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# Remote Server Management for Small and Mid-Sized Server Rooms and Data Centers

by Barry Nance, Network Testing Labs

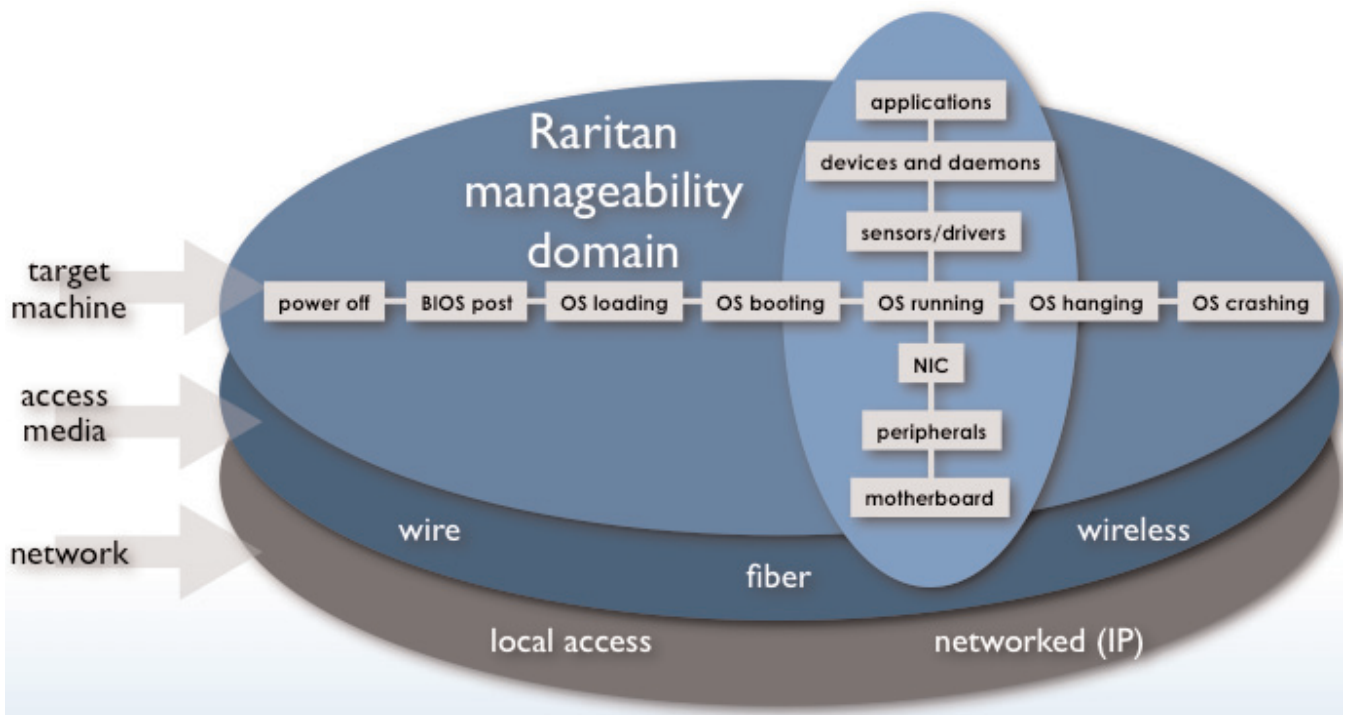
# Introduction

Today's server rooms and data centers are challenging environments to control and manage. IT staffs need to be experts in all types of equipment that make up today's data centers, including servers, routers, switches and other devices. Plus they are charged with maintaining operations performance in multiple locations, at headquarters and remote offices, with limited resources - all while keeping costs down.

Everyone knows that the financial consequence of IT Infrastructure downtime on companies can be severe in terms of lost business, loss of user/customer confidence, labor costs incurred to fix the problem repairs and punitive costs imposed by contracts (Service Level Agreements) with internal or external clients. Depending on the industry, the cost of IT downtime can range from hundreds to millions of dollars per hour.

Even if IT organizations have the resources to invest in software solutions to remotely monitor the functionality of devices on a network (such as IBM's Tivoli®, Computer Associates' UnicenterTNG®, HP Open View) they only solve part of the problem. These software solutions are designed primarily to discover faults and to alert network administrators. Their device management functionality is limited to what can be accomplished when accessing the target device via the network interface card (See Figure 1) and when the device's operating system (OS) is healthy. If the network is down, or the device OS has hung or crashed, you are out of luck – restoration of service still depends on dispatching IT technicians to diagnose the problem and take corrective action.

BIOS-level control or console-level control is critical in bringing up a downed server, because users can still control a computer via the KVM ports, even when the operating system is not functional. This is where hardware-based KVM (keyboard, video, mouse) and serial console management tools are so effective. They help IT professionals restore service and fix device-related problems without ever having to come into direct physical contact with the actual devices.



(Figure 1)

With the right KVM technologies and tools, IT administrators can work more productively, whether inside or outside the data center or server room. They can troubleshoot, configure, maintain and even reboot IT equipment - just as if they were physically present at the rack, even if (and especially when) the server or the network is down. In addition to being able to handle problems far more adeptly, KVM solutions enable a greater level of preventive maintenance. They also save valuable data center and remote office space by eliminating multiple keyboards, monitors, mice and cable.

KVM solutions operate independent of the network - or out of band - and route keyboard, video and mouse signals along a dedicated cable from the servers to the KVM switch. There are digital and analog KVM solutions. Analog solutions are ideal for managing servers from up to 1,000 feet from the data center.

For extended remote access, digital KVM - or KVM-over-IP - solutions are ideal because they use IP-based networks to extend the managerial reach of data center operators. Prior to being routed over a TCP/IP network, analog keyboard, video and mouse presses are converted into digital signals. Systems administrators can use the Internet to log in from anywhere and immediately implement a fix. Server administrators no longer have to travel to remote sites or to headquarters during off hours in order to answer alarms and fix faults.

Not only does remote KVM access enable IT staffs to be more responsive and productive, it also enables companies to leverage their IT resources better. Virtual IT teams, for example, can be assembled for specific projects or to solve specific problems, regardless of geographic location.

Not all remote KVM solutions are equal. This paper identifies and explores the issues an IT manager should consider in order to select the right KVM solution. It explores the type of access that is needed to manage small and mid-sized data centers and server rooms - whether your IT resources work at the rack, across the hall or around the world.

## Who Needs KVM Access?

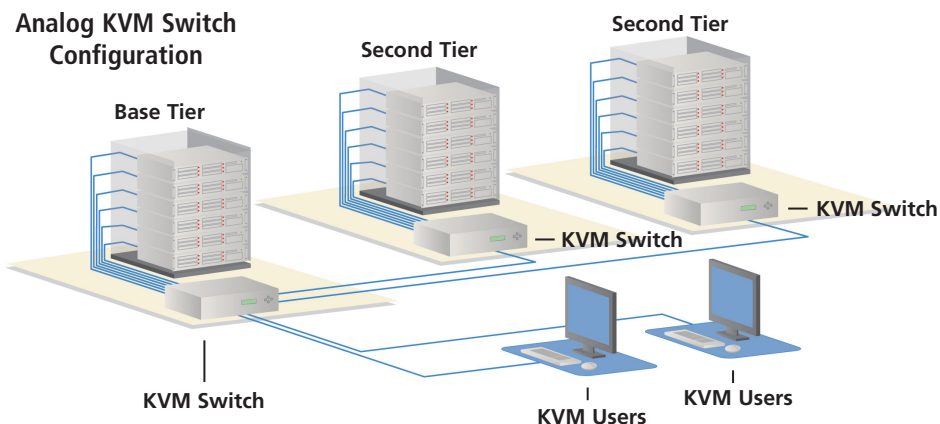
To a large extent, the KVM products used in a company determine the effectiveness, productivity and efficiency of the data center staff. No matter how near or far IT administrators are from the servers, they need responsive, reliable, secure and easy-to-use server access in order to configure, change or fix any server problem in the shortest possible time. Typically administrators need three modes of responsive, reliable access to servers: at the rack, across the hall and remote.

### At the Rack

Some people need "at the rack" access to multiple servers because they are operators whose work includes inserting CD-ROM disks, changing tape cartridges, setting up new servers and, once in a while, replacing failed power supplies, network adapters or hard disk drives.

Data center operations, configuration and repair personnel - who work inside the data center - typically interact with individual servers through a simple, direct-connect analog KVM switch. All the KVM cables from the servers in a pool or subgroup connect directly to a KVM switch, which in turn has a physical keyboard, monitor and mouse attached. For multiple concurrent user access, some KVM switches offer connections for up to 16 users, while others support even more concurrent users when multiple switches are cascaded or stacked.

The local KVM devices might connect via coaxial or Unshielded Twisted Pair (UTP) Cat5 cables. Cat5 cables offer superior bandwidth within a local area, up to about 1,000 feet. Some KVM switches can be daisy-chained or cascaded to handle a large numbers of servers. Other solutions, specifically digital KVM solutions can scale to thousands of servers by just adding switches to the network, each switch with it's own IP address.



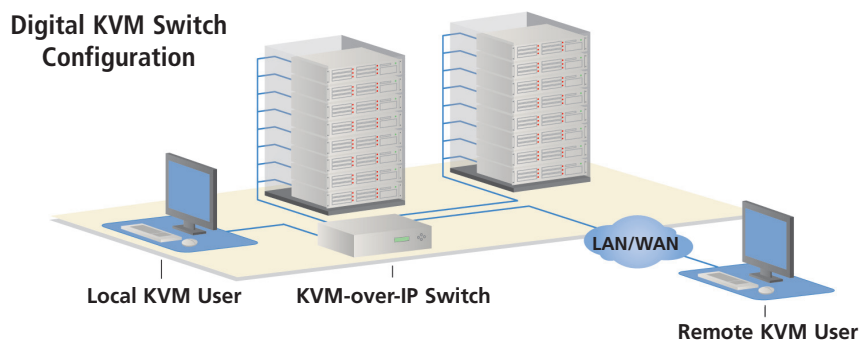
## Across the Hall

A different group of IT employees - consisting of capacity planners, troubleshooters and network engineers, who might be across the hall or somewhere within a campus - also need to operate servers. But these employees don't need to be at the rack. This group needs KVM connections that carry signals over greater distances than ordinary coaxial KVM cables can carry. An adjacent room/floor computer operator needs KVM switch equipment that makes it seem like he or she is right next to the server. While UTP Cat5 cable is appropriate for campus locations within 1,000 feet of the servers, fiber-optic cable is a good solution for distances up to about six miles. KVM-over-IP connections are also a good alternative.

## Virtual Workers – Remote Data Center Access

Still other people, including centrally located, high-level operations center managers, require remote access to servers. These employees may be located at headquarters or in another state or country.

These operation center managers need KVM connections that operate over a network – WAN, VPN or the Internet. Data center operations staff get a special, convenient capability in KVM-over-IP but – depending on the KVM vendor – KVM-over-IP presents tradeoffs in bandwidth utilization and responsiveness. Addressing these tradeoffs means making sure the vendor's KVM over IP tools provide a level of encryption, compression and bandwidth control to meet current and future security and performance requirements.



## Remote Office Access

In addition to needing remote access to servers in data centers, IT staffers are often also responsible for managing servers and networking equipment located in remote or branch offices. This remote office equipment can consist of a wide variety of devices including:

- KVM controlled servers including: Windows®, Linux® and Solaris™ servers
- Serial console controlled devices including: routers/switches, firewalls, network appliances, HVAC controls, security systems, telecom controllers and headless servers (UNIX, Linux, Solaris)

Usually, employees located at these remote sites do not have IT expertise and therefore do not have the skill set to troubleshoot and manage the infrastructure. In some cases, data center staffers use remote access software solutions to address remote infrastructure maintenance. However, software solutions only work if the network is up and, in the case of servers, if the server OS is healthy. When the network is down, or when the server OS has crashed, on-site employees are often asked to "go to the server closet and press the reset button," and then if the router or server does not come back up, the cost and time has to be incurred to travel to the site.

For situations like these, the ideal solution is an "all-in-one" management appliance that contains both KVM ports and serial console ports, and is available in port densities that make it cost effective for remote office use. It is important that you choose a remote office management solution that also has a built-in modem, because if the network edge device at the remote location is a router, and the router goes down, the only way to get to the router and bring it back up without "rolling a truck", is to dial in to the appliance through modem, and access the router through the serial console port.

Some companies use software utilities – such as Carbon Copy®, Windows® Terminal Services and PCAnywhere™ – for remote office management. These low cost solutions have limited access and control capabilities, and also depend on a healthy operating system on the target device. In addition, some software solutions only work with certain servers and devices, requiring the purchase of multiple remote control products. The result is an environment with multiple logins, different user interfaces and other obstacles to managing a remote server closet. While this may be acceptable for remote office application administration, it falls far short of what's needed for OS and server administration.

It's important to select the best solution for each situation. KVM solutions that use Cat 5, coaxial and fiber-cable connections address security and bandwidth issues, but have limitations in distance. KVM-over-IP solutions, of course, provide the greatest distance, but there may be some slight delay in the keyboard video and mouse signals. There are also hybrid solutions that combine analog and digital KVM switching technologies.

Location	Distance to servers	Typical cabling
Data Center	Local/direct access up to 50 feet	Coaxial
Data Center	Local/direct access up to 1,000 feet	UTP Cat 5
Campus	Up to 1,000 feet	UTP Cat 5
Remote Branch Office	Any	Wide Area Network (WAN) (T1, Frame Relay, etc.) Dial-up
From the operator's home	Any	DSL, cable modem, dial-up

Various manufacturers have implemented KVM technologies with varying degrees of success regarding responsiveness, bandwidth utilization, security, scalability and other factors. Some vendors of server-access equipment and technologies offer products that focus on the needs of one of the three groups and then, inappropriately, promote using the same "solution" for the other groups.

Make sure the KVM vendor can provide an integrated, platform-neutral solution that any authorized person from any of the three work groups can use anytime, from anywhere. Keep in mind that fixing IT problems often entails more than having server access; an IT troubleshooter may very well need access to serial (RS-232) devices, such as routers, switches and headless servers. Furthermore, if there are several remote locations, a solution is needed that makes it simple and easy for data center staff to access devices in far-flung sites. The ideal KVM system would also provide a single, consistent view of all the data centers' and remote offices' equipment and provides features, such as an intuitive user interface and single sign-on.

In addition, KVM tools should scale well, support multiple simultaneous users, work with multiple platforms, have flexible access options and be backward compatible with any existing KVM gear.

## KVM-over-IP Technologies

The technology for sharing video, keyboards and mice among myriad servers and devices has come a long way over the past few years. From rudimentary A/B switches to analog KVM boxes with limited functionality to unprecedented access-and-control analog and digital KVM enterprise-class systems, KVM technology is now a critical part of an overall IT management strategy.

A server room or data center operator using KVM-over-IP might be many miles from the server, but he or she can start or stop software, reconfigure the server's software settings and reboot the server - as if being physically in front of the server. The operator can even access BIOS-level computer configuration data.

KVM-over-IP technology turns a network-connected client computer into a server console. The technology encodes keypresses, mouse movements and mouse clicks into TCP/IP packets the client sends to the server, and it similarly encodes the server's video signals into TCP/IP packets the server sends to the client. Each vendor has an upper limit on the video resolution it supports. Making sure a vendor's products will work with the server resolutions that operators now use or will use in the future is critical. Most KVM vendors support a maximum video resolution of 1280 x 1024, with a refresh rate of 60 Hz. Rarely, but significantly, will a vendor support even higher resolutions.

### Bandwidth Constraints

The KVM-over-IP client, ie. the user station, whether a PC or notebook computer or wireless device, typically links to an IP network via a moderate-speed DSL or cable modem connection or perhaps a relatively slow-speed dial-up connection. Unfortunately, the remote operator may very well experience sluggish responses from the server because of bandwidth limitations between the client and the server. Waiting for a keypress to show up on the remotely connected server screen or waiting for a mouse cursor to catch up to the operator's mouse movements is annoying and unproductive. Moreover, if the KVM tool isn't properly designed, multiple concurrent operators accessing a bank of servers can slow each other down.

A very important factor is the volume of data the KVM client and server exchange over the network, especially for a high-resolution server screen - KVM-over-IP video signals can consume significant network bandwidth. Furthermore, if the KVM-over-IP software isn't designed well, multiple users working over the same network connections can use up available bandwidth and slow the network to a crawl.

KVM vendors use two technologies to reduce the network bandwidth required to transmit large volumes of video data. First, a KVM system keeps track of what is already showing on the operator's screen and only sends changed data, called deltas, over the network. Sending just deltas to the client, rather than always sending entire screens, dramatically reduces bandwidth utilization. Note that some KVM vendors have better quality algorithms for determining the deltas and thus use the network more frugally. Second, a KVM system compresses the deltas before transmitting them. Because some vendors have more efficient compression algorithms, the size of the resulting compressed delta varies widely across vendors.

Also note that selectively and intelligently controlling video parameters, such as the amount of color information the KVM system transmits, affects bandwidth utilization. In some implementations, a KVM system will actually allow operators to "tune" the system's transmission of video data. For example, the operator can choose to reduce the color depth and view a screen with fewer colors in order to improve KVM system performance and responsiveness for slower connections.

In addition, some solutions can be programmed to automatically restrict the amount of bandwidth available to users, so that more critical applications are not constrained. A truly ideal KVM solution that's bandwidth-aware allows the tuning of bandwidth utilization on a user-by-user basis. For some network-intensive organizations, using a second, separate network just for KVM access can alleviate bandwidth issues.

## Security

The best KVM solution should offer data security and authentication through a data encryption scheme, such as Secure Sockets Layer (SSL) and it should not require major firewall configuration changes. In the best of all possible worlds, the KVM-over-IP tool would require the opening of only a single port on the firewall. The ability for a KVM-over-IP solution to work across a Virtual Private Network (VPN) is also a big plus.

For security, some vendors employ a 128-bit encryption or 256-bit SSL encryption standard, which can also affect bandwidth utilization and overall performance. Encryption should be used in both the SSL communications and in the data stream transmitted between remote clients and servers. In addition, some vendors only encrypt the keyboard and mouse signals, leaving the video un-encrypted. This is not as secure as systems where the keyboard, mouse and video are encrypted.

Security support should also be built into the KVM-over-IP product. It should not require the purchase and configuration of a separate server just for KVM-over-IP authentication. Because the KVM solution needs to always be available in order to resolve problems that may arise in a data center, it must be a self-contained solution - completely independent from any external servers in order to operate. If the Windows servers in a data center came under attack from a malicious worm or virus, for example, the KVM solution should not rely on the same Windows servers in order to authenticate.

## Server Access Issues and Challenges

A data center operator trying to quickly fix a problem needs a KVM system that's responsive and unobtrusive. The following is a comprehensive list of the issues and challenges to be considered when evaluating and selecting KVM products. To make the job easier, the considerations are grouped into categories – performance, security, flexibility, ease of use and costs.

## Performance

**Performance/mouse synchronization** – How long is the lag time between the server operator's actions and the visual feedback in the monitor?

**Bandwidth utilization** – Will performance degrade in different network environments, dial-up, DSL, WAN, IP? Can the administrator or user throttle the bandwidth? Does it hog bandwidth on the data center network? Does it provide configurable video compression technology?

**Client software responsiveness** – Is the client component for server access well-designed? If it downloads a Java applet into the Web browser, does it take a long time to transfer? Once downloaded, does the applet keep up with the operator or is it sluggish? For non-browser-based clients, is the software highly proprietary? Does it have unusual or restrictive PC or OS system requirements?

**Blocked versus non-blocked access** – Are there enough user paths to each rack so that multiple users can always access the server(s) that they need to manage?

**Disaster recovery** – Can the tool help data center staff members quickly recover from major catastrophes, such as a pervasive network failure?

**Maximum video resolution** – Does the KVM tool support the high-video resolutions required?

**Network backup** – What server access alternatives exist, such as back-up modem access, if the network fails?

**Self contained** – Is the KVM solution self contained so it will always be available when data servers go down?

## Security

**Server and network security** – Does the tool satisfy the company's need to keep server and operator interactions authentic and confidential?

**Protocol support** – Does the KVM system work with industry standard security protocols?

**Authentication** – Is security and authentication built into the box or does the KVM product need a centrally located authentication server? If it needs an external server for authentication, what happens when the WAN goes down? How do operators authenticate themselves from a remote location?

## Flexibility

**Scalability** – Can the remote-access KVM solution scale as the company grows? Does it allow multiple concurrent users access to a server pool? Does it limit concurrent access to just two or four people?

**Collaboration** – Does it let multiple remote users view a target server in order to collaborate on troubleshooting.

**Migration to new technologies** – Is the solution likely to work with new advances in KVM?

**Platform independence** – Does it support the management of a heterogeneous computing environment?

## Ease of Use and Installation

**Breadth of product line** – Does the product come in a variety of user and port configurations to maximize non-blocked access?

**Ease of administration** – To what extent, if any, does the KVM tool intrude on the server operator's daily tasks?

**Span of control** – Does the tool integrate with serial console and power control devices? Does it have a single sign-on for cascaded switches?

**Setup and configuration** – Is it easy to set up and maintain? Does it require additional software or equipment? If a switch loses power, does it remember the server names when it comes back up? If operations people move a server and re-connect it elsewhere on the network, does the KVM product recognize the server in its new location?

## Costs

**Hidden Costs** – Does it require a dedicated authentication or systems management server, or is everything included in the switch itself?

**Budget and resource constraints** – What are the KVM tool's positive or negative dollar value effects on data center expenses, productivity and computing environment utilization?

**Investment protection** – To what extent does a new KVM tool require changing any part of the computing environment — including existing KVM devices — to suit the new tool? Will it work with legacy KVM systems or does it mandate the replacement of perfectly good hardware just to accommodate a KVM upgrade?

**Software** – Does it require additional software – client and/or server?

**Total Cost of Ownership** – What is the KVM tool's overall cost to the organization, taking every aspect of data center operation into consideration?

## Conclusion

Remote-access KVM is a simple, but powerful idea. It provides a cost-effective way to manage data centers, server rooms and branch offices from wherever the IT resources reside. The right KVM decision will give IT staff members responsive, secure, flexible, easy-to-use and cost-effective access for managing your enterprise's IT equipment in order to improve operations.

Raritan offers both analog and digital KVM solutions, ranging from a one-port, palm-sized KVM-over-IP device to a 32-port KVM-over-IP switch, and from 2-port to 64-port analog switches, so that IT organizations can have the highest performing solutions to meet their specific IT infrastructures. Factors such as proximity to the rack, number of servers and devices, and the number of users should be considered in determining the best Raritan solution.

Raritan also offers cost-effective monitoring solutions for mid-sized businesses. Raritan's all-in-one appliances monitor, notify and report network and systems problems; identify and track IT assets; guard against security threats; and help meet compliance requirements.

## About the Author

Barry Nance is a networking expert, magazine columnist, book author and application architect. He has 29 years experience with IT technologies, methodologies and products. Over the past dozen years, working on behalf of Network Testing Labs, he has evaluated thousands of hardware and software products for Computerworld, BYTE Magazine, Government Computer News, PC Magazine, Network Computing, Network World and many other publications. He's authored thousands of magazine articles and three popular books: Introduction to Networking (4th Edition), Network Programming in C and Client/Server LAN Programming.

He's also designed successful e-commerce Web-based applications, created database and network benchmark tools, written a variety of network diagnostic software utilities and developed a number of special-purpose networking protocols.

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## About Network Testing Labs

Network Testing Labs performs independent technology research and product evaluations. Its network laboratory connects myriads of types of computers and virtually every kind of network device in an ever-changing variety of ways. Its authors are networking experts who write clearly and plainly about complex technologies and products.

Network Testing Labs' experts have written hardware and software product reviews, state-of-the-art analyses, feature articles, in-depth technology workshops, cover stories, buyer's guides and in-depth technology outlooks. Our experts have spoken on a number of topics at PC Expo and other venues. In addition, they've created industry standard network benchmark software, database benchmark software and network diagnostic utilities.

## Raritan Computer – Profile

### About Raritan Computer

Raritan, based in Somerset, N.J., is a leading provider of products for managing IT equipment and the mission-critical applications and services that run on it. Raritan's highly reliable and responsive IT management solutions - based on KVM (keyboard, video, mouse) switches, serial console servers, management software and remote connectivity products - enable companies to proactively monitor and manage system health and vulnerability, as well as troubleshoot, access and repair faults from anywhere, at anytime. This simplifies and accelerates data center work processes - improving service uptime and staff productivity. Raritan's solutions are used to manage more than 50,000 data centers and other IT sites around the world. Raritan's Peppercon OEM division develops, manufactures, and markets advanced, hardware-based, remote-management components based on digital KVM-over-IP and IPMI technology. Founded in 1985, Raritan is celebrating 20 years of technical innovation. Raritan has 35 offices worldwide, and its products are distributed in 76 countries. More information on the company is available at [Raritan.com](http://Raritan.com).