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Integrated Hydrological Data and Knowledge Management Transfer for Flood Warning Centres in Germany and Austria

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Hydrological Data and Knowledge Management Transfer for Flood Warning Centres

Instancing by the countries Saxony-Anhalt, Germany and Lower Austria, Austria, the reorganization of infrastructural strategies for Flood Warning Centres will describe. The article demonstrates different scalable realizations beginning by the data acquisition until the public presentation in the Web. The central elements in the Flood Warning Centres are data management and the information transfer inside and outside the institution. Different methods of resolution are shown.

1. General

The flood catastrophe which struck mid-Europe during the summer of 2002 made the need for rapid access to relevant information apparent to all countries involved. Additionally the need for simplified communication pathways was highlighted as well as the speed and efficiency of flood warning distribution process.

A further result that came to light was the necessary partial renewal of the hydro-meteorological measuring network. The measurement network was found, in some cases, to no longer be satisfactory for the demands made by such a catastrophe. Additionally, there was a need for heightened data security through the development of stand-by systems.

The distribution of knowledge during the flood phases was also recognised as being in need of improvement. This related to the integration of all available hydro-meteorological data and information in the existing complex forecasting and warning system. Improvements were also necessary to ensure the rapid and secure forwarding of information to other authorities and services, as well as affected residents and the general public.

This article will present the results experienced from two flood warning centres in Sachsen-Anhalt, Germany and the Flood Warning Centre of the Lower Austrian Hydrographic Service, Austria. In both cases, the KISTERS AG, Germany were contracted to supply all necessary components for the modernisation of the centre. In conjunction with the successful cooperation of other partner companies, the following tasks were accomplished:

1. Optimisation of the remote call process and communication pathways for the online collection of hydro-meteorological data.
2. Optimisation and diversification of the flood warning centre by specific water stage notification regarding content, inflow and details of reservoirs and storage basins.
3. Consolidation of hydro-meteorological data and information from different organisations, authorities and observers. This includes precipitation and snow depth reports, as well as precipitation and thaw forecasting. Information about weather development patterns and storm warnings has also been integrated.

4. Renewal and optimisation of flood reports and warnings based on weather and storm warnings, or raised water table levels in the respective catchments. Examples include the automatic distribution of messages to predefined groups via varied communication methods such as Fax and SMS. The quality assurance of distribution pathways and receiver confirmation and tracing of the transmission is also important.
5. Integration of flood forecasting (models) and other flood information with details of the current situation and potential flood developments.

2. Flood Warning Centre of Saxony-Anhalt, Germany

As a consequence of the flood disaster in August 2002, the federal state Saxony-Anhalt decided to unite and optimise the activities carried out so far by the Flood Control Centre (HWMZ) in the State Office for Environmental Protection Halle (LAU Halle) and the State Office for Flood Control Measures and Water Management (LHW) by combining them to form a modern Flood Warning Centre (HVZ).

Within a public european tender the KISTERS AG accept the bid as system supplier and book runner to equip the new control centre (in common with Björnsen Beratende Ingenieure, Robotron Datensysteme GmbH, Nextira One).

These were the demands made on the Flood Warning Centre:

- Base Data Management (Kisters-HVZ Monitor, Customer Profiles);
- Forecast (Model Integration, Scenario Management);
- Data Publication (Kisters-Inter-/Intranet, FTP, E-Mail, WAP, Voice, Documents, Fax, SMS);
- Other Data (Result sets of Model Scenarios, Documents, Comprehensive Protocols, Archive);
- Redundant Configuration (Two nearly identical customer sites);
- Open Interface (Kisters WISKI Service Provider) between Control Centre administration and: Kisters-SODAmodular Online Data Monitoring (Remote data fetch transfer (FTP, E-Mail, Fax, Speech Dialog System); Time Series Data Management (Kisters-WISKI Database, Online and Manual data); Forecast and other data sources.
- Standardized XML-Interface;
- Data exchange with the Kisters-WISKI-System of the Environmental Agency of Saxony Anhalt;
- Date exchange with the groundwater database the Environmental Agency of Saxony Anhalt.

The Flood Warning Centre is divided into several areas with different functions (Figure 1):

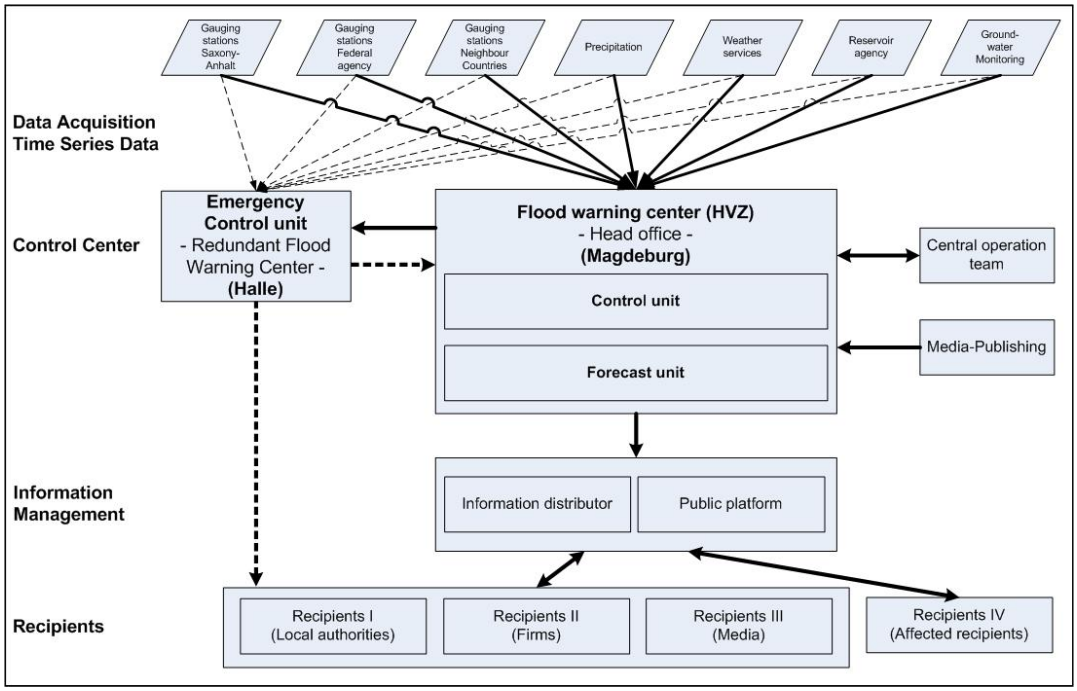

Fig. 1: Functional structure of the Flood Warning Centre Saxony-Anhalt, Germany

2.1 Data Acquisition and Time Series Data Management

A fundamental contribution to the total information management of the Flood Warning Centre is made by the stations with their measured stage, discharge and precipitation data. It is not only the data measured in Saxony-Anhalt itself which flows into the system; there is also data coming from the national river authority, the reservoir systems, the neighbouring countries and the groundwater measuring network. Joining values, forecasts and warning messages of the German Federal Weather Service (DWD). Additional extensive functions for the manual input of values (e. g. by malfunction of gauging stations at flood water situations) are available.

2.2 Control Centre

The head office of the new control centre is Magdeburg. A redundant emergency control unit is developed in Halle.

2.2.1 Control Unit

The Control Unit is the communication point which retrieves and collects, respectively, the measured values of the stations, weather reports and other information which might be flood-relevant. It receives flood alarms from the gauge stations as well as storm warnings and is responsible to alarm the competent authorities and the Forecast Unit. Core component is the Kisters HVZ-monitor, which will be used as web application in the intranet of the LHW. This application clearly displays every data in- and outlets in real-

time. Documents will be sift through and take on into the system. After enabling the forwarding of data and documents is possible.

2.2.2 Forecast Unit

The Forecast Unit creates stage forecasts based on the input values coming from the Control Unit. Under consideration of further information like weather warnings, water levels and precipitation measurements, specific messages (flood information, situation reports) are developed. This part of the public tender is realized by Björnsen, Beratende Ingenieure, Koblenz, Germany.

2.2.3 Central Operation Team

The Central Operation Team continuously analyses the flood situation. It is responsible for the coordination of the flood protection measures and prepares reports which are published, among others, via the public platform.

2.2.4 Media Publishing

On the one hand, the Media Publishing area produces own video films, graphics and charts and on the other hand, it takes over productions of third parties, evaluates, processes, manages and archives them. The results of these activities can be published via the public platform.

2.3 Emergency Control Unit

In the meantime the Emergency Control Unit in Halle is almost the same manner of the Flood Warning Centre in Magdeburg. Merely there are limitations in the speech doalog system. In case of emergency (if the Flood Warning Centre fails, for example), the basic functions of the Control Unit and the Forecast Unit can be maintained here.

2.4 Information Management

One central activity of the Flood Warning Centre is to work out and distribute information. Depending on the specific configuration for each recipients, the distribution of the documents and data occurs automatically, partly automatic or manually.

2.4.1 Information Distributor and Public Platform

The Information Distributor (Kisters WISKI Service Provider) automatically dispatches the warning messages received by the Control Unit as well as the flood reports created in the Forecast Unit.

The Public Platform serves to publish all flood-relevant information on the part of the Flood Warning Centre for third parties.

2.4.2 Recipients

The recipients of such information are divided into three groups:

- Group 1: approx. 300 municipal institutions (districts, towns, counties);
- Group 2: approx. 100 commercial and agricultural enterprises concerned;
- Group 3: approx. 150 interested parties of the public and the media.

Each group gets the information it needs. Furthermore there is an option, that the recipients configures the type, the amount and the specific date of allocation for themselves.

2.5 Net Scheme and IT Infrastructure

The functional structure described above is realized through the appropriate distribution of services within the network structure in the Flood Warning Centre. Figure 2 below shows how the communication paths are optimised. This is achieved by the close technical and functional interaction of the single areas.

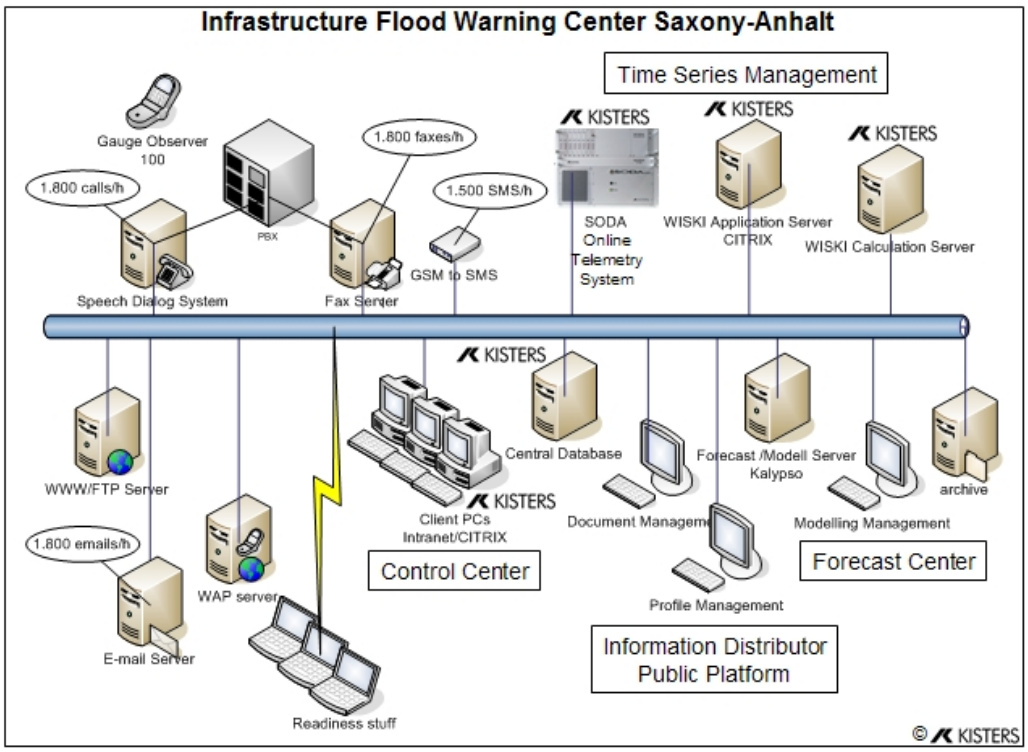

Fig. 2: Net scheme and infrastructure of Flood Warning Centre Saxony-Anhalt

The whole electronic data transfer between the authorities inside and outside the country happens within the TESTA-Network (Trans-European Services for Telematics between Administrations). This network was created as an enclosed net for data transfer between European national organisational units. The benefit is, the use of common Internet technologies, without accepting their endangerments.

Kisters provides the area

- Time Series Data Management (including remote call processes and communication pathways for the online collection of hydro-meteorological data) with his products ***SODAmodular***, ***SODA/WISKI Alarm Module*** and ***WISKI Information System*** based upon central ***Oracle Database***

and the

- Control Centre (including Control Unit, Information Distribution and Public Platform: Internet/Intranet, FTP, email, WAP, Voice, documents, fax, SMS) with the products ***WISKI Web Public*** and ***HVZ-Monitor***.

In addition, KISTERS supplies part of the hardware used in the PC and multimedia field.

The measured data is cyclically retrieved with the Kisters SODAmodular telemetry system and managed, visualized and edited in the Kisters Water Management System WISKI. Each data record in the database is assigned with basic data of the stations. Additional data arrived in the HVZ-Control Centre by email as well as active and passive FTP-connects. Messages from gauge observers can fully automatic take over in the system by mobile phone and DTMF-entries. Also the entry over Telefone answering machine with appended hand input mask is possible.

The information is distributed via the input monitor of the Control Unit in the Control Centre of the HVZ. Using the Kisters WISKI Web HVZ, the entry, processing and forwarding of all hydro-meteorological data is recorded and monitored. This data is made available to other areas of the Flood Warning Centre for further processing. The monitor is automatically and continuously updated (see Figure 3).

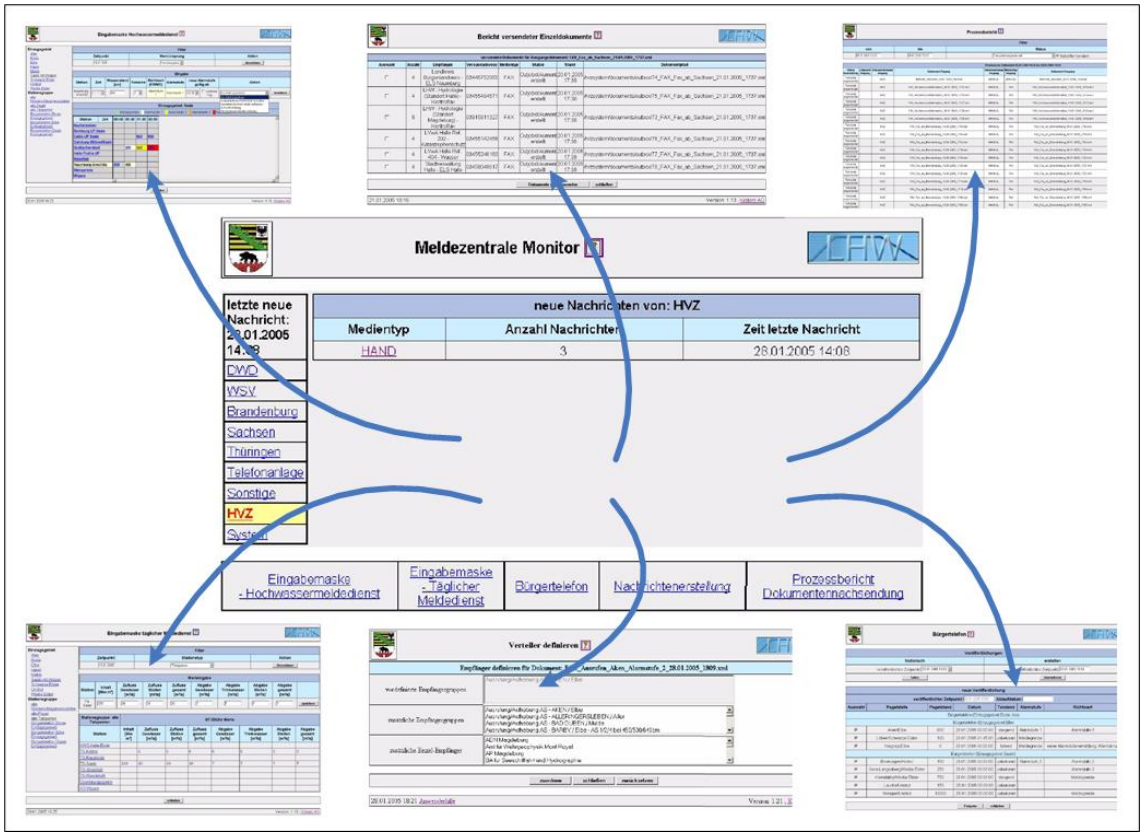

Fig. 3: Information Distribution: Online Monitor in the Control Unit of Flood Warning Centre Saxony-Anhalt

The Public Platform, installed as a web portal, is divided into three areas.

1. The public ***Internet*** with an own http address that can be reached directly or from the state portal environment area;
2. the internal ***Intranet,*** corresponding to the extended public Internet presentation, but only accessible with a specific user account, in which the users can define and administrate their own personal views.
3. the internal ***Intranet*** that can be reached only by means of a user ID and only within the network of the Flood Warning Centre.

The main difference between these areas is the amount of data (stations and measured values) and the additional functions offered to the users.

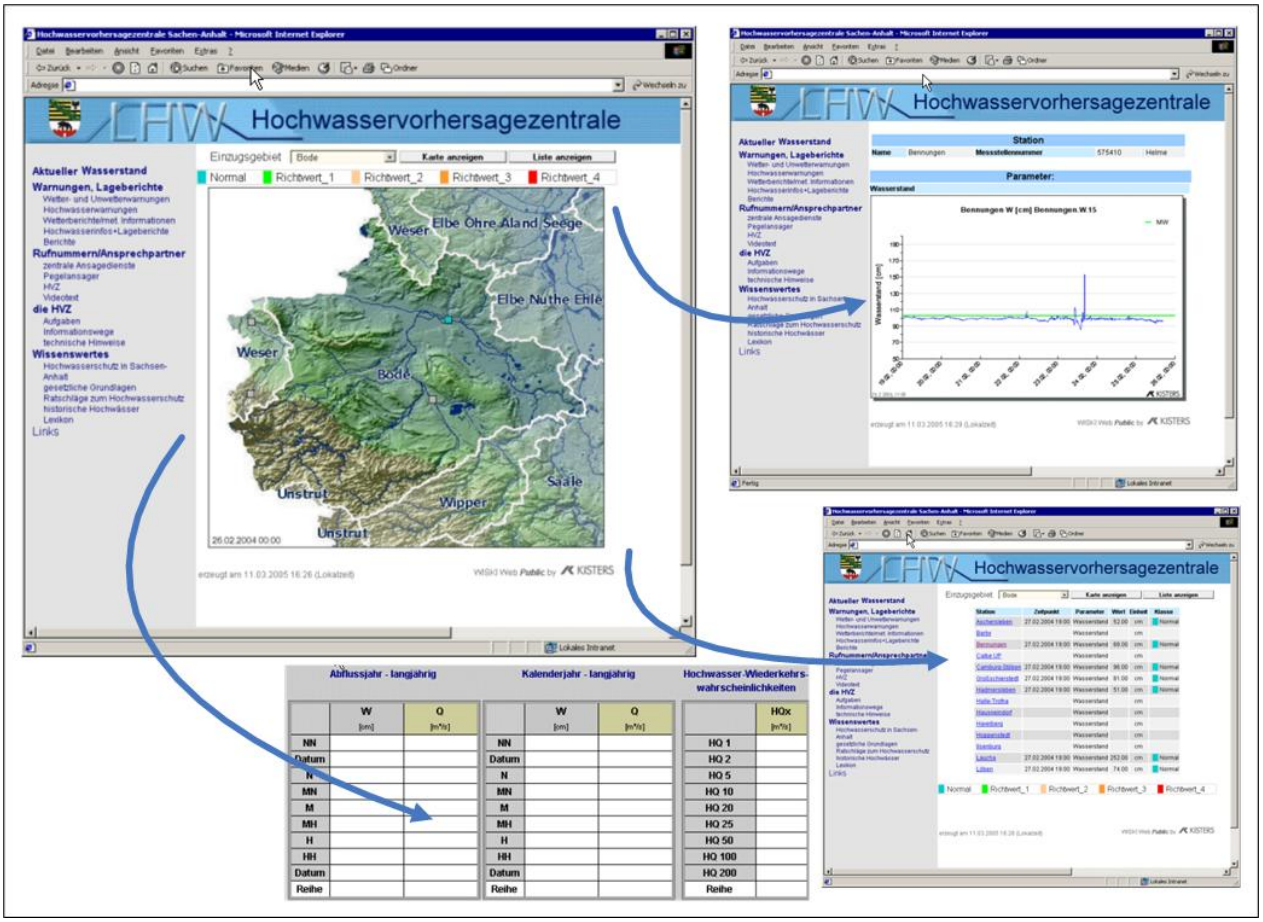

Fig. 4: Public Platform: Public Internet and Inhouse Intranet Presentation in the Control Unit of Flood Warning Centre Saxony-Anhalt

3. Flood Warning Centre of the Lower Austrian Hydrographic Service, Austria

Apart from Eastern Germany, also Lower Austria was seriously affected by the flood in August 2002. The catastrophe showed that the measuring network and the fetch paths did not meet the requirements to some extent. In addition, there was the need of increasing the data security by designing redundant systems.

These were the demands made on the modernization of the Flood Warning Centre (HLZ) of the Lower Austrian Hydrographic Service:

- Data monitoring and remote data fetch transfer (Kisters SODAmodular Online Data);
- Alarm management (Kisters WISKI/SODA alarm module)
- Time series data management (Kisters WISKI and Manual Data, SMS);
- Base data management (Kisters WISKI Data);
- Forecast (model integration, scenario management);
- Data publication (Kisters Internet/Intranet WISKI Web Public, SMS, email);
- Redundant hardware configuration (two identical data monitoring and remote data fetch transfer systems);

The Flood Warning Centre is part of the Lower Austrian Hydrographic Service, an authority of the federal state Lower Austria. The head office is in St. Pölten, the seat of the Lower Austrian state government. The organisational structure of the Flood Warning Centre (HLZ) is shown in Figure 5:

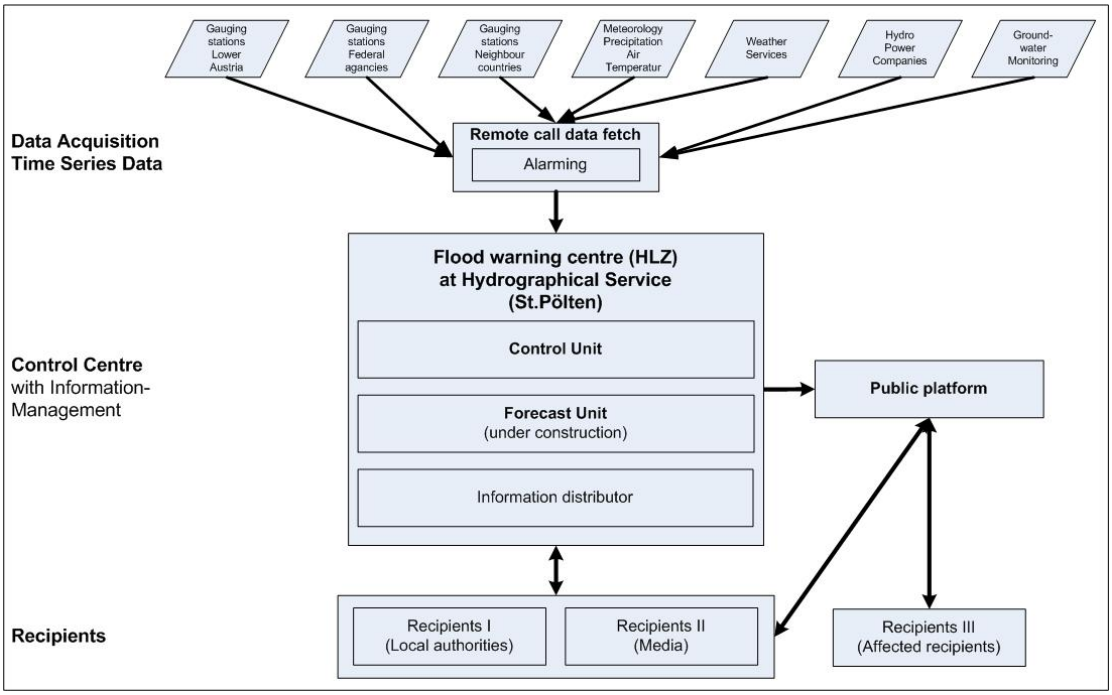

Fig.5: Functional structure of the Flood Warning Centre Lower Austria

3.1 Data Acquisition and Time Series Data Management

As it is also the case in Saxony-Anhalt, the stations with their stage, discharge and precipitation data make a fundamental contribution to the information management of the HLZ in Lower Austria. One gets a comprehensive idea of the situation since it is not only the data measured in Lower Austria itself which flows into the system; there is also data coming from Federal Waterways Directorates (the Danube, for example), forecasts, values and warning messages of the Austrian Weather Service (ZAMG) , the power plant operators (water power) who have a strong influence on the discharge patterns in Austria, the neighbouring countries and the groundwater measuring network.

3.1.1 Alarming

To ensure that the Flood Warning Centre is quickly informed in advance, the measured values transmitted by the stations by phone or GSM are checked for plausibility immediately after having been retrieved. Such plausibility checks are carried out according to individually set limit values. Whenever these limit values are exceeded, the remote call system generates alarm messages for each station. These messages are then automatically sent to the responsible persons in the Flood Warning Centre and to the Central Disaster Control Centre of Lower Austria.

3.2 Control Centre with Information Management

The task of the Flood Warning Centre (HLZ) is to gather, analyse and assess the measured data in Lower Austria and to make this information available to the responsible authorities and the public. Contrary to the Flood Warning Centre in Saxony-Anhalt, the HLZ cannot give instructions for preventive measures.

3.2.1 Control Unit

In the Flood Warning Centre itself, the measured values retrieved from the stations are saved, calculated and visualized. Flood alarms, weather reports, storm warnings and other flood-relevant information are also taken into account for analysis. The HLZ is responsible to alarm and inform the competent authorities.

3.2.2 Forecast Unit

The Forecast Unit in the HLZ is still under development. In selected river territories some hydrological forecast models of the Technical University/BOKU of Vienna, a hydraulic run-off model of Scietec, Linz, for the Danube, and a new developed precipitation forecast simulation of the Austrian Central Authority of Meteorogy and Geodynamic (ZAMG), Vienna, will be applied. All these models shall run under a specific application layer of WL/Delft Hydraulics, Delft, Netherlands.

3.2.3 Information Distributor

The automatic information distribution on the part of the Flood Warning Centre is realized above all by sending flood alarm messages to selected customer groups. This is usually restricted to the customers of group 1 (see the paragraph 3.4) who take appropriate measures on site. The flood reports created in the Forecast Unit are sent by email or fax.

Whether to extend the automatic distribution of any kind of information - by analogy, for example, with the Flood Warning Centre Saxony-Anhalt - is presently investigated.

3.3 Public Platform

The Public Platform of the HLZ uses the state internet portal to offer flood-relevant information directly from the Kisters WISKI database. Here the users can directly access the currently retrieved measured values.

3.4 Recipients

The recipients of information are mainly divided into three groups:

- Group 1: Disaster Control Centre of Lower Austria;
- Group 2: municipal back staff (fire brigade, federal army) and communities;
- Group 3: media (print media, television);
- Group 4: affected people and public.

Only group 1 gets automatically generated information (alarm messages) from the Flood Warning Centre. The other groups get information on request or via the internet portal.

3.5 Net Scheme and IT-Infrastructure

The realization of the cyclic processes that take place in rapid succession requires the network structure described below in Figure 6.

The Kisters SODAmodular telemetry system is designed redundantly and spatially separated. Every system part can call all stations in Lower Austria by means of time-shifted remote call jobs.

The Kisters WISKI database is operated with clustered MS-SQL server technique with the single machines being distributed to two spatially separated locations. A special configuration of the MS-SQL clients ensures that, in case the near node fails, the involved applications will automatically connect to another node even if it is more far away.

Two Kisters application servers, used to quickly process the pending calculation jobs and services (import and export), are also spatially separated and are each assigned to one Kisters SODA.

A test system is operated in addition.

Figure 6 below shows how the communication paths are optimised. This is achieved by the close technical and functional interaction of the single areas.

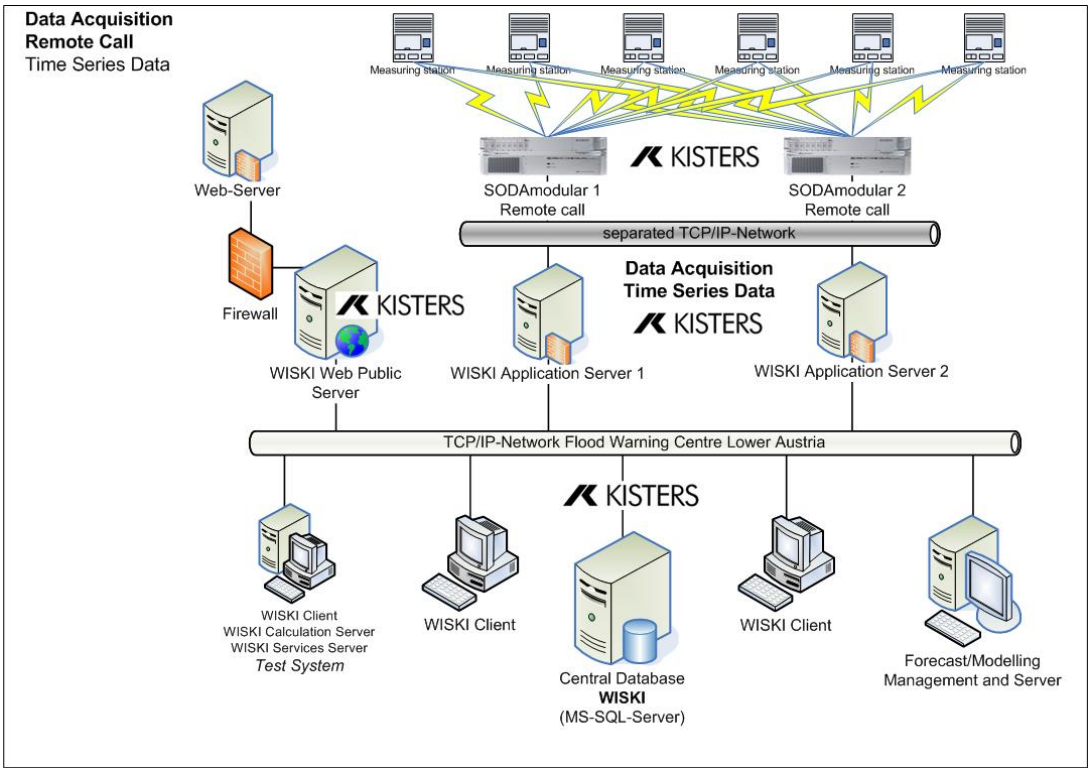

Fig. 6: Net scheme and infrastructure of Flood Warning Centre Lower Austria

Kisters provides the area

- Time Series Data Management (including remote call processes, alarming and communication pathways for the online collection of hydro-meteorological data) of the Flood Warning Centre with its products ***SODAmodular*** and ***SODA/WISKI Alarm Module***

and the

- Control Centre (including online collection of hydro-meteorological data, Control Unit, Information Distribution and Public Platform: Internet/Intranet, FTP, email, fax, SMS) with ***WISKI Information System,*** based upon central ***MS-SQL Server Database*** and ***WISKI Web Public***.

The measured data are cyclically retrieved in intervals from 15 up to 60 minutes, depending on the needs, with the Kisters SODAmodular telemetry system and managed, visualized and calculated in Kisters WISKI.

If a flood limit value (one or several limit values are individually defined for each station) is exceeded for a longer time, alarm messages are automatically sent to selected customer groups by SMS or email. Furthermore, the call intervals are increased for each station to max. 15 minutes.

The public is informed about current and realtime data on special flood pages in the web portal of Lower Austria (see Figure 7). These pages can be configured in the HLZ directly in the Kisters WISKI information system (e.g. selection of the visible stations) or in Kisters WISKI Web Public (e.g. page configuration, graphic templates, flood level marks, historical comparative values).

The main difference between these two areas is the amount of data (stations and measured values) and the additional functions offered to the users.

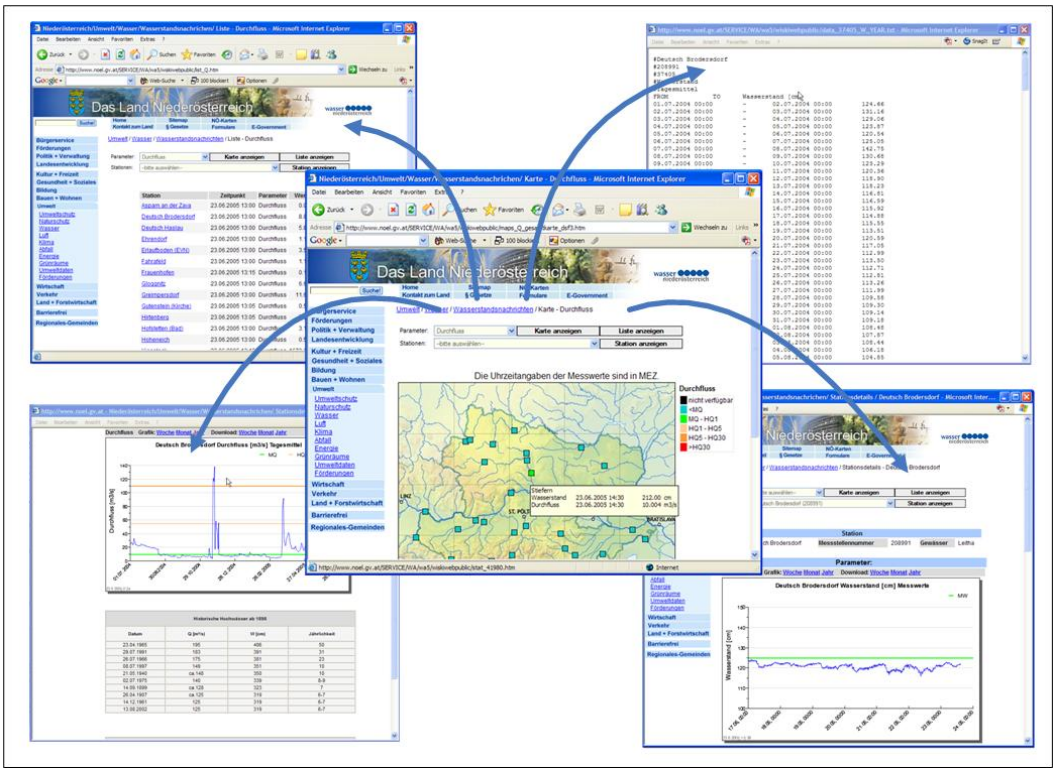

Fig. 7: Public Platform: Internet presentation in the Control Unit of Flood Warning Centre Lower Austria

4. Summary

The two Flood Warning Centres of Saxony-Anhalt, Germany and Lower Austria, Austria have been modernized because of measuring- and communication problems during the catastrophic flood scenary in August 2002. In both cases the Kisters AG, Germany accept the bid to optimize the Control Centers.

In Saxony-Anhalt a new Flood Warning Centre had been bring into being. All relevant flood informations will collected, administered, visualized and send by using automatic or manual defined processes to internal or public recipient lists. Core elements are the central communication structure with numerous interfaces.

In the Flood Warning Centre of the Lower Austria country the whole remote data fetch transfer and time series management was additionaly changed. The information of the recipients and the public with current flood warning messages has been updated.

For both clients, the visualization and distribution of flood informations by web was the most important task to do. This concerns both, the enclosed and the public web areas.

The shown solutions for Flood Warning Centres are highly scalable: from the small local warning centre to the national communication structure all sizes are reproducable.