NIF Device Health Monitoring
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Abstract

The Integrated Computer Control System (ICCS) at the National Ignition Facility (NIF) uses Front-End Processors (FEP) controlling over 60,000 devices. Often device faults are not discovered until a device is needed during a shot, creating run-time errors that delay the laser shot. This paper discusses a new ICCS framework feature for FEPs to monitor devices and report its overall health, allowing for problem devices to be identified before they are needed. Each FEP has different devices and a unique definition of healthy. The ICCS software uses an object-oriented approach using polymorphism so FEPs can determine their health state and report it in a consistent way. This generic approach provides a solution for reporting device faults without a specific problem occurrence.

One of Two of NIF’s Laser Bays

Problem: Hardware Faults Go Undetected
- Most device hardware is not actively monitored, so faults are only detected when an attempt is made to use a device.
- Resolving the fault is then on the critical path; troubleshooting results in shot cycle delays.

Problem: Display of Fault Information is Not Centralized
- Device health is displayed only on specific GUI panels.
- Faults that occur after process startup are not available in the System Manager.

Solution: NIF Device Health Monitoring Framework
- Added monitoring of remote embedded Ethernet networked systems used by FEPs.
- Provided framework for ICCS FEP processes to report and display failures with devices they control.
- Added new process state ‘Unhealthy’ and tied FEP process state to the health of the device it controls.
- Centralized GUI display of ‘Unhealthy’ FEP processes.

System Manager GUI

Extend Existing Process Display
- Operators already look to the System Manager GUI for process state.
- The new Unhealthy process is displayed in a defined color, quickly indicating a problem.
- Existence of Unhealthy processes can be readily seen on bar graph.
- Right-clicking on Unhealthy process to show details on all devices in the process.

FEP Device Informational Dialog
- Pop-up dialog launched by right-clicking on process in System Manager GUI.
- Status of all devices in the process are displayed.
- Selecting a device displays details populated when the state change was reported.
- Device fault detection in the FEP provides summary details that aid in problem diagnosis and repair.

Health Monitoring Framework

Front-End Processor (FEP) Health Agent
- Provides a standardized way to report FEP faults to the System Manager GUI.
- Health Agent is a singleton object instantiated in each FEP process.
- Agent aggregates device states and reports changes to the System Manager.
- Devices may be optionally omitted from health reporting, useful during maintenance.

System Manager GUI?

How to alert operators when they are not looking at the System Manager GUI?
- System-Manager GUI may be covered by other windows.
- When a process goes to an Unhealthy state, a pop-up window is displayed with information on the process.
- Pop-up window stays visible atop all other windows.
- Immediate alerts operators of problems regardless of which screens they are using.

Device Control Object

Active Notification

What’s Next?
- Utilizing FEP Health Monitoring Framework
  - FEP developers are beginning to add monitoring to device classes to detect and report faults.
  - Next phase will focus on remote and networked devices.
  - Extending fault detection beyond FEPs
    - Continuous effort to detect problems across all parts of the ICCS system.
    - Database monitoring.
    - Processor resource monitoring (CPU, memory usage, network bandwidth, etc.)