82551QM/ER/IT Fast Ethernet PCI Controller MDI-X Functional Overview

Application Note (AP-472)

Revision 1.1
September 2006

Information in this document is provided in connection with Intel products. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Intel's Terms and Conditions of Sale for such products, Intel assumes no liability whatsoever, and Intel disclaims any express or implied warranty, relating to sale and/or use of Intel products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright or other intellectual property right. Intel products are not intended for use in medical, life saving, or life sustaining applications.

Intel may make changes to specifications and product descriptions at any time, without notice.

Designers must not rely on the absence or characteristics of any features or instructions marked “reserved” or “undefined.” Intel reserves thee for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

The 82551QM/ER/IT Fast Ethernet PCI Controller may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Copies of documents which have an ordering number and are referenced in this document, or other Intel literature may be obtained by calling 1-800-548-4725 or by visiting Intel's Web site at http://www.intel.com.

Intel is a trademark or registered trademark of Intel Corporation or its subsidiaries in the United States and other countries.

Copyright © 2006, Intel Corporation. All rights reserved.

* Other product and corporate names may be trademarks of other companies and are used only for explanation and to the owners’ benefit without intent to infringe.

Contents

1.0 Introduction and Scope 1
2.0 Connection Types 2
3.0 MDI/MDI-X Auto-Switching Activation 3
4.0 Design Considerations 4

Figure

1 Typical RJ-45 Cable Connection Types 2

Tables

1 RJ-45 Connections 1
2 Compatibility Word (03h) 3
3 MDI/MDI-X Control Register Bit Definitions (Register 28, 1Ch) 3

Revision History

Revision	Revision Date	Description
1.1	Sept 2006	Added a note to section 1.0 “Introduction and Scope” that relates to auto-switching. Added a block of 10/100 code to section 4.0 “Design Considerations” that explains how to turn on/off auto MDI-X.
1.0	August 2004	Initial release

1.0 Introduction and Scope

This application note describes the 82551QM/ER/IT Fast Ethernet PCI Controller's Management Data Interface MDI\MDI-X feature.

The MDI/MDI-X feature provides the ability to automatically detect the required cable connection type and configure the controller-side MAU to the cable type. This feature effectively allows all properly wired Ethernet cables, usable with any Ethernet device, to be connected to the 82551QM/ER/IT without any additional external logic.

This advanced feature enables auto-correction of incorrect cabling with respect to cross-over versus straight-through cables. The 82551QM/ER/IT can identify the cable connection type and adjust its MDI port to the cable by switching between the TD and RD pairs.

Note: The auto-switching function is not supported when forcing speed and duplex modes. While in forced link mode, auto MDI-X cannot properly resolve auto-switching. Refer to Section 4.0 for the code that can be used to turn on/off auto MDI-X.

In a standard straight-through RJ-45 port configuration, the transmit pair is on contacts 1 and 2, and the receive pair on contacts 3 and 6. These are defined by Clause 23.7.1 of the IEEE 802.3u standard.

Table 1 lists the connections for both straight-through and cross-over RJ-45 ports for comparison.

Table 1. RJ-45 Connections

RJ-45 Contact	Straight-Through MDI Signal[a]	Cross-Over MDIX Signal[b]
1	TD+	RD+
2	TD-	RD-
3	RD+	TD+
4	Not Used	Not Used
5	Not Used	Not Used
6	RD-	TD-
7	Not Used	Not Used
8	Not Used	Not Used

a. Straight-through connections used on DTE applications.
b. Cross-over connections used on Hub and Switch applications.

2.0 Connection Types

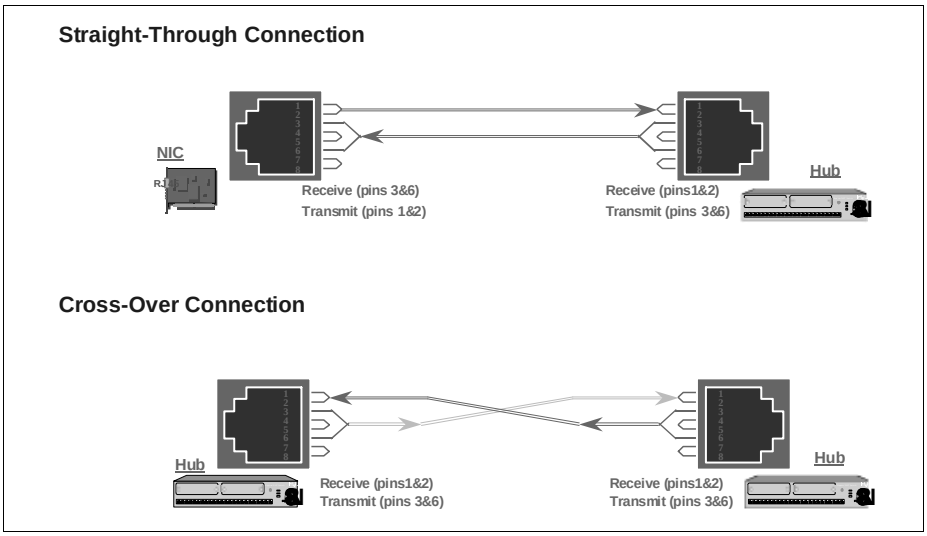
There are typically two cable types used to connect Ethernet devices together: straight-through and cross-over cables (see Figure 1). The networking equipment used determines the required cable type. In a networking environment, the need to manage two different types of cable connections consumes maintenance time and money. Implementing networking systems with manual or automatic correction of cross-over/straight-through cables usually adds to the system cost, as it requires dedicated hardware. The 82551QM/ER/IT Fast Ethernet PCI Controller offers a software-controlled solution for this problem. As a result, a lower system solution cost and simplified maintenance can be achieved.

In a typical Data Terminal Equipment (DTE)-to-repeater/switch connection, the cross-over is implemented in the repeater/switch Medium Attachment Unit (MAU). In this case a straight-through cable is required.

However, in connections between two MAUs of the same type (i.e. hub-to-switch, or switch-to-switch uplink connections), an external cross-over cable is required. If the cable type does not match the MAU configuration on both ends, the cable must be replaced. If the cable that must be replaced is located in a wiring closet then typically the installation or replacement of a “patch panel” is required.

In a typical medium-sized business there are perhaps 100’s of Ethernet ports that connect to a central switch or hub. If the hub or switch had the ability to sense and switch the wire pairs internally on a port basis, overall savings would be realized both in maintenance time and money.

Figure 1. Typical RJ-45 Cable Connection Types



3.0 MDI/MDI-X Auto-Switching Activation

The 82551QM/ER/IT provides an EEPROM bit for software to enable or disable the MDI-X auto-switching feature on a per port basis. This setting (Compatibility Word 03h, bit 7) is accessed via the MII Management Interface (refer to Table 2).

Table 2. Compatibility Word (03h)

Bit	Name	Description	Type[a]
7	Auto Switch Enable	Enables the MDI/MDI-X auto-switching feature. 1 = Enabled. 0 = Disabled (default).	R/W

a. R/W = Read/Write

When auto-switching is enabled, the PHY attempts to detect link activity in a given configuration (MDI or MDI-X) for duration of 80 - 105ms. If no link activity is detected during this slot time, the PHY waits a random amount of time (greater than 80ms) and then switches the MDI pairs to the other configuration (refer to Table 3).

Table 3. MDI/MDI-X Control Register Bit Definitions (Register 28, 1Ch)

Bit(s)	Name	Definition	Type[a]
15:8	Reserved	Reserved for future use. Set these bits to 0.	R/W
7	Auto Switch Enable	Enables the MDI/MDI-X feature (writing to this bit overwrites the default value). 1 = Enabled. 0 = Disabled (default).	R/W
6	Switch	Manual switch (valid only if bit 7 is set to 0). 1 = Forces the port to be MDI-X (cross-over). 0 = Forces the port to be MDI (straight-through); (default).	R/W
5	Status	Indicates the state of the MDI pair. 1 = MDI-X (cross-over). 0 = MDI (straight-through); (default).	RO
4	Auto Switch Complete	Indicates when the correct configuration is achieved. 1 = Resolution algorithm has completed (default). 0 = Resolution algorithm has not completed.	RO
3:0	Resolution Timer	Defines the minimum slot time the algorithm uses in order to switch between one configuration or another. 0000 = 80ms (default). 1111 = 105ms.	R/W

a. R/W = Read/Write
RO = Read Only

4.0 Design Considerations

To fully implement the MDI-X feature, the following hardware layout changes need to be considered:

- The transmit and receive termination resistors should have the same value. 110 ohms is recommended.
- Do not place a capacitor on the transformer center taps for either channel.
- Follow a symmetrical style when selecting magnetics. The transmit and receive channels should have the same construction and electrical specifications. For discrete modules, the Pulse H1338 is suggested.
- Use the following code to turn on/off the auto MDI-X function:

```
#define NCONFIG_AUTO_SWITCH0x0080

#define MII_NCONFIG 0x01C


    if  ((!(nic->eeprom[eeprom_cnfg_mdix] & eeprom_mdix_enabled)) &&

   (Force_Speed_And_Duplex == TRUE))

        e100_write_phy_reg(MII_NCONFIG, 0);

    else

        e100_write_phy_reg(MII_NCONFIG, NCONFIG_AUTO_SWITCH);
```

Refer to the *82562EZ/82551ER/82551IT/82541ER Combined Footprint LOM Design Guide (AP-456)* or the *82551QM/82540EM Interchangeable LOM Design Guide (AP-432)* for additional hardware design considerations.