# Open Source Linux Based Distributed "Real-Time" Environmental Measuring System - DEMS

B. Černač, A. Kolenc
Slovenian Environment Agency, Slovenia

## Abstract

The Slovenian Environmental Agency - SEA is upgrading a network of over 281 automatic measuring stations (AMSs) within the framework of the BOBER (Better Observation for Better Environmental Response) project. The purpose of the project is to increase the capacity of an integrated system for assessing and studying various quantities related to the water cycle from various aspects. The DEMS has been developed to meet the requirements for optimization of surveillance and management of measuring networks. The key benefits of the new DEMS network includes distributed "real-time" data acquisition over various communication channels, interval data processing, local archiving, data dissemination and visualization. Furthermore, a repository oriented traceable software package and documentation management enables transparent application upgrading. Platform independent software ensures portability, (including low power solutions). A built-in debugger/monitor and an information and validation system provide improvement of measurement traceability and data quality assurance. The system supports modular large-scale sensors/analysers integration provided by software/hardware modularity and standardization that result in flexibility and a robust optimized design for end user solutions. The poster provides a brief overview of the DEMS solution related to a software/hardware concept, network management, portability measurement traceability and data quality assurance.

## Concept DEMS - Open source Linux based distributed "real-time" Environmental Measuring System

The DEMS has been developed to meet the requirements for optimization of surveillance and management of measuring networks. The key benefits of the new DEMS network and X-DEG as target measuring systems includes distributed "real-time" data acquisition over various communication channels, interval data processing, local archiving, data dissemination and visualization. Furthermore, a repository oriented traceable software package and documentation management enables transparent application upgrading. Platform independent software ensures portability (including low power solutions). A built-in debugger/monitor and an information and validation system provide improvement of measurement traceability and data quality assurance. The system supports modular large-scale sensors and analyzers (for example air quality and water quality monitoring) integration provided by software/hardware modularity and standardization that result in flexibility and a robust optimized design for end user solutions.
It provides web based structural concept for managing and maintenance of a large AWS network. It is end user oriented and designed to be easily integrated into existing (SEA) measuring networks information system.
In other words DEMS supports **center data base** and **servers** for interval data transfer (SFTP/FTP/SCP), push and pull data dissemination and other tools for network oriented maintenance. It has a built-in information system which contains information data of location, AWS and each connected devices. DEMS includes a project server for traceable code and documentation management, a plug-in visualization server for real-time data storage and visualization and also provides all necessary tools for network oriented maintenance support for X-DEG (Figure 1, Figure 4). DEMS also integrates project server for code and documentation management purposes. The project-server contains WIKI, REDMINE and SUBVERSION applications for code, installation packages and documentation management.

## X-DEG Architecture

X-DEG measuring system is based on the embedded system, powered by the Linux operating system where multiple user applications are running independently and create a comprehensive measurement system. Minimum standard hardware configuration is shown in Figure 2.
It is designed as a "distributed environmental gateway" as an integration module. The expandable topology model is interface/sensor oriented. The measuring system is not necessarily targeted to one location, but can be dispersed on multiple measuring points (e.g. at the airports). Implementation can be done in a standard design type, or it can be adjusted to different already existing solutions at measuring locations and can feature distributed hardware resources according to sensor requirements.

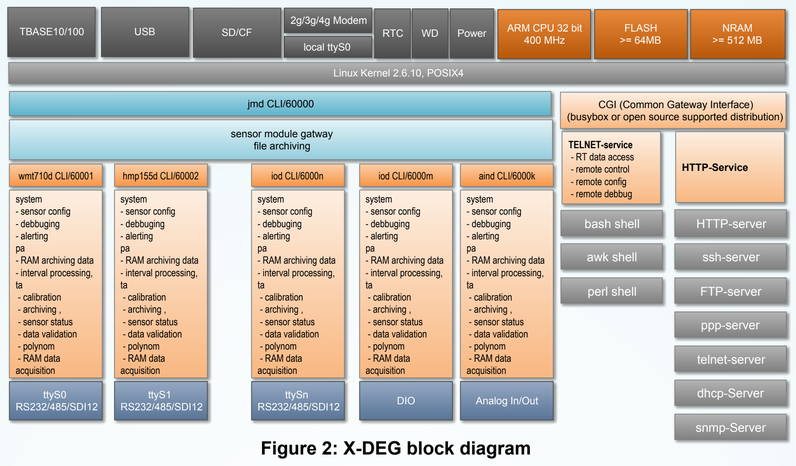


**Figure 2: X-DEG block diagram**

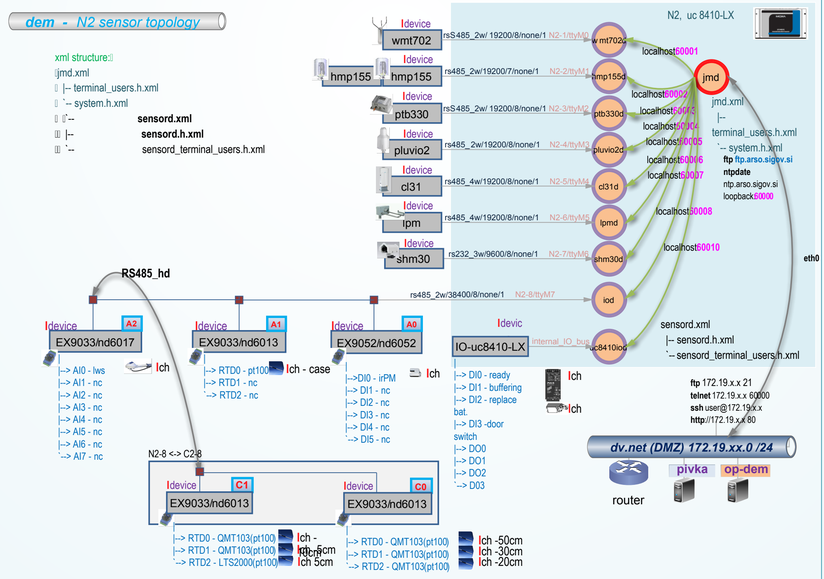


**Figure 3: Modular communications architecture of X-DEG measuring system**

## X-DEG Software

X-DEG has a minimum pre-installed OS of Linux - any distribution which generally provides operating system management tools with the OS system and IP network server applications to access the system: IP/PORT, TCP/IP server socket model. Modularity is achieved by multiclient interface/daemon building block topology - job management daemon, kernel sensor daemon with API integrated sensor interface (Figure 2, Figure 3). No middleware software is needed for X-DEG implementation which gives us practically 100% code portability from the BSP (Board Support package) support.
Figure 3 shows the distributed software architecture and topology of X-DEG measuring system. In general, for each communication interface exist a process - sensord (sensor daemon), which services the measuring device or multiple devices via serial or IP socket interface. Supervising process - JMD (Job Manager Daemon) is responsible for servicing data center and access to all subordinate (sensor daemons) processes at the level of connected measuring equipment.


**Figure 4: Visualisation of X-DEG meteorological data**

**Figure 5: Photo of low power hydrological X-DEG based station at location river Bistrica Sodražica Slovenia**

**Figure 6: Photo of low power ground water X-DEG based station at location Meja Slovenia**

**Figure 7: Photo of meteorological X-DEG based station at location Zadlog Slovenia**

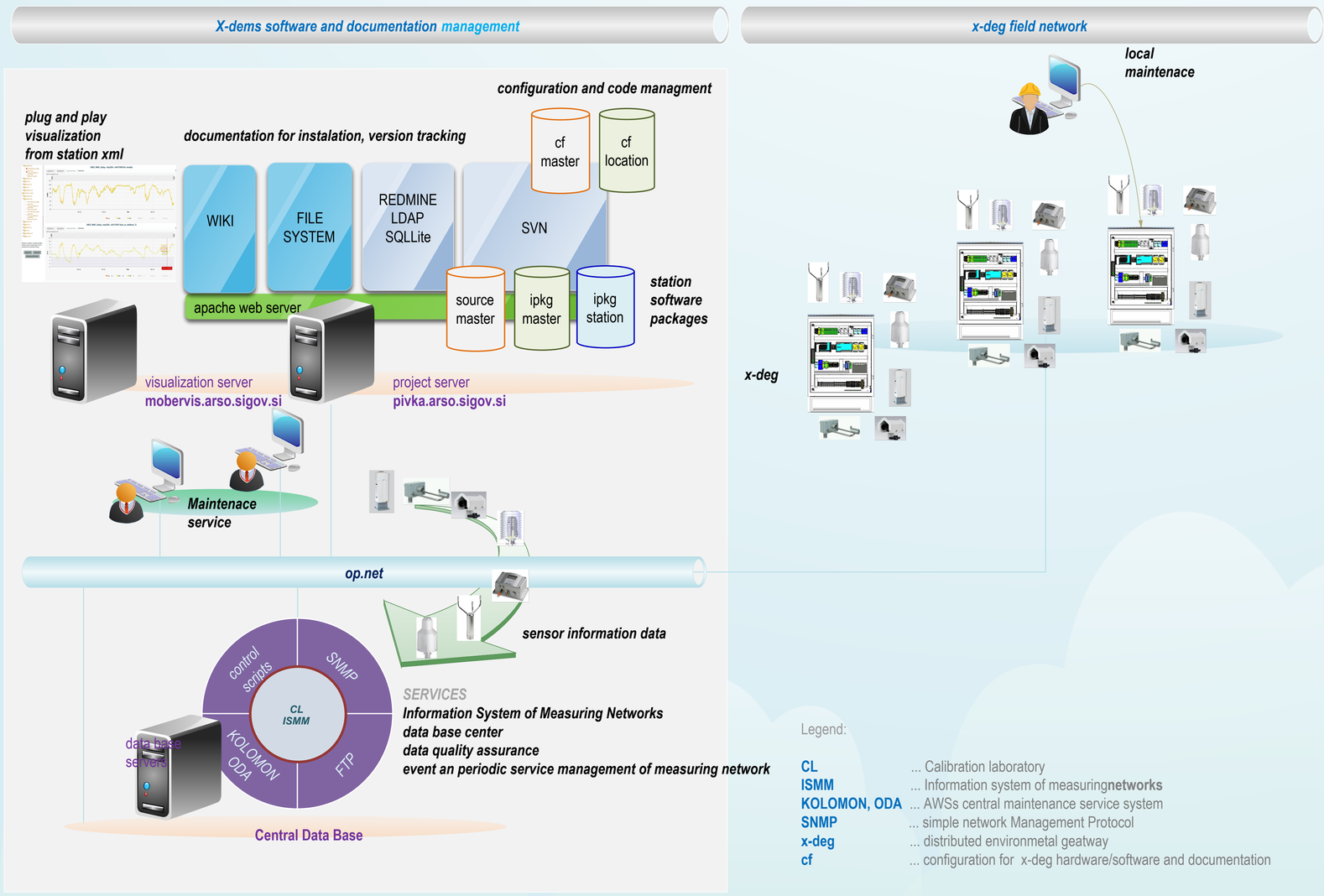


**Figure 1: DEMS concept**

Legend:

| | |
|---|---|
| **CL** | ... Calibration laboratory |
| **ISMM** | ... Information system of measuring**networks** |
| **KOLOMON, ODA** | ... AWSs central maintenance service system |
| **SNMP** | ... simple network Management Protocol |
| **x-deg** | ... distributed environmetal geatway |
| **cf** | ... configuration for x-deg hardware/software and documentation |