Computer Networks for Crises Management in case of environmental Disasters and related Types of Threats

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Abstract

As a result of intuitive considerations, theoretical approaches, practical system tests and related project experience, a proposal is made for the logical structure of such networks, including monitoring and surveillance, prediction and prognostics, early warning, decision support, warning and information of the public and emergency management. The system requirements are described and it will be shown that the proposed architectural design is suitable for the purpose of environmental monitoring, early warning and hazard management.

As an example for the operational feasability and the technical implementation of such a system, a remote monitoring and surveillance system for nuclear power plants is described, including prediction and early warning based on a dispersion modelled transport calculation in case of radioactive releases.

1. Introduction

Almost every day TV news report disastrous environmental events from somewhere in the world. Earthquakes, volcanic eruptions, hurricanes, heavy thunderstorms, floods and avalanches alternate with tanker collisions, oil spills, bushfires, accidents in chemical or nuclear plants (related with the emission of toxic gases or radioactive nuclides) and terrorist attacks.

The loss of human lifes and the tremendous damages caused by those catastrophes as well as the increasing sensitivity of the general public demand for the protection of the population and the environment by means of a new generation of intelligent surveillance, information, early warning and emergency management systems.

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2. The requirements

Defining an adequate logical structure for those networks, a variety of subtasks and prerequisites have to be fulfilled in each case in order to reach the goal of an operational system being up and running in the end:

- development/integration of adequate sensor systems and sensor networks (autonomous or remotely controlled) providing data and background information
- advanced modelling, i.e. development/improvement of prediction models for prognostic calculations of each disaster type supporting interpretation and extrapolation of data
- integration of scientific prediction modules into operational systems and definition of adequate interfaces to allow for fast response actions even under critical conditions
- development and implementation of risk analysis and decision support systems based on sensor data, prognostic calculations and disaster specific experience
- development/improvement and inclusion of knowledge management components (in general and disaster specific) to account for the long-term experience of experts and observations made in the past
- definition of adequate information, alarm and warning strategies
- definition of appropriate interfaces to catastrophe handling and resource management subsystems (transport facilities, shelters, medical care....)

Special care has to be taken for the flow of information and data streams, providing all subsystems with the relevant information within due time, enabling them to fulfill their specific tasks in a rather autonomous way but sharing the results with other subsystems who, on their turn, need it as input.

3. The logical structure of the system

The proposed logical structure is shown in Figure 1 in the form of a Local Area Network (LAN), although some components may be linked together physically by means af a Wide Area Network (WAN).

 # The full paper will contain a more detailed verbal description of the proposed structure #

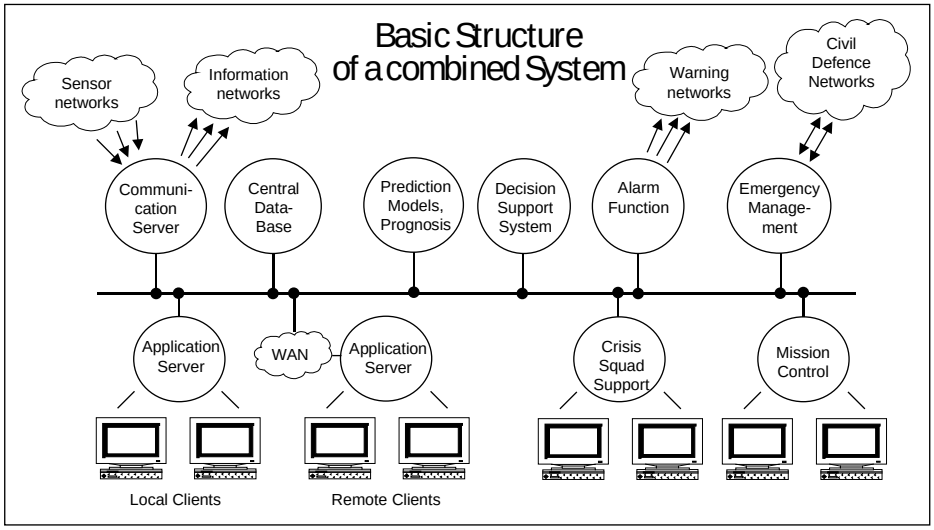

Figure 1
Structure of the System

4. Technical implementation of a reference system

As an example for the operational feasability and the technical implementation of a system in accordance with the proposed logical structure, a remote monitoring and surveillance system for nuclear power plants (RM/NPP) will shortly be described in this section.

The task of this system is to monitor the operation of the nuclear power plants in the Federal State of Baden-Württemberg (Obrigheim KWO, Philippsburg KKP I and II and Neckarwestheim GKN I and II) and of foreign nuclear power plants close to the german border (Fessenheim, France and Leibstadt, Switzerland).

The actual operational state of the nuclear facilities including their emissions into air and water, together with the radioactive immissions into the environment are automatically recorded. In addition, the RM/NPP system continuously surveys the meteorological data at the sites and also receives data from external measuring networks, thus adding up to a volume of approx. 100,000 measurement data per day.

The RM/NPP system provides numerous possibilities to visualize the data and to check them against threshold values and protection objectives. In the case of a ra-

dioactive leak, potentially affected areas can be determined at an early stage by a dispersion modelled transport calculation (DMTC) and protective measures can be adopted by the ministry in cooperation with the authorities responsible for civil protection.

The concept, the architectural design and the user interface of this system had to meet extremely high demands. Therefore, and in accordance with the logical structure proposed above, the system was conceived in form of a client/server architecture with the following components:

- Communication Server (CS)
- Central Database (CDB)
- Application Servers (AS)
- Dispersion Modelled Transport Calculation (DMTC)
- PC based User Interface (Clients)

All important components of the control centre, measuring data recording and networking are organised in a redundant manner. Standard PCs are used as clients, enabling the RM/NPP data to be accessed and visualised with the assistance of GIS functions (Geographical Information System). In order to support the information of the public, the RM/NPP system also allows to be accessed via WWW-browser technology without special need for of the RM/NPP client software.

5. Conclusion

A proposal has been made for the logical structure of computer networks for crises management in case of environmental disasters and related types of threats. It has been shown that the proposed architectural design is suitable for the purpose of environmental monitoring, early warning and hazard management.

As an example for the operational feasability and the technical implementation of such a system, a remote monitoring and surveillance system for nuclear power plants has been described. The high demands placed on the user interfaces in order to guarantee a secure and simple operation of this very complex system could be met due to the ergonomic design, consequent use of graphical and geographical visualisation and operating technologies from the GIS environment.

The described remote monitoring system for nuclear power plants enables the supervisory authorities to meet their obligations under atomic legislation in a safe and economical manner. The extended possibilities of evaluating and visualising measured data, together with the complex models for the transport calculations and the visualization of their results and implications, support and ease the assessment of an incident by the supervisory authority and the Regional Administrations responsible for civil protection.