Communication and Information System for Disaster Relief Operations

Karin Mertens
Royal Military Academy, Renaissancelaan 30,
1000 Brussels, Belgium
E-mail: karin.mertens@rma.ac.be

Wim Mees
Royal Military Academy, Renaissancelaan 30,
1000 Brussels, Belgium
E-mail: wim.mees@rma.ac.be

ABSTRACT

Disaster relief operations are very different from the traditional war operations. In disaster relief operations everything has to go very fast, the relief workers have to leave on very short notice and cooperation with other organizations is needed in order to save as many human lives as possible. The communication and information system of those operations has to be small, flexible, rapidly deployable and mobile. Above that, it has to ensure the information exchange between the coordination center in the home nation and the relief workers in the field in all kinds of situations with changing bandwidths and impermanent connections. In this document the structure and the data warehousing of such an information system are described.

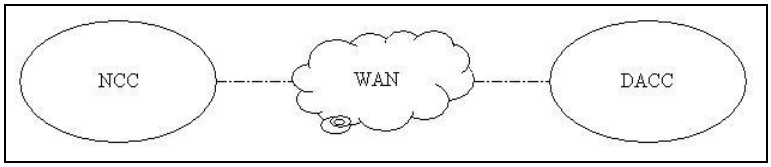
Keywords

Information system, disaster relief operations, relief workers

INTRODUCTION

The number of disaster relief operations is growing and conventional command and control systems are not suited for those operations. They are too big, too complex and they take too long to deploy. A Communication and Information System (CIS) that is usable for Disaster Relief Operations (DRO) has to be flexible, rapidly deployable and user friendly.

A disaster relief operation begins when the disaster relief operations duty officer is notified that a disaster has occurred. Then, even before an official request for assistance is received, a first feasibility check will be started as a preparation. When the official request arrives and the government decides to act, the disaster relief operations team leaves for the disaster area within 24 hours. When they arrive on site, they will immediately set up the Disaster Area Coordination Center (DACC) and get in contact with their National Coordination Center (NCC) using a Wide Area Network (WAN).



From that moment on, there will be a regular exchange of information between the two coordination centers and the CIS will be completely deployed.

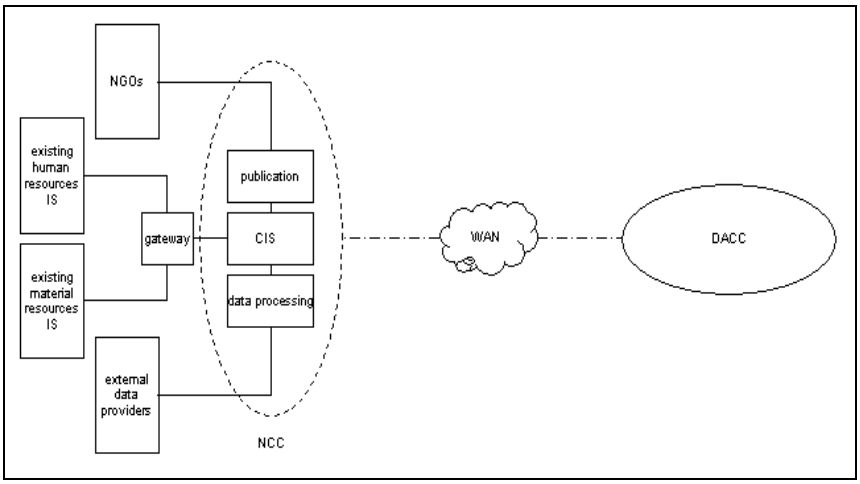
This paper examines the communication and information system that is being developed within the framework of an ongoing research project to support the Belgian First Aid and Support Team (B-Fast). B-Fast is a group of military people, fire fighters, civil protection units and others that perform international relief work. Each time there is an international demand for aid because of a major crisis event, the Belgian government can decide to send this team of relief workers. In order to test how a CIS can speed up the administrative process of a relief operation and how it can improve the situational awareness of the decision makers and the relief workers, a prototype of such a CIS is being built.

In the following sections this communication and information system will be described. First the structure of the system at the NCC will be discussed, followed by an overview of the situation at the DACC and a brief discussion of

the information exchange between the two coordination centers. At the end of each section it is mentioned which parts are already integrated in the prototype and which components are still under development.

NATIONAL COORDINATION CENTER (NCC)

The National Coordination Center will consist of a fixed information and communication system that may be dormant or integrated in a larger permanent coordination center when no relief operations are ongoing.



The NCC will be equipped with the possibility to link to human resources information systems of organizations from which personnel can participate in disaster relief operations and to material resources or logistics information systems of organizations from which equipment can be obtained in the framework of disaster relief operations. Some examples of such organizations are ministry of defense, civil protection, fire departments, etc.

The use of links with human and material resources will prevent duplication and spreading of the information over different information systems. In this way, related information will be grouped in one system what will facilitate and speed up searching and maintaining the information.

A gateway will be used to translate requests and replies from one format into another and to enforce certain policies on the exchange of information between the NCC and the existing resources.

The information that is not available in existing resources information systems, will be stored in the NCC itself. Examples of such information are important telephone numbers, reviews of previous operations, etc. Currently a website is used for consulting and managing this information.

At the level of the NCC, certain parts of the information contained in the information system will be accessible through a publication gateway to third parties such as Non-Governmental Organizations (NGOs), the press and the general public. It will be possible to define very precisely who has access to which elements of information (e.g. types of information, processed or unprocessed, level of detail). One could for instance imagine that detailed information about the medical situation of refugees may be advertised to certain NGOs, but must be hidden from the press and the general public.

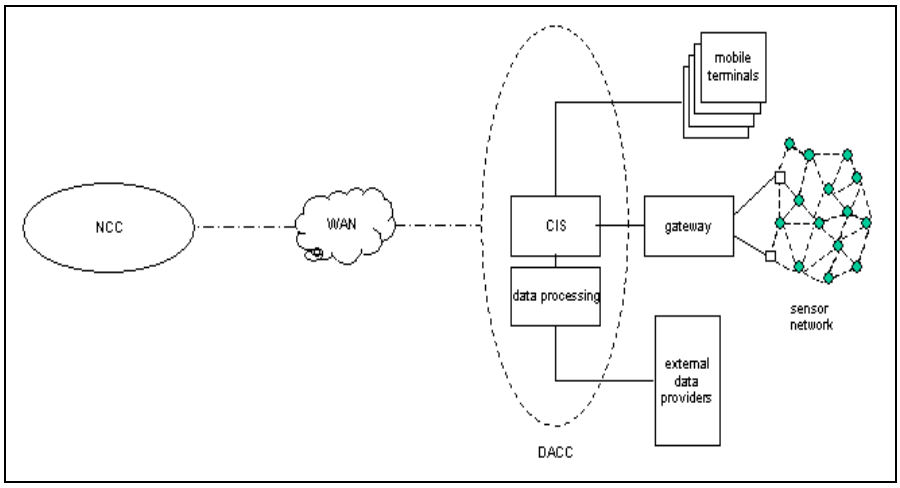
Finally, the NCC will have the possibility to import data coming from a number of external data providers. Any kind of topological or cartographic information can be integrated and displayed by the information system.

The raw information, produced by the sensors that are operated by these external data providers, must be processed before being introduced into the CIS. The processing can vary from a basic geo-referencing operation to the creation of 3D-images of the environment.

In the prototype the possibility to connect to other resource information systems is foreseen, but a real connection using an access gateway will be only established in the final version of the prototype. Data from external providers can be imported and visualized and all information can be managed directly by the administrator or indirectly by the users. The latter can use a web interface to access the data.

DISASTER AREA COORDINATION CENTER (DACC)

In the disaster area the personnel consists of specialized relief workers with generally a very limited support staff (Kleysman, Tripnaux and B-Fast, 2004). Most often, there is no room for an important command and control staff with a dedicated information system support cell. Therefore the CIS component in the DACC has to be very robust and user friendly.



The DACC will contain a server that replicates information with the NCC. The information can come from the DACC itself, but most often it will be entered and retrieved from mobile terminals, carried by the relief workers in the field.

These mobile terminals can vary from Personal Digital Assistants (PDAs) to laptops. They can be equipped with different types of data acquisition devices, such as Global Positioning System (GPS) receivers or digital camera's.

Sometimes there are some external data providers available at the DACC. When both the DACC and the NCC can access the data provider, the data will be introduced into the CIS at the NCC since the necessary human and computing resources for processing the information will more readily be available in the supporting nation than in the disaster area.

Some data sources may however only be accessible from the disaster area, such as for instance an existing local measurement infrastructure for measuring chemical agents in the air or measuring rainfall. When the measurement infrastructure (partially) survived the disaster and the measurement variables are relevant for the disaster relief operations, an effort will be performed to link the measurement infrastructure to the CIS.

Finally, a sensor network can be attached to the DACC CIS. Such a network will provide local information from different places in the disaster area. The information that is acquired by a single sensor can range from a single value (e.g. temperature, rainfall, amount of radiation) to a visual, thermal infrared or hyperspectral image, acquired using a camera that can be oriented in different directions.

As in the NCC the prototype is equipped with the necessary tools to import and present different kinds of external data. A link with the mobile elements is established and the exchange of information is tested and approved. A gateway to a sensor network has not been developed, but its development is planned in the near future.

TYPES OF INFORMATION

The CIS needs to manage a wide range of information types.

First, there is the information related to the personnel and equipment that is involved in the relief operations. It consists of structured information about objects (people, equipment and supplies) with which a geographic position can be associated. This information will be stored in the Geographic Information System (GIS) part of the CIS.

Secondly, there is the information about the disaster area. It consists of topographic information (maps, digital terrain models) and of thematic information. This information will be obtained from libraries with existing

information and from the processing of sensor data. The information about the disaster area will also be stored in the geographic information system part of the CIS.

Finally, there are the remaining bits and pieces of information that do not fit in one of the categories above. This information is treated as unstructured information. Even when by nature, parts of it may be actually structured, they will undergo the same treatment as the unstructured elements of information simply because, in the framework of the relief operations, there is no time to develop structured database models for organizing each and every crumb of information. The unstructured information will be stored in a knowledge base system.

The prototype uses the ESRI products as geographical information system and a SQL server knowledge base system. Thanks to those software items the different types of information, which are inserted in the CIS, are managed perfectly.

EXCHANGE OF INFORMATION

The information that is stored in the CIS will be entered into the system either in the NCC or in the DACC.

The data that is available in the NCC at the time the DACC is prepared for transportation will be preloaded in the DACC CIS module before the departure of the team.

Thereafter, the NCC and the DACC CIS modules will replicate information between both sites, based on the available bandwidth and the time-window of the WAN link between them.

The replication mechanism will transform the information into Multilateral Interoperability Program (MIP) standards in order to secure a possible information exchange with other national or international CIS.

A replication policy will be defined to allow the system to assign priorities to the different chunks of information that are queued for transmission to the other side.

The prototype allows the exchange of information between the NCC and the DACC, although the priorities aren't implemented yet and the information is not transferred in MIP standard. Both of the aspects are however in a development phase and should be implemented before the end of 2006.

CONCLUSION

The communication and information system for disaster relief operations will give the NCC and the DACC the opportunity to exchange information. The NCC will be able to send background information like topographic maps, satellite images, etc to the relief workers in the field, who in turn can reply with a detailed overview of the situation on the field. Both parties will stay up-to-date thanks to the CIS.

At the NCC, there will be the possibility to outsource a part of the information to existing human or material resources information systems and to publish specific information to third parties. The CIS will also be capable of keeping a history of the current and previous operations, making it possible to analyze the operations and to extract the lessons learned and improve subsequent operations.

At the DACC, the sensor network, the external data providers and the mobile terminals will insert a lot of information concerning the situation on the field. Thanks to the underlying geographical information system this information can be presented in a synoptic manner.

The multilateral information exchange standards will provide the CIS the capability to exchange information with other national and international information systems.

In this research in progress a prototype of a communication and information system is being built. Many parts are already developed and the first complete version of the prototype is expected before the end of 2006.

REFERENCES

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