CGMS XXXII NOAA-WP-34
Prepared by NOAA
Agenda Item: IV.2

NOAA Proposed Alternative Dissemination Methods (ADM) System

NOAA-WP-34 discussed current and planned activities on the NOAA proposed Alternative Dissemination Methods (ADM) system. NOAA commissioned an ADM study to develop a conceptual design for the distribution of environmental satellite data and products to meteorological users from sources other than direct broadcast. The Study took in to account the collection, combining and distribution of multiple sources of hyrometeorological data. These sources include the polar, geostationary and selected research satellites data. In addition, NOAA is planning to include information from potential EUMETSAT and JMA satellites. ADM will function as a supplement to Direct Readout broadcast systems from environmental satellites, given that Direct Readout broadcast systems do not have sufficient bandwidth to handle the greatly increasing data rates of the future. ADM can be accomplished via Digital Video Broadcasting – Satellite (DVB-S), landlines, and/or Internet infrastructures, depending on the connectivity available to the user. NOAA will review data dissemination methods in current and planned systems with particular attention to connectivity with end-users. Also, NOAA plans to investigate broadcast systems similar to our ADM. These investigations will be performed in order to avoid replicating the functionality of other dissemination systems, take advantage of technologies employed by other dissemination systems, and begin the process of building interface standards with other dissemination systems. This will provide the basic architectures necessary to continue future work in ADM frame structures, functions, interfaces and performance criteria in terms of meeting end-users' needs. Such needs will vary depending upon service level agreements between the users and service providers, and will include issues regarding coverage, capacity, availability, applications, protocols, Quality of Service (QoS), and affordability.

1. Introduction

In preparation for the GOES-R and NPOESS series of satellites, NOAA did comparative analysis of the data volumes and data rate to access the new data dissemination technologies. Considering the current technology for acquiring the GVAR and HRPT/APT broadcasts, satellite direct readout users must either upgrade their existing system or purchase new stat-of-the-art technology. NOAA has learned that the APT community as it exists today will start a radical change with the launch of METOP-1. After the demise of NOAA-N', the APT service will no longer exist. The HRPT users will have several options available to them. These include; upgrading their existing system, purchasing a Low Rate Data (LRD) or High Rate Data (HRD) system. The GOES-R users can either upgrade their existing system or buy a new GOES ReBroadcast lite (GRD-lite) system.

Users of environmental data have expressed a desire to receive a combination of polar-orbiting and geostationary in a single source. In addition, it was articulated that the acquisition of environmental data should be affordable and available in realtime. NOAA is in the process of investigating an Alternative Dissemination Methods (ADM) system for distribution of environmental data by means of Internet, commercial space communications and/or dedicated landlines. The ADM communications are separate from the technology utilized in Direct Readout (DR) services, which is a broadcast from government owned satellites.

The NOAA study focused on the establishment of an ADM broadcast facility that would allow for the distribution of environmental data to users in realtime at an affordable cost. The study centered upon methods of acquiring the data from various sources, processing and compression and distribution of environmental data. The ADM broadcast facility will provide for the near real time delivery of data, and not provide for the storing or archiving of data.

2. Data Rate Supported by ADM

The data rate supported by ADM for this study is the multiplexing of three 3.5 Mbps data streams, for a total data rate of 3 * 3.5 Mbps = 10.5 Mbps. The 3.5 Mbps data streams are compressed versions of data streams originating from GOES, POES, NPOESS, NASA, or other data sources.

2.1 Internet Distribution of ADM

Internet distribution of ADM is best handled by File Transfer Protocol (FTP) requests. Providers of high bandwidth internet service were consulted regarding current data transfer rate capabilities. The internet provides the most cost-effective dissemination method, although issues of reliability and availability of an internet connection to the ADM user persist.

2.2 Commercial Satellite Communications Distribution of ADM

Commercial satellite communications options for ADM are based on the commercial Direct Broadcast System (DBS) technologies first developed by DirecTV. In order to service the international ADM community, the proprietary communications standard utilized by DirecTV was avoided in favor of Digital Video Broadcast – Satellite (DVB-S), which is an international standard.

Utilization of DVB-S enables a very low-cost ADM User Terminal (on the order of $2000 USD) as well as data rates received by the ADM user of 10.5 Mbps. Commercial communications satellite systems supporting this data rate are either in the Ku-band (about 11 GHz downlink) or the C-band (about 4 GHz downlink). Preliminary link budget calculations indicate the requirement for a 1.2 m diameter receive dish at Ku-band or a 2.4 m diameter dish at C-band. The exact dish size will be determined by the particular implementation of the commercial satellite communications link.

3. Initial ADM Study Activities

The purpose of this paper is to give a top-level introduction into on-going architectural work on a proposed Alternative Dissemination Methods (ADM) System. ADM for environmental data are important as the environmental data rates in the future grow beyond the capacities of current dissemination systems. The ADM System interfaces with and receives data from environmental satellite ground stations, and other weather data processing centers. The ADM System sends environmental data to users with varying data rates and resolutions. It can be viewed as a gateway to environmental satellite ground stations, environmental data processing centers, and service providing centers. The ADM System delivers Near Real Time (NRT) data. The ADM system does not provide for data storage or data archive.

In this document, NOAA focuses on methods for the ADM system to acquire, process, and transmit environmental data. In particular, transmission via the Digital Video Broadcasting – Satellite (DVB-S) standard will be discussed, in order to respond to action items generated at the Coordination Group for Meteorological Satellites (CGMS) XXXI meeting in Ascona, Switzerland. Also, discussions will include other transport mediums (e.g. landlines and internet) in order to maintain a proper systems trade perspective and reserve flexibility and interoperability for future growth of the ADM system. Figure 1-1 illustrates the Systems View - 1 of the ADM system architecture and interfaces.

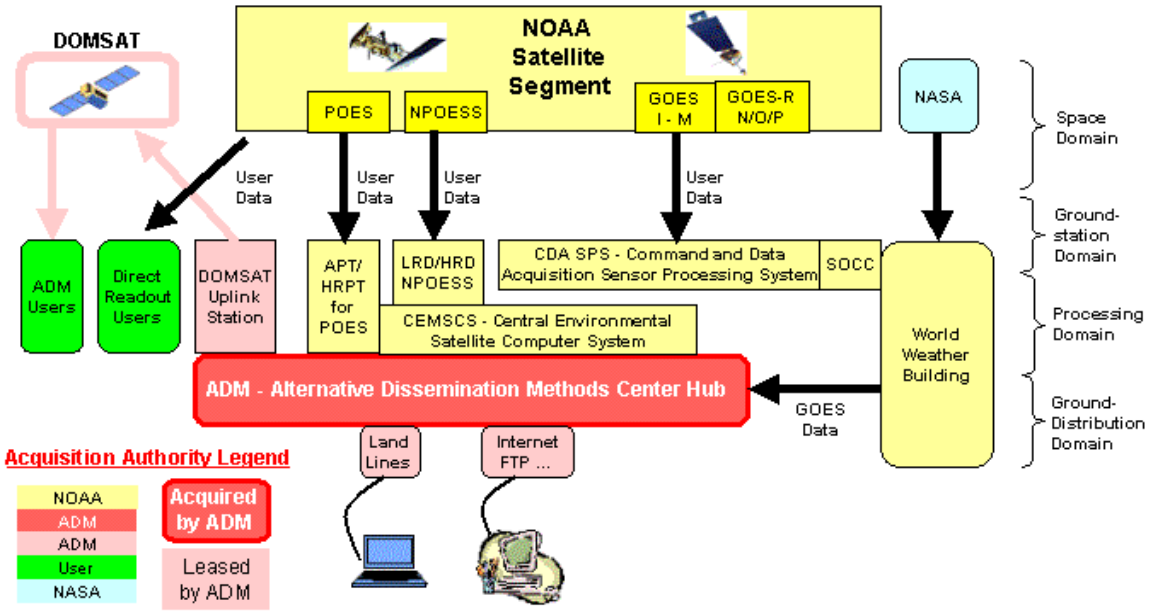

Figure 1-1 Systems View-1 (SV-1) of ADM System Architecture and Interfaces

As shown in Figure 1-1, there are three major segments in the system: Space Segment, Ground Segment, and User Segment. The space segment includes various types of environmental satellites (GOES, POES, NPOESS, etc.). The ground segment includes the geostationary satellite operation-control center, low earth orbit satellite operation-control centers, and commercial satellite uplink stations. The satellite ground stations receive environmental and telemetry data from various satellites. Users will receive the ADM data via DOMSAT broadcast (utilizing the DVB-S standard), dedicated landline, or internet.

4. Current Activities

The scope of work executed in the current study includes defining ADM functions, performance, and interfaces between the spacecraft ground stations, the ADM system, and the users.

4.1 ADM Timeline

NOAA's development of ADM architecture has been categorized along four areas of investigation:

- Task 1: ADM System Description (performed prior to November 2003)
- Task 2: Investigation of Broadcast Systems Similar to ADM
- Task 3: Simulation of Return Link Architectures to ADM
- Task 4: Internal ADM Functionality to Process All Source Data

Work during the rest of 2004 will include population of simulation frameworks and a comprehensive trade analysis of data collection and dissemination options.

Task 1: ADM System Description (performed prior to November 2003)

The ADM system functions, interfaces, and performance are described in this section. Figure 2-1 illustrates the Systems View - 2 of the ADM system functions and interfaces.

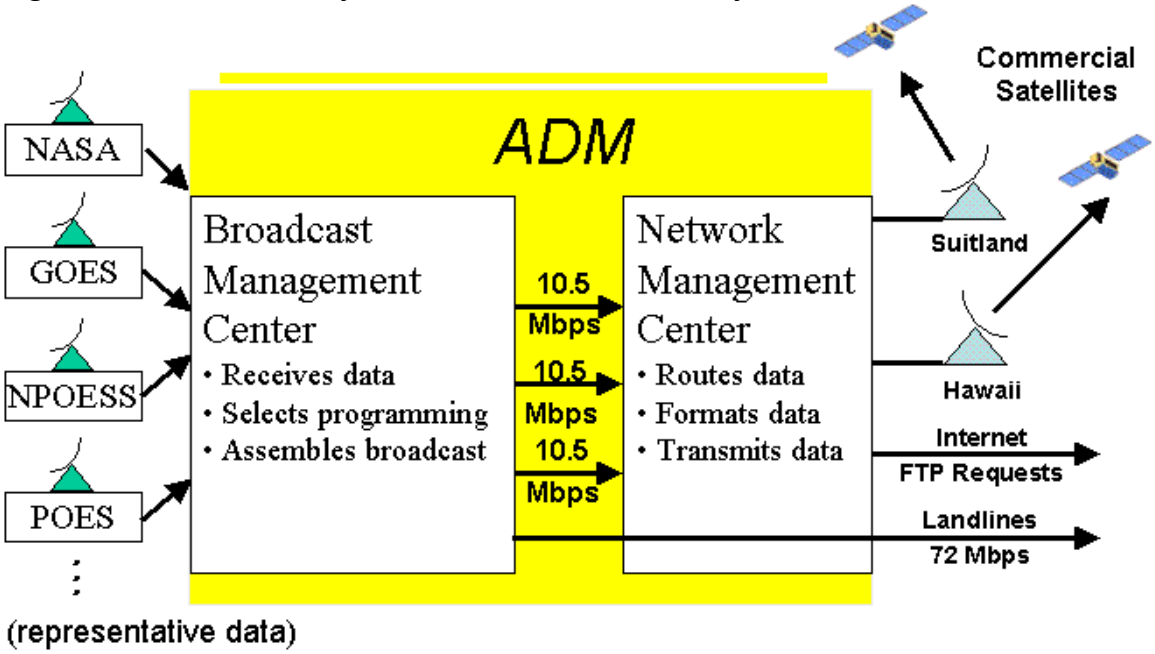

Figure 2-1 Systems View-2 (SV-2) of ADM Functional and Interface Diagram

The ADM system receives data from satellite ground stations, stand-alone terminals and product processing facilities. The received data are processed and formatted, and then transmitted to dedicated and public users.

The ADM system consists of the Broadcast Management Center (BMC) and Network Management Center (NMC). The BMC receives data from various satellite operation-control centers with varying data rate. NOAA anticipates the physical layer and link layer aspects of the data protocol to be processed by the service providing centers. The ADM system will perform network layer and transport layer data processing functions.

Dedicated users consist of general scientific institutions that have a confirmed requirements the entire data compliment for a full-rate landline. The ADM system will have full-rate (approximately 72 Mbps) privately leased landlines from the ADM Center to dedicated users such as the National Centers for Environmental Prediction (NCEP) and the National Center for Atmospheric Research (NCAR) in Boulder, CO.

Public users are all other users besides dedicated users to utilize other forms of data transport, such as commercial satellite communications (utilizing the DVB-S standard) or internet. Public users within the footprint of a commercial communications satellite (DOMSAT) broadcasting the ADM data stream may receive the transmission via the DVB-S standard. Additionally, ADM public users with an Internet connection available may receive environmental information from the ADM Center via File Transfer Protocol (FTP).

The ADM Broadcast will be divided between GOES-R, POES, NPOESS, and NASA data, and almost certainly other types of data. The environmental satellites of the future will produce data rates in excess of what can be accommodated by the ADM data stream (10.5 Mbps baseline). This, of course, means the ADM system must compress the data before transmission to users.

The ADM user terminal can be made from Commercial-Off-The-Shelf (COTS) parts. Preliminary costing of such COTS components include: antenna ($500 USD), low-noise block down converter (LNB, $350 USD), Digital Video Broadcast-Satellite (DVB-S) Personal Computer Interface (PCI) Card ($60 USD), PC Workstation ($2000 USD) and software ($500 USD). The use of COTS parts will enable easier adaptation of the terminal to match future growth.

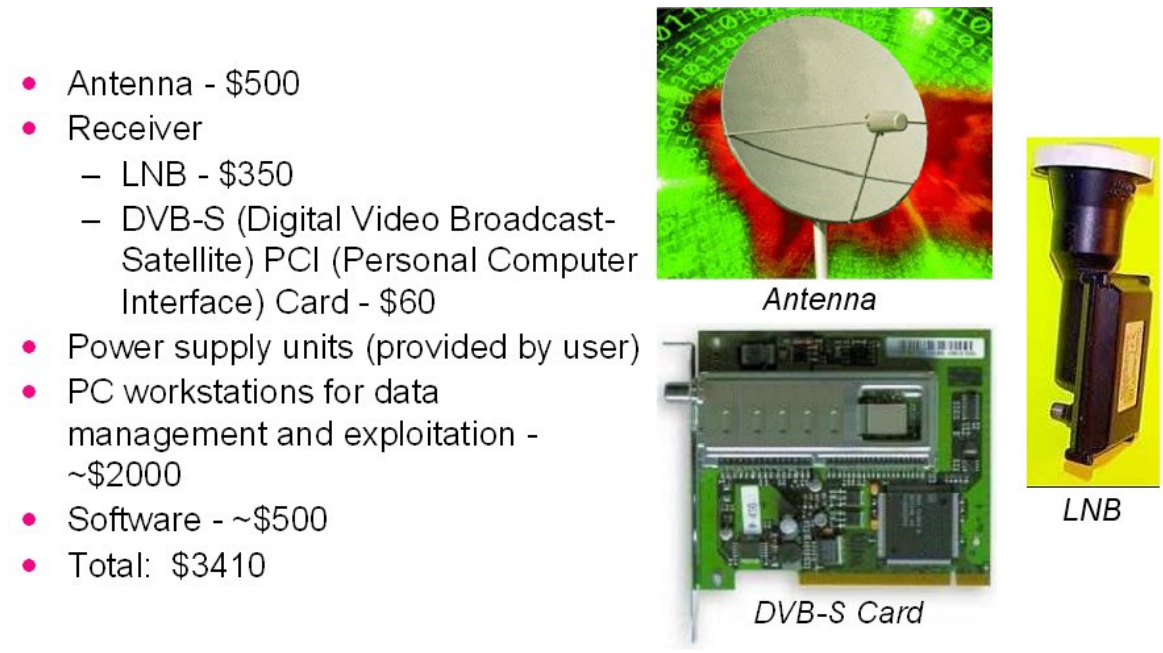

Figure 2-2: Example Commercial Off the Shelf (COTS) Hardware for the ADM User Terminal

Task 2: Investigation of Broadcast Systems Similar to ADM

NOAA has investigated the US Air Force's Mark IV B Environmental Data Server, the Global Information Centre (GIC) proposed system, developments in Future WMO Information System (FWIS), Unidata's Internet Data Distribution (IDD) system, and other distribution systems.

Task 3: Comparison with other Dissemination Systems

NOAA has performed comparisons with the data distribution systems mentioned in Task 2. The purpose of this task is to avoid replicating the functionality of other dissemination systems, take advantage of technologies employed by other organizations, and begin the process of building interface standards with other satellite operators and dissemination systems.

Task 4: Simulation of Return Link Architectures to ADM

The purpose of this task is to investigate the methods of getting data from ground stations, product processing facilities and other data handlers to the ADM. NOAA has considered simulation tools such as Operational Network Evaluation Tool (ONET) and Matrix Laboratory (MATLAB) in order to support detailed standards negotiations with other organizations. In addition, NOAA has begun to formulate system features, set performance goals, and select aspects to be modeled. Given this developing ability of the ADM study to model its capabilities and begin the process of developing standards for interfaces, ADM is ready to move into the phase of collecting information on the protocols for data transmission from data providers.

Task 5: Internal ADM Functionality to Process All Source Data

The purpose of this task is to describe and develop the ADM Processing Center including the functionality of both its components, the Broadcast Management Center (BMC) and the Network Management Center (NMC). A description of the algorithms for the BMC and NMC Functional Processing Flow will be provided. The development of these algorithms will be of use in determining the nature of the applications available to ADM users.

4.2 Response to CGMS XXXI ADM Action Items

The CGMS XXXI generated the following actions relevant to ADM. Based on the progress in ADM Architecture development outlined in the previous section, NOAA has prepared the following responses:

- Action 31.45 CGMS Members to indicate actions enabling global networking of the Alternative Dissemination Methods (ADM) implementations in view of a smooth exchange of specific ADM contents among differing ADM systems and report to CGMS XXXII. Deadline: CGMS XXXII

  Response: Strategies for physical connectivity (landline, internet, satellite) to/from EUMETSAT and JMA were considered during the NOAA ADM study (2003). This effort is being extended to consider data formats/protocols from NOAA as well as other sources. Network simulation activities are underway in order to test protocol compatibility and impact.

- Action 31.46 CGMS Members to consider the FWIS (Future WMO Information System) concept (notion of DCPC, catalogue/metadata standards, protocols) when changing/ implementing processing and dissemination systems and report to CGMS XXXII. Deadline: CGMS XXXII

  Response: FWIS has been researched and considered by the NOAA ADM effort. FWIS data dissemination topologies are similar to dissemination topologies under consideration by NOAA ADM. Network compatibility issues are being addressed by network simulation modeling efforts.

- Action 31.47 CGMS Members to consider WMO Core Metadata profiles within the context of the ISO Standard for Geographic Metadata (ISO 19115) and report to CGMS XXXII. Deadline: CGMS XXXII

  Response: Consultation with the NOAA National Geophysical Data Center has resulted in CGMS-XXXI USA-WP-22 being rescinded. It has been determined that minor deficiencies in the WMO Core Metadata profile as compared to ISO 19115 will not significantly impair compatible network operation.

- Action 31.48 CGMS Members to actively pursue the issue of ADM on a global basis and to ensure the interoperability of those systems and report to CGMS XXXII. Deadline: CGMS XXXII

  Response: NOAA is studying the data dissemination plans of EUMETSAT and JMA. Both physical connectivity and networking standards are under consideration. NOAA work in ADM simulation model development will enable the successful negotiation of networking standards for ADM data interchange between NOAA, EUMETSAT, and JMA.

- Action 31.51 CGMS Members to consider the use of off-the-shelf components for ADM user stations because this would allow easier adaptation of the station to match future growth in the dissemination system and to accommodate changing user requirements and report to CGMS XXXII. Deadline: 30 April 2004

  Response: The ADM user terminal described in the previous section and in other ADM documents utilizes Commercial Off the Shelf (COTS) parts in order to achieve lowest cost and the ability to provide for future data rate growth.

- Action 31.52 CGMS to investigate further data protection techniques appropriate for a global “alternative distribution system”. Deadline: CGMS XXXII

  Response: The concern of EUMETSAT for maintaining encryption of its data upon distribution by other dissemination systems is recognized NOAA will further negotiate protection techniques with EUMETSAT.

5. Conclusion

NOAA has presented a preliminary architecture of the Alternative Dissemination Methods (ADM) system for the distribution of environmental data. The pursuit of alternative methods of distribution is important as the volume of information increases in the future, and satellite constellations become more unique. The NOAA ADM is a system for the distribution of near real time data. Work to develop detailed system architecture is on-going. In the future, an ADM user may receive environmental data via a commercial satellite, internet, or by dedicated landline.

References

[1] ETSI EN 300 421: “Digital Video Broadcasting (DVB); Framing Structure, Channel Coding, and Modulation for 11/12 GHz Satellite Services”
[2] ETSI EN 300 429: “Digital Video Broadcasting (DVB); Framing Structure, Channel Coding, and Modulation for Cable Systems”
[3] ETSI TR 101 154: “Digital Video Broadcasting (DVB); Implementation Guidelines for the Use of MPEG-2 Systems, Video and Audio in Satellite, Cable and Terrestrial Broadcasting Applications”
[4] ETSI ETS 300 802: “Digital Video Broadcasting (DVB); Network-independent Protocols for DVB Interactive Services”
[5] “Proposal for An Overall Strategy for Convergence of Planned ADMs”, CGMS-XXXI EUM-WP-12
[6] “Alternative Dissemination Methods”, CGMS-XXX WMP-WP-22
[7] “Report on Alternative Dissemination Methods for GOES-R”, CGMS-XXX USA-WP-36