

## MOXA White Paper Console Management—Better Network Protection for Industrial Ethernet

---

*by Richard Hsia, Moxa Technologies Product Manager  
[richard.hsia@moxa.com](mailto:richard.hsia@moxa.com)*

### *Introduction*

The commercial IT market has already learned the importance of a solid network maintenance and disaster recovery program. Commercial applications that require an exceptionally reliable network environment have turned to console management for robust network maintenance and recovery. For industrial applications, especially those that involve hazardous chemicals, harsh operating conditions, or materials and equipment in great quantities, network reliability may be critical for effective and safe operation. This paper presents how console management provides critical protection against network disruption in Industrial Ethernet applications.

### *How does console management work?*

Console management involves obtaining remote access to view or modify a device's boot-level settings and parameters through the device's console port.

The console port, or serial console port, is a special RS-232 port typically included on data networking equipment designed for commercial or industrial use. Rather than transmitting data, the console port provides terminal access to the device's configuration parameters. Examples of equipment with built-in console ports include industrial PCs, servers, Ethernet switches, device servers, and routers. Products that already use a serial port for data may rely on a hardware switch or sequence of trigger characters to toggle the port between data operation and

---

Copyright © 2006 The MOXA Group

Released on November 20, 2006

### **About MOXA**

The MOXA Group manufactures one of the world's leading brands of device networking solutions. Products include serial boards, device servers, *ready-to-run* embedded computers, USB-to-serial Hubs, media converters, terminal servers, Modbus gateways, industrial switches, remote I/O servers, and Ethernet-to-fiber converters. Our products are key components of many networking applications, including industrial automation, manufacturing, POS, and medical treatment facilities.

### **How to Contact MOXA**

Tel: 1-714-528-6777  
Fax: 1-714-528-6778  
Web: [www.moxa.com](http://www.moxa.com)  
Email: [info@moxa.com](mailto:info@moxa.com)



*This document was produced by the MOXA Technical Writing Center (TWC). Please send your comments or suggestions about this or other MOXA documents to [twc@moxa.com](mailto:twc@moxa.com).*

console port operation. In either case, by connecting an ASCII terminal to the console port, an administrator can view and manage basic board-level parameters and reboot the device. The ability to reboot the device through a terminal is an especially important benefit, as many instances of network failure can be resolved by simply rebooting the server.

A console server is used to access a device's console port over the network, eliminating the need for attaching a terminal directly to the device. Functionally, console servers are specialized device servers, also known as serial device servers, that manage multiple serial ports over the network. Console management involves using console servers to manage one or more devices from a networked location.

When a console server can establish access to a device's console port without going through the main data network, console management becomes an especially powerful tool for administrators. In such implementations, sometimes referred to as out-of-band management, network peripherals can be effectively diagnosed and serviced even when the network itself is down.

*What are the advantages of using console management?*

Although modern network peripherals typically offer numerous options for management over the network (e.g., SNMP, web browser access, Telnet access), serial console management still offers key advantages for both industrial and commercial environments. One advantage is that management of all devices becomes centralized, including both legacy and modern devices. Centralization can also be used to restrict access to device configuration, in order to prevent unauthorized or accidental changes.

Console management can also allow a device's boot-level parameters to be made available remotely. With many devices, access to boot-level configuration parameters cannot be obtained during normal operation or using other configuration methods.

For example, BIOS settings on a PC are not accessible through the operating system. Using console management, those parameters can be managed remotely instead of requiring a technician's physical presence.

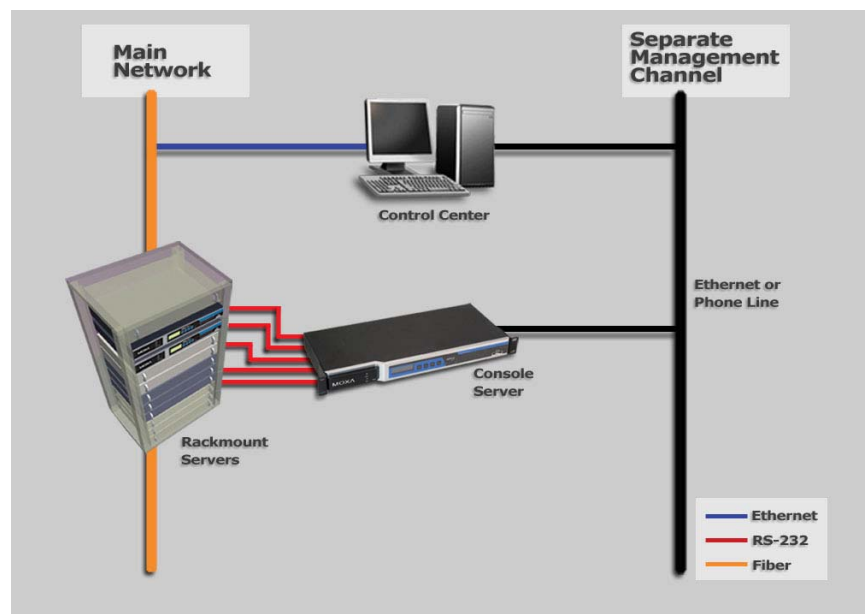
Even greater advantages can be obtained when console management access does not rely on the network used for data traffic. In a typical business environment where data travels over an Ethernet network, telephone lines may be used as an alternate access path. Alternate access can also be obtained by using a physically separate and isolated network dedicated to console management. In either case, using a separate communications channel for console management allows management of network peripherals even when the data network is down.

The advantages of a complete console management solution become clear during a network crisis. Quick and efficient troubleshooting of all network peripherals is critical during a sudden loss of network access. However, typical network-based maintenance solutions are unable to diagnosis network devices when the network is down, precisely when a diagnosis is most needed. Administrators have no choice but to go through a lengthy troubleshooting process involving physical inspection, disconnection, testing, configuration, and testing. With a complete console management solution, the collapse of the data network does not prevent administrators from accessing each device. Using an alternate communications channel such as the phone line, console management allows each network device to be diagnosed, configured, or rebooted from a single remote station.

*How are the needs of industry different from business when it comes to console management?*

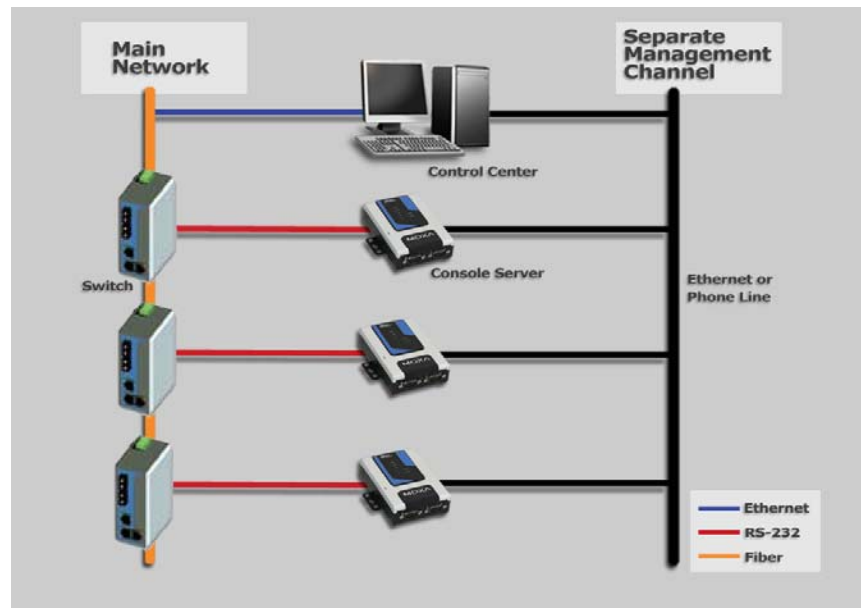
For commercial applications, console management usually involves the management of many servers, routers, and other IT equipment housed in a single location (e.g., server farms). Console servers with high port densities are preferred because they provide the most advantage and save the most space. Since most business applications are located in well-developed areas,

establishing out-of-band access is easily done through parallel Ethernet networks, phone lines, or wireless technology.



**Figure 1: High-density console management**

Some Industrial Ethernet applications closely resemble IT server farms, in which many network devices are installed in a single location. For these applications, a console server would also be expected to have high port densities, and the appropriate console management solution can usually be taken directly from the IT world with only minor modifications. However, for many IE applications, network peripherals are separated by great distances and may be extraordinarily difficult to access. Low port densities would therefore be more typical.



**Figure 2: Low-density console management**

For many IE applications, it may not be cost effective to establish alternate access for console management by installing a fully separate Ethernet network. Phone lines or a wireless connection may be the only feasible options. In some situations, even phone lines or wireless connections are not an option, and console management must be implemented using the data network.

As with all products associated with industrial use, console servers for IE applications require industrial-grade design, construction, and ruggedness. Wide-temperature models (i.e., models able to withstand extreme heat and cold) should be standard. Also, business users tend to have well-established access to IT staff and support, whereas industrial users are less likely to have the same access to network expertise. Rock-solid reliability is therefore crucial, and configuration should be as user-friendly and simple as possible. Operation that requires constant maintenance and user involvement should be avoided. Ideally, devices should be easy to configure and designed for long-time operation without user intervention.

*What are effective implementations of console management for IE applications?*

Console management for Industrial Ethernet can be implemented in a number of ways. The options range from low to high end, depending on level of reliability and type of access.

#### **Circular management**

For a bare bones solution, an Ethernet switch can provide remote access to its own console port using a one-port console server. In this "circular" approach, the switch provides network access to the console server, and the console server connects to the switch's console port. Since the console server relies on the switch for network access, the ability to manage the switch disappears if the switch fails or if the network is inaccessible. Although this implementation offers few advantages over other network management methods, it can be useful for managing devices that do not provide a network or web-based management tool.

#### **In-band crossover management**

If the console server obtains network access from a different Ethernet switch than the one it is managing, the amount of protection provided improves. With the two switches on separate branches of the network or in a ring topology, console servers can be set up on each switch to manage the other switch. This implementation could be considered an "in-band crossover" approach, since console access to each switch still partially relies on the integrity of the data network. If the network is completely off line, neither console server would be inaccessible. However, this implementation still allows remote diagnosis of switch failure because that switch's console access is provided through a different switch.

#### **Dial-up management**

If a telephone line is available on-site, a two-port console server can be used in a powerful and versatile "dial-up" implementation of console management. The console server uses one port to connect to the switch's console port and the other port to connect to a modem that accepts dial-in connections. In addition, the

console server could be connected to the network through the same switch or through a different switch if feasible. During normal operation, the console server can be accessed through the network for management of the switch. If the switch becomes inaccessible due to switch or network failure, the console server can be accessed through a modem connection. An administrator anywhere in the world can then remotely adjust the switch's settings, reboot it, and test the network connection to see if the problem was resolved. Dial-up access to the console server greatly enhances the ability to manage the Ethernet switch, since access is completely independent of the status of the data network. For many IE applications, the combination of a two-port console server and modem is the most cost-effective solution for robust network management and disaster recovery.

#### **Separate channel management**

When devices are widely separated, it is usually prohibitively expensive to install a separate Ethernet network specifically for console management. However, "separate channel" implementation can be cost-effective for certain industrial applications. For example, if brand-new network lines are going to be installed to set up a substation on a cliff or island, the cost of adding extra lines for a dedicated console management channel may be negligible. Some locations are so remote that a major undertaking is required to send an engineer on-site for network repair, such as a helicopter drop. If no telephone or wireless connection is available, the significant reduction in both network downtime and manned maintenance or troubleshooting visits may still make it cost effective to install a separate network channel, especially for operations where the network absolutely cannot be compromised.

#### **Parallel network management**

Many administrators choose to protect the network by providing complete redundancy for the entire system and every device. In these redundant systems, any device failure is immediately covered by an identical backup device, ensuring seamless,

uninterrupted operation for critical applications. For the ultimate in network protection, each device could also be managed using console servers in a “parallel network” implementation. This approach uses console servers in one network to manage the devices on the opposite network. Adding telephone or wireless access to each console server makes such a system extremely well-protected from practically any network disaster that could occur. If one network goes down, console servers on the backup network can troubleshoot the network and all devices. If some physical disaster brings down both networks, wireless or telephone access may allow enough troubleshooting to pinpoint the area requiring repair and determine if any peripheral needs replacing.

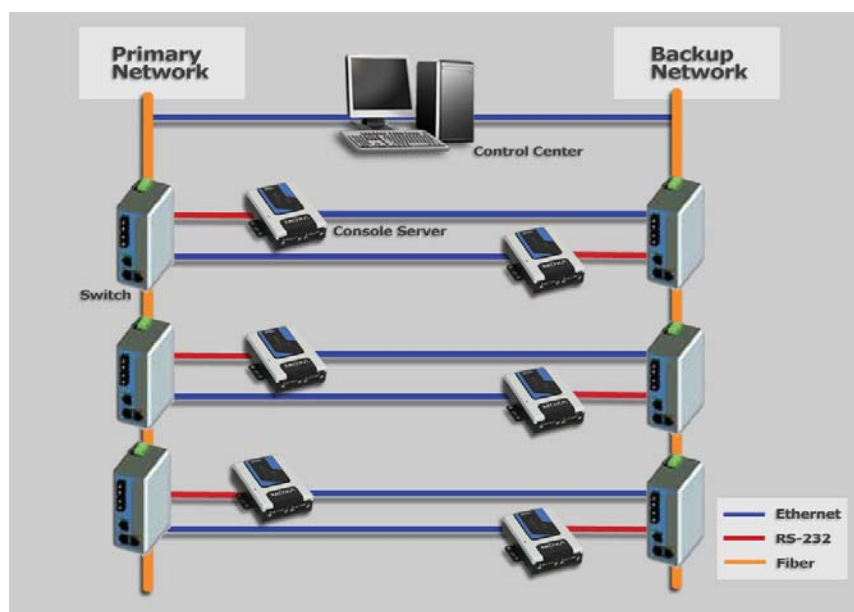


Figure 3: Parallel network management

*Summary*

For Industrial Ethernet applications as well as IT applications, console management provides much greater protection of network systems. Advantages of using console management include centralized device management, remote access to boot-level parameters, and fast network recovery if the network goes down. Console management for IE applications can take different forms that provide different levels of network protection. Those forms include *circular*, *dial-up*, *in-band crossover*, *separate channel*, and *parallel network* configurations.