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Troubleshooting NIC Compatibility Issues On ISUnet

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Background Information

Purpose

The purpose of this document is to cover common issues associated with Network Interface Cards (NICs) interoperating with ethernet switches. With permission, most of this document was summarized and customized for ISUnet from online documentation at Cisco's public website. Network issues, such as slow performance and connectivity problems, as well as switch issues dealing with physical connectivity and data link errors, may be related to NIC issues. This document will discuss how to troubleshoot the following:

- Auto-Negotiation
- Physical Connectivity
- Port Errors (Data Link Errors)
- Continuous Link Up/Down Situations
- Gigabit Port Configuration
- Common NIC Issues and Resolutions

Why Do Auto-Negotiation and Compatibility Issues Exist?

Auto-negotiation issues may result from non-conforming implementation, hardware incapabilities, or software defects. When NICs or vendor switches do not conform exactly to the IEEE specification 802.3u, problems may result. Hardware incompatibility and other issues may also exist as a result of vendor-specific advanced features, such as auto-polarity or cabling integrity, that are not described in IEEE 802.3u specification for 10/100 Mbps auto-negotiation. Generally, if both the NIC and the switch adhere to the IEEE 802.3u auto-negotiation specifications and all additional features are disabled, auto-negotiation should properly negotiate speed and duplex and no operational issues should exist.

General Troubleshooting for 10/100 Mbps NICs

Auto-Negotiation Valid Configuration Table

Speed determination issues may result in no connectivity. However, issues with auto-negotiation of duplex will generally not result in link establishment issues. Instead, auto-negotiation issues mainly result in performance-related issues. The most common problems when investigating NIC issues deal with speed and duplex configuration. The table below summarizes all possible settings of speed and duplex for FastEthernet NICs and Switch Ports.

Note: This section is only applicable for 10/100 Mbps NICs, and not 1000BaseX NICs.

Table 1 - Auto-Negotiation Valid Configuration Table

Configuration NIC (Speed/Duplex)	Configuration Switch (Speed/Duplex)	Resulting NIC Speed/Duplex	Resulting Switch Speed/Duplex	Comments
AUTO	AUTO	100 Mbps, Full-duplex	100 Mbps, Full-duplex	Assuming maximum capability of switch and NIC is 100 full-duplex.
100 Mbps, Full-duplex	AUTO	100 Mbps, Full-duplex	100 Mbps, Half-duplex	Duplex Mismatch [1]
AUTO	100 Mbps, Full-duplex	100 Mbps , Half-duplex	100 Mbps, Full-duplex	Duplex Mismatch [1]
100 Mbps, Full-duplex	100 Mbps, Full-duplex	100 Mbps, Full-duplex	100 Mbps, Full-duplex	Correct Manual Configuration.
100 Mbps, Half-duplex	AUTO	100 Mbps, Half-duplex	100 Mbps, Half-duplex	Link is established, but switch does not see any auto-negotiation information from NIC and defaults to half-duplex.
10 Mbps, Half-duplex	AUTO	10 Mbps, Half-duplex	10 Mbps, Half-duplex	Link is established, but switch will not see FLP and will default to 10 Mbps half-duplex.
10 Mbps, Half-duplex	100 Mbps, Half-duplex	No Link	No Link	Neither side will establish link due to

				speed mismatch.
AUTO	10 Mbps, Half-duplex	10 Mbps, Half-duplex	10 Mbps, Half-duplex	Link is established, but NIC will not see FLP and default to 10 Mbps half-duplex.

[1] A duplex mismatch will result in performance issues, intermittent connectivity, and possible loss of communication. When troubleshooting NIC issues, verify that the NIC and switch are using a valid configuration.

Why Can't the Speed and Duplex Be Hard-Coded On Only One Link Partner?

As indicated in the Auto-Negotiation Valid Configuration Table, manually setting the speed and duplex for full-duplex on one link partner will result in a duplex mismatch. This is the result of disabling auto-negotiation on one link partner and the other link partner defaulting to a half-duplex configuration. A duplex mismatch will result in slow performance, intermittent connectivity, data link errors, and other issues. If the intent is not to use auto-negotiation, both link partners must be configured for speed and duplex manually for full-duplex settings.

Recommended Port Configuration (Auto-Negotiation or Manual Configuration)

There are many opinions on the subject of auto-negotiation. Previously, many engineers were advising customers not to use auto-negotiation with any switch connected device. However, improvements in the interoperation of auto-negotiation and the maturity of the technology has recently changed the view of using auto-negotiation. In addition, performance issues due to duplex mismatches as a result of manually setting speed and duplex only on one link partner, have become more common. Due to these recent issues, using auto-negotiation is regarded as a valid practice.

Conflicts with Power Management

The common resolutions for these issues are listed below:

1. **Disable Windows 2000 and Windows Millenium Edition (ME) Power Management Functions**

Windows 2000 and Windows ME employ a power management capability that can disable the NIC. When the NIC is disabled for power management, the NIC will drop link to the switch. If there is a concern of link going up/down on NICs using operating systems Windows 2000 or Windows ME, disable the power management feature as a first means of troubleshooting link up/down situations.

2. **Disable NIC Power Management Functionality**

   Many NICs support their own power management capability. When troubleshooting link up/down issues, disable this feature as another means of troubleshooting. Please reference the NIC documentation for information on disabling power management.

Understanding Data Link Errors

Many performance issues with NICs can be related to data link errors. Excessive errors usually indicate a problem. When operating at half-duplex setting, some data link errors such as Frame Check Sequence (FCS), alignment, runts, and collisions are normal. Generally, a one percent ratio of errors to total traffic is acceptable for half-duplex connections. If the ratio of errors to input packets is greater than two or three percent, performance degradation may be noticed.

In half-duplex environments, it is possible for both the switch and the connected device to sense the wire and transmit at exactly the same time and result in a collision. Collisions can cause runts, FCS, and alignment errors due to the frame not being completely copied to the wire which results in fragmented frames.

When operating at full-duplex, FCS, Cyclic Redundancy Checks (CRC), alignment errors, and runt counters should be minimal. If the link is operating at full-duplex, the collision counter is not active. If the FCS, CRC, alignment, or runt counters are incrementing, check for a duplex mismatch. Duplex mismatch is a situation where the switch is operating at full-duplex and the connected device is operating at half-duplex, or vice versa. The result of a duplex mismatch will be extremely slow performance, intermittent connectivity, and loss of connection. Other possible causes of data link errors at full-duplex are bad cables, faulty switch port, or NIC software/hardware issues.

Explanation of Port Errors

Counter	Description

Alignment Errors	Alignment errors are a count of the number of frames received that don't end with an even number of octets and have a bad CRC.
FCS (Frame Check Sequence)	FCS error count is the number of frames that were transmitted/received with a bad checksum (CRC value) in the Ethernet frame. These frames are dropped and not propagated onto other ports.
Xmit-Err	This is an indication that the internal transmit buffer is full.
Rcv-Err	This is an indication that the receive buffer is full.
UnderSize	These are frames which are smaller than 64 bytes (including FCS) and have a good FCS value.
Single Collisions	Single collisions are the number of times the transmitting port had one collision before successfully transmitting the frame to the media.
Multiple Collisions	Multiple collisions are the number of times the transmitting port had more than one collision before successfully transmitting the frame to the media.
Late Collisions	A late collision occurs when two devices transmit at the same time and neither side of the connection detects a collision. The reason for this occurrence is because the time to propagate the signal from one end of the network to another is longer than the time to put the entire packet on the network. The two devices that cause the late collision never see that the other is sending until after it puts the entire packet on the network. Late collisions are detected by the transmitter after the first "slot time" of 64 byte times. They are only detected during transmissions of packets longer than 64 bytes. Its detection is exactly the same as for a normal collision; it just happens late when compared to a normal collision.
Excessive	Excessive collision are the number of

Collisions	frames that are dropped after 16 attempts to send the packet resulting in 16 collisions.
Carrier Sense	Carrier sense occurs every time an Ethernet controller wants to send data and the counter is incremented when there is an error in the process.
Runts	These are frames smaller than 64 bytes with a bad FCS value.
Giants	These are frames that are greater than 1518 bytes and have a bad FCS value.

Possible Causes for Incrementing Port Errors

Counter	Possible Cause
Alignment Errors	These are the result of collisions at half-duplex, duplex mismatch, bad hardware (NIC, cable or port), or connected device generating frames that do not end with on an octet and have a bad FCS.
FCS (Frame Check Sequence)	These are the result of collisions at half-duplex, duplex mismatch, bad hardware (NIC, cable, or port), or connected device generating frames with bad FCS.
Xmit-Err	This is an indication of excessive input rates of traffic. This is also an indication of transmit buffer being full. The counter should only increment in situations where the switch is unable to forwarded out the port at a desired rate. Situations such as excessive collisions and 10 megabit ports will cause the transmit buffer to become full. Increasing speed and moving link partner to full-duplex should minimalize this occurance.
Rcv-Err	This is an indication of excessive output rates of traffic. This is also an indication of the receive buffer being full. This counter should be zero unless there is excessive traffic through the switch. In some switches, the outlost counter has a direct correlation to the Rcv-Err.
UnderSize	This is an indication of a bad frame

	generated by the connected device.
Single Collisions	This is an indication of a half-duplex configuration.
Multiple Collisions	This is an indication of a half-duplex configuration.
Late Collisions	This is an indicationof faulty hardware (NIC, cable, or switch port) or duplex mismatch.
Excessive Collisions	This is an indication of over-utilization of switch port at half-duplex or duplex mismatch.
Carrier Sense	This is an indication of faulty hardware (NIC, cable, or switch port).
Runts	This is an indication of the result of collisions, duplex mismatch, dot1q, or ISL configuration issue.
Giants	This is an indication of faulty hardware, dot1q, or ISL configuration issue.

Additional Troubleshooting for 1000BaseX NICs

Gigabit Auto-Negotiation (No Link to Connected Device)

Gigabit Ethernet has an auto-negotiation procedure that is more extensive than what is used for 10/100 Mbps Ethernet (Gigabit Auto-negotiation spec: IEEE Std 802.3z-1998). The Gigabit Auto-negotiation negotiates flow control, duplex mode, and remote fault information. You must either enable or disable link negotiation on both ends of the link. Both ends of the link must be set to the same value or the link will not connect.

If either device does not support Gigabit auto-negotiation, disabling Gigabit auto-negotiation will force the link up. Disabling auto-negotiation "hides" link drops and other physical layer problems. Only disable auto-negotiation to end-devices such as older Gigabit NICs that do not support Gigabit auto-negotiation. Do not disable auto-negotiation between switches unless absolutely required as physical layer problems may go undetected and result in spanning-tree loops. The alternative to disabling auto-negotiation is contacting the vendor for software/hardware upgrade for IEEE 802.3z Gigabit auto-negotiation support.

Table 2- Gigabit Auto-Negotiation Configuration Table

Switch Port Gigabit	Auto-Negotiation Setting	NIC Gigabit Auto-Negotiation Setting	Switch Link/NIC Link
Enabled	Enabled	Up	Up
Disabled	Disabled	Up	Up
Enabled	Disabled	Down	Up
Disabled	Enabled	Up	Down

NIC Compatibility and Operational Issues

Disclaimer: Use this table as guide to troubleshooting NIC issues. Please consult the NIC vendor for verification and proper resolution of issue.

NIC Model/Manufacture	Symptom	Description	Resolution
Apple MAC G3	Intermittently loses network services when using the built-in Ethernet interface.	Drivers version prior to 2.04 may experience this issue. Contact vendor tech support for more information.	Upgrade to driver version 2.04 or higher.
Apple iMAC, Power MAC G3, and Powerbook G3	Unable to set speed and duplex of built-in Ethernet interface manually.	Apple Speed/Duplex tool is required to manually set Speed/Duplex of Ethernet Interface.	Download Apple Speed/Duplex tool from Apple support web site.
Apple MAC OS with Open Transport 2.5.1 and 2.5.2	Unable to obtain DHCP address from DHCP Server.	Upon bootup, MAC may fail to obtain IP address from DHCP Server.	See Apple tech info library article 25049.
Apple MAC Built-In Ethernet	Unable to determine hardware MAC address.	In order to troubleshoot network connectivity issues, host MAC address may be	Contact vendor tech support.

		required.	
Apple MAC Performance Issues vs. NuBus	Built-in Ethernet interfaces out perform NuBus Ethernet cards.	Concern of maximum data transfer rate possible with the built-in Ethernet port in comparison to NuBus Ethernet cards.	See Apple tech info library Article 12000.
Apple Powerbook G3/G4 with Internal NIC	Slow Performance when performaning large file transfers.	Somes NICs may operate out-of-spec, as published in IEEE 802.3. Some Catalysts are more tolerant of out-of-spec NICs and will not notice any performance degradation.	Use of external or PCMCIA NIC. Contact Apple tech support.
Various Apple G3/G4 Laptops and Workstations with Internal NICs	Slow performance.	Notable slow performance.	Upgrade to latest NIC driver and load DUPLEXER utility. Verify auto-negotiation settings.
AsantéFAST 10/100 PCI	Slow login or fails to log in to server.	N/A	See tech document no: TID1084 at Asanté support web site.
AsantéFAST 10/100 PCI	Numerous CRC and FCS errors reported on switch when connected to Power Macintosh 9500.	N/A	See tech document no: TID1109 at Asanté support web site.
AsantéFAST 10/100 PCI	Slow network through-put after Macintosh OS 8.5 or 8.6 upgrade.	N/A	See tech document no: TID1976 at Asanté support web site.

Asanté GigaNIC 1064SX PCI Card-Mac	Network performance fluctuates.	When the energy saver mode is active under OS 8.6, the network speed comes to a slow crawl as soon as the monitor goes dim.	Turn off the energy saver mode in the control panel. The network speed will remain constant. See tech document no:TID2095 at Asanté support web site.
Asanté GigaNIC 1064SX PCI Card-Mac	Slow performance with AppleShare IP servers and PCI Ethernet cards.	Customers report AppleShare IP servers slow down and eventually crash over time. This occurs using both built-in Ethernet and various PCI cards.	See tech document no: TID2227 at Asanté support web site.
3COM 3C574/575 PCMCIA 10/100	Extremely slow performance when operating at 10 MB.	The 3C574/3C575 experiences slow performance when connecting at 10 MB with Catalyst 2948G, 2980G, 4000, 5000, and 6000s switches. This issue is due to the NIC doing auto-polarity upon linkup.	Upgrade to latest NIC card driver and disable auto-polarity.
3COM 3C595	FCS and/or alignment errors recorded on switch. Noted slower performance. when using the 3C595 adapter in 100 MB half-duplex. This problem only usually represents 1% - 2% of the total	FCS and/or alignment errors when using the 3C595 adapter in 100 MB half-duplex. This problem usually represents 1% - 2% of the total traffic.	Upgrade to the latest NIC driver and disable Bus Master. These steps will reduce FCS and alignment errors.

	traffic.		
3COM 3C905/3C905B	Intermittent DHCP Issues.	Despite configuring Catalyst switch ports correctly, workstations still experience some intermittent DHCP issues.	Upgrade to driver version 4.01b or higher which resolves DHCP issues.
3COM 3C905/3C905B	Unable to login into Novell IPX Network.	Despite configuring Catalyst switch ports correctly, workstations still experience intermittent Novell IPX login issues.	Upgrade to driver 4.01b or higher, which resolves IPX auto-frame type issues. Alternatively, manually configure workstations for IPX frame type.
3COM 3C905B	Slow performance when receiving large files.	Notable slow performance when receiving large files. Problem only occurs with standard Microsoft NT 4.0, regardless of service pack.	Download latest driver from 3COM tech support.
3COM 3C905C	L2 errors reported on switch port (FCS, alignment, CRC, and runts), and slow performance on high speed workstations.	Under normal operating conditions, a Catalyst wwitch will report numerous L2 (physical) errors on ports connected to 3C905C NIC adapters.	Load latest driver and diagnostic tools available from 3COM. Test performance back-to-back between two PCs, and note errors on diagnostic tools. Errors reported such as transmit underrun and receive overun will result in physical layers being reported by switch and minor performance issues. See Bug ID CSCdt68700 for more details.
3COM 3C980	Data corruption using Novell	N/A	See 3COM tech support reference 1.0.33921641.2241835.
3COM	3C985/3C985B	Novell 5.0 Issues	See 3COM tech support reference 1.0.16744826.2027011.

3COM 3C985/3C985B	Clients unable to login or browse server, but pings work correctly.	N/A	See 3COM tech support reference 2.0.4428387.2305072.
3COM 3C985/3C985B	Packets larger than Ethernet MTU (1518 bytes) are generated. These packets are noted as giants on Catalyst switches.	N/A	Contact 3COM tech support.
3COM 3C905C or 3C920 intergrated NIC on Dell Dimension XPS	Network connectivity is dropped every two to three minutes and/or network card must be reinitialized several times to gain network connectivity.	A 3C905C or 3C920 intergrated NIC on Dell Dimension XPS may experience network connectivity issues when running Windows 2000 due to a power management issue.	Disable all power management functions. Contact Dell for details on disabling power management or more details surronding this issue. For more documentation, see 3COM tech support reference: 2.0.47464140.2853794
Compaq Netflex-3 Model NIC Adapters	Slow performance	Auto-negotiation may fail to Cisco Catalyst 5000/5500 Switches.	This problem is resolved in software release 4.5(1) and later for the Catalyst 5000/5500 Switches. (CSCdk87853)
IBM 10/100 EtherJet CardBus Adapter	Extremely slow performance when operating at 10 Mbps.	Certain 10/100 switches implement automatic correction for polarity reversed cables that are not completely compatible with the same correction provided by the IBM 10/100 EtherJet CardBus Adapter. If the network speed	To resolve this problem, a new Auto Polarity keyword in the adapter's advanced properties has been added. If needed, the default setting of ON (meaning that the card will compensate for reversed cables) can be set to OFF to disable polarity correction. This will restore normal throughput.

		is forced to 10Mbps, severe throughput problems may be experienced.	
IBM ThinClient Workstations	Link flaps continuously after extended operation.	Workstations prior to Service Pack 3.0 will bounce link on switch after continuous use when attached to Catalyst 2948G/4000 switches on software version 6.x and later.	Upgrade IBM ThinClient to Service Pack 3.0.
Intel Pro/100	Consistent Link Up/Down Connections to Catalyst Switches	May be caused by Power Management. Contact Intel tech support for further information.	Go to Control pannel / System /Hardware /Device Manager. Click the Network Adapters / Intel Pro 100 +. At the Power Managment tab , Unmark the "Allow the computer to turn off this device" tab.
Intel Pro/1000 T Gigabit Copper NIC	When an Intel Pro/1000 T NIC is connected to a Catalyst switch, the customer may see poor network connections or excessive numbers of dropped packets. The interoperability issue arises when a module with a TBI interface transmits an odd byte packet to a receiver with a	The interoperability issue arises from the implementation of Carrier Extension. Carrier Extension is detailed in sub section 35.2.3.5 in the IEEE 802.3 specification. Carrier Extension can be used to pad the last byte of a packet, so the packet is aligned on an even numbered boundary.	Contact Intel Tech Support for the latest driver.

	Gigabit Media Independent Interface (GMII).		
SUN Microsystems QFE Card	Unable to manually set speed and duplex correctly.	Manually setting speed and duplex only effects the first of four ports only.	Contact vendor tech support to obtain latest driver to resolve issue.
SUN Microsystems v1.1 Gigabit Cards	Unable to establish link.	V1.1 may not establish link to switch.	Contact vendor tech support or V2.0 Gigabit Card.
XIRCOM CreditCard Ethernet 10/100 CE3B-100	Not negotiating or operating correctly at 100 Mbps full-duplex.	Full-duplex operation is only supported at 10 Mbps. Full-duplex is not supported at 100 Mbps. The LineMode keyword has no effect on performance at 100 Mbps. If the LineSpeed keyword is set to 10 0Mpbs and the LineMode keyword is set to full-duplex, the LineMode keyword will be ignored. Full-duplex at 10Mbps is only available when the adapter is connected to a full-duplex capable switch or hub.	Do not operate this NIC card at 100 Mbps full-duplex.
XIRCOM CreditCard Ethernet 10/100 CE3B-100	Not negotiating 10 Mbps full-duplex.	The CE3 and in some cases the CE3B are not capable of negotiating to 10 Mbps full-duplex mode.	On these adapters, in order to operate in full-duplex mode, the LineSpeed keyword must be set to 10 Mbps and the LineMode keyword must be set to full-duplex. The cable type keyword can be set to Auto Detect or 10BT/100BTX. The

			corresponding port on the attached hub or switch should also be set to 10Mbps full-duplex.
XIRCOM RealPort2 CardBus Ethernet 10/100 Adapter (R2BE/RBE/CBE) Models	Extremely slow performance when operating at 10 Mbps.	Certain 10/100 switches implement automatic correction for polarity reversed cables that are not completely compatible with the same correction provided by the CBE/RBE. If the network speed is forced to 10 Mbps, severe throughput problems may be experienced.	To resolve this problem, a new Auto Polarity keyword in the adapter's advanced properties has been added in driver version 3.01.If needed, the default setting of ON (meaning that the card will compensate for reversed cables) can be set to OFF to disable polarity correction. This will restore normal throughput.
XIRCOM RealPort2 CardBus Ethernet 10/100 Adapter (R2BE/RBE/CBE) Models	Initial Network Connections may fail. DHCP may obtain IP address and Windows NT login and Novell IPX may fail.	Initialization delay. Certain switches and routers are unable to immediately forward network traffic when a network adapter first establishes link to one of its ports due to initialization delays. This problem is most commonly seen when the network adapter is connected directly to ports on the switch. The adapter by default (when used under	A new keyword, Initialization Delay, has been added to the adapter's advanced properties which will prevent forwarding of network requests for a user-selectable period of time. Delays can be added ranging from one to sixty seconds. In most cases adding a delay in the one to three second range will be sufficient to resolve the problem.

		some operating systems) will have almost no delay between link and the initial network request.	
XIRCOM RealPort2 CardBus Ethernet 10/100 Adapter (R2BE/RBE/CBE) Models	Not able to connect to network or get an IP address from DHCP Server when connected to port replicator or docking station.	Contact vendor tech support.	If you are attempting to use a CBE/CBE2/RBE in a port replicator or docking station, using Windows 95 and are having problems, and then confirm that your laptop has the latest BIOS and that the latest manufacturer's patches and utility software have been installed.
Xircom XE2000 PCMCIA NIC	Will not auto-negotiation to 100 Mbps, full-duplex.	NIC will only auto-negotiate to 100 Mbps, half-duplex.	Known limitation of XE2000 NIC, see XE2000 release notes.

Understanding How Auto-Negotiation Works

Auto-negotiation uses a modified version of the link integrity test that is used for 10BaseT devices to negotiate speed and exchange other auto-negotiation parameters. The original 10BaseT link integrity test is referred to as Normal Link Pulse (NLP). The modified version of the link integrity test for 10/100 Mbps auto-negotiation is referred to as Fast Link Pulse (FLP). 10BaseT devices expect a burst pulse every 16 (+/- 8) msec as part of link integrity test. FLP for 10/100 Mbps auto-negotiation will send these bursts every 16 (+/- 8) msec with the additional pulses every 62.5 (+/- 7) microseconds. The pulses within the burst sequence generate code words that are used for compatibility exchanges between link partners. This process of FLP used in auto-negotiation maintains backward compatibility with existing 10BaseT connections with the pulse burst every 16 (+/- 8) msec to comply with the link integrity test for normal 10BaseT hardware. If a device is sending FLP and only receives NLP, the hardware will immediately cease transmission of the FLP and enable the standard 10BaseT hardware to continue 10BaseT operation.

The following table describes the possible programmable options of the control register for a FastEthernet Interface. These options determine how the FastEthernet Interface will function when connected to a link partner. The 0 in the bits column refers to the programmable register address and the decimal number following the 0 refers to the bit placement within the 16-bit register.

Table 3 - PHY Control Register Programmable Options

Bits	Name	Description
0.15	Reset	1 = PHY Reset 0 = Normal Mode
0.14	Loopback	1 = loopback mode switched on 0 = loopback mode switched off
0.13	Rate Selection (LSB)	0.6 0.13 1 1 Reserved 1 0 1000 Mbps 0 1 100 Mbps 0 0 10 Mbps
0.12	Auto-negotiation Enable	1 = auto-negotiaton enabled 0 = auto-negotiation disabled
0.11	Power Down	1 = power down 0 = normal down
0.10	Isolated	1 = PHY electrically isolated from MII 0 = normal mode
0.9	Restart Auto-negotiation	1 = restart the auto-negotiation process 0 = normal mode
0.8	Duplex Mode	1 = Full-duplex 0 = Half-duplex
0.7	Collision Test	1 = COL signal test active 0 = COL signal test switched off

0.6	Rate Selection (MSB)	See bit 0.13

The register bits relevant to this document include 0.13, 0.12, 0.8, and 0.6. The other register bits are documented in the 802.3u specification. According to this IEEE 802.3u specification in order to manually set the rate (speed), the value of the auto-negotiation bit, 0.12, must be set to a value of 0. As a result, auto-negotiation must be disabled in order to manually set the speed and duplex. If the auto-negotiation bit, 0.12, is set to a a value of 1, bits 0.13 and 0.8 have no significance and link will use auto-negotiation to determine the speed and duplex. When auto-negotiation is disabled, the default value for duplex is half-duplex, unless the 0.8 is programmed to 1 representing full-duplex.

Per the IEEE 802.3u specification, it not possible to manually configure one link partner for 100 Mbps full-duplex and still auto-negotiate to full-duplex with the other link partner. Attempting to configure one link partner for 100 Mbps full-duplex and the other link partner for auto-negotiation will result in a duplex mismatch. This is a result of one link partner auto-negotiating and not seeing any auto-negotiation parameters from the other link partner and defaulting to half-duplex.

As described previously, pulses within the FLP are used to derive code words that exchange link partner capabilities. The first code word exchanged is referred to as the base page. It informs each link partner of the message type, IEEE 802.3 or IEEE 802.9a, and a technology ability field. This technology ability field is encoded to exchange the maximum operational speed and duplex of each link partner.