Electro Standards Laboratories
ADVANCED SYSTEMS DESIGN & SERVICES

Advances in Network Switches

Raymond B. Sepe, Sr.
Electro Standards Laboratories
36 Western Industrial Drive
Cranston, RI 02921

Telephone: 1-401-943-1164
Fax: 1-401-946-5790
E-mail: eslab@electrostandards.com
Web: www.ElectroStandards.com

Abstract: Backup switches allow the users the capability of sharing devices or networks connected to the COMMON port/s among devices or networks connected to the (A, B, C, etc.) lettered or (1, 2, 3, etc.) numbered ports. Network switch designs and capabilities have changed significantly since the dawn of the computer age. This white paper delineates and clarifies some of the capabilities of the network switches on the market today.

Introduction:

Network switches have come a long way since they were simply used to select either printer A or B for that report coming from a particular computer. Today's switches can still have simple designs and functions; however, new demands for high speed, high reliability, and sophisticated control methods have developed a market for technically advanced network backup switches.

1. Today's Switch Requirements

Let's start at the beginning. The significant number of questions that need to be answered in order to determine the exact switch to meet the user's requirements is an indication of the growing complexity of today's data network backup switches.

A) The following table lists the basic determinants of a copper network switch.

Copper Network Switch List:					
Positions:	A/B/COMMON	A/B/C/COMMON		A/B/OFFLINE	Other
Chassis Type:	rack-mount	desktop		modular	board
Rack Configuration:	19" wide rack	7.75" wide	5.10" wide	DIN-Rail mounted	
Rack Height:	1.75" (1U)	3.5" (2U)		5.25" (3U)	
Connector/port preference:	BNC, DB9, DB25, DB37, DB50, HD15, RJ45, RJ11/12, SCSI, Telco 50-Pin, .1 x .1, Mini-Din, USB, Coax, other				
Port Polarity:	Male	Female			
Port Compliance:	Cat5	Cat5e		Cat6	Cat6a
Port Connectors:	Unshielded	Shielded		Recessed	
Coax Ports:	Impedance				
Switch Control:	Local Manual	Remotely Controllable		Automatic	Any Combination
Remote Control Type:	RS232 Serial	Contact Closure		IP Addressable	GUI
Automatic Control:	Port A	Port B		COMMON	Any Combination
Local Manual Control:	Pushbutton	Keylock		No Local Control	

Copper Network Switch List: (continued)					
Security:	Physical Off-Line Position		Automatic Off-Line Position		
Power Loss:	Pass data through last selected position		Pass data through default position		
Power Loss: (continued)	Data will not pass upon power loss				
Power Up:	Remain in last position		Return to default position		
Channels per chassis:	Single Channel	Multiple Channels			
Channel Control:	Simultaneous	Individual	Simultaneous and Individual		
Power Supply Requirements:	Wide Range	US, non-polarized plug	IEC 30620 C14 inlet	CE, UL	RoHS

B) Here are the basic parameters of a fiber optic network Switch.

Fiber Optic Network Switch List:						
Positions:	A/B/COMMON	A/B/C/COMMON		A/B/OFFLINE	Other	
Chassis Type:	rack-mount	desktop				
Rack Configuration:	19” wide rack	7.75” wide	5.10” Wide	DIN-Rail mounted		
Rack Height:	1.75” (1U)	3.5” (2U)		5.25” (3U)		
Connector/port preference:	ST, SC, LC, ESCON, FC, other					
Fiber:	Duplex	Simplex				
Mode:	Multimode	Single Mode				
Fiber Size: (microns)	62.5/125	50/125	100/140	9/124/900	Other	
Wave length: (nanometers)	850	1300		1310	1310-1610	
Local Manual Control:	Pushbutton	Keylock		No local Control		
Security:	Physical Off-Line Position			Automatic Off-Line Position		
Power Loss:	Pass data through last selected position			Pass data through default position		
Power Loss: (continued)	Data will not pass upon power loss					
Power Up:	Remain in last position			Return to default position		
Remote Control Type:	RS232 Serial	Contact Closure		IP Addressable	GUI	
Channels per chassis:	Single Channel	Multiple Channels				
Channel Control:	Simultaneous	Individual		Simultaneous and Individual		
Power Supply Requirements:	Wide Range	US, non-polarized plug		IEC 30620 C14 inlet	CE, UL	RoHS

The point is that both copper and fiber optic switches can be complex. Let's try to demystify some of the sticking points with further explanations and examples.

2. Flexibility in Switch Controls

Here we are with the control methods. Of course the push-button is simple to understand.

A) Local Control – Local control can be as simple as turning a knob or pushing a button on the front panel of your switch.

i. Push-button - Most switches developed by Electro Standards Laboratories offer front-panel push-button for local control. Any person with access to the switch can easily change the switch position. If that's all you need, push-button control is the way to go.

ii. Keylock - Electro Standards offers several switches with Keylock features. The Pass Key ensures proper authorized usage. The advantage of the keylock is the security of knowing that only the person with the key can change the switch position. The ***Quick-Switch® Model 6286K Fiber Optic A/B Switch***, 1300nm, SC Duplex, Multimode switch with remote control port is an example of a keylock switch. The keylock mechanism is on the front panel. Removing the key ensures that the switch will remain in the exact position that it was in when it was locked. Pocket the key and rest assured that the switch will continue operating exactly as it was intended.

B) Remote Control – Now the switching choices are a little more complicated, but there are definite advantages. The switch can be controlled remotely in a number of fashions.

i. RS232 Serial Control - With RS232 serial control, the REMOTE connector accepts RS232 serial data ASCII commands. The remote port may be connected to any standard RS232 port on a computer. The computer, once connected to the remote port, may use any common terminal emulation software to generate RS232 serial data ASCII commands.

ii. Contact Closure - The REMOTE connector accepts Contact Closure signaling for remote control operation. The ***Model 4875 Remotely Controllable Special Interface KVM A/B Switch*** uses this method of remote control. If the Model 4875 detects a transition from open to close and remains closed across pins 2 and 3, the unit will switch to the B position. If the Model 4875 detects a transition from closed to open and remains open across pins 2 and 3, the unit will switch to the A position.

iii. **IP Addressable** - An IP Addressable feature is ideal for critical network alternate-path switching. The ***QuickSwitch® Model 6283 single channel LC duplex A/B switch*** uses this technology. Remote control and monitoring of the switch position is from a 10/100 Base-T LAN Ethernet environment. Users communicate with the switch via TELNET session. The user setup allows assignment of an IP address for the switch unit.

iv. **Graphical User Interface (GUI)** - The remote GUI interface allows the user to control the switch remotely with simple point and click operation. The ***Model 7810 8-to-1 HD-15 Switch with 10/100 Base-T LAN*** access offers extensive GUI features. To utilize the user-friendly software, connect to the switch from a computer with access to the LAN to which the Model 7810 LAN port is connected. Simply launch a standard Web browser and type in the appropriate IP address. Establish your new password and log in.

The software features include:

- Easy access via standard web browser
- Easy-to-use point and click operation
- Remote access to control or monitor the Model 7810 switch
- The ability to change the login password and/or the switch's IP address
- Lockout front panel manual access
- LAN access gives users across the LAN or over the Internet access to control the switch.

v. **Code-Operated** - The switch position and lockout can be changed through the data stream on the COMMON p ort. The ***Model 4410 remotely controllable RS232 A/B switch*** is an example of a code-operated switch. It monitors its COMMON port and its "A" port for a specified trigger character sequence.

C) Automatic Switching - Electro Standards manufactures a number of switches with Automatic Sensing capability.

i. Auto Sensing - The Model 4145 is an example of a switch with automatic sensing. It can switch itself based on sensing a loss of carrier (DCD), it can be controlled locally via a front-panel push-button, or the switch can be managed off-site with the Remote option. The ***Model 4145 Automatic Fallback A/B Switch with Optional Remote Management Port*** allows a device connected to the COMMON port to connect through to the A port. The unit monitors carrier presence (DCD) signal on the primary line, port A. If carrier is lost, the unit automatically switches to port B. The Model 4145 will maintain its connection to port B until carrier presence is again detected on port A. When carrier is detected on port A, the unit will automatically return to the A position. The user can override the automatic fallback operation from the front panel and force the unit to operate as an A/B switch. To override the automatic operation, the user simply depresses the front panel push-button, holds it for 5 seconds, and then releases. The status LED previously lit steady ON begins to flash, representing manual override operation.

To sum up flexibilty in switch control, today's switches are available with automatic, manual and remote control systems and with any number of combinations.

3. Redundancy in Network Switches

Redundancy in network switches can mean added reliability. In the first example, the Model 4148 uses a redundant system to back itself up. In the second example the Model 7282 uses an extra remote port as an additional means of communicating with the switch and an additional power supply port to ensure power is always available to the unit.

A) Redundant Backup – The ***Model 4148 is a normal/redundant fallback switch*** that self-configures connectivity based on the devices connected to it. The Model 4148 switch allows data broadcast, TD of the RS232 interface, from two data origination devices to be channeled to two devices designated as destination devices. The Model 4148 will self-configure its connectivity based on the devices connected to it, or the user can override its connection status from a front panel pushbutton.

This is how the Model 4148 Normal/Redundant switch works. During the Normal mode, the origin device connected to port D1 is connected to port COM1. The device connected to port D2 is connected to port COM2. If the RTS signal is lost from the device connected to D1, the Model 4148 changes to Redundant Fallback mode and automatically broadcasts the data from D2 device to both destination devices, COM1 and COM2. Likewise, if the RTS signal is lost from the device connected to the D2, the Model 4148 automatically broadcasts the data from the D1 device to both the devices COM1 and COM2. One of the status LED's will be lit steady ON to

reflect the connectivity status and signify that the unit is in Automatic operation. To override the Automatic operation, the user simply depresses the front panel pushbutton and holds it down for 5 seconds and then releases.

B) Redundant Remote Port/Power Supplies – Redundancy can also refer to achieving reliability through using duplicate methods. The ***Model 7282 Dual-Channel RS530 A/B switch with DB25 interface*** incorporates dual serial remote control ports and dual power supply ports to achieve high reliability via redundancy. Remote access can be accomplished by RS232 commands sent via the remote serial ports. Users can remotely monitor status and control switch functions. The dual power supply ports allow each of two separate external power supplies to be connected to the unit for redundancy. Internal circuitry will automatically regulate which supply source powers the unit. If a supply is removed, the supply remaining will power the switch.

The point is that your network is critical to the operation of your enterprise and your data switch cannot be a weak link in the network. Innovative switch designs that incorporate redundancy or other reliability enhancements can be built right into your switch.

4. Data Transmission and Power Loss

Rolling blackouts, wind storms, hurricanes, automobile accidents can all cause power loss. The lights flicker and everyone groans. Will your network hiccup?

A) Pass Data in Event of Power Loss – One solution to avoid a disruption in the data stream during a power loss is using a network switch that utilizes latching relays and maintains the last set position upon a power loss and continues to pass data. An example of a switch that incorporates this technology is the ***Model 7261 RS232*** / ***RS530 A/B/C/D***. This switch can be controlled manually via a front-panel push-button. The DB9 Remote port provides control either by RS232 serial commands or by dry contact open/closure logic. All 25 pins of the DB25 interface are switched enabling the Model 7261 to switch any 25 conductor interface device. The ability to continue to pass data in the event of a power loss is a feature that is in demand today.

B) Switch Position Memory – If you do not want your switch to pass data during a power loss, that can be handled also with Switch Position Memory. In the event of a temporary power failure, the switch will return to the last ordered position when power is restored. Data will not pass through the unit during a power loss.

i. **Model 7387** -The ***Model 7387 is an interesting A/B switch with Fallback and Remote Port***. The switch can sense RD activity or DCD presence on the ports and switch accordingly. This switch can be controlled manually via push-button or remotely via contact closure. All switched signals are passed via latching copper contact relays that maintain their position and continuity in the event of a power loss. When power is restored, the Model 7387 loads the previous position and mode of operation and checks DIP switch settings and the remote port to determine the correct startup configuration.

ii. **Model 7263** - The ***Model 7263 Fiber Optic ST duplex A/B/Cut-off switch/converter*** also has switch position memory. The switch position, password, and configuration data is written to memory. In the event of a power loss, all information is retained. The switch retains the last switch position in the event of a power loss and continues to pass data.

iii. **Model 7274** - The ***Model 7274 single channel RS530 A/B switch, DB25 interface with contact remote control port*** retains the last switch position and continues to pass data upon power loss. When power is restored, the switch position will be determined by the state of contact command on the Remote port.

The conclusion is that you can have it your way. If you want the data to continue streaming during a power loss, the switch can be designed to do just that. The switch can stop passing data during a power outage if that works for you. The switch can handle power loss and restarts in any way that works best for your network application.

5. Switch Monitoring

A) Front Panel Indicators – Monitoring your switch can be as simple as looking at the front panel. Front panel LED's are frequently used to display the current position of the connected devices and the power status. Or the rotary knob is simply pointed to A, B, C or D.

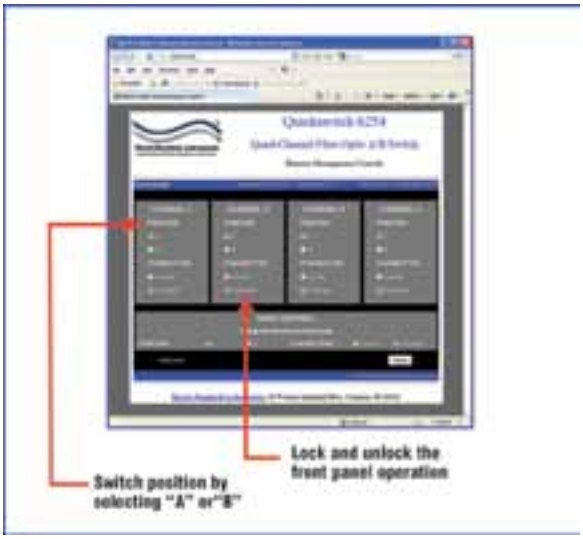
B) Other Methods:.

i. RS232 Remote Port -The ***Model 4185 Fiber Optic SC Duplex, Multimode Switch/Converter includes an RS232 serial security enhanced Supervisory Remote Port***. Upon proper authentication, a terminal or computer in terminal mode connected to this port can communicate with the unit, determine its status, change the switch position as desired, and/or lockout the front panel switching capability. A modem can also be connected to this port for remote access to the switch.

ii. Graphical User Interface (GUI) - GUI software is also available to control and monitor your data switch. Utilizing user-friendly remote GUI software enables users across the LAN or over the Internet access to control and monitor the switch with simple point-and-click operation.

iii. Telnet and GUI - The ***Model 6254 Quad Channel LC Duplex A/B Switch features Telnet and a GUI***. With this software program, the user can easily check to see if the front panel push-button capability is locked or unlocked and to see which channel is active. The user can change the lock status of the front panel push-button by clicking the virtual control labeled "Front Panel."

Changing Switch Position and Lock Status



Using Gang Control

iv. **Voltage Signaling** - Voltage signaling is another method of remote monitoring. The ***Model 4196 Fiber Optic SC Duplex A/B/C/D/Offline Switch with remote port*** offers a fully decoupled off-line capability. The switch position can be changed either by depressing the desired front panel A, B, C, D, or Off-line push-buttons, or by a device connected to the Remote port located on the rear panel. Applying the appropriate voltage to the designated pins of the Remote connector will cause the switch to change position. The Remote control port allows off-site monitoring and switch management via 24 VDC signaling.

v. **Supervisory Remote Port and Telnet** - The ***Model 6283 Single Channel LC Duplex A/B Switch with Telnet Remote port*** provides control through Telnet commands and allows the user to control the switch position, lock-out the front panel operations and obtain the switch position remotely.

To sum up the discussion on switch monitoring, the switch front panel LED's, the remote serial port, your computer, your Internet connection, a user-friendly GUI, or a voltage signaling method can provide switch status information.

6. Summary

Of course switches today have much more capability than the A/B switch that sat on my desk so many years ago. Network switches can be designed to fit anywhere: desktop, computer room rack, process control system, nuclear power plant and other rough environments, ships and other mobile/motion applications and even built into a wall. Switches can be built as boards to be incorporated into other products. Switches can be built with the ruggedness necessary to function in areas subject to noise, vibrations and extreme temperatures.

Copper and fiber optic switches can handle any number of channels and positions. Electro Standards offers the ***Model 9741 1000Base-T, CAT5e, High Density 40 Channel A/B Switching System*** that takes up only 8.75 inches panel height. That's a lot of switching capacity in a compact rack enclosure.

Switches can handle data at high speeds. A number of fiber optic switches designed by Electro Standards support Gigabit data rates. Fiber switch technology includes MEMS based mirror technology. Electro Standards designs copper network switches for CAT5, CAT5e, CAT6 and CAT6a data rates.

Security issues are addressed with passwords, passwords with limited privileges, secure offline positions, key-locks, and the ability to lockout the front panel controls remotely. Switches are smart and can switch channels either independently or simultaneously. They can switch via RS232 serial data ASCII commands sent by the user, via Contact Closure signaling, via a trigger character sequence, or via a Graphical User Interface point & click. They can switch automatically by sensing a loss of data.

Network switch designs are always adapting to the needs of the IT Managers worldwide. Electro Standards Laboratories stays on the cutting edge of this technology by working with its customers to provide them with the copper or fiber optic switch to meet their exact requirements.