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Finnish Meteorological Institute Modernizes Automatic Weather Stations Data Collection System

Vaisala MetMan™ Network Software MM400 was taken into operative use at the Finnish Meteorological Institute (FMI) in April 2004. The software controls data acquisition in the national observation network consisting of 193 weather stations.

A nationwide surface observation network typically consists of dozens or hundreds of weather stations. The stations may be fully automatic or manned. In the latter case, the station may still transmit some of the messages automatically.

At the FMI, the station network is very heterogeneous, consisting of roughly 120 Vaisala Automatic Weather Stations MILOS 500, some 30 MILOS 200 stations for synoptic and climatological use, airports, radiation measurement and air quality stations. The stations have been installed over a long period of time and have different types of operating configurations, modes of

communications and data collection schedules. Consequently, the management of such a network poses challenges to the design of the network data collection system.

Central station

The hardware setup of the central station is shown in figure 1. The central station consists of a production system and development subsystems, each having their own servers and modems. New PC servers were acquired to replace the old servers, which were running under an OpenVMS (Virtual Memory System) operating system. Once the data has been collected from weather stations, it is stored in an Oracle

9i database running in high-availability cluster servers.

Vaisala MetMan™ Network Software MM400 uses the same modem bank as the old system. Utilizing the existing hardware not only resulted in cost savings for the FMI but also guaranteed there would be no problems due to mismatch between AWS modems and central weather station modems. The modems at the data collection center have been divided into three groups. Any modem in a given group can be used to call stations that have a similar type of modem. Currently, the system has been equipped with 20 modems. In addition to dial-up modems, the system polls data from FTP ►

(File Transfer Protocol) servers and receives data files from different sources.

Operative use

The production system is run continuously, 24 hours a day. At regular intervals, MM400 makes calls to the stations. The system keeps a record of groups of stations that have similar data collection schedules. It is possible to define the data collection intervals freely within the 24 hour cycle. Since most of the stations in the network use dial-up modems and connection times are relatively long (30-50 seconds), the system's overall throughput can be increased by maximizing the number of dial-up modems in service.

During a communications session, a station can be polled for one or more data messages. At the server, the messages are decoded and data values are stored in the database. The database forms an interface between MM400 and FMI's real-time and climatological database systems, where all measurement data is automatically forwarded for postprocessing.

The operators can observe the data collection process from an application screen that displays stations currently being polled, calls queuing for free modems, state of communication ports and system events. The operators have the option of initiating manual polls to stations, either one at a time or to groups of stations. If a station is undergoing maintenance, operators may decide to remove it temporarily from the data collection process. If an error is noticed (e.g. a station does not reply or replies with an invalid message), the operators enter an error report into the FMI's error tracking system.

Support for current and future data formats

Besides FM-12 SYNOP, the FMI currently has 5-10 different raw data message formats in use. Managing the message formats requires detailed planning. In particular, one has to take into account the possibility of being able to support new kinds of message formats that have not been used before. The Vaisala MetMan™ Network Software was designed with an API (appli-

cation programming interface) that allows users to add their own message decoding modules (parsers) into the operative system. Following the instructions and sample code provided by Vaisala, the FMI implemented a set of parsing modules that fit the network's needs.

Managing configurations

The operative functions of MM400 software can be controlled manually by operator actions or automatically via predefined configuration parameters. While the number of operator tasks have been reduced to minimum, there are hundreds of configuration parameters. The parameters include basic information regarding the network, including the station names, telephone numbers, modems to be used, measurement variables, data collection schedules, etc.

Manually adjusting the values of the parameters and checking their internal consistency would easily be an insurmountable task for any system administrator. Therefore, a special software module was developed to

automatically load a valid set of parameters into operational servers. This guarantees the system is always working using a consistent set of parameters.

Operating a large weather observation network software is similar to mission-critical software systems that are used at banks, airlines, factories and other industries. System failure must be avoided and all down-time (when the system is not operating) must be carefully preplanned. When making major changes to the system (e.g. introducing new stations, modem types, changes in station configuration, polling commands, software updates), the administrators can test the validity of the new configuration in a separate test environment.

Designing for reliability

The Vaisala MetMan™ Network Software MM400 has been designed to include back-up functions at several levels for almost every contingency. The modem pools offer a natural aid against modem malfunction. In the servers, the software processes performing the data collection tasks are watched over by a supervising process that will reset failing processes. Should the server hardware fail, the operators will bring a back-up server online. If the database goes offline (unusual but it happens perhaps once a year), the system will keep on collecting data and storing it in temporary files from which it will be restored once the database returns online.

Continuity and further development

Vaisala's objective is to develop the MM400 system further according to users' needs. The FMI and Vaisala have signed a service agreement for the continuous improvement of the system. Within the contract, the FMI is entitled (but not obliged) to receive upgraded versions of the Vaisala MetMan™ Network Software twice a year. At the same time, Vaisala can include features suggested by the FMI into standard software releases. ●

Figure 1. Data collection hardware at the Finnish Meteorological Institute.

