

3) *Central Operation Room Monitoring System (CORMS)*: CORMS is an alarm Monitoring Automation System: provides alarm reporting and routing, service management & accounting for existing emergency response systems, and emergency call taking systems it also allows for statistical reporting on dispatch activities. Through GIS Maps it provides real-time map displays for CAD ands, management of Automatic Vehicle Location (AVL) position data, and GIS services such as address verification and Automated Vehicle Routing, all these functionality is being monitored all over the 16 branches in the KSA. Moreover these items can provide a live video streaming from all 16 operation rooms and video streaming from special kind of ambulance containing camera to record the incident if there is a disaster or so on. All these functions give the chance for decision maker to take certain action like increasing ambulance unit in this place, or making a new branch to handle certain incident, also decision makers can propose report to external organization as police station to inform them that this area get many car accidents or so on.

III. GIS SERVICES FOR DISPATCH CENTER USERS

GIS real-time services are provided to dispatch center users by a fully custom made Viewer developed by Unicom for Communication Technology Team using the GIS regional online database, related DQL Server data tables containing data required by CAD/EPCR. The following services are provided:

- **AVS**: Address Verification Service (AVS) is automated utilized by loading from the Database so instead of waiting for CAD during event entry, and any time CAD requires verification of a location entered by the user. CAD sends address verification requests to AVS, specifying the location entered the system automatically perform AVS on all data entered so CAD cant at all choose a wrong or missing street name or any7 type of address. If a single matching location is identified, AVS returns that location to CAD. If several locations potentially match, AVS returns the list to CAD.
- **AVL**: Ambulance Unit forward Global Positioning System (GPS) reports from special device called Spider Net to CAD, via normal Enterprise Global System for Mobile communications (GSM) reporting is configured using distance traveled and/or elapsed time; for example, an MDC might be configured to report its position every 5 seconds and according to its status whether it is moving or no. CAD forwards

just the GPS information to the AVL service, which normalizes the location report and stores it in the regional database, for use by the real-time map displays and AVRR.

- **AVRR:** AVRR is utilized by CAD to prepare unit recommendation displays. When a dispatcher requests a unit suggestion, CAD prepares and displays a recommendation, and also sends a list of candidate units to AVRR, along with the event location. For each candidate in the list, AVRR determines a route between the unit's last reported GPS location and the event location, taking road closures or road vehicle restrictions into account, provides a quickest route solution, and calculates the driving time. AVRR returns the candidate list to CAD (minus any candidate for which a route could not be determined), showing the calculated drive time, and CAD adds the AVRR list to the unit suggestion display.
- **Real-Time Map Displays:** Real-time map displays are available at all CAD workstations. The map displays the following:
 - GIS layers selected by the user; for example, street centerlines, and building.
 - Current unit locations reported by AVL
 - Incident locations, for open events reported by CAD
 - Shortest route Information.
- **Online GIS Updates:** Dispatch center users have a limited ability to apply immediate updates to the GIS database, as follows:
 - Additions/changes to building/facility names and other common place identifiers
 - Additions/changes to street aliases and street types
- **AVL Playback:** The GIS regional data manager can connect to the regional online database, and play back historical AVL data for a selected date/time range. AVL also offers an AVL "playback" service using the GIS data administration workstation where AVL position reports from Spider Net can be retrieved for a specified date/time range, and played back to review the vehicle's route from time of dispatch to arrival at the incident location.
- **GIS Services for PDA Users:** GIS real-time services are provided to PDA users by GIS applications running in the PDA, using the GIS dataset loaded into the PDA; and using road closure information and dispatch notifications received from CAD. PDA do not access the GIS data GIS server located at the Operation Room. Instead, each PDA associated with the installation stores one or more installation specific GIS datasets, selected in accordance with the installation(s) where the unit responds. The installation-specific GIS dataset contains complete data for the installation GIS services for PDA users center on the real-time map, which shows the following:
 - GIS layers selected by the user; for example, street centerlines, and building.
 - The unit's last known GPS position reported to AVL and also provided to the PDA's GIS services.
 - Event location for the unit's assigned event, obtained from the last dispatch message received from CAD.
 - A recommended route from the unit's current location to the event location or to any selected location. Routes are calculated within the PDA by its GIS services.
 - Road closure information.

IV. PERFORMANCE MEASUREMENT

After completing this large project there must be a way to measure its performance in a scientific way. for this aim we created Key Performance Indicators (KPIs) for all project stages. Types of KPIs are:

- KPIs for Delivering Hardware and software
- KPIs for Installing Hardware and software
- KPIs for operating the system

V. CONCLUSIONS

Implementation of EMIS provides an integrated, scalable, and expandable Emergency Management Information system to support First Responders at field. EMIS provides positive operational and organizational impact by improving emergency response management through the utilization of automated, reliable products and procedures. As a conclusion, the change management operation is the most critical, success factor in this kind of huge projects.

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