

ERROR MESSAGE RECORDING AND REPORTING IN THE SLC CONTROL SYSTEM*

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ABSTRACT

Error or information messages that are signaled by control software either in the VAX host computer or the local microprocessor clusters are handled by a dedicated VAX process (PARANOIA). Messages are recorded on disk for further analysis and displayed at the appropriate console. Another VAX process (ERRLOG) can be used to sort, list and histogram various categories of messages. The functions performed by these processes and the algorithms used are discussed.

1. INTRODUCTION

In an accelerator control system, it is often important to determine the chronological order in which error conditions or other activities occur to help diagnose problems. Based on this fact, and additionally to present a single coherent message system to the user, the message facility supported by VAX/VMS has been extended to include messages generated by various components of the SLC control system. Processes running in the VAX under VMS and tasks running in the microprocessor clusters under iRMX handle error or information messages in an identical manner. When a condition is detected that requires notification of a user, it is reported using a set of predefined messages.

The information that appears in the message that the user receives is defined in message source files as described in the VAX/VMS Message Utility Manual.¹ Groups of messages associated with a particular facility are collected together in a single disk file. For example, there are separate facilities associated with Magnets, Beam Position Monitors, Klystrons, etc. Each message has associated with it a unique message code, message symbol, severity, and message text including formatting directives for any parameters of that message. The message originator needs to know only the message symbol and the parameters associated with that message but not the text or format of the message. This feature makes it easy to change the text of a message if necessary, saves memory and disk space, and insures that identical wording is always used for a particular message.

One of the following five levels of severity are specified for each message: Success, Informational, Warning, Error or Fatal. Software modules are able to temporarily or permanently suppress messages below a specified severity for a given facility; however, fatal messages are always issued. Additionally it is possible to specify that a message be logged but not broadcast to a user terminal. This feature is useful to indicate when a particular activity is initiated or terminated or to include information in the log that is of interest to the software group but not the user.

2. PARANOIA

In general, all messages are first sent to a VAX process known as PARANOIA. PARANOIA has two main responsibilities:

message handling and control system monitoring. All messages issued by programs running in the VAX are sent to a dedicated mailbox for PARANOIA. Messages issued by tasks in the microcomputers are sent to a dedicated SLCNET² interrupt owned by PARANOIA.

The messages have a simple internal structure consisting of header information followed by data words. The header includes source and destination specifiers, a time stamp indicating the date and time, a function code, and the length of the data. The source and destination are 4 character Ascii names used to identify either a VAX process or a microcomputer. The data includes the message code, the number of arguments for the message, and the message arguments themselves. Each message can have up to a maximum of ten arguments.

PARANOIA receives the messages either from its mailbox or from the network, logs them, formats them using FORTRAN conventions, and broadcasts them to the terminals of the appropriate control consoles³ running the SLC Control Program (SCP).⁴ Messages from a SCP or messages sent from a microcomputer in response to a command from a SCP are broadcast only to the control console associated with that SCP. Messages generated by monitoring activities of either PARANOIA or the microcomputers themselves are broadcast to all active consoles. The messages are displayed in different graphic renditions on the terminal to indicate their severity. For example, Fatal messages are displayed in reverse video to bring them to immediate attention.

PARANOIA logs the messages in two places: one is a disk file that contains 8 hours worth of messages (corresponding to one operational shift), the other is an area of VAX memory known as a shared-global section which can hold the most recent 80 messages. Figure 1 shows PARANOIA's message handling schematically.

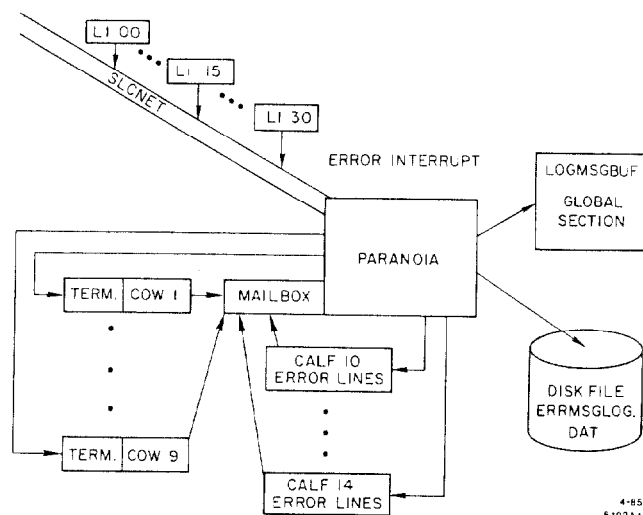


Fig. 1. Schematic of message handling by PARANOIA.

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The SCPs have access to the most recent 80 messages and can display them color-coded by their severity. Additionally, touch panel controls exist to select subsets of messages based on Source, Destination, or Facility. Figure 2 shows a display of an error log generated by a SCP. Figure 3 shows the touch panel used to select an error log display.

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09:50 LI18 CAR SDLC error interrupt received by timing job,
      error code = FF06
09:51 V016 Magnet CHCK function TIMED OUT to DR01
09:51 V016 Magnet CHCK function completed with ERRORS
      to LI00
09:52 V010 Magnet TRIM function successful to DR01
09:54 LI17 CAMAC MBCD failure: C 1, N 2, A0, F0,
      Stat=11438006
09:55 V016 CAMAC error detected on magnet CHCK function
      to LI17
09:57 V010 Magnet TRIM function completed with ERRORS
      to DR01
09:58 V008 Magnet STDZ function successful to DR02
10:06 BOOT SCP-5 - BOOT86 Micro Bootstrap Program
      version H2.4
10:06 BOOT SCP-5 - Polling stopped for station 155 (NP25)
10:06 BOOT SCP-5 - Station 155 (NP25) booted from
      DRA1:[SLCRMX]MICRO.I86;250
10:06 BOOT SCP-5 - Polling resumed for station 155 (NP25)
10:06 BOOT SCP-5 - BOOT86 Micro Bootstrap Program
      exiting
10:06 DR01 LGPS 1 Out of Tolerance! TRIM before using
      KNOB
10:06 NP25 IPLed and at your service
      16-APR-1985 10:07:22.19

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Fig. 2. Display of an Error Log generated by a SCP.

ERRORS PANEL		ERRLOG FIRST PAGE	ERRLOG LAST PAGE	MESSAGE SYMBOL OFF	PRINT	INDEX
		ERRLOG NEXT PAGE	ERRLOG PREV PAGE	SEND TEXT MSG		HELP
ALL SOURCE	SELECT SOURCE					
ALL REMOTE DEST	SELECT REMOTE DEST					

ALL FACIL- ITIES	DATA- BASE	CAMAC	STAT	OPS	SLCNET	MICR	MSG
MPG	CAVM	MGNT	LGPS	PIOP _ERR	KLYS	BPMO	CRATE
TIME	BOOT86						

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Fig. 3. Touch Panel used to select an Error Log display.

Once every 8 hours, PARANOIA prints all the messages that have been logged during the previous 8 hours and starts a new disk file for the next 8 hour period. These files typically remain

disk resident for an entire running cycle and can be looked at with a program named ERRLOG. After that they are archived on magnetic tape.

3. ERRLOG

ERRLOG is a process that runs interactively in the VAX host computer and allows one to examine the messages that have been logged. It has access to all log files that are disk resident and can be used to determine short term problems, correlations, or long term trends. It can be used to list a selected set of messages, to count the number of occurrences of a selected set of messages, or to histogram the number of messages as a function of time.

ERRLOG uses the VAX/VMS Command Language Interpreter (CLI)⁵ which allows it to have a user interface that is similar to other VAX/VMS utilities. It supports various Verbs (actions to be performed) and Qualifiers (modifiers or feature specification). Once a qualifier has been set it is sticky i.e. it remains set for the remainder of the session or until reset.

The verbs LIST and PLOT are used to specify the type of output one desires. LIST produces an Ascii file of message text, while PLOT produces histograms. There are qualifiers for time, facility, source, destination and severity. All qualifiers have a value to which they default if left unspecified. In general, the defaults are such that all messages are selected.

The time qualifiers are BEFORE, SINCE or DATE. By the appropriate use of these qualifiers, one can select the period of time that is of interest. ERRLOG will search through all files necessary in order to find the time period specified. In this way it is possible to ignore the fact that the logs are broken up into separate files each containing 8 hours worth of messages.

The FACILITY qualifier allows one to specify the facility or list of facilities of interest. It is also possible to preface a particular facility with "NO" to indicate that messages from that facility are to be explicitly excluded. At the present time approximately 30 different facilities are defined.

The SOURCE and DESTINATION qualifiers allow one to look at messages originating from a particular VAX process or micro-computer or messages destined for a particular process. "NO" can also be used to exclude specific sources or destinations. The SEVERITY qualifier makes it possible to examine messages with a specific severity or to ignore those with a specific severity by the use of the "NO" prefix.

Figure 4 shows a histogram produced by ERRLOG. This histogram represents the number of transmission errors on the network over an 8 day period.

4. OPERATIONAL EXPERIENCE

We have found this system of message reporting and recording to be flexible and easy to expand. Message texts have been changed to increase clarity, new messages are added easily as are entire new facilities. The logs have proved invaluable in reconstructing events. They are more accurate and consistent than operations logs kept by humans who must remember to write down when and what occurred. It has been possible to trace problems to the installation of new software or hardware after noticing the periodicity of error messages being produced and the date when they began. Additionally, the logs have been used to histogram when certain hardware errors occur to see if they can be correlated to a particular time of day or activity.

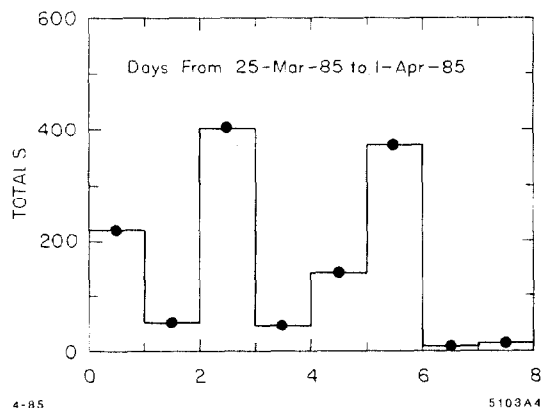


Fig. 4. Histogram produced by ERRLOG of network transmission errors for an 8 day period.

The log for each shift is printed at the end of the shift so that it can be scanned for error conditions that occurred during that shift. By looking carefully through the logs, we have been able to find software "bugs" that occur infrequently under anomalous conditions.

At present several software modules "meter" their messages so that users are not flooded with messages if an error condition persists. A uniform implementation of this feature is planned. Future versions will include alarm displays so that those messages that severely impact performance can be directed to a particular display and will disappear from that display when the fault has been corrected.

REFERENCES

1. VAX/VMS Utilities Reference Manual, Chapter 11, Digital Equipment Corp., Maynard, Mass.
2. See the Report on the SLC Control System, N. Phinney, K. Crook, M. Crowley-Milling, Proceedings of this conference; also SLCNET Reference Manual, internal SLAC report.
3. See Dissecting the COW, J.E. Linstadt, Proceedings of this conference.
4. See the Report on the SLC Control System, N. Phinney, K. Crook, M. Crowley-Milling, Proceedings of this conference.
5. VAX/VMS Utilities Reference Manual, Chapter 5, Digital Equipment Corp., Maynard, Mass.