615-85

MVM'73 MOS SOFTWARE

EVTMDR

REQUIREMENTS

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

LIST OF FIGURES

1.0   SCOPE

This specification presents the detailed software requirements
for the MVM'73 mission dependent EVTMDR program. For the
purposes of this specification, EVTMDR is called a program. In
actuality, it is the set of controls/directives which utilize
the capabilities of the MARK IV File Management System (a
proprietary product of Informatics, Inc.) to perform the
required processing. This specification does not stipulate
requirements for modifications to MARK IV and no such interpretation
is intended.

2.0   APPLICABLE DOCUMENTS

The latest issues of the following documents are directly
applicable to and furnish source requirements or supplementary
information for this specification.

   (1)   MOS-73-3-300   Functional Requirements Specification,
                             MVM'73 Ground Data System, Command System

   (2)   MOS-73-3-400   Functional Requirements Specification,
                             MVM'73 Ground Data System, Planning and
                             Analysis Software System

   (3)   MOS-73-3-410   Functional Requirements Specification,
                             MVM'73 Ground Data System, Planning and
                             Analysis Software System, Mission Control
                             Software

   (4)   MOS-73-3-500   Functional Requirements Specification,
                             MVM'73 Ground Data System, Data Records

   (5)   615-59   Software Requirements Document, Command
                             Generation (COMGEN) Program

(6) 615-84   Software Requirements Document, AMCOMPRX
                    Program

(7) 615-86   Software Requirements Document, Command
                    Translation Requirements

(8) COMGEN-4   Software Interface Specification, COMGEN
                    to SEG, SPOP, FIP

(9) COMGEN-5   Software Interface Specification, COMGEN
                    to EVTMDR

(10) AMCOMPRX-1   Software Interface Specification, AMCOMPRX
                    to EVTMDR, COMGEN

(11) EVTMDR-1   Software Interface Specification, EVTMDR
                    to SPOP, SEG

(12) EVTMDR-2   Software Interface Specification, EVTMDR
                    to FIP

3.0   FUNCTIONAL DESCRIPTION

The EVTMDR program supports the generation of the Event MDR
(Master Data Record) by providing capabilities to determine the
correctness of data to be included in the Event MDR and to
display and accumulate these data. The sections which follow
define the Event MDR and its constituent components, and describe
the capabilities of the EVTMDR program and how these capabilities
will be used to generate and maintain the Event MDR.

3.1   Event MDR

Two forms of the Event MDR are generated/maintained on magnetic
tape: the Daily Event MDR and the Accumulated Event MDR. The
second form is usually considered as the Event MDR; therefore,
the name 'Event MDR' will be used hereafter when the 'Accumulated
Event MDR' is referenced. The data contents of the two forms is
different, as described below.

The Daily Event MDR magnetic tape is generated by the OPSCOP
utility program for input to EVTMDR. This tape contains four
sets of data:

    (1)   The set of all ground commands to be transmitted to the
           spacecraft as determined by the COMGEN program, where

               - Each command is tagged with the transmit (TRM)
                 time, and

               - The commands are in chronological order.

(2) The set of all ground commands actually transmitted to the spacecraft as determined by the AMCOMPRX program, where

- Each command is tagged with the TRM time, and

- The commands are in chronological order.

(3) The set (1) above of ground commands plus the resulting on-board CC&S events, where

- Each command and each event is tagged with the spacecraft event (SCE) time, and

- The commands and events are merged in chronological order.

(4) The set of TV occurences which correspond to set (3) above, where

- Each occurence is tagged with the SCE time, and

- The occurences are in chronological order.

The Daily Event MDR is normally generated on a TRM-related data day; that is, the second set above contains all the ground commands transmitted during the data day.

The Event MDR magnetic tape is generated by EVTMDR and contains sets (3) and (4) only. This tape is normally generated daily; however, the time span of the data may be from one day to many days.

The data sets comprising the Event MDR are represented in the
form of data collections produced by the COMGEN and AMCOMPRX
programs. Both the Daily Event MDR and the Event MDR are
maintained in two forms: a magnetic tape containing data
collections and tab listings of the data collections. The
magnetic tape format is defined in Reference 9, while the tab
listing forms are described in Section 6.0. The data collections
are described in the sub-sections which follow.

3.1.1   Command Collection

A command (CMD) collection is a well ordered set of alpha-numeric
representations of ground commands. Normally, a CMD collection
is a 'timed' set, where each command representation carries with
it an associated TRM time. The TRM values in a CMD collection
are monotonically increasing starting from the first command in
the set. It is also possible to have a 'priority' collection,
where no command carries a time tag value. Timed and priority
commands will never be mixed in a CMD collection.

A CMD collection may be input to EVTMDR in either of two forms:
a punched card deck or a file of card images on magnetic tape.
The normal method of input will be via magnetic tape.

A CMD collection may contain any of the cards shown in Figure 4
of Reference 9, and they may appear in any order (depending only
on the use/result intended). However, there will be only one
EOC (End-of-Collection) card in any collection and it will be the
final card. If the collection is 'timed', every card (with the
possible exception of the EOC card) will contain the TRM field
shown in Figure 7 of Reference 9. If the collection is a 'priority'
one, then the columns allocated to the TRM field will be blank
in all cards. A hypothetical 'timed' CMD collection is shown in
Figure 3-1; the contents are not intended to reflect an actual
set of commands, but only to illustrate the concept of a CMD
collection.

```
00000000001111111111222222222233333333334444444444555555555566666666667
1234567890123456789012345678901234567890123456789012345678901234567890l
```

DC-17			09:00:00	TRM 321 73
CC-3	246		09:10:25	TRM 321 73
DC-27			09:31:40	TRM 321 73
DC-65			09:32:10	TRM 321 73
CC-6	HGA DS P	HI 37	11:07:10	TRM 321 73
DC-19			12:55:00	TRM 321 73
CC-5 7	2435		16:00:30	TRM 321 73
CC-1/2 240	NOP	132 507	17:30:00	TRM 321 73
DC-6			18:02:30	TRM 321 73
CC-4	ROLL	32	20:22:00	TRM 321 73
DC-30			23:10:50	TRM 321 73
EOC	NAMCOL		23:11:20	TRM 321 73

Figure 3-1

Example of a CMD Collection

3.1.2   Command and Event Collection

A command and event (CMD+EVT) collection is a well ordered set
of alpha-numeric representations of ground commands and
spacecraft Central Computer and Sequencer (CC&S) events. The
ground commands and CC&S events are intermixed in the set and
each command and each event carries with it an associated SCE
time. The SCE values in the collection are monotonically
increasing starting from the first item in the set.

A CMD+EVT collection may be input to EVTMDR in either of two
forms: a punched card deck or a file of card images on magnetic
tape. The normal method of input will be via magnetic tape.

A CMD+EVT collection may contain any of the cards shown in
Figures 4 and 5 of Reference 9, and they may appear in any order
(depending only on the use/result intended). However, there will
be only one EOC card in any collection and it will be the final
card. All cards, with the possible exception of the EOC card,
will contain the SCE field shown in Figure 7 of Reference 9. A
hypothetical CMD+EVT collection is shown in Figure 3-2; the
contents are not intended to reflect an actual set of commands
and events, but only to illustrate the concept of a CMD+EVT
collection.

3.1.3   TV Occurence Collection

A TV occurence (TVP) collection is a well ordered set of TV picture
descriptors. Each descriptor contains the parameters of a TV
picture taken at the specified time. Each descriptor carries with
it an associated SCE time. The SCE values in the collection are
monotonically increasing starting from the first item in the set.

```
0000000001111111111222222222233333333334444444444555555555566666666667 7
1234567890123456789012345678901234567890123456789012345678901234567890 1
```

```
CC-1/2  454  UNJ     1  137                    08:27:36.247 SCE 047 74
CC&S-NUL                                       08:29:40.025 SCE 047 74
CC&S-4L                                        08:29:42.000 SCE 047 74
CC&S-15A PNL -X P     LO  527                  09:07:52.723 SCE 047 74
DC-7                                           09:07:55.209 SCE 047 74
CC-4    PTCH             614                    11:00:05.631 SCE 047 74
CC&S-6A    12    467                           11:10:12.000 SCE 047 74
DC-28                                          11:40:17.054 SCE 047 74
CC&S-SPARE 7                                   12:02:16.073 SCE 047 74
EOC    COLNAM                                  12:03:00.000 SCE 047 74
```

Figure 3-2

Example of a CMD+EVT Collection

A TVP collection may be input to EVTMDR in either of two forms:
a punched card deck or a file of card images on magnetic tape.
The normal method of input will be via magnetic tape.

A TVP collection may contain the cards shown in Figure 6 of
Reference 9 and they may appear in any order (depending only on
the use/result intended). However, there will be only one EOC
card in any collection and it will be the final card. All cards,
with the possible exception of the EOC card, will contain the
SCE field shown in Figure 7 of Reference 9.

3.1.4   Collection Generation Processes

This section describes the nominal data flow and processing steps
which produce the collections input to EVTMDR for processing.
The flow and processing described here is depicted in Figure 3-3.

The COMGEN program is utilized to generate the sets of ground
commands to be transmitted to the spacecraft and to simulate the
events which (should) occur in certain on-board components (in
particular, the CC&S) and the TV picture sequence, as a result
of transmitting these commands. The commands and events are
generated/produced in alpha-numeric representation form and are
placed in the COMGEN Interface File area on disk. The commands
are output as a CMD collection, while a subset of the simulation
results (and the commands) are issued as a CMD+EVT collection.
The TV picture data is issued as a TVP collection. Analysts
examine the listings of these collections and, if the contents
are found to be as desired, a command file is generated via
COMGEN for input to the Command System; a command file is a CMD
collection without the EOC card and is placed in the RTSPOOL
data set on disk. The generation of the command file and of the
collections may be performed on the same run or on separate runs,
as the situation merits. The collections reside in the COMGEN
interface file area until replaced or deleted.

At the appropriate time the command file is input to the Mission
Control and Computing Center (MCCC) portion of the Command System
for processing. The first step is the translation of the input
alpha-numeric representations into 26-bit patterns acceptable to
the spacecraft, and formatting these patterns into High Speed
Data (HSD) blocks. The MCCC portion of the Command System sends
these HSD blocks to a Deep Space Station (DSS) for processing
and subsequent transmission to the spacecraft. In addition to the
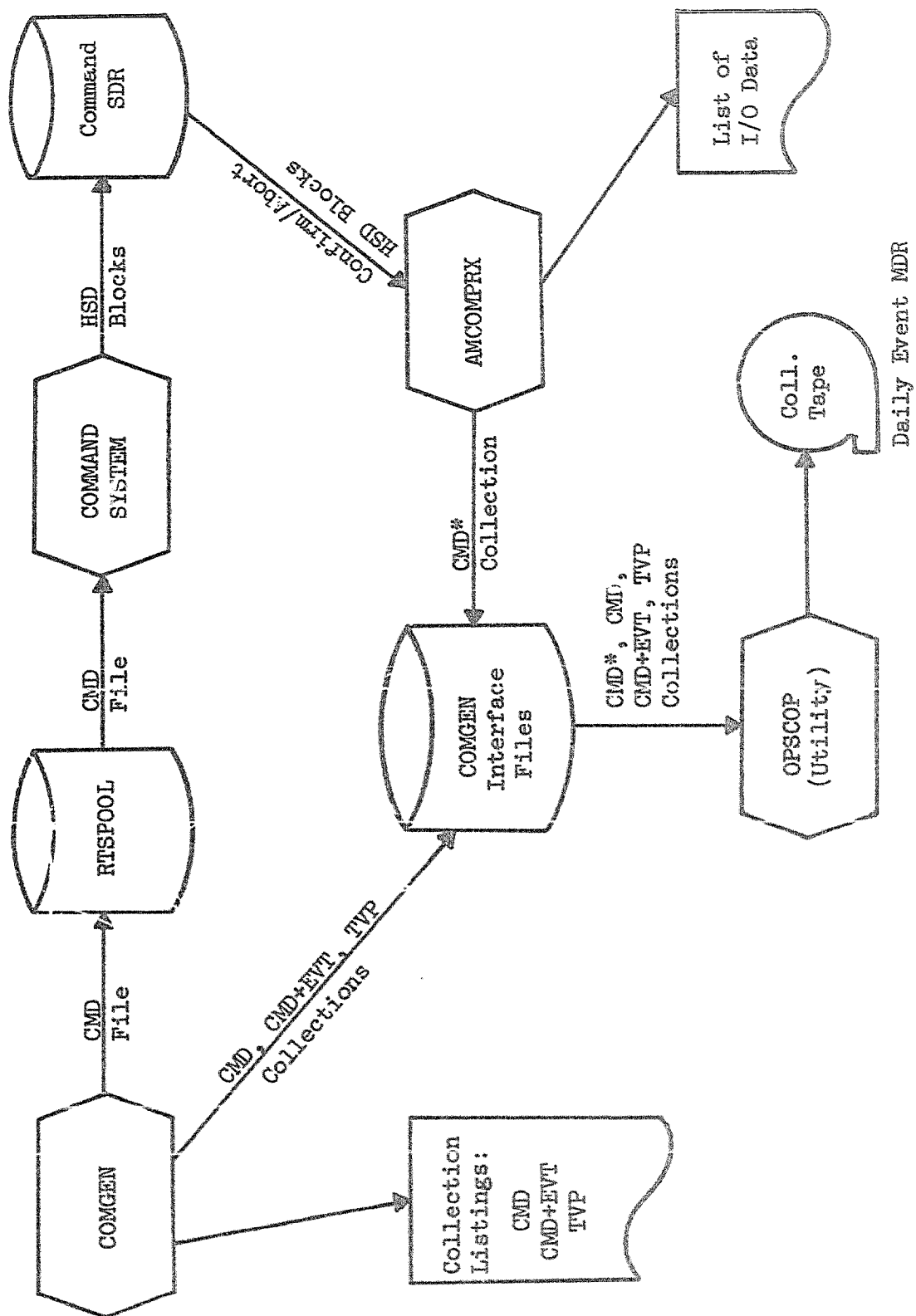HSD blocks containing the command bit patterns, many other HSD

Figure 3-3

Collection Generation Processes

blocks are sent in both directions between the MCCC and the DSS in order to cause the commands to be transmitted in the sequence and at the times desired. Except when outages occur, the messages flowing between the MCCC and the DSS are logged onto the Command SDR (System Data Record) which is resident on disk in the MCCC.

Of particular interest are the Confirm/Abort HSD blocks which originate at a DSS whenever a command transmission is attempted. If the transmission is successful, a Confirm HSD block is sent to the MCCC; otherwise, an Abort HSD block is issued. The Confirm block contains the command bit pattern and the time when transmission started. The Abort block specifies the reason for a transmission failure and the time when the transmission started.

The AMCOMPRX program retrieves those Confirm/Abort blocks which lie in a given time interval (and which possess other specified attributes) for the next step in the processing chain. This program is essentially an inverse of the Command Translator in that it converts the 26-bit command in a Confirm block into an equivalent alpha-numeric command representation in the COMGEN fixed-format. The set of generated representations are output as a CMD collection which is written into the COMGEN interface file area. In Figure 3-3, this collection is identified as the CMD* collection to show its different source. If no commands have been added, deleted or aborted in real time, the CMD* collection will be identical to the corresponding CMD collection produced by COMGEN, with one possible exception: both forms of the CC-1/2 command may be output from COMGEN while AMCOMPRX will only output the Instruction Word Form.

At this point in time, four collections of interest reside in the COMGEN interface file area: the CMD, CMD+EVT and TVP collections output by COMGEN and the AMCOMPRX-produced CMD* collection. These four collections are then written to magnetic

tape (or punched into cards) by the OPSCOP program. The format of this tape is defined in Reference 9. This tape is the principal input to the compare function of EVTMDR, and is the first cut at the Daily Event MDR. It should be noted that the collections on the tape have the fixed sequence of CMD*, CMD, CMD+EVT, and TVP.

3.2   EVTMDR Processing

The processing performed by EVTMDR consists of two primary
functions and a display capability which may operate in
conjunction with either primary function or by itself in the
manner of a utility program. The primary functions, comparing
two CMD collections and accumulating Event MDR collections, are
intended to be executed on two separate runs of the program
with an analysis effort taking place between runs. However, the
capability will exist to execute the compare function and then to
perform the accumulate function as the next step in the same run.
These capabilities are described in the sub-sections which follow.

Although the discussion below refers only to magnetic tapes,
punched card decks may be used in lieu of magnetic tapes for
inputting data. However, magnetic tape will be the normal
method for the input of collection data. The program will not
issue collection data in punched card form.

3.2.1   Compare Option

The principal function of EVTMDR is the comparison of two CMD
collections and the determination of differences between these
collections. The nominal data flow for the compare option is
shown in Figure 3-4.

The current Daily Event MDR, generated by the OPSCOP utility
program, is input to EVTMDR after the appropriate control
parameters have initialized the program. This tape will normally
contain all four collections of interest: CMD* from AMCOMPRX;
CMD, CMD+EVT and TVP collections from COMGEN. The CMD+EVT and
TVP collections are normally included since if no significant
differences are determined to exist between the CMD and CMD*
collections, then this tape is the master Daily Event MDR tape
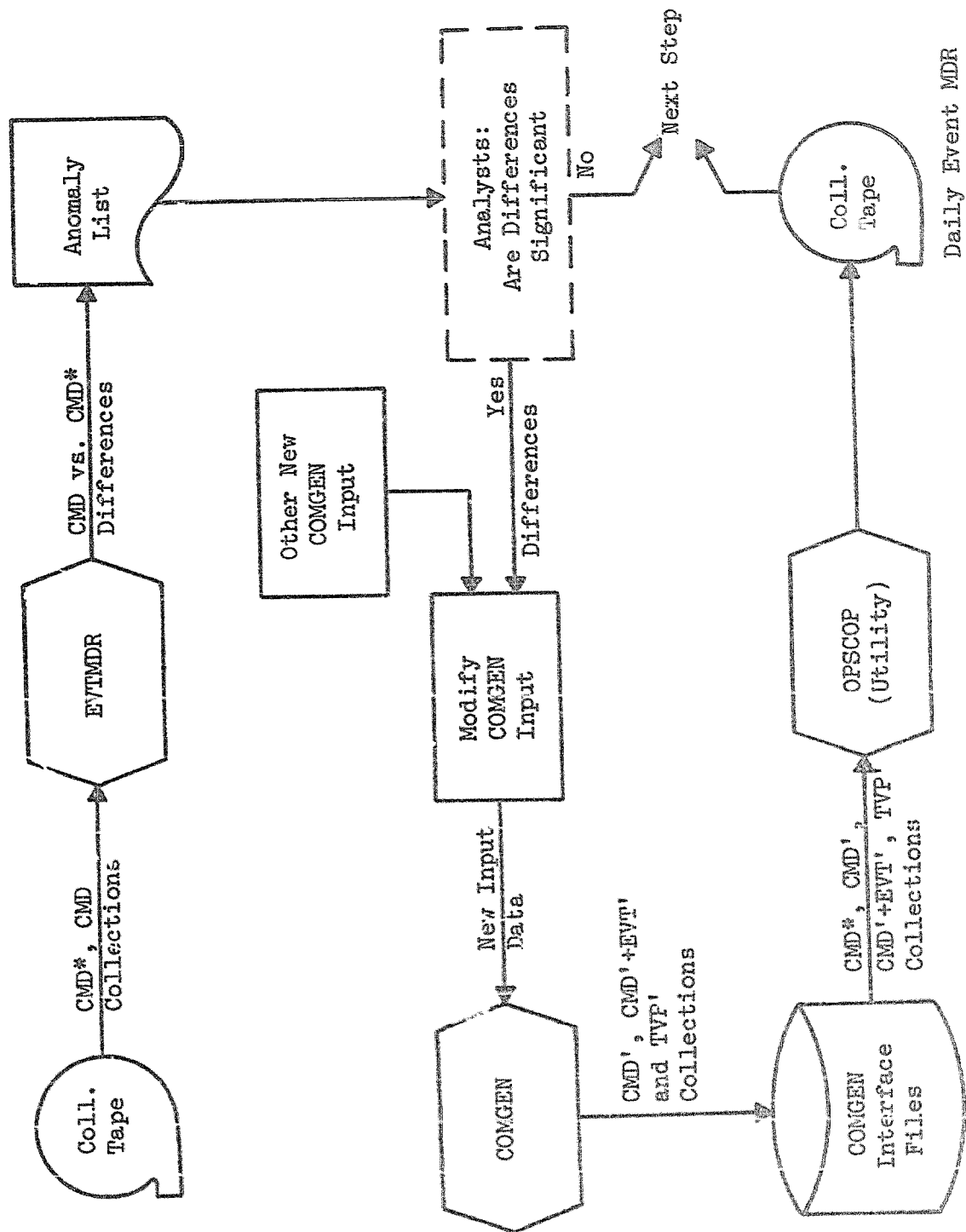for the corresponding time interval.

Figure 3-4

Data Flow for EVTMDR Compare Option

EVTMDR processes the CMD and CMD* collections by comparing their contents and determining whether any of these differences exist:

- A command exists in the CMD collection, but not in the CMD* collection (a planned command was not transmitted or else it aborted); or

- A command exists in the CMD* collection, but not in the CMD collection (an unplanned command was transmitted); or

- A command exists in both the CMD and CMD* collections, but the TRM times are significantly different (the planned transmission time was advanced or delayed by an amount exceeding a value specified in the control parameter inputs).

During the comparison process, the CMD* collection is used as the baseline set and the CMD collection is compared against it. Thus, the comparison is a 'planned vs. actual' analysis.

If any of these differences or anomalies are detected, the Anomaly Report detailed in Section 6.1.6 is issued; otherwise, a null report will result, in which case the collection tape is the desired Daily Event MDR.

If the Anomaly Report does contain significant differences, it is given to analysts for study. Normally, they will define changes (additions, deletions or modifications) to the COMGEN data deck which produced the CMD, CMD+EVT and TVP collections. COMGEN will then be re-executed to yield new collections, labelled CMD', CMD'+EVT' and TVP' in Figure 3-4. Then OPSCOP will be executed to create a new collection tape (Daily Event MDR); this time the tape will contain the CMD*, CMD', CMD'+EVT', and TVP' collections.

If the analysts and programmers are confident that all the previously discovered anomalies were removed during the COMGEN rerun, this now collection tape becomes the desired Daily Event MDR for the covered time period. However, the tape will almost always be cycled through EVTMDR for another comparison.

3.2.2   Accumulate Option

The other primary function of EVTMDR is the capability to accumulate/combine pairs of CMD+EVT collections and pairs of TVP collections. Two tapes are input to EVTMDR as shown in Figure 3-5:

- The current Daily Event MDR and an old/previous Daily Event MDR, or

- The current Daily Event MDR and an Accumulated Event MDR, or

- An Accumulated Event MDR and an old Daily Event MDR, or

- Two Accumulated Event MDR tapes.

Each input tape must contain a CMD+EVT collection and a TVP collection. There is no real difference between the two input tapes other than data volume and the time periods covered.

The specified CMD+EVT collection is merged with the CMD'+EVT' collection to yield the accumulated CMD"+EVT" collection. Similarly, the specified TVP collection is merged with the TVP' collection to yield the TVP" collection. The collection merge will normally be performed on an all inclusive basis: the totality of both input collections will be combined to yield the output collection. The capability will exist, however, to perform a partial merge. In this case, particulary when two Accumulated
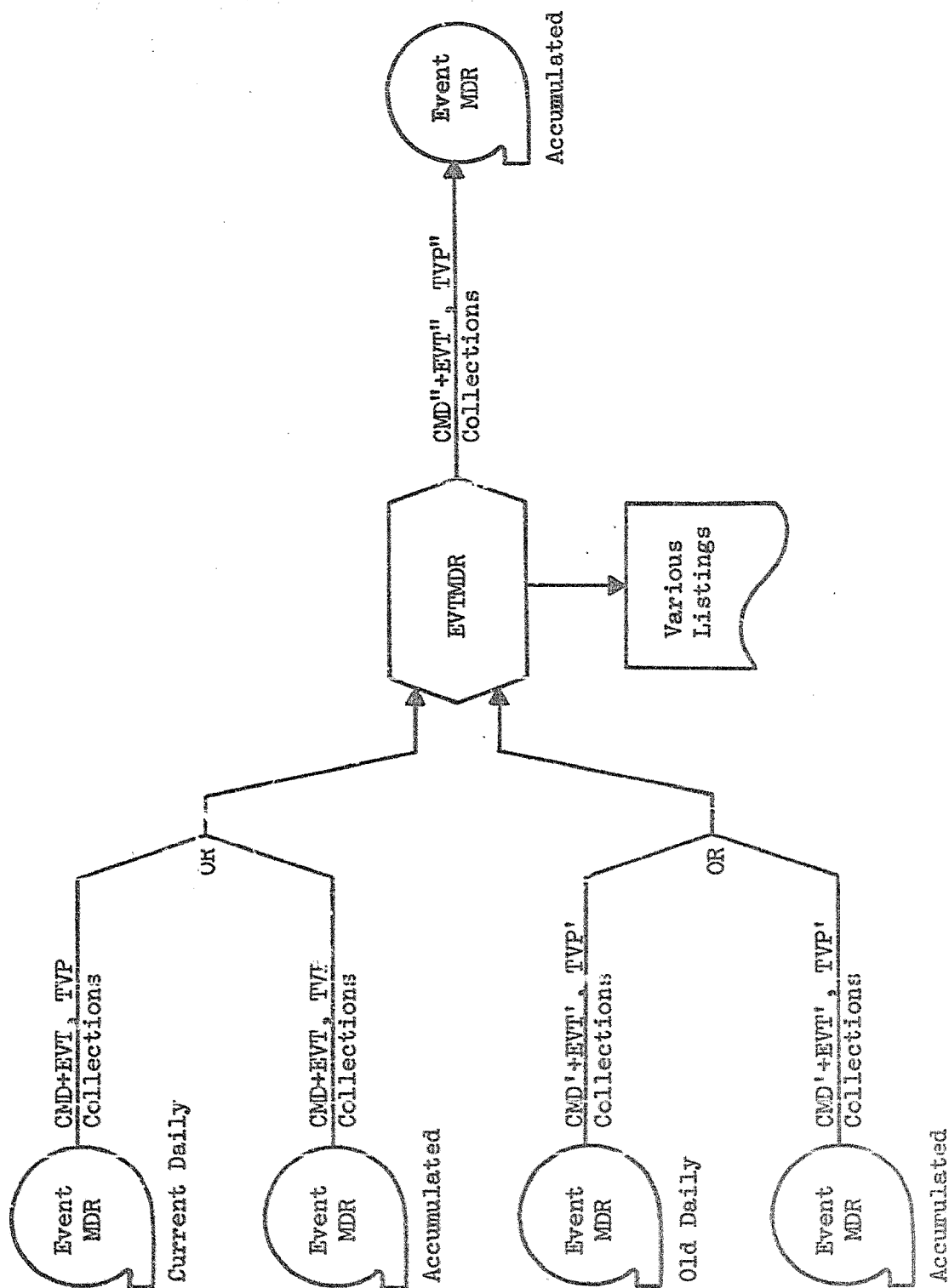
Figure 3-5

Data Flow for EVTMDR Accumulate Option

Event MDRs are input, the last part of one collection is
combined with the first part of the second collection to yield
a merged set covering a time interval of interest which is
shorter than the time spanned by the two input collections.

3.2.3   PIO-Type Statistics

EVTMDR also provides for the generation and display of certain
PIO-type statistics. The program will examine any one specified
collection (input or output) to detect the presence of various
types of commands and/or events. The result is a set of counts
of the number of occurences of each type of command or event
within the specified collection. These data are displayed in the
Statistics Report described in Section 6.1.7.

3.2.4   Other Display Output

The preceeding sections have referred to the Anomaly Report and
to the PIO-type statistics displays (described in Sections 3.2.1
and 3.2.3, respectively). By specifying the appropriate
parameters in the control parameter input set, EVTMDR can also
be made to issue the following displays:

    - A listing of any specified CMD, CMD+EVT or TVP input
      collection, and/or

    - A listing of any specified CMD+EVT or TVP output collection.

These displays are described in Sections 6.1.3, 6.1.4, and 6.1.5.
The program will also automatically issue a transaction listing
(see Section 6.1.1) and diagnostic messages (see Section 6.1.2).

4.0   CONSTRAINTS AND LIMITATIONS

This section presents the constraints and limitations imposed
on the EVTMDR program by existing software (particularly those
programs which supply data to or receive data from the program)
hardware, procedures, and MVM'73 software development philoso-
phy.

4.1   MARK IV Application

The EVTMDR program shall be implemented as an application of
the MARK IV File Management System. That is, the program shall
consist of that set of controls/parameters (and own code, if
necessary) which utilize the capabilities of MARK IV to perform
the required processing. No requirement in this specification
shall be construed as stipulating that modifications be made to
the MARK IV system.

4.2   Operating Environment

The program shall be executable interchangably on the flight
support IBM 360/75 computer in the background mode or on an
alternate IBM 360/75 computer in the batch mode. Since the
program may be run on the flight support computer, reasonable
effort shall be expended to minimize the amount of core memory
required at execution time.

4.3   Data Formats

Formats of the data upon which EVTMDR is to operate were defin-
ed for programs which existed prior to the conception of the
EVTMDR program. Since EVTMDR must interface with these other
programs via data transfers, EVTMDR is constrained to utilize
these formats (see Reference 9).

4.4 Future Growth

The program shall be structured in a manner which maximizes modularity of the functions to provide for future growth. The types of growth envisioned include input/output of data sets not now processed, a different set of processing instructions and/or different printed reports.

4.5 Input Tape Integrity

The program shall be incapable of writing data onto the magnetic input tape, if one is utilized. This feature will ensure that the integrity of the input source is maintained.

615-85

5.0 INPUT DATA REQUIREMENTS

This section presents the set of requirements which specify the types/kinds of input data to be processed by EVTMDR or required by EVTMDR to support the processing.

5.1 Data Types

The program shall accept input of four types of data:

- Control Parameters
- Command Collections
- Command and Event Collections
- TV Occurence Collections

The requirements for each of these data types are specified in the sub-sections which follow.

5.1.1 Control Parameters

The program shall accept input of processing control parameters via data cards and/or JCL (Job Control Language), as appropriate. The set of parameters and data items termed control parameters include at least the following:

- Designation of the desired program operating mode: compare, accumulate, display, or a mix;

- Designation of the desired displays;

- Name(s) or the input collection(s) to be processed;

- Name(s) of the output collection(s) to be generated;

- Source of each input collection: magnetic tape or cards;

- Name(s), number(s) and attributes of the input tape(s), when applicable;

- Name and attributes of the output tape, when applicable;

- Spacecraft number to which all collections must belong;

- Delta time value, in the form of SSS.FFF seconds, to be used in the compare processing option to determine whether the actual TRM time differs significantly from the planned TRM time;

- If the Statistics Report is selected for a CMD+EVT collection, the designation of whether none, all or a subset of the CC&S events are to be counted; and

- If the subset option is specified in the above item, a list of from one to ten event names/designators which comprise the subset.

Refer to Section 7.0 for the set of permitted combinations of operating mode vs. desired display output.

Collection names are EBCDIC character strings of up to eight characters. If the collections are input/output via magnetic tape, the collection names are those names which appear in words 9 through 208 of the Directory File (see Reference 9).

5.1.2   Command Collection

The program shall provide for and accept the input of one or more CMD collections. The number of collections to be input to a given run of EVTMDR depends on the operating mode and displays selected. Each collection shall be specified and identified by a unique name. The attributes of these CMD collections are

given in Section 3.1.1, while the formats of the contents are
defined and illustrated in Reference 9.

5.1.3   Command and Event Collection

The program shall provide for and accept the input of one or
more CMD+EVT collections. The number of collections to be input
to a given run of EVTMDR depends on the operating mode and
displays selected. Each collection shall be specified and
identified by a unique name. The attributes of these CMD+EVT
collections are given in Section 3.1.2, while the formats of
the contents are defined and illustrated in Reference 9.

5.1.4   TV Occurrence Collection

The program shall provide for and accept the input of one or
more TVP collections. The number of collections to be input
to a given run of EVTMDR depends on the operating mode and
displays selected. Each collection shall be specified and
identified by a unique name. The attributes of these TVP
collections are given in Section 3.1.3, while the formats of the
contents are defined and illustrated in Reference 9.

5.2   Data Sources

The program shall accept the input of collection data via
either magnetic tape or punched cards, while control parameter
data shall be input as stipulated in Section 5.1.1.

5.2.1   Magnetic Tape Input

Collection data shall be accepted from magnetic tapes formatted
according to the specifications in Reference 9. Although a
collection tape produced by the OPSCOP program may contain up to
101 physical files, the program shall only accept data which is
provided in the first five (5) physical files. Any data contained
in files beyond the fifth shall be ignored.

5.2.2   Punched Card Input

Collection data shall be accepted from punched card decks
formatted according to the specifications in Reference 7. A
collection input in this manner shall consist of a contiguous
set of properly formatted cards preceded by a header card which
specifies (1) the name of the collection, (2) the spacecraft
number, and (3) the number of cards in the deck exclusive of the
header card, and additional data as appropriate.

5.2.3   Source Configurations

The program shall accept the input of collection data in any of
the possible combinations of magnetic tape and punched cards
provided that the following limitations are observed:

- A maximum of two magnetic tapes may be used for input on
  any one run of the program;

- When executing the compare option, a maximum of four
  input collections may be specified, where two of these
  must be CMD collections;

- When executing the accumulate option, a maximum of four
  input collections may be specified, where two of these
  must be TVP collections and two must be CMD+EVT
  collections;

- When executing the display only option, a maximum of
  four input collections may be specified; and

- The files on a Daily Event MDR input tape are in the
  sequence CMD*, CMD, CMD+EVT, and TVP. On an accumulated
  Event MDR, the sequence is CMD+EVT and TVP.

6.0 OUTPUT DATA REQUIREMENTS

This section presents the set of requirements which specify the types/kinds of printed reports and magnetic tapes to be output by EVTMDR.

6.1 Printed Reports

The sub-sections which follow specify the printed output which EVTMDR is to generate.

6.1.1 Transaction Listing

During any execution of the program, a series of status messages which identify the transactions performed by the program shall be issued as SYSOUT data. These messages, comprised of output from the operating system, from the MARK IV system and from the EVTMDR software, are collectively termed the 'Transaction Listing'. No requirement exists to have these messages appear as a contiguous set of information, only that the messages are issued when and as appropriate. The transactions for which appropriate messages are to be issued shall include at least the following:

- Control parameter data cards are input. The message shall display these data together with pertinent identifying labels/text.

- A tape mount is requested. The message shall identify the name of the tape and, for input tapes, the tape number.

- The first read operation on a collection on an input tape occurs, i.e., the Table of Contents Record is input. The message shall display the contents of the header record together with pertinent identifying labels/text.

- The first read operation on a punched card collection occurs, i.e., the header card is input. The message shall display the contents of the header card together with pertinent identifying labels/text.

- The end of an input collection is encountered. The message shall specify the collection name and the number of cards, including the EOC card, found in the collection.

- The Directory File is written for an output collection tape. The message shall display the entire Directory File together with pertinent identifying labels/text.

- A collection is written to an output collection tape. The message shall display the contents of the Table of Contents Record together with pertinent identifying labels/text.

- A program run is terminated due to a fatal error condition. The message shall specify that a fatal error caused run termination.

6.1.2   Diagnostic Messages

Diagnostic messages shall be issued as error conditions are
encountered. These messages shall contain sufficient identifying
detail such that their meaning is unambiguous, and shall appear
in the transaction listing (see Section 6.1.1) or in the body of
a printed display/report, as appropriate. The situations where
such messages shall be issued shall include at least the
following:

- The number of collections specified in the control
  parameter data exceeds the configuration limit. Fatal
  error.

- Tape read/write errors are sensed by the system or by
  MARK IV. The status of the error (fatal or warning) shall
  be determined by the existing software in the system or
  in MARK IV.

- The spacecraft number of a specified collection is
  different from the spacecraft number specified in the
  control parameter data. If the error occurs in a CMD
  collection designated as part of a compare function, or
  is any collection in an accumulate run, it shall be a
  fatal error. Otherwise, the program shall delete the
  collection and attempt to continue execution.

- A specified input collection cannot be found. Fatal
  error.

- The number of cards in a collection does not agree with
  the count specified in the Table of Contents Record
  (tape input) or in the header card (card input). Warning
  condition.

6.1.3   Command Collection Listing

The program shall provide the capability to list CMD collections
under the conditions stipulated in Section 7.0. The required
features of a CMD collection listing include:

- Each collection listed shall begin on a new page.

- Line count control and pagination shall be effected so
  that the listing may be bound along the long edge of
  the paper.

- Each page of the listing shall bear the title

      CMD COLLECTION name

  where 'name' is the name of the CMD collection.

- The contents of the collection shall be displayed in the
  form of one card image per line, where the last line of
  the listing contains the EOC card.

- Each line shall include a generated sequence number (on
  the left side) beginning with the number 1 and continuing
  through the EOC card.

- Each line shall have the following form:

      #. 'card image

  where # is the generated sequence number and the card
  image is set off by vertical bars.

- If an error message is generated due to the contents of
  the card image, the message shall appear either to the
  right of the right-hand vertical bar or at the foot of
  the listing.

- Pages shall be numbered sequentially starting from one.

- The date the listing was produced shall appear on each
  page.

6.1.4   Command and Event Collection Listing

The program shall provide the capability to list CMD+EVT
collections under the conditions stipulated in Section 7.0. The
required features of a CMD+EVT collection listing are the same
features as those stated in Section 6.1.3 for a CMD collection
listing, except that each page of the listing shall bear the
title

    CMD+EVT COLLECTION name

where 'name' is the name of the CMD+EVT colleciton.

6.1.5   TV Occurence Collection Listing

The program shall provide the capability to list TVP collections
under the conditions stipulated in Section 7.0. The required
features of a TVP collection listing are the same feature as
those stated in Section 6.1.3 for a CMD collection listing,
except that each page of the listing shall bear the title

    TVP COLLECTION name

where 'name' is the name of the TVP collection.

6.1.6   Anomaly Report

The program shall provide the capability to generate the Anomaly Report under the conditions stipulated in Section 7.0.

The report will essentially be a listing of two CMD collections combined into one listing. References are made to cards in both collections, but only one card image (from one collection or the other) is listed. The body of the Report shall have the general appearance indicated by the hypothetical subset shown in Figure 6-1. The Figure illustrates the following:

- Commands 25 and 26 in the CMD* collection are the same as commands 25 and 26 in the CMD collection.

- Command 27 in the CMD* collection does not exist in the CMD collection. (A command was added.)

- Command 28 in the CMD* collection is command 27 in the CMD collection.

- Command 29 in the CMD* collection is command 28 in the CMD collection, but the time values are significantly different.

- Commands 29 and 30 in the CMD collection do not exist in the CMD* collection. These planned commands were either deleted (not transmitted) or they aborted.

- Command 30 in the CMD* collection is command 31 in the CMD collection, but the time values are significantly different.

CMD*	CMD	COMMAND	COMMENT
..	..	.	
..	..	.	
..	..	.	
25	25	Card Image (CMD*)	
26	26	Card Image (CMD*)	
27	*****	Card Image (CMD*)	
28	27	Card Image (CMD*)	
29	28	Card Image (CMD*)	Time (CMD)
*****	29	Card Image (CMD)	
*****	30	Card Image (CMD)	
30	31	Card Image (CMD*)	Time (CMD)
..	..	.	
..	..	.	
..	..	.	

Figure 6-1

Hypothetical Segment of an Anomaly Report

The required features of the Report (in addition to the previous requirement) include:

- The Report shall start on a new page.

- Line count control and pagination shall be effected so that the listing may be bound along the long edge of the paper.

- Each page of the listing shall bear the two line title

    ANOMALY REPORT
    name1 VS. name2

where 'name1' and 'name2' are the names of the CMD and the CMD* collections, respectively.

- If an error message is generated due to the contents of the card image(s), the message shall appear to the right of the time field(s) or at the foot of the report.

- Pages shall be numbered sequentially starting from one.

- The date the Report was produced shall appear on each page.

6.1.7   Statistics Report

The program shall provide the capability to generate the Statistics Report under the conditions stipulated in Section 7.0. The required features of the Statistics Report include:

- The Report shall bear the title

    STATISTICS REPORT: name

    where 'name' is the name of the CMD, CMD+EVT, or TVP
    collection analyzed.

- The body of the Report shall consist of at least one
  column of two variables: the alpha-numeric identifier
  of the command or event, and the number of occurences of
  the item.

- The items shall be sequenced in the following order:
  CC-1/2, CC-3, CC-4, CC-5, CC-6, DC-1, DC-2, ..., DC-96,
  CC&S events in alphabetical order (non-TVP report).

- Only those items which have at least one occurrence shall
  be reported.

- The date the Report was produced shall appear on the
  Report.

6.2 Magnetic Tapes

The program shall provide the capability to generate an Accumulated
Event MDR magnetic tape. The tape shall be formatted according to
the specifications in Reference 9, i.e., this tape shall have the
same format as an input Event MDR or collection tape. The program
shall generate only three files for this tape: the Directory
File, one accumulated CMD+EVT collection file, and one accumulated
TVP collection file. This tape shall be the only tape output by
the program.

7.0   PROCESSING REQUIREMENTS

This section presents the requirements which specify the tasks
to be performed by the EVTMDR program.

7.1   Operating Modes

The program shall provide for execution in any of these six
operating modes:

- Compare Option
- Accumulate Option
- Display Option
- Compare and Display Option
- Accumulate and Display Option
- Compare, Accumulate and Display Option

The first three modes are basic modes, while the last three
modes are combinations of the first three. The mode of operation
shall be selectable by specifying a parameter value in the
control parameter input data. The essential requirements of
each of the above operating modes are specified in the sub-
sections which follow.

Implementation of the Compare, Accumulate and Display Option
is subject to the following constraint: If the program would
be prohibited from running on the flight support computer string
due to the core requirements of this operating mode, then in
shall not be implemented.

7.1.1   Compare Option

The program shall provide the following capabilities which, as a set, comprise the Compare Option:

1 - Input of two CMD collections;

2 - Comparison of these two CMD collections on an item-by-item basis;

3 - Automatic generation of an Anomaly Report;

4 - Automatic generation of a Transaction Listing; and

5 - Automatic generation of Diagnostic Messages, as appropriate.

7.1.2   Accumulate Option

The program shall provide the following capabilities which, as a set, comprise the Accumulate Option:

1 - Input of a CMD+EVT and TVP collection pair from each of two Event MDRs, where the possible Event MDR pairs are listed in Section 3.2.2;

2 - Input of an optional time interval specification for application to Items 3, 4 and 5 below;

3 - Merging of one CMD+EVT collection with the other CMD+EVT collection to produce an accumulated CMD+EVT collection;

4 - Merging of one TVP collection with the other TVP collection to produce an accumulated TVP collection;

5 - Generation and output of an accumulated Event MDR;

6 - Automatic generation of a Transaction Listing; and

7 - Automatic generation of Diagnostic Messages, as appropriate.

If Item 2 is input, only data which is in the specified time interval shall be processed in Items 3, 4 and 5. Otherwise, all data in the input collections shall be processed.

7.1.3   Display Option

The program shall provide the following capabilities which, as a set, comprise the Display Option:

1 - Input of up to four collections in any mix of CMD, CMD+EVT and TVP collections;

2 - Input of an optional time interval specification for application to Items 3 through 6 below;

3 - Automatic generation of a CMD Collection Listing for each CMD collection input;

4 - Automatic generation of a CMD+EVT Collection Listing for each CMD+EVT collection input;

5 - Automatic generation of a TVP Collection Listing for each TVP collection input;

6 - Optional generation (by selection) of a Statistics Report for any one of the input collections;

7 - Automatic generation of a Transaction Listing; and

8 - Automatic generation of Diagnostic Messages, as appropriate.

If Item 2 is input, only data which is in the time interval shall be processed in Items 3 through 6. Otherwise, all data in the input collections shall be processed.

7.1.4   Compare and Display Option

The program shall provide the following capabilities which, as
a set, comprise the Compare and Display Option:

    1 - Input of two CMD collections;

    2 - Optional input of a CMD+EVT and/or a TVP collection
        in addition to the input of the two CMD collections;

    3 - Comparison of the two CMD collections on an item-by-
        item basis;

    4 - Automatic generation of an Anomaly Report;

    5 - Input of an optional time interval specification for
        application to Items 6 through 9 below;

    6 - Optional generation (by selection) of a CMD Collection
        Listing for either or both CMD collections input;

    7 - Optional generation (by selection) of a CMD+EVT
        Collection Listing for a CMD+EVT collection, if input;

    8 - Optional generation (oy selection) of a TVP Collection
        Listing for a TVP collection, if input;

    9 - Optional generation (by selection) of a Statistics
        Report for any one of the input collections;

    10 - Automatic generation of a Transaction Listing; and

    11 - Automatic generation of Diagnostic Messages, as
        appropriate.

Input of the optional time interval specification (Item 5) shall
not affect the compare process; it shall apply only to the
display processing (Items 6 through 9). When specified, only
data which is in the specified time interval shall be displayed;
otherwise, all data input in the selected collection(s) shall be
displayed.

7.1.5   Accumulate and Display Option

The program shall provide the following capabilities which, as
as set, comprise the Accumulate and Display Option:

1 – Input of a CMD+EVT and TVP collection pair from each
of two Event MDRs, where the possible Event MDR pairs
are listed in Section 3.2.2;

2 – Input of an optional time interval specification for
application to Items 4 through 10 below;

3 – Input of an optional time interval specification for
application to Items 11, 12 and 13 below;

4 – Merging of one CMD+EVT collection with the other
CMD+EVT collection to produce an accumulated CMD+EVT
collection;

5 – Merging of one TVP collection with the other TVP
collection to produce an accumulated TVP collection;

6 – Generation and output of an accumulated Event MDR;

7 – Automatic generation of a CMD+EVT Collection Listing
for the CMD+EVT collection output;

8 – Automatic generation of a TVP Collection Listing for
the TVP collection output;

9 – Automatic generation of an all-parameter Statistics
Report for the CMD+EVT collection output;

10 – Optional generation (by selection) of a Statistics
Report for the TVP collection output;

11 - Optional generation (by selection) of a CMD+EVT
Collection Listing for either or both CMD+EVT collections
input;

12 - Optional generation (by selection) of a TVP Collection
Listing for either or both of the TVP collections
input;

13 - If Item 10 is not selected, optional generation (by
selection) of a Statistics Report for any one of the
CMD+EVT or TVP collections input;

14 - Automatic generation of a Transaction Listing; and

15 - Automatic generation of Diagnostic Messages, as
appropriate.

If Item 2 is input, only data which is in the specified time
interval shall be processed in Items 4 through 10. Similarly,
if Item 3 is input, only data which is in the specified time
interval shall be processed in Items 11, 12 and 13. Otherwise,
all data in the input/output collections shall be processed.

7.1.6   Compare, Accumulate and Display Option

The program shall provide the following capabilities which, as
a set comprise the Compare, Accumulate and Display Option:

1 - Input of a current Daily Event MDR containing four
    collections: CMD*, CMD, CMD+EVT, and TVP;

2 - Input of an accumulated Event MDR, or an old/previous
    Daily Event MDR containing a CMD+EVT and TVP collection
    pair;

3 - Comparison of the two CMD collections on an item-by-
    item basis;

4 - Automatic generation of an Anomaly Report;

5 - Input of an optional time interval specification for
    application to Items 6 through 10 below;

6 - Merging of one CMD+EVT collection with the other
    CMD+EVT collection to produce an accumulated CMD+EVT
    collection;

7   Merging of one TVP collection with the other TVP
    collection to produce an accumulated TVP collection;

8 - Generation and output of an accumulated Event MDR;

9 - Automatic generation of a CMD+EVT Collection Listing
    for the CMD+EVT collection output;

10 - Automatic generation of a TVP Collection Listing for
     the TVP collection output;

11 - Automatic generation of a Transaction Listing; and

12 - Automatic generation of Diagnostic Messages, as
    appropriate.

If Item 5 is input, only data which is in the specified time
interval shall be processed in Items 6 through 10. Otherwise,
all data in the input/output collections shall be processed.

7.1.7   Operating Mode Summary

The capabilities to be provided by the program are summarized in
Tables 7-1 and 7-2. Table 7-1 shows the input/output of
collections as a function of operating mode. Table 7-2 shows
the display capability of the program as a function of operating
mode. In both Tables, the captions for the six data columns are:

    C   = Compare Option
    A   = Accumulate Option
    D   = Display Option
  C & D = Compare and Display Option
  A & D = Accumulate and Display Option
  C A D = Compare, Accumulate and Display Option

Operating Mode Collections	C	A	D	C & D	A & D	C A D
CMD Input	R		X	R		R
CMD* Input	R		X	R		R
CMD+EVT #1 Input		R	X	Y	R	R
CMD+EVT #2 Input		R	X		R	R
CMD+EVT Output		A			A	A
TVP #1 Input		R	X	Y	R	R
TVP #2 Input		R	X		R	R
TVP Output		A			A	A

A = Automatically produced

R = Required input

X = Optional, up to 4 in any combination

Y = Optional

Table 7-1

Collection I/O vs. Operating Mode

Operating Mode / Display	C	A	D	C & D	A & D	C A D
Transaction Listing	A	A	A	A	A	A
Diagnostic Messages	A	A	A	A	A	A
Collection Listings for:						
CMD Input			B	X		
CMD* Input			B	X		
CMD+EVT #1 Input			B	X	X	
CMD+EVT #2 Input			B		X	
CMD+EVT Output					A	A
TVP #1 Input			B	X	X	
TVP #2 Input			B		X	
TVP Output					A	A
Anomaly Report	A			A		A
Statistics Report for:						
CMD Input			Y	Y		
CMD* Input			Y	Y		
CMD+EVT #1 Input			Y	Y	Y	
CMD+EVT #2 Input			Y		Y	
CMD+EVT Output					C	
TVP #1 Input			Y	Y	Y	
TVP #2 Input			Y		Y	
TVP Output					Y	

A = Automatically generated

B = Automatically generated, if input

C = Automatically generated, all parameters

X = Optional, any or all in the column

Y = Optional, one only in the column

Table 7-2

Display Capability vs. Operating Mode

7.2   Compare Function

When executing either the Compare Option or the Compare and
Display Option, the program shall perform a comparison analysis
between two collections: a CMD collection generated by COMGEN
and a CMD* collection produced by AMCOMPRX. The CMD* collection
shall be used as the baseline and the CMD collection compared
against it, where the analysis is displayed in the Anomaly
Report.

The comparison shall be performed on a card-by-card basis, where
the analysis is to determine which of these four conditions
exist at a given point:

    (1) The same command (including all parameters) exists in
        both collections and their time values are either
        identical or the difference is less than a specified
        amount.

    (2) A command exists in the CMD* collection, but does not
        exist in the CMD collection.

    (3) A command exists in the CMD collection, but does not
        exist in the CMD* collection.

    (4) The same command (including all parameters) exists in
        both collections, but their time values differ by an
        amount greater than or equal to a specified amount.

Referring to Figure 6-1 in Section 6.1.5, define the following
display line types:

    - The 1-st, 2-nd and 4-th lines are Type 1 display lines;

    - The 3-rd line is a Type 2 display line;

- The 6-th and 7-th lines are Type 3 display lines; and

- The 5-th and 8-th lines are Type 4 display lines.

Then during the compare process, the following actions shall be performed:

- If a Condition 1 situation is found, issue a Type 1 display line.

- If a Condition 2 situation is found, issue a Type 2 display line.

- If a Condition 3 situation is found, issue a Type 3 display line.

- If a Condition 4 situation is found, issue a Type 4 display line.

7.2.1   Comparing a Priority Collection

The specifications above are predicated on the situation where both the CMD and the CMD* collections are 'timed' collections. The CMD* collection produced by AMCOMPRX will always be a 'timed' collection. However, as is noted in Section 3.1.1, COMGEN may output a 'priority' collection. If EVTMLR is given a 'priority' collection as input to the compare function, the processing must be slightly different from that described above.

The comparison shall be performed on a card-by-card basis, where the analysis is to determine which of these three conditions exist at a given point:

(1) The same command (including all parameters) exists in both collections;

(2) A command exists in the CMD* collection, but not in the CMD collection; and

(3) A command exists in the CMD collection, but not in the CMD* collection.

In determining the existence of Condition 1 above, the time field in the CMD* collection is ignored during the test. The actions which follow determination of Condition 1, 2 or 3, are reduced to the first three actions listed in Section 7.2, where the time field does appear in the Type 1 and 2 display lines.

7.2.2   Conversion of the CC-1/2 Command

The discussion in Section 3.1.3 points out the fact that COMGEN can output two different forms of the CC-1/2 command: the Instruction Word Form and the Data Word Form (see Reference 7). On the other hand, AMCOMPRX can only output the Instruction Word Form. Therefore, the following requirement is placed on the EVTMDR program:

> If the program is executing either the Compare Option or the Compare and Display Option, and if a Data Word Form of a CC-1/2 command is found in the CMD collection, the program shall convert that command to its equivalent Instruction Word Form (without destroying the original command) before attempting to match the command with a CC-1/2 command in the CMD* collection.

There are $2^{31} = 2,147,483,648$ unique CC-1/2 Instruction Word Form commands and the same number of unique CC-1/2 Data Word Form commands. There is a one-to-one relationship between these two sets; that is, for a given Instruction Word Form command, there is one and only one equivalent Data Word Form command.

Using the notation and definitions given in Reference 7
the problem is to convert the alpha-numeric form

$$CC-1/2 \quad LLL \quad DATA \quad QQQQ \quad EEE \qquad (1)$$

to the equivalent alpha-numeric form

$$CC-1/2 \quad LLL \quad CCC \quad AAA \quad BBB \qquad (2)$$

This conversion is accomplished by executing the following steps.

Step 1: Transfer columns 1-13 from the input command to columns 1-13 of the new image. The command designator (CC-1/2) and the memory location (LLL) are the same in either form.

Step 2: Convert the parameter QQQQ from EBCDIC to the binary integer Q. Compute the numbers $X = Q \pmod{16}$ and $Y = \lfloor Q/16 \rfloor$. That is, X is the remainder when Q is divided by 16 and Y is the integer portion of the division result; another representation is $Q = 16 * Y + X$. For example, if QQQQ is 2708, then X is 4 and Y is 169.

Step 3: Using X as an index, select the operation code (CCC) from Table 7-3 and place it in columns 14-16 of the new image. Place blanks in columns 17-19 of the new image.

Step 4: Convert Y from binary integer to the EBCDIC A-address (AAA), with leading blanks, and place the result in columns 20-22 of the new image.

Step 5: Transfer columns 23-27 from the input command to columns 23-27 of the new image. The event address EEE is the same as the B-address BBB.

R	Mnemonic Operation Code	Operation
0	NOP	No Operation
1	CLJ	Conditional Jump
2	CTJ	Count and Jump
3	WOH	Word Output and Halt
4	ADD	Add
5	TAB	Transfer A to B
6	SUB	Subtract
7	WIH	Word Input and Halt
3	HLT	Halt
9	DAJ	Decrement Address and Jump
10	UNJ	Unconditional Jump
11	ROJ	Reset Operation Code and Jump
12	DHJ	Decrement Hours and Jump
13	DVJ	Decrement Variable and Jump
14	DMJ	Decrement Minutes and Jump
15	DSJ	Decrement Seconds and Jump

Table 7-3

Operation Codes for CC-1/2 Form Conversion

The program shall execute the above steps to effect the conversion from the Data Word Form CC-1/2 command to the Instruction Word Form CC-1/2 command. Note that the time field, if present, is unaffected by the conversion and becomes a part of the new image.

7.3   Accumulate Function

The program shall provide the capability to accumulate pairs of CMD+EVT and TVP collections as described in Section 3.2.2. The two collections in each pair to be accumulated will be disjoint sets of data, in that the time spans of the two sets will not overlap. If an overlap is sensed by the program, it shall be a fatal error. Therefore, the accumulate function shall be performed in the manner of a concatenation; the later set shall be 'attached' to the end of the earlier set, replacing the EOC card in that set.