The MOSAIC Concept

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Summary:
Meteosat Operational System for data Acquisition and Inter-Change (MOSAIC) is the integrated use of standard Meteosat missions. This concept does not introduce any new elements to the Meteosat system. The MOSAIC elements are; Meteosat imagery (digital & WEFAX), weather data transmitted via the Data Collection System (DCS) and the Data Collection Platform Re-transmission System (DCPRS), and meteorological products or data transmitted via the Meteorological Data Distribution (MDD) mission.

As an initial step towards this concept, a project was initiated to enhance the MDD User Station software and to display alphanumeric data in graphical form on a "stand-alone" MDD workstation. The graphical display of alphanumeric bulletins is handled by utilizing MAGICS/GKS (developed at ECMWF). As part of the development of a prototype MOSAIC station, satellite observation reports (SATOB) and binary GRIB code, received via MDD, as well as data from Data Collection Platforms (DCP) have been included for display.

In the final step observations received via the DCPRS, meteorological information and observations received via MDD will be merged and the quality controlled data will be overlaid onto Meteosat images.

1. Introduction

Meteosat is part of the global system of operational meteorological satellites and operates in geostationary orbit at a fixed location above the equator on the Greenwich meridian. The operational Meteosat satellites have to fulfil three primary and two additional main missions. The three fundamental missions are:

Earth Imaging in which the full earth disc is sensed in three spectral channels every 30 minutes.

Image Dissemination is carried out using Meteosat's transponders in order to relay images and charts from the central ground station to two classes of user stations within the field of view of the satellite. Images are disseminated in both digital (full resolution) and analogue (reduced resolution) modes.

Data Collection and Re-transmission is used to collect environmental data from automatic observation stations and to relay these data to the central ground station for re-transmission and distribution by other means.

In addition to these three principal missions, the extraction and distribution of meteorological products derived from basic image data is carried out. Finally, there is a full archive and retrieval system for all images and derived image products.

With the start of the Meteosat Operational Programme, a completely new mission or service has been introduced - **Meteorological Data Distribution (MDD)**. Its primary purpose is the transmission of meteorological information and observations.

2. MOSAIC Elements and MOSAIC Stations

2.1 Digital Image Dissemination

The half-hourly Meteosat images of the full earth disc in all three spectral channels are pre-processed in the European Space Operations Centre (ESOC) of the European Space Agency (ESA) before distribution to the user community. The digital or high resolution image dissemination system provides a service of frequent high quality images in full radiometric and spatial resolution, transmitted through METEOSAT to major user centres. The system is designed primarily to meet the requirements of national meteorological services. The dissemination programme includes images of the European sector and full earth disc images each half-hour, together with images from the neighbouring Atlantic satellite every three hours. The high resolution reception and display system is called a Primary Data User Station (PDUS).

2.2 Analogue (WEFAX) Image Dissemination

Pre-processed image data are also re-transmitted via Meteosat as image sectors in analogue (WEFAX) format. Meteosat broadcasts this WEFAX service to a very wide user community with Secondary Data User Stations (SDUS), which are less sophisticated and expensive than a PDUS.

2.3 Data Collection and Re-transmission System (DCS and DCPRS)

Data Collection and Re-transmission are carried out using the total of 66 telecommunication channels available onboard the satellite. Environmental data are collected from a large number of automatic and semi-automatic weather stations in remote locations and then relayed to the central ground station to be routed to end-users by various means including direct satellite re-transmission and distribution via the Global Telecommunication System (GTS) of the WMO. The re-transmission system allows the rapid relay of data to sites which are not connected to the GTS. The DCP data are re-transmitted in a time-sharing mode via one of the image dissemination channels.

2.4 Meteorological Data Distribution (MDD)

The Meteorological Data Distribution (MDD) mission is a capability incorporated in the METEOSAT Operational Programme (MOP) satellites. This is a satellite broadcast system designed to supplement the GTS in Africa and other areas with poor communications. Currently two uplink stations, one in Rome (Italy) and another in Bracknell (UK) are transmitting meteorological information to the satellite, which is then transponded to small User Stations. Data are transmitted using up to four discrete transmission channels at a rate of 2400 bit/sec per channel. The data sets to be disseminated via MDD channels consists of meteorological information in form of alphanumeric characters, bit oriented data streams, and graphical information (charts). GTS codes and standards are used.

An MDD User Station is used for the reception, processing and display of the transmitted data. In the multi-channel version an MDD Station can simultaneously receive data from up to four channels. A standard User Station has basic software which can display either the original message in its WMO code (for the alphanumeric data) or charts, transmitted in CCITT T4 coded form.

2.5 The different MOSAIC Stations

Two different MOSAIC stations have been defined. The first, the MOSAIC-A station, is more sophisticated and includes digital image data received with an PDUS, as well as observations and meteorological information available from the DCPRS and MDD. It is the kind of system that would be installed at a National Meteorological Centre and provides both operational and research staff with a very powerful means of displaying and processing digital data for a wide range of applications.

The MOSAIC-B station, combines WEFAX image data from an SDUS, observations distributed via DCP Re-transmission System (DCPRS) and meteorological information available via MDD. The standard Meteosat missions can be used together in this system in a very cost effective way and could be used at local or regional weather forecast offices, but also at many universities, research institutes and schools.

3. Implementation Status

In 1990 a project was initiated in order to enhance the MDD User Station software and to display alphanumeric data in graphical form on a "stand-alone" prototype MDD workstation. It was the aim of the project to make use of already existing software packages in order to reduce the software development and to make demonstration software available as soon as possible. The **Automatic Data Extraction (ADE)** software, which is part of the WMO SHARE package is provided by the Irish Meteorological Service and is used for data extraction and quality control of alphanumeric bulletins.

The graphical display of alphanumeric bulletins, reports of satellite observations (SATOB) and binary

fields in GRIB code is handled by utilizing the **Meteorological Applications Graphics Integrated Colour System (MAGICS)**, developed at the European Centre for Medium-Range Weather Forecast (ECMWF). This software allows the plotting of observations, texts, contours and wind fields.

The alphanumeric bulletins, the satellite observation reports and the binary GRIB code are normally received on Channel 4 from the RTH in Rome. Currently the following WMO codes are supported: FM12-IX, FM13-IX, FM35-IX, FM36-IX, FM88-VI and FM92-IX.

Alphanumeric bulletins are converted to a suitable format for the ADE software, where data extraction and quality control are performed and an intermediate database is generated. In the next step the data are prepared for input to MAGICS processing. Application software allows the user to display observations in graphical form for a given synoptical hour and a predefined map area. A list of parameters can be selected in any combination for plotting.

MDD GRIB code fields and satellite observation reports (currently only Cloud Motion Winds) are also pre-processed and then prepared for suitable input to the MAGICS processing.

4. The Prototype MOSAIC Station

The data processing software described above together with the basic MDD User Station software is running on a "stand-alone" VMS based workstation. In a follow-on project EUMETSAT will make use of these software packages in the development of a **prototype MOSAIC-A Station**.

Such a station will comprise a single antenna, pre-amplifier and downconverter. The different receivers for the PDUS, SDUS, MDD and DCPRS are connected in cascade followed by independent pre-processing of satellite images, MDD and DCPRS data. The actual MOSAIC display system will be implemented on a transputer based image memory and display system with 8 Bit resolution for image data and two overlay bit planes for meteorological information. In Figure 1 the EUMETSAT MOSAIC-A Station is depicted which will be finalised in early 1992. It uses part of the infrastructure implemented for the comprehensive EUMETSAT monitoring system.

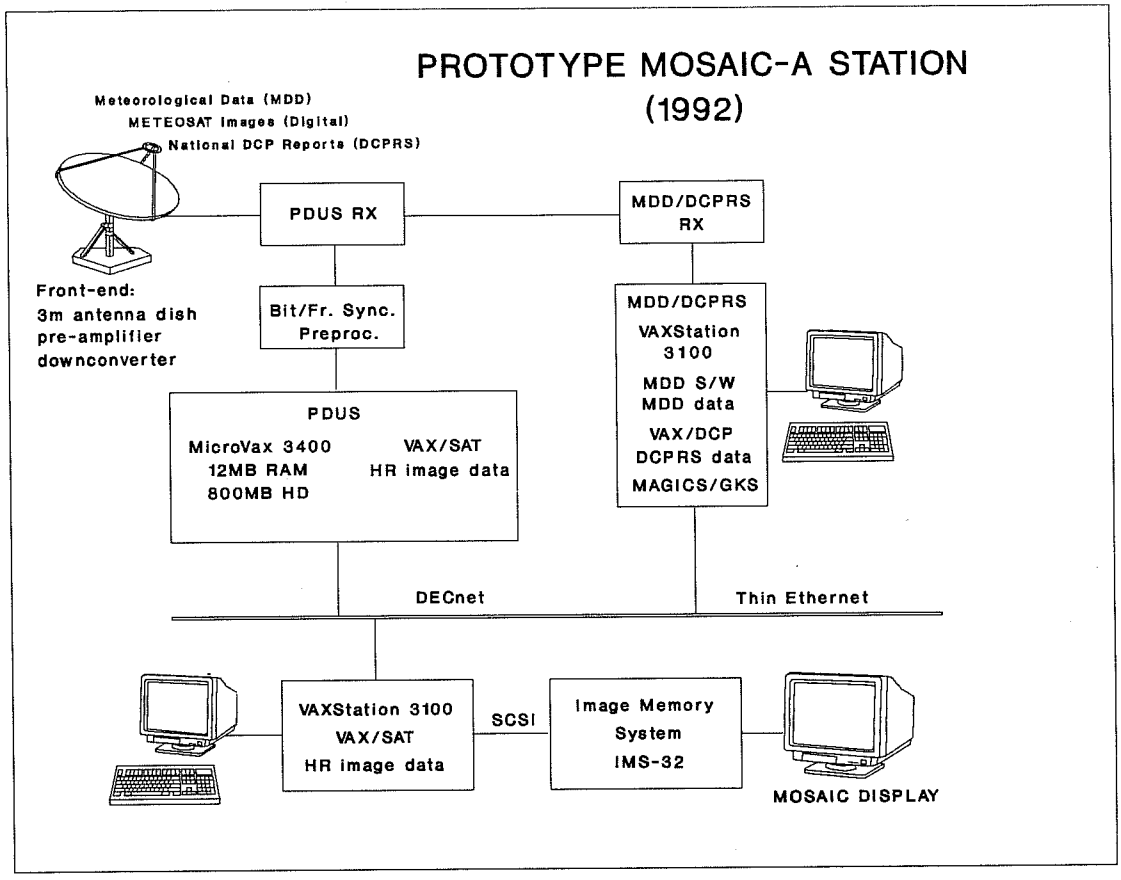

Figure 1: EUMETSAT's Prototype MOSAIC-A Station

The independently pre-processed images and meteorological information will be stored in a common format. The digital image data will be available in three different projections (satellite, polar-stereographic and cylindrical). MAGICS/GKS output of MDD and DCPRS observation data, as well as of MDD GRIB fields, will be produced according to a common look-up table in the same projections as the image data. An appropriate conversion of the MAGICS/GKS output data will allow to overlay the meteorological fields onto the satellite image data by the use of the two additional bit planes. An appropriate user interface will be available to set-up the look-up tables and to select the MAGICS overlays and combinations of images and overlays in a menu driven system.

5. References

1. EUMETSAT Mission and Services, EUM BR 02, 1989

2. Introduction to the Meteosat Operational System, ESA BR-32, September 1987

3. Meteosat WEFAX Transmissions, ESOC/MEP, March 1990

4. Meteosat High Resolution Image Dissemination, ESOC/MEP, October 1989

5. Meteosat Data Collection System, ESOC/MEP, 1990

6. Meteosat DCP Re-Transmission System, ESOC/MEP, 1990