

Alarm Handler for the Advanced Photon Source Control System*

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Abstract

The Advanced Photon Source (APS), now under construction at Argonne National Laboratory, will have a control system employing graphics workstations at the operator interface level and VME-based microprocessors operating with a distributed database at the field level. The alarm handler is an application utilizing X-Windows running on one or more operator interface workstations which monitors alarms generated by the VME-based microprocessors. Alarms can be grouped in a hierarchical manner. The operator can monitor, acknowledge, and mask alarms either individually or aggregately. Alarm changes of state and all operator modifications are logged. When alarms occur, display windows are automatically generated conveying system and subsystem relationships and severity. Menus are used to modify the alarm action configuration files and to obtain help. Since alarm groups are defined via an alarm configuration file, the alarm handler is a general purpose application which can be customized to monitor a single subsystem or configured to monitor the entire accelerator complex.

I. INTRODUCTION

The APS control system uses the Experimental Physics and Industrial Control System (EPICS) software. The original version of EPICS was developed by the Controls Group of the Accelerator Technology Division at Los Alamos National Laboratory (LANL). EPICS is currently being co-developed by the LANL group, and by the APS Controls Group.

EPICS is a distributed control system consisting of Operator Workstations and front end Input/Output Controllers (IOCs) all linked via a local area network. Each IOC contains a memory resident database composed of an arbitrary number of records. A software layer called Channel Access provides transparent network-wide access to the IOC databases. A record within a database is referenced via the field of "channel name". Each record contains alarm status and severity fields. Whenever a record is processed alarm conditions are checked. Software

residing anywhere on the local network can request notification whenever alarm conditions change (value changes and archive changes can also be monitored). The Alarm Handler (ALH), which is an Operator Interface tool, uses this mechanism.

Because of the complexity of an advanced accelerator system, many hardware devices and thousands of IOC channels need to be monitored. The ALH allows the operator to quickly identify groups and channels entering an alarm state, acknowledge alarms, disable alarms, log alarms, etc. It provides a useful tool to help assure normal operation of the accelerator system.

This paper briefly describes how alarms are configured, what information is displayed, and how the operator interacts with the ALH.

II. ALARM CONFIGURATION

The ALH is a general purpose tool that can monitor alarms from subsystems as well as an entire facility. The ALH accepts as input an Alarm Configuration File, which determines the set of channels to be monitored. An alarm configuration file defines a set of alarm groups. Each group consists of a set of lower level groups and/or database channels. Each group is assigned a name. Figure 1 gives an example to demonstrate the hierarchy of an alarm configuration.

In this example, the system to be monitored is a Linac and only a subset of the Alarm Configuration groups are shown. The whole configuration is just a repetition of groups which are linked together to form a tree structure. Each group is composed of a list of subgroups and/or IOC channels. Each group, except the main group (Linac in Figure 1), has a parent group. The lowest "leaf" groups contain only channels. A complete branch of a link of subgroups always terminates at IOC channels (like the Coil1 in Figure 1).

III. GROUP DISPLAY WINDOW

Each group has an associated display window containing a line for each subgroup and each channel in the group. Each line (subgroup or channel) contains the following items: Acknowledgement button, Severity character, Name of subgroup or channel, and a mask. A subgroup line also shows how many channels in that group are at each alarm severity. A

*Work supported by U.S. Department of Energy, Office of Basic Energy Sciences under Contract No. W-31-109-ENG-38.

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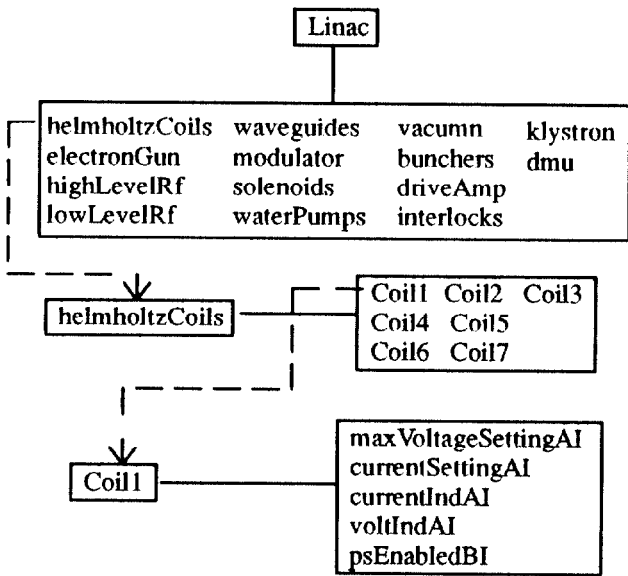


Figure 1. Example hierarchy of an alarm configuration.

channel line shows the current status and severity and the highest unacknowledged status and severity.

The acknowledgement button, which is color coded, is shown only if the group/line has gone into alarm state and has not been acknowledged by the operator. The alarm severity character, which is also color coded, shows the highest severity outstanding alarm for the group/channel.

The alarm mask, which is given defaults in the configuration file and can be dynamically changed by the operator, defines the following attributes: Add/Cancel, Enable/Disable, Ack/NoAck,

Ack/NoAck transient, and Log/NoLog. If an alarm is canceled then the ALH is no longer notified by the IOC when a channel changes alarm state. If an alarm is disabled then it always appears to be in no alarm state. NoAck specifies that the operator is not required to acknowledge alarms for the group/channel. NoAck transient specifies that an automatic acknowledgment occurs if a group/channel goes into alarm and comes out before the operator has a chance to acknowledge. If NoLog is specified, changes of alarm state are not logged. Mask settings for a group apply to all channels in the group.

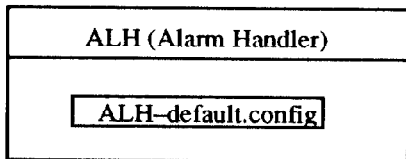
The ALH provides guidance information about each group and channel. The guidance information, which is specified in the configuration file, can help an operator quickly identify and correct the cause of an alarm.

IV. USER INTERFACE

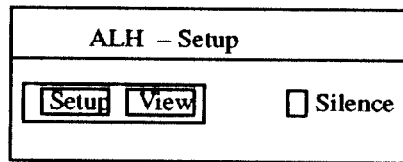
The user interface is implemented via the OSF/Motif toolkit. Most ALH functions are invoked via the workstation mouse. The appropriate window display pops up according to the user specified actions. Selection menus are in the form of pulldown or popup menus. File selection is via file selection dialog. Help and dialog information is presented via menu and message dialogs.

Figure 2 gives the key ALH user interface components. They are represented by three windows: Icon, Setup, and Group/Subgroup. Each push button, i.e. active area, is enclosed in a rectangular box.

Icon Window



Setup Window



Group Window

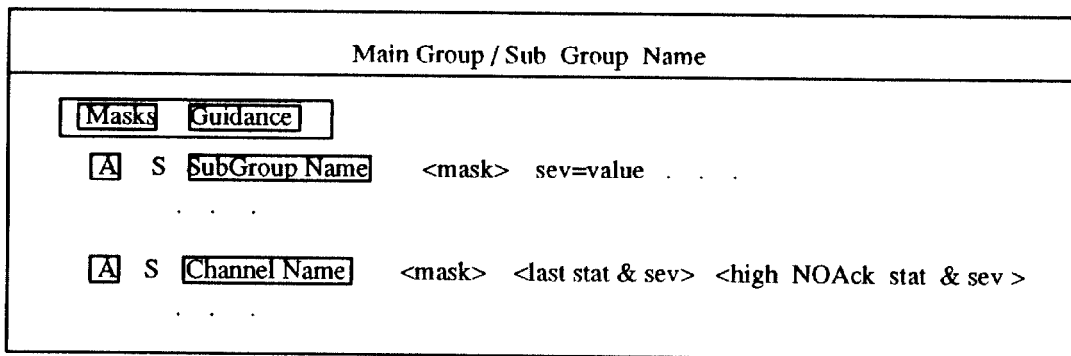


Figure 2. The key user interface components in the ALH.

A. Icon Window

The Icon window appears whenever the ALH is running. The Icon window contains a single control push button. This control button reflects the name of the configuration file. Pushing this control button pops up the setup window, the main group window, and possible lower level subgroup windows. Toggling this control button alternatively unmaps/remaps the lower level display windows. When any unacknowledged alarm is outstanding the control button starts blinking and beeping. It has a color reflecting the severity of the highest outstanding alarm.

B. Setup Window

The setup window contains three control buttons: Setup, View, and Silence. Setup allows the operator to specify the following: configuration file, alarm log file, operator modification log file. It also allows the operator to save the current configuration, set a severity for beeping, or exit the ALH. View opens a text window which dynamically displays all information written to the log file. If unacknowledged alarms are outstanding, the silence button can be used to stop beeping.

C. Group Windows

Each group window shows the status of each subgroup and channel in the group. The window display strategy is to display an alarmed channel as quickly as possible. When a group window is displayed, if exactly one subgroup is in alarm state, that subgroup is also displayed, etc. The operator can, however, select any subgroup name. In this case, any lower level windows being displayed are removed and the selected subgroup is displayed.

The masks pulldown menu provides options for showing group masks, and changing group masks. The guidance pulldown menu provides options for showing group guidance and accessing online help information.

Pushing an acknowledgement button acknowledges the channel or subgroup, and updates the window display. Acknowledging a group is an implied acknowledgment for all subgroups and channels in the group. Pushing a subgroup name pops up the subgroup window. Pushing a channel name button, presents a menu providing options for displaying channel details, for changing channel masks, and for displaying channel guidance or help information.

V. REQUIREMENTS

The ALH was implemented on a SUN workstation using the X window system and the OSF/MOTIF toolkit. It requires a color monitor with X graphics capability.

The key to successful use of the ALH is the alarm configuration file. Alarm groups must be defined so that they properly model the system being monitored. A systematic group naming convention should be adopted so that operators can easily understand each display window.

VI. CONCLUSION

Preliminary testing of the ALH with a test IOC database has been performed. The test results show that the ALH can be a very useful alarm monitoring tool. It displays subsystem groups and channels according to easily defined configuration files. It brings alarms to the operator's attention, allows the operator to acknowledge alarms, logs alarms, records all operator modifications, and provides optional guidance information. The ALH is a general purpose tool which can monitor a single subsystem or a complete accelerator complex.

The ALH is installed and being used in the Los Alamos Ground Test Accelerator Facility. The performance of the ALH with a very large configuration file has not yet been tested but its design should provide good performance.

The alarm group configuration concept allows alarms to be filtered hierarchically. It allows the operator to see the summary of various alarmed groups. This automatically prevents the operator from being flooded with alarm messages when alarm storm occurs.

VII. ACKNOWLEDGEMENT

We are grateful to Ned Arnold for providing a test IOC database and alarm configuration file which simulates a Linac application. We are grateful to Bob Dalesio and many others of AT-8/GTA at Los Alamos National Laboratory for making release 2.0 of the control system available such that we could integrate the new channel access calling functions into the ALH.

VIII. REFERENCES

- [1] OSF/Motif Programmer's Reference, Prentice Hall, Revision 1.0, 1990
- [2] Bob Dalesio, Private communication, AT-8/GTA, Los Alamos National Laboratory.