TECHNOLOGY BRIEF

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Compaq Computer Corporation

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Remote Server Management With Integrated Remote Console

Distributed enterprise trends continue to affect the marketplace as companies grow more global and decentralized. As a result of the growth of the distributed enterprise, high-availability solutions and server management tools are in high demand. Compaq has responded to customer needs for cost-effective remote server management by providing another innovative solution: Integrated Remote Console. This paper discusses the use of existing integrated server management solutions and the enhancements Integrated Remote Console brings. The paper also briefly describes additional features available with the optional Compaq Remote Insight Board. The key features of Integrated Remote Console, such as remote console and remote reset abilities, are identified. An overview of the Integrated Remote Console architecture is also given.

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REMOTE SERVER MANAGEMENT WITH INTEGRATED REMOTE CONSOLE
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SERVER MANAGEMENT TOOLS

An overwhelming trend affecting the server marketplace today is the growth of the distributed enterprise. As a result of the server proliferation throughout an enterprise, customers are demanding high-availability solutions that reduce or eliminate downtime whenever possible. One method of achieving high availability is through the use of effective server management tools. To determine the appropriate tool, customers need to answer the following questions:

- How will the server be accessed?
- What management functions need to be performed?
- How critical is the managed server?

A server can be accessed in different ways, depending on connection method and server state, as shown in Figure 1. A server can be connected to other computers through either an *in-band* connection or an *out-of-band* connection. An in-band connection refers to a standard network connection that is made through a medium such as twisted pair 10Base-T, while an out-of-band connection is established through a phone line or direct serial connection. The out-of-band connection is also referred to as an asynchronous connection. Once this connection is made, the administrator may need to use different tools, depending on whether the server is online or offline. An *online* server refers to one in which the operating system is up and running. If the operating system is down, the server is *offline*.

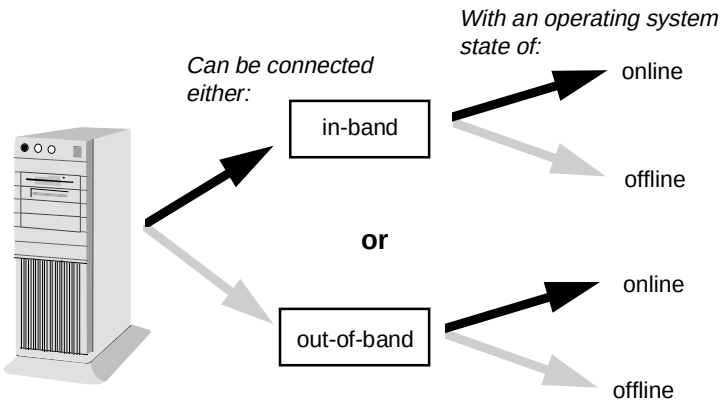

Figure 1: Example of server access methods.

Compaq provides tools to help its customers manage servers using both in-band and out-of-band connections. In addition, tools are available for both online and offline server states. These tools vary in their management capabilities. Depending on the criticality of the server, a customer may need different management functions or means of access. For remote applications, a server management tool must be able to:

- Access servers from a single administration site, whether the servers are spread across multiple remote sites or grouped in a centralized site away from the administrator.
- Monitor, diagnose, and correct existing or potential problems.
- Protect business-critical data and applications with security features.

Compaq makes tools with these capabilities available as "standard" features, integrated into the hardware or software shipped with the server. These standard tools include:

- Compaq Insight Manager software for fault, configuration, and performance management.
- Insight Asynchronous Management, the ability to access Insight Manager using an out-of-band connection.
- Automatic Server Recovery (ASR) reset, the hardware-based ability to reset the server after critical hardware or software errors.
- System partition utilities, including the System Configuration Utility, Server Diagnostics, Drive Array Advanced Diagnostics, and the ROMPaq Utility.

With the introduction of the Compaq ProLiant 2500 Server, Compaq adds the innovative Integrated Remote Console function to the existing standard server management abilities. The ProLiant 2500 is a new server from Compaq designed to meet the evolving demands of departmental and remote offices through cost-effective server technology. Integrated Remote Console (IRC) gives this server robust hardware-based capabilities that raise the level of standard Compaq server management tools. The following sections briefly describe the existing integrated tools and the new IRC function.

EXISTING INTEGRATED SOLUTIONS

Online Server States

Compaq Insight Manager, shipped with every Compaq server, provides in-band management of a server when the operating system (OS) is up. Insight Manager includes access to all Simple Network Management Protocol (SNMP) based alerts and hundreds of management parameters. Normally, Insight Manager is used with its graphical user interface application to manage the server from the administration site. Additional server control can be obtained through Insight Manager by opening an OS console window. This feature is available on a managed server equipped with telnet server software.

For out-of-band access when the server is online, Insight Asynchronous Management can be used through the industry standard Point-to-Point Protocol (PPP). Insight Asynchronous Management provides out-of-band SNMP management through the PPP connection. Insight Asynchronous Management gives the customer all the alerting and data collection functions of Insight Manager and the ability to access them remotely, as long as the OS is functioning. More complete information about Compaq Insight Manager and Insight Asynchronous Management can be found in the white paper titled "Compaq Insight Manager," document number 170A/0696.

Offline Server States

For offline server management, Compaq provides the following capabilities:

- ASR alerting
- System partition utilities remote console

If a critical hardware or software error occurs in a Compaq server, the ASR feature resets the server automatically. If the server has an out-of-band connection, a paging alert can be sent to notify the network administrator immediately that an error has occurred. With either in-band or out-of-band connections, the administrator can access the server through the system partition utilities to identify and possibly correct the source of the fault. Each of the system utilities can be accessed through the use of any standard modem and a communications package that supports ANSI terminal emulation. This access is available when the server is booted to the system partition by an ASR reset or by Compaq Insight Manager.

The existing Insight Manager, Insight Asynchronous Management, ASR, and system partition utilities tools provide important management features for the administrator. However, there are instances in which a customer may need more access and control, especially when the operating system is offline. For instance, after an ASR reset, system utilities are available for diagnostic work, but they may not provide enough information to resolve the problem. If the administrator cannot bring the operating system back up after the ASR reset, the server is inaccessible. IRC provides a solution to these types of problems.

IRC: A NEW LEVEL OF INTEGRATED SERVER MANAGEMENT

Compaq has developed Integrated Remote Console to allow out-of-band management capabilities such as remote console and remote reset, independent of the state of the network operating system. With the IRC function, an administrator has full text mode video and keyboard access even if the OS is down (Figure 2). The administrator now has the ability to access the server, perform diagnostics, reset the system, watch the reset process remotely, and view ASR reset sequences, regardless of whether the server OS is online or offline.

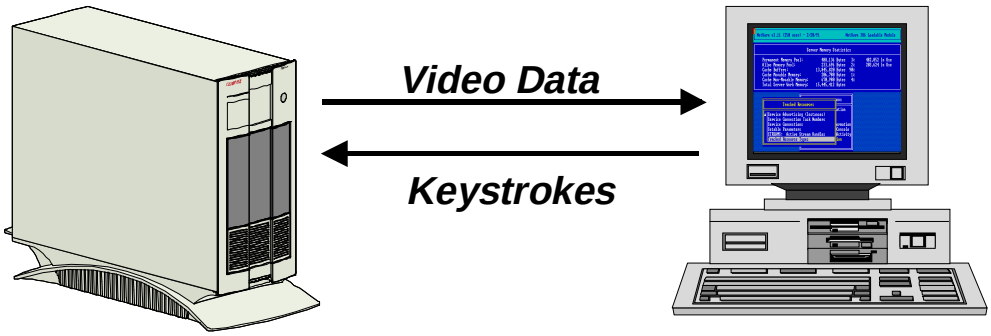

Figure 2: Graphic representation of IRC remote console capability.

IRC complements Insight Asynchronous Management by providing an easy-to-use remote console feature while the OS is up. IRC interfaces with Insight Asynchronous Management so that both capabilities are available to the customer in an out-of-band, online, situation.

IRC gives a customer the ability to access remote servers, monitor and diagnose problems, and protect data with security features, through its combination of hardware and firmware integrated onto the server motherboard. The seamless hardware-based remote console, hardware-based remote reset, and reset sequence replay features are available to the customer whether the servers are in multiple remote locations or grouped in a centralized site, yet still away from the administrator. These features, discussed more fully in the IRC feature section, are independent of the state of the OS.

However, some customers may need even more capabilities than are present with the new IRC function. Compaq also offers the optional Compaq Remote Insight Board for customers that require access and alerting at all times, regardless of the state of the server hardware or OS.

COMPAQ REMOTE INSIGHT BOARD (OPTIONAL)

Remote Insight offers complete hardware independence from the server, as it is essentially a "computer within a computer." Because the board has its own processor, memory, and battery backup, it can continue operating should the server have a hardware fault or lose power.

Because of the on-board battery back-up, the enhanced alerting features of Remote Insight (alphanumeric paging, Insight Manager alerts) are available at all times, even in the case of power outages.

Remote Insight provides seamless PPP integration so that the customer can move between Insight Manager/SNMP management and the resident remote console application without any loss of connection, regardless of server condition.

In addition, Remote Insight captures critical information through enhanced video sequence replay, which includes failure sequences as well as reset sequences. The enhanced abilities allow two generations of reset sequence data to be stored and preserved by the on-board battery during power outages.

The optional Remote Insight board offers the most complete out-of-band server management solution. If a server goes down due to a hardware fault, software fault, or even a power outage, the administrator can be alerted and can access Remote Insight to bring the server back up. More complete information about Remote Insight can be found in the technology brief titled "Compaq Remote Insight Product Overview," document number 078A/0496.

Table 1 summarizes the Compaq server management tools available and when each can be accessed, including the optional Remote Insight board.

Access Method	Server State	
	Online (OS up)	**Offline (Os down)**
In-band (through a network interface controller)	• Insight Manager w/ SNMP agents	• ASR Reset • System Utilities
Out-of-band (through a modem)	• Insight Asynchronous Management w/ SNMP • **Integrated Remote Console** • *Remote Insight Board (optional)*	• ASR Reset • System Utilities • **Integrated Remote Console** • *Remote Insight Board (optional)*

Table 1: Compaq Server Management Tools

IRC FEATURE DESCRIPTION

The most important features of Remote Insight are now integrated into the server hardware and firmware through IRC. These features are described in the following sections:

- Remote console
- Remote reset
- Reset sequence replay
- Security features

Remote Console

The remote console application redirects the video from the remotely managed server to an off-site administrator console, providing the administrator with full text mode video and keyboard access. Since IRC is independent of the OS, the administrator can bring the OS up or down or even reset the server, all while remaining in control of the server through the IRC connection. Because of its design, IRC allows viewing of these remote activities, including reset events and event connection logs. IRC monitors the server video activity in such a way that provides a very realistic simulation of the server console and that avoids information loss.

IRC provides flexibility of access. The administrator can access IRC either through an internal or external modem connection or through a direct serial connection. IRC utilizes industry-standard, third-party modems, so that the customer is free to choose any standard modem. The modem connection will normally be used to manage the server remotely. However, an on-site administrator with a laptop could use the serial connection to access a server directly, further enhancing the flexibility of IRC.

Integrated Remote Console can be accessed either through Compaq Insight Manager or through any communications package that supports ANSI terminal emulation. IRC can be accessed through Compaq Insight Manager by configuring the modem remote console feature associated with the managed server. When accessed through Insight Manager, IRC supports dynamic text mode changes and extended keyboard functionality, including the function (*Fn*) and alternate (*Alt*) keys.

The remote console application can also be accessed through any ANSI terminal emulation program. This gives the customer multiple options in the choice of a server management console application. In addition, the IRC design supports complex keystroke combinations. The user can synthesize complex combinations, such as function (*Fn*) and alternate (*Alt*) keys, which would otherwise be unavailable through the ANSI standard. As a result, virtually any keystroke combination can be entered from any terminal emulation package. IRC also supports different terminal line modes (for example, 80x25 or 80x50) in both monochrome and color.

Remote Reset

If a shutdown of the OS is required, the administrator should first attempt a graceful shutdown using Insight Manager or Insight Asynchronous Management. If the host OS does not respond, the administrator now has the ability through IRC to reset the server. IRC can perform two types of system resets: a server reset or a complete power cycle.

When *Server Reset* is selected, IRC will perform an unconditional reset of the managed server. All server hardware and internal peripherals will be reset, except for those necessary to maintain the remote connection to the management site. The administrator will be able to view the entire reset process, since the IRC connection remains intact throughout the process. Because IRC is independent of the OS, this reset option allows the administrator to view the memory count and all POST messages in the OS initialization stage.

The *Cycle Power* option is a more drastic technique to reset the server. This option will cycle the server power supply, unconditionally resetting the server. The managed server will completely power down for a period of approximately 15 seconds, after which power is restored. Before activating the cycle power sequence, IRC will prompt the user for an optional dial-back telephone number so the IRC connection can be reestablished when power returns to the server. Compaq Insight Manager will detect dial-back sequences and will reestablish the connection to IRC automatically.

After the server is sucessfully reset through IRC using either reset command, IRC will inform the user if the OS goes into graphics mode. At this time, the user can disconnect IRC and access the

graphics-based OS using a third-party application such as Microsoft Systems Management Server or Symantec pcANYWHERE.

Reset Sequence Replay

IRC has native video encoding technology that allows video activity to be recorded for later playback. This allows the administrator to view previously captured video activity, and is particularly useful following an ASR event. An administrator can be notified of ASR events through Insight Manager and later, through IRC, can review the last reset process. Under certain operating systems, the recorded video activity may also contain a snapshot of the failure sequence on the console screen just before the ASR event. The sequence replay feature enables the remote administrator possibly to identify and correct the cause of a server failure.

Once the reset sequence recorder is activated, all text mode video is collected until the recorder is full or the duration timer expires (approximately 5 minutes). When viewing the reset sequence, the administrator can control the replay speed to pause and more carefully examine specific sections as needed. Reset sequences are stored in system RAM and are not available after power to the server is deactivated.

Security Features

Security features are a vital component of any server management tool to protect critical data and applications. Since IRC allows direct access to the managed server without any permission by the OS, it is crucial that IRC protect the server and the attached network with security features. These security features include username and password recognition, variable user access, optional dial-back, and the event log.

IRC detects and rejects any unauthorized user who attempts access without proper username and password identification.

The IRC application can be configured to allow access by up to eight users. Each user has the ability to change his password at any time. For setting any other user parameters, supervisor privileges are required. Supervisors can add, delete, or modify existing user profiles. The user profile includes variable access rights to all of the functions supported by IRC. In all cases, the default configuration will be "enabled," but a supervisor could restrict these rights if desired.

To protect against an unauthorized user who somehow obtains a legal password and username, a supervisor can activate an optional dial-back feature for any or all users. With this option, pre-defined phone numbers are configured into user profiles. When a user initiates contact, IRC verifies the username and password, disconnects, then re-dials the user at the predetermined (actual user) phone number. For an authorized user, remote access can proceed as usual; however, the unauthorized user will lose the connection to the server at this point.

The IRC event log contains connection information as well as other system events pertinent to the operation of IRC. Through viewing the event log, the administrator has the security of knowing who accesses the IRC application. This information is stored in non-volatile RAM so it is available even in the event of a power cycle.

IRC HARDWARE

Country Compatibility

IRC supports multiple keyboard layouts to allow international characters through the ANSI standard. With supervisor level access, an administrator can specify the type of keyboard attached to the managed server. For proper remote keyboard operation, the IRC configuration must match the keyboard country layout configured in the managed server's OS. The following keyboard layouts are available: Belgian, British, Danish, Finnish, French, French Canadian, German,

Italian, Japanese, Latin American, Norwegian, Portuguese, Spanish, Swedish, Swiss French, Swiss German, and United States.
While certain modems are localized for different countries, this does not affect the modem functionality required by IRC. Thus, country localization issues should not hinder modem operations with IRC.

Modem Support

To enable IRC, the managed server must have a suitable serial communications device: an internal modem, external modem, or a dedicated null modem serial cable. IRC can communicate with any high-speed(14.4 kbaud or greater), Hayes compatible, UART-based modem. If an internal modem is used, IRC supports either EISA or ISA modems, assuming they are Hayes compatible and UART-based.

Both IRC and the OS can use a single modem line. This modem sharing feature is accomplished by the IRC hardware and its associated firmware. When a call is received by the managed server, it is automatically forwarded to the OS unless a specific sequence of keystrokes is entered. If this keystroke combination is given, the server recognizes that the user wants to connect to IRC. The modem sharing function allows a single modem to support other system management tools, such as allowing Insight Manager SNMP-based alerts to be transmitted through the modem.

System Configuration Options

When IRC is configured, the default setting shares the modem between IRC and the OS. However, the modem can be dedicated to IRC so that all incoming calls go directly to the remote console application. If the user wants to disable the IRC application entirely, this can also be done. If IRC is disabled, all incoming calls go immediately to the OS and the IRC remote console application is inaccessible by the user. Both the modem sharing feature and the IRC application are configured through the system configuration utility.

IRC ARCHITECTURE

The IRC functions are performed by the system microprocessor with assistance by the Compaq-designed IRC ASIC (Application Specific Integrated Circuit) and associated firmware. The IRC ASIC captures and encodes video data, performs timing-critical operations, and incorporates modem arbitration logic to enable modem sharing between IRC and the Insight Asynchronous Management software.

The system microprocessor executes the IRC firmware that is incorporated into the server's system ROM. The firmware runs in a protected environment above and completely independent of any other code which is executing. Operating system code is physically prevented from accessing or interfering with the IRC firmware in any way. Because the IRC firmware runs in a protected environment, it essentially is executed on a "virtual microprocessor" which is assisted and controlled by the IRC ASIC. This architecture minimizes any impact on server performance, requiring processing power only when a remote console session is in progress. By leveraging the existing microprocessor in this way, the cost of providing hardware-based server management capabilities is reduced.

Figure 3 shows a high-level block diagram of the IRC architecture highlighting the primary function of the IRC ASIC: real-time video encoding. The IRC ASIC monitors all video activity between the system microprocessor and the video controller, and from the content of the individual PCI bus cycles, identifies the original operation that the OS is performing. These operations include scrolling the server console screen, clearing the screen, and drawing text. After the operation is identified, the ASIC encodes the data needed to reconstruct that operation.

When the collected data exceeds a defined threshold, the "virtual microprocessor," controlled by the IRC firmware, retrieves and processes the collected data.

The Compaq design splits the resource allocation so that hardware and software do tasks best suited to each. The hardware provides the additional value of the IRC function without slowing down the microprocessor to achieve it. By allocating certain tasks to the firmware, the design allows the flexibility of future upgrades through ROMPaq.

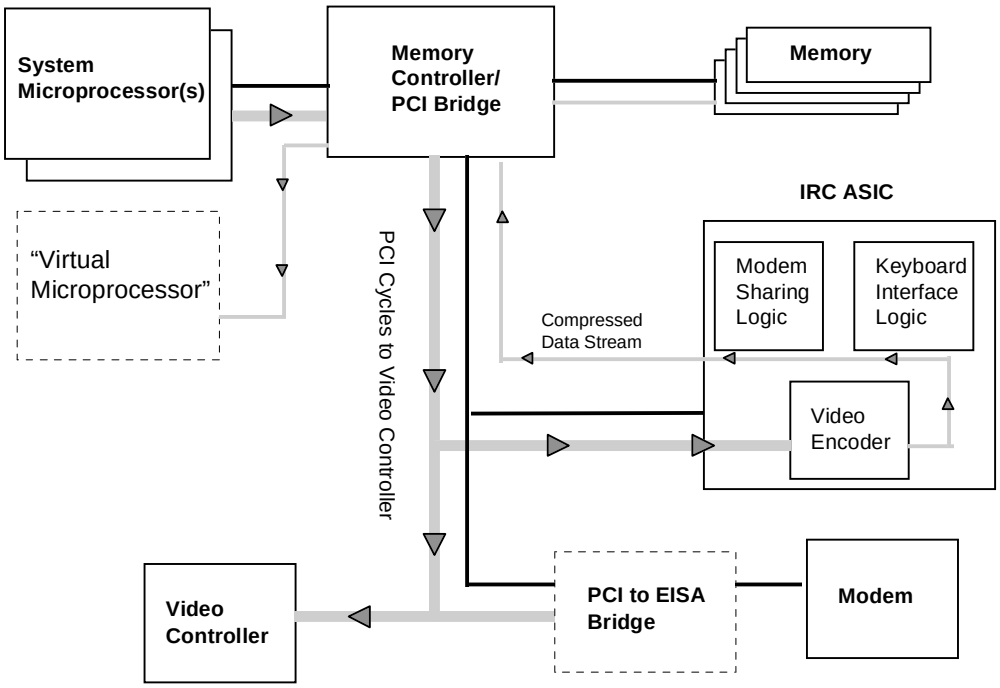

Figure 3: Block Diagram of IRC Architecture.

CONCLUSION

With the introduction of the Integrated Remote Console function in the ProLiant 2500 Server, Compaq raises the level of remote server management solutions that are integrated with a server. The IRC function gives a customer enhanced out-of-band management capabilities that add to the existing ASR feature and System Partition Utilities when a server OS is offline. If a server is online, a customer still has out-of-band access to all the features of Insight Asynchronous Management, along with an easily used remote console feature. By providing remote server console and remote reset capabilities regardless of the state of the server OS, Compaq gives customers with remote servers in critical environments an additional measure of control.