11.6 THE NEW METEOROLOGICAL OBSERVATION NETWORK IN THE NETHERLANDS

Foeke Kuik*
Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
Tony Haig
Almos Systems

1. INTRODUCTION

At the end of the 90's, the Royal Netherlands Meteorological Institute (KNMI) had to replace its network of automated weather stations and the meteorological systems that were used at the airports in the Netherlands. In designing a new network, the following issues were considered most important:

- It had to be possible to perform monitoring and remote maintenance of all acquisition systems and sensors from any site, using a network architecture;
- Standard proven but modern technology had to be used to ensure the expected life cycle of approximately 10 years.
- Meteorological users at airports had to be able to access systems at any other airport in the Netherlands, and make meteorological aviation reports for any airport from any other airport or from the central site in De Bilt.
- The network had to support facilities for completely unmanned stations. Only airports will still have observers in the (near) future.

In 2000 the KNMI and the supplier of the new network (Almos Systems, Perth, Australia and Culemborg, The Netherlands) started the project to implement the new meteorological network. In total there are 23 fully automated observation stations, 5 civil airports and 2 navy airports, and a central site, De Bilt, where all data is collected, processed and stored. All meteorological reports are generated at site, and they are disseminated via the message switch (MSS).

2. ARCHITECTURE OF THE NEW NETWORK

In Figure 1 a graph is shown with the architecture of the new Netherlands meteorological network as it is currently being implemented. The various components will be discussed now.

2.1 Automated stations

The automated stations (23 in total) contain several components. All components except the sensors and SIAM are new.

* Corresponding author address: Foeke Kuik, KNMI, MI-IO, P.O. Box 201, 3730 AE De Bilt, The Netherlands; e-mail: Foeke.Kuik@knmi.nl

Sensors The sensors are not part of the upgrade, they are not replaced or upgraded.

SIAM The SIAM (**S**ensor **I**ntelligent **A**daptation **M**odule) is an interface between the sensors and the data acquisition systems that was designed by KNMI itself. For each type of sensor there is a unique SIAM. It performs measurements once every 12 seconds, it computes several averages, and it also validates the incoming data. All SIAMs have an identically structured output message, so that the data acquisition systems only need to be able to handle one type of input. The SIAMs are not part of the upgrade, but they will be replaced with new modern version within the next few years.

MUF The MUF (**MU**ltiplexing **F**acility) is a device that is able to take in strings from up to from 5 SIAMs and put them after each other on its output. Each MUF input channel can also be used as input for another MUF to enable the use of virtually an unlimited number of sensors.

MIOU A MIOU is the central unit of the remote stations. It is basically an industrial PC running Windows NT Embedded, it has a 266 MHz processor, 256 Mb SDRAM, a 140 Mb Disk on chip, a watchdog, a UPS, 4 serial ports, and both an ISDN modem and an Ethernet interface. It has been designed (the MUF as well) for conditions between –20 to +55 °C.

The MIOU has one (RS422) input to interface the MUFs. The MUFs regularly forward the data received from the SIAMs to the MIOU. Once every 10 minutes this data is being collected by the central acquisition system in De Bilt (CIBIL, see later), either by dialling in (ISDN) or via an Ethernet link. In both cases TCP/IP is used. If communication is disrupted the MIOU has sufficient solid-state disk capacity to store data for at least 14 days (configured for 7 days storage), for later retrieval.

To locally present the data at a station, a **MUF display** is available. It simply reads the RS422 string from the last MUF and the data is shown on a user defined presentation screen.

2.2 Airports

At the airports (7 in total, including Schiphol as the largest) the sensors and SIAMs remained unchanged. The systems at all airports and the

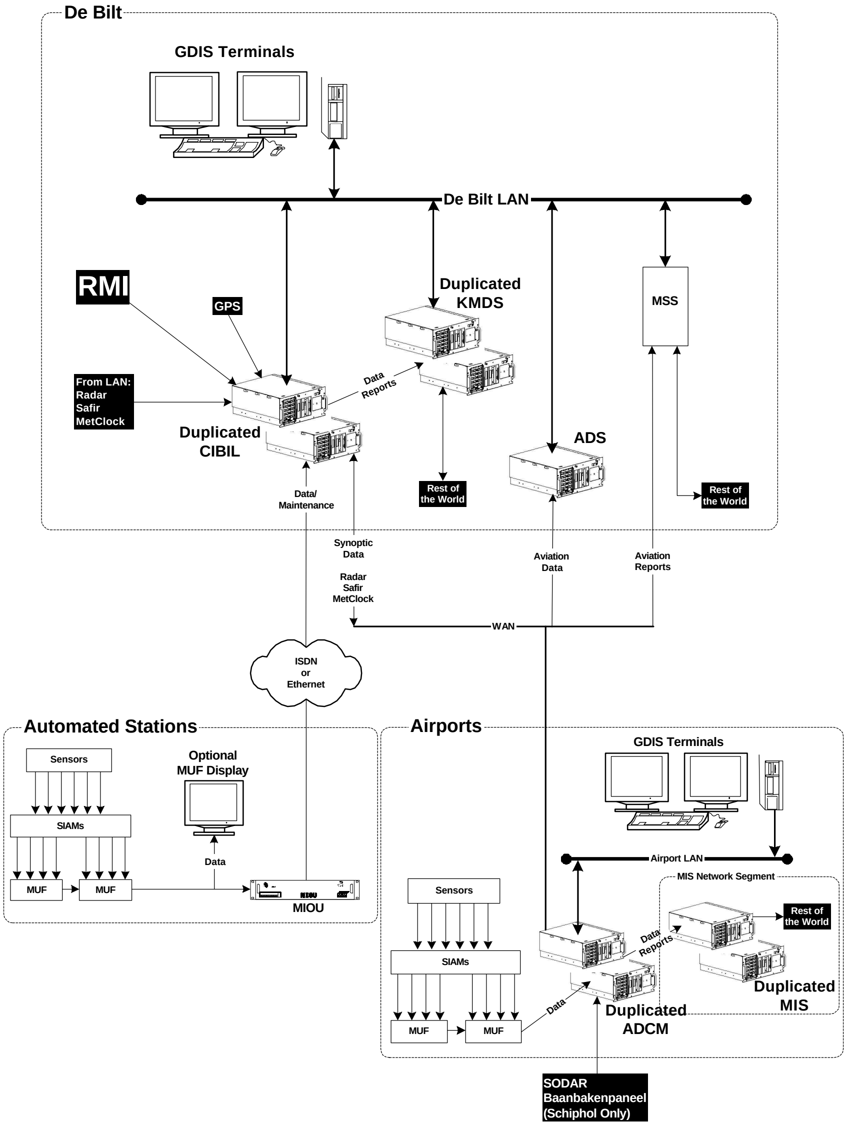

Figure 1 The architecture of the new Netherlands meteorological observation networks.

central site in De Bilt can communicate to each other by WAN connections. The new components at the airports:

ADCM This is a server that acquires and stores the data from all sensors (approximately 60 at Schiphol). This server also computes all derived quantities that are required for meteorological reports, makes those reports automatically at the times they are due, and sends them to the message switch in De Bilt. The ADCM has a hot-standby backup, that takes over as soon as the primary server fails.

GDIS The GDIS is a graphical display system that is connected as a client to an ADCM. This can be the ADCM that is located at the airport itself, or one of the ADCMs that is at one of the other airports. The GDIS has 14 different screens to display meteorological information from the airport to observers and forecasters. There are overview graphs, maps of the airport with the RVR, wind, etc. Also the screens for observers to prepare the METAR and SPECI are found here, although the reports themselves are made on the ADCM. The GDIS thus is a multi functional graphic display system. An example of the Schiphol overview map is shown in Figure 2. Clicking on one of the buttons on the right side of this screen, navigates to a new screen.

MIS The MIS is a server (also with a hot-standby) with only one task: to enable local users at an airport to get meteorological information that is to be supplied by KNMI. KNMI copies all sensor data and meteorological reports to the MIS. All users of the

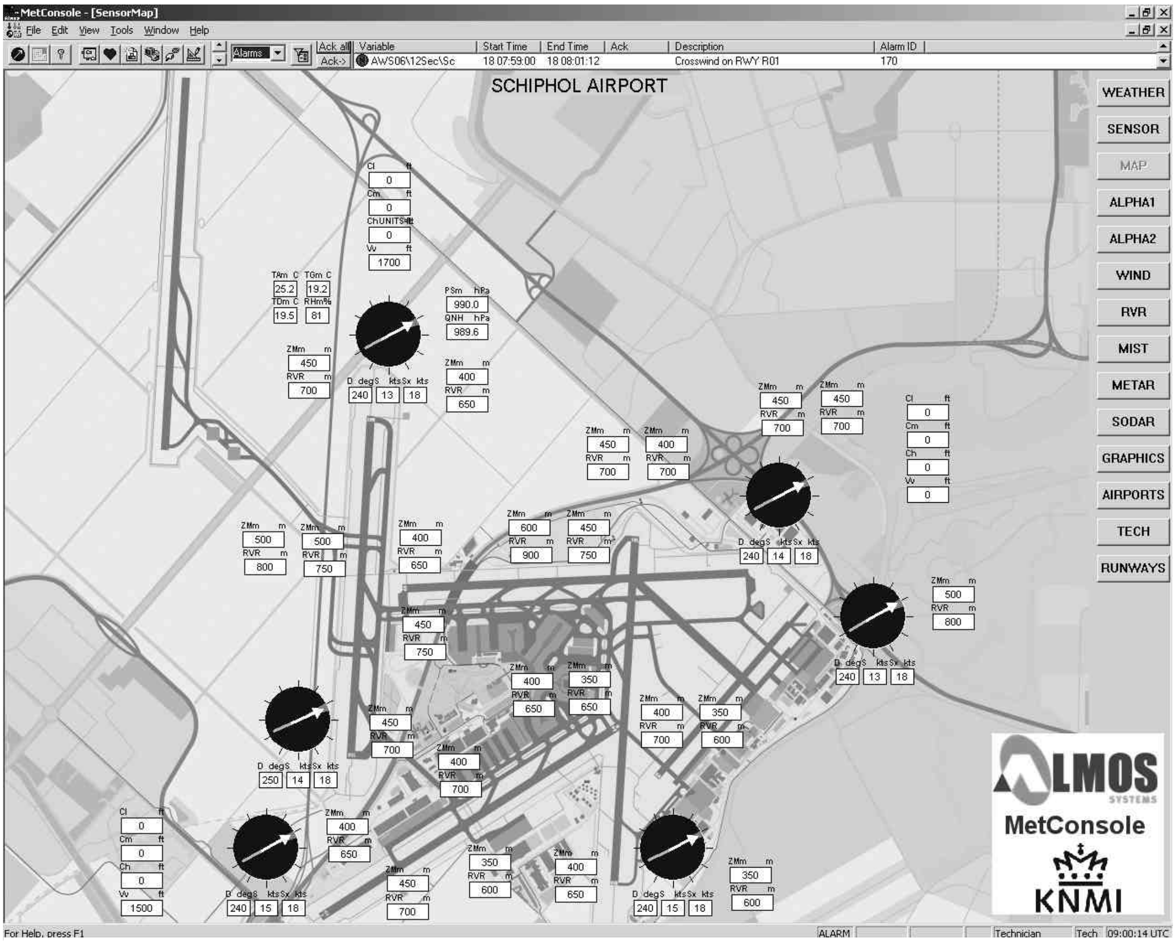

Figure 2 The overview map of Schiphol on the GDIS.

data get access to the MIS via a username and password, and via a very simple protocol they can retrieve the data they need. The MIS works with subscriptions, i.e. once a client subscribes to a set of data, it will be sent to the client as soon as it becomes available on the MIS. Again TCP/IP is used for all data communication.

2.3 Central site De Bilt

The De Bilt central site is the ‘heart’ of the synoptic meteorology in The Netherlands. The data from all station (automatic and airports) is collected here, data is processed here, and several reports are generated here and disseminated via the message switch (MSS) in De Bilt. The role of the new components:

CIBIL(and its hot-standby) is the new central systems for the KNMI observations network. It

- collects observations from all automated stations and airports (every 10 minutes via ISDN, LAN or WAN),
- collects data from the RMI network, which is a non-KNMI network with 66 meteorological and hydrological sensors in the Dutch coastal region,
- collects data from the KNMI lightning detection system (SAFIR) and derives information for the neighborhoods of all stations,
- collects Meteosat cloud pictures and derives information for the neighborhoods of all stations,
- collects data from the KNMI precipitation radar (Gematronic) and derives information for the neighborhoods of all stations,
- it performs all other calculations to obtain the so-called ‘derived quantities’,
- tries to recover missing data (if applicable),
- fully automatically generates SYNOPS and other reports at the time they are due,
- fully automatically sends all reports and bulletins to the message switch (MSS),
- performs quality checks of all data coming in and for the derived quantities,

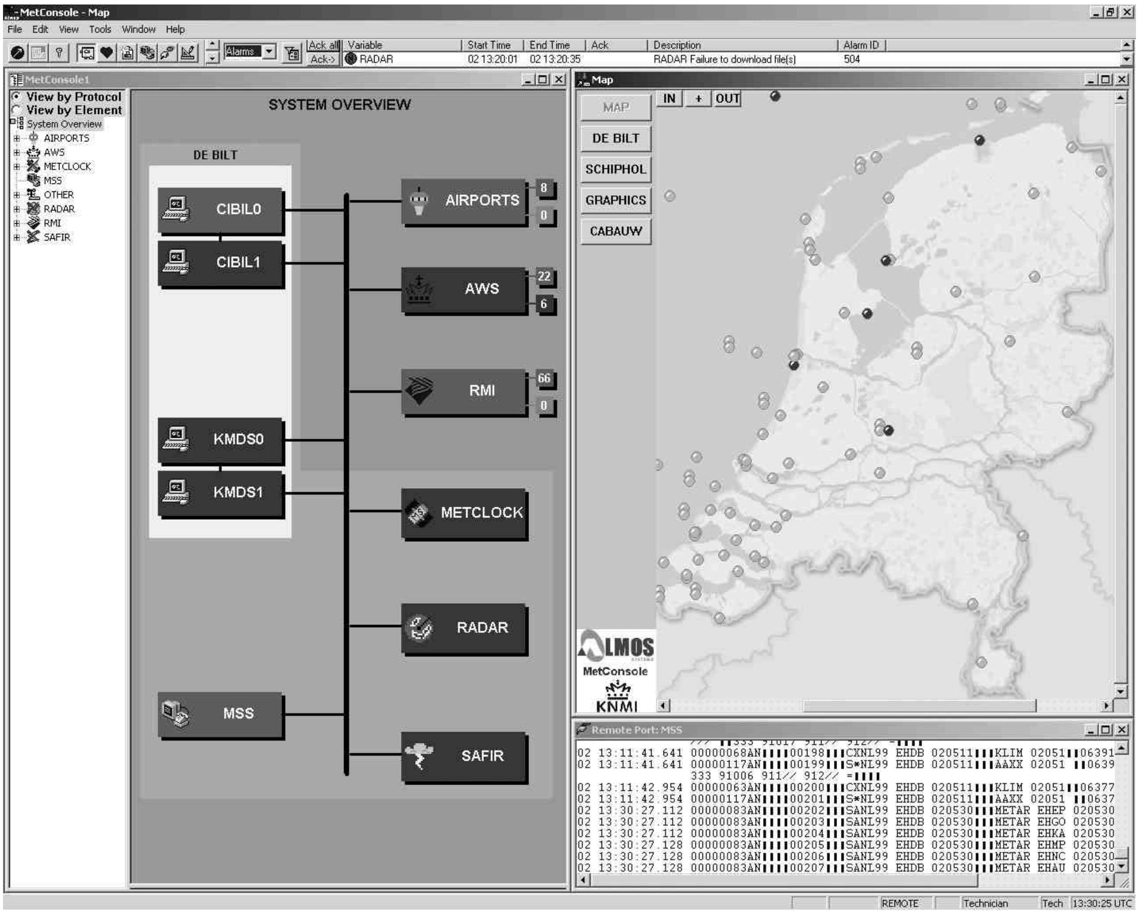

Figure 3 The typical CIBIL home screen

- is used as a powerful maintenance tool to monitor the status of all components in the KNMI observations network (from individual sensors to all servers present at the various airports, etc).

CIBIL is based on Windows 2000 Server and the MetConsole software from Almos Systems. The hardware consists of standard commercially available servers. A GPS is connected to CIBIL, which synchronizes all servers, all MIOUs and GDIS' locally in De Bilt, and also those connected to CIBIL via the WAN.

With the introduction of the new KNMI observations network, KNMI will only still have human observers at the airports. All other stations will be unmanned from the end of 2002. At some 10 main stations throughout The Netherlands, stations have been equipped with ceilometers and present weather sensors.

In CIBIL the cloud measurements for each station are combined with Meteosat measurements from clouds. An algorithm has been implemented that derives cloud cover and cloud layers for each station based on the combination of these measurements (Wauben(a), 2002).

CIBIL also acquires data from the KNMI SAFIR lightning detection system and our precipitation radar. In CIBIL this data is combined with the present weather information for each station to generate the WaWa code for the SYNOP for those stations (Wauben(b), 2002).

From the end of 2002 KNMI will produce only a fully automatically generated SYNOP that contains information obtained with instruments only. In the future research will be done to find out if the same procedure can be used to generate fully automated METARs as well.

KMDS The KMDS is a kind of mirror machine of the CIBIL. The whole database with all observations, derived quantities and reports, are copied from CIBIL to the KMDS (and to its hot-standby). Everyone that wants data from the KNMI observations network can connect to the KMDS and retrieve data from it in two different manners. The first is by using the GUI, a built in facility in the KMDS software. The second option is to use SQL, in the usual way by composing queries.

ADS The ADS is a database server that stores all the observational data and reports from all airports in The Netherlands for a period of 100 days (based on an ICAO requirement). It is a simple server with a disk capacity of 218 Gb. All data is supplied to the ADS directly by the ADCMs via the WAN. In case of network failures, the ADS has an automatic recovery mechanism built in.

The **GDIS** systems in De Bilt are identical to the ones at the airports. They can be used to log on to any of the servers, i.e. to CIBIL or any of the ADCMs at the airports. Depending on which system one logs on to, a 'home screen' is shown. For the CIBIL this is shown in Figure 3, for the Schiphol ADCM it was shown in Figure 2. The important thing is that one is able to access any of the servers via the LAN or WAN from any site using any of the GDIS'.

In Figure 3 the typical CIBIL home screen is shown. On the left the various 'components' of the observations network can be seen, the middle pane shown an overview of all servers in De Bilt and the systems presents at the airports and automated stations. On the right all stations are visible on the map of The Netherlands, red indicating that there is something wrong at those stations. For maintenance purposes and trouble shooting it is possible by clicking on the stations (and also on the buttons or network icons) to descend down to sensor level to look at the performances of all systems in the chain. On the bottom right, the output reports that are being sent to the MSS are shown, but various other options are possible as well.

3. CONCLUDING REMARKS

The architecture of the new meteorological observations network for The Netherlands has been discussed and some examples have been shown. The basic idea behind the architecture was that KNMI needed a TCP/IP network from sensor to MSS, network monitoring and maintenance had to be done from a central site as much as possible, and it had to be possible to perform task for certain sites from other remote locations. The automation of visual observations had to be possible for the SYNOP, and the system has to be ready for the next generation of fully automated aviation meteorological reports.

The implementation activities have started in September 2001 and will end at the end of 2002, when all 7 airports, 23 automated stations and De Bilt have been installed. In the future the 7 air force airbases in The Netherlands may also be installed with the airport systems described here.

4. REFERENCES

Wauben(a), W. M. F., 2002: Automation of visual observations at KNMI: (ii) Comparison of automated cloud reports with routine visual observations.

Wauben(b), W. M. F., 2002: Automation of visual observations at KNMI: (i) Comparison of present weather.