



Using the SEL System Control Library for Computer System Monitoring

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INTRODUCTION

With the introduction of the SEL-3355 Computer, SEL has released an application programming interface (API) for its system control hardware features. The SEL System Control (SSC) library provides programming level access to the diagnostic data, outputs, and the system watchdog built into SEL computers. The SSC library is available for SEL devices that use Microsoft® Windows®, VMWare® ESXi™, Red Hat®, and CentOS® Linux® releases. APIs are provided in C and Python programming languages.

PROBLEM

SEL industrial computers perform critical tasks, so ensuring their proper operation is a top priority. From the introduction of its first computer, SEL has provided diagnostic data, alarm outputs, and a system watchdog to aid computer management. In the past, these features have only been available through the SEL System Monitor (SysMon) software and only on a limited number of operating systems.

Many customers have expressed a desire to integrate these features directly into their own applications. Others have asked that these features be extended to operating systems other than those directly supported by SEL SysMon.

SEL SOLUTION

The SSC library is an API that allows programmers access to exclusive data and controls on SEL computer systems. APIs are provided for both the C and Python programming languages. Note that the Python interface is currently limited to Linux/Unix-based operating systems. Applications written in the C and Python languages, or languages with access to C libraries, can have direct access to the same features that SEL SysMon uses to provide its functionality.

The features of the library are as follows:

- **Hardware diagnostics.** Hardware diagnostics include voltage and temperature measurements of critical internal systems and overcurrent alarms for external ports.
- **System diagnostics.** System diagnostics provide a convenient interface for monitoring central processing unit (CPU), memory, and file system usage.

- Output control. SEL computers can communicate through contact outputs and LEDs. Direct control of these outputs is provided by the library, allowing custom alarming schemes to be implemented.

All SEL computers have **ENABLED** and **ALARM** LEDs. Certain computers also have auxiliary LEDs that can be used for application-specific purposes. At a minimum, all SEL computers have one alarm output contact. The alarm contact is synchronized with the **ALARM** LED and is energized when the **ALARM** LED is illuminated.

- Watchdog. A watchdog is a hardware countdown timer that reboots the computer if it reaches zero. It operates in conjunction with a software application—a supervisor—that periodically refreshes the count of the timer. If the supervisory application is functioning properly, it prevents the watchdog from resetting the computer by ensuring the watchdog never times out. If the application closes prematurely or stops executing due to system lockups, the watchdog timer is not refreshed and eventually expires. This causes the computer to reboot and restore normal operation.

The SSC library has been released for the following operating systems, with more operating systems to be added in the future:

- Microsoft Windows 7.
- Microsoft Windows Server® 2008 R2.
- Red Hat Enterprise Linux (RHEL) 6.5 and 7.
- CentOS 6.5 and 7.
- VMWare ESXi.

USE CASES

Integrate Hardware Features Into Your Applications

Exclusive Hardware Diagnostics

Increase the ability of your application to detect problems early by allowing it to monitor SEL's exclusive hardware diagnostics. The following parameters can be queried through the SSC library:

- All CPU and peripheral voltages.
- Temperature measurements for CPU, platform controller hub (PCH), memory, mainboard power supply, and mainboard ambient.
- Overcurrent alarms for external ports.
- Self-Monitoring Analysis and Reporting Technology (SMART) drive health status.

Customize ENABLED and ALARM LED Responses

All SEL computers have an **ENABLED** and an **ALARM** LED (see Figure 1) to provide a quick method to check system health. They can be particularly valuable on computers that are not always connected to a monitor and keyboard. Under the control of SysMon, these LEDs indicate the general state of the system. For example, the **ALARM** LED will be on if a voltage rail or system temperature is out of specification.



Figure 1 ENABLED and ALARM LEDs on the SEL-3355

While SEL SysMon provides a good indication of the overall system health, it is not application aware. If your critical application fails, the system is not functioning correctly even if the hardware and operating system are functioning normally. Using the SSC library, an original equipment manufacturer (OEM) or system integrator can include hardware, operating system, and application state information in these health indicators. This provides a more complete view of the overall system.

Use Auxiliary LEDs to Display Progress or State Information

LEDs are a simple but effective way to communicate information, which is why many SEL computers come equipped with auxiliary LEDs (see Figure 2). Auxiliary LEDs have no predefined system-level functionality and are provided as a means for applications to communicate information specific to their task.



Figure 2 Auxiliary LEDs on the SEL-3355

Some potential uses for these LEDs are as follows:

- Progress or state indicators. Auxiliary LEDs can be used to communicate state or progress information. For instance, the three bicolored auxiliary LEDs on the SEL-3355 (see Figure 2) provide up to 27 unique patterns. Each pattern can represent a different stage in a process. Changing patterns can represent activity or progress.
- Error indication. External LEDs can be used to communicate error information without the need for a monitor.

Watchdog

Even the most carefully engineered software occasionally fails or locks up. Sometimes, simply closing and restarting the application is all that is needed to fix it. Other times, a complete reboot of the computer is required. These situations are easily remedied on a desktop computer where an operator is present to restart the application or computer. Situations like these can be very disruptive and dangerous for computers running autonomously that must detect and recover from these problems independently.

Software failures are the reason SEL designed a hardware watchdog into each of its computers. The watchdog provides a mechanism, independent of software, to restore normal operation after a catastrophic system lockup. Before the introduction of the SSC library, supervision of the watchdog was provided exclusively by the SEL SysMon service. While SysMon can help the computer recover from systematic problems, like running out of resources, it may not detect a problem if it is only affecting a single application. Because application lockups are more common than complete operating system failures, it is useful to directly link the watchdog to critical applications.

The SSC library allows supervision of the watchdog to be moved from SysMon to your critical application. Managing the watchdog directly from your application protects against both the application and operating system locking up. This also allows you to synchronize the watchdog functionality with other recovery mechanisms that may be employed.

Limited System Monitoring for Operating Systems Without SysMon

It is possible to use the SSC library to implement limited system monitoring on operating systems that do not have full SysMon support. The SSC library will always be available on more operating systems than the SysMon software suite because the SSC library is easier to port. Some specific examples of how the library can be used to provide a limited system monitor are as follows:

- Write a simple service or daemon program to monitor system memory and hard disk space, and set the **ALARM** LED if usage is above a prescribed level.
- Use a script to read CPU and memory temperatures and pass this information to a remote system monitoring agent (e.g., Zabbix®).

CONCLUSION

The SSC library allows integration of SEL hardware features with customer applications. It also allows control of these features on operating systems not supported by SysMon. For more information about the SSC library, contact the SEL Computing Systems Department.

