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13. ABSTRACT *(Maximum 200*
As part of the NATO implementation forces, peace keeping mission, 20,000 U.S. troops were deployed to Bosnia-Herzegovina. The U.S. Army chose to deploy telemedicine and teleradiology in support of the deployed personnel. This provided state-of-the-art diagnostic services to the troops, along with real-time immediate diagnosis of the radiological images by a remote Radiologist. The Deployable Radiology(DEPRAD)network was designed by personnel at the Imaging Science and Information Systems(ISIS)Center at Georgetown University Medical center to provide rapid access to radiological images acquired in Bosnia. In less than 8 weeks, a complete system was designed, developed and deployed utilizing 11 vendors equipment and their standard off the shelf components. Wide area communications were designed and coordinated by the U.S. Army Medical Research and Materiel Command. The Defense Information Systems Agency (DISA) and Department of Defense, Health Affairs, contracted commercial satellite support and terrestrial communication lines to support the project in Bosnia and Hungary. The success of the telemedicine network prompted the U.S. Army to consider and arrange for deployment of similar technologies in other parts of the world where troops are deployed. This article details the DEPRAD network configurations installed in Bosnia, Hungary, and Germany. Usage statistics are also provided to demonstrate the usefulness of the network.

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FOREWORD

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1. Introduction

The U.S. military has been a proponent of digital imaging and teleradiology for over 15 years[1]. When the 20,000 US troops were deployed to Bosnia-Herzegovina in December 1995, as part of the NATO peace keeping Implementation Force (IFOR), a DOD decision was made to support deployment of advanced technologies to augment the medical capabilities of the US troops.[2] As described above, advances in medical imaging systems, diagnostic quality workstations, satellite communications, and computer inter-networks proved critical to the DOD decision to implement telemedicine, including teleradiology, to support the troops in Bosnia-Herzegovina. The goals of Operation Primetime III are to provide high quality medical care, rapid and definitive response to trauma, and maximize patient return to duty while minimizing soldier movement. DEPRAD - Deployable Radiology - is part of Operation Primetime III.

The ISIS Center at Georgetown University Medical Center (GUMC) was selected as the system integrator for this effort to design, develop, and implement a deployable teleradiology system that could support remote diagnosis of radiology images generated in Bosnia-Herzegovina and Hungary. Three requirements of the DEPRAD implementation were that commercial off-the-shelf (COTS) telemedicine equipment be used, that sufficient military and commercial telecommunications support be provided by the DOD to support the telemedicine network and that the system be deployed within 90 days.[2] The DEPRAD team worked within these requirements to design an off-the-shelf teleradiology network that provides connectivity between multi-vendor systems and allows for transmission of digital radiology images anywhere in the world at anytime.

2. Military Medical Care

There are 4 echelons of military medical care in this project: the forward medical and surgical elements (FME's and FSE's), the mobile army surgical hospital (MASH), the combat support hospital (CSH), and a European-based tertiary care U.S. military medical center in Germany. The FME's and FSE's have no or limited radiological support. Those elements with radiological service have conventional x-ray imaging and a single x-ray technologist as well as other medical support. The MASH has radiological imaging support, and x-ray technologists, but no radiologist. There is only one MASH within Bosnia-Herzegovina. The CSH in Hungary has radiological imaging, multiple x-ray technologists, and a radiologist. Finally, the Landstuhl Regional Medical Center (LRMC) is a complete medical center located in Landstuhl, Germany and is the final stop in the European echelon of care before a soldier is sent back to the continental US (CONUS). A diagram of the echelons of care is shown in Figure 1.0.

The FSE's and FME's are located throughout Bosnia-Herzegovina in an effort to provide medical care to the troops throughout the region. Although the FSE's and FME's have limited medical capabilities, they serve an important role in providing basic medical care to the deployed troops. Patients are first seen at these sites before a decision is made to transport them to the 212th MASH. As patients require more advanced medical care, they are evacuated from the MASH first to the 67th CSH in Taszar, Hungary and then to the LRMC in Landstuhl, Germany before being sent stateside. However, transport of personnel out of Bosnia-Herzegovina is difficult due to limited air transports, weather conditions, terrain, and the potential risk to the troops. There are over two million land mines still in place in Bosnia-Herzegovina, (there were over 7 million at the start of this operation) and troop movement is highly controlled. Convoys, with a minimum of four vehicles and eight healthy soldiers, are required to transport personnel within or out of Bosnia-Herzegovina. Helicopters flying in and out of Bosnia-Herzegovina must fly in groups of two or more with an attack helicopter escort with guns in the ready position.

Therefore, bringing health care expertise to the patients electronically is far preferable, when appropriate, than bringing the patients to the care.

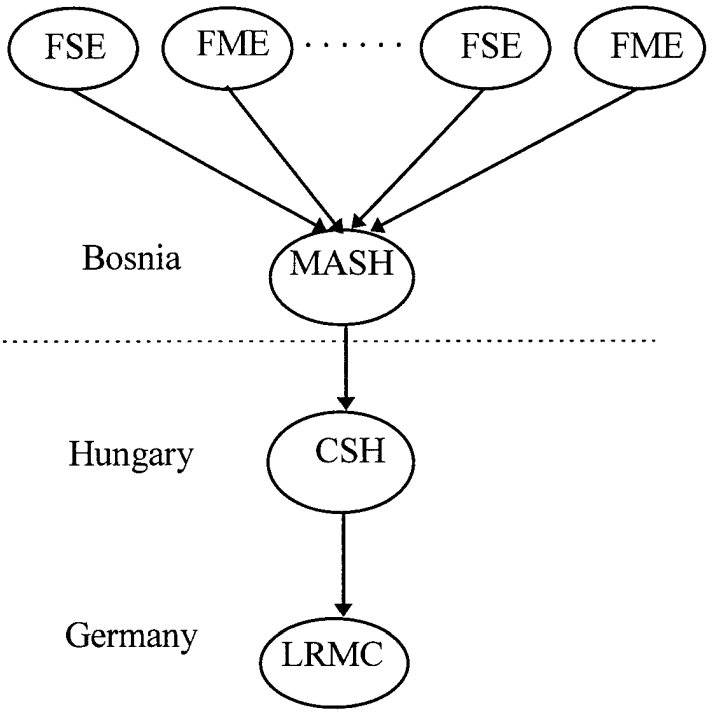

Figure 1.0 Echelons of Care

The rules governing assignments of personnel to the different echelons of military medical care do not provide for a radiologist to be assigned to the MASH. Therefore, before the installation of DEPRAD, x-ray images taken at the MASH were either read by non-radiologist medical doctors or the patient and their films were evacuated to the CSH in Hungary before a primary diagnosis could be attained.

3. Configurations

The DEPRAD systems integration team worked closely with military personnel to understand the different echelons of military medical care and the imaging modalities available or desired at each level of care. With this information the DEPRAD team designed an off-the-shelf teleradiology network that provided real-time primary diagnosis to the MASH in Bosnia-Herzegovina. The

imaging modalities provided by the Army included Picker PQS CT scanners equipped with a 3M 8700 Dry View film printer, conventional x-ray imaging, and a Diasonics ultrasound unit with an ALI DICOM interface box in Bosnia-Herzegovina. Working with this equipment, the remaining tasks were to:

- select and implement computed radiography (CR)
- select and implement softcopy display stations
- develop a local area network (LAN) to connect imaging devices to display stations
- provide technology to use the 3M 8700 film printer as a network accessible printer
- provide a diagnostic quality solution for getting old films into the imaging network
- provide for the transfer of images between Bosnia-Herzegovina, Hungary, and Germany as required
- provide for the transfer of images to other locations via the Internet or a secure military wide area network

The DEPRAD team required the DICOM 3.0 medical imaging communications standard for any equipment connected to the network.[3] While DICOM is fast becoming the standard of choice by most medical imaging vendors, the limitations of the standard were realized. System integration of this magnitude could not have been accomplished in such a compressed time-frame if a standard like DICOM was not used as the base for the integration effort. DICOM conformance statements were provided by most of the vendors. These statements theoretically provide a mechanism for determining the level of DICOM conformance between multiple vendors. While none of the devices were plug and play, the extra work required to make the systems communicate was far less than if proprietary interfaces needed to be developed.[4,5,6] Among the seven DICOM implementations we encountered for this project, none were connected without modification to configuration files, software changes or patches required by vendors, or operational changes by the user.

The Picker PQS CT scanner and the Diasonics ultrasound machine with the ALI gateway had DICOM 3.0 interfaces. These interfaces provided for the transfer of images from the CT scanner or the US machine to a DICOM storage service class provider (SCP). The 3M 8700 film printer did provide a DICOM print management SCP. The workstations that were sending images to the printer are not print storage class users (SCU), so they can not communicate with a print SCP. Therefore, additional software was provided to convert the print server form a print SCP to a storage SCP. A CR reader, a CR DICOM gateway, display stations, and a film digitizer still needed to be selected.

The Fuji AC-3 computed radiography reader was selected because of its cost, size, image quality, and Georgetown's expertise in working with the device. The Analogic CR DICOM gateway was selected because the image processing algorithms implemented on the gateway were Fuji approved. This gateway receives the Fuji CR images from a proprietary interface, applies Fuji approved image processing algorithms and passes the images through a DICOM interface to the receiving workstation.

A single display station vendor was selected to facilitate training, service, and maintenance requirements. One of the defining factors for selecting the Siemens MagicView workstations was the availability of 2Kx2K monitors. It was felt that a 2Kx2K display was essential since the CR produces 2K image data sets and the American College of Radiology recommends the full data set be used for teleradiology.[7] Displaying the 2K image set on a 1K monitor is not always convenient for the radiologist since they can only view part of the image at a time and are required to pan the image around the screen to see the entire image.

The communications network at each site requires each imaging modality to send directly to the radiology display station. Each imaging modality, often through the use of second-party software and/or hardware, is able to produce a DICOM 3.0 store message to transfer images to the Siemens MagicView. The MagicView is configured to receive DICOM 3.0 messages from each imaging modality and is also configured to send DICOM store messages to the 3M Dry View print server to produce hard copy films when needed.

MASH:

At the 212th MASH, the following equipment is installed (Figure 2.0):

- Picker PQS CT scanner
- Diasonics US machine with an ALI interface box
- Fuji AC-3 CR device with an Analogic SD-100 CR gateway
- Lumisys Lumiscan 75 laser film digitizer (LFD) with a Dejarnette Image Share workstation
- 3M 8700 Dry View film printer
- 3 Siemens MagicView display stations
    - Radiology

      MagicView 500

        - single 1K monitor
        - 2 GB of disk storage
        - MOD drive for archival
    - Intensive Care Unit (ICU)

      MagicView 200

        - single 1K monitor
        - 2 GB of disk storage
    - Emergency Medical Treatment (EMT)

MagicView 200

- single 1K monitor
- 2 GB of disk storage

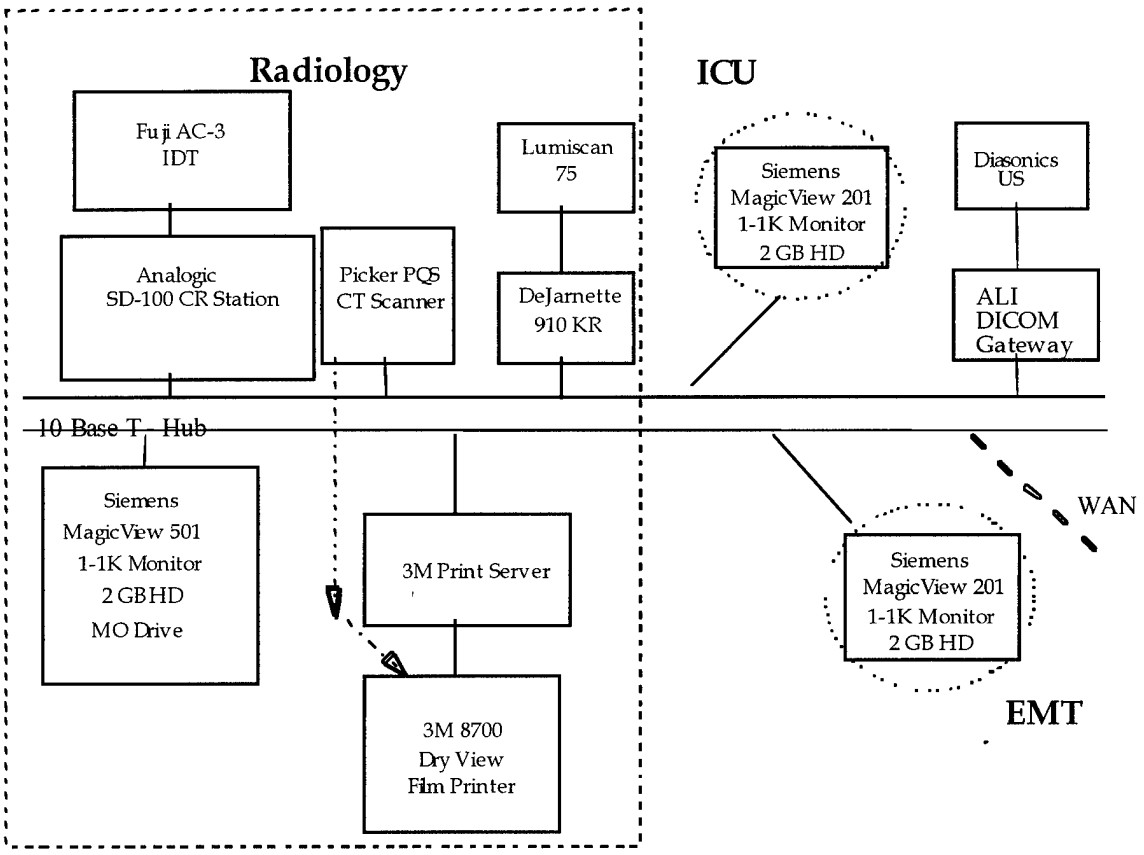

Figure 2.0 MASH Configuration

CSH:

At the 67th CSH, the following equipment is installed (Figure 3.0):

- Picker PQS CT scanner
- Fuji AC-3 CR device with an Analogic SD-100 CR gateway
- Lumisys Lumiscan 75 laser film digitizer (LFD) with a Dejarnette Image Share 910 workstation
- 3M 8700 Dry View film printer
- 6 Siemens MagicView display stations
    - Radiology

      MagicView 500

        - 2 high luminance 1K monitors
        - 9 GB of disk storage
        - MOD drive for archival

      MagicView 1000

        - dual 2K monitors
        - 2 GB of disk storage
    - Intensive Care Unit (ICU)

      MagicView 200

        - single 1K monitor
        - 2 GB of disk storage
    - Emergency Medical Treatment (EMT)

      MagicView 200

        - single 1K monitor
        - 2 GB of disk storage
    - Orthopedics

MagicView 200

- single 1K monitor
- 2 GB of disk storage

♦ Physician consultation area (DCCS)

MagicView 200

- single 1K monitor
- 2 GB of disk storage

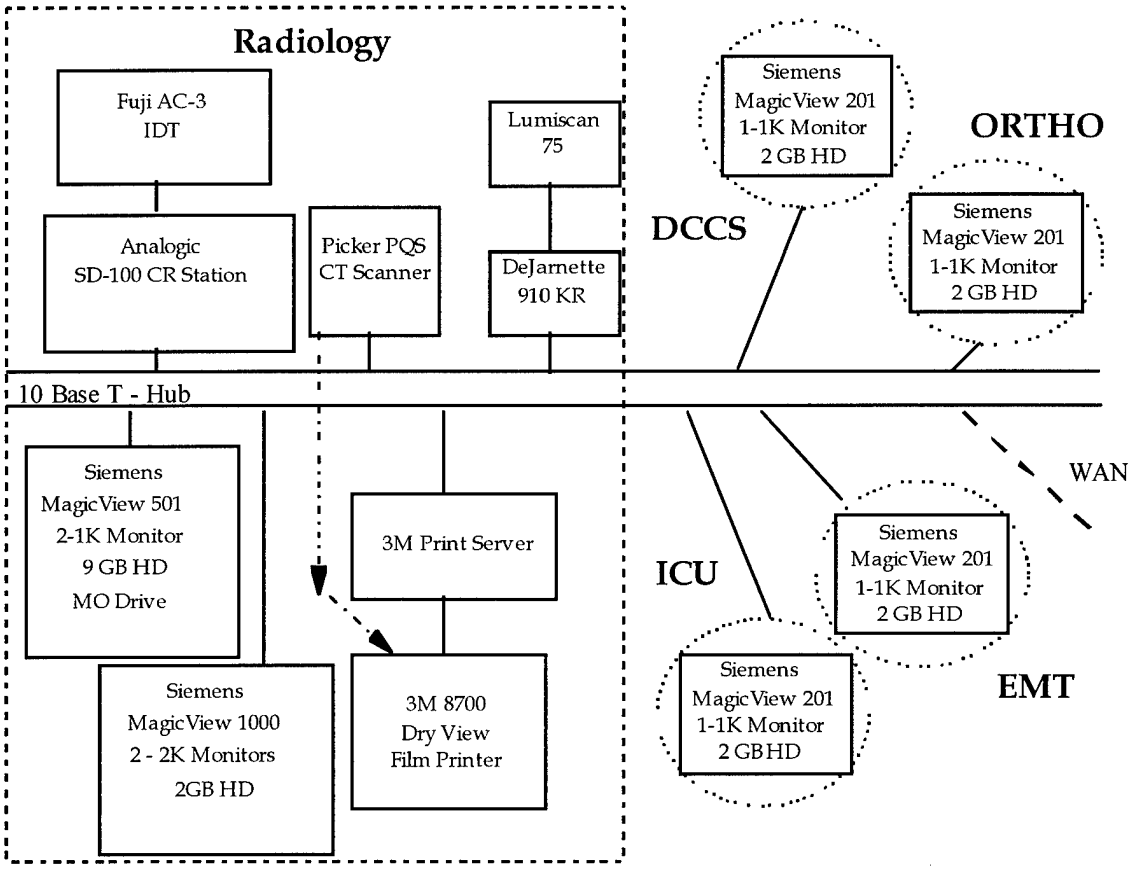

Figure 3.0 CSH Configuration

LRMC:

At LRMC, the following equipment is installed (Figure 4.0):

- Polaroid Helios dry film printer
- Dejarnette Lasershare print server
- Dejarnette Imageshare gateway
- 2 Siemens MagicView display stations
    - ♦ Radiology

      MagicView 500

        - 2 high luminance 1K monitors
        - 9 GB of disk storage
        - MOD drive for archival

      MagicView 1000

        - dual 2K monitors
        - 2 GB of disk storage

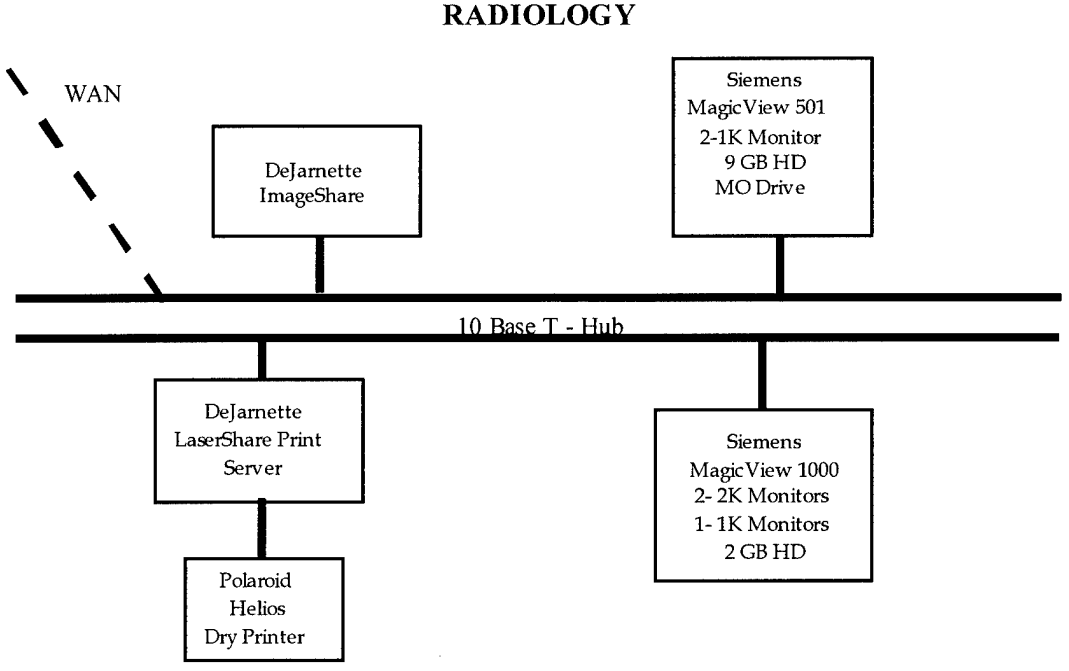

Figure 4.0 LRMC Configuration

4. Communications

Wide area network (WAN) communications were established by the US military with the integration, testing, and implementation assistance of GTE personnel. The communications infrastructure consists of a 10BASE-T local area network (LAN) at each site for internal communications of images. A tandem microwave antenna extension set and a satellite earth station are in place for WAN communications between the MASH and LRMC. Leased E-1* lines from the Hungarian and German telephone companies provide communications between LRMC and the CSH. The communications path is shown in figure 5.0.

Images are transmitted out of Bosnia-Herzegovina via the microwave extension set from the MASH to Tuzla air base (10 miles away), then through satellite communications to a satellite farm in Landstuhl, Germany, and then over leased E-1 lines to the CSH.

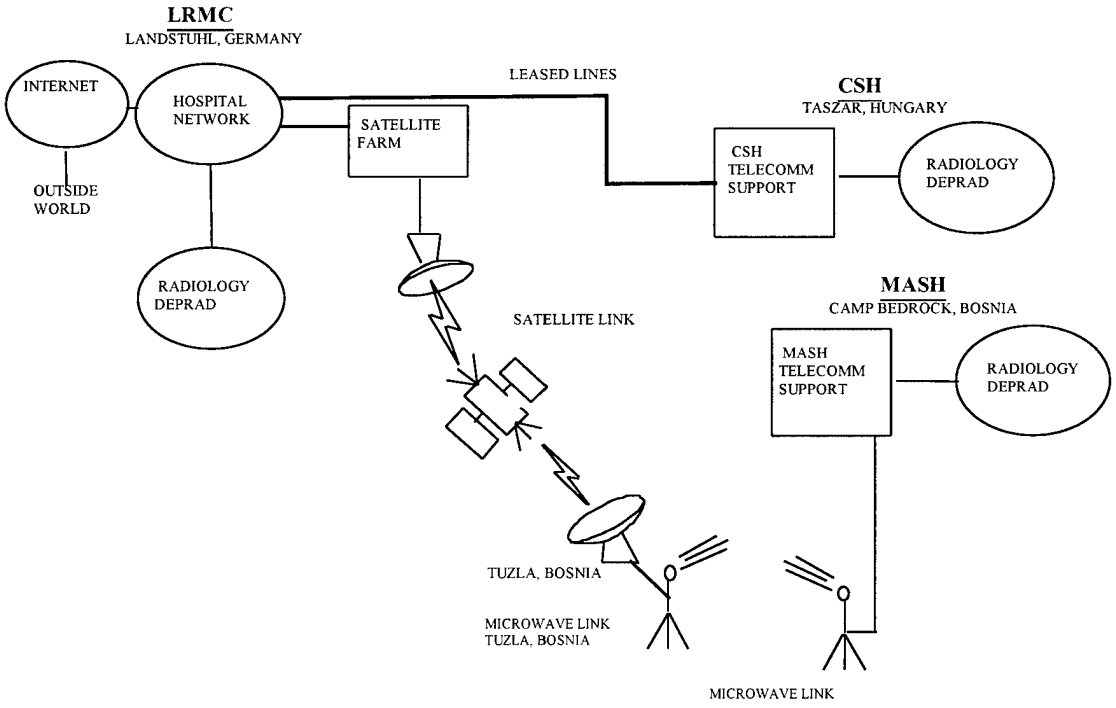

Figure 5.0 DEPRAD Communications Path

* An E-1 line is the European equivalent of a T-1 line and provides a 2.048 Megabits/second transfer rate.

Similarly, images that need to reach LRMC are sent from the satellite farm in Landstuhl to the hospital over a leased E-1 line. Communications between the CSH and LRMC are through leased E-1 lines connecting the two sites. Internet access is available at all sites through the network and at military medical centers in the United States so that images can be transferred to other military institutions for backup overflow diagnostic clinical support if needed. The Georgetown team continues to support and maintain the systems daily via the Internet.

Image transfer on the LAN is sufficient for this application. A 7-10 MB image (a single CR or LFD image) is transferred between the imaging modalities and the workstation in under 2 minutes. Images are transferred between local workstations in under 30 seconds. Image transfer from the MASH to the CSH or LRMC takes approximately 10 minutes and between the CSH and LRMC, about 2 minutes. Over the Internet, transfer times vary considerably dependent on time of day and can take from 20 minutes to more than 60 minutes for a single CR image.

Clinical Scenarios

Images are acquired digitally at the MASH and CSH. Since there is no radiologist stationed at the MASH all images acquired there are sent to the CSH for primary diagnosis. Simultaneously, images are transferred within the MASH and CSH to local workstations and/or printed at the 3M 8700 printer as needed. (Printing is done routinely for operating room cases, and as needed for follow up care at civilian hospitals for foreign nationals and other peacekeeping partners seen in the MASH's emergency room.) All diagnoses are done softcopy at the CSH. Initially, all images were to be sent to LRMC (from both the CSH and MASH) for permanent archival. However, it became evident shortly after implementation that it was not practical to transfer all the images to LRMC, so the permanent archive is maintained at the CSH. Images are transferred to LRMC only when a patient is being evacuated there or if a radiologist is unavailable at the CSH.

Usually images are sent to the CSH in batch mode at the end of the day; however, emergency cases are transferred immediately. Once studies are diagnosed at the CSH, the radiologist will either phone back the report to the MASH or record it at once into the Composite Health Care System (CHCS) information system, the military's world-wide hospital information system, at the MASH to ensure fast turn around times.

Project support at the sites was not unanimous. During installation at LRMC initially there was some skepticism on the part of the already busy computer systems personnel who saw this as an additional burden. Radiology personnel were uncertain as to what their new roles would be in supporting the troops in Bosnia-Herzegovina. Support was found among the radiology technologists, the radiology chairman, and the information systems chairman. This provided an administrator for the equipment we left behind and two advocates to see that support for the deployment continued. After the radiologists were trained in using the workstations their support increased.

Enthusiastic support was received among the radiology personnel, information systems people, and medical maintenance personnel at the CSH. However, referring clinicians (Orthopedics, EMT, ICU) were less enthusiastic about the equipment. At the time the equipment arrived at the CSH, the workload was light. Everyone was grateful that there were not many casualties. The surgeons and radiologists complained about too much time on their hands. They were anxious to learn the systems, especially the computed radiography. A technologist from Georgetown University Medical Center trained the technologists on the subtleties of CR and an Army radiologist trained the radiologists, referring physicians, and technologists on the use of the workstations. Medical maintenance and information systems personnel were trained on

maintaining and troubleshooting the system by a GUMC engineer. They were eager to begin using the network.

Most MASH personnel saw the arrival of the equipment as an added burden to an already busy department. They were nervous about the new technology, they were concerned about the true advantages they would see, and they were uncertain as to who was ordering the use of system. Again everyone was trained, reluctantly. Military personnel convinced the MASH personnel of the importance of the project and that helped allay their fears of the new system.

System usage and the steady requests for information about the system signified the success of the DEPRAD installation. There were many situations where immediate access to a Radiologist, through the DEPRAD network, proved invaluable in providing rapid and first rate medical care to the patients in Bosnia-Herzegovina.

5. Continued Support & Maintenance

The ISIS Center at Georgetown University Medical Center continues to support the systems daily over the internet. Initially upon return from overseas, the daily support was tremendous. Approximately 10 hours a day were spent on support. However, as the systems stabilized and personnel at the sites grew more comfortable with the equipment, support needs have diminished greatly. As an effort to make the sites more self sufficient, the engineers at the ISIS Center produced a system description manual and a system administrator's guide. These were distributed to the sites and are included in Appendices A and B.

All systems are checked daily to verify continued operations, that disks are not full, and that no errors have occurred. Usage statistics are captured to monitor how much the systems are being

used and what, if any, changes are required. One significant change that was noticed from daily monitoring of the network was that the work load at the MASH was higher than originally expected. Conversely, the number of image transfers to LRMC was less than expected. Thus, in response to actual usage, the primary workstations at the MASH and LRMC were swapped to provide 9 GB of storage to the MASH and 2 GB to LRMC. Since the network was designed to be easily reconfigurable as patterns of usage became evident, this swap did not greatly interfere with continued operations.

Image quality problems have been diagnosed remotely. Images were sent from the MASH to Georgetown over the Internet because an image quality concern was raised a few weeks after initial installation. A Georgetown radiology technologist and a Georgetown physicist, who are experts on CR imaging, viewed the images, talked with the Fuji engineers and were able to determine the cause of the problem. A computer board was accidentally left in the CR reader and was causing degradation of the image quality under certain circumstances. MASH medical maintenance personnel removed the board and they were operational again within days.

To ensure that problems can be diagnosed, recreated and new software tested prior to deployment in the field, a prototyping and integration lab has been setup at Georgetown. Much of the same equipment that is installed in Bosnia-Herzegovina, Hungary, and Germany has been purchased and installed so that software fixes and new software releases can be tested, and problems diagnosed without affecting clinical operations in the field.

6. Usage Statistics

The teleradiology network has been used extensively since it was installed. Since mid-May, system usage has been carefully tracked. The statistics provided here are from mid-May until September. Computed radiography is used almost exclusively at the MASH and CSH for all

general x-ray exams. As shown in Figure 6.0, over 2700 CR images have been acquired at the MASH, and over 1600 at the CSH. The computed tomography (CT) equipment has been used for over 150 patient studies, with the majority of these done at the MASH. There have been 67 ultrasound (US) studies performed at the MASH.

Every image acquired at the MASH is sent to the CSH for archival on a magneto-optical disk (MOD). There have been over 550 patient folders sent to the CSH from the MASH. A patient folder normally consists of one type of exam (CR, CT, or US) with a CR folder typically containing one to eight images, a CT folder about 30 images, and an US folder about 20 images. In July, when the radiologist at the CSH was on vacation, about 200 patient folders were sent from the MASH and CSH to LRMC. Also, during a four day visit to the MASH by the CSH radiologist, more than 40 patient folders were sent from the CSH to the MASH for primary diagnosis. As can be seen from these statistics, this is an excellent example of teleradiology since the images can be sent to any location where there is a radiologist.

While printing is available at all the sites, filmless radiology is the primary mode of operation. In the first 8 weeks of statistics gathering, we estimate that approximately 10% of all patient folders were printed at the MASH and CSH combined with the majority of these printed at the MASH where they see more foreign nationals.

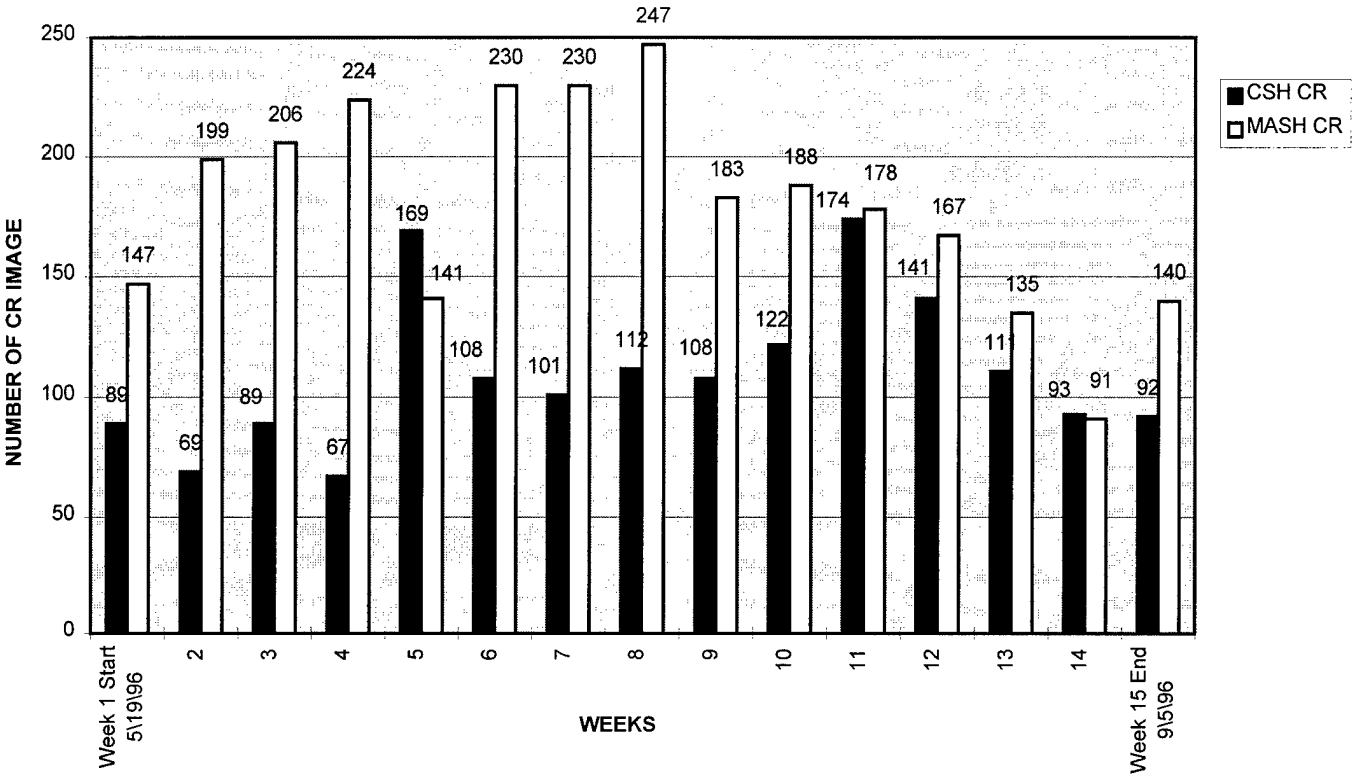

Figure 6.0 Computed Radiography Usage at the CSH and MASH

7. Conclusion

In conclusion, the success of the DEPRAD network has shown that teleradiology is a viable alternative, and can significantly contribute to improved medical care in the deployed environment. Image transfer rates over satellite links provide fast enough transfer speeds to allow for improved diagnosis by a radiologist.

Due to a compressed time frame, if the DICOM standard was not used, this type of network could not have been developed. It was only due to the advantages offered by having a baseline to start the integration effort that this network came together so quickly. The other factor which added to the success of the project was the unconditional support received from all the vendors involved in the project. The importance of supporting the U.S. troops deployed to Bosnia-Herzegovina was universal

among all participants. The vendors were willing to put a lot of engineering effort on the project and provide support, often 24 hour support, to ensure the systems would communicate.

The success of this project contributed to the Army decision to deploy a film digitizer and workstation, plus INMARSAT communications to some of the more forward sites in Bosnia-Herzegovina. While this technology checked out fine in the US and Germany prior to deployment in Bosnia-Herzegovina, there were some problems with the satellite communications from within Bosnia-Herzegovina and this phase of the deployment was not used often. A copy of the System Description, Installation and Operations Manual for phase II of the project is included in Appendix C.

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Appendix A
Phase I:

System Description Manual

Deployable Radiology Network (DEPRAD)

System Description Manual

IMAGING SCIENCES AND INFORMATION SYSTEMS
DEPARTMENT OF RADIOLOGY
GEORGETOWN UNIVERSITY MEDICAL CENTER

PRELIMINARY

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David Lyons

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INTRODUCTION

This document describes the deployable radiology (DEPRAD) system installed in Germany, Hungary, and Bosnia as part of the Primetime III project. The Primetime III project is part of Operation Joint Endeavor, and is intended to provide state-of-the-art telemedicine support for the troops in Bosnia and Hungary. The DEPRAD system is a computer-based radiology imaging network that will manage radiographic images in a deployed environment and allow these images to be transmitted to remote sites for primary diagnosis.

As described in the Task Force Primetime III Network Implementation Plan and Master Schedule document, the telemedicine network has been deployed at a number of sites in Europe. Initially, the network includes the Landstuhl Regional Medical Center (LRMC) in Germany, the 67th Combat Support Hospital (CSH) in Hungary, and the 212th Mobile Army Surgical Hospital (MASH) in Bosnia. In the future, additional facilities in Bosnia may be added.

This document consists of the following sections:

- Germany site installation
- Hungary site installation
- Bosnia site installation
- Communications network

In addition, the DEPRAD System Administration Manual is a separate document which describes how to maintain each piece of equipment.

GERMANY SITE INSTALLATION

In Germany, the DEPRAD system has been installed at the Landstuhl Regional Medical Center (LRMC) in Landstuhl. A schematic of the LRMC configuration is shown in Figure 2.1, and the physical location of the equipment is shown in Figure 2.2. A map of the hospital is shown in Figure 2.3. This equipment has been set up in a room in the Radiology Department and consists of:

1. Siemens Magicview 500 viewing station with two 1K siemomed monitors
2. Siemens Magicview 1000 viewing station with one 1K color monitor and two 2K Megascan monitors
3. Polaroid 1417 Helios dry film printer
4. Dejarnette Lasershare print server
5. Dejarnette Imageshare image gateway

All the equipment is connected to each other and the hospital network through a Cabletron MR9T repeater. Port 9 of this repeater goes to the hospital network, while the other ports are used for the equipment listed above. Internet access is provided through the hospital network.

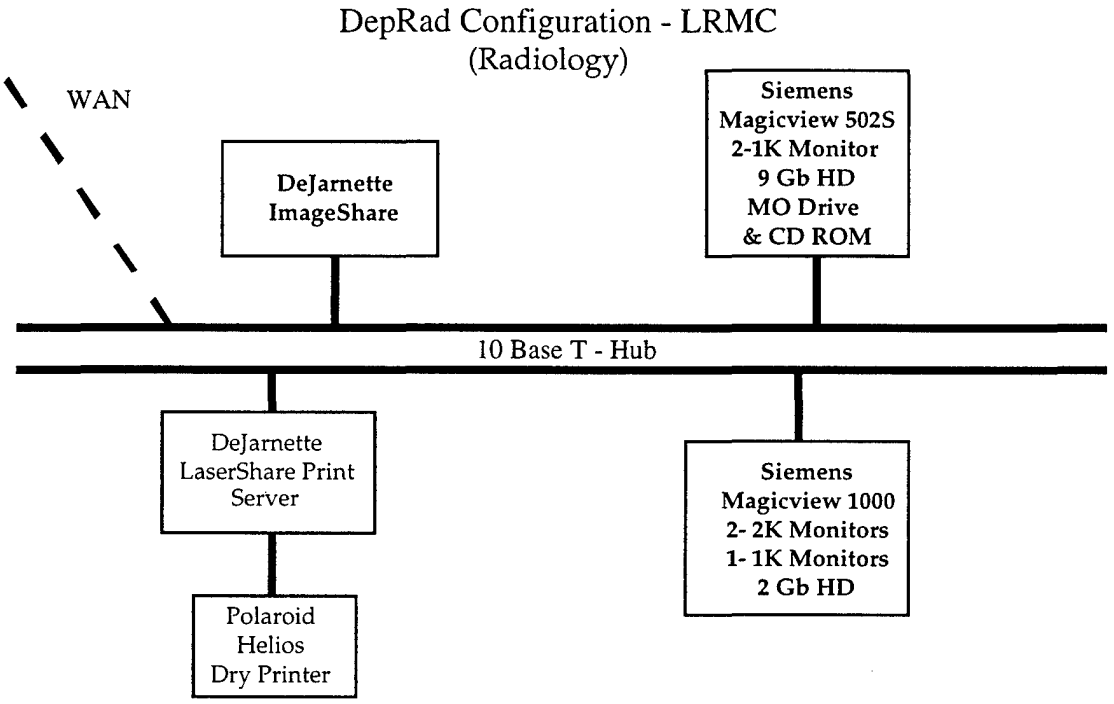


Figure 2.1 LRMC network configuration

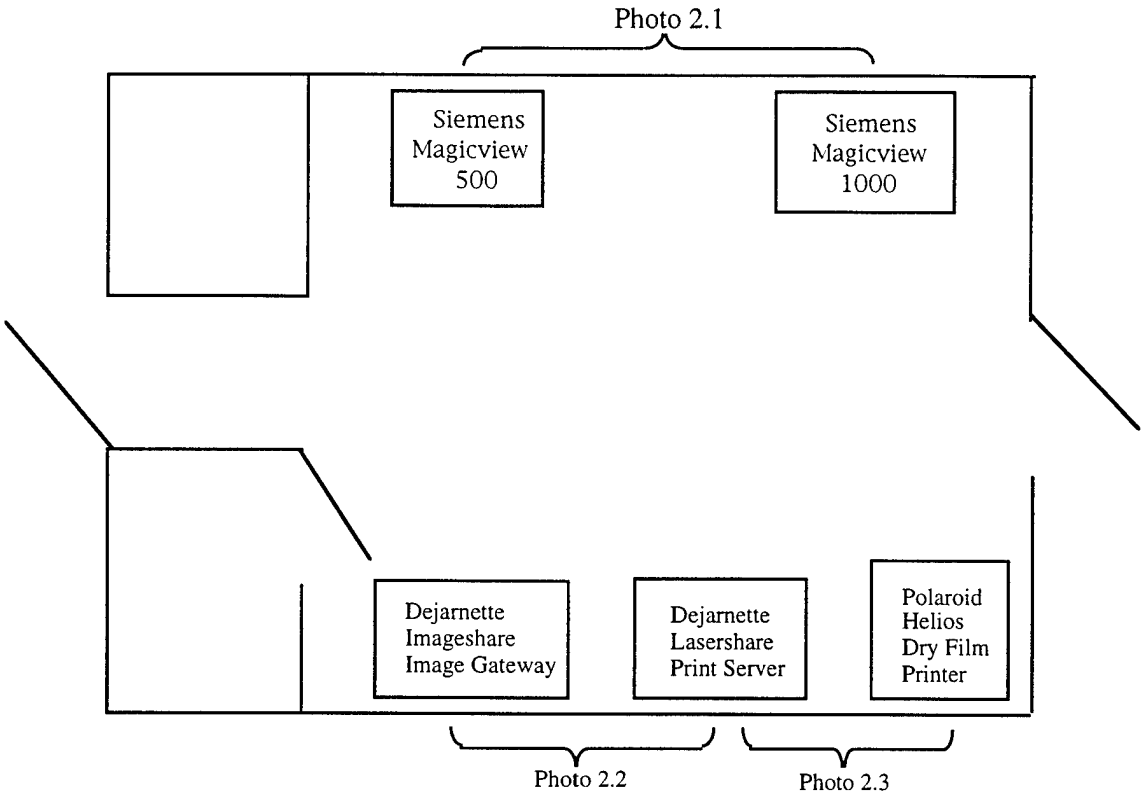


Figure 2.2 Equipment placement

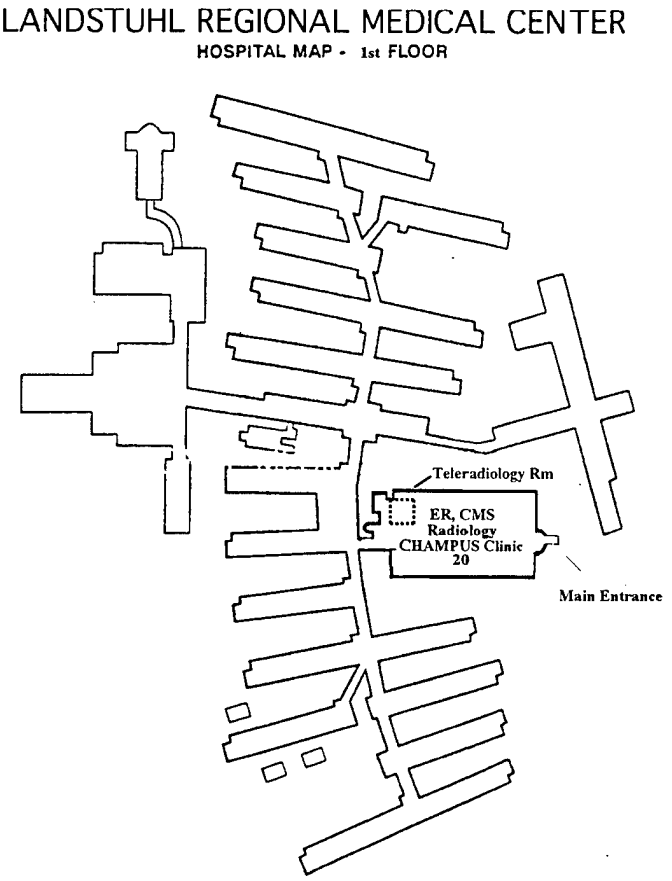


Figure 2.3 LRMC hospital and teleradiology room location

Some photographs of the hospital installation are shown in the following pages. Photo 2.1 shows the viewing workstations. The image gateway and print server are shown in Photo 2.2. The dry film printer is shown in Photo 2.3.

Photo 2.1 Viewing stations: Magicview 500 on left and Magicview 1000 on right

Photo 2.2 Image gateway on right and print server on left

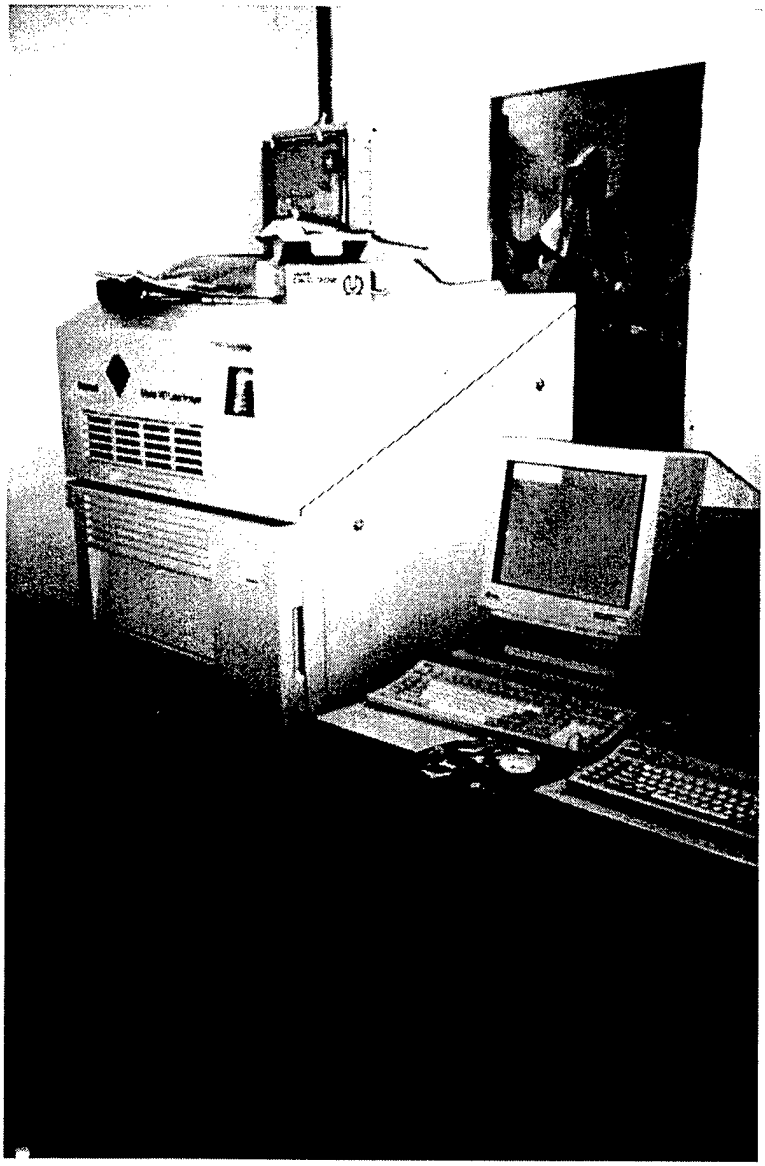


Photo 2.3 Dry film printer

HUNGARY SITE INSTALLATION

In Hungary, the DEPRAD system has been deployed at the 67th Combat Support Hospital (CSH) in Taszar. A schematic of the CSH configuration is shown in Figure 3.1. A layout of the hospital is shown in Figure 3.2. The equipment consists of:

1. Fuji ID terminal card writer/ reader, and AC-3
2. Analogic SD-100/DASM
3. Picker CT scanner
4. Lumiscan 75 film digitizer
5. Dejarnette 910KR film digitizer gateway
6. 3M print server with Dejarnette print software
7. 3M 8700 dry film printer
7. Four (4) Siemens Magicview 200 workstations
8. Siemens Magicview 500 workstation
9. Siemens Magicview 1000 workstation

The equipment is connected to each other and the WAN through a Cisco router and a Synoptics hub. In addition, all of the computers are on uninterruptible power supplies (UPS) from American Power Conversion.

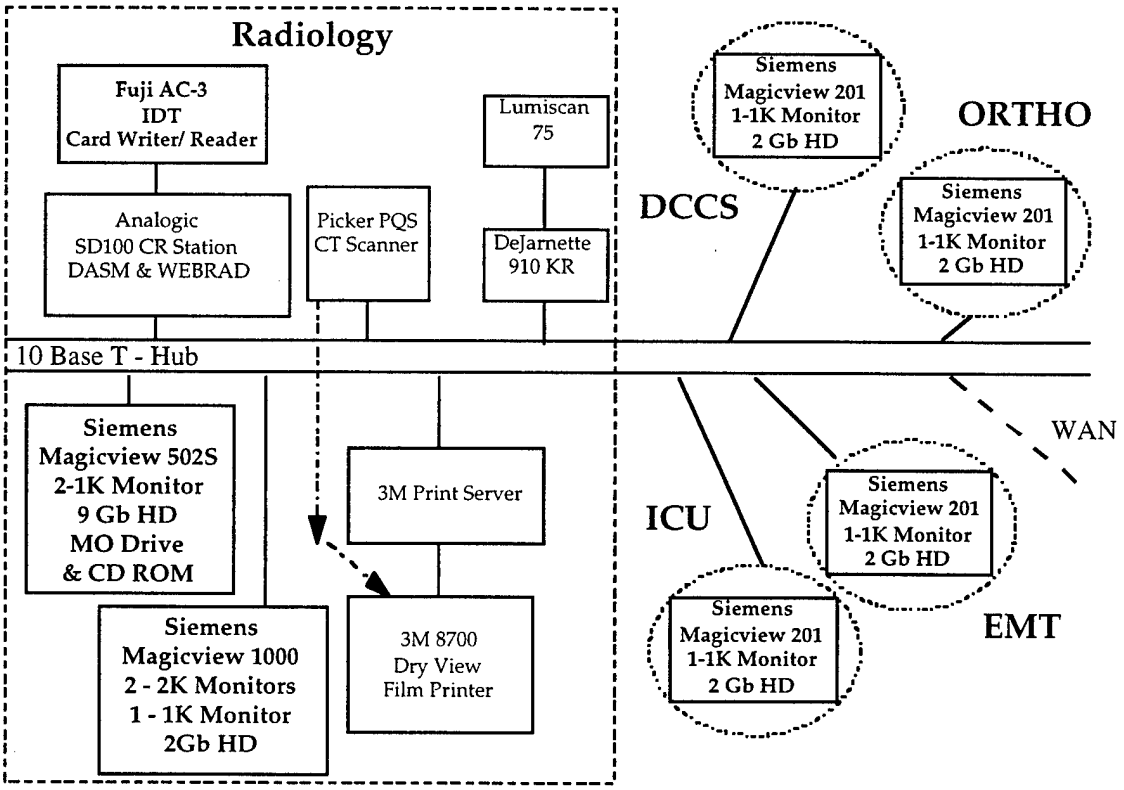


Figure 3.1 CSH network configuration

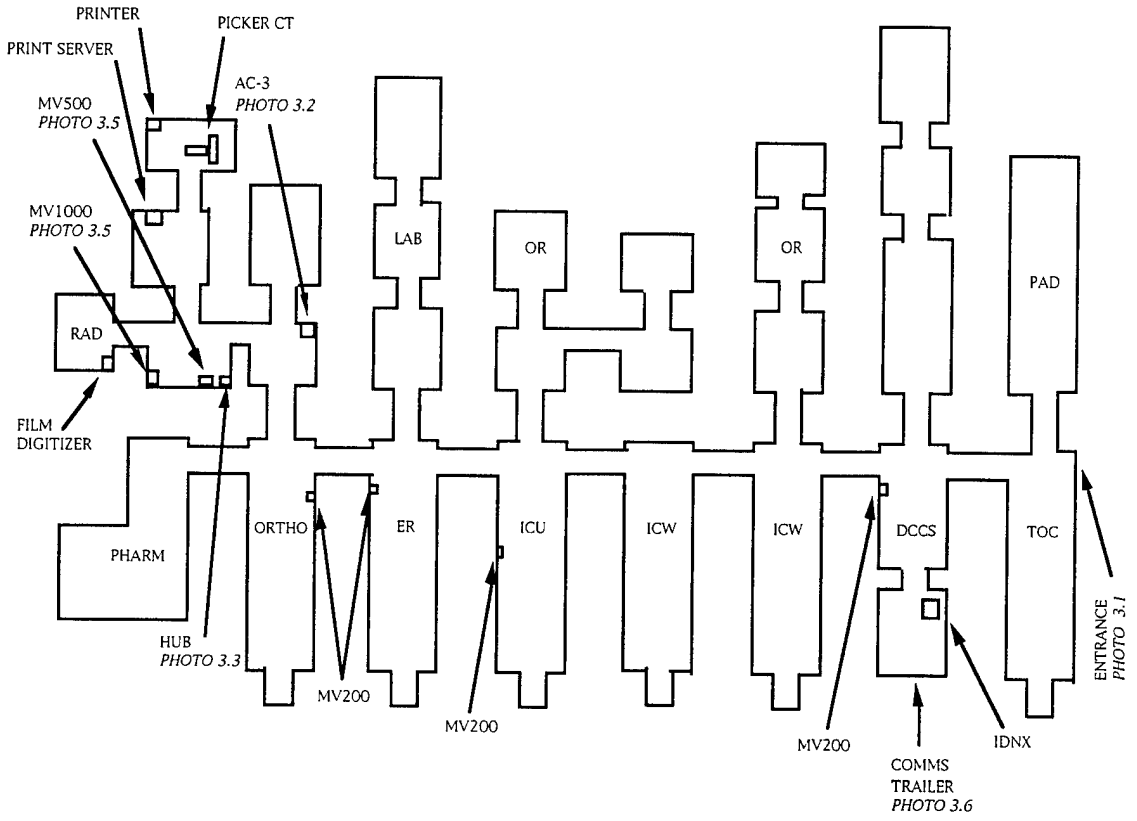


Figure 3.2 CSH layout and equipment placement

Some photographs of the CSH are shown on the following pages. Photo 3.1 shows the front of the CSH. Photo 3.2 shows the computed radiography equipment. The communications hub is shown in Photo 3.3. Photo 3.4 shows the Magicview 500, and the Magicview 1000 is shown in Photo 3.5, The communication trailer is shown in Photo 3.6. Finally, an aerial photo of the CSH is shown in Photo 3.7.

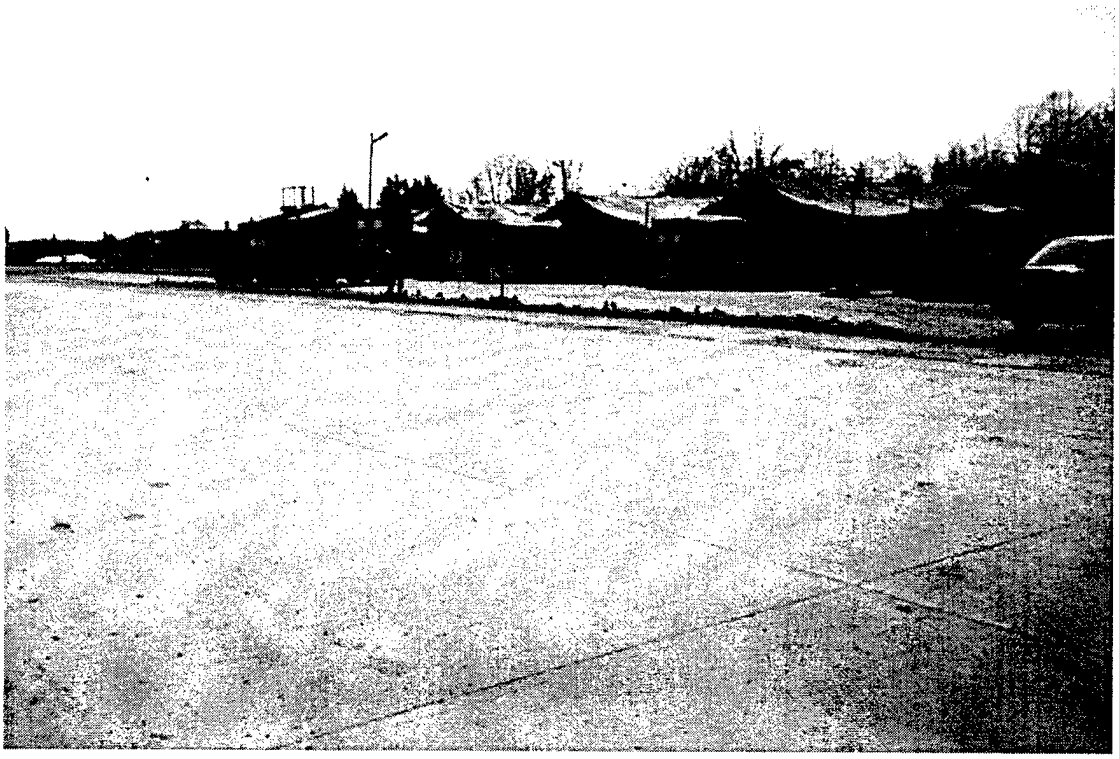


Photo 3.1 A front view of the CSH

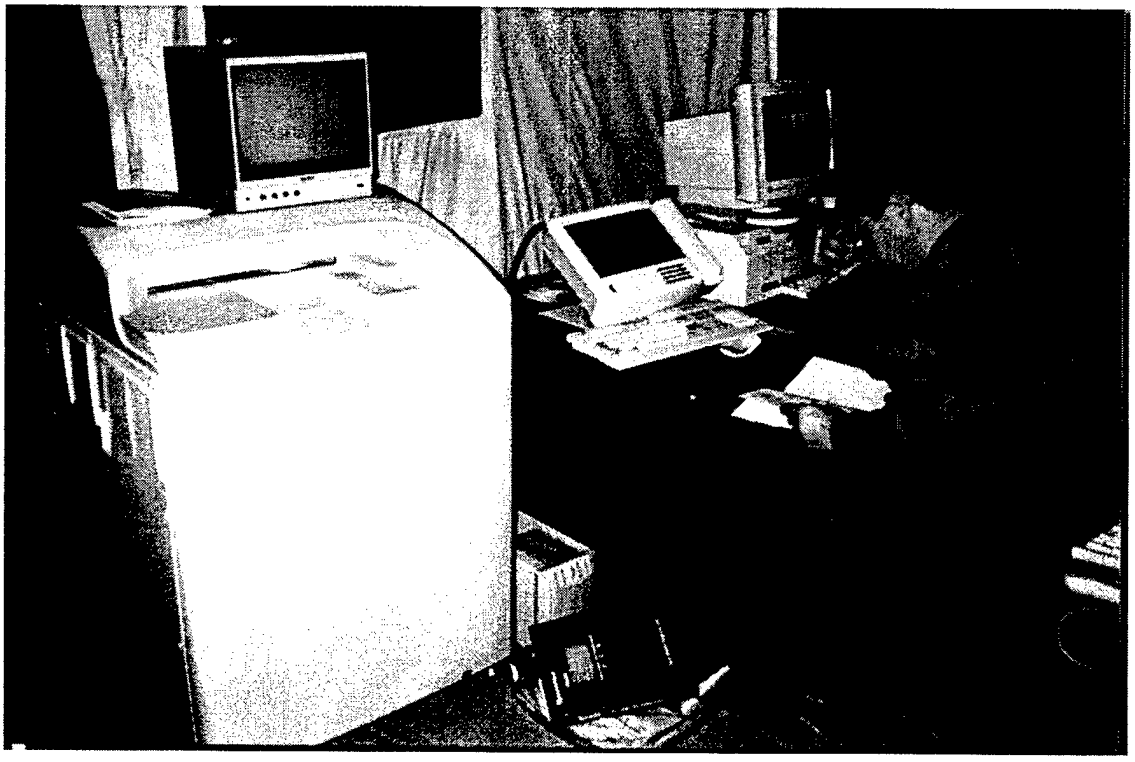


Photo 3.2 Computed radiography equipment

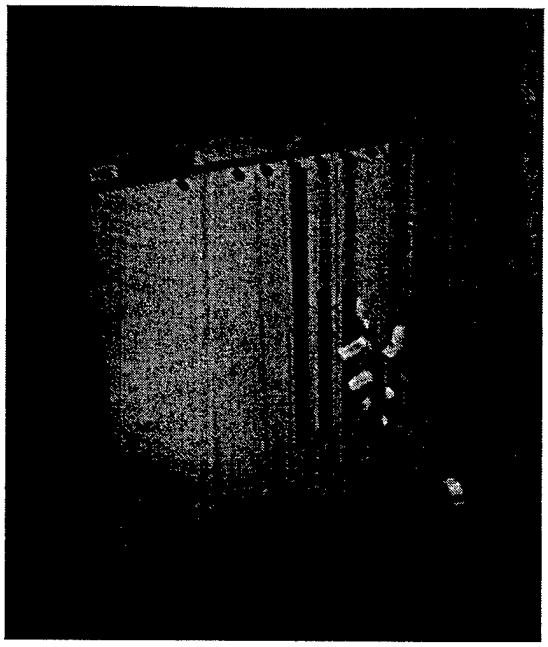


Photo 3.3 Communications hub

Photo 3.4 Magicview 500 viewing station

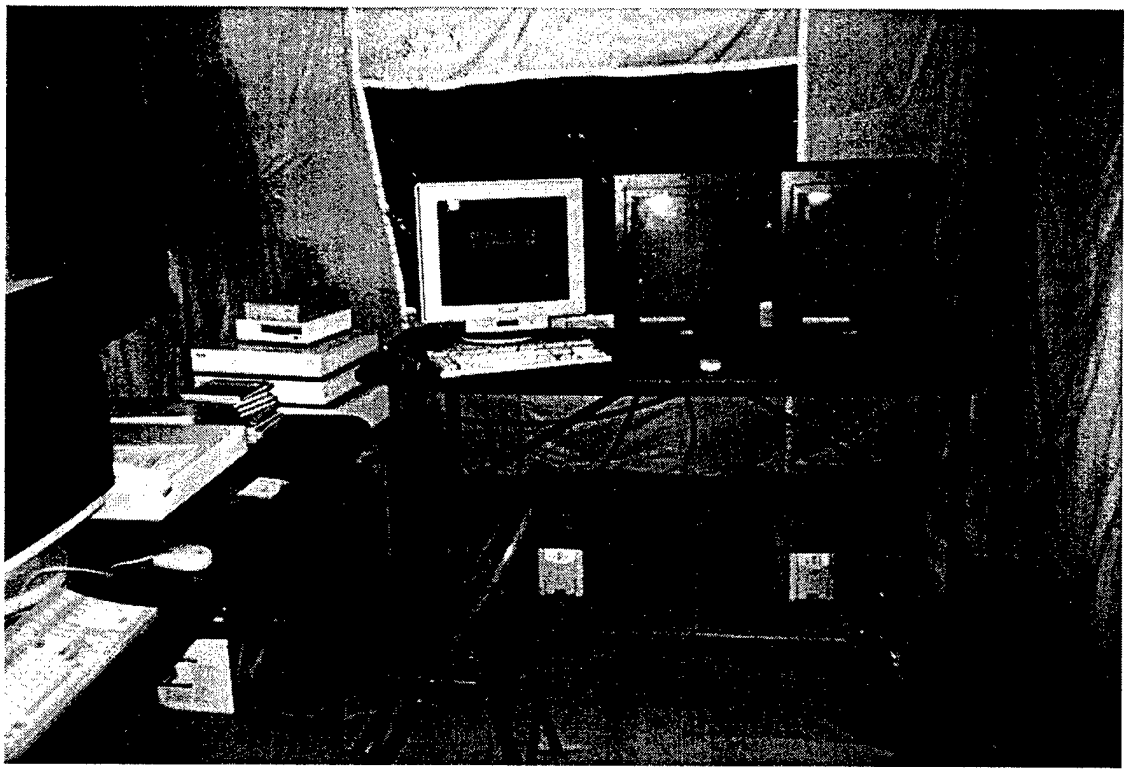


Photo 3.5 Magicview 1000 viewing station

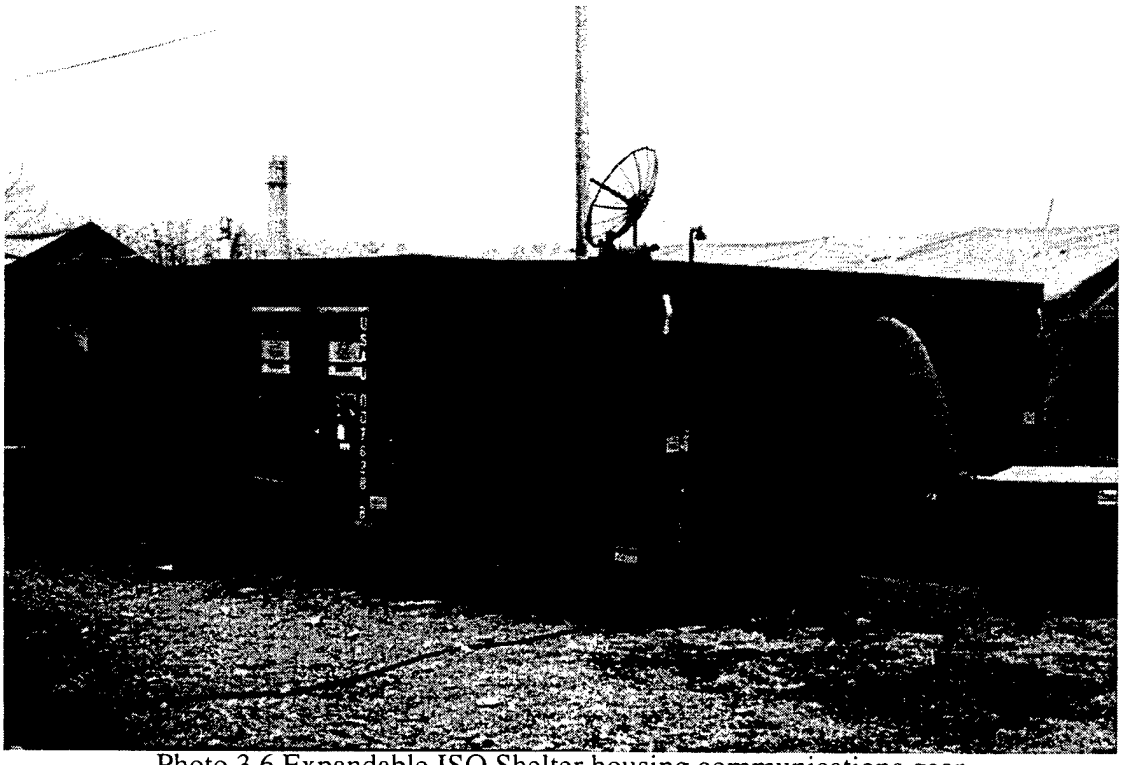


Photo 3.6 Expandable ISO Shelter housing communications gear

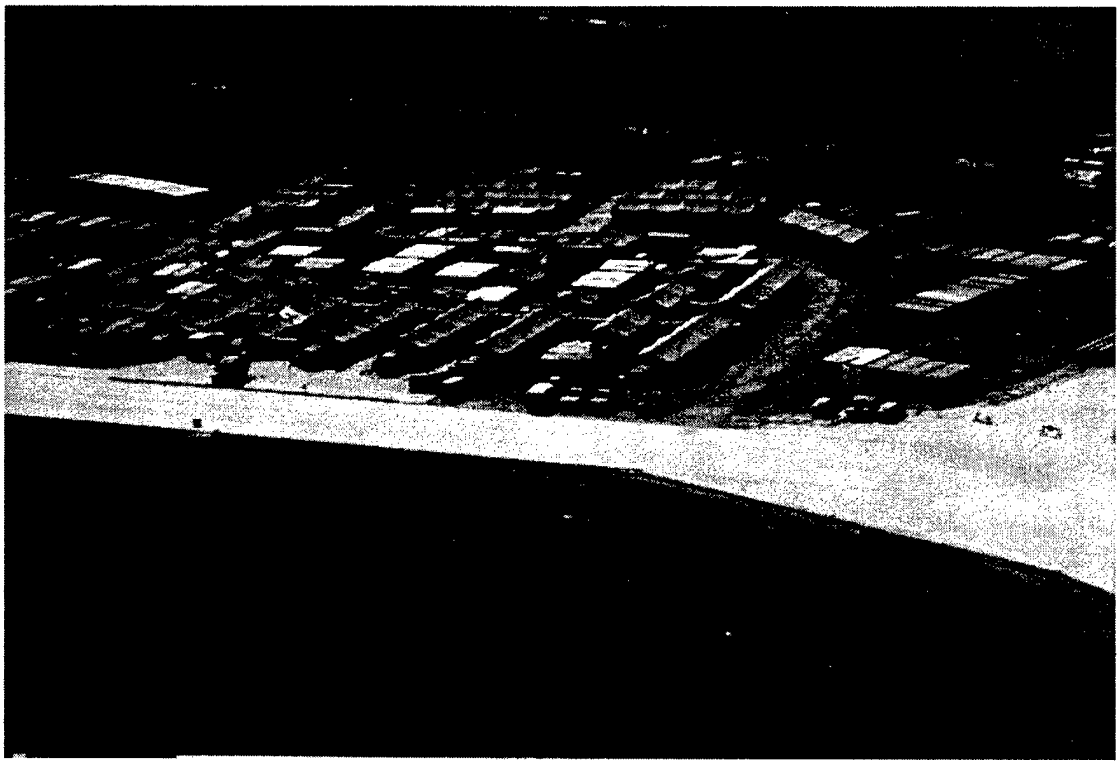


Photo 3.7 Aerial view of CSH

BOSNIA SITE INSTALLATION

In Bosnia, the DEPRAD system has been deployed at the 212th Mobile Army Surgical Hospital, located at Camp Bedrock near Tuzla. A schematic of the MASH configuration is shown in Figure 4.1. A layout of the MASH is shown in Figure 4.2.
The equipment consists of:

1. Fuji ID terminal card writer/ reader, and AC-3
2. Analogic SD-100/DASM
3. Picker CT scanner
4. Lumiscan 75 film digitizer
5. Dejarnette 910KR film digitizer gateway
6. 3M print server with Dejarnette print software
7. 3M 8700 dry film printer
7. Two (2) Siemens Magicview 200 workstations
8. Siemens Magicview 500 workstation with no drive, CD-ROM
9. Diasonics ultrasound and ALI PC

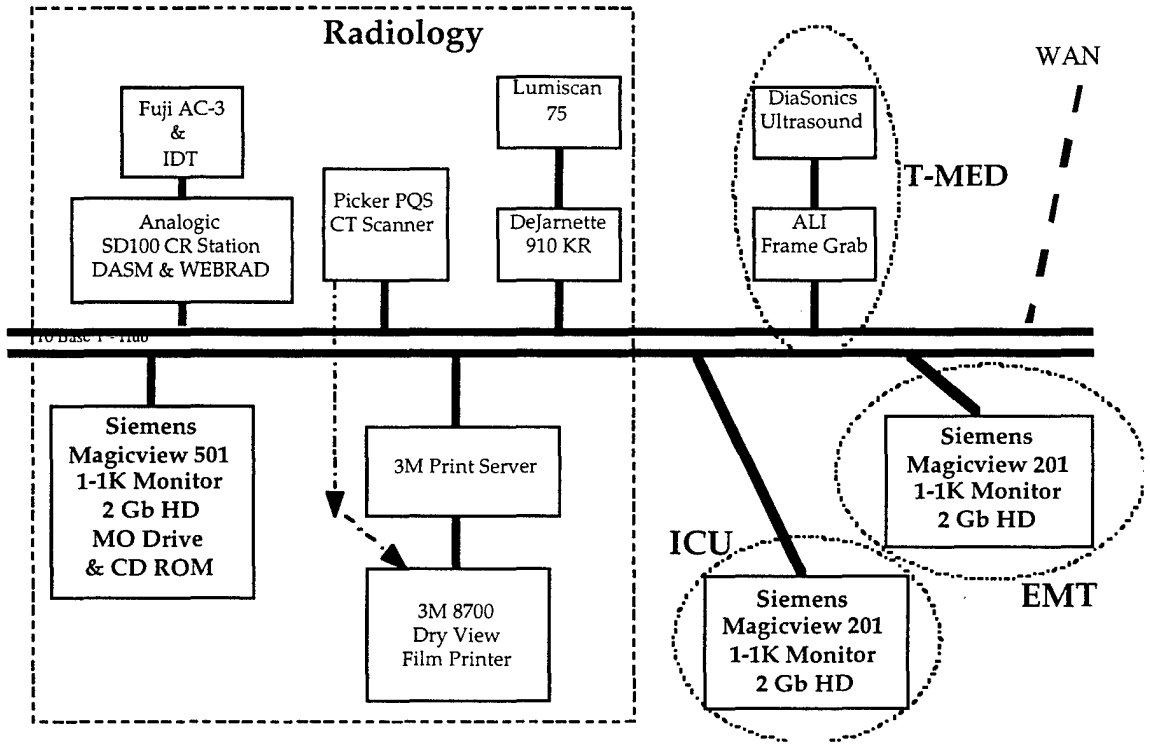


Figure 4.1 MASH network configuration

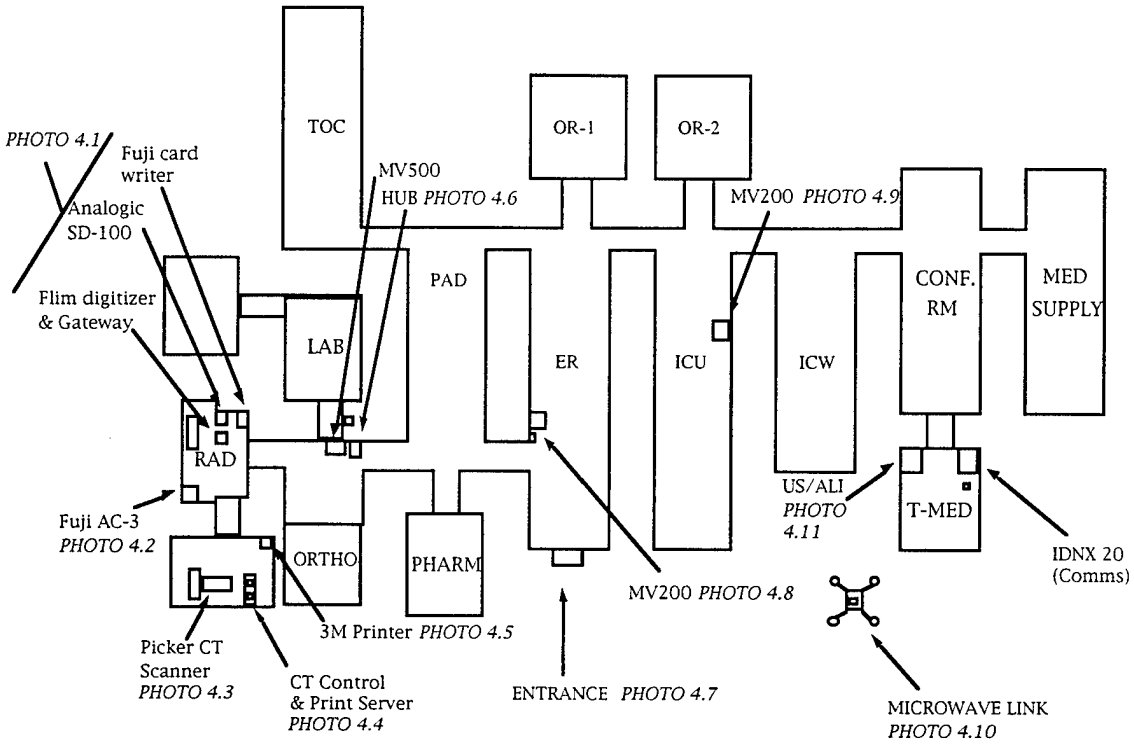


Figure 4.2 MASH layout and equipment placement

Some photographs of the MASH are shown on the following pages. Photo 4.1 shows the Fuji card writer, the Analogic SD 100, the Dejarnette gateway , and the Lumiscan film digitizer. In photo 4.2, the AC-3 is shown. Photo 4.3 is a view of the X-ray area including the Picker computed tomography scanner. In photo 4.4, the Picker control console, 3M print server, and 3M printer can be seen. A close-up view of the 3M dry film printer is shown in figure 4.5. Photo 4.6 shows the Magicview 500 workstation and the communications hub, which connects all the DEPRAD computer equipment. The entrance to the 212th MASH is shown in photo 4.7. The two Magicview 200 workstations are shown in photo 4.8 and 4.9. The microwave communications dish is shown in photo 4.10. Finally, the ultrasonic station and computer interface are shown in Photo 4.11.

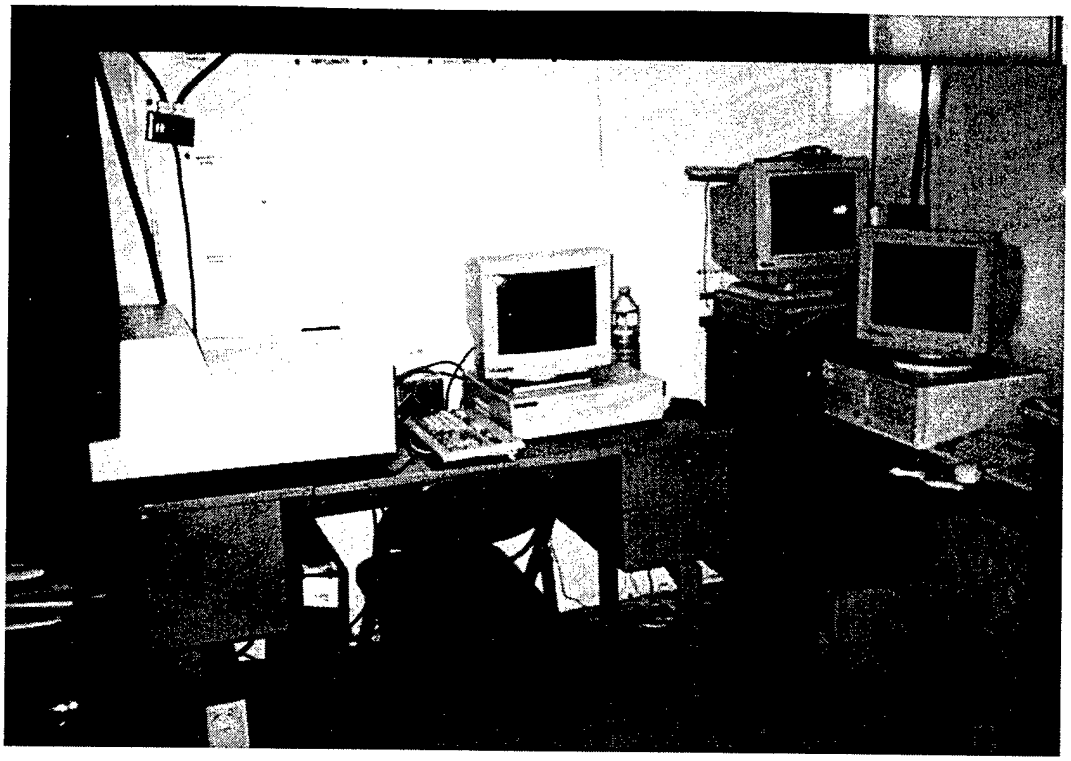


Photo 4.1 Card writer, CR gateway, and the film digitizer with gateway

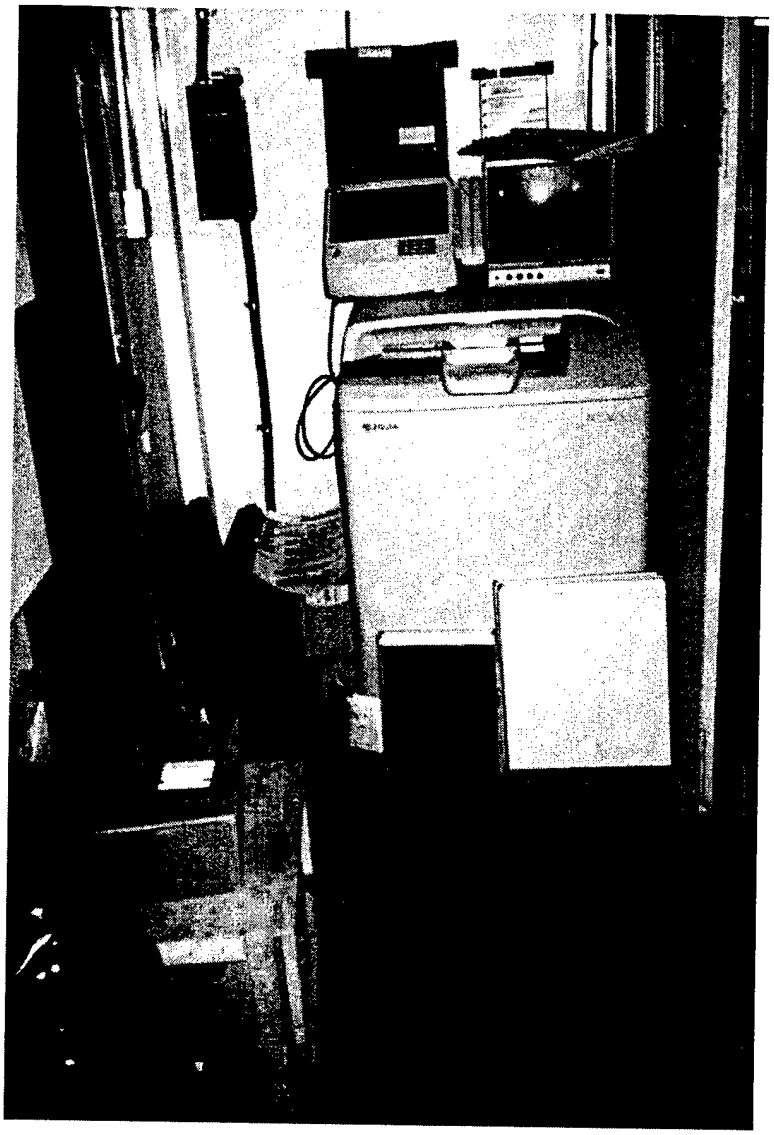


Photo 4.2 Computed radiography equipment

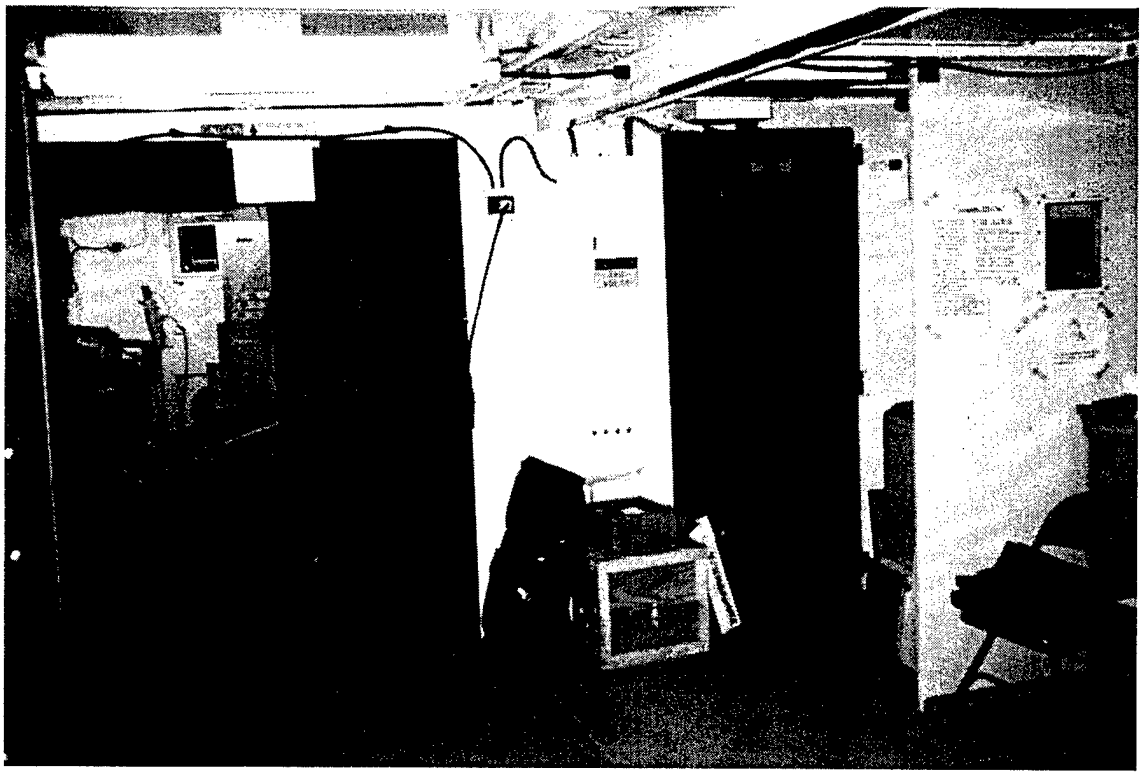


Photo 4.3 X-ray and CT scanner

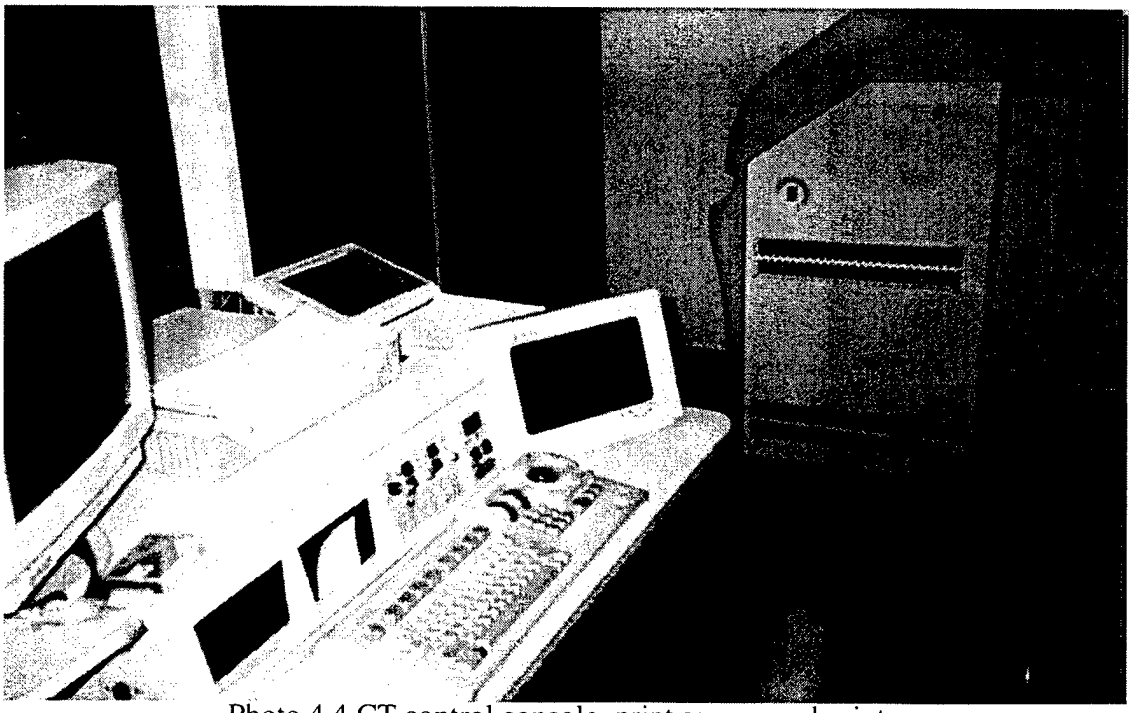


Photo 4.4 CT control console, print server, and printer

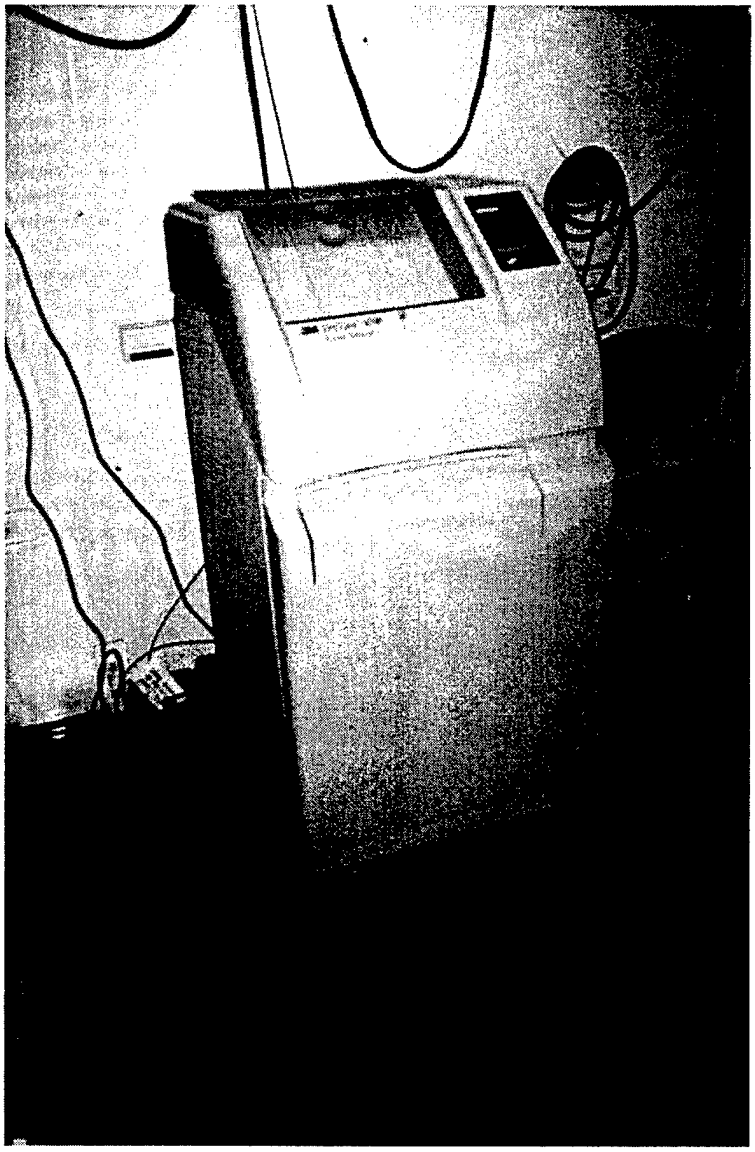


Photo 4.5 Dry film printer

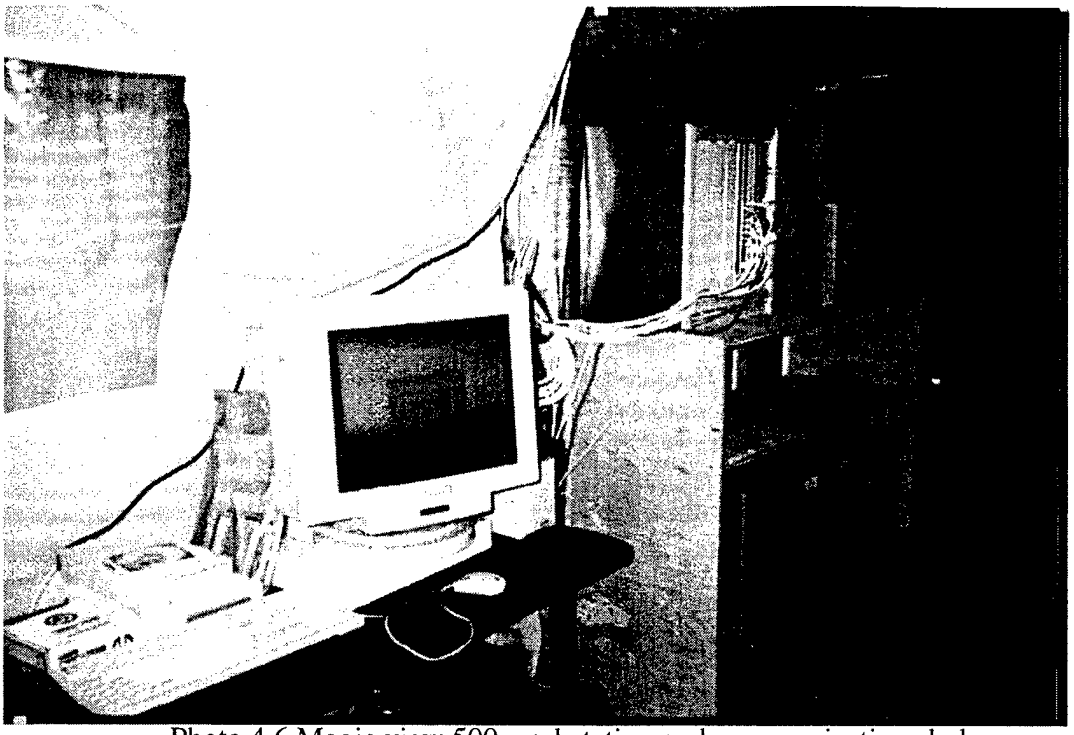


Photo 4.6 Magic view 500 workstation and communications hub

Photo 4.7 Entrance to 212th MASH

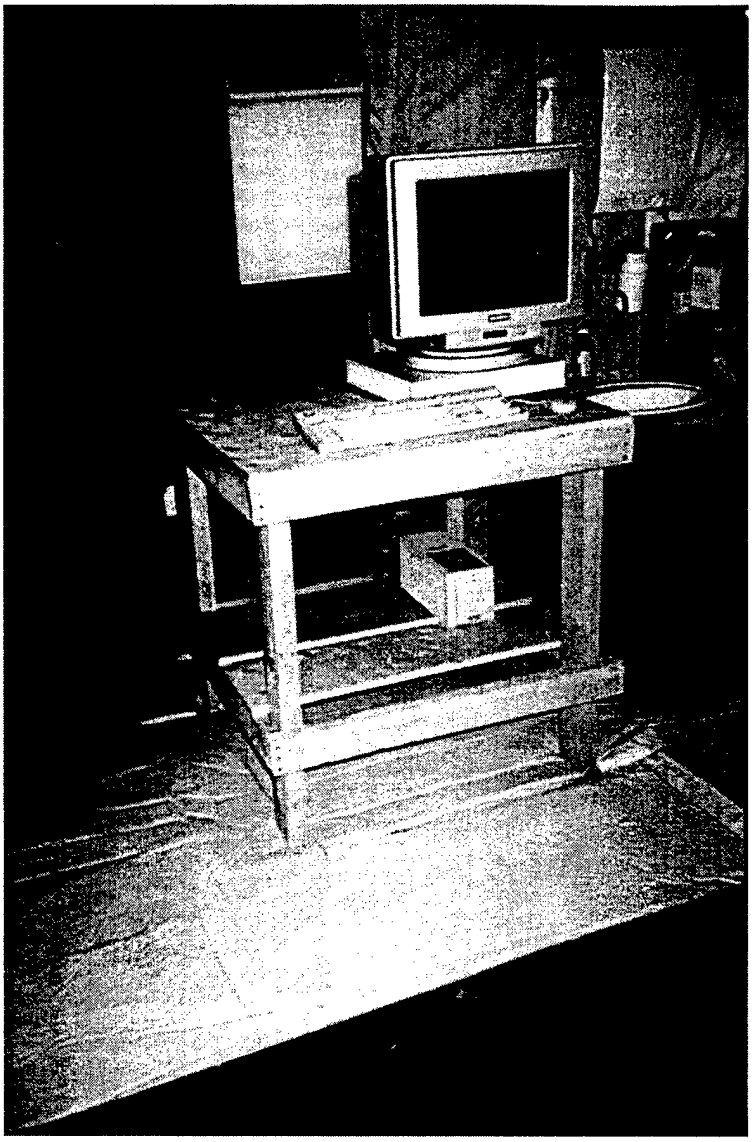


Photo 4.8 Magicview 200 workstation in ER

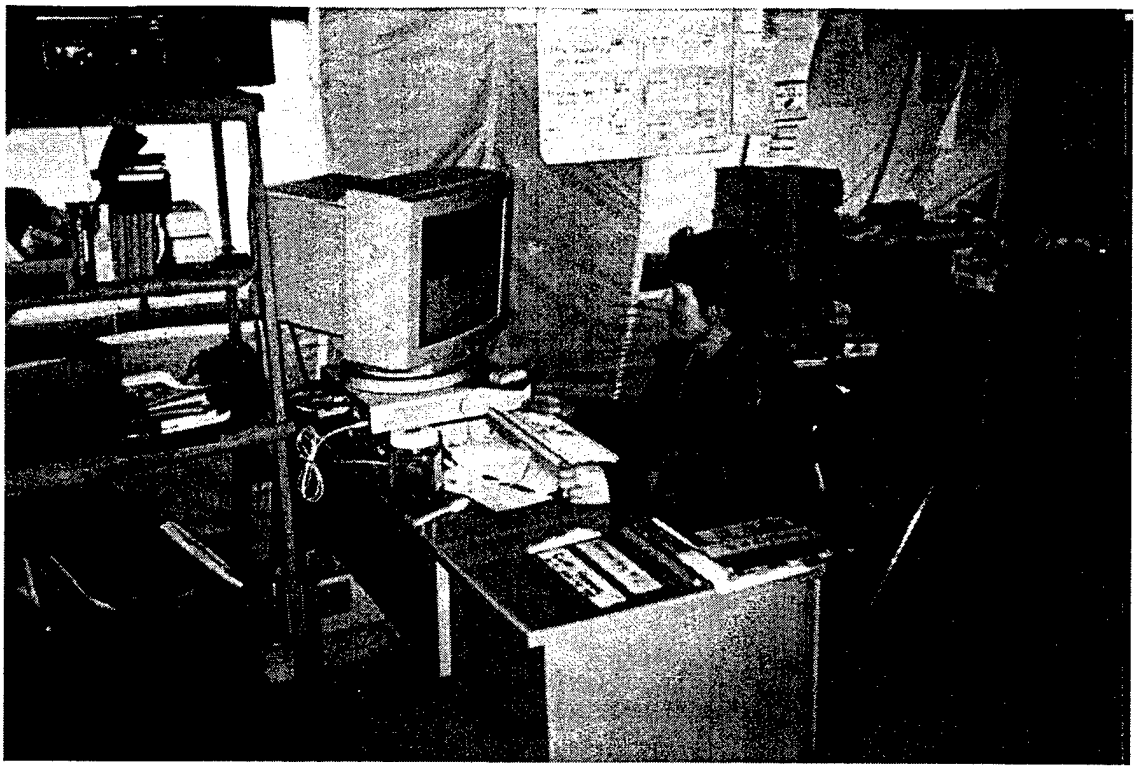


Photo 4.9 Magicview 200 workstation in ICU

Photo 4.10 Microwave link to Tuzla

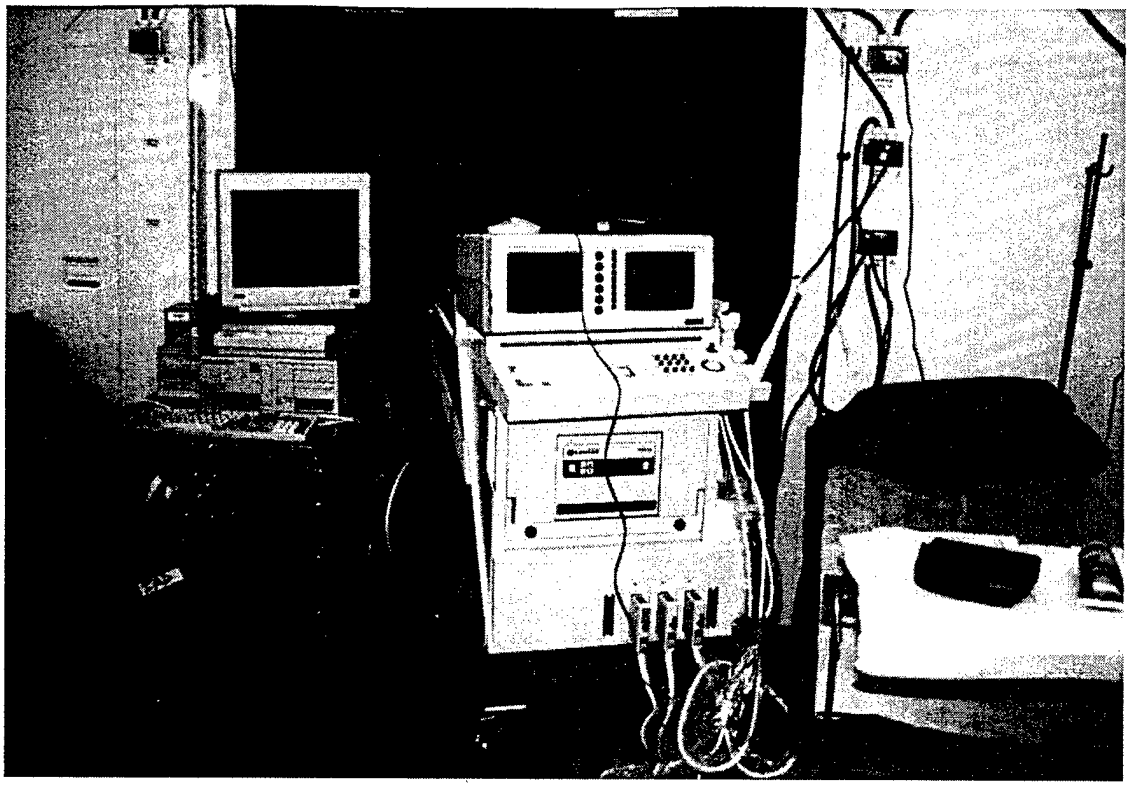


Photo 4.11 Ultrasound machine and computer interface

COMMUNICATIONS NETWORK

An essential component of the Primetime III deployment is the communications network. This network links the sites in Germany, Hungary, and Bosnia through dedicated, high speed communications channels. The network allows voice, video, and data to be passed over the same channel in a manner that is transparent to the end user. For the DEPRAD installation, the key component of the communications network is the data communications capability. This capability will be briefly described below. For a more complete description of the communications network, see Reference 1.

A sketch of the data communications network is shown in Figure 5.1 below. The three sites are linked together using IDNX backbone equipment from Network Equipment Technologies (NET). The IDNX backbone allows the management and multiplexing of voice, video, and data over a single communications channel.
At the remote sites in Hungary and Bosnia, the DEPRAD installation consists of a number of pieces of radiology equipment connected through a local area network (LAN). This LAN connects to the IDNX backbone through a Synoptics hub and a Cisco router. A photo of the IDNX backbone and the Cisco router are shown in photo 5.1. At LRMC, the situation is slightly different in that the hospital already had a LAN installed. At LRMC, the DEPRAD equipment is connected to a Cabletron multiport repeater which is connected to the hospital LAN. Access to the IDNX backbone and to the Internet is provided through Cisco routers.
The IDNX backbone is linked using dedicated communications channels. From LRMC to Hungary, the communications link is provided by a leased line. From LRMC to Bosnia, the communications link is provided by a satellite link to Tuzla and then a microwave hop from Tuzla to Camp Bedrock.

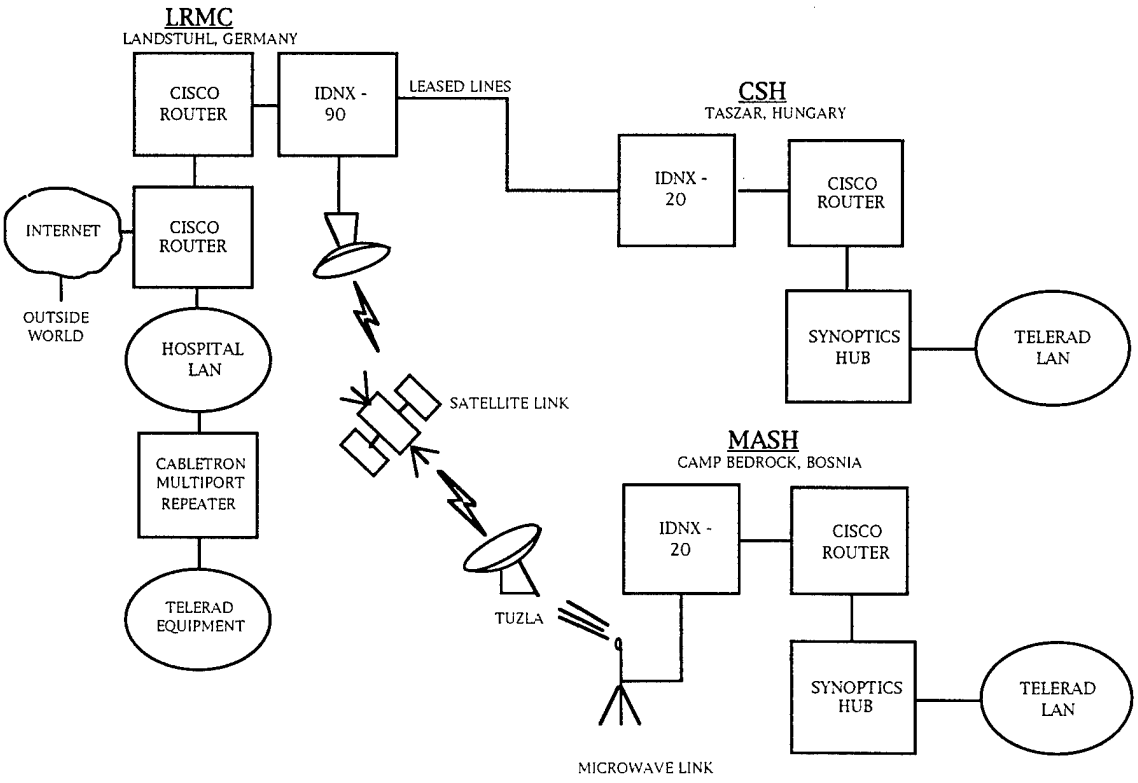


Figure 5.1 Data communications network

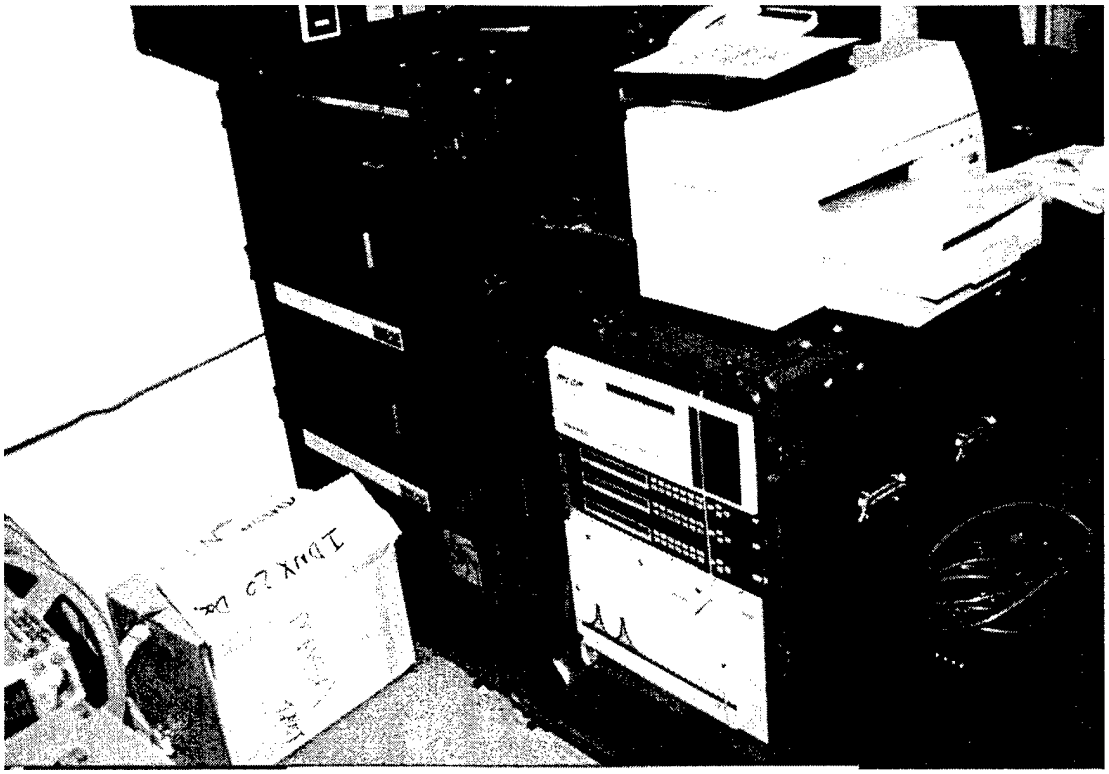


Photo 5.1 INDX backbone and Cisco router

EQUIPMENT INSTALLATION AND MAINTENANCE

Siemens

Magicview 1000

This workstation is based on a SPARC-10 computer. It displays radiological examinations from various independent modalities on a maximum of 2 screens. The images are displayed either on flicker-free standard monitors or on high contrast SIEMOMED monitors. Basic applications of this viewing and reporting workstation are image optimization and selection as well as film Preparation. The minimal space requirements make it ideal for use as a local viewing station where images are distributed over a hospitals network. Should hardcopies be required, image data can be transmitted to a SIENET camera server. The high performance of the SPARC-processors additionally allows for post-processing tasks such as multiplanar reconstruction or 3D calculations depending on their configuration.
The magicview 1000 is configured with one 1K Conrac[1] color monitor and two 2K Megascan monitors. The unit is connected as shown in Figure 6.1.

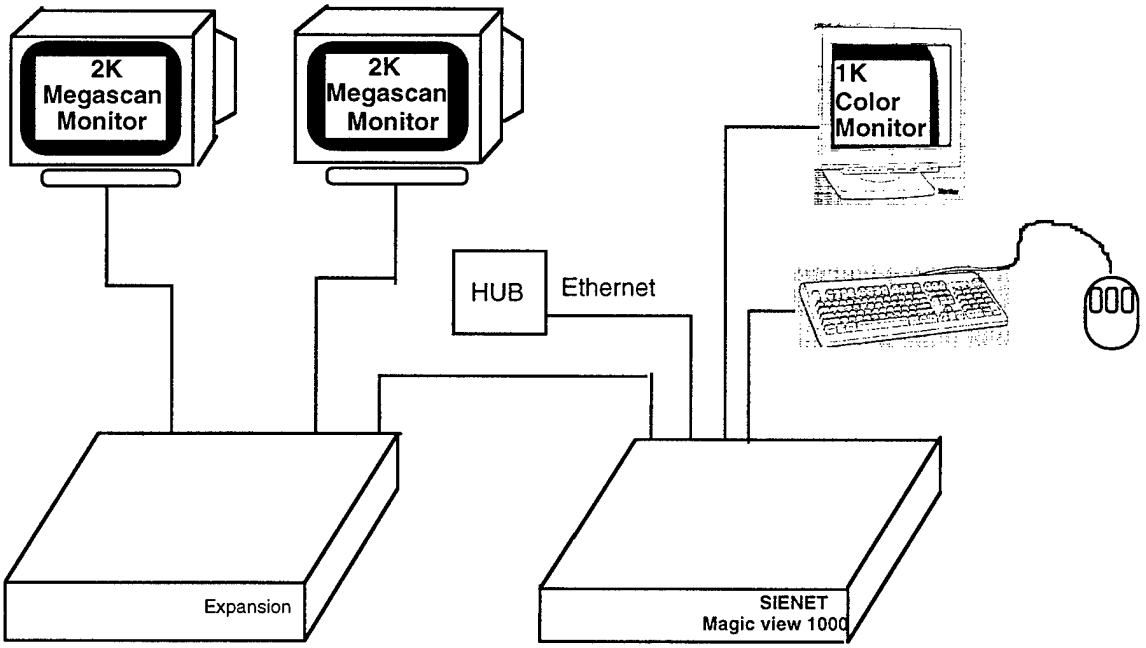


Figure 6.1 Overview of the MagicView 1000 Connections

[1] The Conrac color monitor is described in the MagicView 500/1000 system manual installation page 3-3, Figure 4.

Rear view of the MagicView 1000 is shown in Figure 6.2, and a view of the expansion box is shown in Figure 6.3.

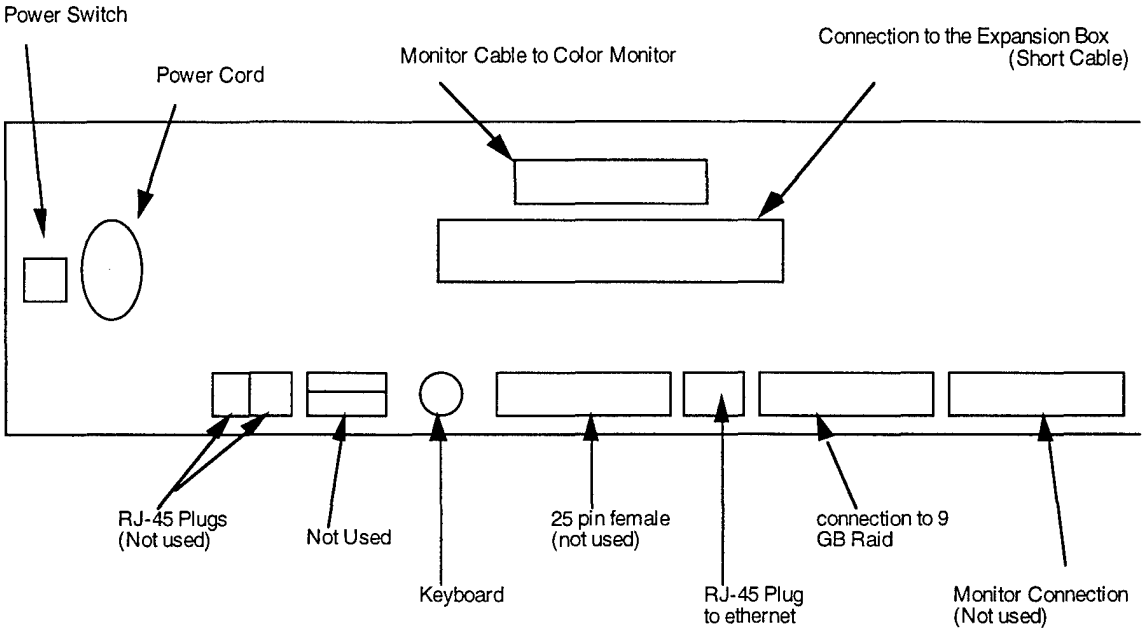


Figure 6.2 Rear View of MagicView 1000

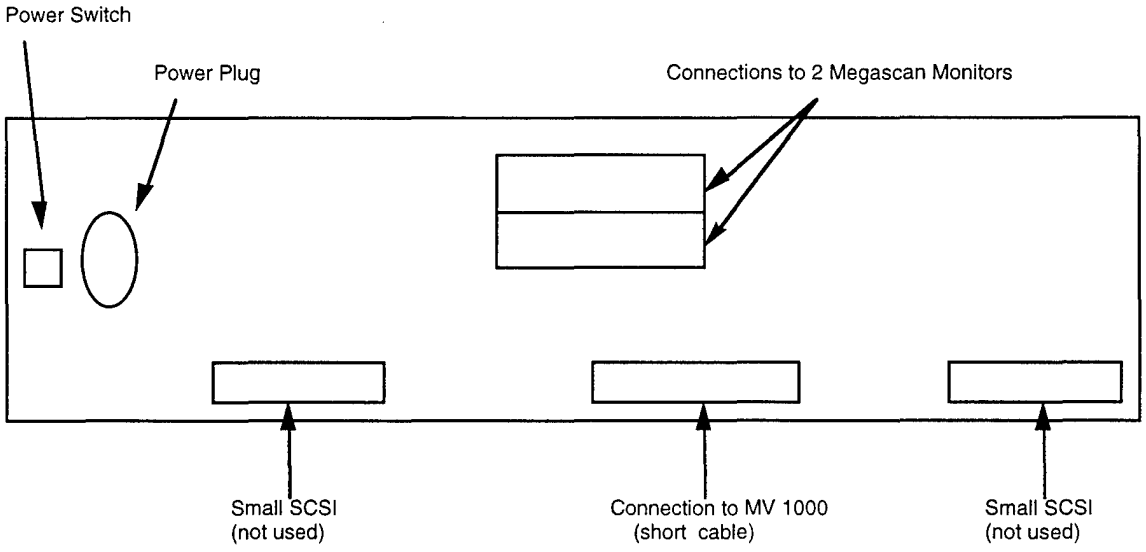


Figure 6.3 View of Expansion Box

Magicview 500

This workstation is based on a SPARC-5 computer. It displays radiological examinations from various independent modalities on a maximum of 2 screens.
The magicview 500 is configured with two Siemomed monitors[2]. The unit is connected as shown in Figure 6.4.

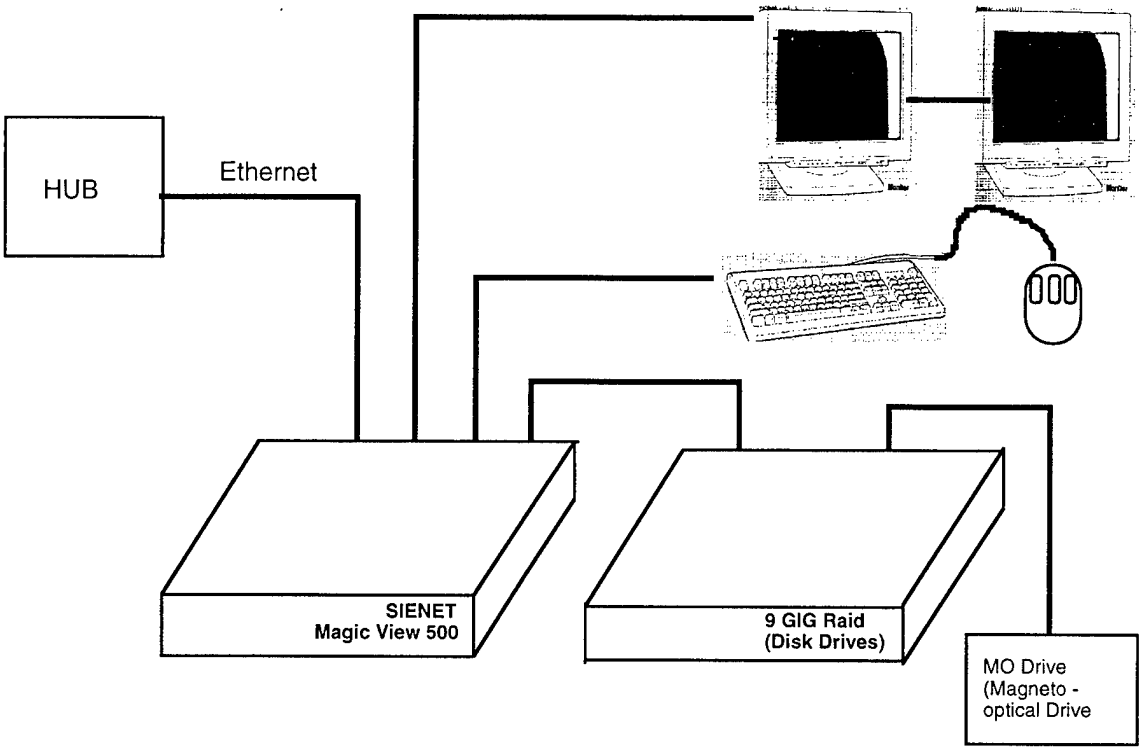


Figure 6.4 Overvie of the Magic View 500 Connections

A rear view of the MagicView 500 is shown in Figure 6.5, and a rear view of the 9 GB Drive is shown in Figure 6.6.

[2]These monitors are shown on Magicview 500/1000 system manual installation page 3-1, Figure 1.

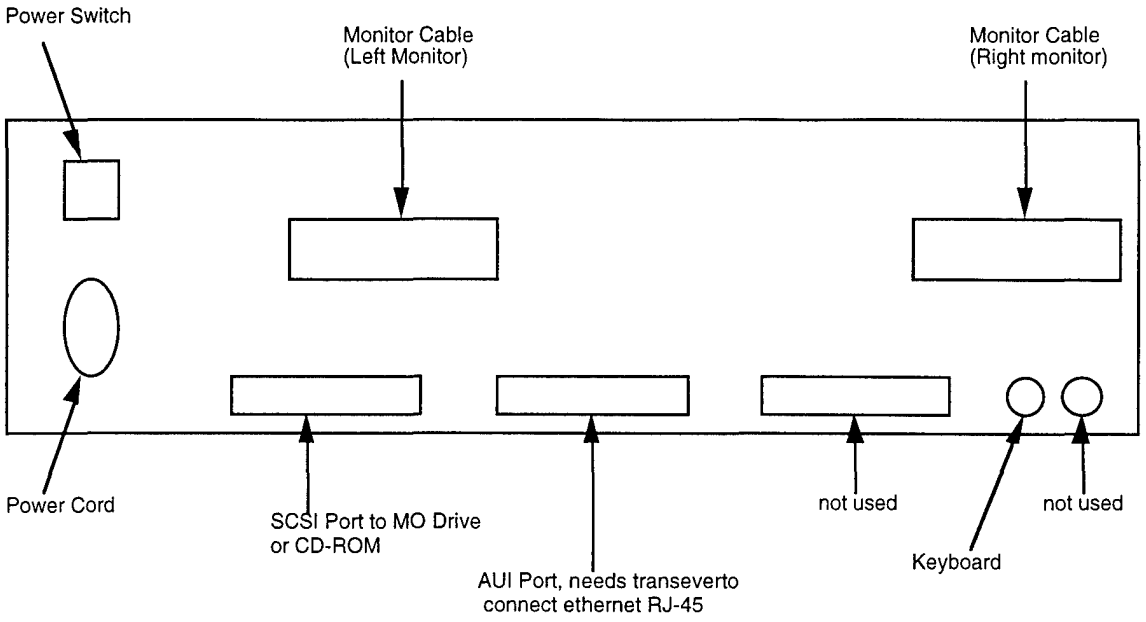


Figure 6.5 Rear View of Magicview 500

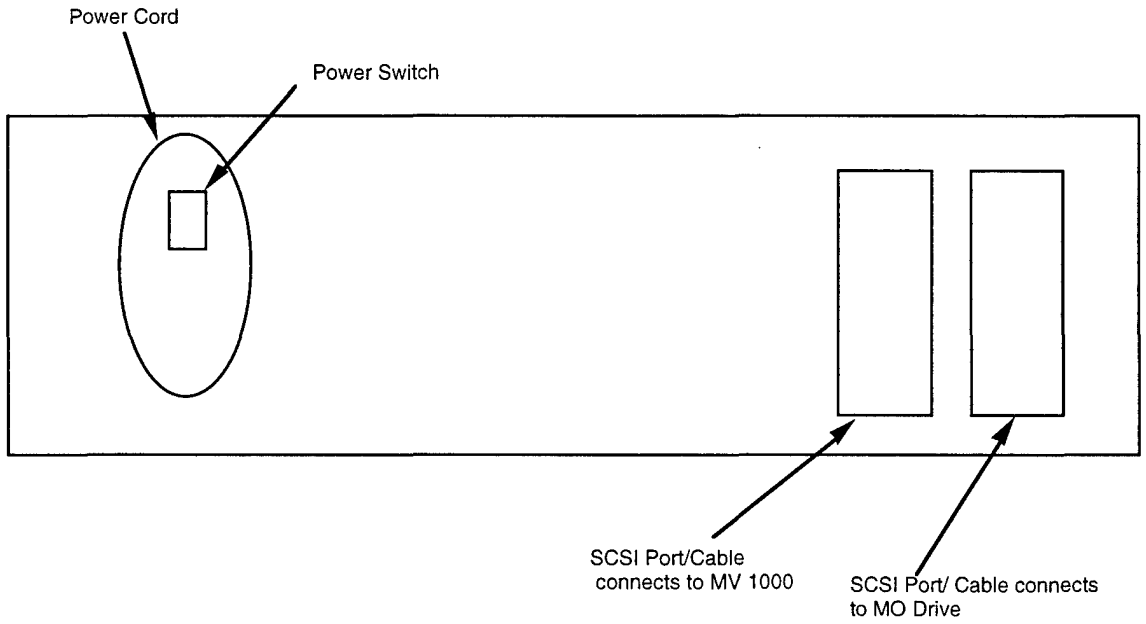


Figure 6.6 View of 9 GB Drive

Magicview 200

The MagicView 200 is used for secondary viewing of images. The graphical user interface allows for simple and intuitive operation. On the other hand , primary reporting and post-processing are not possible. This product is available as also as a software-only.

The images are displayed either on flicker-free standard monitors or on high contrast SIEMOMED monitors.
The magicview 200[3] is only at the sites in Hungary and Bosnia. The system is configured with one 1K color monitor. The unit is connected as shown in Figure 6.7. A rear view of the processor box is shown in Figure 6.8.

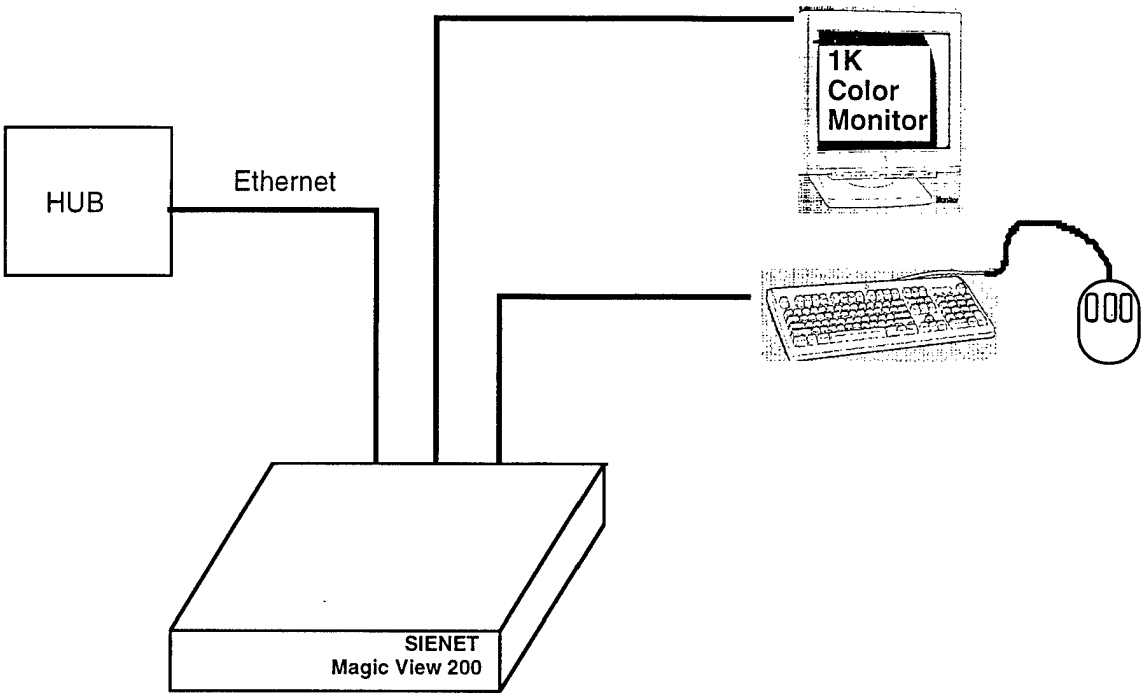


Figure 6.7 Magicview 200

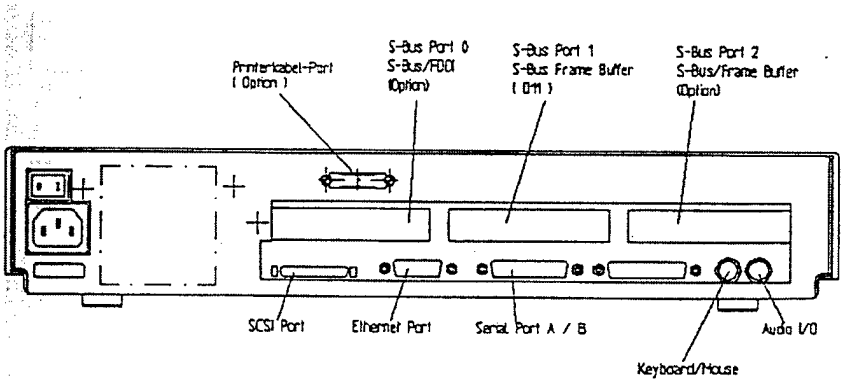


Figure 6.8 Rear View of the Processor Box MagicView 200

[3] The installation of the magicview 200 is described in Magicview 200 system manual installation.

Maintenance
Chris Spilker: 609-547-1011

Polaroid

Helios dry film printer

The Polaroid Helios Model 1417 Laser Imager is a laser printing system that produces high-quality 14 x 17-inch black and white diagnostic film. The imager uses Polaroid Helios Dry Film, which is carbon-based and contains no silver halid. The film is not sensitive to daylight and can be loaded in normal room light, eliminating the need for a darkroom. In addition, the film requires no chemical processing. Polaroid Helios Dry Film is available with a clear or a blue base. This unique carbon-based film responds digitally to laser energy above a certain threshold, enabling it to produce pixels with unprecedented sharpness and clarity.

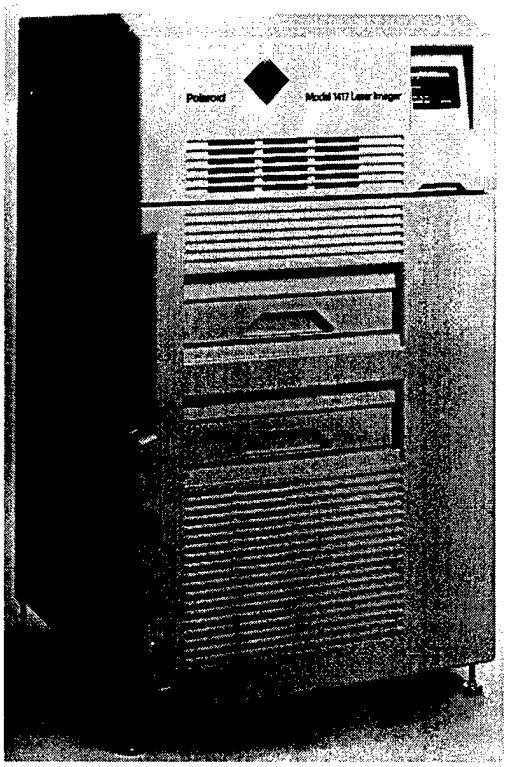


Photo 6.1 Polaroid Helios Dry Film Printer

To install:

1) Plug in power
2) Plug in ethernet

Maintenance

Sales: Richard Borrelli 617-386-4102

References

Helios model 1417 Laser Images Service Manual, Revision 1.2, January 1996, Polaroid Corporation.

Dejarnette Research System

Lasershare print server

The lasershare is shown in Photos 2.2 on the left and 2.3 on the right. The lasershare is a Unix workstation running the operating system. Installation is simple, just plug the keyboard and monitor into the system box. the mouse then plugs into the keyboard.

Imageshare image gateway

This device is shown in Photo 2.2 on the right hand side. This device serves as a general purpose gateway machine. This machine is mostly used by the teleradiology system administrations, so user documentation is not available.

910 KR Film Digitizer gateway

The imageshare 910/KR is a Medical imaging gateway , that receives images from Lumisys film digitizers. The Imageshare 1000 Film Digitizer Acquisition Station allows the user to scan a film, inspect the image and transmit the data. All the functions of the digitizer can be accessed through the computer terminal. The user can scan film in variety of formats and send them to a number of destinations. These units are deployed in Hungary and Bosnia (Left hand side of Photo 4.1).

Lumisys Film Digitizer

The Lumisys[4] Model 75 is a high resolution laser film digitizer. The system has a network adapter that provides 10BaseT/10Base2/AUI connections. The Lumisys Model 75 can only scan one film at the time, but the sheet feeder option allows the digitizer to hold up to 6 films at a time during the digitizing process.

Maintenance

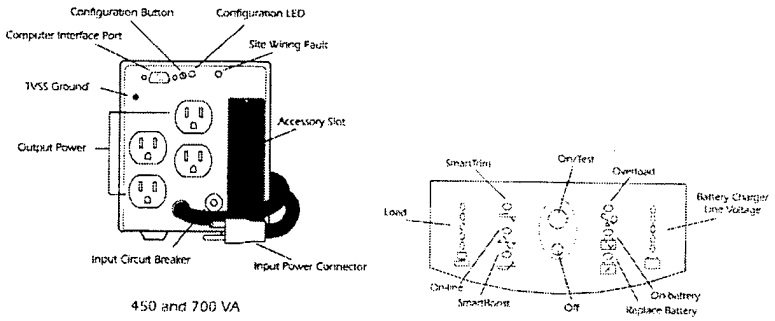
Sales: Dan Caruza: 410-583-0680 x682

American Power Conversion (Uninterruptible Power Source(UPS))

Uninterruptible power source (UPS) provides clean, reliable, AC power to computer system- protecting them from blackouts, brownouts, swells, sags, surges, and interference. Normally, the UPS operates 'on-line,' supplying power from the utility input to the load (work-station, server, or other device). The converter circuitry is used to maintain an optimal float charge level on the battery. When the utility fails, the converter supplies AC power to the load and the disconnect switch opens. The loads operate normally until shut down or until the battery is exhausted. The UPS automatically transfers the load back to utility power when the line voltage returns to normal.

---

[4] The installation of Imageshare 910/KR is described in Dejarnette Imageshare 910/KR system manual Installation section page 5.



The UPS also provides surge protection and EMI/RFI filtering, as well as Smart-Boost and SmartTrim, which correct high and low input voltage without drawing power from the battery. OutPut control uses the UPS's remote interface to turn the load on or off, without disabling other UPS functions.

Analogic

SD-100

The Analogic[5] SD-100 is deployed at the CSH (right hand side of Photo 3.2) and the MASH (middle computer in Photo 4.1). The SD-100 receives the digitized images from the Fuji AC-3 and sends them to siemens workstation.

Maintenance

Equipment: SD-100, W[6]ebrad
Sales: Richard Smillie: 703-793-0675
-maintenance agreements are typically signed with OEMs only
-can support from Peabody
POCs: Paul Keezer, ED Steen: call 508-977-3000

Fuji

CR reader

Maintenance

Equipment: AC-3, ID terminal, card writer
sales: Susan Lewis 203-353-0300

Picker

CT scanner

Maintenance

Equipment: CT Scanner
sales: Don Mitchell 216-473-2825

---

[5] The installation procedure is described in chapter 1-SD100 of Analogic Corporation Computer Design and Applications Division, SD series Installation and Operation Manual.

ALI

Ultrasound

Maintenance

During ALI office hours, calling the 604-279-5422 number and pressing 0 will get a representative who will transfer the callers to the service department. For emergency calls outside of these hours, calling the above number and pressing 324 will take the person to the service department voicemail, which will automatically page the on-call service representative once a new message is left. If a working phone number is left so that the service representative can call them back, then whoever is paged can contact whichever user is experiencing the problem with the system.

Appendix B
Phase I:

System Administrator's Manual

DEPRAD

System Administrator's Guide

Betty A. Levine, MS

Kevin R. Cleary, PhD

Bradford L. Arkin, SA

IMAGING SCIENCES AND INFORMATION SYSTEMS
DEPARTMENT OF RADIOLOGY
GEORGETOWN UNIVERSITY MEDICAL CENTER

August 1, 1996

Draft Version 0.3b

DEPRAD

System Administrator's Guide

The authors would like to thank the following individuals for their help and support in writing this manual:
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1. Introduction

The purpose of this document is to provide information required to maintain and troubleshoot the DEPRAD network installed as part of the Primetime III project deployed to Bosnia, Hungary and Germany. This document will focus mainly on troubleshooting the interface boxes and the general network operations. Individual vendors modalities will not be detailed, due to the availability of technical reference manuals by most vendors and the availability of vendor technical support. All information to make maintainability of this network more manageable will be included.

This document covers the following equipment:

- Fuji computed radiography and related systems
- Siemens Magicview workstations and peripherals
- Lumiscan film digitizer and peripherals
- Polaroid Helios printer
- 3M print server and printer

In addition, the DEPRAD System Description Document is a separate document which provides an overview of the project and a description of each site.

Please note that while every attemp has been made to provide accurate information, some errors may still exist.

2. Fuji Computed Radiography & Related Systems

The Fuji AC-3 Computed Radiography machine is designed to digitally acquire radiology images using phosphor plates instead of film. The device consists of a magnetic card writer/reader, an ID Terminal (IDT), the phosphor plate reader, and an Analogic SD-100 workstation

2.1 Operation

FUJI MAGNETIC CARD WRITER/READER:

This equipment's function is to deposit patient demographic information onto a magnetic card that is then transferred via a reading mechanism on the IDT. The IDT then attaches the demographic information to the radiographic image.

FUJI ID TERMINAL (IDT):

The function of this unit is to power up the computed radiography reader (AC-3), attach patient demographic information, and attach the image processing algorithm via choosing an anatomical region (AR) and the menu item. This unit also functions as the service utility device where errors are logged and changes to the standard algorithms can be made by the user.

FUJI AC-3 COMPUTED RADIOGRAPHY READER:

The function of this equipment is to house the software and hardware necessary to extract analog information stored on a photostimulable storage phosphor plate and convert that information into a digital form. Mechanically the unit accepts a cassette containing an imaging plate, removes the plate, reads the information from the plate using laser optics, erases the plate, and deposits it back into the cassette ready for the next exposure. A photograph of the reader is shown in Photo 2.1.

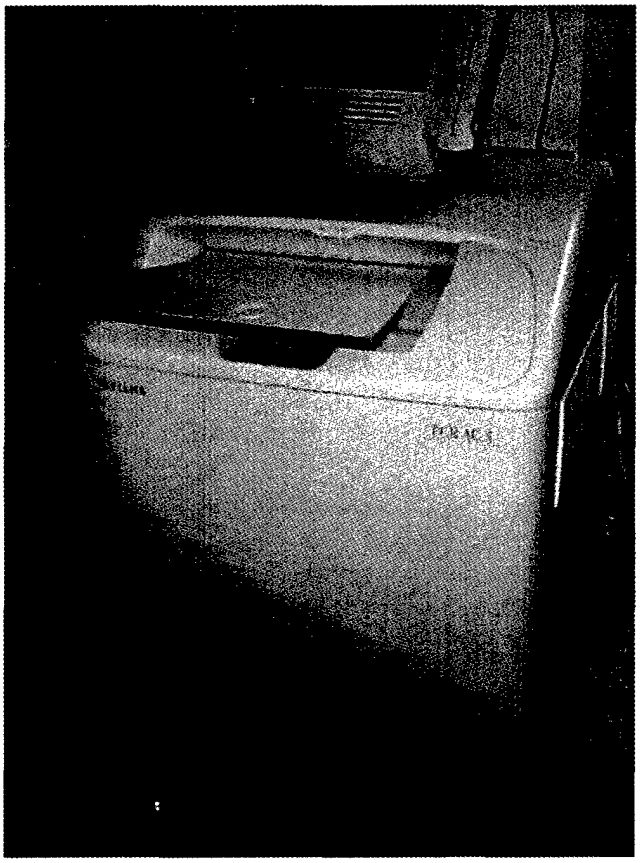


Photo 2.1 AC-3 Computed Radiography Reader

ANALOGIC SD-100 WORKSTATION

The function of this workstation is to receive the Fuji CR images and convert them to a DICOM image message and transmit them to a local workstation. The SD-100 is connected to the plate reader via a Fuji DMS interface (proprietary) and is connected to the local network via ethernet. The SD-100 workstation is a Sparcstation 4 running the Solaris operating system and software provided by Analogic.

2.2 Login Information

At both locations, the SD-100 is available over the internet using the following login.

```
login>  spooler
```

Note: The password for this as well as all the other accounts is given in Appendix B.

Once logged in, spooler has privileges to check on the operations of the system, perform routine maintenance, and troubleshoot problems that might arise. As needed, switch to super user to change information in config files and shutdown or restart the system as necessary. To temporarily switch to super user issue the following command at a command prompt:

`su` (to switch to super user (aka root))

Note: The password for this as well as all the other accounts is given in Appendix B.

Once done with commands that require super user privileges, type `exit` to return to the spooler login. To log out of the SD-100, type `exit`.

If local to the machine, the system will already be logged in and all that is needed is access to a command prompt. There are 2 ways that this can be done. First, go to the monitor window and hit the return key to exit the rs_monitor program and get a UNIX command prompt. When finished using the command prompt, restart the monitor software by typing `rs_monitor`. The other method for gaining access to a command prompt is to open a new command tool.

2.3 Maintenance & Troubleshooting

FUJI AC-3

1. When an error occurs, the AC-3 will alarm.
2. Turn off the alarm by pressing the button next to the ALARM OFF icon.
3. The AC-3 will automatically display messages that describe how to correct the error which is displayed in a highlighted box on the IDT.
4. Read the highlighted area and follow the instructions.
5. Record the message and/or any error code, the cassette size that was inserted prior to the alarm, and the exam menu that was chosen in the maintenance log book.
6. Do not try to perform functions with the equipment until the error is clear. By trying another operation, the computer in the AC-3 is not allowed time to correct the existing error and the system may crash.
7. If an error code is present, refer to the service manual under ERROR CODES to find a description of the problem. This will help determine the next course of action.
    - A. Call Medical Maintenance
    - B. Call Fuji Service in Germany: They may be able to explain how to correct the problem.
    - C. Final option: Call Georgetown
8. Be sure to take accurate notes on the procedure used up to calling Medical Maintenance, so they will have a clear understanding of the problem to that point. Accurate notes in the log book will result in faster and more efficient service.

Examples of common errors:

1. Plate Jam: Turn off alarm

   Remove cassette if possible---DO NOT USE FORCE

   Check if disk is full on SD-100--Do NOT reboot the system unless directed to by Fuji or GU.

Note: The plate may become stuck if the software on the Analogic SD-100 workstation that receives the images is not running or if the disk is full. See below for how to check and correct this.

2. Demographic information has not been entered: Press the OK icon or

   Press SETTING icon

3. Erasure lamp burned out: Call Med. Maintenance

These are three of the most common errors; however, the equipment is quite robust and 90% of the time rebooting the system will clear the error as the system goes through all of the mechanical checks.

ANALOGIC SD-100

The most common problem with the SD-100 will be that images are not transferring from the SD-100 to the Siemens workstation. First verify that images are being transferred from the AC-3 to the SD-100. To do this access a UNIX command prompt. If at the workstation, open the monitor window or bring it to the front of the display. If logged in remotely, type `rs_monitor` to start the monitor software. The screen will look like this:

```
                                    MASH


                                RESOURCE GATEWAY V1.62


Started:  Mon May 13 12:26:16 1996      Current:  Mon May 20 12:07:57
1996


-------------------------------------------------------------------------
ID SCSI Name       Type Protocol   Route           Jobs     State
Event
-------------------------------------------------------------------------
 0      WEBRAD       P  952        -               192              0
 1      DICOM        P  952        -               192              0
 2      FFPGTR       G  952        [1]             0                0
 3      DLR2952      F  DLR/952    -               192              0
 4  0-3 FUJI-CR      G  DLR        [0][1]          192              0


Press Return to exit...
```

Ensure that the FUJI-CR has a state that is either blank or a slashed line switching between / and \. This means that the Fuji CR is operating. If the state is Oos (Out of service) then ensure that the reader is turned on and connected.

If the CR is operating and images are not reaching the SD-100 the CR plate reader will probably have a plate jam. Verify that the filesystem has not filled up on the SD-100. To do this, go to a command prompt. Type `df -k`. If /images or /disk2 is near or at 100% capacity then there is a problem.

If /disk2 is near 100% capacity there is a problem and GU or Analogic should be contacted immediately. The **disk2** partition should be at about 5 - 7 percent full. If it is higher, that probably means that there is a problem with one of the three processes that uses the *.spif files in the disk2 partition. If this is the case, then we suggest trying to contact somebody at Analogic to look at the problem. If no one from Analogic is available, try deleting the .spif files that might be causing the problem.

If /images is near or at 100% check whether the images are transferring to the MagicView 500 by doing the following.

`cd /images/spooler/net_dicom` (to get to the correct directory)

`ls -l` (lists the contents of the directory)

If neg10.dat is the only file in the directory then images are being transferred. See the information below on how to create more room in the filesystem. If the filesystem looks fine once finished, and the plate still can't be unjammed, then the machine should be rebooted. However, be cautious, becausethe image on the plate may be lost.

If the AC-3 is transferring images to the SD-100 but they are not reaching the Siemens workstation, then check on the status of the SD-100 system and its network connections.

First check that the network connection is operational and that the receiving workstation is up. Start by typing:

`ifconfig -a` (to check the status of the SD-100 ethernet interface)

this should respond with the following:

at the CSH:

```
le0:  flags=863<UP, BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu 1500
            inet ip_address netmask ffffff00 broadcast broadcast_address
```

and this at the MASH:

```
le0:  flags=863<UP, BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu 1500
            inet ip_address netmask ffffff00 broadcast broadcast_address
```

Now type:
at the CSH:
`ping cm501` (to ensure the receiving workstation is up - should respond with `cm501 is alive`)

at the MASH:
`ping mm501` (to ensure the receiving workstation is up - should respond with `mm501 is alive`)

If the network connections seem fine, next check that the image files are transferring to the workstation by typing:

`cd /images/spooler/net_dicom` (to change to the DICOM image transfer directory)

`ls` (to list all DICOM files waiting to be transferred)

The response should be: `neg10.dat`. If this is the only file in the /images/spooler/net_dicom directory then image transfer between the SD-100 and the workstation should be fine. If there are a lot of files beginning with FFP_C and FFP_I in this directory then transfer between the SD-100 and receiving workstation is not operational. If this is true, trouble shoot the problem as follows:

Ensure that the file system on the SD-100 that temporarily stores CR images is not full:

`df -k` (to view the percentage full of the /image file system)

If /image is near 100% capacity then the file system is full and needs attention. If the net_dicom directory is fairly empty, then the most likely cause for the file system filling up is that the WebRad software has been activated and it has filled the file system. To check this, do the following:

`cd /disk2/spooler/conf` (to change to the configuration files directory)

`cat ffpcopies.web` (to type out the contents of this file)

The value 0 will print if the WebRad software is turned off, 1 if it is turned on. The WebRad should be turned off. To toggle WebRad software on and off, type the following:

`set_copies_web 0` (to turn on WebRad)

`set_copies_web 1` (to turn off WebRad)

Once it is determined whether WebRad is on or off, some directories on the SD-100 may need to be cleared out so that the file system is no longer full. Check the following directory to see if there are a lot of files in the directory.

`cd /images/spooler/net1` (to change to the WebRad temporary image directory)

`du` (to display how many 512 byte blocks are in the directory)

If the number of 512 byte blocks in the directory is greater than 1 000 000, do the following:

`find /images/spooler/net1 -mtime +3 -exec rm {} \;`

(to remove all files in the current directory that are older than three days old -- To erase all the files that are older than X days, use X in place of 3.)

`du` (to display how many 512 blocks are now in the directory)

If the number of 512 byte blocks in the directory is still close to 1 000 000, then repeat the `find` command using a number smaller than three.

Next, check that the permanent WebRad directory isn't full.

`cd /images/rep1` (to change to the permanent WebRad directory)

`du` (to display how many 512 byte blocks are in the directory)

If the number of 512 byte blocks in the directory is greater than 1 000 000, do the following:

`find /images/rep1 -mtime +3 -exec rm {} \;`

(to remove all files in the current directory that are older than three days old - To erase all the files that are older than X days, use X in place of 3.)

`du` (to display how many 512 blocks are now in the directory)

If the number of 512 byte blocks in the directory is still close to 1 000 000, then repeat the `find` command using a number smaller than three.

Images should start moving automatically across to the workstation. If things are still not working, please contact the appropriate individuals.

2.4 Dicom Software

If it becomes necessary to change the receiving workstation for the CR images, a change must be made to the DICOM sending process on the SD-100. The script file `/usr/bin/start_dicom` starts the DICOM software. The resource gateway software must be stopped before making any changes to the script file. This can be done by logging in as root and issuing the following command, `rs_stop`.

The start_dicom script looks like the following:

```
# Starting the DICOM Server software.
#
echo "starting the DICOM Server program. . . . . ."
(cd /opt/DRS-DICOMFFP/bin;./dicomffp -vA -s SD-100_AET -d
/disk2/spooler/net_dicom hostname dicom_port_number dicom_AET)
exit
#Done
```

The items in italics are different for each location. A description of and the current values for each parameters are:

SD100_AET - The application entity title for the calling machine. (CSH: dicomffp; MASH: dicomffpmash)

hostname - The hostname of the receiving workstation. This can be an alias as defined in the /etc/hosts file (CSH:cm501; MASH:mm501) or the IP address of the receiving workstation.

dicom_port_number - The DICOM port number of the receiving workstation. (CSH & MASH: 50082)

dicom_AET - The DICOM application entity title for the receiving workstation. (CSH: 036S02DC15DIC1 MASH: 036S02DC23DIC1)

If the receiving workstation changes, then these values may change and the hostname, dicom port number, and dicom AET for the new receiving system must be entered into the start_dicom script. Once the changes have been made, type `rs_start` to restart the resource gateway application.

2.5 CR Flowchart Description

The process for acquiring a computed radiography image and transferring it to the Siemens MagicView 500 begins with information about the patient being written to a magnetic card, and that card being read by the magnetic card reader. The cassette is then inserted into the CR.

Once the cassette has been inserted into the CR, the plate is removed, scanned and erased by the CR, and then put back into the cassette. This cassette can be reused once it has been ejected by the CR.

When the plate is read, the image is passed to the Analogic SD-100 via the DASM. The SD-100 goes through three processes before handing the images over to the DICOM software to send to the Siemens MagicView 500. They are called the **getter**, **filter**, and **putter**. When the image is first being scanned, the **getter** takes the data and puts it into ***.spif** files that are located in **/disk2/spool/spooler**. Once the plate has been read, the **getter** hands the ***.spif** files over to the filter.

The **filter** process can be run several times, but it is normally just run once. The filter process performs image processing algorithms on the *.spif files in the /disk2/spool/spooler directory. Once the files have been filtered, they are passed to the **putter** process. This process makes sure that the image is moved from its ***.spif** files to one **FFP_C.XXX** file that contains information about the files that make up the image, and three **FFP_I.XXX** files. The XXX is a three digit hex number, with the lowest number belonging to the FFP_C file. The first FFP_I file is a small file that contains information such as anatomical region. The next FFP_I file is a very large file and contains the image itself. The last FFP_I file contains the patient name and the study date.

Once the **putter** transforms the files to FFP format, it puts the files in the **/images/spooler/net_dicom** directory, and a second putter process puts copies of the original files in the **/images/spooler/net1** directory. This directory is cleaned out regularly by GUMC, but an image can be retrieved if it is three days old or newer. The "original" copy of the image is placed in the directory **/images/spooler/net_dicom.**

To follow the image once it has reached the MV 500, see the chapter concerning the MagicView Workstation.

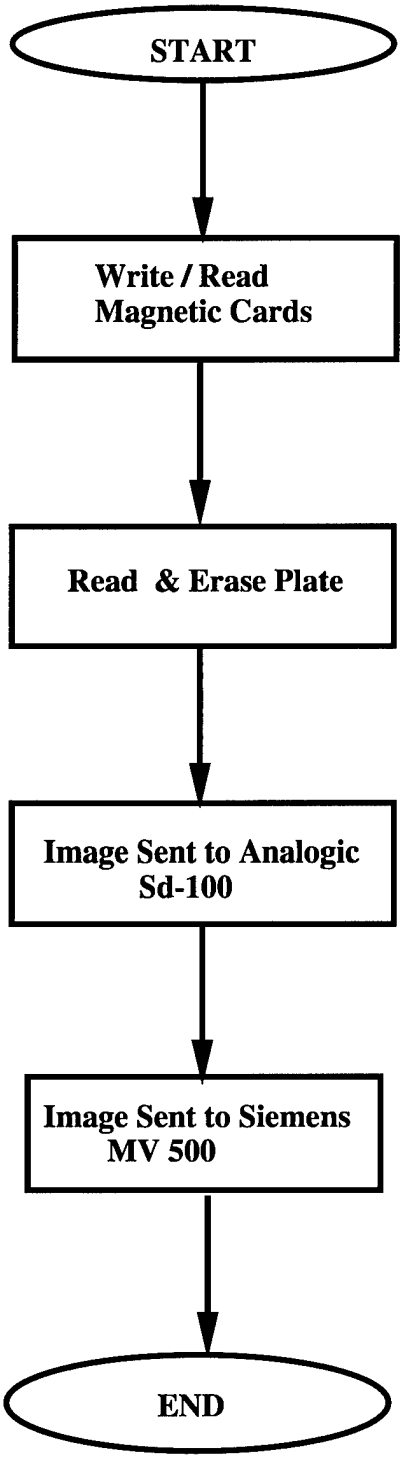


FIGURE 2.1 FLOW CHART FOR COMPUTED RADIOGRAPHY

2.6 Resending Images to the Siemens MV 500

It may be necessary to resend images from the Anologic SD-100 to the MagicView. Please read the CR Flowchart Description in the previous section to learn where the images should be.

If the image is in the **/images/spooler/net1** directory, then it should be possible to get the image resent to the Siemens MagicView 500. The last of the four files that make up an image contains the patient name. To decide which FFP_I files are most likey to be the files containing the image to be resent, do the following.

`ls -l` this print the files and their time stamps to the screen

`date` this prints the current time and date according to the computer

The first command prints to the screen all the file names and when they were created. The second command is important becuase the SD-100 might not be running on local time. By comparing the files that were created close to the time that the image was taken, then the number of likely canidates can be narrowed. To find the image do the following for the last of the set of four files that might comprise the correct image:

`cat FFP_I.XXX` this prints the file to the screen

If this is not the correct patient name, then select another likely group of files and try it again.

Once the set of four files that need to be imported to the MagicView have been located, first make copies of the files because they will be deleted once the image is successfully sent. To copy all four of the files to the net_dicom directory, do the following:

`cp FFP_I.XXX ../net_dicom` this puts a copy of the file in the net_dicom directory

This should be done for all three of the FFP_I files that contain the image. The next step is to copy the FFP_C file. When a FFP_C file is in the net_dicom directory it is automatically sent to the Siemens MV 500.

`cp FFP_C.XXX ../net_dicom` this puts a copy of the file in the net_dicom directory

The three FFP_I files will be removed from the net1 directory, and the FFP_C file will be deleted from the net_dicom directory. To replace all the files that were deleted, do the following.

`mv FFP_I.* ../net1` this moves all FFP_I files to net1

This will take the three FFP_I files and put them in the net1 directory, and since the FFP_C file that was deleted was a copy, it does not need to be replace. The image transfer can be tracked by using the status logs on the MV 500.

2.7 Starting the System

See section 2 of the SD-100 Installation & Operation Manual for more details. Turn on all external devices (monitor and external hard drive) first. Next turn on the Sparcstation - the power switch is located at the back right of the workstation. Hold the switch on until the system beeps, then release the switch and it will begin booting up.

After a few minutes, some windows will appear on the monitor. They include the DICOM, CernServer, Console, and Monitor windows. If the computer is running WebRad, a WebRadDaemons window will also appear.

Once the Monitor window appears, the system will be fully booted and operational. To access to a Unix prompt, enter the return key in the monitor window and get a Unix prompt. When completed with the Unix commands type `rs_monitor` to restart the rs_monitor program.

2.8 Shutting Down the System

See section 2.4 of the SD-100 Installation & Operation Manual for more details. It is important to shut a Unix box down correctly, and not just turn it off. Please follow the following steps to shutdown the SD-100.

1. Ensure that no image transfers are in progress. Do this by checking the rs_monitor screen and verifying that the CR is not sending to the SD-100. Also, verify that no images are being transferred to the workstation by checking the /images/spooler/net_dicom directory and ensure only the file neg10.dat is there.

2. Gain access to a command line prompt by either going to the monitor window and hitting the return key or opening a new command tool. If remotely logged in, there will be at a prompt once logged in.

3. Switch to super user status (a.k.a. root) by typing `su` and type in the password when prompted for a password.

4. Stop the spooling process by typing : `rs_stop`. Once the following line is printed, the spooling process should be stopped: `The Resource Gateway is not running.`

5. Shut down the operating system by typing `halt`. If logged in remotely to do this, someone at the site needs to know that the system should be coming down and when they see the OK prompt it is safe to turn the computer off or to type `boot` to reboot the system. When turning off the computer, the order that items get turned off does not matter.

   It is also possible to reboot the system remotely by typing `reboot` instead of halt once the resource gateway has been stopped. This will throw all users off the system as the computer comes down, but the system will reboot itself immediately.

2.9 Maintenance Schedules

DAILY

1. Login as **spooler** to the remote machine.

2. `df -k`

   ** Note what the capacity percentage is for the **/images** file system.*

3. `cd /images/spooler/net1`

4. `find . -mtime +3 -exec rm {} \;`

5. `df -k`

Note the capacity percentage for the **/images file system, and repeat the find command with a number less than three if the percentage is greater than 70%.*

FUJI AC-3

1. Keep the equipment as dust free as possible.

2. See Appendix E page 6 for other Fuji AC-3 daily maintenance issues.

WEEKLY

SD-100:

There are no SD-100 weekly maintenance issues.

FUJI AC-3

1. Examine cassettes, especially the hinges and the clips, for damage or failure. A broken cassette or warped cassette can cause the reader to error or crash

2. See Appendix E page 7 for other Fuji AC-3 weekly maintenance issues.

MONTHLY

There are no SD-100 monthly maintenance issues.

FUJI AC-3

1. Clean plates every 1-2 months or more often if white artifacts are visible.

2. See Appendix E page 7 for other Fuji AC-3 monthly maintenance issues.

SEMI-ANNUALLY

There are no SD-100 semi-annual maintenance issues.

FUJI AC-3

1. The standard acceptance test that is outlined in the service manual should be performed every 3-6 months. This is a good QA/QC procedure to make sure that the reader is processing information correctly.

2. See Appendix E page 7 for other Fuji AC-3 semi-annual maintenance issues.

ANNUALLY

There are no SD-100 annual maintenance issues.

See Appendix E page 7 for Fuji AC-3 annual maintenance issues.

2.10 Reference Manuals

Fuji Computed Radiography Service Manual for the AC-3

Fuji Computed Radiography Operators Manual for the AC-3

Analogic SD-100 Installation and Operation Manual

3. Siemens MagicView Workstations & Peripherals

The Siemens MagicView workstations are designed to receive images from Radiology imaging modalities and store, display and transmit these images. The workstations are connected to an ethernet network and use either PACSNet or DICOM as a means of communicating with other devices on the network. Some key pieces of information for maintaining and troubleshooting the Siemens workstations will be provided in this section. More information can be found in the manuals listed in the Reference Manuals section of this chapter.

3.1 Operation

SIEMENS MAGICVIEW

These are quality workstations placed in the Radiology department and other clinical areas are to facilitate the softcopy reading of radiology images off a monitor. These workstations allow for the display and transfer of all images on the network. They can display multiple exams, perform measurements, window/level modifications, and other image enhancement techniques. A photograph of the Magicview 200 with a Conrac monitor is shown in Photo 3.1. A photograph of the Magicview 1000 with a Simomed monitor and optical drive is shown in Photo 3.2.

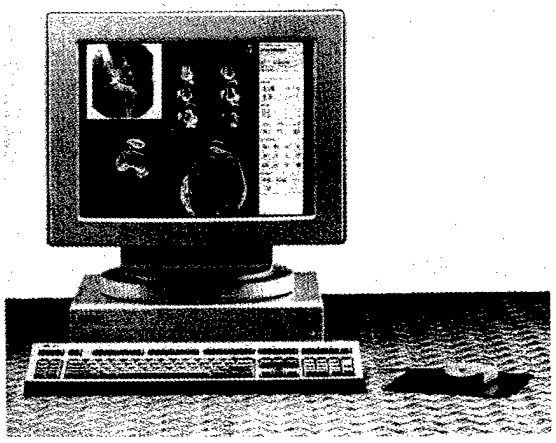


Photo 3.1 Magicview 200 with Conrac monitor

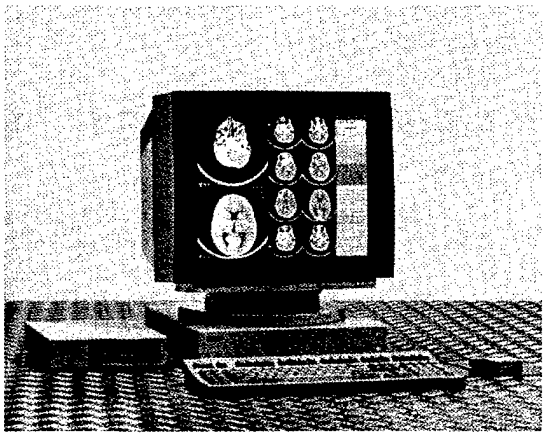


Photo 3.2 Magicview with Simomed monitor

MEGASCAN 2K MONITORS

These are high resolution monitors which are connected to the MagicView 1000's. Each MagicView 1000 has 2 of these monitors attached to facilitate softcopy diagnosis of CR and LFD images. These exist at the CSH & LRMC in the Radiology department.

SIMOMED 1K MONITORS

These are high luminescence 1K monitors that provide exceptionally bright image display. These monitors are excellent for reviewing CR or LFD images reduced to 1K or for viewing CT and US images. 2K versions of the CR and LFD images can be displayed on these monitors, however, pan and roam tools need to be used. These exist at all sites in the Radiology department.

CONRAC 1K COLOR MONITORS

These are the standard color monitor supplied with the MagicView. They are not considered diagnostic quality but are sufficient for clinical areas such as EMT, ICU, and Ortho.

SIEMENS 9 GB RAID DRIVE

This drive is a 9 GB redundant array of inexpensive disks (RAID). It provides additional storage for the CSH and LRMC. This is currently attached to the Siemens MagicView 500 at each of these locations. This drive can hold approximately 420 CR images.

SIEMENS MAGNETO-OPTICAL DRIVE

This is a read/writeable magneto-optical disk drive used for archiving images off the Siemens MagicView workstations. All permanent archiving will be done at the CSH. These disks can hold about 600 MB or about 37 CR images.

SIEMENS CD-ROM READER

The function of this unit is to provide a mechanism for installing new versions of the Siemens software or reloading existing software if it should become necessary.

3.2 Application Login Information

There are different logins which provide different access to the workstations. If the MagicView login screen apperas, access to the Application logins--not operating system logins--are available. The application logins with their related priveleges are:

CSH: (test, admin)

MASH: (rad, admin)

This login provides total access to the application as well as access to administrative functions of the workstation, such as stopping the MagicView application, shutting down the workstation, starting a command tool window, and others.

(demo, ↵)

This login provides access to the application only. Other logins that have been set up for application access are listed below and are the same at all the sites:

(user, ↵)

This login is used by all clinicians for reading or viewing of images.

(rad, tech)

This login is intended for all technologists. It grants the privilege to merge folders.

3.3 Operating System Login Information

Once the application has been stopped, if priveleged to get command tool from application login, or if logged in remotely, the following remote logins are available:

(dicom, *password**)

**Note that this and other passwords are located in Appendix B.*

This login allows access the dicom configuration tool for setting parameters and configuration items. Aliases and other information needed for the dicom software are set. It also helps in the diagnosis of DICOM problems and provides access to the DICOM queues.

(install, *password*)

This login automatically starts the installation tool which permits setting up different parameters and configuration items for the MagicView software.

(config, *password*)

This login automatically starts a configuration script that allows installation of new software releases, backing up user files to the MOD, installing the dicom software, or reconfiguring the workstation for use with or without a 9 GB RAID or optional 2 GB disk.

(root, *password*)

This login allows total access to the operating system and should be used with caution!!!

(dvc, *password*)

This login when entered at the workstation will automatically restart the MagicView application. When entered remotely will give access to the operating system while setting up the MagicView environment without starting the application.

3.4 Maintenance & Troubleshooting

To ensure that the workstation is communicating with other devices on the network, the following commands can be issued from a command prompt.

`ifconfig -a` (to check the status of the MagicView ethernet interface)

this should respond with something that looks like:

```
le0:  flags=863<UP, BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu 1500
          inet ip_address netmask ffffff00 broadcast broadcast_address
```

This will verify that the local ethernet connection is up and running. To verify that communications to other devices on the network are working, issue the following command:

`ping ip_address` (to ensure the other devices are up - this should respond with *ip_address* is alive)

ip_address is the IP address of the device being checked or an alias set up through the installation and configuration tool and resides in /etc/hosts.

If communications seem fine, but images transfer does not seem to be working, check some other error logs to determine the problems.

If the problem seems to be between Siemens workstations, then check that the node configuration is accurate for both systems. To do this do the following:

1. Open a command tool window or stop the MagicView application and get a system login prompt.

2. If the application is running, ensure no patient or exam folders are open. Open a command tool window and issue the following command:

   `su - install -f` (to start the installation tool editor)

   `install` (at the password prompt)

   `cd /home/sn_root/config/scripts` (to change directory to the installation tool directory)

   `main` (to start the installation tool editor)

   The installation tool is menu driven.

3. If the application is not running, at the Unix login prompt login as user install as follows:

   `install` (at the login prompt to login as user install)

   `install` (at the password prompt)

   The installation tool editor will start up automatically.

4. To verify that the workstations are configured correctly, edit the configuration options by selecting the follow menu items from the installation tool menus;

   `edit` (to select edit option)

   `config` (to edit configuration options)

   `list` (to list information regarding all defined nodes)

To make any changes, enter the following:

```
update n                                    (to update node entry n)
```

To add an entry, enter the following:

```
create                                      (to create a new node)
```

Use the Installation and Operation manual for information on using the installation tool and proper entry of node entry information. The IP address and PLA prefix of the Siemens workstation being connected to must be known. Once all changes or additions are made, exit out of each menu until returning to the main menu in the Siemens Installation tool. At this point install the changes. To do this type the following commands:

```
install                                     (to get the install menu)

all                                         (to install all information)
```

Enter the super user password when prompted. The passwords are given in Appendix B.

```
exit                                        (to return to the main menu)

exit                                        (to exit the installation tool)
```

At this point, the system should be rebooted so the changes take effect. See the section on shutting down the workstation for information on shutting down or rebooting the workstation.

If image transfer between workstations is failing due to time-out errors, then the send and receive time-out values need to be increased. This type of error may be seen when transferring to Siemens workstations over the wide area network. To change the time-out values, issue the following commands:

1. If the application is running, stop the application.
2. Login as root.
3. Issue the following commands:

```
cd /home/sn_root/bin/rcv                    (to change to the receive process
                                             directory)
```

Edit the file rcv_env to change the time-out values for the receive process. The default values are 600 seconds and should be increased to increase the time-out. These parameters are:

```
setenv rcv_pn_write_timeout    600

setenv rcv_pn_wait_timeout     600

cd /home/sn_root/bin/fos                    (to change to the send process
                                             directory)
```

Edit the file fos_env to change the time-out values for the send process. The default values are 600 seconds and should be increased to increase the time-out. These parameters are:

```
setenv fos_pn_write_timeout    600

setenv fos_pn_wait_timeout     600
```

4. This must be done on both the sending and receiving computers.
5. logout by typing:

```
exit
```

6. Log in as dvc to restart the application.

Logs should be checked for messages and errors. The first log that should be checked is the full log which is accessed directly from the application. On the MagicView 500/1000 select full log from the menu bars and on the MagicView 200 select the icon at the bottom of the menu bar that is a triangle surrounding an exclamation point (!). The full log of messages for importing and exporting of exams will be shown. If errors are displayed in this full log there are some other error logs that can be viewed and the appropriate Siemens or GUMC personnel should be contacted.

Some error logs that can be displayed using more, cat, or a Unix editor like vi include:

`/gateway/dg_root/imp/err/dgw_drcv.eml`	(list of dicom receive messages)
`/gateway/dg_root/imp/err/dgw_import.log`	(list of dicom import messages)
`/gateway/dg_root/exp/err/dgw_dfos.eml`	(list of dicom send messages)
`/gateway/dg_root/exp/err/dgw_export.log`	(list of dicom export messages)
`/home/sn_root/error/rcv.eml`	(list of PACSNet receive messages)
`/home/sn_root/error/fos.eml`	(list of PACSNet send messages)
`/home/sn_root/error/user_log.eml`	(full log listing)

Note: Only root has access to some of these logs.

3.5 Dicom Software

If image transfer into and out of the Siemens workstation is problematic, check the DICOM queues. They may get stuck and fill up the local disk space causing all image transfer to be affected. First check the export queue, that is images going out of the workstation. To begin do the following:

`su - dicom`	(to switch to the dicom user)
`diag`	(to start the DICOM diagnostic tool)
`export`	(to change to the export queue)
`show`	(to show a list of jobs in the queue)

If there are jobs in the queue with a status of failed, retry sending them after checking to see if the export route is working.

`show routing`	(to show availabe export routes)

This would result in a list of the possible export routes similar to this one.

```
transfer direction: DICOM Gateway --> DICOM node

<Receiver PLA> <Application Entity>

036S02DC15RCV0 LS_STORESRVR

036S02DC15RCV2 LS_STORESRVR
```

To test only one route, use the enrty in the column <Appication Entity>, which would be LS_STORESRVR in this example.

`test "route"`	(to test the export route)

If the printer accepts the request, then resend the failed folders by doing the following.

`retry N` (send folder number N to the printer)

`y` (response to the question regarding deleting the folder)

Repeat this for each of the failed folders only after the previous folder is done transferring. (Either listed as `Transferred` or `Failed`.) To check on the status of a folder transfer, do the following:

`show` (to show a list of jobs in the queue)

> **Note that this queue is not updated once it has been displayed to the screen. Therefore, for any up-to-the-second status reports, the show command must be re-entered. Also, to exit this program and return to the UNIX prompt, use the command* ***end****. The command* ***help*** *provides a listing of all the commands available within the diag program.*

If the send fails, get additional information on the folder with the following:

`dump N I` (dumps information to the screen about folder N, image I)

This command prints to the screen a whole lot of information. Some of the more useful stuff is the patient info, including name, date of birth, etc., the type of image (CR, CT, or US), and also the time and date that the image was taken. If this patient folder is no longer required on the system it is being sent to, it can be deleted from the queue with the following command:

`delete #` (to delete the job with folder ID #)

`y` (response to the question regarding deleting the folder)

Deleting the export queue, or at least the first item in the queue will often reestablish communications with other DICOM interfaces. After deleting the first item in the queue try to resending other items in the queue by typing:

`retry #` (where # is the folder ID)

If there is still having trouble printing, check Chapter 6 for more information about the 3m printer, or other DICOM device manuals. Next check the DICOM import queue to see if CR, CT, LFD, or US images are getting stuck in the queue.

`import` (to change to the import queue)

`show` (to show a list of jobs in the queue)

If there are jobs in the queue with a status of failed, try resending them once images have been deleted from the export queue. If this fails, contact the appropriate Siemens or GUMC personnel. To retry sending the images in the queue, type:

`retry #` (where # is the folder ID)

If the queues are empty, exit the diag tool by typing `end`. Next, check that the node configurations are correct for the DICOM nodes. To do this do the following:

1. Open a command tool window or stop the MagicView application and get a login prompt.
2. If the application is running, ensure no patient or exam folders are open. Open a command tool window and issue the following command:

   `su - dicom` (to login as user dicom)

   ↵ (at the password prompt)

   `scit` (to start the DICOM installation tool editor)

The installation tool is menu driven.

3. If the application is not running, at the Unix login prompt login as user dicom as follows:

`dicom`	(at the login prompt to login as user dicom)
↵	(at the password prompt)
`scit`	(to start the DICOM installation tool editor)

4. To verify that the workstations are configured correctly, edit configuration options by selecting the follow menu items from the installation tool menus;

`edit`	(to select edit option)
`config`	(to edit configuration options)
`list`	(to list information regarding all defined nodes)

To make any changes, enter the following:

`update n`	(to update node entry *n*)

To add an entry, enter the following:

`create`	(to create a new node)

Use the Installation and Operation manual for information on using the installation tool and proper entry of node entry information. The IP address, DICOM application entity title, and DICOM port number of the device being connected to must be know in advance. If changes or additions are made to a DICOM export device, check the parameters settings to ensure this is setup correctly for DICOM export nodes. To check the parameters exit out of the current configuration menu and enter the parameters menu. Do this by entering the following commands:

`exit`	(to back out of the configuration menu)
`param`	(to enter the parameters menu)
`list`	(list all parameters entries)

Verify the DICOM export nodes are assigned correctly. Use the Installation and Operation manual for information on setting up a DICOM export node.

Once all changes or additions are made, exit out of each menu, by typing **exit**, until returning to the main menu in the DICOM installation tool. At this point install the changes. To do this type the following commands:

`install`	(to get the install menu)
`all`	(to install all information)

Enter the super user password when prompted.

`exit`	(to return to the main menu)
`exit`	(to exit the installation tool)

At this point, the system should be rebooted so the changes take effect. See the section on shutting down the workstation for information on shutting down or rebooting the workstation.

If there is still having trouble receiving DICOM images, there is a configuration file that can be checked. Login as user dicom and change to the dicom configuration directory as follows:

`cd /gateway/dg_root/imp/tables` (to change to the correct directory)

`more dgw_drcv.pro` (to verify certain variables are set correctly)

Verify that the following parameters are set correctly:

```
RETURN_SAME_CONTEXT_NAME = YES

ACCEPT_ANY_APPLICATION_TITLE = YES

INSURE_EVEN_UID_LENGTH = NO
```

If these values are not set correctly, edit the file to change these values. Edit the following file to ensure that these values don't get reset the next time an installation change is made.

`cd /gateway/dg_root/exp/tables` (to change to the correct directory)

`more dgw_dfos.pro.in` (to ensure that the variables listed above are set correctly)

If these variables are not set as stated above, edit the file to change these values.

Reboot the workstation.

3.6 Starting the System

Turn on all external devices (monitors, 9 GB RAID, MOD, CD-ROM, 2K video drivers). Next turn on the Sparcstation - the power switch is located at the back right of the workstation. Hold the switch on until the system beeps, then release the switch and it will begin booting up.

After a few minutes the windowing environment will startup and then the MagicView login screen will appear. At this time, the system is fully booted and operational. To access to the operating system environment, first log in to the application and then stop the application. At this time, log in to the operating system.

3.7 Shutting Down the System

It is important to shut a Unix box down correctly, and not just turn it off. Please follow the following steps to shutdown the MagicView workstations from the workstation.

1. Ensure that no image transfers are in progress. Do this by checking the full log.

2. Close all open folders.

3. If the application is running, first stop the application. To do this, log in as test or admin. On the MagicView 500/1000 move the cursor to a blank part of the screen, click the right button once and select shutdown workstation from the menu. On the MagicView 200, move the cursor to the bottom left hand corner of the display, and select with the left mouse button from the utilities box the key I and it should change to II. Then click with the right mouse button on the box II and a menu will appear. Select shutdown workstation from the menu. At this point the application will stop and the operating system will shutdown as well. Once the OK prompt appears, the workstation can be turned off.

4. If the application has been stopped and the operating system environment is running, first log in as root. Then shutdown the workstation by issuing the following command:

   ```
   shutdown -h now
   ```

   Once at the OK prompt, it is safe to turn off the workstation.

5. If turning off the computer, the order that items get turned off does not matter.

To shutdown or reboot the workstation remotely, please follow the following procedure.

1. Call ahead and ask someone to ensure that no folders are open (if possible).
2. Log in as user dvc.
3. Ensure that no image transfers are in progress. Do this by checking the full log.
4. Type `stop` to shutdown the MagicView application.
5. Type `shutdown -h now` or `reboot` to shutdown or reboot the application.
6. Switch to user root.
7. If shutting down the system, call and let someone know that it is coming down and they can turn it off or type boot to restart it.

3.8 Maintenance Schedules

DAILY

For remote maintenance of the MagicView 500 or MagicView 1000, use the following.

1. `telnet` *`IP Address`*

Note that often times the connection with the machine cannot be made. The connection can be tested with the command* ***ping* **IP Address**, *which will tell the user whether or not the machine at* IP Address *can be "seen" by the local computer. If the computer is not "visible," then one should try again later. However, if* ***ping*** **IP Address** *returns with the message* **Machine Name** ***is alive***, *then the command* ***telnet*** **IP Address** *should be retried.*

2. Login as **dvc** to the remote machine.

3. `df`

** Note what the percentages are for the directories named* ***images_N*** *and* ***gateway***. *If any of the* ***images_N*** *directories are over 80%, or if the* ***gateway*** *directory is over 20%, it should be reported immediately.*

4. `cd /home/sn_root/error`

5. `cat user_log.eml`

**Note any irregularities in the most recent entries in the user log and report them within 24 hours.*

6. `su - dicom`

7. `diag`

8. `show`

9. `test`

*Note that if the queue is not empty, and if **test** returned with* **Machine Name** ***accepts request**, then the command **retry** **N** should be used, answering **y** to the second prompt. After a while (Sometimes as long as ten minutes.) the item will be removed from the list. Until that time it will be listed as **transferring** when the command **show** is executed.*

*To learn more about the item in the queue, the command **dump** **N** will print to the screen info about the file waiting in the queue such as the patient name and the date that the images were taken.*

10. `import`

11. `show`

12. `test`

*Note that if the queue is not empty, and if **test** returned with* **Machine Name** ***accepts request**, then the command **retry** **N** should be used, answering **y** to the second prompt. After a while (Sometimes as long as three minutes.) the item will be removed from the list. Until that time it will be listed as **transferring** when the command **show** is executed.*

*To learn more about the item in the queue, the command **dump** **N** will print to the screen info about the file waiting in the queue such as the patient name and the date that the images were taken.*

13. `end`

14. `exit`

15. `cd /gateway/dg_root/exp/err`

16. `cat dgw_export.log`

Note any irregularities in the most recent entries in the export log and report them within 24 hours.

17. `cd ../../imp/err`

18. `cat dgw_import.log`

Note any irregularities in the most recent entries in the import log and report them within 24 hours.

19. `exit`

For remote maintenance of a MagicView 200, do the following.

1. `telnet` *`IP Address`*

*Note that often times the connection with the machine cannot be made. The connection can be tested with the command **ping** **IP Address**, which will tell the user whether or not the machine at* IP Address *can be "seen" by the local computer. If the computer is not "visible," then one should try again later. However, if **ping** **IP Address** returns with the message* **Machine Name** ***is alive**, then the command **telnet** **IP Address** should be retried.*

2. Login as **dvc** to the remote machine.

3. `df`

** Note what the percentages are for the directories named **images_N** and **gateway**. If any of the **images_N** directories are over 80%, or if the **gateway** directory is over 20%, it should be reported immediately.*

4. `cd /home/sn_root/error`

5. `cat user_log.eml`

**Note any irregularities in the most recent entries in the user log and report them within 24 hours.*

6. `exit`

WEEKLY

The disk usage on the MagicView should monitored on a weekly basis. Archiving is a manual process and needs to be monitored. The disk usage is displayed in the worklist option and this should be sufficient for monitoring usage. Once the usage begins to get above 80%, the oldest and least used exams should be moved to the MOD and then they can be deleted from the local drive.

The full log should be cleared out weekly so that the number of messages in it is not unruly. This log contains messages from all image transfers, archive requests, etc. When the full log is selected for display, there is a button to select to clear the log.

The DICOM queues should be checked to ensure that images are not stuck in the queue and therefore filling up the file system.

MONTHLY

There are no MagicView monthly maintenance issues.

SEMI-ANNUALLY

There are no MagicView semi-annual maintenance issues.

ANNUALLY

There are no MagicView annual maintenance issues.

3.9 Reference Manuals

Siemens MagicView 500/1000 Installation guide

Siemens MagicView 200 Installation guide

Siemens MagicView 500/1000 Users guide

Siemens MagicView 200 Users guide

4. Lumiscan Film Digitizer & Peripherals

The Lumiscan film digitizer and interface box were purchased from Dejarnette Research Systems and provide the capability to digitize an existing film and convert it to digital format to store it on the Siemens workstation or transmit it across the DEPRAD network. A photograph is shown in photo 4.1.

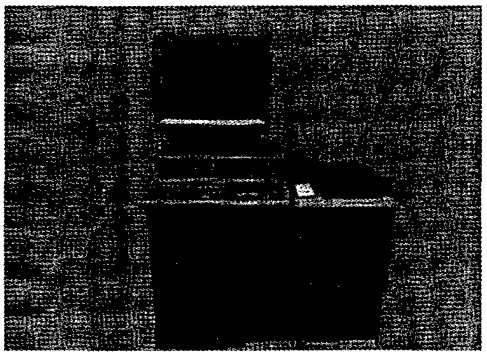


Photo 4.1 Lumiscan Film Digitizer

4.1 Operation

LUMISCAN DIGITIZER

The function of this device is to accept a hard copy image and produce a digital image that is passed to the Dejarnette Imageshare PC.

DEJARNETTE IMAGESHARE

This is a DOS PC which acts as an interface from the Lumiscan 150 film digitizer and the DEPRAD network. Its function is to provide an interface to the user to enter minimal patient demographics to attach with the images, to verify the correct orientation of the image prior to transmitting it to the network, and to convert the image into a DICOM formatted message and pass it to the Siemens workstation.

4.2 Login Information

There is no log in on the PC.

4.3 Maintenance & Troubleshooting

There are some log files that can be displayed from the ImageShare application. Please refer to the ImageShare manual for more information.

4.4 Starting the System

Turn on all peripherals (lumiscan and monitor) before turning on the PC. The system will begin to boot and then offer the option to go to DOS. To continue booting to the Lumiscan application, hit the return/enter key to continue. To go to DOS, hit the `CTRL C` when prompted, and then type `yes` to abort batch file.

4.5 Shutting Down the System

To shut down the system, simply turn it off or hit CTRL, ALT, DEL keys while in the application to reboot the system. If at a DOS prompt and not running the ImageShare application, just turn off the computer or hit CTRL, ALT, DEL to reboot. If the computer is not running the ImageShare application, but running some other DOS application like the editor, exit out of that application and get to a DOS prompt before shutting down the system.

4.6 Maintenance Schedules

There are no maintenance schedules for the Lumsican film digitizer.

4.7 Reference Manuals

Dejarnette Imageshare 910 Film Digitizing station user reference

Dejarnette Imageshare 910/KR Film Digitizing system manual

5. Polaroid Helios Printer*

*Located only at LRMC

A photograph is shown in photo 5.1.

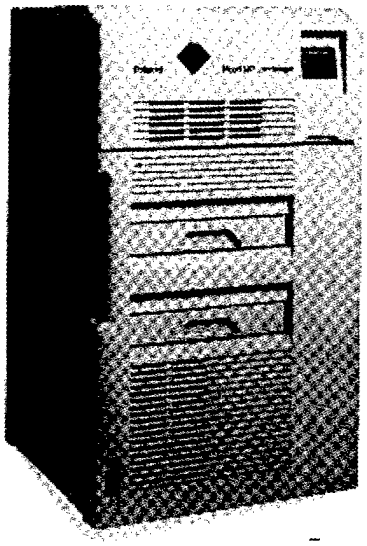


Photo 5.1 Helios Printer

This section has not been completed.

6. 3M Print Server and Printer

The 3M print server is designed to accept DICOM print messages and spool them to the 3M Dry Laser film printer. Software was purchased from Dejarnette Research Systems to allow the 3M print server to accept DICOM send messages, convert them to DICOM print messages and then spool them to the 3M Dry Laser Printer. This section will contain information on the 3M printer server and the Dejarnette software. It is not intended to be complete. See the 3M print server manual for more information.

6.1 Operations

The print server is a SUN Sparcstation that does not have a monitor or keyboard. It is a standalone box that does not require much intervention from an administrator. To configure this box, either connect a terminal emulator to the serial port on the print server, or remotely login over the network. This machine is running Sun OS 5.3.

6.2 Login Information

At both locations there are 2 logins available.

`(mmmims)` (to log in and automatically access the printer Admin App)

This login will allow access the 3M print server administration application. From this menu check on the print queue and see some problems. This menu allows one to access error and event logs, perform print server configuration, diagnostics, and queue management. This login works best with vt100 terminal emulation.

`(root)` (to gain root access to the system)

This login allows access to the config files utilized by the Dejarnette software to convert DICOM send messages to DICOM print, as well as perform any other system command. Be careful when using the root login. It can be very dangerous.

6.3 Maintenance & Troubleshooting

If the printer is failing to print out film, and it has been verified that it is turned on and not malfunctioning, the first thing to do is remotely log in to the 3M print server using the mmmims login, as described above. If images were sent to the print spooler and the printer was not up, the print spooler will retry sending images to the printer for a given period of time. After that point, it will stop trying to print the images and the queue will need to be manually restarted once the printer is back on line. Therefore, once logged in to the 3M print server follow the following steps to begin troubleshooting the printer.

1. Select `Server Operation` from the Main_Menu.
2. Select `Printer PrintServer 3MPS psd` from the Select_Server_Menu.
3. Select `Print Queue Management` from the Print_Server_Menu
4. Select `Show Print Jobs` from the Print_Queue_Management_Menu to see what is in the queue.
5. Press `ESC` key to return to previous menu.
6. To cancel a print job stuck in the queue select `Cancel Print Job`
7. When done with Print Queue Management press `ESC` key to return to the Print_Server_menu

8. To check out the configuration select `Configuration`

9. To start, restart, or stop print server software, or shutdown or reboot the computer select `Control`

10. To verify communications from printer to the print server select `Diagnostics`

11. Medical Maintenance at both the CSH and MASH are familiar with the operations of the 3M printer and print server and should be contacted before contacting GUMC or 3M.

If all seems fine but things are not reaching the print server queue, verify that the communications link to the print server is working. To ensure that the workstation is communicating with other devices on the network, the following commands can be issued from a command prompt.

`ifconfig -a` (to check the status of the MagicView ethernet interface)

this should respond with something that looks like:

```
le0:  flags=863<UP, BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu 1500
          inet ip_address netmask ffffff00 broadcast broadcast_address
          ether 8:0:20:79:3d:b3
```

This will verify that the local ethernet connection is up and running. To verify that communications to other devices on the network are working, issue the following command:

`ping` *`ip_address`* (to ensure the other devices are up - this should respond with *ip_address* is alive)

ip_address is the IP address or an alias residing in /etc/hosts of the device trying to send images to the printer.

To check to make sure that the printer is listening on the right port, use this command:

```
netstat -an | grep 2008

*.2008             *.*        0      0        8576      0      LISTEN
```

This line indicates that the printer is listening on port 2008, and that (as long as the cables are attached correctly) it should be able to make a connection with the workstation.

If network communications seem fine, but images are still not reaching the print queue, then there may be a problem with the Dejarnette DICOM print to DICOM send proccesses.

To do an initial check of this software, first verify that it is running. Remotely log in as root and issue the following commands from a Unix command line prompt:

`ps -ef | grep srv` (to list all process running with srv in their name)

There should be 3 processes, srv_print, srv_film, and storagesrv that are running. This command should print something like this to the screen.

```
root   203     1 80   Jun 02 ?      21:40 srv_film -f lsserver.cfg -v
root   204     1 80   Jun 02 ?      10:36 srv_print -f lsserver.cfg -v
root   206     1 80   Jun 02 ?      13:12 /opt/DRS-LS/storagesrv -v
root 19606 19573  5 12:04:03 pts/1      0:00 grep srv
```

If any of these processes are not running, then there is a problem with the Dejarnette software on the 3M box. To restart the processes correctly, first kill the ones that are running. The numbers in the second

column (203, 204, 206, and 19606 in this example) are the PID's for each process. To kill these processes, first learn their PID's. To do this, be at a UNIX prompt and logged on as root.

`kill` *PID*	(kill the process with *PID*, repeat this for each process, EXCEPT for grep srv)
`cd /opt/DRS-LS`	(move to the directory with the start up program)
`ls_start &`	(start the print server software)
`ps -ef | grep srv`	(check that all three processes are running.)

If this didn't work, GUMC or Dejarnette personnel should be contacted immediately and given this information.

From a command tool on the MagicView 500 it is possible to check the DICOM connection. See Chapter 3 on the MagicView 500 DICOM diag tool.

6.4 Starting the System

To start the system, the Sparcstation box needs to be connected to the printer and the network. The Sparcstation gets turned on using the switch on the back right-hand side of the cpu. The system will boot up automatically and the applications will start. There is no user intervention required.

6.5 Description of the Printing Proccess

The flow chart in figure 6.1 visually presents the sequence of events leading up to the printing of an image. The process starts with the user selecting a folder from the worklist and sending that folder to the printer. At this point the progress of the folder can be monitored from a MagicView 500 using the "diag tool." The following steps describe how to access the diagnostic program from a UNIX system command tool window, and display the contents of the export queue.

To get a UNIX system command tool window on the screen on a MagicView 500, log in to the Siemens application as test or admin, and then point the mouse to a blank spot on the screen and hold down the right-hand mouse button. Drag the pointer to the last option on the menu, **System**. Highlight this option and move the button to the right and high light the first option of this new menu, **Command Tool**. Release the mouse button. The menus should disappear from view and a **System Command Tool** window should appear in the middle of the screen after a pause lasting a couple seconds.

Make sure that the mouse is somewhere inside the window (If the mouse is pointing somewhere else, the windown will not acknowledge any typing.) Then type the following commands to follow the printing process.

```
su - dicom

diag
```

show — This will display the DICOM queue

> **Note that this queue is not updated once it has been displayed to the screen. Therefore, for any up-to-the-second status reports, the show command must be re-entered. Also, to exit this program and return to the UNIX prompt, use the command* ***end****. The command* ***help*** *provides a listing of all the commands available within the diag program.*

The exchange between the printer and the Siemens is handled by Dejarnette DICOM store to DICOM print software. This handles the communication of the images once they have reached the print server, and places them in the directory **/opt/data** on the print server. To check if these images are in this directory, log on to the print server, and use the following commands.

```
cd /opt/data

ls -l

date
```

The **ls** command prints the contents of the directory to the screen, and the **-l** flag attaches the details of each element in the directory to the listing. One of these details is the date the file was last modified, and for the new incoming files, this time stamp should be very close to the current date, which the **date** command prints to the screen. Be sure to remember that the material is not updated once it is printed to the screen, and so the **ls -l** command must be re-entered every time the contents of the directory are checked.

Before the Dejarnette software is done handling the images and turns the job over to the 3m software, it moves the image files out of the **/opt/data** directory and splits them between **/opt/data/ps/images** and **/opt/data/ps/pj.** Once the files are in the the **/images** and **/pj** directories, the job is turned over to 3m software.

The **/images** directory files are very large (~10MB) and contain the image portion of the print job. To see the new files in this directory use the **ls -l** command. (Remember that this will provide the time stamps of when the files were added.)

The **/pj** directory files are small (~1K) and are named *pj#* . These hold the information needed by the 3m software to tell which files in the **/images** directory belong to the particular folder that is being printed. To see the new files in this directory use the **ls -l** command.

From the **/pj** and **/images** directories the 3m software is able to print the images to film. Once this is done, the files should be erased automatically from the **/pj** and **/images** directories, and the event should be recorded in the file **evtlog**. This file is located in **/opt/mmmims/logs** and can be viewed with the command **tail evtlog**.

> **Note: The command **tail** **filename** prints to the screen the last 10 lines of the file filename. To see more than the last ten lines (for instance, to see the last N lines,) then use the command **tail** **-N** **filename**. To learn more about this and other UNIX commands, look in Appendix C.*

To monitor the new lines being entered in evtlog use the command **tail -f evtlog.** This prints the last 10 lines of the evtlog like **tail evtlog**, but it will print each new line that is added to **evtlog** until the command is killed by holding down the **control** key at the same time as the **c** key. A Unix prompt will not be availabe until the **tail -f** command is killed.

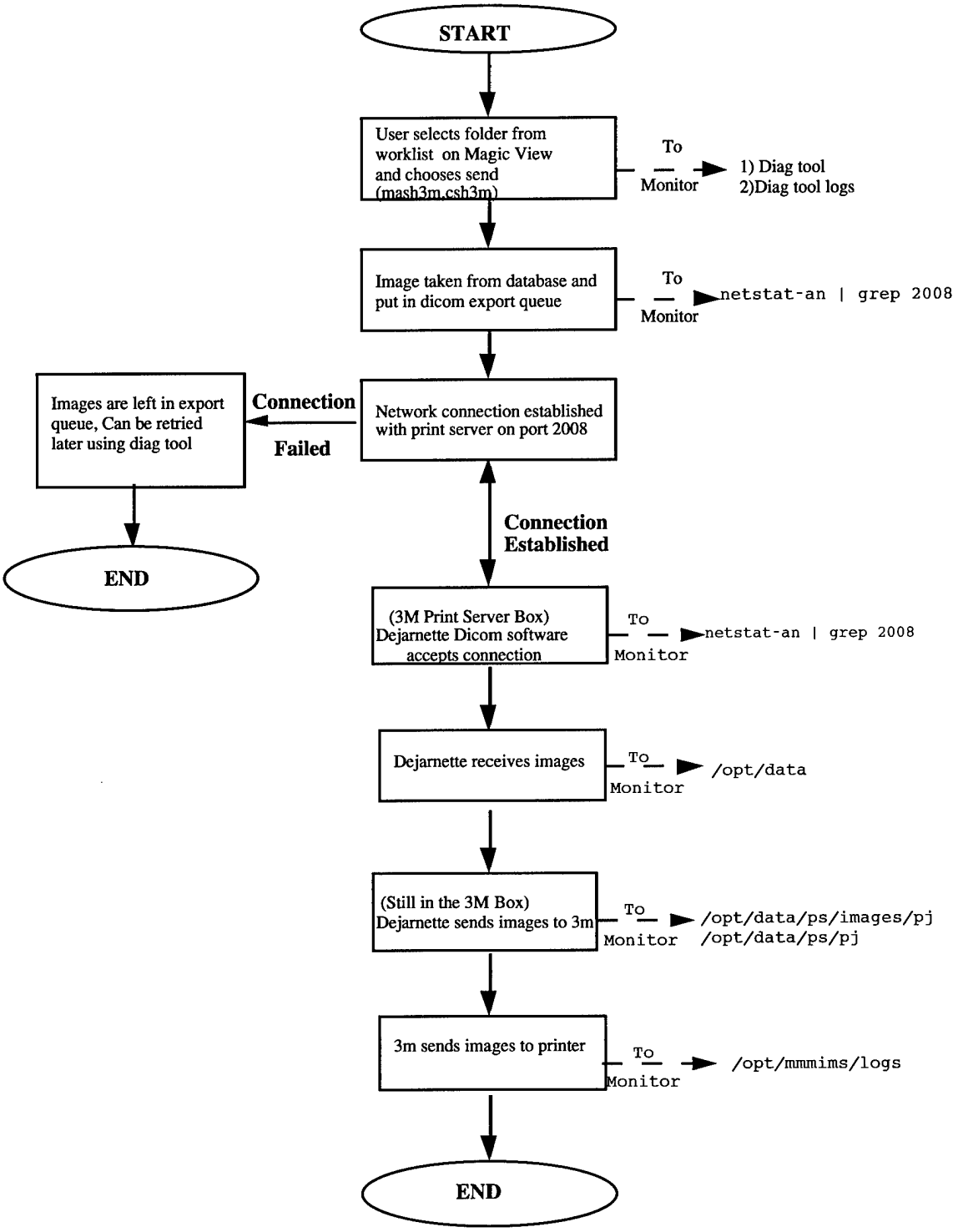
The 3M software which handles the printing process writes all the major events to the **evtlog**, and therefore the process can be followed by periodically looking at this file with the **tail** command. The line signalling the completion of a print job looks like this:

960620-071300, pid=174, tid=145: printed: job=7, #pages=1, study=DSVRc, moduality=LS_SRVR

The **tracefile** contains a more detailed history of what has been happening in the printer.

If print jobs are stuck in the print queue on the print server, use the instructions on how to shut down and start back up the print server to try to restart the printing process.

FIGURE 6.1 FLOW CHART FOR PRINTING AT SITES



6.6 Shutting Down the System

It is important to shut a Unix box down correctly, and not just turn it off. Please follow these steps to shutdown the 3M print server.

1. Either attach a terminal to the serial port on the print server box and log in as mmmims or remotely log in as mmmims.

2. Select `Server Operations`

3. Select `Printer PrintServer 3MPS psd`

4. Select `Control`

5. Select `Shutdown Computer`

6.7 Maintenance Schedules

DAILY

There are no 3M print server daily maintenance issues.

WEEKLY

The print queue status should be checked weekly to verify that things are not backing up in the print queue.

MONTHLY

There are no 3M print server monthly maintenance issues.

SEMI-ANNUALLY

There are no 3M print server semi-annual maintenance issues.

ANNUALLY

There are no 3M print server annual maintenance issues.

6.8 Reference Manuals

3M 9940 Print Server for DICOM (PSD) Service

7. APPENDICES

7.1 Appendix A IP Addresses

7.1.1 LRMC IP ADDRESSES

IP ADDRESS	Host Names	EQUIPMENT
199.226.69.105	lm501	MagicView 500 Radiology
199.226.69.106	lm1000	MagicView 1000 Radiology
199.226.69.107	helios	Polaroid Helios Printer (Lasershare)
199.226.69.108	ishare	LRMC imageshare

7.1.2 CSH IP ADDRESSES

IP ADDRESS	Host Names	EQUIPMENT
204.208.21.99	cshcr	Analogic SD-100 Workstation
204.208.21.101	csh3m	3M print Server
204.208.21.102	cshfd	Lumiscan Film Digitizer
204.208.21.103	cm201	MagicView 200 ICU
204.208.21.104	cm202	MagicView 200 Telemed
204.208.21.105	cm203	MagicView 200 Ortho
204.208.21.106	cm204	MagicView 200 EMT
204.208.21.107	cm501	MagicView 500 Radiology
204.208.21.108	cm1000	MagicView 1000 Radiology

7.1.3 MASH IP ADDRESSES

IP ADDRESS	Host Names	EQUIPMENT
204.208.22.99	mashcr	Analogic SD-100 Workstation
204.208.22.102	mashfd	Lumiscan Film Digitizer
204.208.22.103	mm201	MagicView 200 ICU
204.208.22.104	mm202	MagicView 200 EMT
204.208.22.107	mm501	MagicView 500 Radiology
204.208.22.109	mash3m	3M Print Server

7.1.4 GUMC IP ADDERESSES

IP ADDRESS	Host Names	EQUIPMENT
141.161.77.71	gtown	MagicView 500
141.161.77.78	homer	3M Print Server

7.2 Appendix B Remote Login

7.2.1 LOGIN TABLE LMRC

EQUIPMENT	LOGIN	PASSWORD "*" means no password needed
MagicView Workstations		
System	root	pizza
	dvc	*
	install	install
	dicom	*
	config	pizza
Application	demo	*
	user	*
	rad	tech
3M Print Server	drsadmin	drsadmin

7.2.2 LOGIN TABLE CSH

EQUIPMENT	LOGIN	PASSWORD "*" means no password needed
Analogic SD-100 Workstation	spooler root	spooler1 *
3M Print Server	root mmmims	Stillwater mmmims1
Magicview Workstation		
System	root dvc config install dicom	pizza * pizza install *
Application		
	test demo user rad	admin * * tech

7.2.3 LOGIN TABLE MASH

EQUIPMENT	LOGIN	PASSWORD
Analogic SD-100 Workstation	spooler	spooler1
	root	*
3M Print Server	mmmims	mmmims1
	root	Stillwater
Magicview Workstation		
System	root	pizza
	dvc	*
	config	pizza
	install	install
	dicom	*
Application		
	admin	admin radsys
	demo	*
	user	*
	rad	tech

7.3 Appendix C Unix Commands

`cat` *`filename`*	prints a file called *filename* to the screen
`cd` *`path`*	change working directory to that specified in path
`date`	display the date
`df`	display a computer's disk usage (df -k on some machines)
`find . -mtime +N -exec rm {} \;`	find files that are older than N days in the current directory and removes them (be very careful with this command)
`grep string filename`	prints out each line in *filename* which has *string* in it
`head -N filename`	prints the first *N* lines of a file to the screen
`ls`	list the contents of a directory
`ls -l`	list the contents of a directory including information such as file size, permissions, the time the file was created, and which user created the file
`man command`	display reference manual pages about *command*
`mkdir directory`	make a directory
`more filename`	browse or page through a text file, pausing after each page of new text has been printed to the screen
`mv path1/filename1 path2/filename2`	moves *filename1* from *path1* to *path2*, and saves as *filename2*
`netstat -an`	prints status of sockets and routing table entires
`ps -ef`	display the status of current processes
`pwd`	display the pathname of the current working directory
`rm` *`filename`*	remove (unlink) *filename* (DELETES!)
`rmdir` *`directory`*	remove (unlink) *directory* (DELETES!)
`tail -N filename`	prints the last *N* lines of a file to the screen
`talk`	talk to another user
`vi`	primitive text editor
`whoami`	display the effective current username

Appendix C
Phase II: Forward Sites

System Description, Installation, and Operation Manual

Deployable Radiology (DEPRAD)

Phase II: Forward Sites

System Description, Installation, and Operation Manual

IMAGING SCIENCES AND INFORMATION SYSTEMS
DEPARTMENT OF RADIOLOGY
GEORGETOWN UNIVERSITY MEDICAL CENTER

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Version 2.2

20 November 1996

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1. Introduction

1.1 Overview

This document describes Phase II of the deployable radiology (DEPRAD) system installed in Europe as part of the Primetime III project. The DEPRAD system is a computer-based radiology imaging network that manages radiographic images in the deployed environment and allows these images to be transmitted to remote sites for primary diagnosis.

Please note that this document is based on the best information available at this time. While every attempt has been made to be accurate, some errors may exist. In addition, this document is not intended to be a substitute for the vendors' documentation. It is suggested that all operators familiarize themselves with the vendors' manuals.

Planning meetings for Phase I of the project were held in January 1996, and the initial system was up and running at sites in Germany, Hungary, and Bosnia by April 1996. Phase I is described in the DEPRAD System Description Manual prepared by Georgetown University Medical Center, and links the following sites:

- Landstuhl Regional Medical Center (LRMC) in Germany
- 67th Combat Support Hospital (CSH) in Hungary
- 212th Mobile Army Surgical Hospital (MASH) in Bosnia

For Phase II, the current plan is to add a total of eight additional sites to the Primetime III project. There will be seven sites in Bosnia, and one at the 48th Air Transportable Hospital (ATH) in Zagreb, Croatia. While all eight sites will have telemedicine capabilities, a teleradiology capability will only be deployed at the two sites with x-ray capability in Bosnia (Linda and Gradacac), and in Saudi Arabia.

1.2 Revision History

Revision	Date	Author(s)	Description
1.0	21 August 1996	K. Cleary	Original release
2.0	5 September 1996	K. Cleary B. Levine	Edits after initial Bosnia training
2.1	4 October 1996	K. Cleary B. Levine F. Fouladi S. Kirby	Edits after Dr. Cramer training, UPS software installation, copy editor's remarks
2.2	20 November	K. Cleary F. Fouladi	Edits after Saudi test

2. Phase II Description

The purpose of the Phase II DEPRAD system is to provide a teleradiology capability for remote sites. The teleradiology package consists of the following equipment:

- Lumisys Film Digitizer (Model 75)
- Dejarnette Film Digitizer Acquisition Gateway (Imageshare 1000)
- Eastern Research Remote Access Router (SpanNet 2500)
- American Power Conversion Uninterruptible Power Supply (Back-UPS Pro 650PNP)
- Nera Telecommunications Inmarsat Terminal (Saturn Bp)

The first four pieces of equipment will be provided by Georgetown University Medical Center (GUMC) and the Inmarsat terminal is government furnished equipment (GFE).

A schematic of the Phase II configuration is shown in Figure 2.1. The schematic is divided into two sides: the remote site (uplink) is shown on the left-hand side and the installation at LRMC (downlink) is shown on the right-hand side. The shaded boxes indicate components that are part of the Inmarsat system and the commercial phone network. The dotted box on the right-hand side indicates that GUMC will provide this equipment which consists of:

- ISDN terminal adapter (Euro-ISDN compatible)
- Eastern Research Remote Access Router (SpanNet 2500)

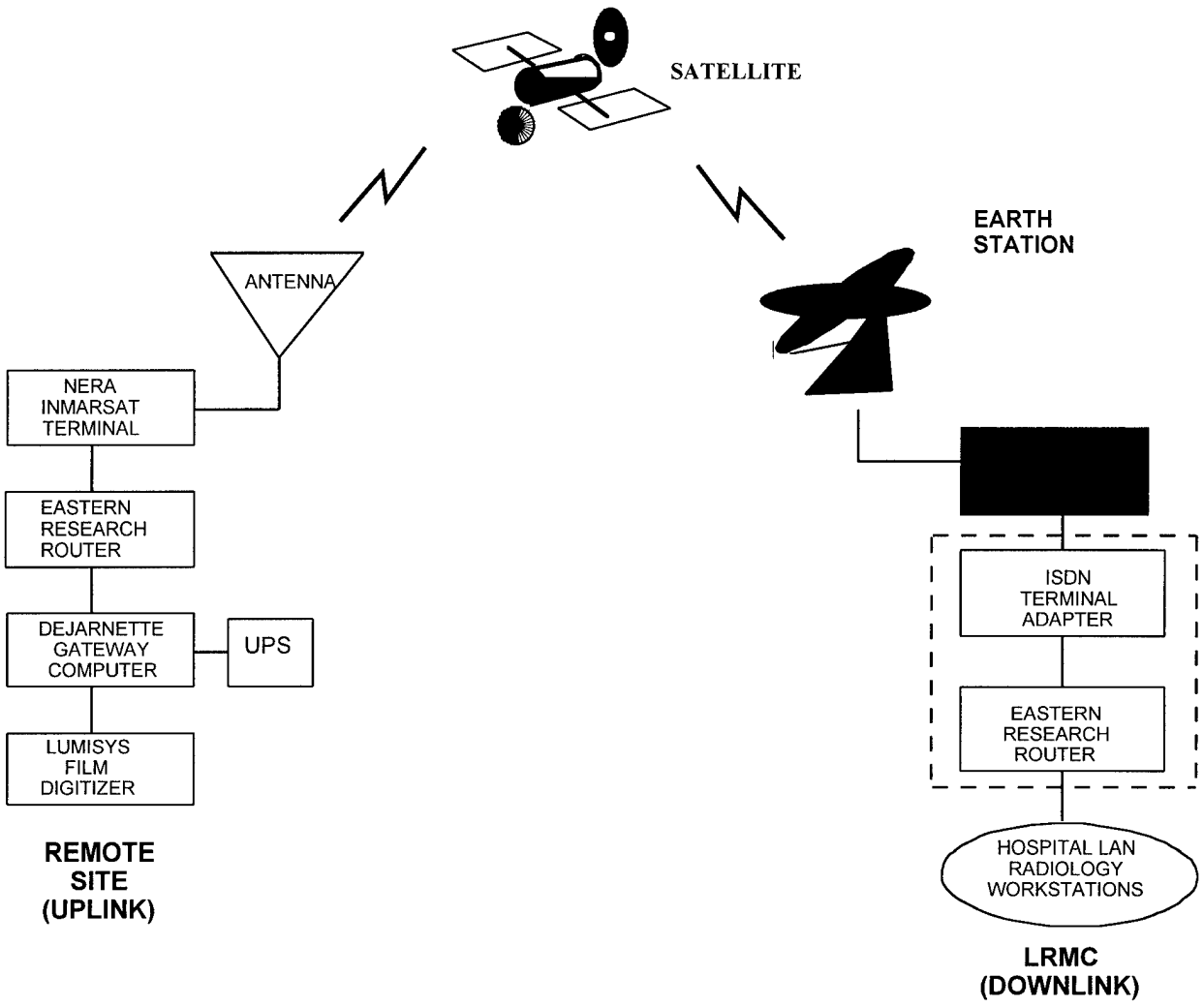


Figure 2.1. Phase II Configuration

The system is designed to work as follows. At the remote sites, the operator will digitize the x-ray film and store it on the gateway computer. To transmit the image to LRMC or another site for diagnosis, the first step is to establish a satellite connection using the Inmarsat terminal. The Inmarsat terminal has both voice and data capabilities and allows the user to connect to the commercial phone network. Here, the operator will dial into the phone number for an ISDN line at LRMC and the Inmarsat system will automatically establish a data connection. Once the data connection has been established, the operator can transmit the image to a radiology workstation at LRMC where it can be interpreted by a radiologist. Note that once the image comes into the network at LRMC, it can also be sent to the radiology workstations in Hungary and Bosnia.

3. Equipment Description and Reference

In this section, each piece of equipment is described. An equipment list for each site along with serial numbers is provided in Appendix 6.1.

3.1 Lumisys Film Digitizer (Model 75)

The Lumisys Model 75 is a high resolution film digitizer that accepts film sizes from 8" by 10" to 14" by 17". This device digitizes x-ray film and the resulting image file is stored on the Dejarnette Film Digitizer Acquisition Gateway. The Lumisys Model 75 was purchased through Dejarnette along with the Acquisition Gateway to make a complete system.

Photographs of the film digitizer are shown next. Photo 3.1 shows the top of the digitizer and the output tray. Photo 3.2 shows the front of the digitizer -- this is where the film is placed for digitizing. Photo 3.3 shows the rear of the digitizer along with the power connection and the SCSI connection to the Dejarnette computer. Photo 3.4 shows the digitizer after the crate cover is removed. The accessory box and strap can be seen in this photo.

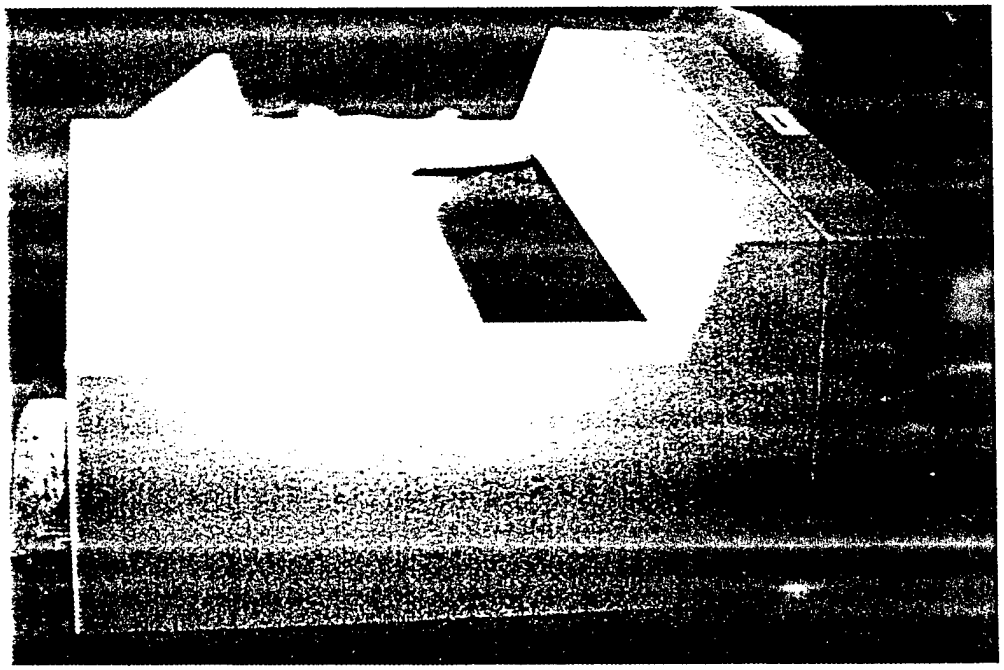


Photo 3.1. Film digitizer output tray

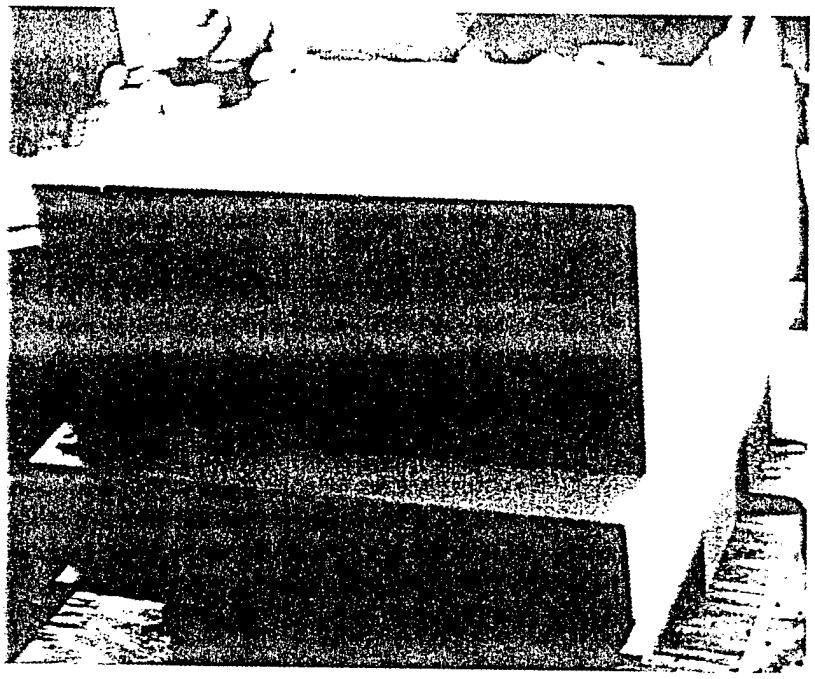


Photo 3.2. Film digitizer front view (film is inserted vertically here)

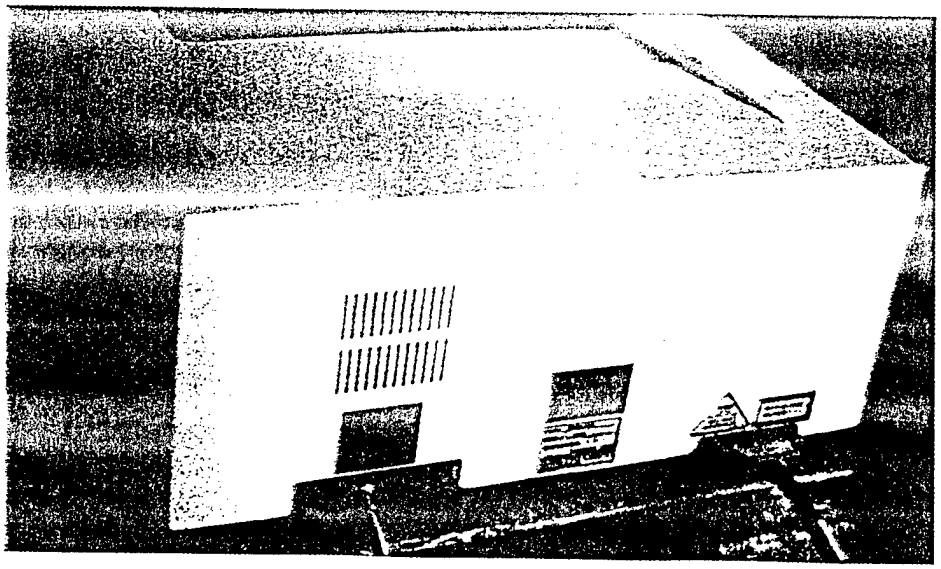


Photo 3.3. Film digitizer rear view

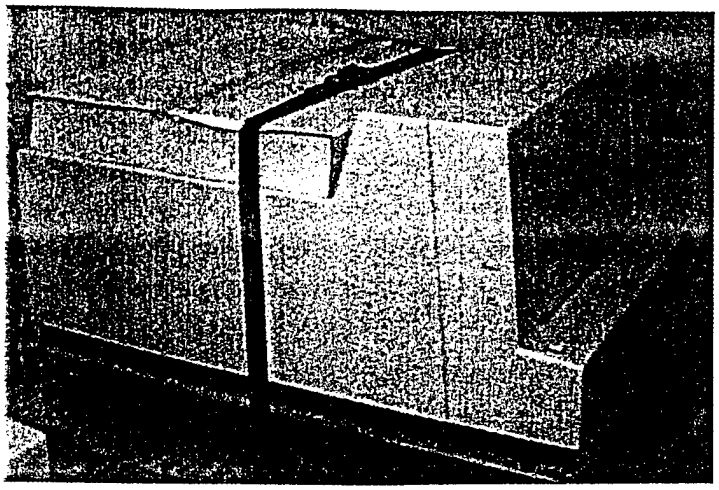


Photo 3.4. Digitizer after crate cover is removed

3.2 Dejarnette Film Digitizer Acquisition Gateway (Imageshare 1000)

The Imageshare 1000 is a medical imaging gateway that acquires digitized film data, adds the associated patient information, and can then send the data to a remote system. The Imageshare 1000 is a PC-based system that runs under the OS/2 operating system. The Imageshare 1000 was purchased from Dejarnette along with the Lumisys Model 75 film digitizer to make a complete system.

The Imageshare 1000 consists of:

- Intel Pentium Computer System (with AC power cord)
- keyboard
- mouse
- SVGA color monitor (ViewSonic 14ES with AC power cord)
- Imageshare 1000 Film Digitizer Acquisition Station System Manual (gray binder)
- Imageshare 1000 Film Digitizer Acquisition Station User's Guide (clear cover)

A photograph of the Imageshare 1000 showing the system unit, monitor, keyboard, and mouse is in Photo 3.5. The APC uninterruptible power supply is also shown in this photo. A rear view of the unit is shown in Photo 3.6.

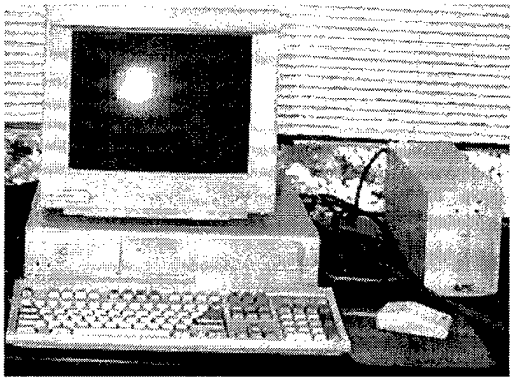


Photo 3.5. Imageshare 1000 system

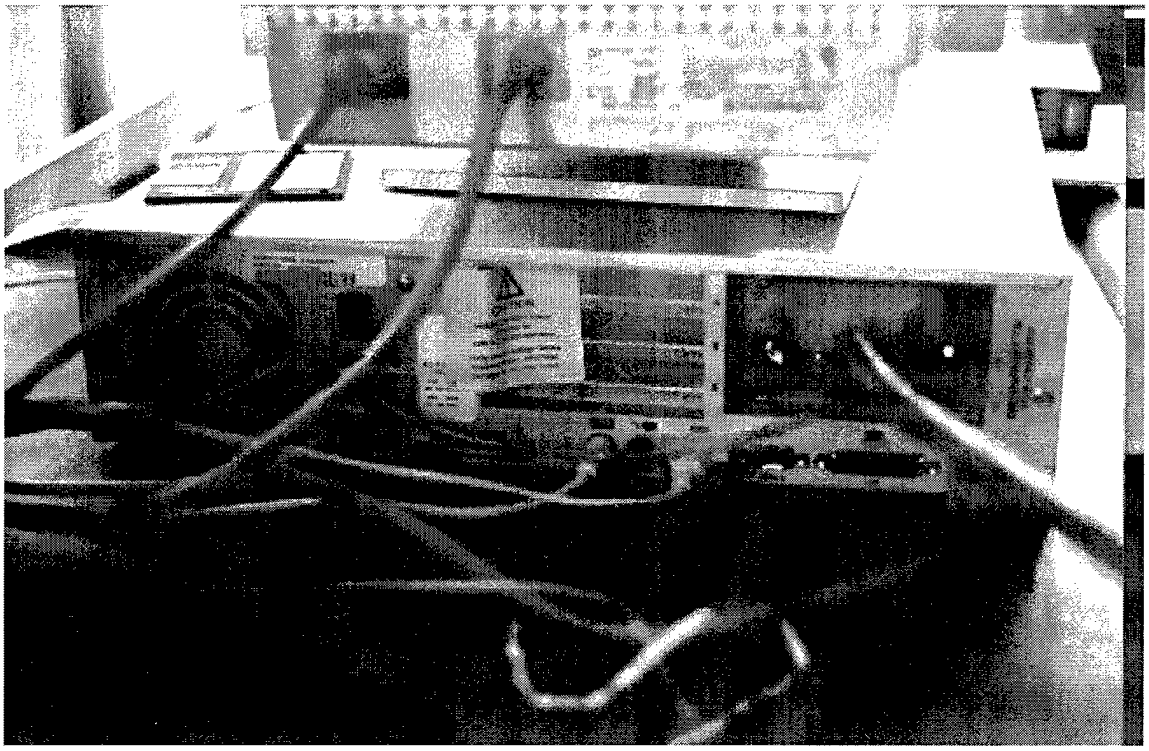


Photo 3.6. Imageshare 1000 rear view

3.2.1 Configuration

The Imageshare 1000 must be configured for each site before it can be used. This has already been done by Georgetown personnel and the information here is only provided for reference. Please note that the remote sites should not change any configuration files unless instructed to by Georgetown personnel.

The configuration is described in Chapter 6 of the Imageshare 1000 System Manual.

3.2.2 TCP/IP Configuration

Since TCP/IP will be used as the low-level protocol, the first step is to configure the TCP/IP parameters as described in Section 6.1.1 on page 22. There is a TCP/IP configuration worksheet in Section B.2 on page 81. For the Phase II teleradiology deployment, the IP addresses and host names for the film digitizer sites are[1]:

Site	IP Address	Host Name
Linda	199.226.69.241	ims310
Gradacac	199.226.69.243	im1000s307
Saudi Arabia	199.226.69.245	ims309
Georgetown	199.226.69.247	ims311

Table 3.1. Film Digitizer IP Addresses and Hostnames

The IP addresses and host names for the destination sites are:

Destination	IP Address	Host Name
LRMC_500	199.226.69.105	lm501
LRMC_1000	199.226.69.106	lm1000
CSH_500	204.208.21.107	cm501
CSH_1000	204.208.21.108	cm1000
MASH_500	204.208.22.107	mm501
Georgetown	141.161.77.71	gtown

Table 3.2. Destination IP Addresses and Hostnames

To configure the TCP/IP parameters under OS/2, type tcpcfg from the C:\ prompt. Note that an OS/2 session (the C:\ prompt) can be accessed from the Administration Screen button of the Main Menu Screen. The System Shell button opens an OS/2 session. Also note that one can get a list of all the OS/2 windows by hitting Ctrl-Esc.

[1] Brendan Molloy at LRMC has reserved IP addresses 199.226.69.240 to 199.226.69.249 for our use.

The first screen is as shown in Figure 6.1.-1 (TCP/IP Configuration - Network Section) of the Dejarnette manual. On this screen, make sure that LAN interface 0 is chosen (it should be highlighted). The Enable Interface check box should be checked to enable the interface. The IP address and subnet mask must be filled in with the site specific data. While the IP address will change depending on your site, typically the subnet mask is fixed at 255.255.255.0.

The hostname is entered in the Hostnames section of the notebook. The hostnames section is shown in Figure 6.1-2 of the Dejarnette manual. All that needs to be entered on this screen is the hostname. Note that this hostname cannot be changed as the software will not work due to licensing restrictions.

Next, go to the second page of the Hostnames section by clicking the right arrow at the bottom of the screen. This page is shown in Figure 6.1-3 of the Dejarnette manual and is labeled "Name Resolution Services". This screen holds the hostnames and IP addresses for the remote systems (the systems you wish to send to). You can add names as described in the Dejarnette manual.

The next step is to configure the Routing section of the TCP/IP parameters. This screen is shown in Figure 6.1-5. The router address can be configured as described in the Dejarnette manual. Note that if you configure a default route, a NET route type will automatically be added as well. The default route should be the main router at LRMC (199.226.69.1). Also, the Net route should be deleted as it can cause problems when sending to remote machines.

After these steps, you are finished with the TCP/IP configuration. Select the System Control Box at the top left of the screen (the one that looks like a notebook with a pencil) and double click (or single click and select Close). You will get a dialog box asking if you want to Save, Discard, or Cancel the TCP/IP configuration. Select Save which will save the parameters, close the TCP/IP configuration window, and return the user to the OS/2 session (this may take 10 or 15 seconds, so be patient). Ignore a warning titled "Default Router Entry" if it appears. Answer No to the "Autostarting Sendmail" dialog box if it appears. See section 6.1.1.3 of the Dejarnette manual for a picture of these boxes. You can then type exit to return to the Administration Menu.

Once the TCP/IP parameters have been configured, you can connect the computer to the router. Note that some of the standard Unix network commands can be entered at an OS/2 shell. For example, `ifconfig lan0` will show the status and IP address of the Ethernet interface. Also, `ping ip-address` will check the network connection with the system at ip-address.

3.2.3 PACSNET over TCP/IP Configuration

This is the method we are using to send images to the Siemens Magicview workstations. The configuration is described in Section 6.2.3 of the Dejarnette manual. To configure PACSNET over TCP/IP, the PLA for the destination site is needed as shown in Table 3.3. These have already been put in the configuration file.

Destination	PLA
LRMC_500	036S02DC01RCV0
LRMC_1000	036S02DC02RCV0
CSH_500	036S02DC15RCV0
CSH_1000	036S02DC16RCV0
MASH_500	036S02DC23RCV0
Georgetown	001S01DC11RCV0

Table 3.3. Destination PLAs

3.2.4 Other Configuration and Imageshare Notes

The configuration file im1000.cfg is in \usr\im1000. Use the epm editor to edit this file.

It is important to shut down the Imageshare 1000 properly using the shutdown system option from the Administration menu. One can also type "shutdown" in a command window. Do not just turn the box off.

3.3 Eastern Research Remote Access Router (SpanNet 2500)

This router is typically used to connect local area networks (LANs) to wide area networks (WANs) and handle the routing of data between the two networks. The router supports TCP/IP and IPX protocols (for this project, only TCP/IP is used). The router can also be used in bridging applications.

A front view of the router is shown in Photo 3.7 below and on page 1-1 of the router manual.

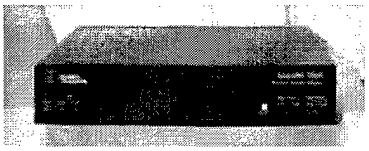


Photo 3.7. Front view of router

A rear view of the router is shown in Photo 3.8 below and on page 1-2 of the router manual.

Photo 3.8. Rear view of router

The router is packaged in a cardboard box measuring approx. 4 inches high by 13 inches wide by 17 inches deep. The box contains:

- router
- power cord
- DB-9 male to DB-25 male cable (for configuring router only)
- SpanNet Bridge/Router Series Installation and Operation Manual (Jan. 1996)

A serial cable for connecting to the Inmarsat terminal and a crossover Ethernet cable for connecting to the computer should also be packaged in this box.

3.3.1 Configuration for Bridging

The router must be configured for each site before it can be used. This has already been done by Georgetown personnel and the information here is only provided for reference. Please note that the remote sites should not change the configuration unless instructed to by Georgetown personnel.

To configure the router, connect a terminal or computer with terminal emulator software to the supervisor port on the back of the unit. You can also telnet into the router from the Dejarnette computer. Terminal settings of 9600-N-8-1 should work fine, but see page 2-2 of the router manual for details. When configuring the router, note that you must save each menu you change by typing X as noted at the bottom of the menu.

As shipped, the routers have been configured as bridges. A bridge connects devices on the same class C ethernet address (in our case, 199.226.69.xxx).

To configure bridging, start by resetting the router to the factory setting by using the Return to Default Setting option on the utilities menu. Then, configure the following items:

- on the WAN/WAN-1 menu, set the speed to 64000 BPS
- on the logical ports /LAN menu, set the port IP address. The router IP addresses are shown in table 3.4.
- on the logical ports /WAN menu, enable compression. If you are having trouble syncing up with the remote router, it is recommended that compression be disabled on both ends.

Site	IP Address
Linda	199.226.69.240
Gradacac	199.226.69.242
Saudi Arabia	199.226.69.244
Georgetown	199.226.69.246

Table 3.4. Router IP Addresses

3.3.2 Configuration for Routing

Note this configuration is no longer used, and the information here is for reference only.

The configuration parameters are described in Section 3 of the router manual. The key configuration items will now be described briefly. From the LAN configuration menu, the parameters were set as shown on page 3-2 of the router manual. Note that is important to choose the correct IP encapsulation, but the default of Ethernet II is correct here. The only exception from the manual is that the IPX network segment was set to 00000000, but I don't think this matters.

The next step is to set the WAN configuration. At the moment, there is only one WAN port, so select WAN #1. The parameters are set as shown on page 3-4 of the manual, except that the speed must be set to 64000 BPS. This is the speed of the WAN link. To exit from any menu and save the parameters, type "X' as indicated at the bottom of the each menu.

The next step is to configure the logical ports. From the main menu, choose Logical Port Summary and you will see a screen similar to that shown on page 3-13 of the router manual. In our case, the screen shows LAN, WAN-1, and WAN-2 at the top. First, select LAN and the screen will look like the figure on page 3-14 of the router manual (except the Physical Port field will say LAN). Since there is some configuration to be done here, I will list all the fields. For the LAN interface, set up the fields as follows:

Physical port: LAN
Frame relay DLCI: 16

Bridging: Disabled
Spanning tree: Disabled
IP: Enabled
IP RIP: Disabled
OSPF: Disabled
IPX: Disabled
Data compression: Disabled

Protocol: Ethernet

Port IP address:	xxx.xxx.xxx.xxx
Port IP mask:	255.255.255.0
Remote IP address:	0.0.0.0[2]
Cost:	0

For the WAN-1 interface, set up the fields as follows:

Physical port:	WAN-1
Frame relay DLCI:	16
Bridging:	Disabled
Spanning tree:	Disabled
IP:	Enabled
IP RIP:	Disabled
OSPF:	Disabled
IPX:	Disabled
Data compression:	Enabled[3]
Protocol:	PPP
Port IP address:	0.0.0.0
Port IP mask:	0.0.0.0
Remote IP address:	0.0.0.0
Cost:	0

Your screen should look like the following when done:

```
LAN         --I--
WAN -1 16   --I-C
```

The next step is to configure the IP route table as described on page 3-19 of the manual. In our case, all traffic is sent to LRMC. Therefore, we want to get a default route to the LRMC router. The IP address of the LRMC router as assigned by Brendan Molloy of LRMC is 199.266.69.250.

Edit the table to look like this:

Dest Address	MASH	Next Hop	Hops
0.0.0.0	0.0.0.0	199.226.69.250	1

[2] This parameter is only used when frame relay is being used and is not applicable here.
[3] Compression is currently turned off at LRMC. If the routers have trouble syncing up, you may need to change this parameter.

3.4 American Power Conversion Uninterruptible Power Supply (Back-UPS Pro 650PNP)

The UPS provides clean AC power to computer systems in order to protect them from power blackouts, surges, and interference. In normal operation, the UPS merely acts to filter the power from the utility source. However, if the utility source fails, the UPS will supply power from its battery until the battery is exhausted or the utility source comes back on-line.

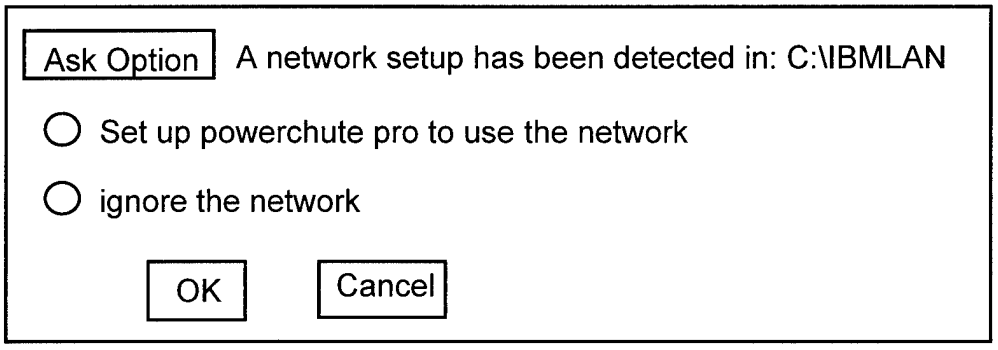
The UPS is shipped in a cardboard box approximately 12 inches high, 11 inches wide, and 20 inches deep, weighing approximately 25 pounds. The box includes the following items:

- UPS unit
- User's manual (hardware)
- User's guide (software)
- 2 cables:
    - 1 black smart cable
    - 1 gray simple cable
- Phone cord (not needed)

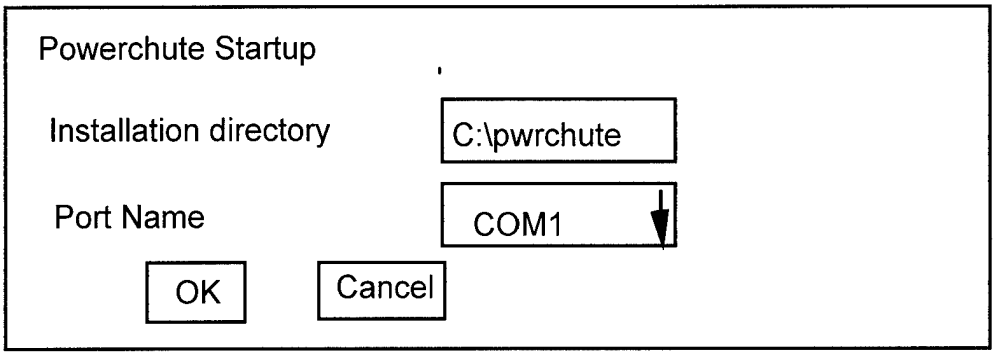
To install the UPS, plug it into a two-pole, three-wire, grounded receptacle only. Do not use extension cords and adapter plugs. The computer and monitor are then plugged into the back of the UPS into any of the four outlets.

To install the back-up software, insert the Powerchute Pro for OS/2 diskette into the floppy disk drive. To open an OS/2 window click on the Administration Screen button. The Administration menu will appear on the screen. Click on the System Shell button. When you see the dialog box just click on the OK button. The C:\ prompt will appear on the screen. Change the C:\ to A:\ (just by typing A:\ and hit return key). When you see A:\ on your screen type install, and follow the instructions. Note that the back-up software is not installed on the units as shipped and should not be unless instructed by Georgetown personnel.

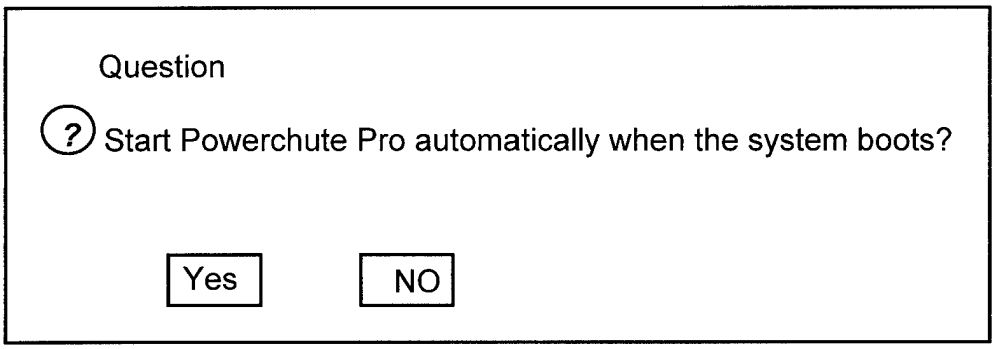
The following dialog boxes will appear on the screen while you are installing the software.



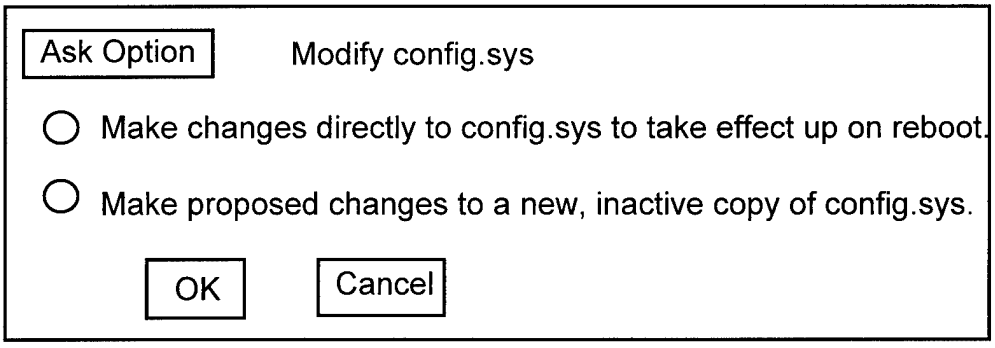
Please click on the second option which is "ignore the network" and then hit OK button.



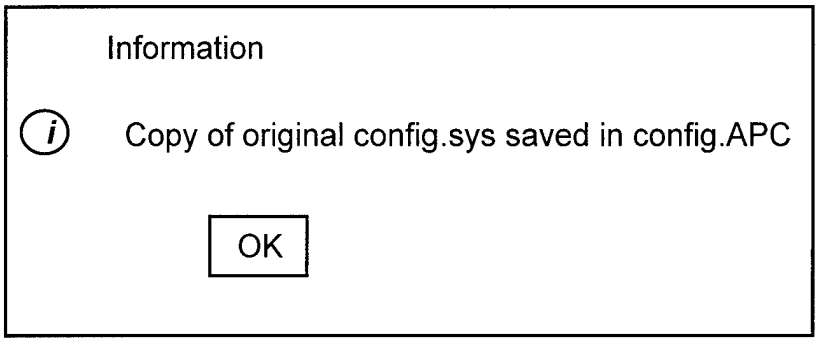
Your installation directory and port name should matches with the ones on the screen.



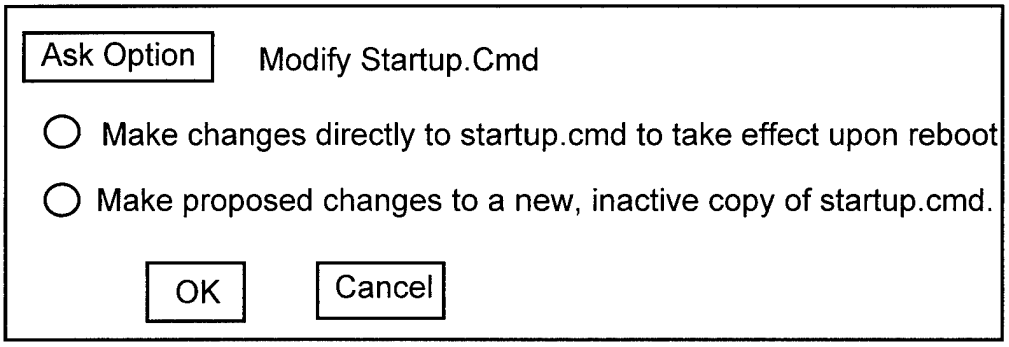
Answer Yes to this question.



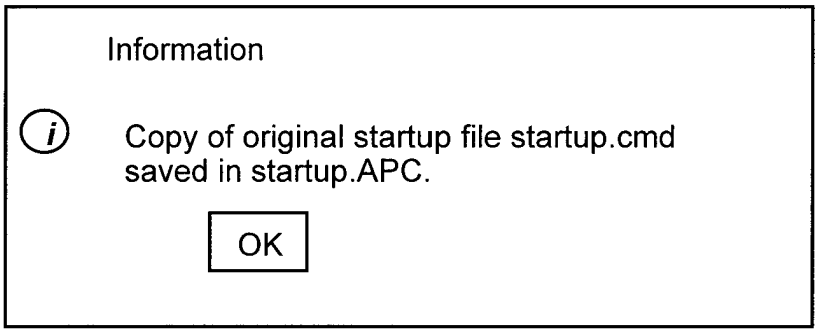
Please choose the first option and click on OK button.



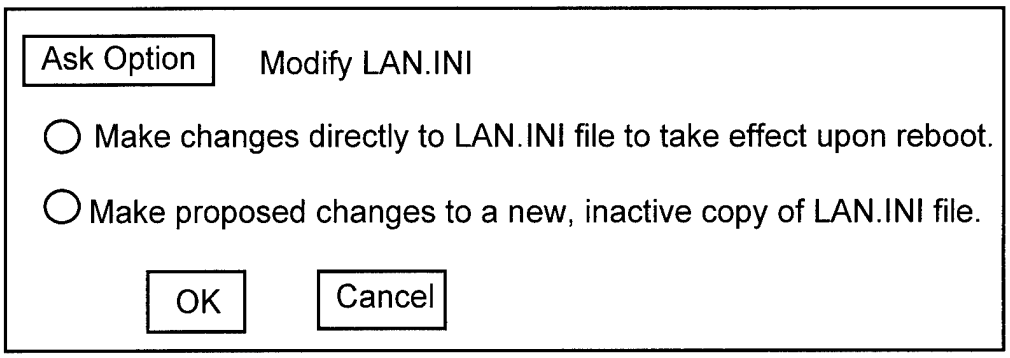
Click on OK button.



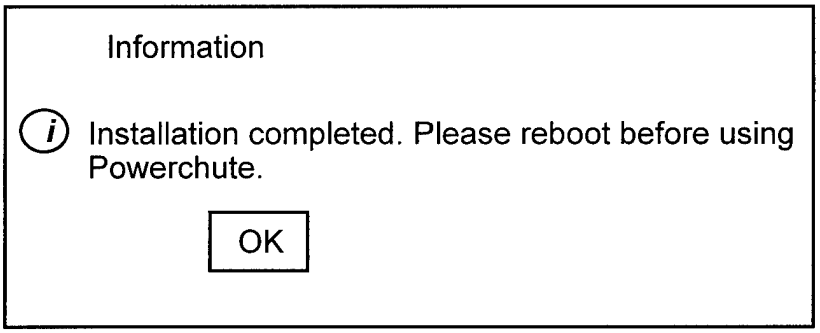
Please choose the first option to make changes directly to startup. cmd and then click on OK button.



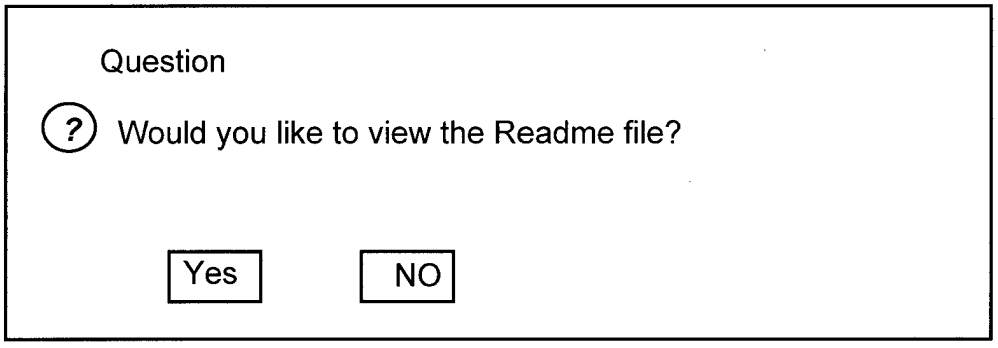
Click on OK button.



Please choose the first option to make changes directly to LAN.INI and then click on OK button.



Click on OK button.



It is suggested that the operator view the Readme file. The installation is now complete.

Note that when the input power to the UPS is lost, the UPS will beep and the yellow light on the front left of the unit will illuminate. At this point, it is best to shut down the computer. The UPS battery will only last for 5 to 20 minutes.

3.5 Nera Telecommunications Inmarsat Terminal (Saturn Bp)

Saturn Bp is a portable Inmarsat-B terminal providing access to the international dial-up telephone, facsimile, and data network. The unit is manufactured by Nera Telecommunications of Norway.

The unit is packaged in a suitcase container 25" wide, 19" deep, and 9" high. The complete system includes the four-section antenna, main control unit, and display handset. There is an Operator's Manual, another manual titled Standard Enhanced Functions, and a High Speed Data Function Manual.

To connect the unit, follow the directions in the Operator's Manual. Here is a brief description of how we proceed. Set up the antenna first. Connect the antenna to the suitcase using a coax cable. Note the right angle connector attaches to the antenna. The next step is to connect the power cord to an appropriate power source. At the PITLAB, we use a 120 VAC source.

As noted in the Operator's Manual on page 1.5, turn on the power. The power switch is on the external connector panel on the left of the unit. When the unit is first turned on, "PLEASE WAIT" will appear in the handset. After a minute or two, the handset will change to "DIAL 00+ ..." and the system is ready for operation.

Note that the antenna must be oriented properly so that the satellite can be found. If you get a "No Satellite Found" or similar message in the handset, the antenna may not be oriented properly or the coax cable may not be connected. Also, check the satellite you are using. At Georgetown and Fort Detrick, we use the AOR-W satellite, but it may be different in the field.

To check the signal strength from the antenna, press SHIFT + 7 as described on page 1.9 of the operator's manual. Adjust the antenna to gain the maximum signal strength. At the PITLAB, we were able to achieve a number in the range of 700 to 800. However, it did work for us in the rain with a signal strength around 300. We have also been able to get a signal strength of 300 to 400 through a window at Georgetown University Medical Center.

3.5.1 Placing a Voice Call

To dial a number using the default land earth station (LES), see page 1.10 of the manual. To dial the PITLAB, for example, key in 001-301-619-3140 and press the pound (#) key. When the phone goes off-hook, the phone icon appears in the handset display (see page 1.2 of the manual for a description of the handset and display). The speaker icon also appears. Then, when the call is established, the yellow light (the second indicator from the right on the handset) comes on.

Don't forget to end the call when done by pressing the escape key. The handset will say "Busy with call" and then the call will be disconnected.

3.5.2 Placing a Data Call

Data mode is described in the High Speed Data Function System Manual. The high speed data (HSD) service provides a 56/64 Kbps full duplex link with the terrestrial ISDN network.

To send data proceed as described in Section 5.2 of this documentation.

3.5.3 Inmarsat Notes

Figure 3.1 shows the external connector panel of the Inmarsat terminal (this figure was taken from page 1.7 of the Inmarsat manual).

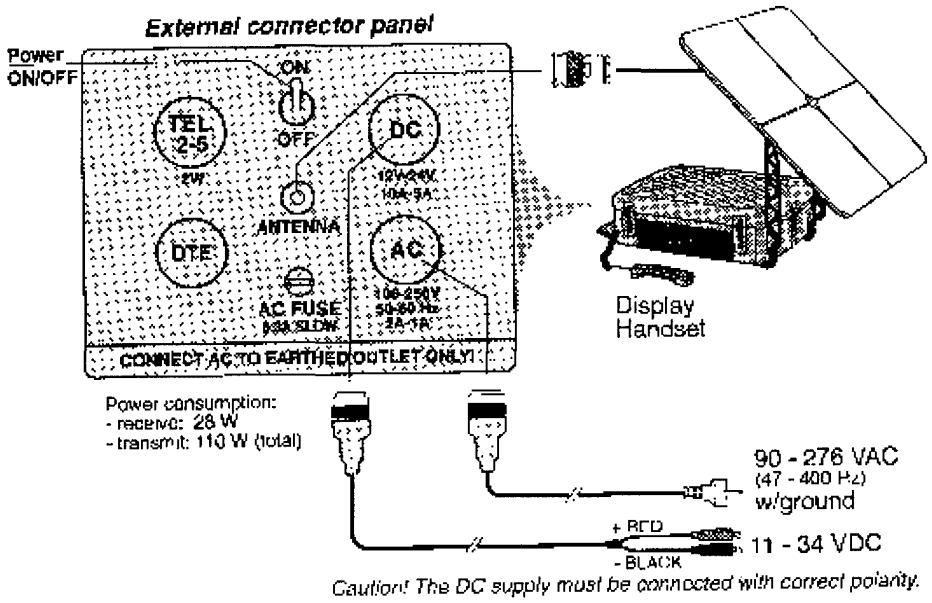


Figure 3.1. External connector panel

Figure 3.2 shows the internal connector panel. Note that the DTE connectors on the external and internal panels correspond to the same serial interface. Therefore, when connecting the Inmarsat terminal to the router as described in section 4.2, make sure there is no unused cable left connected on the **external** DTE connector.

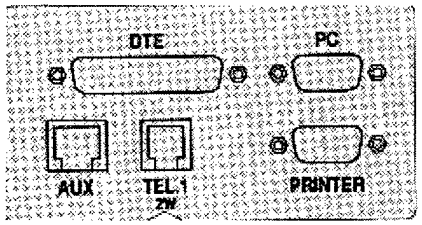


Figure 3.2. Internal connector panel

A photograph of the Inmarsat terminal with the cover open is shown in photo 3.9. Note the cable going to the inside of the box which is connected to router (router is not shown in this photo). The only external connectors used here are the antenna connector and the AC power connector.

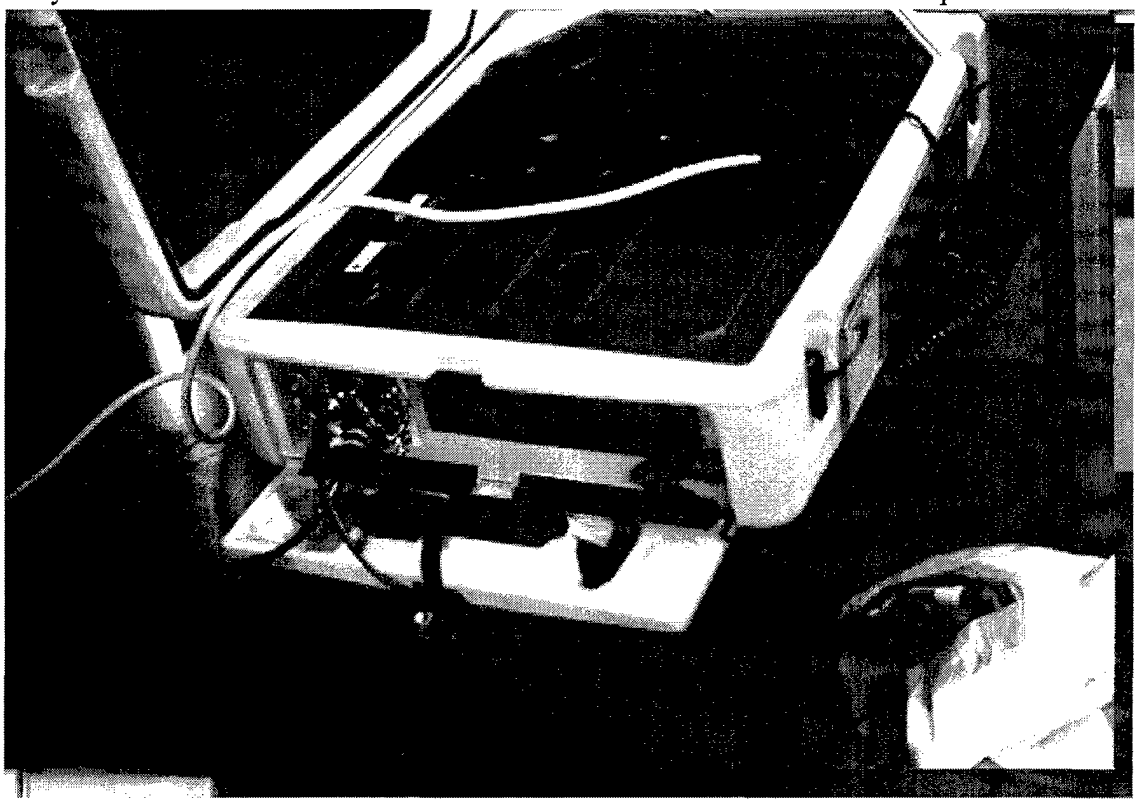


Photo 3.9. Inmarsat terminal with cover open

4. Installation

As described above, the teleradiology package for the remote sites consists of a film digitizer, a gateway computer, a router, and an Uninterruptible power supply (UPS). The first step in the installation process is to unpack each piece of equipment. The next step is to connect the equipment.

4.1 Unpacking the equipment

Unpacking and installation instructions for each piece of equipment are given in the manuals that come with the equipment. A brief summary is given here. The equipment can be unpacked in any order, but a suggested order is:

- American Power Conversion UPS
- Dejarnette computer and monitor
- Eastern Research router
- Lumisys film digitzer

- Nera Inmarsat terminal

It is suggested that each piece of equipment be plugged in and checked separately as it is unpacked before the next piece of equipment is unpacked. Also, adequate table space such as a 30" by 72" table (or 2-3 smaller tables) is required to hold the computer, monitor, router, and Inmarsat terminal. Note that the router must be placed close to the Inmarsat terminal as the cable connecting these devices is short. The computer and digitizer must also be close to each other. A suggested layout is shown in Figure 4.1.

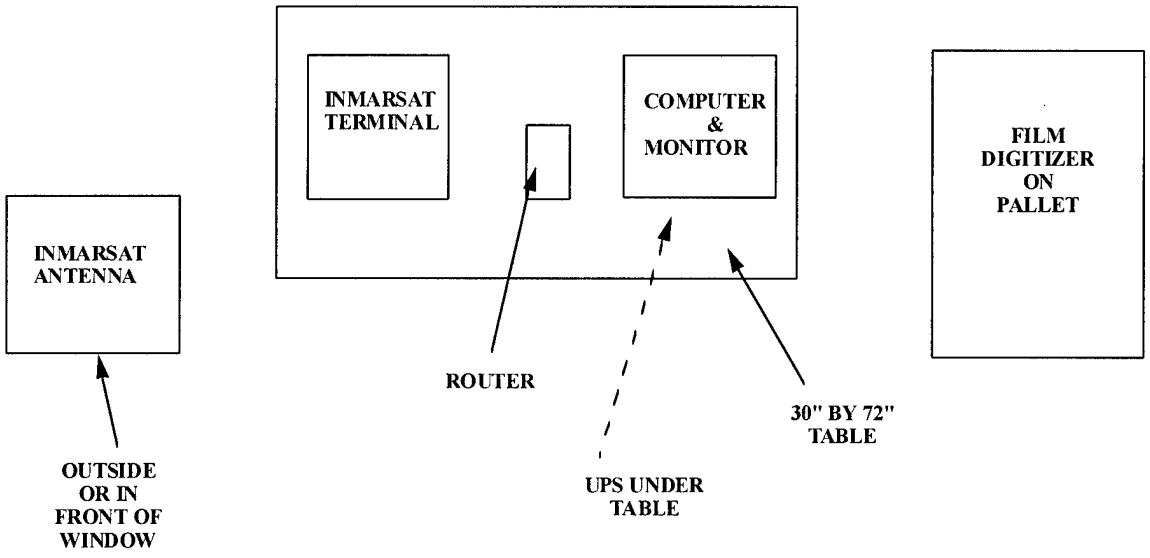


Figure 4.1. Suggested Layout for Equipment

The first step is to unpack the UPS. Save all packing materials and manuals for future use. The UPS is shipped in a cardboard box approximately 12 inches high, 11 inches wide, and 20 inches deep, weighing approximately 25 pounds. As stated on page 6 of the UPS User's Manual, plug the UPS into a two-pole, three-wire grounded receptacle. Avoid using extension cords and adapter plugs. It is suggested that the UPS be put below the table where the computer will sit.

The next step is to unpack the Dejarnette computer and monitor. The Imageshare 1000 is shipped in two cardboard boxes. The first box measures roughly 12" high, 23" wide, and 23" deep and contains the computer, keyboard, and mouse (approx. weight is not known but I guess it's between 25 and 50 pounds). The second box measures roughly 17" high, 18" wide, and 19" deep and contains the monitor (approx. weight is 25 pounds).

The instructions for unpacking the Imageshare 1000 are in Section 4.1.2 on page 14 of the Imageshare 1000 Service Manual. There are no special tools required. Following these instructions, unpack the computer and monitor and connect the equipment. Note that the power cords from the computer and monitor should be plugged into the back of the UPS. You can use any of the four outlets on the back of the UPS as they are all the same.

The next step is to unpack the router. The router is shipped in a cardboard box approx. 4 inches high by 13 inches wide by 17 inches deep. Plug the router into the back of the UPS. The router is plugged into the UPS for surge protection.

The next step is to unpack the film digitizer. The film digitizer is shipped in a wooden crate roughly 21" high, 27" wide, and 34" deep. The crate and digitizer weigh roughly 100 pounds (this is a best guess!). The instructions for unpacking the film digitizer are in Section 4.1.1 on page 13 of the Imageshare 1000 System Manual. The detailed instructions are in the manual, but a wrench and large blade flat screwdriver are required for unpacking. Basically, one removes the six clamp brackets from the bottom of the case using the screwdriver. The crate cover can then be lifted off the pallet. At Georgetown, we typically keep the digitizer attached to the pallet and use the crate cover as a table for the pallet, but the pallet can be removed if desired. See the Imageshare 1000 System Manual for more instructions if needed. The film digitizer also comes with a SCSI cable for connection to the gateway computer. Note this cable is only five feet long so the computer and digitizer must be placed close together.

An accessory box and power cord are also packaged with the digitizer. The accessory box that came with our unit included a combination wrench, a Lumisys Driver diskette, a Lumiscan LSDT Service Manual, and a Lumiscan Operators' Reference Manual. Save these materials for future reference.

Plug the film digitizer into a 120 VAC outlet. Do not plug the digitizer into the UPS as this may overload the UPS.

Unpack the Inmarsat terminal and set it up as described in Section 3.5 of this document.

Now that all the equipment has been unpacked, the next section describes how to connect the equipment.

4.2 Connecting equipment

The equipment is connected as shown in Figure 4.2. The film digitizer connects to the computer through a SCSI cable. The computer connects to the router through a 10BaseT crossover cable. The router connects to the Inmarsat terminal through a serial cable. The Inmarsat terminal connects to its antenna through a coaxial cable.

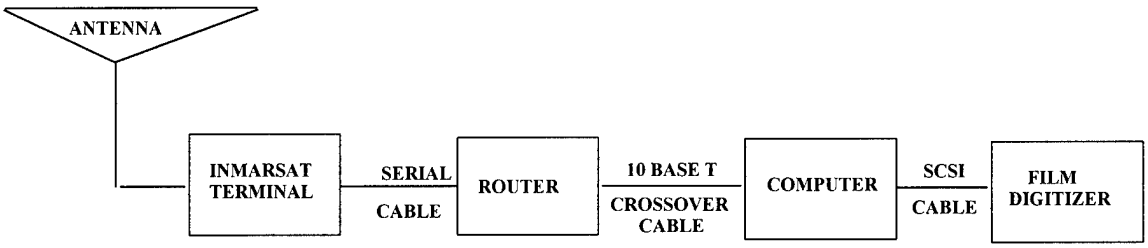


Figure 4.2. Equipment Connection

The connection sequence is as follows.

1. Connect the film digitizer to the computer using the SCSI cable that came with the film digitizer. This cable plugs into the rear of the film digitizer and the rear of the computer. See photo 3.3 for the connection to the film digitizer and photo 3.6 for the connection to the computer.

2. Connect the computer to the router using the 10BaseT crossover cable provided by GUMC[4]. This cable plugs into the rear of the computer and the rear of the router. The connection on the router is labeled 10BaseT.

3. Connect the router to the Inmarsat terminal using the serial cable provided by Georgetown. This cable is a DB-25 male to DB-25 male cable. The connector on the router is labelled "SP10530 SERIAL INT" (WAN # 1). On the Inmarsat terminal, the cable is plugged into the DB-25 connector marked DTE on the inside of the terminal. Note that a short cable is used here to ensure signal integrity.

5. Operation

An image can be digitized and transmitted using the following steps:

Step 1: Digitize the image
Step 2: Establish data connection
Step 3: Send image
Step 4: Disconnect data connection

[4] Note that this cable must be a crossover cable and not a straight through cable since there is no hub between the computer and router.

Each step will be now be described.

5.1 Step 1: Digitize the image

Follow the instructions in the Dejarnette User's Guide and Lumisys manual to digitize images. A summary is given here.

Turn on the film digitizer and allow it to warm up (this may take up to 30 minutes). The power up sequence is described in chapter 3 of the Dejarnette User's Guide and chapter 5 of Lumiscan Operators Reference Guide. The power switch is next to where the power cord plugs in. When the power is turned on, the power LED on the left side of the unit illuminates.

Turn on the UPS by pressing the on/off button in the front top/center. The green light on the front top left will illuminate.

Turn on the acquisition station as described in chapter 3 of the Dejarnette User's Guide. The first step is to flip the power switch on the back of the PC (above the power cord) to the ON position. Then press in and release the power button on the right front of the computer. The green power LED (has a light bulb symbol above it) on the front of the PC will illuminate. Turn the monitor on by pushing the power button on the right front of the monitor to the right. The green LED above the power switch on the monitor will illuminate.

The information below is for reference and troubleshooting only. The startup sequence for the computer is as follows. First, there is a BIOS check, followed by an OS/2 WARP display. Then, a line stating "The current hard disk drive is C:' appears. Next, some text scrolls by including some messages about Digital Equipment Corporation and the default router (if configured). Finally, the GUI starts. The first window is titled "STARTUP.CMD". In this window, a message will appear stating "The Requester service is starting..." and this will continue for a minute or two. Finally, the main menu should appear as described in chapter 3 of the Dejarnette User's Guide. The entire process takes about 2-3 minutes.

Click on the Acquisition screen button from the Main Menu to open the application screen. Then, review chapter 4 of the Dejarnette User's Guide for an overview of this screen and the user interface in general.

To digitize an image, note the instructions in chapter 5 of the Dejarnette User's Guide. A brief summary is given here. First click on the Patient Worklist button to enter new patient data. From the Patient Worklist screen, click on the New button to add a new patient. On the New Worklist Entry screen, there are 3 parameters that must be entered:

- Patient Name
- Patient ID
- Study ID

Note that the last name of the patient should be entered first in the Patient Name field.

When the New Worklist Entry screen is complete, click on the OK button to close the window. Then click on the OK button on the patient worklist screen to return to the application screen. At this point, the patient data you just entered should appear at the top left of the screen. The system is now ready to digitize an image.

The following parameters should be set[5]:

- Mode (always use preview)
- Pixel size (use 12 bit)
- Resolution (high)

Place the film in the carriage of the film digitizer following the labels on the front of the digitizer. See photo 3.2 for where to place the film. Appendix A of the Dejarnette manual also describes how to place the film.

Click on the Acquire button to scan the film. Once the film has been completely scanned, it will drop into the film tray.

Examine the image on the computer monitor. If the image is not in the required orientation, flip or rotate the image until it is oriented properly.

5.2 Step 2: Establish data connection

The data connection is establish using the Inmarsat terminal. One can dial out on the Inmarsat terminal as described in the High Speed Data Manual and reproduced in Figure 5.1. Since the figure is a little hard to read, the steps will be detailed here.

1. Make sure the terminal is ready for operation (handset shows DIAL 00+INTL). If not in this mode hit the ESC key.
2. Select data call mode by pressing the SHIFT key, then the DATA key (a data indicator that looks like a tape icon should appear in the handset).
3. Key in the subscriber number. For the ISDN line at LRMC, use 00496371912174.
4. Press the # key to send the number.
5. If the dialed number rings, you will see HSD RINGING in the handset.
6. If the dialed number connects, HSD CONNECTED will appear in the handset and the yellow light will come on (the second indicator light from the right in the handset).

[5] Images for primary diagnosis should be digitized in 12 bit high resolution. However, since these images can take a long time (20 minutes or greater) to transmit, one may want to digitize an 8 bit low resolution image when training or testing the transmission link.

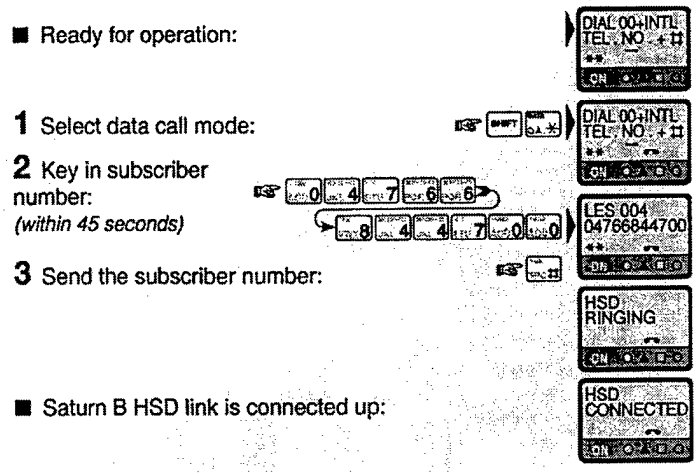


Figure 5.1. Dialing Using Inmarsat Terminal

Once the data connection is established, the routers should sync up. If the routers have synced up, the ALM light on the front of the router will not be lit (normally it is red when not communicating with another router).

5.3 Step 3: Send image

To send the image, first select a destination from the Destination Box. The destinations are as listed in Table 3.2. For training, LRMC_500 or LRMC_1000 is suggested. Then, click on the Send Image button.

The progress of the transmission can be monitored by watching the status area at the lower left of the Imageshare 1000. You will see:

- Sending image....
- Building message....
- Transmitting to.....

When the transmission is complete, a message will appear in the status area. Note that it can take 20 minutes or greater to send a high resolution 12-bit image.

After all the images that comprise a study have been sent, click on the End Study button. This will let the receiving site know that all images for the current study have been sent.

Note that if the image is not successfully transmitted, the Imageshare 1000 will automatically retry transmission after a brief time interval. The only way to stop the system from retransmitting is to go to the directory where the image files for transmission are stored and delete them. These files are in directories under C:\usr\images and stored by destination. You must then shut down and restart the system.

5.4 Step 4: Disconnect data connection

The data connection must be disconnected on the Inmarsat terminal when the transmission is complete. This is extremely important as otherwise satellite transmission costs will continue to accrue. To disconnect the data connection, press the ESC key on the display handset. The handset will say "BUSY WITH CALL" and then return to the default state.

6. Appendices

6.1 Equipment List and Serial Numbers[6]

6.1.1 Remote Sites

Equipment	Vendor	Item	Serial # Linda (Bosnia #1)	Serial # Gradacac (Bosnia #2)	Serial # Saudi Arabia	Serial # Georgetown	Size[7] (height x width x depth) (inches)	Weight (lbs.-est.)	Volts	Current Draw (amps)
film digitizer	Lumisys[8]	Model 75	7832	7754	2075	7346	21 x 27 x 34	100	100-120	1.5
gateway computer	Dejarnette	Imageshare 1000	IM1000 2441-0310	IM1000 2441-0307	IM1000 2441 0309	IM1000-2441-0311	12 x 23 x 23	25-50	100-120	3.0
computer monitor	Dejarnette		A155075658	A155080294	A153761927	A155080293	17 x 18 x 19	25	100-240	2.0
router	Eastern Research	SpanNet 2500	106274	105587	106273			10	110	0.250
UPS	APC	650PNP	096067214293	096067214316	096067214322		12 x 11 x 20	25	120	

[6] The Inmarsat terminal is not listed here as it is government furnished equipment.
[7] These are the dimensions of the boxes the equipment is shipped in.
[8] Lumisys is the manufacturer but the film digitizer was purchased through Dejarnette.

6.1.2 LRMC (GUMC purchased)

Equipment	Vendor	Item	Serial #	Dimensions (height x width x depth) (inches)	Weight (pounds - approx.)	Voltage	Current Draw (amps)
terminal adapter	Black Box	Model 75			10	230	
router	Eastern Research	SpanNet 2500	106275		10	230	

6.2 Points of Contact

Name	Company	Location	Position	Phone[9]	Email
Pat Caselli	Eastern Research	New Jersey	technical assistance	800-337-4374	pat@erinc.com
George Hobday	Yorkleigh Engineering	Baltimore	router sales/support	410-876-7424	
Brendan Molloy	LRMC	Germany	network division	011-49-6371-86-7749	molloy@larmc-amedd.army.mil
Dale Garaux	LRMC	Germany	network division	011-49-6371-86-7899	Dale_Garaux_at_LRMC1__LANDSTUHL@ftdetrck-ccmail.army.mil
Craig Taylor	LRMC	Germany	primetime support	011-49-6371-86-7746	craig_taylor@larmc-amedd.army.mil
Chris Motlenski	Mackay Comms. (Inmarsat rep.)	New York	Inmarsat sales/support	516-666-1596 (skypage: 800-759-7243 x2770156)	
Gyrid Elder	Nera Telecomm.	Norway	Saturn Bp product manager	+47 66 84 44 64	gyrid.elder@nera.no
Sigvald Refsum	Nera Telecomm.	Norway	applications manager	47 66 84 43 99	sigvald.refsum.@nera.no
Bill Peterson Dan Mueller	Dejarnette	Baltimore	technical support	410-583-0680 x200	support@dejarnette.com
Kevin Cleary	Georgetown University	Wash. DC	Bosnia support	202-687-8253 (page: 202-901-2033)	cleary@isis.imac.georgetown.edu
Betty Levine	Georgetown University	Washington. DC	Bosnia support	202-687-7950	levine@isis.imac.georgetown.edu

[9] Overseas numbers are given as dialed from the states.

6.3 Troubleshooting

This section contains troubleshooting tips.

6.3.1 Problem Shutting Down Dejarnette Computer

Press ctrl-Esc to get a list of windows. Also, use Alt-Tab to move from window to window. Select the GUI with STARTUP.CMD as the title. Scroll down to the bottom of the window. If the C:/ prompt is not visible, hit ctrl-c to get a C:/ prompt. Type "chkdsk" and press enter to run this utility. Type "shutdown" to shutdown the computer and answer yes to the message box. When you see:

> Shutdown has completed.
> It is now safe to turn off your computer, or restart the system by pressing ctrl+Alt+Del.

You can turn off the computer.

6.3.2 Problems Digitizing Images

If you are unable to digitize an image, first check that the digitizer is turned on and connected to the gateway computer. The directory C:\lsdt\tools contains some utility programs for testing the digitizer and its communications with the gateway computer. The contents of this directory are described on page 7-4 of the Lumiscan LSDT service manual. Since these programs are intended for use by service engineers, exercise extreme caution when using these programs.

For a simple test of the digitizer's ability to acquire images, run the program DDT.EXE. Place the film to be scanned in the digitizer and press 1 to scan the film. Press Enter to accept the default value of 2048 pixels per line. If the digitizer and communication with computer are OK, the film will be scanned.

6.4 Configuration of LRMC

The configuration at LRMC is as shown on the right hand side of Figure 2.1. There are two pieces of equipment here that need to be configured:

- Eastern Research Remote Access Router (Span Net 2500)
- Securicor 3 net Mini WIZARD VOX ISDN Terminal Adaptor

Router configuration in general was discussed in Section 3.3. The LRMC router is configured for bridging as described in Section 3.3.1.
However, note there are two WAN ports installed here so you must configure WAN-1 and WAN-2. The IP address of this router is 199.226.69.250. This router has a password- contact Georgetown if you need it.

There is one more menu that needs to be configured here. A defult rout must be entered in the IP route table (see the router manual on the bottom right of page 3-19 for details). Enter the following:

Dest Address	0.0.0.0
mask	0.0.0.0
Next Hop	199.226.69.1
Hops	1

Finally, Ip may need to be enabled on WAN-1 and WAN-2. For now it is enabled and the router works, so I recommend you leave it like that.

The Mini WIZARD is an ISDN terminal adaptor with 2 data ports, 2 voice ports, and a configuration port. A sketch of the front panel (page 1-3 in the Mini WIZARD manual) is shown in Figure 6.1. A sketch of the rear panel (page 1-4 of the Mini WIZARD manual) is shown in Figure 6.2.

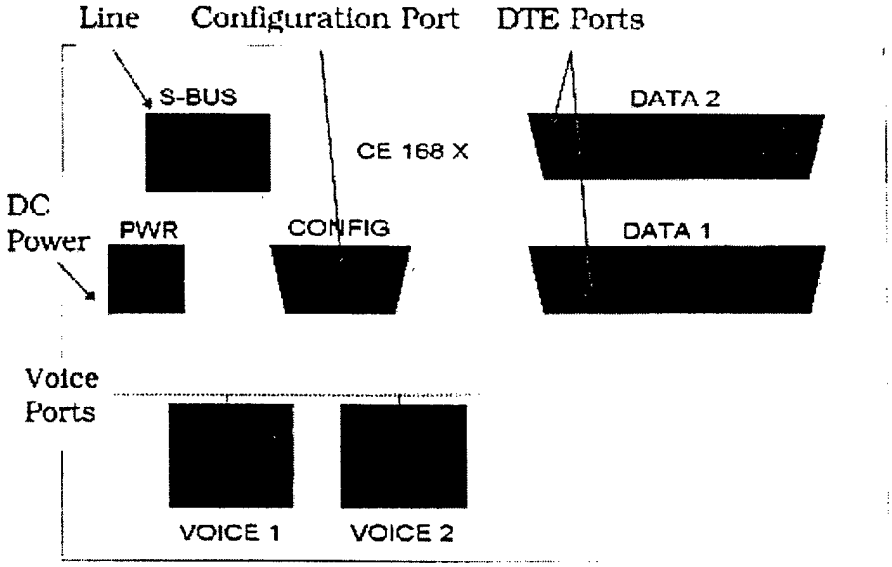


Figure 6.1. Rear View of the Mini WIZARD VOX

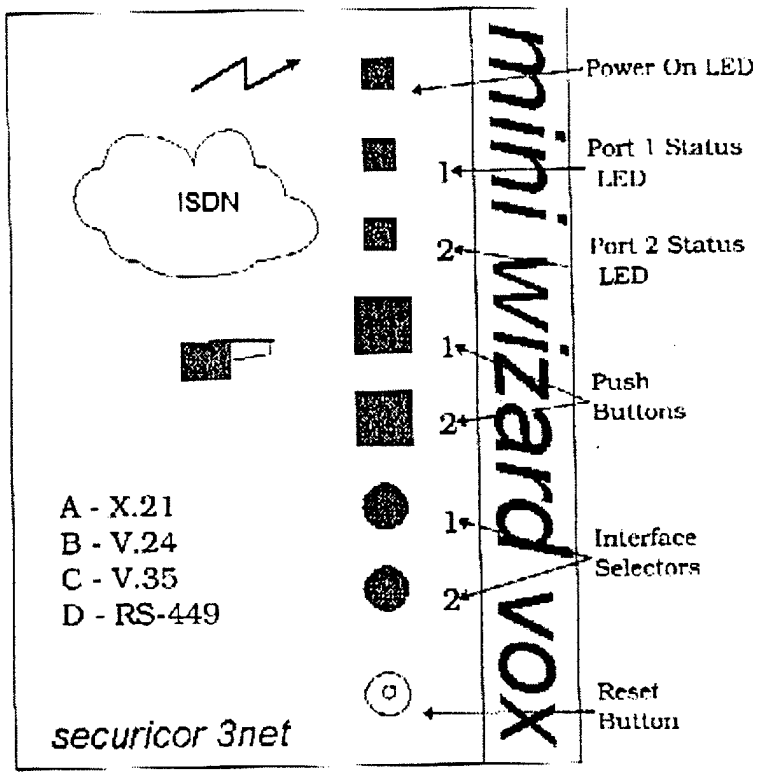


Figure 6.2. Front View of the Mini WIZARD VOX

The Mini WIZARD is connected to the router through two standard serial cables. The DATA1 port on the Mini WIZARD is connected to the WAN # 1 port on the router. The DATA2 port on the Mini WIZARD is connected to the WAN # 2 port on the router.

The Mini WIZARD must also be configured. The front panel interface selector switch (both 1 and 2) must be set to V.24. Then, a terminal or PC running terminal emulation software must be connected to the CONFIG port using a serial cable. Each data port should be configured as follows:

set port sync
set monitor enabled
set answer auto
set filter disabled

Note you may also need to save the parameters once they are changed. See the manual for details.

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