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Monitoring Servers Using Baseboard Management Controller

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ABSTRACT: Facebook announced the Open Compute Project in 2011. The aim of Facebook was to form a community around open-source designs and specifications for data center hardware. Facebook shared its hardware specification, which resulted in 38% less energy consumption and 24% cost savings compared with its existing data centers. Facebook and other hyperscalers (Google, Microsoft, et al.) donate their solutions to the Open Compute Project to the agonizing problems.

Since then, this project has expanded to all aspects of the open data center: baseboard management controllers (BMCs), network interface controllers (NICs), rack designs, power busbars, servers, storage, firmware, and security.

A baseboard management controller is a service processor which monitors the physical state of servers, computers and other hardware devices with the help of sensors.

KEYWORDS: KVM, u-boot, ActiveX, HTML5, IPMI

I. INTRODUCTION

If the CPU is the brain of the board, then the BMC is the brain stem.

General Micro Systems' Baseboard Management Controller (BMC) is a set of specialized service hardware including processor, memory, Ethernet and etc. that implements the Intelligent Platform Management Interface (IPMI) on GMS products. BMC is the part of the Intelligent Platform Management Interface which is embedded within the main circuit board or motherboard of the device or computer to be monitored. With the help of a baseboard management controller, a single administrator can monitor a large number of servers or devices remotely, thereby helping reduce the operating cost of the network. The BMC communicates to the data center control network using the IPMI, a message-based, hardware-level interface specification for managing and operating computer systems. BMC operates independently of the operating system, the server's CPU, and the firmware that allows administrators to manage a system without an operating system or any system management software.

A baseboard management controller's sensors can measure physical parameters such as:

- Power supply voltage
- Fan speeds
- Operating system functions
- Humidity
- Temperature

If any of the parameters are outside the permissible limits, the system administrator is notified to take appropriate measures.

FEATURES Of BMC

IPMI 2.0 based management

- BMC stack with a full IPMI 2.0 implementation
- Hardware health monitor
- Customizable sensor management policies
- Remote power control

Keyboard, Video & Mouse (KVM) console redirection

- Console Redirection
- Simultaneous floppy and CD/ DVD redirection
- Support for USB key



LAN support

- DHCP client with SNMP support
- LDAP support
- SSL security
- Event Log and Alerting

Web interface support

- Web browser and server support
- Multiple language support for multiple clients simultaneously
- Full Unicode support
- HTTP and HTTPS support

Web-based configuration

- Configuration using web UI
- Fail-safe firmware upgrade capability

Objective

The main advantage of using a BMC is that it allows a system administrator to perform many different monitoring and management tasks remotely without being physically located next to and connected to the system such as power cycling, installing BIOS or firmware updates, and monitoring fan speeds and temperatures. In case of any hardware failure such as a hard drive, fan or PSU that needs replacing or any kind of error or fault, BMC notifies the administrator via email or text message.

The BMC is an extremely efficient and time saving feature. The administrator does not need to physically connect with each server to perform maintenance tasks. Modern data centers have hundreds of racks and thousands of servers, it would be impossible to live without it. As a result, all modern servers and other devices used in a data center such as switches, storage devices, power supply devices etc. now have a BMC.

BMC Security Concerns

The BMC has its own problems with largely proprietary software and vulnerabilities. The most recent BMC vulnerability is USB Anywhere which was discovered by Rick Altherr, principal engineer at Eclipsia. An attacker can use USB anywhere to connect remotely to a server and virtually mount any USB device to the server and attacker could load a new operating system image or implant a firmware backdoor to facilitate ongoing remote access.

Another vulnerability is Pantsdown, which allows read and write access to the BMC's address space from the host. Pantsdown is an example of a requested feature that causes a vulnerability.

The BMC Becomes Open Source

OpenBMC

The OpenBMC project encompasses u-boot. U-boot is an open-source bootloader which is used to boot a Linux kernel with a minimal root file system that contains all the tools and binaries needed to run OpenBMC. OpenBMC is designed with a service-oriented approach. Services are started and maintained by systemd and they communicate with each other over dbus. Service designing is an easy way for multiple collaborators and vendors to contribute to a single BMC implementation. This design allows each vendor contributing to the codebase to have separate daemons and it can turn on to ship in its specific distribution of OpenBMC. Thus, it also makes the BMC software more complex to debug, audit, and put into production.

u-bmc

After OpenBMC, u-bmc came into picture. It is a software project started by Christian Svensson of Google. Written in Go. The aim of u-bmc is more minimal BMC software architecture, challenging the status quo by replacing IPMI with gRPC. Removing IPMI makes u-bmc provocative from a security perspective because the attack surface area is reduced. Unlike OpenBMC, u-bmc boots a Linux kernel directly from the ASPEED startup code after DRAM initialization, thus removing the need for a bootloader such as u-boot.

RunBMC

The RunBMC allows swapping out BMCs from the rest of the board, isolating and locking down the BMC subsystem. Previously, the BMC was soldered onto the board. This is compelling from a security perspective since focus is shifted



to a single, swappable BMC card. RunBMC can easily be replaced if broken, updated with a different version, or integrated with other security features.

II. METHODOLOGY

Baseboard management controllers are used in servers to perform the tasks that an administrator does not need to physically visit the racked server to accomplish. Use cases of BMC are power cycling a server and monitoring fan speeds and component temperatures, and hardware failures.

Administrators do not need to physically go into the data center and hooking up a keyboard or monitor, one can get a Java, ActiveX, or HTML5 browser-based keyboard, video, mouse remotely. The trend is toward HTML5 browser-based iKVM implementations. This feature allows an admin to do low-level tasks from anywhere without physically visiting the data center.

BMCs allow not just single server administration, but are armed with IPMI and Redfish APIs. Redfish API has the ability to manage clusters of servers at a time. For example, when a cloud provisioning system needs to reboot a server, nowadays it does via an automated call to the BMC on the server.

III. CONCLUSION

This is a common misconception that BMC is a server's IPMI. IPMI is the standard for remote server administration. Baseboard management controllers are the physical chips that implement Intelligent Platform Management Interface. Again, think of the BMC as a Raspberry Pi, where the various I/O elements are used to provide IPMI functionality. BMCs are also an integral part of the next-generation management tooling.

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