

ARM Mobile Facility – Design and Schedule for Integration

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Abstract

The Atmospheric Radiation Measurement (ARM) Program has a need for an ARM Mobile Facility (AMF) that can be deployed anywhere in the world for up to 12 months at a time. This system shall be modular so that it can meet the needs of ARM science objectives of each individual deployment. The design phase for developing the AMF has begun. A design review was held for the AMF in December 2002. The design of the shelters, instrumentation, and data system along with the schedule for integration will be presented.

Introduction

Early in the development of the ARM Program, the need to be able to make atmospheric measurements in a wide variety of climatic regimes was established. ARM “founders” recognized that a mobile system would be able to go to locales where a full ARM site could not. In February 2001, a workshop was held to set the preliminary design requirements for the AMF. This workshop was followed up with a special breakout session at the 2001 ARM Science Team Meeting to further refine the requirements.

The requirements from these meetings describe a facility that is relatively small and quite similar to the requirements that were used for ARM’s contribution to the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment from 1997 through 1998. A core suite of instrumentation was identified along with suggested locales for deployment. ARM’s SHEBA effort was, in effect, a prototype for the AMF.

The overall philosophy for the design of the AMF shall be simplicity. In most deployment scenarios, the locations will be in remote sites and outside support may be minimal. The AMF must be self-sufficient. The standardization of components (e.g., hardware, software, operating systems, and connectors) shall be considered wherever practical.

Major Assumptions for Design

- Due to the nature of these short-time deployments, data availability is priority. Mean-time-to-repair must be quicker than is allowable at the ARM Cloud and Radiation Testbed (CART) sites.
- The staff that will operate the AMF shall have sufficient technical background and training beyond what is currently required at the ARM CART sites.

- A minimum of two staff will be used for setting up and tearing down/packing the AMF.
- The AMF shall be operable by one person for an 8-hour shift. Although there will nominally be two people staffing the AMF, it may become necessary to operate the AMF with one person while the other rests.

Operation Locales

During the workshop and 2001 Science Team Meeting breakout session, numerous locations were put forward by ARM scientists representing climatic regimes of interest. This list was distilled to the following locales. With each locale is an estimate of the possible transport modes.

- Amazonia – by ship to port and then transport by air, barge, or land
- High Latitudes (Arctic and Antarctic) – by ship to port then transport by air
- Asia – by ship to port then transport by air or land
- Australia – by ship to port then transport by air or land
- Continental North America – by land
- Europe – ship to port then transport by land
- Islands – ship or air with minimal land transport
- Shipboard – land transport to embarkation point.

Shelters

Flexibility is paramount in deploying to these various locales in a timely and cost-effective manner. Different locales will have differing constraints with respect to shelter requirements. The various shelter options available and a short discussion of where these shelters may be utilized are listed as follows:

- **Reusable shelters.** Shelters that are easily transported by numerous modes (land, sea, and air) shall be the primary shelter. The reusable shelter (Figure 1) is approximately 12 ft long by 7 ft wide by 7 ft tall. Its empty weight is approximately 1500 lbs. It is built to military standards as a tactical shelter. We plan on modifying the length to 16 ft and will procure two of these shelters.
- **Disposable shelters.** Deployments are envisioned where the cost of deploying/recovering the shelter (transportation, customs, labor, etc.) is more expensive than the replacement cost of the shelter. In this case, a shelter that can be shipped to the deployment site on pallets, assembled, used, and then locally disposed of (burned, landfill, or given away) might be a cost-effective solution. These types of shelters were used at the SHEBA ice camp and were made of foam laminated between plywood (Figure 2).
- **Use of existing facilities.** Before deployment, the use of existing facilities should be explored. If the cloud radar and lidar are packaged so that they are standalone, space will be needed only for the data system and instrument computers. This has worked well at Nauru where we have set up a suite of instruments adjacent to the Menen Hotel and have operated the computers from a hotel room for over a year. Figure 3 shows the instrument field for the Nauru Island Effect Study.



Figure 1. Reusable shelter.



Figure 2. Disposable shelter.



Figure 3. Existing facility at Nauru.

- **Atmospheric Radiation and Cloud Station (ARCS) shelters.** The existing ARCS shelters are relatively heavy and not amenable to portable operations. However, there may be some locales in which the infrastructure exists that will make the use of these shelters desirable. For instance, it might be desirable to pre-deploy ARCS shelters at sites that we will come back to every few years, returning with only instruments and data systems. Pictures of two ARCS vans are shown in Figure 4.



Figure 4. ARCS vans.

Figure 5 shows where the various shelter options would match up with possible deployment locales. The best match would be dependent on logistic scenarios for a particular deployment and would be made during deployment planning.

	Amazonia	High Lat.	Asia	Australia	US	Europe	Islands	Shipboard
Reusable	X	X	X	X	X	X	X	X
Disposable	X	X					X	
ARCS			X	X	X	X		X
Existing facilities	X	X	X	X	X	X	X	X

Figure 5. Various shelter options and locales.

Instruments

Figure 6 shows instruments that will be the baseline instrument set to deploy with the AMF. It is anticipated that this list will be augmented depending on the deployment locale and the science required from that locale. It is essential that the AMF be readily adaptable to add and subtract from this instrument list as necessary. This also includes easily adding duplicate data streams, i.e., two microwave radiometers. All instruments shall interface with the data system via a 10/100BaseT Ethernet network connection.

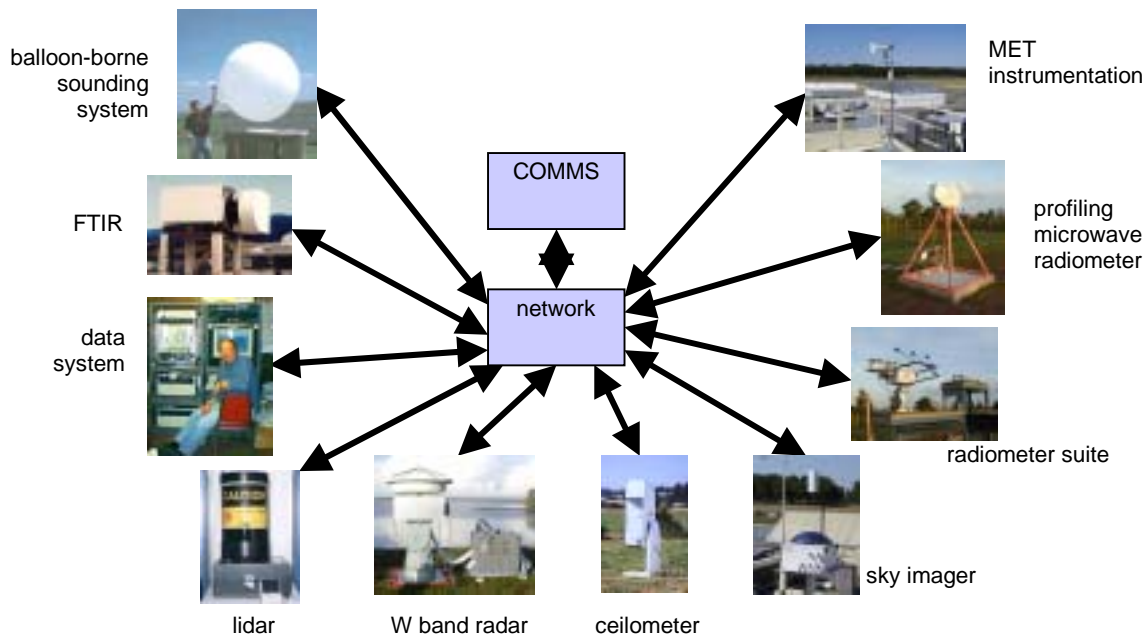


Figure 6. Baseline instrument set to be deployed with the AMF.

Data System

The data system will serve the primary function of collecting data from the individual instruments. Secondary functions of the data system will include:

- data ingest to NetCDF
- data sharing during combined operations with other organizations
- data display
- health and status monitoring.

It is anticipated that a stripped-down version of the current ARM data system will be used. This will maximize data integration into the ARM Archive and operational support while minimizing development cost. Figure 7 is a block diagram of the data system.

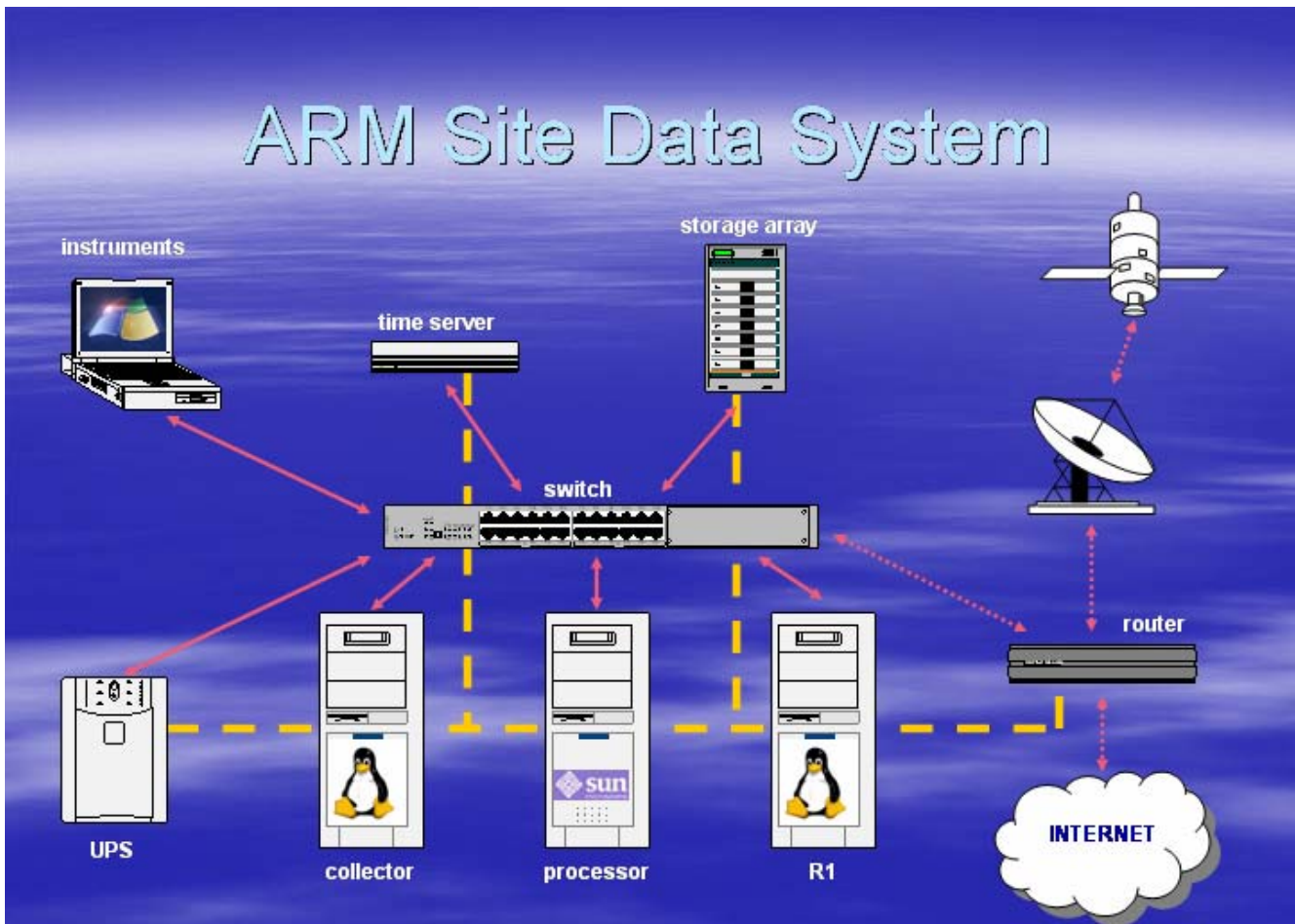


Figure 7. Block diagram of the data system.

Power

The power distribution system has been designed to handle practically all voltages (110 volts to 240 volts AC) and frequencies (50/60 Hz) we would be expected to encounter. Each deployment will be evaluated to determine what power is available and its reliability, and whether a backup generator can be leased locally or not. Uninterruptable power supply will be used to provide backup power to allow power switching from the local distribution to the backup generator.

The AMF will have enough power handling capacity to accommodate instrumentation from collaborators that may deploy with us. Figure 8 shows the power distribution for each shelter.

Schedule

The schedule presented during the design review in Washington, D.C. in December 2002, showed a beta test at the ARM Southern Great Plains (SGP) site during autumn 2003. However, we learned in

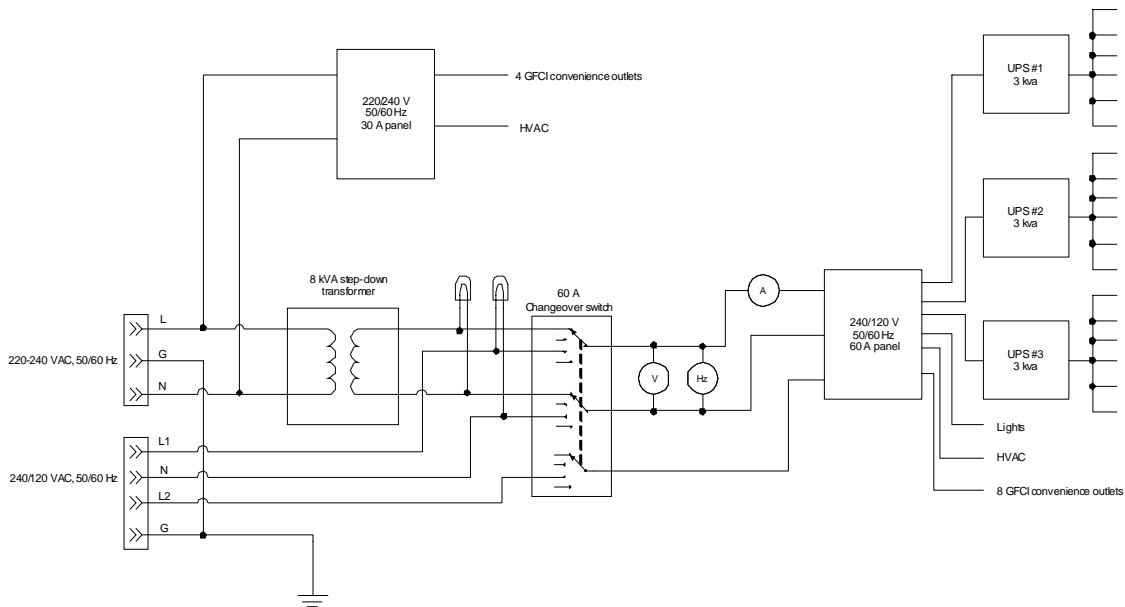


Figure 8. Power distribution schematic for shelters.

February 2003 that the funding that would have been used to develop the AMF was retracted. We are planning now to begin work at the beginning of FY 2004. If this occurs, beta test at the SGP site can be expected by late summer/early fall 2004.

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