SYSTEMS AND METHODS FOR OUT-OF-BAND GAMING MACHINE MANAGEMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Patent Application No. 12/113,005 filed April 30, 2008.

BACKGROUND

Technical Field

This disclosure generally relates to gaming machines and more particularly to management of gaming machines.

Description of the Related Art

At a casino, electronic gaming machines may be clustered together in a relatively small geographical region such as a casino floor. Electronic gaming machines may also be distributed over a relatively large geographical region as is the case when electronic gaming machines provide lottery tickets for a state-run lottery.

Electronic gaming machines may be communicatively coupled to a management server. The management server may monitor the electronic gaming machines. The management server may reconfigure electronic gaming machines with which it has an active communication path. However, when the communication path between the management server and a gaming machine is down, the management server cannot monitor or reconfigure the gaming machine. Among other reasons, the communication path between the gaming machine and the management server may be down because the gaming machine is powered off or the gaming machine has crashed, *i.e.*, the gaming machine is powered on but an operating system of the gaming machine is not being executed.

BRIEF SUMMARY

There exists a need for remote monitoring, as well as remote reconfiguration and remote diagnostics and repair, of gaming machines.

In one aspect, the present disclosure is directed to an electronic gaming machine that includes a core processor electrically powered by a power supply when the gaming machine is in a powered on state and electrically isolated from any power supply when the gaming machine is in a powered off state, the core processor executing instructions in the powered on state; a memory in communication with the core processor and having instructions stored therein that cause the processor to execute a game title on an operating system of the gaming machine; a remote management controller electrically powered by the power supply when the gaming machine is in either one of the powered off state or the powered on state, the remote management controller operable to provide remote access to the gaming machine; and an unalterable boot up procedure for the gaming machine. The electronic gaming machine may further include a non-volatile memory electrically powered by the power supply when the gaming machine is in either one of the powered off state or the powered on state. The non-volatile memory may store event logs, wherein the remote management controller is operable to provide the event logs over an out-of-band channel to a remote computing device. The non-volatile memory may store authentication information, wherein the remote management controller is operable to provide the authentication information over an out-of-band channel to a remote computing device. The non-volatile memory may store an indicator of at least one software title stored in the memory, wherein the remote management controller is operable to provide the indicator of at least one software title over an out-of-band channel to a remote computing device.

In another aspect, the present disclosure is directed to a method of managing a plurality of remote gaming machines that includes: configuring each respective gaming machine of the plurality of gaming machines to enable

remote access while an operating system of the respective gaming machine is not being executed; configuring each respective gaming machine of the plurality of gaming machines to have a respective unalterable boot up; and accessing a respective first memory of a respective gaming machine while the operating system of the respective gaming machine is not being executed for at least one respective gaming machine of the plurality of gaming machines. In some embodiments, accessing a respective memory of a respective gaming machine may further include retrieving a respective software title indicator of at least one respective software title stored in a respective second memory storing of the respective software title. This may include managing a portfolio of licenses for software titles based at least on software title indicators retrieved from the plurality of gaming machines. Managing a portfolio of licenses for software titles may include determining at total number of the gaming machines which store a respective software title, wherein a respective license for the respective software title is included in the portfolio of software titles. In some embodiments, accessing a respective memory of a respective gaming machine may further include retrieving a respective event log for the respective gaming machine while a core processor for executing the operating system is powered and concurrently while the operating system of the respective gaming machine is not being executed. This may further include providing the respective gaming machine with a repair storage device image and initiating a reboot of the respective gaming machine. In some embodiments, accessing a respective memory of a respective gaming machine may include retrieving a respective diagnostic indicator for the respective gaming machine while a core processor for executing the operating system is powered off. In some embodiments, accessing a respective memory of a respective gaming machine may further include retrieving a respective authentication indicator for the respective gaming machine while a core processor for executing the operating system is powered off. This may further include verifying the authentication indicator for the respective gaming machine. In some embodiments, accessing a respective

memory of a respective gaming machine may further include retrieving an asset indicator of at least one respective asset of a respective gaming machine. This may include managing a portfolio of assets based at least on asset indicators retrieved from the plurality of gaming machines. Managing a portfolio of assets may include determining a total number of the gaming machines which include a respective asset, wherein a respective license for the respective asset is included in the portfolio of assets.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In the drawings, identical reference numbers identify similar elements or acts. The sizes and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements and angles are not drawn to scale, and some of these elements are arbitrarily enlarged and positioned to improve drawing legibility. Further, the particular shapes of the elements as drawn, are not intended to convey any information regarding the actual shape of the particular elements, and have been solely selected for ease of recognition in the drawings.

Figure 1 is a schematic diagram of a gaming machine management system according to one non-limiting illustrated embodiment.

Figure 2 is a schematic diagram of the gaming machine of Figure 1, according to one non-limiting illustrated embodiment.

Figures 3A-3C are a flow diagram of a process to manage a plurality of remote gaming machines.

DETAILED DESCRIPTION

In the following description, certain specific details are set forth in order to provide a thorough understanding of various disclosed embodiments. However, one skilled in the relevant art will recognize that embodiments may be practiced without one or more of these specific details, or with other methods, components, materials, *etc.* In other instances, well-known structures

associated with computing systems, computing devices, communications devices and/or with gaming machines have not been shown or described in detail to avoid unnecessarily obscuring descriptions of the embodiments.

Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as, "comprises" and "comprising" are to be construed in an open, inclusive sense, that is as "including, but not limited to."

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

As used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the content clearly dictates otherwise. It should also be noted that the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

The headings and Abstract of the Disclosure provided herein are for convenience only and do not interpret the scope or meaning of the embodiments.

Any process descriptions or blocks in flowcharts described below may be understood as representing modules, segments, or portions of code which include one or more executable instructions for implementing specific logical functions. In alternative embodiments, various logical functions, or acts may be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, and/or manually, depending on

the functionality involved, as would be understood by those reasonably skilled in the art.

Figure 1 shows a schematic diagram of a gaming machine management system 100 according to one non-limiting illustrated embodiment. The gaming machine management system 100 has a gaming machine management server 102 that is in remote communication with at least one gaming machine. While Figure 1 shows three gaming machines, individually referenced as 104a-104c and collectively referenced as 104, it is to be understood that the gaming machine management system 100 may include more or less gaming machines 104. The illustrated embodiment is provided merely for the sake of clarity and the number of gaming machines is not limited thereto.

In the embodiment shown in Figure 1, the gaming machine 104a is in a powered on state with an executing operating system. The gaming machine 104a is communicatively coupled to the game management server 102 by an in-band communication channel 106a. Communications carried by the in-band communication channel 106a are at an "operating system" level and include communications provided by an operating system of the gaming machine 104a and communications provided to the operating system of the gaming machine 104a.

The gaming machines 104b, 104c are configured to communicate with the game management server 102 via in-band communication channels 106b, 106c, respectively, when said communication channels 106b, 106c are "up" or operative. In-band communication channels are collectively referenced as 106.

In the embodiment shown in Figure 1, the communication channels 106b, 106c between the game management server 102 and the gaming machines 104b, 104c, respectively, are shown as being broken or inoperative such that there is no communication via the respective communication channels 106b, 106c.

In the embodiment shown in Figure 1, the gaming machine 104b is in a powered off state. In the powered off state, the gaming machine 104b uses an amount of electrical current such that the gaming machine 104b may be re-booted faster than it would otherwise re-boot. In the powered off state, an operating system of the gaming machine is not being executed, and consequently, standard communications via the communication channel 106b are "down" or inoperative.

In the embodiment shown in Figure 1, the gaming machine 104c is in a powered on state, but an operating system of the gaming machine 104c is not executing. In other words, the gaming machine 104c may be a state similar to a "crashed" personal computer. In this case, the operating system of the gaming machine is not being executed, and consequently, standard communications via the communication channel 106c are down.

In some embodiments, the gaming machine 104c is in a powered on state, but standard communications via the communication channel 106c are down. This situation may arise when an application on the gaming machine 104c freezes or crashes in such a way that the communication channel 106c is brought down, even if the operating system is being executed concurrently.

Each one of the gaming machines 104 is communicatively coupled to the game management server 102 by an out-of-band communication channel, individually referenced as 108a-108c and collectively referenced as 108. Among other things, the out-of-band channels 108 enable the game management server 102 to remotely monitor and manage the gaming machines 104. Among other things, communications carried by the out-of-band channels 108 may be at a service level or a device level and may include communications carrying information such as hardware self-test information.

Out-of-band communications from the gaming machine 104a, which is powered on with an executing operating system, may include information related to asset management of the gaming machine, authentication information, background diagnostics, *etc.* Asset management

information may include information indicative of software loaded on the gaming machine 104. Authentication information may include information indicative of a configuration of the gaming machine 104. For example, authentication information may include information related to a core processor speed, capacity of a hard drive, an operating system version, a boot-up procedure version, game titles, peripheral devices, authentication certificates, authentication keys such as private/public key pairs, a hash of some quantity such as a key or software, a signed software image, *etc.* Background diagnostic information may include information indicative of a memory integrity check, an image of a hard drive, *etc.*

Similarly, out-of-band communications from the gaming machine 104b, which is powered off, may include information related to asset management of the gaming machine, authentication information, background diagnostics, *etc.*

Out-of-band communications from the gaming machine 104c, which is powered on without an executing operating system, may include information related to diagnostics such as event logs of the gaming machine 104c, image tests, *etc.* Out-of-band communications to the gaming machine 104c may include repair information for correcting a crash of the gaming machine 104c such as a hard drive re-image, *etc.*

In some embodiments, the gaming machines 104 may be geographically distributed over a large region. For example, the gaming machines 104 may be lottery ticket dispensing machines for a state-run lottery. Alternatively, the gaming machines 104 may be distributed over a relatively small geographic region such as a casino, airport, lounge, or gas station. In some embodiments, the gaming management system 100 may include distributed clusters of gaming machines 104, an example of which may be multiple geographically distributed casinos where each casino has a cluster of gaming machines 104. In any case, the game management server 102 may manage, monitor, reconfigure, authenticate, verify, and perform diagnostics and

repair of the gaming machines 104. The game management server 102 may remotely access the gaming machines 104, perform remote diagnostics and repairs, provide remote downloads, remotely power on/off, and reboot the gaming machines 104.

An access control device 103 may be coupled to the game management server 102 for limiting access to the game management server 102 to only authorized personnel. The access control device 103 may take a variety of forms such as a biometric identification device, a security card reader, *etc.*

In some embodiments, communications via one or both of the in-band channel 106 and the out-of-band channel 108 may be encrypted. In that case, unauthorized personnel will not be able to hack into the gaming machines 106 via the encrypted channel(s).

In some embodiments, the game management server 102 generates an activity log. The activity log may include information such an indicator of past operators, past operations, accessed gaming machines 104, time of access, *etc.* In other words, the activity log may show who performed or attempted to perform what operation on which gaming machine and when.

Figure 2 shows a schematic diagram of the gaming machine 104a, which is representative of the gaming machines 104b, 104c, according to one non-limiting illustrated embodiment. The gaming machine 104a has a memory controller hub 110 that is communicatively coupled to a core processor 112, a memory 114, and output devices 116 by one or more buses 118.

The core processor 112 may be a device for executing software, particularly that stored in the memory 114. The core processor 112 may be a custom made or commercially available processor, a central processing unit (CPU), a semiconductor based microprocessor (in the form of a microchip or chip set), or generally any device for executing software instructions.

The memory 114 may include any one or combination of volatile memory elements such as a read-only memory (ROM) and a random access

memory (RAM). The random access memory (RAM) may include dynamic random-access memory (DRAM), static random-access memory (SRAM), synchronous dynamic random-access memory (SDRAM), flash RAM, *etc.*

The memory 114 may store one or more logic modules or logic routines, each of which may comprise an ordered listing of executable instructions for implementing logical functions. In particular, the memory 114 stores an operating system 120 and applications 122. The execution of the operating system 120 by the core processor 112 essentially controls the execution of other logic, such as applications 122, and provides scheduling, input-output control, file and data management, memory management, and communication control and related services. The applications 122 include one or more ordered listings of executable instructions for implementing logical functions for a game title, *e.g.*, blackjack, poker, roulette, slot games, *etc.*

The output devices 116 may include user interface devices such as display devices and/or various output cards such as graphics cards.

The memory controller hub 110 has a microprocessor 124a. Among other things, the microprocessor 124a has a management engine. The management engine may take a variety of forms including firmware. The management engine implements various services on behalf of management applications.

The gaming machine 104a further includes an input/output controller hub 126 that is communicatively coupled to a storage device 128, communications devices 130, a remote management microcontroller 132, and an unalterable media 134 by one or more buses 118. The input/output controller hub 126 has a microprocessor 124b that embodies a management engine. The management engine may take a variety of forms including firmware. The management engine implements various services on behalf of management applications.

The storage device 128 may take a variety of forms such as, but not limited to, a hard drive, a CD-drive, a DVD drive, *etc.*

The communications devices 130 may include a network interface card and/or wireless communication devices such as, but not limited to, Ethernet devices and/or 802.11 devices that provide a communication link with the gaming machine management server 102. The communication link may be a wireless communication link, a wired communication link or media, an optical fiber, *etc.*, and/or a combination thereof. The communication link may provide both the in-band channel 106 and the out-of-band channel 108. Alternatively, a first communication link may provide the in-band channel 106, and a second communication link may provide the out-of-band channel 108. The communications devices 130 include an in-band module 136 and an out-of-band module 138. The in-band module 136 provides system level communications with the gaming machine management server 102 via the in-band channel 106. The out-of-band module 138 provides out-of-band communications via the out-of-band channel 108.

The remote management microcontroller 132 facilitates remote out-of-band management of the gaming machine 104. The remote management microcontroller 132 may take a variety of forms such as a small microprocessor with firmware. The firmware may be stored in a non-volatile memory 140. The non-volatile memory 140 may take the form of flash memory. The remote management microcontroller 132 may include a built-in web server that is remotely accessible. The non-volatile memory 140 may store, among other things, authentication information and diagnostic information. Additionally, the gaming machine 104 is typically secured from unauthorized access to the physical components of the gaming machine 104 via a door of a cabinet that houses the gaming machine 104. The non-volatile memory 140 may store door access information indicative of when the gaming machine was opened for physical access to components of the gaming machine, who accessed the gaming machine, and what operation, change, and/or modification occurred or was attempted. Additionally, the non-volatile memory

140 may store software title indicators that are indicative of software titles stored in the memory 114.

In some embodiments, the gaming machine management server 102 may configure the gaming machine 104a to store selected information in the non-volatile memory 140. For example, the gaming machine management server 102 may specify components, modules, software, *etc.* that are considered as an asset. The non-volatile memory 140 may store a respective asset indicator that is indicative of the gaming machine 104a having one of the specified assets.

The unalterable media 134 may take the form of a read-only memory such as EEPROM. The unalterable media 134 may store firmware for booting up the gaming machine 104a similar to Basic Input/Output System (BIOS) firmware of many personal computers. When the gaming machine 104a is first powered on, the boot-up firmware stored in the unalterable media 134 identifies and initiates various hardware components of the gaming machine 104a. Obviously, the firmware for booting up the gaming machine 104a cannot be updated if the firmware is stored in the unalterable media 134. However, by storing the firmware in the unalterable media 134, the firmware cannot be tampered with by either authorized or unauthorized personnel. Consequently, the gaming machine 104a is more secure with the boot-up firmware stored in the unalterable media 134 than stored in a writeable media.

The gaming machine 104a further includes a power supply 142 that is electrically coupled to various components of the gaming machine 104a via an electrically conductive medium 142. The gaming machine 104a is configured such that various components of the gaming machine 104a are electrically powered by the power supply 142 even when the gaming machine 104a is "powered off." The input/output controller hub 126, the storage device 128, communications devices 130, the remote management microcontroller 132, unalterable media 134 and non-volatile memory 140 may receive a small amount of electrical current from the power supply 142 when the gaming

machine 104a is powered off. The amount of electrical current supplied to various components of the gaming machine 104a is sufficient for the operation of the remote management microcontroller 132 and for out-of-band communication with the gaming machine management server 102.

In some embodiments, various components and/or functions of the gaming machine 104a such as the remote management microcontroller 132 and the management engine may be embodied in Intel® Active Management Technology.

Method of Asset Management

Figures 3A-3C show a flow chart of an exemplary process 300 to manage managing a plurality of remote gaming machines according to one non-limiting illustrated embodiment. Certain acts in the processes or process flow described in all of the logic flow diagrams referred to below must naturally precede others to function as described. However, the various embodiments are not limited to the order of the acts described if such order or sequence does not alter the functionality of one or more of the embodiments. That is, it is recognized that some acts may be performed before, after, or in parallel with other acts. Further, some embodiments may include additional acts and/or omit other acts.

At 302, each respective gaming machine of the plurality of gaming machines is configured to enable remote access while an operating system of the respective gaming machine is not being executed.

At 304, each respective gaming machine of the plurality of gaming machines is configured to have a respective unalterable boot up sequence. The unalterable boot up initializes and identifies various hardware components of the gaming machine when the gaming machine is powered on.

At 306, a respective first memory of a respective gaming machine is accessed while the operating system of the respective gaming machine is not

being executed for at least one respective gaming machine of the plurality of gaming machines.

At 308, which may be optional in some embodiments, a respective software title indicator of at least one respective software title stored in a respective second memory storing of the respective software title is retrieved.

At 310, which may be optional in some embodiments, a portfolio of licenses for software titles is managed based at least on software title indicators retrieved from the plurality of gaming machines.

At 312, which may be optional in some embodiments, a total number of the gaming machines which store a respective software title is determined wherein a respective license for the respective software title is included in the portfolio of software titles.

At 314, which may be optional in some embodiments, a respective event log for the respective gaming machine is retrieved while a core processor for executing the operating system is powered and concurrently while the operating system of the respective gaming machine is not being executed.

At 316, which may be optional in some embodiments, the respective gaming machine is provided with a repair storage device image. The repair storage device image may be an image of a memory or a portion of a memory, such as memory 114, and/or may be an image of a hard drive.

At 318, which may be optional in some embodiments, a reboot of the respective gaming machine is initiated.

At 320, which may be optional in some embodiments, a respective diagnostic indicator for the respective gaming machine is retrieved while a core processor for executing the operating system is powered off.

At 322, which may be optional in some embodiments, a respective authentication indicator for the respective gaming machine is retrieved while a core processor for executing the operating system is powered off.

At 324, which may be optional in some embodiments, the authentication indicator for the respective gaming machine is verified.

At 326, which may be optional in some embodiments, a respective asset indicator of at least one respective asset of a respective gaming machine is retrieved.

At 328, which may be optional in some embodiments, a portfolio of assets is managed based at least on asset indicators retrieved from the plurality of gaming machines.

At 330, which may be optional in some embodiments, at total number of the gaming machines which include a respective asset is determined, wherein a respective license for the respective asset is included in the portfolio of assets.

The above description of illustrated embodiments, including what is described in the Abstract, is not intended to be exhaustive or to limit the embodiments to the precise forms disclosed. Although specific embodiments and examples are described herein for illustrative purposes, various equivalent modifications can be made without departing from the spirit and scope of the disclosure, as will be recognized by those skilled in the relevant art.

For instance, the foregoing detailed description has set forth various embodiments of the devices and/or processes via the use of block diagrams, schematics, and examples. Insofar as such block diagrams, schematics, and examples contain one or more functions and/or operations, it will be understood by those skilled in the art that each function and/or operation within such block diagrams, flowcharts, or examples can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. In one embodiment, the present subject matter may be implemented via Application Specific Integrated Circuits (ASICs). However, those skilled in the art will recognize that the embodiments disclosed herein, in whole or in part, can be equivalently implemented in standard integrated circuits, as one or more computer programs running on one

or more computers (*e.g.*, as one or more programs running on one or more computer systems), as one or more programs running on one or more controllers (*e.g.*, microcontrollers), as one or more programs running on one or more processors (*e.g.*, microprocessors), as firmware, or as virtually any combination thereof, and that designing the circuitry and/or writing the code for the software and or firmware would be well within the skill of one of ordinary skill in the art in light of this disclosure.

The various embodiments described above can be combined to provide further embodiments. To the extent that they are not inconsistent with the specific teachings and definitions herein, all of the U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet are incorporated herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary, to employ systems, circuits and concepts of the various patents, applications and publications to provide yet further embodiments.

These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

CLAIMS

1. A method of managing a plurality of remote gaming machines, comprising:

configuring each respective gaming machine of the plurality of gaming machines to enable remote access while an operating system of the respective gaming machine is not being executed;

configuring each respective gaming machine of the plurality of gaming machines to have a respective unalterable boot up; and

accessing a respective first memory of a respective gaming machine while the operating system of the respective gaming machine is not being executed for at least one respective gaming machine of the plurality of gaming machines.

2. The method of claim 1 wherein accessing a respective memory of a respective gaming machine further includes retrieving a respective asset indicator of at least one respective asset of a respective gaming machine.

3. The method of claim 2, further comprising:

managing a portfolio of assets based at least on asset indicators retrieved from the plurality of gaming machines.

4. The method of claim 3 wherein managing a portfolio of assets titles further includes:

determining a total number of the gaming machines which include a respective asset, wherein a respective license for the respective asset is included in the portfolio of assets.

5. The method of claim 1 wherein accessing a respective memory of a respective gaming machine further includes retrieving a respective software title indicator of at least one respective software title stored in a respective second memory storing of the respective software title.

6. The method of claim 5, further comprising:

managing a portfolio of licenses for software titles based at least on software title indicators retrieved from the plurality of gaming machines.

7. The method of claim 6 wherein managing a portfolio of licenses for software titles further includes:

determining a total number of the gaming machines which store a respective software title, wherein a respective license for the respective software title is included in the portfolio of software titles.

8. The method of claim 1 wherein accessing a respective memory of a respective gaming machine further includes retrieving a respective event log for the respective gaming machine while a core processor for executing the operating system is powered and concurrently while the operating system of the respective gaming machine is not being executed.

9. The method of claim 8, further comprising:

providing the respective gaming machine with a repair storage device image; and

initiating a reboot of the respective gaming machine.

10. The method of claim 1 wherein accessing a respective memory of a respective gaming machine further includes retrieving a respective diagnostic indicator for the respective gaming machine while a core processor for executing the operating system is powered off.

11. The method of claim 1 wherein accessing a respective memory of a respective gaming machine further includes retrieving a respective authentication indicator for the respective gaming machine while a core processor for executing the operating system is powered off.

12. The method of claim 11, further comprising:

verifying the authentication indicator for the respective gaming machine.