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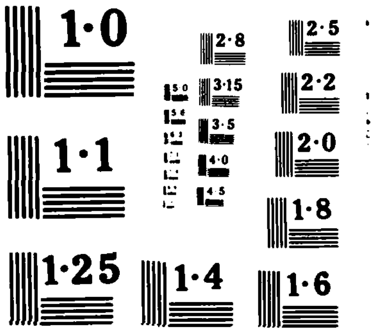
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Prepared in Response to

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Title: SCIENTIFIC AND TECHNICAL REPORTS, TYPE II FINAL

Prepared by

NORTHROP CORPORATION
ELECTRO-MECHANICAL DIVISION

NORTHROP

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Electro-Mechanical Division
Electronics Systems Group
Northrop Corporation
500 East Orangethorpe Avenue
Anaheim, California 92801
Telephone 714 871-5000

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Night Vision & Electro-Optics Center
Visionics Division
Ft. Belvoir, Virginia 22060-5677

Attention: DELNV-V
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Subject: Management Information & Downloader
Interface System (MIDIS)
Contract DAAL01-85-C-0404

Reference: CDRL Item No. S002
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Gentlemen:

Northrop Corporation, Electro-Mechanical Division, herewith submits the referenced data item in accordance with the requirements of the subject contract.

NV&EOC is requested to sign and date the attached Material Inspection and Receiving Report, DD Form 250 in Block 21B and return it to the attention of D. E. Robbins, Orgn. 2858/Y16-4.

If additional information should be required, please contact the undersigned on telephone (714) 441-4784.

Very truly yours,

NORTHROP CORPORATION
Electro-Mechanical Division

J. K. Francois

J. K. Francois, MIDIS Data Manager
Configuration & Data Management
Y7461/Y16-3 (714) 441-4784

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NORTHROP CORPORATION
ELECTRO-MECHANICAL DIVISION

Approved by: Stan Wong Per GSR
S. Wong, Project Engineer

Approved by: MO Paul
M.O. Paul, Program Manager

NORTHROP

Electro Mechanical Division
Electronics Systems Group
Northrop Corporation
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Document # 321953 -1
September 11, 1987

FINAL REPORT

for

Management Information and Downloader Interface System (MIDIS)

Contract Number DAAL01-85-C-0404
Contract Period August, 1985 - September, 1987
CDRL Item S002

Prepared by Stan Wong
MIDIS Project Engineer
(714) 441-4269

Northrop Corporation
Electro-Mechanical Division
500 E. Orangethorpe Avenue
Anaheim, CA 92801

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1.0 SCOPE

The Final Scientific and Technical Report, Type II for the Management Information and Downloader Interface System (MIDIS) has been developed in accordance with the requirements of Data Item DI-S-10614 and the Contract Data Requirements List (CDRL) Sequence Number S002.

1.1 Definitions and Abbreviations

ASSET	-	Airborne Sensor System for Evaluation and Test
ATRWG	-	Automatic Target Recognizer Working Group
CCT	-	computer compatible tape (i.e. 9-track tape)
DEC	-	Digital Equipment Corporation
HBR	-	high-bit Rate
HBR I/F	-	HBR interface unit
MIDIS	-	Management Information and Downloader Interface System
RDBMS	-	relational data base management system
VAX	-	VAX-11/780 computer

2.0 EXECUTIVE SUMMARY

2.1 MIDIS Overview

The Management Information and Downloader Interface System (MIDIS) is a program to develop the foundation for an advanced sensor test facility for the U.S. Army Center for Night Vision and Electro-Optics (CNVEO). MIDIS will perform a variety of tasks related to the acquisition, manipulation, and animation of image data collected from a variety of sensors with differing formats and media. In addition, MIDIS will collect, manage, and make available ground truth information from high bit rate (HBR) digital tapes formatted to the Advanced Target Recognizer Working Group (ATRWG) specification of February 1985.

The MIDIS functions are :

- o download to computer disk image data in the following formats :

  a) HBR digital tape,
  b) 9-track magnetic tape,
  c) 525- and 875-line analog video tape,

- o collect and catalog ground-truth data from HBR tapes;

- o manipulate image data;

- o manage image data catalog (ground truth),

- o upload images on computer disk to :

  a) HBR ATRWG tape,
  b) 9-track magnetic tape,
  c) 525- and 875-line video tape
  d) monitor

The MIDIS Program hardware and software configuration nearly matches that of the Northrop Image Processing facility. Northrop has developed a number of hardware and software capabilities using its own capital funds as it continuously evolves a state-of-the-art image processing facility with the maximum functionality for the lowest possible cost. The intent is to reduce the risk and expense to the MIDIS program by using technology already developed at Northrop.

2.2 Program Objectives

The MIDIS Program objectives can be classified into two main areas: technical and risk/cost. The overriding concerns of the program were to maximize technical return while minimizing cost and risk.

2.2.1 Risk/Cost Approach

The Northrop Corporation Electro-Mechanical Division is developing a state-of-the art research and development facility for developing hardware, software, and algorithms for automatic target recognition (ATR) applications. Since Northrop is investing its own money in the facility the overriding concerns are that the maximum functionality and maximum flexibility be achieved for the lowest possible cost. Function and flexibility are favored over throughput issues.

The MIDIS Program was designed to benefit from Northrop's experience by essentially duplicating portions of their system already in place or under development and expanding certain capabilities through software enhancement.

2.2.2 Technical Objectives

The primary mission of the MIDIS is to collect, catalog, and distribute data for ATR algorithm developers. The data are collected primarily from test ranges with static and/or moving targets. The usual platform containing the image-gathering sensors is a helicopter. Data are recorded on analog video tape (525- and 875-line) and on high-bit rate (HBR) tape recorded to the Automatic Target Recognizer Working Group (ATRWG) 85-001 standard.

HBR tapes are starting to be gain wider acceptance and usage. But not every user can accept 28-track track tape as input to their image processing system. Analog video tapes and 9-track computer compatible tape (CCT) are also important media that must be created as well as read since there exists a large historical image data base.

Another important source of data is the CNVEO ASSET helicopter. Data are collected on HBR tapes in a unique format. This format was developed before the ATRWG standards were finalized.

2.2.3 Program Objective Results

The MIDIS Program as a whole was successful with all major technical objectives achieved. The program was successfully completed within budget but later than planned. This was due to some turnover in design engineering personnel. In addition, some minor slippage was caused by unexpected results from the ASSET Program. This is discussed in following paragraphs.

2.3 Technical Issues

The MIDIS development fell into three categories:

- o System integration
- o HBR interface hardware and software
- o Executive software

2.3.1 System Integration

Computers and peripherals from many different manufacturers comprise MIDIS. Even though the same models of equipment were specified for MIDIS to match the Northrop configuration as closely as possible, equipment model variations due to the passage of time created problems. None of these problems were technical in nature but took time to solve.

Another major problem was incomplete and sometimes incorrect documentation supplied by vendors. The major headaches were encountered in the ASSET tape format specification by way of the Recorder Signal Processor Electronics (RSPE) and the Digital Equipment Corporation (DEC) DR11-W interface used in the HBR interface.

Equipment performance figures provided by equipment vendors were usually optimistic. While past experience on other programs have taught us that these figures are usually theoretical maximums, trying to decide on nominal numbers took some educated guesswork and laboratory experimentation. This can make committing to a technical approach during the proposal phase quite risky.

2.3.1.1 ASSET Integration

The RSPE portion of the ASSET system was changing while we were developing the HBR interface. The result was a successful test of MIDIS at Northrop but initial problems were uncovered during system installation and test at CNVEO. Please refer to section 4.1.2 for more information.

2.3.2 HBR Interface

The HBR interface is a complex device. This is due almost entirely to the fact that it must be compatible with the ATRWG 85-001 specification for 28-track tapes. This specification provides flexibility to record data in a variety of formats. This imposes a burden on the interface since it must accommodate the entire range of possible formats. For instance, vertical and horizontal blanking times are usual components of video images, however, the ATRWG specification allows the retrace times to be eliminated.

2.3.2.1 HBR Tape Drives

The HBR Tape Drives themselves posed a few problems. The main problem is that the Ampex HBR is a fast (10MHz) streaming device. Since it is not a start/stop device the computer and interface must be able to accept the data as it comes.

Most of the problems encountered involved differences between the Ampex HBR 1700i and 3000i models used for testing. Ampex Field Service was called out on numerous occasions to ensure optimal performance of the HBR units.

2.3.2.2 Asymmetric Data Transfer Rate

The time to transfer one pixel worth of data between the HBR interface and the VAX computer differed depending on the direction of the transfer. In theory the transfer time should be identical.

The time to transfer a pixel out of the VAX (upload) is longer than the time required to transfer a pixel into the computer (download).

The HBR interface itself was eliminated as a possible source if the asymmetric data transfer time. This leaves the VAX computer itself as the source of the extra time used. Our rough analysis shows that the software driver supplied by DEC for the DR11-W interface is probably the source of the extra time. A custom modification would be necessary to eliminate the extra time.

Operationally, the asymmetry in data transfer rates poses no problem. On output (uploading), the horizontal and vertical blanking intervals are recreated to give a 30Hz frame rate. This is more than enough time to transfer all pixel data. On input (downloading) the ATRWG 28-track standard states that there need not be any inactive pixel time. The interface is fast enough in either case.

2.3.2.3 Pixel Offset

Pixel data that is downloaded is shifted by one pixel. Taking the pixel shift into account, however, the downloaded data compares on a bit-by-bit basis demonstrating the accuracy of the upload and download cycle.

2.3.2.4 ASSET Interface

ASSET generated HBR data does not conform to the ATRWG specification. It has implicit rather than explicit video timing information. The MIDIS hardware must re-generate the proper timing signals. Since the interface receives no timing information it must make certain assumptions. This can lead to glitches in the data stream if the tape/tape drive/tape speed combination is not consistent.

2.3.3 Executive Software

No significant problems were encountered during the development of the Executive software. Most of the problems encountered were minor in nature and can be classified as being system-integration in nature.

2.4 Technical Results

2.4.1 ASSET Interface

The ASSET HBR interface uncovered several problems with recordings made with the ASSET helicopter via the RSPE/DSC. With the appropriate support from Rockwell, these RSPE/DSC problems can be corrected before extensive data collection efforts are made. Specifically, image inversion and image "compression" are two items which are noticed when the ASSET-generated HBR tapes were played on MIDIS.

2.4.2 HBR Tape Creation

The ability to create an HBR tape from real or synthetically generated data in non-real time is a unique feature in the image processing field. The ability to generate synthetic data on the VAX computer and create an HBR tape to test sensor systems is potentially a powerful tool. Real and synthetic data may be merged using the Megavision image processing facilities. A potential application would be to record a real background and then merge synthetically generated moving targets into the scene. This would have two advantages:

- o Target characteristics are precisely known,
- o Expensive data collection effort at test ranges would be minimized or eliminated.

2.4.3 Image Media Conversion

The MIDIS system can process image data from a variety of sources and output in a variety of different media formats. This is a unique feature that does not exist elsewhere except at Northrop and CNVEO to our knowledge. The media conversions are summarized in paragraph 2.1.

2.5 Findings and Conclusions

The major conclusions of this program can be summarized as follows:

- o ATRWG 85-001 specification is too general
- o HBR bandwidth not high enough
- o HBR technology is expensive

2.5.1 ATRWG Specification

The ATRWG 85-001 specification for 28-track HBR tapes is too general. It allows for too many recording possibilities which complicates the interface. In addition it allows for the recording of data which is not compatible with video technology. That is, image data does not need to be recorded with the necessary horizontal and vertical retrace times necessary for display on a video monitor.

2.5.2 Bandwidth

The ATRWG specification allows for a data rate of 10MHz which is insufficient for recording full-frame 875-line data. Since this is the video standard of the U.S. Army, other video recording technologies should be investigated.

2.5.3 HBR Technology

HBR technology suffers from several deficiencies which has slowed its adoption by government agencies and commercial firms. The bandwidth limitation is discussed above. The high cost of a system is the other major limitation. The entry cost for one system is about $200K. This is in addition to the cost of interfacing the system to a computer or a display subsystem.

A simple operation like duplicating a tape would require two recorders. The investment then starts to approach $400K.

2.6 Further Research

There several areas which should receive further attention

- o Newer digital recording technology
- o Ground truth merge function
- o User interface
- o Higher Bus Bandwidth (Faster data transfer)

2.6.1 New Digital Recording Technology

New techniques for recording high-bandwidth, high-rate digital data should be investigated. The limitations of the current digital HBR systems have been briefly discussed earlier. A potential candidate is the high-speed cassette technology developed by Ampex.

2.6.2 Ground Truth Merge Function

The MIDIS system allows image data and ground truth data to be merged onto a new HBR tape. The source of the ground truth data comes from real-time sources. In some situations it would be desirable to pre-compute all the ground truth ahead of time, such as in a ground truthing situation, and then merge it with the pixel data in non-real time.

2.6.3 User Interface

The Megavision 1024XM environment is not as robust as other image processing systems in terms of user and programmer friendliness. It does have comparable image processing functions with other image processing systems.

Northrop has, and is continuing, to develop a consistent and powerful user interface for image processing systems. Currently versions exist for the Megavision (MIS) and the I2S (IIS) systems. The advantage to the user is that regardless of which system he or she is using, the interface remains the same.

2.6.4 Future Growth

Faster data transfers mean less time to upload and download images and ground truth data. The current 40:1 slowdown in downloading images is due to the bandwidth limitations of the DR-11W general-purpose interface and of the UNIBUS.

The DR-11W has a maximum data rate of 250 Kpixels/second and the UNIBUS has an effective data rate of 750 Kpixels/second. A higher speed interface is available however it is unique to the VAX-11/780 computer. The DR-11W is, or should be, transportable to any UNIBUS equipped VAX computer.

Since the project was initiated, the Digitial Equipment Corporation has introduced a new line of VAX computers with a newer and faster interface called the BI bus. The DRB-32 is the general-purpose interface which, as one of its operating modes, emulates the DR-11W/UNIBUS combination.

The DRB-32 would theoretically allow a data transfer rate slowdown of 2:1. The HBR interface would have to be redesigned although the basic architecture would remain unchanged. At issue is whether or not the current architecture would require integrated circuits faster than what is currently available. A separate study would have to be performed to accurately determine the feasibility of this change.

The benefit in productivity from such a large speed gain would be significant. A side benefit of the faster bus would be a faster CPU which would allow more data processing to occur. A processor in the range of the VAX 8530 to 8800 would be appropriate and allow for expansion.

The DRB-32 would also allow migration to the DEC BI architecture without modifying the HBR interface hardware. Of course the speed of downloading and uploading would remain the same but greater processing power would be available for other tasks.

2.6.5 Real-Time Ground Truth Merge

A different real-time ground truth merge facility would be useful in addition to the capability delivered. Rather than recording real-time ground truth data, the ground truth would be prepared in advance on the VAX computer and then merged with pixel data in real-time.

Currently ground truth data consists of two portions:

- o Invariant data which stays fixed from field to field,
- o Real-time data which changes over time.

The invariant data is pre-loaded into the ground truth RAMs using the DUB operation. Only the first 2K words are processed. This is intended for data which does not change such as the sensor information (e.g. sensor serial number). This can also be used for data which does change but not a significant amount for the recording run (typically less than ten minutes). An example might be the observed weather conditions.

The MIDIS HBR interface allows up to 253 real-time inputs to be written to the ground truth track. An example of this capability might be the recording of real-time weather information.

The new concept behind the real-time ground truth merge is to "dub" a new ground truth track onto an existing HBR tape. Dubbing is not possible, however, due to limitations of the Ampex HBR tape units. In practice, pixel data from one HBR tape unit could be merged with a pre-prepared ground truth track in the VAX computer and written to another HBR tape unit in real-time. This has the disadvantage that it is inherently susceptible to loss of synchronization if bit errors are encountered from the HBR recorder source.

The discussion of this new capability was the subject of several documents. Our white paper of May 4, 1987 outlines an approach preferred by Northrop. Subsequent to meetings held with CNVEO on May 4-5, a revised approach preferred by CNVEO was submitted by Northrop on August 7, 1987.

2.6.6 Monitor Mode

There is a desire to improve the performance of the 875-line monitor mode. The operation of the system is not affected currently by this: i.e. DOWNLOADED data is not affected by displayed image quality.

It is perceived that the 875-line MONITOR mode displays a picture that is noisier than the 525-line mode. There are several possible sources of the noise probably due to interaction between signal lines and other external sources. In addition, digital aliasing is also causing some of the perceived degradation of the image although there is little that can be done because the video digital-to-analog conversion is done internal to the video (DAC) integrated circuit. Only filtering the higher frequencies can reduce aliasing; this also reduces image bandwidth.

3.0 APPLICABLE DOCUMENTS

This document refers to material contained in other deliverable documents under this contract. Detailed information about the hardware and software can be found in the following documents.

MIDIS User's Manual, CDRL M003, Northrop Document # 321951
MIDIS RDT&E Manual, CDRL M001, Northrop Document # 321949-2
MIDIS Monthly Progress Reports, CDRL A002,
    Northrop Document # 321946-1 through # 321946-19
MIDIS Interim Reports, CDRL S001
    Northrop Document # 321952-1 through # 321952-2

Megavision User's Manual
Megavision Programmer's Manual

Oracle User Manual Set

VAX User Manual Set

In addition, much of the information contained in this report refer implicitly to the following ATRWG specifications:

ATRWG 85-001 28-Track HBR Tape Specification
ATRWG 85-002 9-Track Computer-Compatible Tape Specification

4.0 SYSTEM

The Management Information and Downloader Interface System (MIDIS) is a program to develop the foundation for an advanced sensor test facility for the U.S. Army Center for Night Vision and Electro-Optics (CNVEO). MIDIS will perform a variety of tasks related to the acquisition, manipulation, and animation of image data collected from a variety of sensors with differing formats and media. In addition, MIDIS will collect, manage, and make available ground truth information from high bit rate (HBR) digital tapes formatted to the Advanced Target Recognizer Working Group (ATRWG) specification of February 1985.

The overall system is described in the following paragraphs. The specifics of the hardware and software can be found in sections 5 and 6, respectively.

The system is depicted in Figure 4-1 on the next page.

4.1 Digital Interface

The digital interface of MIDIS consists of two portions: HBR and CCT. The HBR interface can read and write 28-track HBR tapes. The CCT interface can read and write 9-track computer-compatible tapes.

4.1.1 HBR Interface

The HBR interface is a Northrop designed and built device that provides a flexible means of reading and writing 28-track HBR tapes in ATRWG format (ATRWG 85-001 specification). In addition, the interface also is able to read tapes in ASSET format (ASSET was developed before the ATRWG specification was developed).

Some of the key features of the interface are:

- o Download (read) ATRWG 28-track tapes to computer disk,
- o Download (read) ASSET 28-track tapes to computer disk,
- o Monitor (view) ATRWG and ASSET tapes,
- o Upload (write) ATRWG 28-track tapes from computer disk,
- o Create ground-truth track from real-time input.

4.1.2 ASSET Interface

Two problems were uncovered with the HBR tapes recorded on the ASSET. These are discussed in the following subparagraphs.

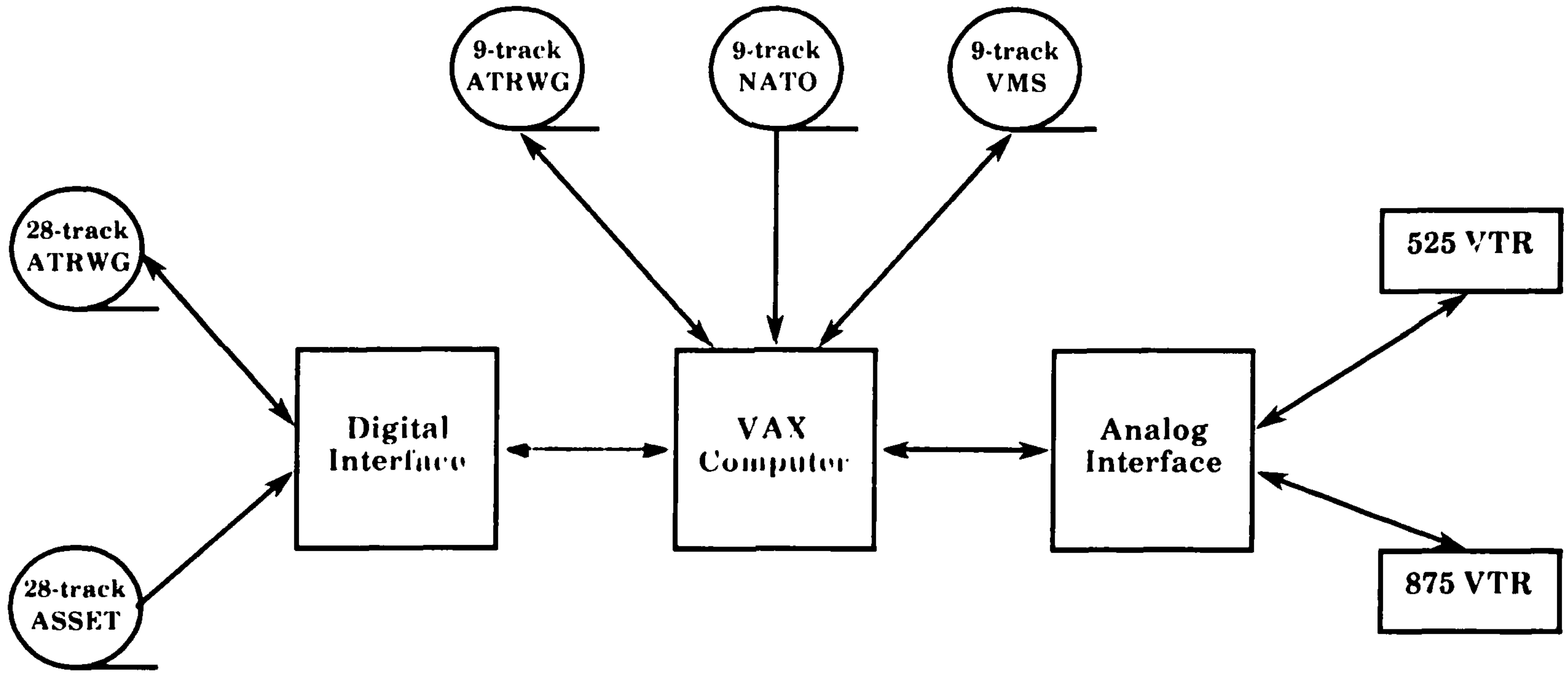


Figure 4-1. MIDIS System

4.1.2.1 Gain Compression

The high-order bit, bit 10, was inverted on tapes recorded at Northrop prior to delivery of the ASSET to CNVEO. The MIDIS was modified to accomodate this. The data tapes recorded at Ft. Huachuca after delivery have the high-order bit not inverted, as it should have been. The MIDIS hardware was re-modified to accomodate this change.

In addition, the Ft. Huachuca tapes show that the image data is compressed in the low-order 6 bits of the ten bit pixel space. Data dumps of the Northrop ASSET tape show that the full 10-bit dynamic range is used.

Our conclusion is that the internal RSPE gain is compressed. This was confirmed not only by the data dump of the tape but the monitor gain was artificially boosted by shifting the data cables so that the low-order pixels bits were shifted up by three bits.

4.1.2.2 ASSET Image Inversion

The ASSET image is inverted during playback. This is a rotation about the z-axis so that the original lower right corner of the image is now the upper left corner. The inversion occurs somewhere during the recording of the ASSET HBR tape. This cannot be corrected without extensive modifications to the MIDIS hardware. Information has been provided to CNVEO to correct the Rockwell RSPE image inversion.

4.1.3 CCT Interface

The mechanization of the CCT interface for reading 9-track digital tapes is provided by the VAX computer system. The 9-track tapes to be read are either in ATRWG format or in VAX/VMS Backup format depending on the application.

4.1.3.1 ATRWG Applications

For image processing applications, 9-track tapes are read and written that conform to the ATRWG 85-002 specification. In addition, NATO format tapes can also be read. A typical application for ATRWG tapes is for the distribution of image data downloaded through the digital (HBR) interface. These tapes would be sent algorithm developers along with the appropriate ground truth data.

4.1.3.2 Backup Applications

9-track CCT can also be processed in standard VAX Backup format. These are for data sets to be exchanged between VAX computer sites or for archival purposes. The ATRWG format is only necessary for data interchange between incompatible computer types.

4.2 Analog Interface

The analog interface of MIDIS reads and writes analog video tapes. The READ process converts the data from analog to digital data. The WRITE process is the reverse of the READ process.

The analog interface consists of a Megavision 1024XM image processor with a Northrop designed "tape shuttle" mechanism to automate the digitizing and animation processes. Digitizing is defined to be the process of converting the analog signals from video tape to digital form to be stored on the VAX disk. Animation is defined to be the process of converting the digital data stored on VAX disk into an analog video tape.

4.3 Image Processing

MIDIS provides several generalized image processing capabilities as well as several specialized capabilities.

4.3.1 Hardware Image Processing

The Megavision 1024XM image processor implements a number of common image processing functions in hardware. Some of these functions are:

- Edge enhancement
- Contrast enhancement
- Digitization
- Median filter

Please refer to the Megavision User's manual for a complete list of functions.

4.3.2 Software Image Processing

The Megavision 1024XM image processor implements a number of image processing functions in software on the VAX computer. Some of these functions are:

- Histogramming
- Scan conversion

Please refer to the Megavision User's manual for a complete list of functions.

4.3.3 Image Exchange

The strength of MIDIS is the ability to translate different image formats. For instance, image data on a 28-track HBR tape, either ATRWG- or ASSET-format, can be read and then written to the Megavision, written to 9-track CCT, or rewritten to HBR tape.

4.4 Image Cataloging

Ground truth data from 28-track ATRWG tapes can be processed to form a "catalog" of information about each tape processed. The MIDIS catalog then is essentially similar to the card catalog in a library. The intent is to record only enough information of interest to an algorithm designer so that a question such as:

"Find tapes which have overcast weather conditions"

can be asked, and answered. The Oracle Relational Database Management System is used to provide the recording and interactive query capability. Northrop provided software processes the ground truth track and makes entries into the Oracle database.

The ERIM data base structure was also provided to CNVEO. No software was provided to take advantage of the database. The intent was to allow CNVEO the ability to import ERIM databases. The database structures delivered were to the May 23, 1986 revision level at ERIM.

5.0 HARDWARE

The MIDIS hardware can be divided into three logical units as depicted in Figure 5-1. The HBR Interface Unit (HBR I/F) provides the interface to digital HBR (high-bit rate) digital tapes. The Megavision subsystem provides the interface to analog video tapes in either 525-line or 875-line formats. The Image Data Processor (IDP) controls the functions of the HBR I/F and Megavision as well as providing for computer analysis of image data.

The data from HBR and 9-track digital tape conforms to the Advanced Target Recognizer Working Group (ATRWG) tape standards ATRWG 85-001 and 85-002. In addition, ASSET HBR tapes can be read and converted to ATRWG format. Non-ATRWG HBR tapes can be read in via a "bit-dump" capability, within certain limitations.

Analog video tapes used by MIDIS conform to the RS-170 and RS-343 formats (525- and 875-line).

5.1 System Configuration

The Image Data Processor (IDP) controls the operation of the HBR interface hardware and other peripheral units under control of the user. The MIDIS user issues commands through the MIDIS Executive software which controls the functioning of the HBR I/F and Megavision. The IDP also provides general purpose computing power so that downloaded images may be processed by various algorithms for analysis.

The IDP has been implemented using a Digital Equipment Corporation (DEC) VAX-11/780 computer. The VAX and its peripherals are depicted in Figure 5-2.

5.2 VAX Computer

The VAX computer reads and writes HBR data to and from two CDC 9715-500 fixed disks. Each disk is capable of holding 437 MB of data (formatted). The CDC disks were selected because :

- Large capacity - 437 MB formatted / 516 MB unformatted
- Fast - 20 ms average access time
- Compact in size - 10.2" x 8.5" x 30"

The capacity and speed figures are not on the cutting edge of technology. It is difficult to obtain drives which combine the attributes of large storage and fast access. For example, optical disks can store two to four times as much data but have access times which are an order of magnitude greater.

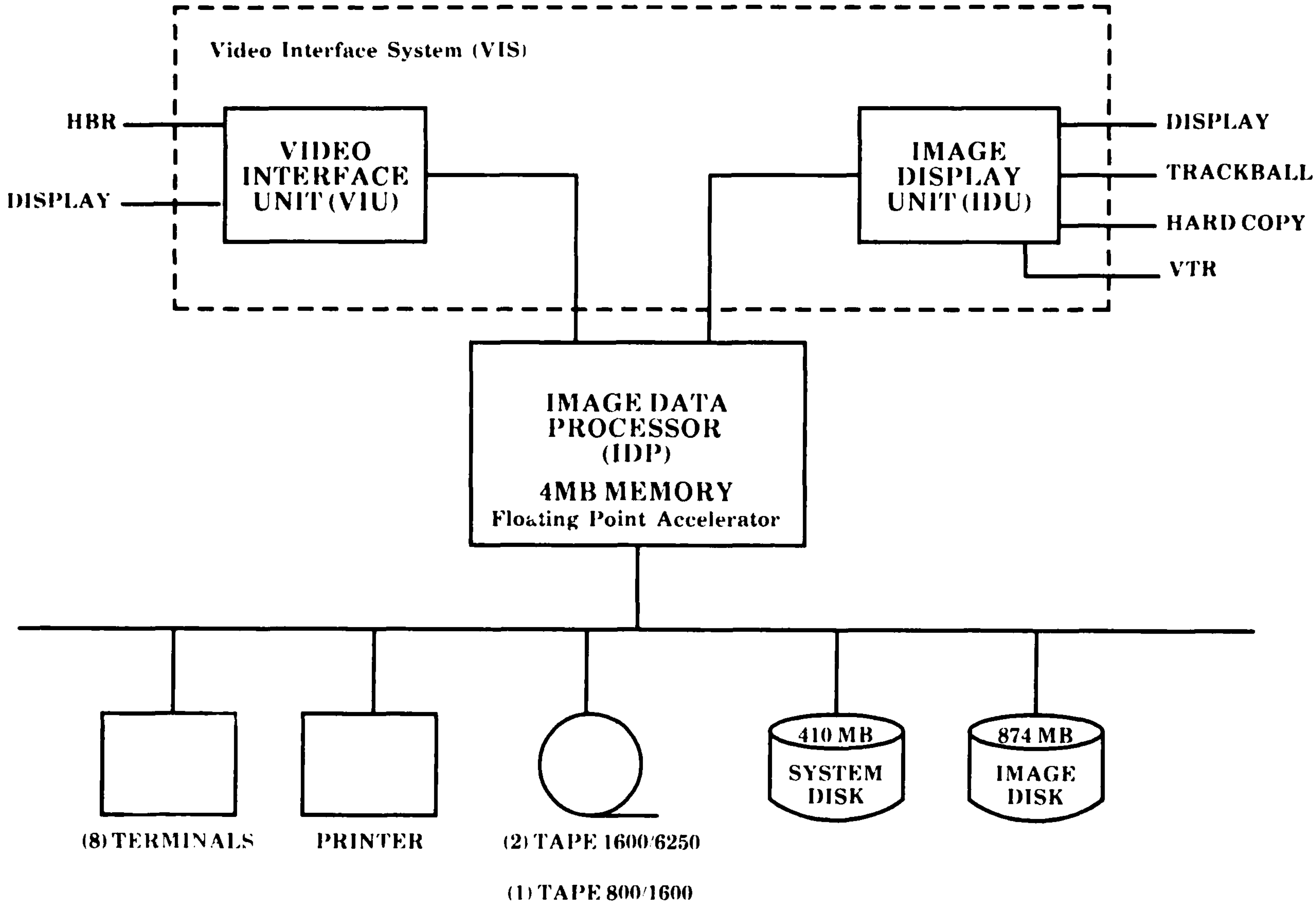


FIGURE 5-1 **MIDIS HARDWARE CONFIGURATION**

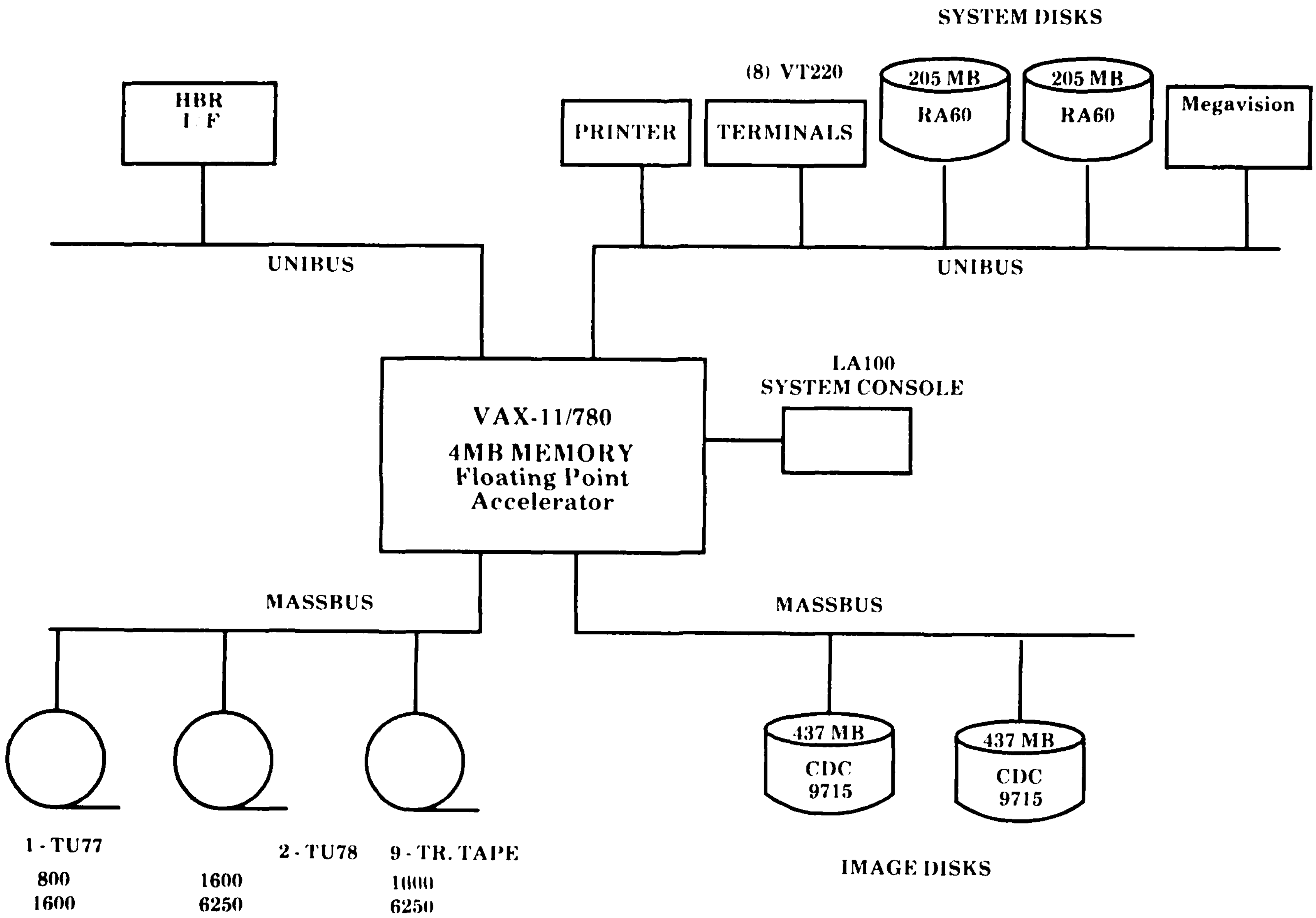


Figure 5-2. IMAGE DATA PROCESSOR CONFIGURATION

5.2.1 CDC Disk Image Capacity

A short analysis, which discusses how many images a CDC 9715-500 disk can hold, is given below for a typical 512x512 image size :

512x512 image = 262,144 pixels = 524,288 bytes

The ATRWG specification for 28-track HBR tapes allows for 10 bits of pixel data. This translates into 2 bytes of computer storage.

437 MB = 447,488,000 bytes = 853 images (512x512)

At a standard TV rate of 30 frames per second this becomes:

853 images/disk at 30 fps = 28 seconds of video/disk

With two disks the capacity is 48 seconds. With different size images the number of seconds is either higher or lower. For example with a standard TV 525-line image (640x480) each disk can hold about 24 seconds of video data.

5.2.2 CDC Disk I/O Timing

As mentioned above, the HBR tape unit is a streaming device which means that the system must accept data and write it to disk as it comes. There are no means for stopping the tape drive without losing data. Although the disk data transfer rate is specified as 14MHz this does not account for disk head movement and disk latency time. This is obviated by implementing a buffering scheme using the QIO facility provided by the VAX computer. The QIO is a means for requesting an I/O operation. QIOs can run asynchronously therefore a previously filled buffer from the HBR can be written to the disk while another is being filled. A short timing analysis follows.

The CDC disks are formatted so that data are written in a continuous fashion. This means that there are no random accesses. Each cylinder will be filled with data before proceeding to the next contiguous cylinder. This minimizes the distance and the amount of movement of the disk heads.

The specification sheet for the CDC 9715-500 unit states that 20 ms is the average access time but the track to track access time is only 5 ms. The worst-case full-stroke access time is 45 ms. The transfer rate is 14.6 MHz.

The maximum data rate from the HBR tape unit is 250 KB/second which is a DR11W limit. This is at the slow speed of the HBR unit. Given the 14.6 MHz disk data transfer rate and the worst-case access time the CDC disk is faster than the HBR tape unit.

Therefore sufficient timing margin exists in the CDC disks.

5.3 Megavision

Northrop has integrated a Megavision 1024XM system into Northrop's Capital Asset Image Processing Laboratory. The Megavision system replaces the Gould DeAnza and digitizing systems. The goal of the Megavision upgrade was to improve operator productivity rather than to improve the speed of the digitization process.

The Megavision 1024XM system has been specially modified by Megavision under contract to Northrop as part of its continuing IR&D effort to improve sensor processing technology while containing cost.

A unique "tape shuttle" mechanism allows the Megavision system to back up the tape and continue reading the next sequence of frames of data precisely where it left off. In this fashion, an arbitrarily long sequence of video tape may be digitized without operator intervention. The only limitation is the capacity of the VAX disk.

The tape shuttle mechanism also allows sequences of images from the Vax to be "animated" onto video tape. Applications include showing unprocessed versus processed image data or showing computer generated synthetic imagery.

5.3.1 Digitizing Rates

The MIDIS Megavision has been configured with 6 MB of memory. This will allow 3/4 second of video data to be stored in memory at once for 525-line images and 2/3 second for 875-line images. If a long sequence of analog video tape is being digitized to the Vax computer, even the Megavision standard 1 MB memory is not a limitation. The predominating factor in the time to digitize information is the time to transfer digital data to the VAX once it has been digitized. Note that while digitizing of the video is accomplished in real time, the tape recorder must be repositioned and started for each sequence.

5.3.2 Digitizing 525-line Analog Video Tape

525-line video images are stored four frames per 1024x1024 image page (1 MB memory). This provides four 512x512 images which means that a portion of the image is "lost " on either side. Nothing is lost in the vertical direction. Figure 5-3 shows how each image is stored.

5.3.3 Digitizing 875-line Analog Video Tape

The process of digitizing 875-line analog video tape is the same as for 525-line data with the exception of how the image is stored in Megavision memory. The digitized image format is shown

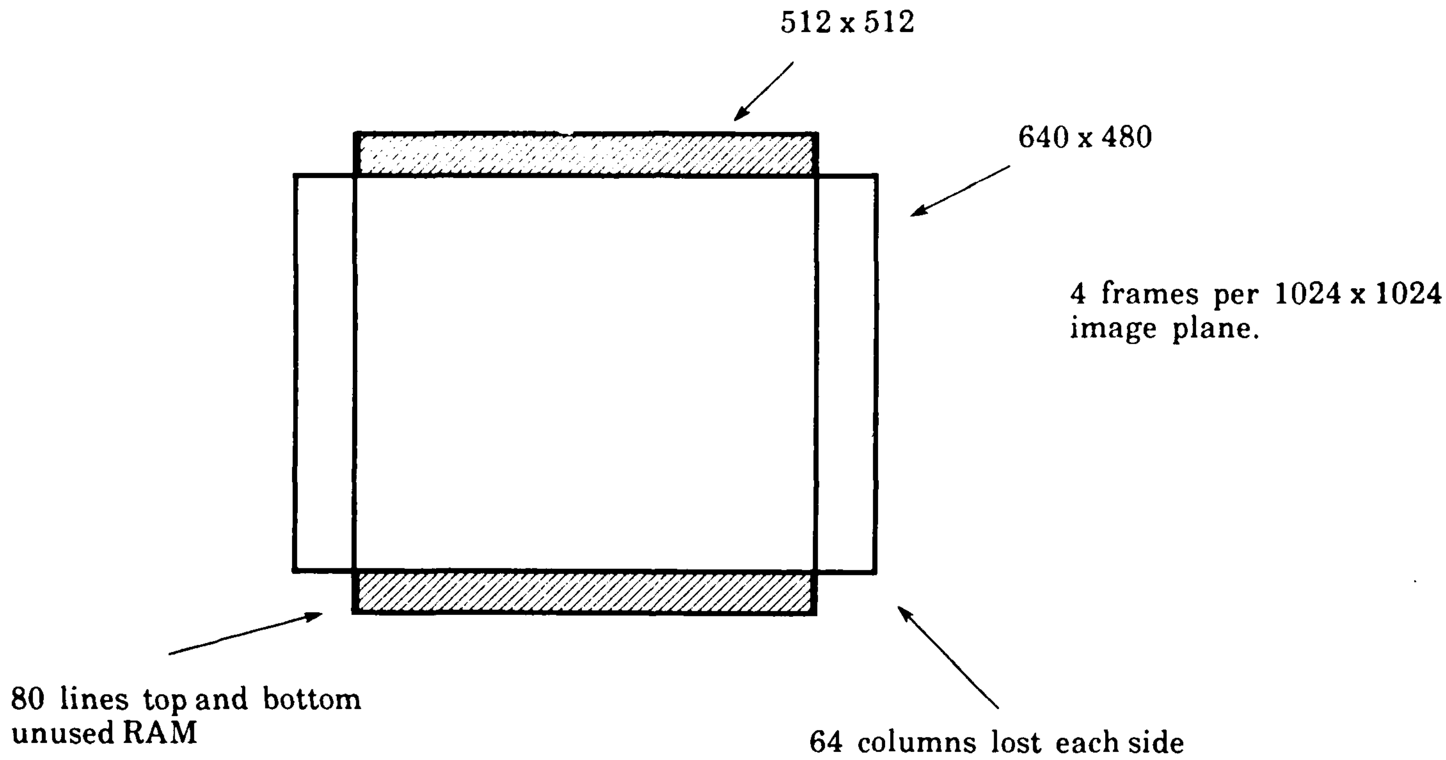


Figure 5-3. Megavision Digitized 525-line Image Format

in Figure 5-4. The image is digitized as 360x808 pixels and finally stored as 336x808 which allows for three frames of data per 1024x1024 image page at the expense of 24 columns of data in the horizontal direction. Vertical resolution is unchanged.

5.4 HBR Interface

The Northrop-built HBR interface is briefly discussed in the following subparagraphs. The detail descriptions of the hardware can be found in the RDT&E Manual, and the detailed software descriptions found in the User's Manual. Please consult section 3.0 for more details.

5.4.1 Vertical Blanking Definitions

The ATRWG 28-track specification for vertical blanking time differs from standard raster terminology.

ATRWG Definition -- Vertical Blanking

"Start of field or start of frame is referenced to the start of the first inactive line."

Raster Scan Terminology -- Vertical Blanking

"Start of field or frame is referenced to the start of the first active line."

For sequences of images it doesn't matter if the inactive time is defined at the beginning or the end of a frame as long as it appears between frames. The difference in definition does, however, have an impact on how ground truth data is treated.

The ground truth data sync word (55AA) occurs concurrently with the first inactive line code which means the first portions of the ground truth occur in the inactive line times. See Figure 5-5 for reference.

Compact data, in MIDIS, is defined to be only active pixel data. The compact data mode is designed so that the minimum amount of data is moved to and stored on the Vax computer. More images can be downloaded in this manner. Since the Vax never sees the inactive lines, all ground truth data and pixel data cannot be downloaded at the same time. Two passes on the tape must be made.

The hardware Ground Truth FIFO could be used to get around this limitation if only a subset of the ground truth data is desired. Up to 64 words may be specified.

5.4.2 Frame Memory

The HBR interface (I/F) has a frame memory to store data. The

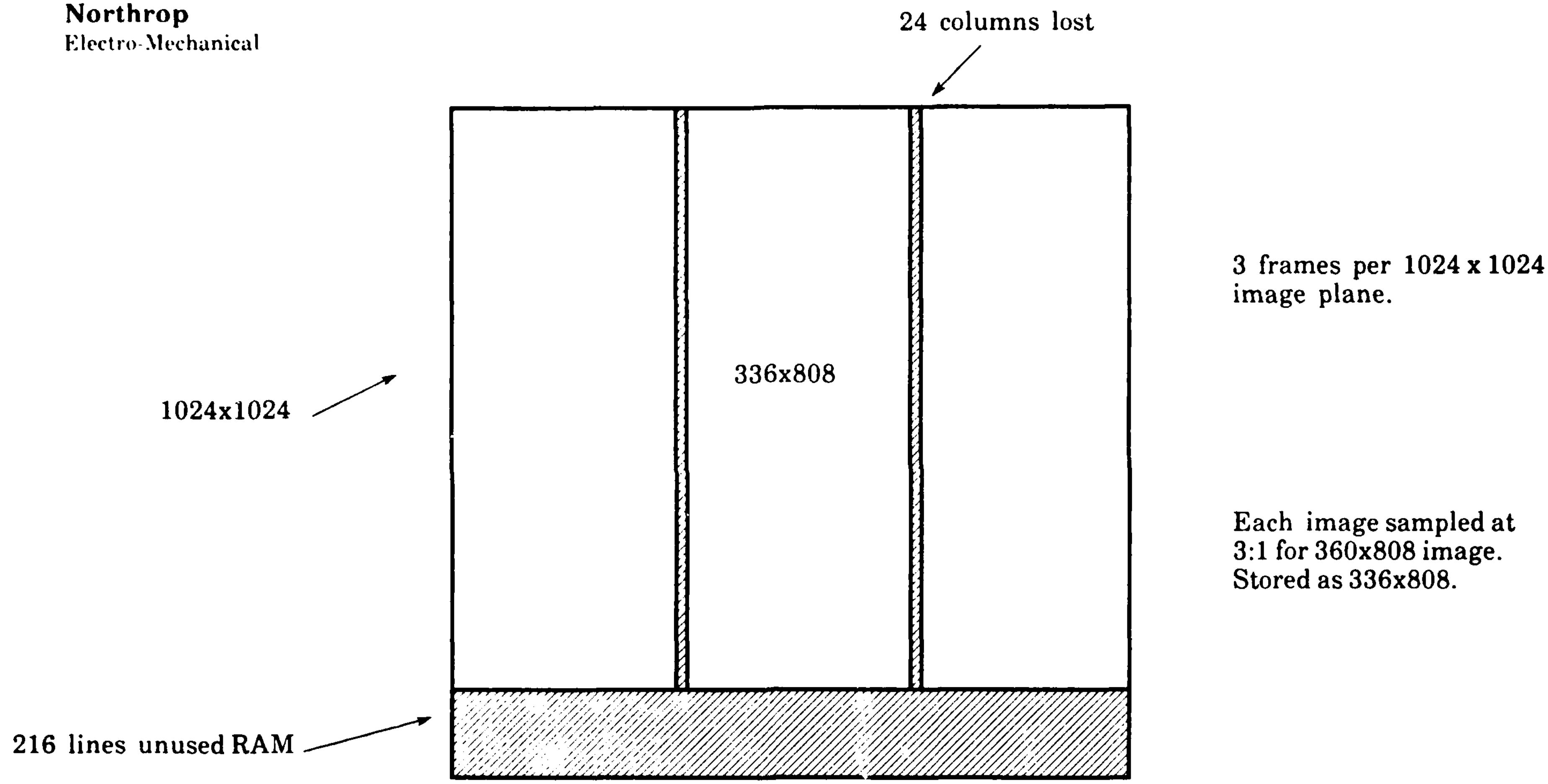
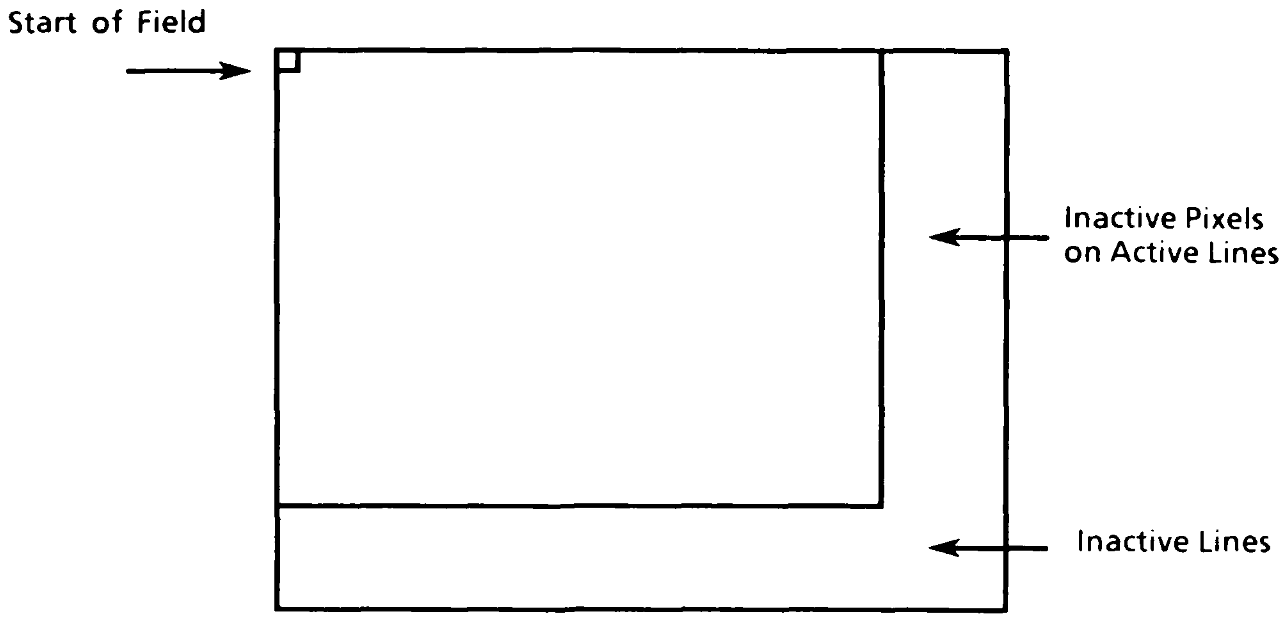
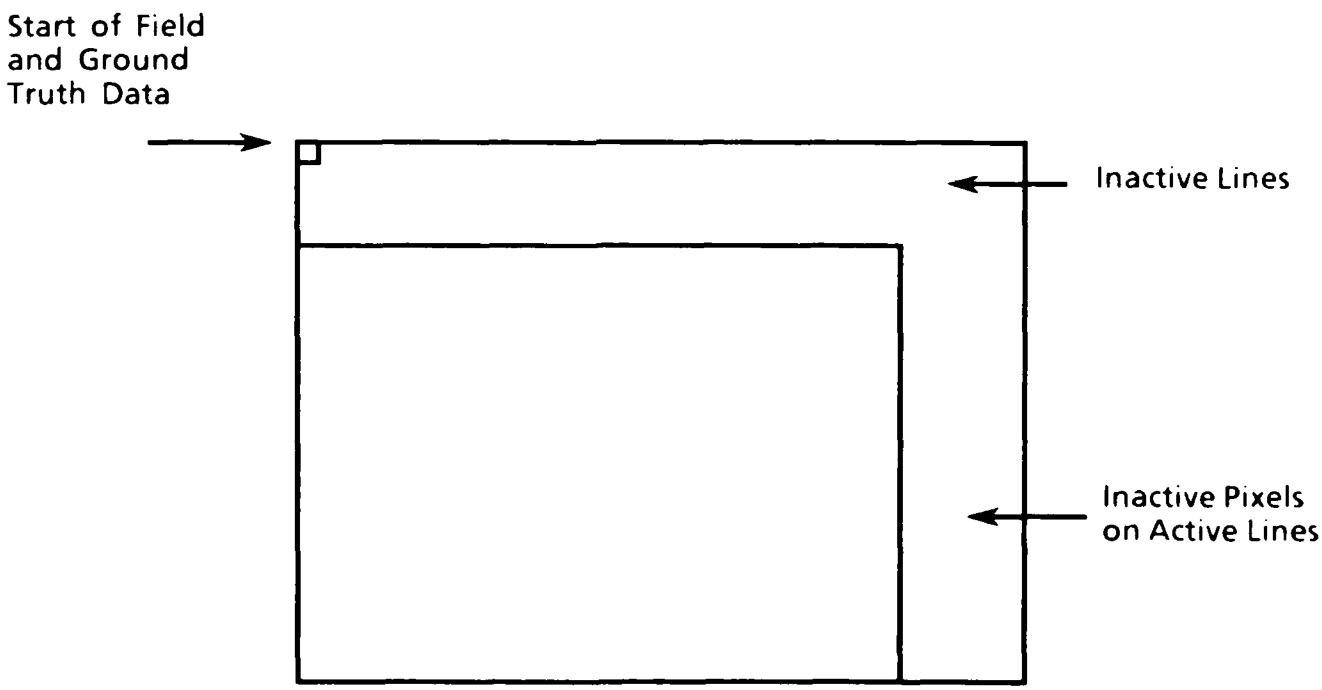


Figure 5-4. Megavision Digitized 875-line Image Format



Standard Definition



ATRWG Definition

Figure 5-5. Vertical Blanking Time

memory is organized as two fields, that is, an odd and an even field. This corresponds to the typical two field per frame format of many television-type system. The following paragraphs describe the operation of the field memories for input and output operations.

Each field memory consists of:

- o 168K 12-bit words

- o organized into odd and even pixel banks

o since the ground truth data (GTD) and Line/Frame Sync (LFS) words occur every other pixel, a special 2 bit sync code has been mechanized and is inserted during the Input code in lieu of the GTD and LFS.

o the two bit sync code is added to the pixel data to identify the end-of-field and causes the hardware to select the other field memory (ping-pong effect) since the current field memory is, or could be, full.

o the 12 bits per word are divided into 10 bits of pixel data and 2 bits of other data. The four bits vary depending on whether it is an even or odd pixel. See Figure 5-6.

o during the "odd pixel time" 2 bits of the nonpixel data contain the serial GTD and serial LFS (per the ATRWG specification).

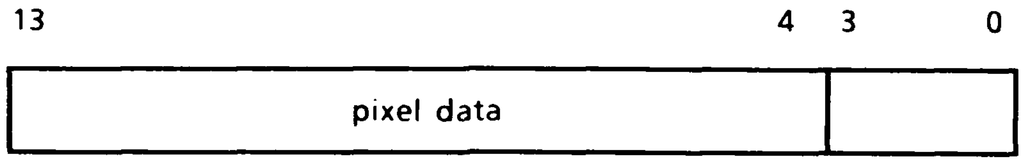
o during the "even pixel time" the 2 bits contain a code generated by the HBR I/F to define:

Start of Field
Start of Frame
Active Pixel
Inactive Pixel

o certain sequences of the codes above are required to cause the hardware memory to flip from one 192K memory to the other.

5.4.3 Data Transfer Accuracy

Data transfer accuracy was verified by several means. One approach was to replace the HBR tape unit by a pattern generator to eliminate the recorder and tape as a potential source of errors. The other approach was to upload data and then download it using a know data pattern.



Bits 0-1 Definitions

2 Bits Sync Code

00 - Active Pixel
01 - Start of Field
10 - Start of Frame
11 - Inactive Pixel

Bits 2-3 Unused

Figure 5-6. HBR Data Word Definition

5.4.3.1 Download Accuracy

An Interface Technology RS4000 pattern generator was used to simulate an HBR tape unit. A know pattern was programmed and a download of the data performed. An analysis of the data using the VAX Dump utility and several Northrop written utilities (SCAN16 and FR_STAT) showed that the data are transferred accurately.

The data were also downloaded via the BIT DUMP operation. The pixel portion of the data transferred also matched that of DOWNLOADed data.

5.4.3.2 Upload Accuracy

The accuracy of uploaded (written) data was verified by downloading the data. A one pixel offset was observed. The data compared exactly otherwise. Bit dumping the data also confirmed the accuracy, as well as the one pixel offset, of the data.

6.0 SOFTWARE

6.1 MIDIS Executive

The MIDIS Executive controls the functions of the system. The Executive runs on the VAX computer and performs as the interface between the operator and the Ampex HBR tape unit and other equipment. The major feature of the Executive is that it is designed to accommodate a wide range of user capability from novices to advanced users of the system.

User interfaces can usually be classified as either being command oriented or menu oriented. In a command oriented system the user tells the computer system what operations are to be performed via (usually) cryptic commands. An example of a command driven system would be the VAX/VMS operating system. A menu interface on the other hand assumes a novice user and at any stage of operation always presents the user his/her options. An example of a menu driven system would the Lotus 1-2-3 spreadsheet package for microcomputers.

Novices prefer menu systems since they can view their choices and select the next option or operation. Advanced users prefer command-driven systems since they already know what they want to do and don't want to traverse four levels of menus to select all of their operations.

The MIDIS Executive has been designed with both features available to the user. The default mode will assume an expert user, however, the novice may select the menu mode at any time or call for on-line help. The principles to be embodied in the Executive are discussed in a paper that appeared in NEPCON West 1982 entitled "User-Friendly Interface Concepts" (NEPCON is the National Electronics Packaging and Production Conference). Reference 1 in section 4.0 is the citation for this paper.

The MIDIS commands and their structure are shown is Figures 6-1 through 6-4.

A sample MIDIS session might look like :

```
$ MIDIS                       <--- invoke MIDIS Executive

MIDIS> HBR                           <--- select HBR subsystem
Operation> Download                 <--- read data from HBR
Source> ASSET                     <--- input is ASSET format
Number of Frames? 200             <--- amount of data to read

--> Please ready HBR tape on transport.  Press enter when ready.
<CR>

--> Download operation is complete.
```

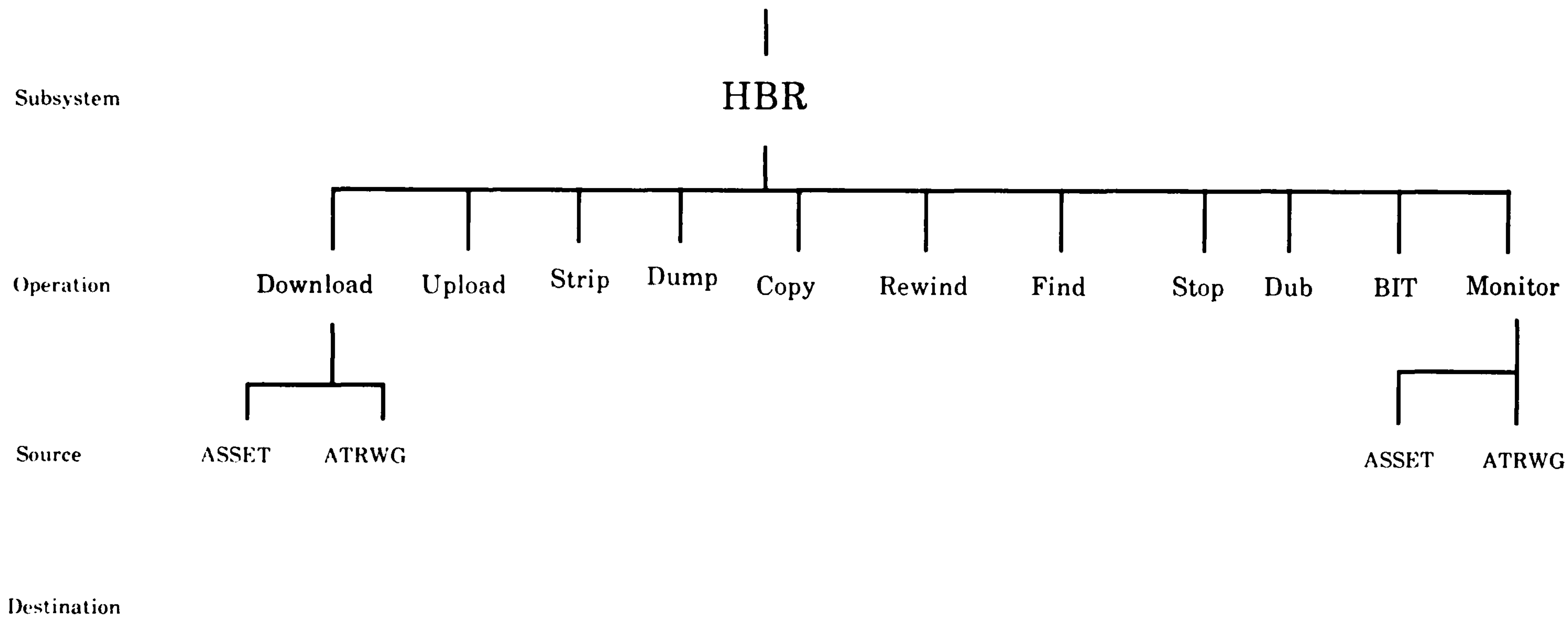


Figure 6-2. HBR Subsystem Command Structure

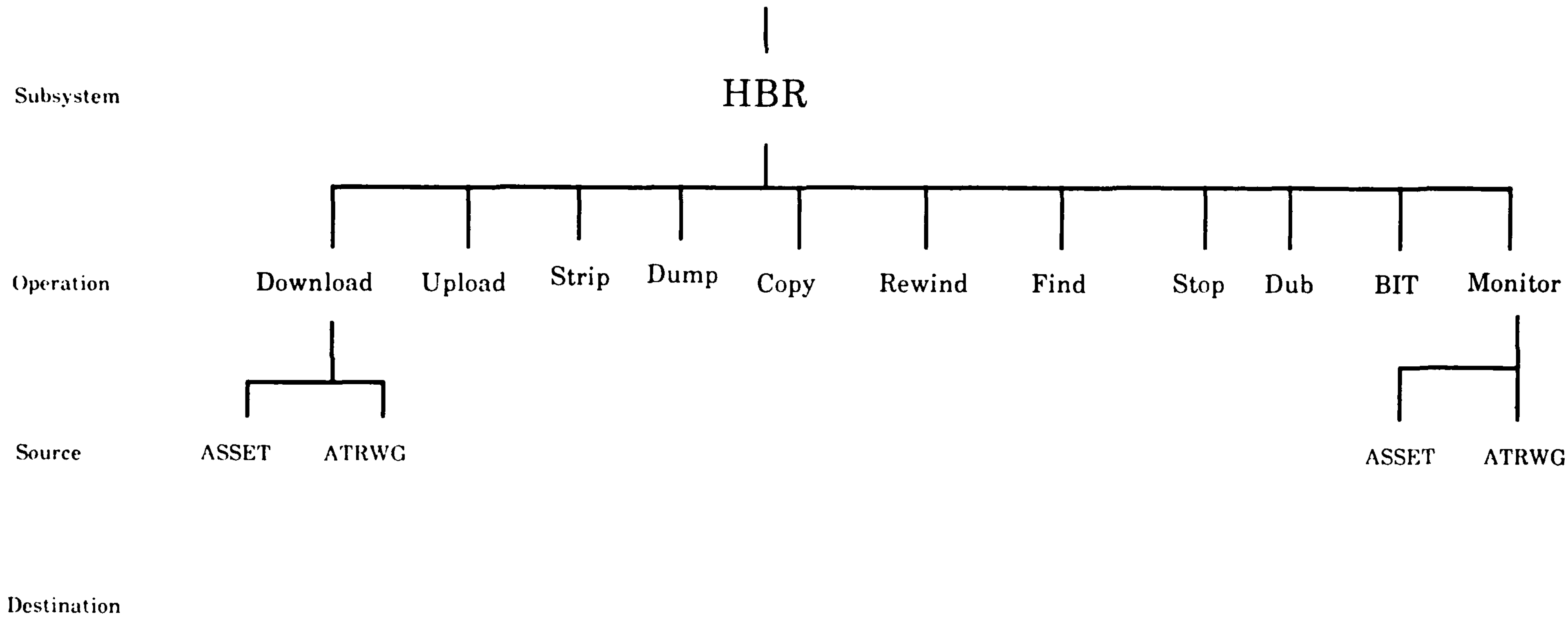


Figure 6-2. HBR Subsystem Command Structure

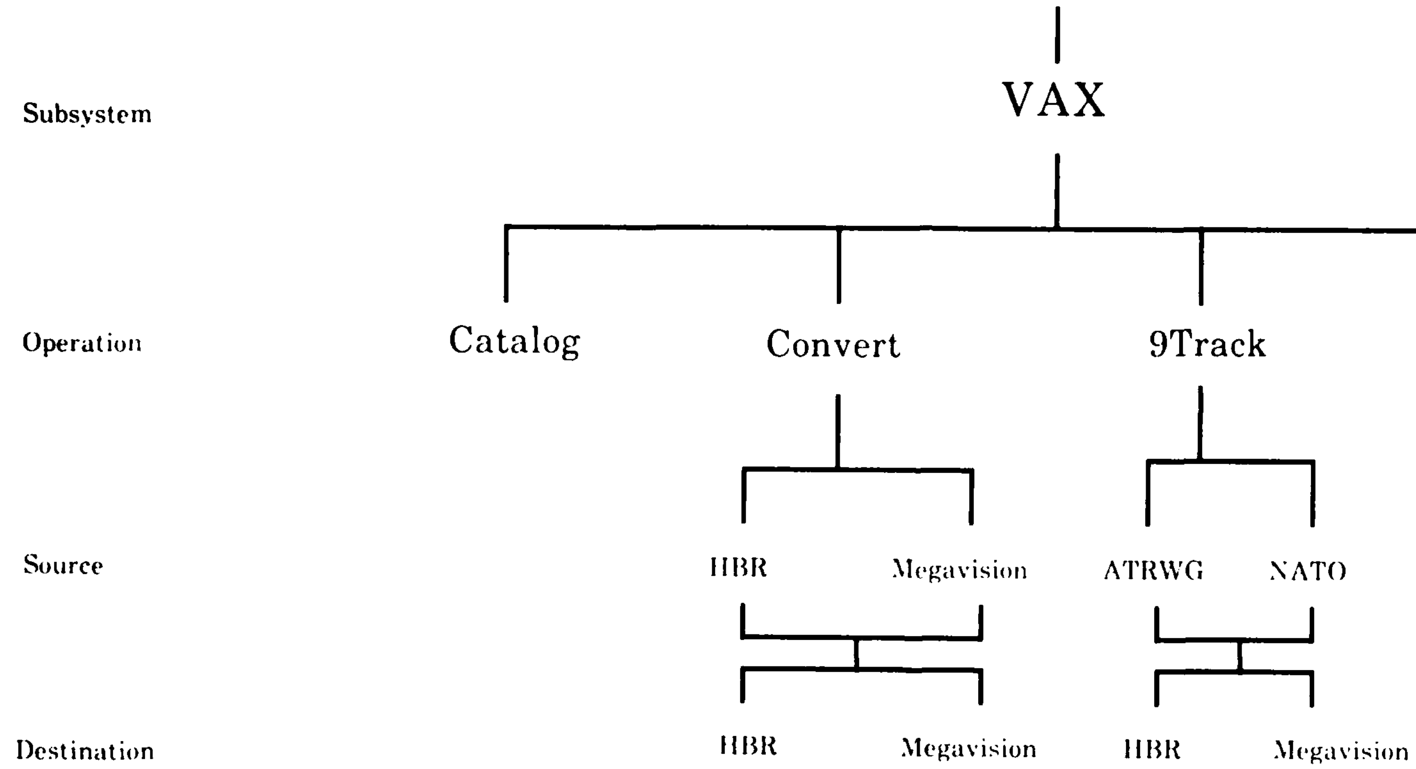


Figure 6-3. VAX Subsystem Command Structure

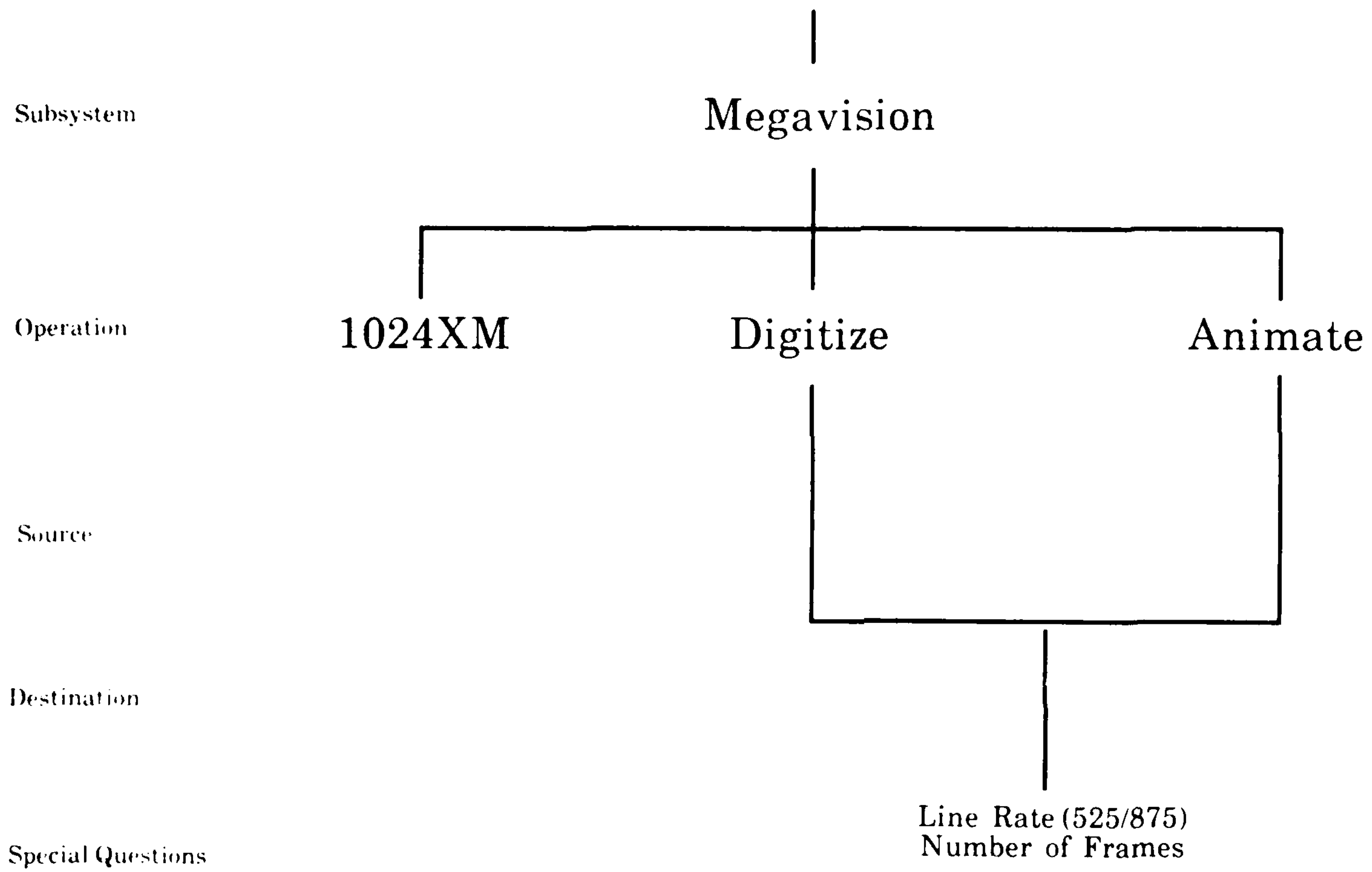


Figure 6-4. Megavision Subsystem Command Structure

```
MIDIS> HBR;REWIND                    <--- command chaining (rewind)

--> Rewind operation started.  Use the HBR;STOP command to stop.

MIDIS> HBR;STOP              <--- stop the tape motion
```

Note: The symbol <CR> denotes the ENTER or RETURN key.

6.2 MIDIS User Interface

The User Interface (UFI) function of the MIDIS Executive is responsible for conducting a dialog with the user to determine what functions in the MIDIS systems are to be performed. In today's jargon it is a "user-friendly" interface.

The results of the dialog are passed back to the MIDIS Executive in the form of tokens for action. The parsed or tokenized user command line is used by the Executive software. The tokens are simply indexes into tables which denote what action is to be taken by the software.

UFI offers the following capabilities:

- o Command chaining
- o Command abbreviations
- o Continuation lines
- o Defaults
- o Help
- o optional Menu mode

6.3 User Interface Command Structure

The command structure of the user interface is based upon the principle of consistency. The user should know what to expect regardless of where he or she is in the system. The command structure is base upon the following six levels :

System
Subsystem
Operation
Source
Destination
Special Questions

These questions are always asked and in this order regardless of what type of operation is being selected by the user. The exception to this rule is some questions may not be asked because the answer is implied by a previous question.

The subsystem level defines a major portion of the MIDIS system. Currently the subsystems are HBR, Vax, and Megavision.

The operation level defines an event within the context of the selected subsystem. For example, the DOWNLOAD operation within the HBR subsytem specifies that data is to be extracted from an HBR tape and loaded onto the Vax computer disk.

The source level defines where the data is to be taken from in the context of the selected operation. Not all operations require a source level specification. For instance, the UPLOAD command in the HBR subsystem assumes that the source of its data is the Vax disk therefore it will not give the source prompt.

The destination level defines where data is to go in the context of the selected operation. As with the source specification, the destination prompt is not given when the destination is fixed or "obvious". For instance for a DOWNLOAD operation, the downloaded data will always be placed on the Vax disk.

Special questions are asked when they do not fall into the categories listed above. For example, for a DOWNLOAD operation, the number of frames to be downloaded must be specified.

The five categories of questions are always asked in the order given above.

6.3.1 Command Line

The default command input mode is the command line. The user specifies what action the system is to take by typing in commands one at a time. The system will propmt for input. For example:

```
MIDIS> HBR
Operation> Download
Source> ATRWG
```

The characters before the ">" symbol represent the current system prompt. The type of data expected of the user is specified by the current prompt. For instance, the "Source>" prompt indicates that the user specify where the data is coming from to be processed.

The command line mode is suited for experienced MIDIS users since the user must specify the action to be taken.

6.3.2 Menu Mode

The Menu mode is an alternate means of action specification to the command line mode. A list of actions is presented to the user and he/she is asked to select from that list. The user choices are converted to command line form internally for processing.

6.3.3 Command Abbreviations

Commands may be abbreviated. Any unique abbreviation is acceptable. For instance, the following list are acceptable abbreviations for the DOWNLOAD command:

```
DO
DOW
DOWN
DOWNL
DOWNLO
DOWNLOA
```

6.3.4 Command Chaining

Commands may be entered on one line rather than separate lines. The semicolon is used to separate commands. For example,

```
MIDIS> HBR;Download;ATRWG
```

is equivalent to

```
MIDIS> HBR
Operation> Download
Source> ATRWG
```

6.3.5 Continuation Lines

Long command lines may be continued by terminating the current command line with a hyphen followed immediately by a carriage return. A continuation prompt will appear and the rest of the command line may be entered. For example,

```
MIDIS> HBR;Download;-
Continue: ATRWG
```

is equivalent to:

```
MIDIS> HBR;Download;ATRWG
```

6.3.6 Defaults

Commands for the Subsystem, Operation, Source and Destination categories have default values associated with them. The default value is invoked by typing a carriage return in response to the command prompt.

To find the default value, type HELP at the command prompt. The list of valid commands will be displayed with the default value preceded by an asterisk. For instance,

```
MIDIS> help

     The following are acceptable MIDIS Subsystem commands:

     * HBR     Vax       Megavision     Help      Menu
       Exit

MIDIS>
Operation> Download
```

The user session above shows that the HBR subsystem is the default answer to the MIDIS command prompt. The user has answered the MIDIS> prompt by pressing the <RETURN> key.

6.3.7 Help

On-line help is available by typing HELP at any MIDIS command prompt. A display of the available commands will be given. See the paragraph above for an example. For more detailed help type a keyword after the word help. For example:

```
MIDIS> help megavision
```

will give a short help message about the Megavision subsystem.

6.4 HBR Subsystem

The HBR subsystem controls all functions associated with the HBR tape drives and the HBR interface. The functions provided and a brief description of that operation are contained in the subparagraphs that follow.

6.4.1 Monitor Operation

The MONITOR operation provides the ability to view the contents of a 28-track HBR tape on a standard 525-/875-line monitor. The contents of the HBR I/F video memory are dumped to the monitor.

The data arriving from the HBR tape must be at a 30Hz frame rate to match the display rate of the monitor. Compact data will not display correctly although it will download correctly.

The ATRWG specification allows for the recording of compact data however all the HBR tapes that we have seen so far do have the appropriate horizontal and vertical blanking intervals inserted to achieve a 30Hz frame rate.

6.4.2 Rewind Operation

The REWIND operation commands the HBR tape unit to rewind at the high tape speed. The user must issue the STOP command to actually stop the tape. If the end of tape is reached before the stop command is issued, the tape drive electronics automatically halts tape motion.

6.4.3 Stop Operation

The STOP operation stops any tape motion on both tape drives.

6.4.4 Download Operation

The DOWNLOAD operation reads a 28-track ATRWG tape and puts the data onto VAX disk. Any inactive pixels (horizontal and vertical retrace times) are discarded. This is called "compact" data. Compact data saves disk space.

The download operation also has a "read-after-find" mode where data is not downloaded until a certain ground truth word number/value combination is detected. Paragraph 6.4.8 gives more details.

6.4.5 Upload Operation

The UPLOAD operation is the reverse of the download operation. Enough inactive pixels are added to the end of each field to achieve a 30Hz frame rate. This allows uploaded tapes to be monitored.

6.4.6 Dump Operation

The DUMP operation allows a bit-dump copy of an HBR tape to VAX disk.

6.4.7 Copy Operation

The COPY operation allows one HBR tape to be copied at high-speed to another. Two HBR tape drives are required. The tape drives are cabled so that the output of drive 1 is the input of drive 2. The control signals to start and stop the drives are provided by the VAX computer.

6.4.8 Find Operation

The FIND operation positions the HBR tape based upon data in the ground truth track. The user input is a ground truth word number and value. The word number is defined in the ATRWG 85-001 specification.

The FIND operation is a gross positioning command. Once the word number/value combination is found the tape drive to stopped. Due to tape momentum the final position will be past the point found. In a normal operating environment the user will specify a word number/value before what he/she wants. For example, word 4, field i.d., is a increasing count (or should be) of field numbers. If field 7346 is desired, then a FIND on field 7000 will get the tape positioned correctly for a download operation.

6.4.9 Strip Operation

The STRIP operation reads the ground truth track from a 28-track ATRWG HBR tape to the VAX computer disk.

6.4.10 Dub Operation

The DUB operation loads the ground truth RAMs of the HBR I/F. This data will be repeated as the ground truth track during an Upload operation.

6.4.11 BIT Operation

The BIT operation invokes a diagnostic program that is controlled by the user. HBR I/F control words may be set individually to provide a fine level of control during hardware checkout and debugging.

6.5 VAX Subsystem

The VAX subsystem contains operations which are totally contained within the VAX computer and do not rely on the image data devices such as the HBR I/F and the Megavision. The VAX subsystem does, however, rely on inputs from these devices and prepares data for these devices.

6.5.1 Catalog Operation

The CATALOG operation places an entry in the MIDIS catalog about ground truth data previous downloaded in a STRIP operation. The information is a summary of the ground truth information rather than a frame-by-frame catalog.

6.5.2 Convert Operation

The CONVERT operation reformats image data between the HBR and Megavision formats.

6.5.3 9Track Operation

The 9TRACK operation allows the reading and writing of 9-track CCT in the ATRWG 85-002 format. NATO format tapes can also be read.

6.5.4 VMS Operation

The VMS operation creates a VMS shell from which the user can access all standard VAX/VMS functions. For instance, the user may edit a file and then return to the MIDIS Executive by typing EXIT at the VMS prompt.

6.5.5 Oracle Operation

The ORACLE operation puts the user into the Oracle RDBMS. The MIDIS Executive first puts the user into the VMS mode. The user then types SQLPLUS. At this point any Oracle function may be accessed.

6.6 Megavision

Megavision software is supplied by Megavision. It is called the XM environment. Northrop also supplied software to automate the digitizing and animation processes. The software makes use of the XM environment.

6.6.1 Software by Megavision

Software to control the Megavision 1024XM Digital Image Processor is provided by Megavision, Inc. The 1024XM software environment provides a rich set of fast, hardware implemented image processing commands.

There are also a set of commands which provide VAX computer based image processing capabilities such as scan line conversion.

Additionally, software hooks are provided to control the Megavision hardware directly from user written software.

More detail about the Megavision supplied software can be found in the Megavision User's Manual and the Megavision Programmer's Manual.

6.6.2 Software by Northrop

Software is provided by Northrop that automates the process of digitizing and animating analog video tapes. The three major modules provided are described below.

6.6.2.1 Digitize Operation

The DIGITIZE operation reads an analog video tape in either the 525- or 875-line rate and stores the data on the VAX computer disk. An arbitrarily long sequence may be digitized. The only limitation is the amount of computer disk space available.

Each frame of image data occupies about .25 MB of disk. Therefore a 205 MB RA60 disk can hold about 800 frames or about 25 seconds of video data.

The Digitize operation relies on an Videomedia Eagle editor which repositions the video tape after each 3/4 second sequence has been digitized. Occasionally a frame is skipped between sequences due to repositioning problems inherent with video tape.

6.6.2.2 Animate Operation

The ANIMATE operation is the reverse of the Digitize operation. It can create an analog video tape from previously digitized data. The data source can also comes from an HBR tape after being processed by the Convert operation. The data can also be synthetically generated.

6.6.2.3 1024XM Operation

The 1024XM operation creates a shell from which the user may access all of the Megavision 1024XM environment.

6.7 Oracle

The Oracle relational data base management system is provided by the Oracle Corporation.

6.7.1 Data Base

The next two paragraphs describe the two Oracle data bases in MIDIS. The first is the ERIM data base which duplicates the structure of that used by the Environmental Research Institute of Michigan. It is for compatibility with ERIM. The other data base is a catalog about HBR tapes. It is analogous to the card catalog in a library. The MIDIS catalog does not contain any image data but gives information about the tape such as where the data was collected and what the weather conditions were. This information is obtained from the ground truth track on 28-track HBR tapes in ATRWG format.

6.7.2 ERIM Data Base Software

The ERIM Oracle data base structure has been updated. Dwayne Carmer of ERIM sent new information on their current image data base. The ERIM data base structure description of May 23, 1986 is attached to this report as Appendix A.

6.7.3 MIDIS Catalog

The MIDIS catalog structure has been finalized and implemented. Coding on the access routines have started. The Oracle data definitions as implemented for MIDIS appears in Appendix B.

7.0 REFERENCES

1. S. Wong, "User Friendly Interface Concepts," NEPCON West '82 Proceedings of the Technical Program, National Electronic Packaging and Production Conference, volume 1, pp. 11-18.

2. Raymond C. Houghton,Jr., "Online Help Systems: A Conspectus" Communications of the ACM, volume 27, number 2, February, 1984, pp. 126-133.

3. Asahina, J. and J. Traficante, "Peripheral Performance," Hardcopy, vol.7, no. 3, March 1987, pp. 88-89.

4. MIDIS User's Manual

5. MIDIS RDT&E Manual

6. ATRWG 85-001 28-track HBR Tape Specification

7. ATRWG 85-002 9-track CCT Specification

8. Megavision User's Manual

APPENDIX A

ERIM Oracle Data Base Definitions

AIRTDB TABLE AND COLUMN DESCRIPTIONS
May 23, 1986

TABLE MNEMONICS

1. GND : Ground Truth Data
2. IMG : Image Information
3. TAP : Tape Information
4. TGT : Target Information
5. TXT : Documentation Information
6. VND : Vendor Information
7. SXX : Data Set Information
8. BTGTY : Box Truth Local Metrics
9. CPR : CAPIR Results
10. AIRPAR: AIRSTECH participants

Table name: GND

Information in the GND table is taken from the vendor supplied ground truth data. Normally, this information will be supplied in header two of the tape. The format of this information will be that described in the "Digital Image Data Exchange Format Specification", ATRWG 85-001, February 1985 (or latest revision).

The exception to this rule are the target block entries starting at word 1003 through word 1020 and following. This information is found in the target table TGT.

Column Name	Description
G_1	SYNC word = Hex 55AA (Always)
G_2	Tape(volume) number
G_3	Pass (file sequence) number
G_4	Field (file) number
G_5	Mission(flight) number
G_6	GMT year (Greenwich Mean Time)
G_7	GMT month
G_8	GMT day
G_9	GMT hour
G_10	GMT minutes
G_11	GMT seconds
G_12	GMT tenth seconds
G_13	IRIG hour
G_14	IRIG minutes
G_15	IRIG seconds
G_16	Source of data
G_17	Location of collection
G_18	(Obsolete)
G_19	Ground truth
G_20	Bit error rate
G_21	Classification
G_22	Sensor type
G_23	Sensor serial number
G_24	Recorder transport serial #
G_25	IRIG milliseconds
G_26	Field of frame
G_27	Last update year
G_28	Last update month
G_29	Last update day
G_30	Standards document revision #
G_31	Recorder electronics serial #
G_32	Bit error rate units
G_101	Imager type
G_102	Field Of View (FOV) mode (N,M,W)
G_103	Narrow FOV azimuth
G_104	Narrow FOV elevation
G_105	Medium FOV azimuth
G_106	Medium FOV elevation

G_107	Wide FOV azimuth
G_108	Wide FOV elevation
G_109	Detector angular subtense (horiz.)
G_110	MRT1 (0.25fc)
G_111	MRT2 (0.50fc)
G_112	MRT3 (0.75fc)
G_113	No. of active pixels per line
G_114	No. of vertical detectors
G_115	No. of horizontal detectors
G_116	Polarity
G_117	Gain setting
G_118	Level setting (DC Offset)
G_119	Wavelength region
G_120	AC coupling Code
G_121	Calibration code
G_122	Calibration procedure code
G_123	Calibration Source 1 temp
G_124	Calibration Source 2 temp
G_125	Analog video tape type
G_126	Tracker mode
G_127	Gimbal azimuth
G_128	Gimbal elevation
G_129	Gimbal rate azimuth
G_130	Gimbal rate elevation
G_131	Fields per frame
G_132	Detector ang. subtense (vert.)
G_133	Zoom setting
G_134	Temp. source accuracy
G_135	Gimbal angle (& ang. rate) units
G_136	No. of vertical pixels (active)
G_137	No. of bits from sensor
G_138	FOV size units
G_139	fc (Sensor Cutoff Frequency)
G_140	Gimbal roll
G_141	Gimbal rate roll
G_142	Gimbal order
G_143	Sensor mount depression angle
G_201	Range to Center Field Of View (CFOV) int. part
G_202	Range to CFOV fract. part
G_203	Ranging methods/units
G_204	Altitude-barometric
G_205	Altitude-radar
G_206	Bearing to target
G_207	Airspeed
G_208	Ground speed
G_209	Speed units
G_210	Aircraft attitude pitch
G_211	Aircraft attitude roll
G_212	Aircraft attitude yaw
G_213	Aircraft velocity X (vert.)
G_214	Aircraft velocity Y (horiz.)
G_215	Aircraft velocity Z (forward)
G_216	Velocity units
G_217	Aircraft heading
G_218	Sensor location on aircraft

G_219	Aircraft location word 1
G_220	Aircraft location word 2
G_221	Aircraft location word 3
G_222	Aircraft location word 4
G_223	Aircraft location units
G_224	Attitude units
G_225	Secondary velocity units
G_226	Heading units
G_227	Platform type
G_301	Weather station location
G_302	Weather code
G_303	Air Temperature
G_304	Relative humidity
G_305	Visibility
G_306	Atmospheric transmission
G_307	Dewpoint temperature
G_308	Barometric pressure
G_309	Cloud code
G_310	Solar insolation (instantaneous) -- radiation impinging on target area
G_311	Solar insolation (cumulative) -- radiation impinging on target area
G_312	Wind speed
G_313	Wind direction
G_314	Terrain code
G_315	Clutter code
G_316	Surface soil moisture
G_317	Transmission range
G_318	Trans. band min. wavelength
G_319	Trans. band max. wavelength
G_320	Insolation units
G_901	User defined words per target blk
G_902	Bearing to target formation
G_903	Bearing units (Units per Degree)
G_1001	Target formation
G_1002	Target formation location word 1
G_1003	Target formation location word 2
G_1004	Target formation location word 3
G_1005	Target formation location word 4
G_1006	Target location units
G_1007	Number of target blocks
G_1008	Words per target block
G_TAP	Tape number of tape containing image
G_SEQ	AIRTDB sequence number
G_IMG	Vendor's image number
G_FL1	User utility flag
G_KEY	Unique key value for image

Table name: IMG

Column Name	Description
I_VND	Identity of vendor in country/lab format
I_DAT	Date of image generation
I_IMG	Image number in VND/ID number format
I_NRF	Number of records in this file
I_BH2	Number of bytes in header 2
I_BPR	Number of bytes per record
I_EPS	Number of entries per sample
I_BIE	Number of bytes per integer entry
I_BME	Number of bytes per mantissa entry
I_BEE	Number of bytes per exponent entry
I_SPL	Number of samples per image line
I_LPI	Number of lines per inch
I_IDV	Image data value type
I_AUX	Auxiliary data type field
I_FH2	Format of header 2
I_PAK	Number of lines per tape record
I_CLS	Image classified flag, Y/N
I_INI	Initial image flag Y/N
I_RSL	Characterized image flag (are there Global metrics (Y/N)?)
I_TAP	Tape number of tape containing the image
I_SEQ	Sequential number of image on tape
I_KEY	Unique key value of image

The following columns in table IMG are the global metric entries

I_ALG	Alpha_g (Multiplier for outer box size)
I_EPG	Epsilon_g (Guard ring size)
I_EOG	ESR_offset_g (Spacing factor for Sobel operator)
I_TFS	Target filter switch
I_NTIR	Sample size (number of windows)
I_MNTS	TIR2 Min-signed
I_MXTS	TIR2 Max-signed
I_XTS	TIR2 Mean-signed
I_STTS	TIR2 Standard deviation-signed
I_MNTP	TIR2 Min-positive
I_MXTP	TIR2 Max-positive
I_XTP	TIR2 Mean-positive
I_STTP	TIR2 Standard deviation-positive
I_MNTBS	TBIR2 Min-signed
I_MXTBS	TBIR2 Max-signed
I_XTBS	TBIR2 Mean-signed
I_STTBS	TBIR2 Standard deviation-signed
I_MNTBP	TBIR2 Min-positive
I_MXTBP	TBIR2 Mean-positive
I_XTBP	TBIR2 Mean-positve
I_STTBP	TBIR2 standard deviation-positive

I_NESR	Sample size (number of ESR samples)
I_MNES	Edge Strength Ratio (ESR) Min-signed
I_MXES	ESR Max-signed
I_XES	ESR Mean-signed
I_STES	ESR Standard deviation-signed
I_MNEP	ESR Min-positive
I_MXEP	ESR Max-positve
I_XEP	ESR Mean-positive
I_STEP	ESR Standard deviation-positive
I_MNIN	Min intensity (of image)
I_MXIN	Max intensity (of image)
I_XIN	Mean intensity (of image)
I_STIN	Standard deviation of intensity (of image)
I_WSS	Window spacing string (in lines and pixels)
I_KRI	Number of range intervals, 10 max
I_RGS	Range string, combine: Range to region Window height Window length Repeated for each region
I_INS	Information string, combine: Program id. Run Date Run Time Constant or Variable Boxes

Table name: TAP

Column Name	Description
T_TAP	Tape number, ERIM sequential, unique
T_VND	Vendor, in country/lab format
T_NIM	Number of images on tape
T_LAB	Information from the tape label
T_RVD	Date tape was received at ERIM
T_STA	Status of tape, short description
T_FRM	Format of tape
T_BPI	Bits per inch of tape (Standard is 1600)
T_CPY	Copy number of this tape
T_TYP	Type of recording medium
T_ITY	Image type on tape
T_PRO	Vendor proprietary flag, Y/N
T_RLD	Tape release date, i.e. date tape can be reused
T_CLS	Contains classified data flag, Y/N
T_LOC	Physical tape location
T_CFL	Comment flag
T_VTN	Vendor/contractor tape number

Table name: TGT

Column Name	Description
TG_TYP	Target type (use target codes in ATRWG 85-001)
TG_CON	Target condition
TG_HIS	Target history (i.e. Temperature)
TG_ASP	Target aspect (i.e. orientation)
TG_TBC	Target to thermal background contrast
TG_LIN	Line number of target coordinate
TG_PIX	Pixel number of target coordinate
TG_POT	Number of pixels on target
TG_CMC	Counter measure code
TG_HDG	Target heading
TG_RNG	Range of target in 10s of meters
TG_OBS	Percent of target obscured
TG_TAP	Tape number that this target appears on
TG_IMG	Image number that this target appears on
TG_SEQ	Image sequence number target appears on
TG_INT	Initial target flag, Y/N
TG_RSL	Characterized flag (has image been characterized (Y/N)?)
TG_CLS	Classified target flag, Y/N
TG_FL1	User utility flag
TG_FL2	User utility flag
TG_KEY	Unique key value of image with this target

The following columns in table TGT are the local metric entries

Column Name	Description
TG_APL	Alpha_1 (Multiplier for outer box size)
TG_EPL	Epsilon_1 (Guard ring size)
TG_EOL	ESR_offset_1 (Spacing factor for Sobel operator)
TG_TYPE	Target type
TG_AA	Target observation aspect angle
TG_DA	Target observation depression angle
TG_RANGE	Target Range
TG_TBS	Target box string, combine: Target box line coordinate (upper left corner) Target box pixel coordinate (upper left corner) Target box height (vertical) Target box length (horizontal)
TG_TBF	Target box fault (flag for edge effect)
TG_NO	Pixels on target
TG_RNO	Resolution cells on target
TG_TIR	TIR2
TG_TBIR	TBIR2
TG_ESR	Edge Strength Ratio (ESR)
TG_ESRSG	ESR sign
TG_ESREC	ESR error code (edge effect flag)
TG_SMRT	Similarity ratio
TG_CSM	Correlation coefficient same class

TG_CDF	Correlation coefficient different class
TG_CTS	Centroid string, combine:
	Geometric centroid - line
	Geometric centroid - pixel
	Intensity centroid - line
	Intensity centroid - pixel
TG_XBT	Mean intensity on target
TG_X2BT	Mean square intensity on target
TG_STT	Standard deviation of intensity on target
TG_NB	Number of pixels on background
TG_XBB	Mean intensity on background
TG_X2BB	Mean square intensity on background
TG_STB	Standard deviation of intensity on background
TG_RESL	Scale factor from line to line
TG_RESP	Scale factor within a line
TG_LSPC	Line spacing
TG_PSPC	Pixel spacing
TG_DTS	Data set field
TG_RCFOV	Range to CFOV
TG_RMU	Ranging methods/units
TG_DAC	Depreciation angle cfov
TG_NUM	Target number (within image)
TG_NCL	Number of classes
TG_CLASS	Assigned target class
TG_INS	Information string, combine:
	Program id
	Run Date
	Run Time

Table name: TXT

Column Name	Description
TX_IMG	Image number of this text
TX_LIN	Line number of this text
TX_TXT	Text
TX_UPD	Date of last update to this information
TX_WHO	Identity of originator of this info
TX_TAP	Tape number of image or this text
TX_KEY	Unique key value of image
TX_VND	Vendor

Table name: VND

Column Name	Description
V_VND	Vendor name in country/lab format
V_ADR	Vendor address, comma delimited
V_PHO	Vendor company phone number
V_NAM	Vendor company name in full
V_POC	Vendor point of contact
V_PPN	Point of contact phone number
V_ACC	Vendor access to classified material flag, Y/N
V_NTP	Number of tapes vendor has sent to ERIM
V_CHG	Vendor to be billed flag, Y/N
V_ATR	Vendor is ATR program sponsored flag, Y/N
V_DOD	Vendor is DOD contractor flag, Y/N

Table name: SXX

Column Name	Description
S_KEY	Unique key value of image
S_SET	Demo,Development,Characterization, or Validation
S_OUT	Output Tape

N.B. These tables contain all the key values in a specific set and are used primarily as join tables.

As of Feb. 21, 1986, ORACLE contains tables for the demo set and datasets 1 through 5. (S00,S01,S02,S03,S04,S05)

Table name: BTGTM

The BTGTM table contains the original set of boxtruth local metrics data that was done on the development sets of datasets 1 and 2. The TGT table currently holds the wireframe truth local metrics.

Column Name	Description
BL_IMG	Image number that this target appears on
BL_KEY	Unique key value of image with this target
BL_APL	Alpha_1 (Multiplier for outer box size)
BL_EPL	Epsilon_1 (Guard ring size)
BL_EOL	ESR_offset_1 (Spacing factor for Sobel operator)
BL_TYPE	Target type
BL_AA	Target observation aspect angle
BL_DA	Target observation depression angle
BL_RANGE	Target Range
BL_TBS	Target box string, combine: Target box line coordinate (upper left corner) Target box pixel coordinate (upper left corner) Target box height (vertical) Target box length (horizontal)
BL_TBF	Target box fault (flag for edge effect)
BL_NO	Pixels on target
BL_RNO	Resolution cells on target
BL_TIR	TIR2
BL_TBIR	TBIR2
BL_ESR	Edge Strength Ratio (ESR)
BL_ESRSG	ESR sign
BL_ESREC	ESR error code (edge effect flag)
BL_SMRT	Similarity ratio
BL_CSM	Correlation coefficient same class
BL_CDF	Correlation coefficient different class
BL_CTS	Centroid string, combine: Geometric centroid - line Geometric centroid - pixel Intensity centroid - line Intensity centroid - pixel
BL_XBT	Mean intensity on target
BL_X2BT	Mean square intensity on target
BL_STT	Standard deviation of intensity on target
BL_NB	Number of pixels on background
BL_XBB	Mean intensity on background
BL_X2BB	Mean square intensity on background
BL_STB	Standard deviation of intensity on background
BL_RESL	Scale factor from line to line
BL_RESP	Scale factor within a line
BL_LSPC	Line spacing
BL_PSPC	Pixel spacing
BL_DTS	Data set field
BL_RCFOV	Range to CFOV

BL_RMU	Ranging methods/units
BL_DAC	Depreciation angle cfov
BL_NUM	Target number (within image)
BL_NCL	Number of classes
BL_CLASS	Assigned target class
BL_INS	Information string, combine:
	Program id
	Run Date
	Run Time

Table name: CPR

Column Name	Description
C_VTN	Vendor/contractor tape number
C_RRD	Results report date
C_CCD	CAPIR contractor code
C_EXN	Experiment number
C_EXT	Experiment title/name
C_SET	Collating data set
C_ATN	ERIM's analyzed results tape No.
C_PPR	Preprocesser name
C_FUN	Function name
C_GAT	Gate/filter name
C_ACL	Algorithm class
C_ANA	Algorithm name
C_MD1	Name of first modifier
C_MD2	Name of second modifier
C_MD3	Name of third modifier
C_MD4	Name of fourth modifier

Example:

C_VTN	SP2004
C_RRD	January 20, 1986
C_CCD	10
C_EXN	D1
C_EXT	Detection
C_SET	Set 1A
C_ATN	to be arranged
C_PPR	Synthetic Image Correction
C_FUN	Dectector
C_GAT	Double window
C_ACL	Statistical
C_ANA	Cramer-Von Mises
C_MD1	Parametric Hot Spot Test
C_MD2	None
C_MD3	None
C_MD4	None

Table name: AIRPAR

Column Name	Description
A_NAM	Contact person's name
A_COM	Company name
A_ADR	Mailing address of company
A_PHO	Phone number
A_CAP	CAPIR contracter flag

Ground Truth Data (GND)

#	size	csize	type	name
1	22	40	2 numeric	G_1
2	22	40	2 numeric	G_2
3	22	40	2 numeric	G_3
4	22	40	2 numeric	G_4
5	22	40	2 numeric	G_5
6	22	40	2 numeric	G_6
7	22	40	2 numeric	G_7
8	22	40	2 numeric	G_8
9	22	40	2 numeric	G_9
10	22	40	2 numeric	G_10
11	22	40	2 numeric	G_11
12	22	40	2 numeric	G_12
13	22	40	2 numeric	G_13
14	22	40	2 numeric	G_14
15	22	40	2 numeric	G_15
16	22	40	2 numeric	G_16
17	22	40	2 numeric	G_17
18	22	40	2 numeric	G_18
19	22	40	2 numeric	G_19
20	22	40	2 numeric	G_20
21	22	40	2 numeric	G_21
22	22	40	2 numeric	G_22
23	22	40	2 numeric	G_23
24	22	40	2 numeric	G_24
25	22	40	2 numeric	G_101
26	22	40	2 numeric	G_102
27	22	40	2 numeric	G_103
28	22	40	2 numeric	G_104
29	22	40	2 numeric	G_105
30	22	40	2 numeric	G_106
31	22	40	2 numeric	G_107
32	22	40	2 numeric	G_108
33	22	40	2 numeric	G_109
34	22	40	2 numeric	G_110
35	22	40	2 numeric	G_111
36	22	40	2 numeric	G_112
37	22	40	2 numeric	G_113
38	22	40	2 numeric	G_114
39	22	40	2 numeric	G_115
40	22	40	2 numeric	G_116
41	22	40	2 numeric	G_117
42	22	40	2 numeric	G_118
43	22	40	2 numeric	G_119
44	22	40	2 numeric	G_120
45	22	40	2 numeric	G_121
46	22	40	2 numeric	G_122
47	22	40	2 numeric	G_123
48	22	40	2 numeric	G_124
49	22	40	2 numeric	G_125
50	22	40	2 numeric	G_126
51	22	40	2 numeric	G_127
52	22	40	2 numeric	G_128
53	22	40	2 numeric	G_201
54	22	40	2 numeric	G_202

55	22	40	2	numeric	G_203
56	22	40	2	numeric	G_204
57	22	40	2	numeric	G_205
58	22	40	2	numeric	G_206
59	22	40	2	numeric	G_207
60	22	40	2	numeric	G_208
61	22	40	2	numeric	G_209
62	22	40	2	numeric	G_210
63	22	40	2	numeric	G_211
64	22	40	2	numeric	G_212
65	22	40	2	numeric	G_213
66	22	40	2	numeric	G_214
67	22	40	2	numeric	G_215
68	22	40	2	numeric	G_216
69	22	40	2	numeric	G_217
70	22	40	2	numeric	G_218
71	22	40	2	numeric	G_219
72	22	40	2	numeric	G_301
73	22	40	2	numeric	G_302
74	22	40	2	numeric	G_303
75	22	40	2	numeric	G_304
76	22	40	2	numeric	G_305
77	22	40	2	numeric	G_306
78	22	40	2	numeric	G_307
79	22	40	2	numeric	G_308
80	22	40	2	numeric	G_309
81	22	40	2	numeric	G_310
82	22	40	2	numeric	G_311
83	22	40	2	numeric	G_312
84	22	40	2	numeric	G_313
85	22	40	2	numeric	G_314
86	22	40	2	numeric	G_315
87	22	40	2	numeric	G_316
88	22	40	2	numeric	G_1001
89	22	40	2	numeric	G_1002
90	22	40	2	numeric	G_1003
91	22	40	2	numeric	G_1004
92	22	40	2	numeric	G_1005
93	22	40	2	numeric	G_1006
94	22	40	2	numeric	G_1007
95	22	40	2	numeric	G_1008
96	22	40	2	numeric	G_TAP
97	22	40	2	numeric	G_SEQ
98	20	1	1	character	G_IMG
99	1	1	1	character	G_FL1
100	15	1	1	character	G_KEY
101	22	40	2	numeric	G_25
102	22	40	2	numeric	G_26
103	22	40	2	numeric	G_27
104	22	40	2	numeric	G_28
105	22	40	2	numeric	G_29
106	22	40	2	numeric	G_30
107	22	40	2	numeric	G_31
108	22	40	2	numeric	G_32
109	22	40	2	numeric	G_129
110	22	40	2	numeric	G_130
111	22	40	2	numeric	G_131
112	22	40	2	numeric	G_132
113	22	40	2	numeric	G_133
114	22	40	2	numeric	G_134

115	22	40	2	numeric	G_135
116	22	40	2	numeric	G_136
117	22	40	2	numeric	G_137
118	22	40	2	numeric	G_138
119	22	40	2	numeric	G_139
120	22	40	2	numeric	G_140
121	22	40	2	numeric	G_141
122	22	40	2	numeric	G_142
123	22	40	2	numeric	G_143
124	22	40	2	numeric	G_220
125	22	40	2	numeric	G_221
126	22	40	2	numeric	G_222
127	22	40	2	numeric	G_223
128	22	40	2	numeric	G_224
129	22	40	2	numeric	G_225
130	22	40	2	numeric	G_226
131	22	40	2	numeric	G_227
132	22	40	2	numeric	G_317
133	22	40	2	numeric	G_318
134	22	40	2	numeric	G_319
135	22	40	2	numeric	G_320
136	22	40	2	numeric	G_901
137	22	40	2	numeric	G_902
138	22	40	2	numeric	G_903

Image Information (IMG)

#	size	csize	type		name
1	8	1	1	character	I_VND
2	7	75	12	date data type	I_DAT
3	[illegible]	1	1	character	I_IMG
4	22	40	2	numeric	I_NRF
5	22	40	2	numeric	I_BH2
6	22	40	2	numeric	I_BPR
7	22	40	2	numeric	I_EPS
8	22	40	2	numeric	I_BIE
9	22	40	2	numeric	I_BME
10	22	40	2	numeric	I_BEE
11	22	40	2	numeric	I_SPL
12	22	40	2	numeric	I_LPI
13	22	40	2	numeric	I_IDV
14	22	40	2	numeric	I_AUX
15	22	40	2	numeric	I_FH2
16	22	40	2	numeric	I_PAK
17	1	1	1	character	I_CLS
18	1	1	1	character	I_INI
19	1	1	1	character	I_RSL
20	22	40	2	numeric	I_TAP
21	22	40	2	numeric	I_SEQ
22	15	1	1	character	I_KEY
23	14	1	1	character	I_ALG
24	22	40	2	numeric	I_EPG
25	14	1	1	character	I_EOG
26	19	1	1	character	I_WSS
27	22	40	2	numeric	I_TFS
28	22	40	2	numeric	I_NTIR
29	14	1	1	character	I_MNTS
30	14	1	1	character	I_MXTS
31	14	1	1	character	I_XTS

32	14	1	1	character	I_STTS
33	14	1	1	character	I_MNTP
34	14	1	1	character	I_MXTP
35	14	1	1	character	I_XTP
36	14	1	1	character	I_STTP
37	14	1	1	character	I_MNTBS
38	14	1	1	character	I_MXTBS
39	14	1	1	character	I_XTBS
40	14	1	1	character	I_STTBS
41	14	1	1	character	I_MNTBP
42	14	1	1	character	I_MXTBP
43	14	1	1	character	I_XTBP
44	14	1	1	character	I_STTBP
45	22	40	2	numeric	I_NESR
46	14	1	1	character	I_MNES
47	14	1	1	character	I_MXES
48	14	1	1	character	I_XES
49	14	1	1	character	I_STES
50	14	1	1	character	I_MNEP
51	14	1	1	character	I_MXEP
52	14	1	1	character	I_XEP
53	14	1	1	character	I_STEP
54	14	1	1	character	I_MNIN
55	14	1	1	character	I_MXIN
56	14	1	1	character	I_XIN
57	14	1	1	character	I_STIN
58	22	40	2	numeric	I_KRI
59	132	1	1	character	I_RGS
60	80	1	1	character	I_INS

Tape Information (TAP)

#	size	csize	type		name
1	22	40	2	numeric	T_TAP
2	20	1	1	character	T_VND
3	22	40	2	numeric	T_NIM
4	132	1	1	character	T_LAB
5	7	75	12	date data type	T_RVD
6	20	1	1	character	T_STA
7	10	1	1	character	T_FRM
8	4	1	1	character	T_BPI
9	3	1	1	character	T_CPY
10	8	1	1	character	T_TYP
11	20	1	1	character	T_ITY
12	1	1	1	character	T_PRO
13	7	75	12	date data type	T_RLD
14	1	1	1	character	T_CLS
15	20	1	1	character	T_LOC
16	1	1	1	character	T_CFL
17	20	1	1	character	T_VTN

Target Information (TGT)

#	size	csize	type		name
1	22	40	2	numeric	TG_TYP
2	22	40	2	numeric	TG_CON
3	22	40	2	numeric	TG_HIS
4	22	40	2	numeric	TG_ASP

5	22	40	2	numeric	TG_TBC
6	22	40	2	numeric	TG_POT
7	22	40	2	numeric	TG_CMC
8	22	40	2	numeric	TG_HDG
9	22	40	2	numeric	TG_RNG
10	22	40	2	numeric	TG_OBS
11	22	40	2	numeric	TG_LIN
12	22	40	2	numeric	TG_PIX
13	22	40	2	numeric	TG_TAP
14	20	1	1	character	TG_IMG
15	22	40	2	numeric	TG_SEQ
16	1	1	1	character	TG_CLS
17	1	1	1	character	TG_INT
18	1	1	1	character	TG_RSL
19	1	1	1	character	TG_FL1
20	2	1	1	character	TG_FL2
21	15	1	1	character	TG_KEY
22	14	1	1	character	TG_APL
23	22	40	2	numeric	TG_EPL
24	14	1	1	character	TG_EOL
25	22	40	2	numeric	TG_TYPE
26	14	1	1	character	TG_AA
27	14	1	1	character	TG_DA
28	22	40	2	numeric	TG_RANGE
29	22	40	2	numeric	TG_TBF
30	22	40	2	numeric	TG_NO
31	22	40	2	numeric	TG_RNO
32	14	1	1	character	TG_TIR
33	14	1	1	character	TG_TBIR
34	14	1	1	character	TG_ESR
35	22	40	2	numeric	TG_ESRSG
36	22	40	2	numeric	TG_ESREC
37	14	1	1	character	TG_SMRT
38	14	1	1	character	TG_CSM
39	14	1	1	character	TG_CDF
40	14	1	1	character	TG_XBT
41	14	1	1	character	TG_X2BT
42	14	1	1	character	TG_STT
43	22	40	2	numeric	TG_NB
44	14	1	1	character	TG_XBB
45	14	1	1	character	TG_X2BB
46	14	1	1	character	TG_STB
47	14	1	1	character	TG_RESL
48	14	1	1	character	TG_RESP
49	22	40	2	numeric	TG_LSPC
50	22	40	2	numeric	TG_PSPC
51	22	40	2	numeric	TG_DTS
52	14	1	1	character	TG_RCFOV
53	22	40	2	numeric	TG_RMU
54	22	40	2	numeric	TG_NUM
55	22	40	2	numeric	TG_NCL
56	22	40	2	numeric	TG_CLASS
57	14	1	1	character	TG_DAC
58	59	1	1	character	TG_CTS
59	27	1	1	character	TG_TBS
60	59	1	1	character	TG_INS

Documentation Information (TXT)

#	size	csize	type	name
1	20	1	1 character	TX_IMG
2	22	40	2 numeric	TX_LIN
3	80	1	1 character	TX_TXT
4	7	75	12 date data type	TX_UPD
5	10	1	1 character	TX_WHO
6	22	40	2 numeric	TX_TAP
7	15	1	1 character	TX_KEY
8	8	1	1 character	TX_VND

Vendor Information (VND)

#	size	csize	type	name
1	8	1	1 character	V_VND
2	80	1	1 character	V_ADR
3	18	1	1 character	V_PHO
4	30	1	1 character	V_NAM
5	30	1	1 character	V_POC
6	15	1	1 character	V_PPN
7	1	1	1 character	V_ACC
8	22	40	2 numeric	V_NTP
9	1	1	1 character	V_CHG
10	1	1	1 character	V_ATR
11	1	1	1 character	V_DOD

Data Set Information (S00)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	5	1	1 character	S_SET
3	5	1	1 character	S_OUT

Data Set Information (S01)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	17	1	1 character	S_SET
3	5	1	1 character	S_OUT

Data Set Information (S02)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	17	1	1 character	S_SET
3	5	1	1 character	S_OUT

Data Set Information (S03)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	17	1	1 character	S_SET
3	5	1	1 character	S_OUT

Data Set Information (S04)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	17	1	1 character	S_SET
3	5	1	1 character	S_OUT

Data Set Information (S05)

#	size	csize	type	name
1	15	1	1 character	S_KEY
2	17	1	1 character	S_SET
3	5	1	1 character	S_OUT

Box Truth Local Metrics (BTGTM)

#	size	csize	type	name
1	20	1	1 character	BL_IMG
2	15	1	1 character	BL_KEY
3	14	1	1 character	BL_APL
4	22	40	2 numeric	BL_EPL
5	14	1	1 character	BL_EOL
6	22	40	2 numeric	BL_TYPE
7	14	1	1 character	BL_AA
8	14	1	1 character	BL_DA
9	22	40	2 numeric	BL_RANGE
10	27	1	1 character	BL_TBS
11	22	40	2 numeric	BL_TBF
12	22	40	2 numeric	BL_NO
13	22	40	2 numeric	BL_RNO
14	14	1	1 character	BL_TIR
15	14	1	1 character	BL_TBIR
16	14	1	1 character	BL_ESR
17	22	40	2 numeric	BL_ESRSG
18	22	40	2 numeric	BL_ESREC
19	14	1	1 character	BL_SMRT
20	14	1	1 character	BL_CSM
21	14	1	1 character	BL_CDF
22	59	1	1 character	BL_CTS
23	14	1	1 character	BL_XBT
24	14	1	1 character	BL_X2BT
25	14	1	1 character	BL_STT
26	22	40	2 numeric	BL_NB
27	14	1	1 character	BL_XBB
28	14	1	1 character	BL_X2BB
29	14	1	1 character	BL_STB
30	14	1	1 character	BL_RESL
31	14	1	1 character	BL_RESP
32	22	40	2 numeric	BL_LSPC
33	22	40	2 numeric	BL_PSPC
34	22	40	2 numeric	BL_DTS
35	14	1	1 character	BL_RCFOV
36	22	40	2 numeric	BL_RMU
37	14	1	1 character	BL_DAC
38	22	40	2 numeric	BL_NUM
39	22	40	2 numeric	BL_NCL
40	22	40	2 numeric	BL_CLASS
41	59	1	1 character	BL_INS

CAPIR Results (CPR)

#	size	csize	type	name
1	20	1	1 character	C_VTN
2	7	75	12 date data type	C_RRD
3	4	1	1 character	C_CCD
4	8	1	1 character	C_EXN
5	20	1	1 character	C_EXT
6	15	1	1 character	C_SET
7	8	1	1 character	C_ATN
8	40	1	1 character	C_PPR
9	40	1	1 character	C_FUN
10	40	1	1 character	C_GAT
11	20	1	1 character	C_ACL
12	40	1	1 character	C_ANA
13	45	1	1 character	C_MD1
14	45	1	1 character	C_MD2
15	45	1	1 character	C_MD3
16	45	1	1 character	C_MD4

AIRSTECH participants (AIRPAR)

#	size	csize	type	name
1	30	1	1 character	A_NAM
2	20	1	1 character	A_PHO
3	50	1	1 character	A_COM
4	80	1	1 character	A_ADD
5	1	1	1 character	A_CAP

APPENDIX B

MIDIS Catalog Oracle Definitions

APPENDIX B - MIDIS CATALOG

	Name	Type	Size	Description
	DB_ID	CHAR	20	Unique Database ID
	MIS_NO	INTGER	8	Mission (Flight) Number
	GMT_YEAR	INTEGER	4	GMT Year
	GMT_MONTH	INTEGER	2	GMT Month
	GMT_DAY	INTEGER	2	GMT Day
	GMT_HOUR	INTEGER	2	GMT Hour
	SOURCE	CHAR	20	Source of Data
	LOCATION	CHAR	20	Location of data collection
	CLASS	CHAR	20	Classification
	SENSOR	CHAR	20	Sensor type
	SENSOR_SER	CHAR	20	Sensor serial number
	RTRANS_SER	CHAR	20	Recorder transport serial number
	RELECT_SER	CHAR	20	Recorder electronics serial number
	IMAGER	CHAR	20	Imager type
	FOV	CHAR	20	Field of view selection
	PIX_P_LIN	INTEGER	4	Number of active pixels per line
	VERT_DET	INTEGER	4	Number of vertical detectors
	HORZ_DET	INTEGER	4	Number of horizontal detectors
	MNT_ANGLE	REAL	6.2	Sensor mount depression angle
	AIR_SPEED	REAL	7.2	Platform airspeed
	GND_SPEED	REAL	7.2	Ground speed
	SPEED_UNITS	CHAR	10	Speed units
*	WEATHER	INTEGER	4	Weather code
	AIR_TEMP	REAL	6.2	Air temperature
	REL_HUMID	REAL	6.2	Relative humidity
	VISIBILITY	REAL	6.2	Visibility
	ATM_TRANS	REAL	6.2	Atmospheric Transmission
	DEW_POINT	REAL	6.2	Dew point temperature
	BAR_PRES	REAL	6.2	Barometric presure
*	CLOUDS	INTEGER	4	Cloud code
	WIND_SPD	REAL	6.2	Wind speed
	WIND_DIR	REAL	6.2	Wind direction
*	TERRAIN	INTEGER	4	Terrain code
*	CLUTTER	INTEGER	4	Clutter code
	TGT_P_FRM	INTEGER	4	Average number of targets per frame
	TGT_TYPES	INTEGER	4	Number of diferent target types.
	ID_VIDEO	CHAR	20	Video tape ID number
	ID_28TRK	CHAR	20	28 track HBR tape ID number
	ID_9TRK	CHAR	20	9 track tape ID number

The fields denoted with an asterisk (*) are fields that are linked to thes tables listed below.

Table : WEATHER

Name	Type	Size	Description
CODE	INTEGER	4	Weather code
CONDITION	CHAR	40	Weather condition

Table : CLOUDS

Name	Type	Size	Description
CODE	INTEGER	4	Cloud code
TYPE	CHAR	40	Cloud type

Table : TERRAIN

Name	Type	Size	Description
CODE	INTEGER	4	Terrain code
TYPE	CHAR	40	Terrain type

Table : CLUTTER

Name	Type	Size	Description
CODE	INTEGER	4	Clutter code
TYPE	CHAR	40	Clutter condition

END
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