Module Introduction

Purpose
• This training module covers 68K/ColdFire Ethernet and USB

Objectives
• Describe the features of the 10/100 Fast Ethernet Controller module
• Explain the USB device controllers available on ColdFire devices.

Content
• 10 pages
• 2 questions

Learning Time
• 15 minutes

This module introduces you to the integrated Ethernet and USB controllers of the ColdFire family. It describes the features of the 10/100 Fast Ethernet Controller module and the USB device controllers available on ColdFire devices.
Fast Ethernet Controller

- Fully IEEE 802.3 standard compliant
- Supported interfaces:
  - 10 Mbps 7-wire
  - 100 MII and 10 MII
- Supported data rates:
  - 10 Mbps full duplex and half duplex operation
  - 100 Mbps half duplex operation
  - 100 Mbps full duplex operation
- Dedicated DMA
- FIFOs:
  - Large on-chip transmit and receive FIFOs to support a variety of bus latencies
- Off-chip descriptor rings/buffers permit wide user capabilities and flexibility

Let's examine the features of the Fast Ethernet Controller (FEC) module. The integrated Fast Ethernet Media Access Controller (MAC) performs the full set of IEEE 802.3/Ethernet CSMA/CD media access control and channel interface functions. It requires an external interface adaptor and transceiver function to complete the interface to the media.

The FEC incorporates a number of new features. First, it is in full compliance with the IEEE 802.3 standard.

Second, it supports three different physical interfaces: 100 Mbps 802.3 media independent interface (MII), 10 Mbps 802.3 MII, and the 10 Mbps seven-wire interface.

Third, the half-duplex and full-duplex 100 Mbps operation require a system clock frequency equal to or greater than 50 MHz.

The Fast Ethernet controller has a dedicated direct memory access controller that moves data in and out of the controller.

Integrated transmit and receive FIFO memory supports a range of bus latencies. Retransmission from the transmit FIFO following a collision does not use a processor bus. In addition, automatic internal flushing of the receive FIFO for runts and collisions is done without using a processor bus.

The off-chip descriptor rings/buffers of the FEC permits wide user capabilities and flexibility.
Let’s look at ColdFire’s FEC module in more detail. The FEC is implemented using a combination of hardware and microcode. The figure here shows a functional block diagram of this module.

The descriptor controller opens and closes the buffer descriptors. The descriptor controller manages data flow in both transmit and receive directions. It is programmed with microcode to open and close buffer descriptors, control the transmit collision recovery process, and filter receive frame addresses. The descriptor controller accesses both the transmit and receive descriptor rings through the descriptor access block. The descriptor access block acts as a dedicated single channel DMA that either reads a descriptor in external user memory or writes an updated descriptor back into user memory.

The DMA controller manages the data transfer in the module. As soon as the DMA channel is initialized, it begins transferring data. An on-board RAM acts as both a transmit and receive FIFO. It also provides scratch memory for the FEC.

The RAM is the focal point of all data flow in the FEC. The RAM is divided into three sections: transmit FIFO, receive FIFO, and descriptor controller memory. User data flows to or from the DMA unit from the receive/transmit FIFOs. Transmit data flows from the transmit FIFO into the transmit block. Receive data flows from the receive block into the receive FIFO.

The user controls the FEC by writing into the control registers located in each block. The Control and Status Registers (CSRs) provide global control (i.e. Ethernet reset and enable) and interrupt handling. The MII block provides a serial channel for the FEC and external physical layer device to pass control and status information.
Which of the following are features of the Fast Ethernet Controller (FEC) module? Select all that apply and then click Done.

A. The DMA provides a serial channel for the FEC and external physical layer device to pass control and status information.
B. The Fast Ethernet Controller (FEC) module supports three different physical interfaces.
C. The user controls the FEC by writing into the control registers located in each block.
D. The Fast Ethernet Controller (FEC) module requires an external interface adaptor and transceiver function to complete the interface to the media.

Done

Consider this question about the Fast Ethernet Controller module. Select all that apply and then click Done.

Correct!

B, C, and D are features of the Fast Ethernet Controller. The Fast Ethernet Controller (FEC) module requires an external interface adaptor and transceiver function to complete the interface to the media. Also, it supports three different physical interfaces, and the user controls it by writing into the control registers located in each block.
USB 2.0 Full Speed Device

- Supports full-speed 12-Mbps USB devices and low-speed 1.5-Mbps devices
- Full compliance with the *Universal Serial Bus Specification, Revision 2.0*
- Automatic hardware processing of USB standard device requests
- USB device controller with protocol control and administration for up to 8 endpoints, 16 interfaces, and 16 configurations. Endpoint types are programmable with support for up to eight control, interrupt, bulk, or isochronous endpoints
- Independent interrupts for each endpoint
- Supports remote wakeup via a register bit
- Detects start-of-frame and missed start-of-frame for isochronous endpoint synchronization
- Notification of start-of-frame, reset, suspend, and resume events

Many ColdFire devices are available with USB 2.0 device controllers capable of operating at full- and low-speeds.

The USB 2.0 full-speed device controller is compliant with the USB specification version 2.0, and enables implementation of a USB device function.

The controller handles USB standard requests with little to no requirement for software intervention.

The controller supports all endpoint types (control, interrupt, bulk and isochronous) and provides support for up to 8 independent endpoints, 16 interfaces, and 16 configurations.

Each endpoint has its own set of independent interrupts.

The USB device controller also supports remote wake-up capabilities and it automatically detects start-of-frame tokens for isochronous applications.

The USB device controller also provides indications to the application for bus events such as start-of-frame, reset, suspend, and resume.
The MCF547x and MCF548x families provide a USB 2.0 hi-speed device controller.

This device controller is capable of operating at 480 Mbps in hi-speed mode and 12Mbps in full-speed mode.

The controller supports all the endpoint types as well as offering many configurations, interfaces and alternate interfaces.

A dedicated RAM is provided for endpoint FIFOs and USB descriptors. The device controller can process the USB standard requests with little intervention from application software.

An integrated USB 2.0 physical layer interface is included on-chip.
The USB On-The-Go extension to the USB specification allows for a single device to operate as either a USB host or device.

The ColdFire implementation of USB OTG is compliant to specification revision 1.0a and supports full-speed and low-speed operation with an on-chip transceiver. A

An optional UTMI-plus Low Pin Interface (ULPI – pronounced you-lip-ee) is provided which supports hi-speed operation using an external physical layer transceiver.

Power sourcing capabilities in host mode are provided by an off-chip supply.

The embedded USB host is fully compatible with the EHCI specification revision 1.0.
USB 2.0 Full-Speed Host

- Compliant with the USB Specification, Revision 2.0
- Supports full-speed (12Mbps) and low-speed (1.5 Mbps) devices with on-chip full speed and low speed transceiver
- Compatible with the Enhanced Host Controller Interface (EHCI) Specification for USB, Rev. 1.0

The ColdFire implementation of USB Full-speed host is compliant to specification revision 2.0

The USB 2.0 full-speed host controller supports full-speed and low-speed operations with a on-chip transceiver.

The host controller is compatible with the EHCI specification revision 1.0.
Which of the following are features of the USB Device Controller available on ColdFire devices? Select all that apply and then click Done.

A. It handles USB standard requests with little to no requirement for software intervention.
B. It supports control and interrupt endpoint types only.
C. The full-speed host controller supports full-speed and low-speed operations with an on-chip transceiver.
D. Power sourcing capabilities in host mode are provided by an on-chip supply.

Correct!

A and C are features of the USB Device Controller’s that are available on ColdFire devices. It handles USB standard requests with little to no requirement for software intervention. Also, the full-speed host controller supports full-speed and low-speed operations with a on-chip transceiver.

Click the forward arrow to continue on to the next page.
In this module, you learned about the integrated Fast Ethernet Controller. This module is common to many ColdFire devices and allows embedded applications to be network enabled.

We also introduced the USB device controllers that are implemented on a variety of ColdFire devices. These device controllers come in a variety of flavors and enable embedded applications to communicate with a USB Host.

The embedded USB Host controller allow ColdFire devices to communicate with other USB device and the new OTG controller allows embedded applications to negotiate for the role of device or host.