ML250
Fibre Channel Architecture & Instrumentation

Course Contents
- Introduction to Fibre Channel SANs
- FC-2 Fibre Channel Framing
  FC Frame Structure
  Exchange Management & Flow Control
- Behavior on a Fibre Channel Point-to-Point Topology
  Basic Link Initialization
  Addressing
- Behavior on a Fibre Channel Switched Fabric
  Naming & Addressing
  Logins
- Behavior on a Fibre Channel Arbitrated Loop
- FC-4 Upper Layer Protocol
  Transporting SCSI through Fibre Channel
  Error Recovery
- 10 Gigabit Fibre Channel (optional)

Interspersed with the lecture sections, students analyze fibre channel traces using the latest Finisar XGig® Trace Viewer and Expert products.

Target Group
ML250 is a low-level introduction to the technical fundamentals of the Fibre Channel (FC) architecture. It is intended for anyone requiring an introduction to FC architecture including: Design Engineers, Field Application Engineers, Test Engineers and Technical Marketing professionals.

Knowledge Prerequisites
Previous experience with SCSI technology is helpful, but not required.

Course Objectives
Students develop a working knowledge of Fibre Channel protocol and behavior through lecture and protocol analyzer exercises.

Reservation and Registration
We will be glad to make a free and non-binding course reservation for you for the duration of two weeks. On www.experteach.de under *Registration*, you can conveniently make course reservations, registrations, and hotel reservations. Alternatively, call us under +49 6074 4868-0.

For closed groups of participants, we can modify the course contents according to your requirements. Do not hesitate to contact us!

4 days **€ 3,000** exclusive of V.A.T.

Course date (mm/dd/yy)/Location

09/28-10/01/10	Frankfurt	11/23-11/26/10	Frankfurt

Up-to-date information: www.experteach-training.com ML25

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ML250 – Fibre Channel Architecture & Instrumentation

Basic Elements of the Fibre Channel SAN
This section identifies the basic features of and the premises upon which Fibre Channel technology has been designed. Fibre Channel specific objects and terminology is defined. Upon completion students are able to:
• Identify the basic features of Fibre Channel.
• Identify the physical options for a Fibre Channel SAN.
• Identify the encoding scheme used in Fibre Channel.
• Identify the Special Character used in Fibre Channel and how it is used.
• Define three Ordered Sets (Primitive Signals, Primitive Sequences & Frame Delimiters) and explain their usage.
• Identify three topologies which may be created with Fibre Channel.
• Define the Nodes and Ports used in Fibre Channel.
• Explain how the Node and Port types are related.

FC-2 Fibre Channel Framing Protocol
This section introduces the format and usage of the Fibre Channel Frame as defined by the FC-2 layer of the Fibre Channel protocol. Fibre Channel control and management including available credit models are also introduced and illustrated. Upon completion students are able to:
• Define and illustrate the usage of Exchanges, Sequences and Frames.
• Explain the principles of Segmentation and Reassembly
• Describe all Classes of Service defined by the Fibre Channel standard.
• Identify the features and benefits of the most common class of service used in Fibre Channel implementations.
• Define and explain the differences between the Buffer-to-Buffer credit model and the End-to-End credit model.
• Identify the layout of a Fibre Channel Frame.
• Identify the fields of the Fibre Channel Frame header.

Behaviour in a Fibre Channel Point-to-Point Topology
This section details the behaviors of a Fibre Channel Point-to-Point (Node to Node) topology. Basic Link Initialization as well as proper login steps are covered. Trace analysis is used to demonstrate a real-world login between two nodes. Upon completion students are able to:
• Diagram the initialization steps required to bring up a link between two nodes.
• Describe how FLOGI is used in the Point-to-Point login. Explain why it is used.
• Explain how the nodes determine the source of the PLOGI.
• Describe how PLOGI is used to determine the addresses of the two nodes.

Behaviour in a Fibre Channel Switched Fabric
This section details the behaviors of a Fibre Channel switch as defined by FC-SW-2 standard. Fibre Channel naming and addressing are covered along with the initialization steps for logging in with a switch. Fibre Channel Zoning concepts are investigated. Connections between two or more switches (Inter-Switch Links) are also discussed and illustrated. Trace analysis is used to demonstrate both real-world login between a node and a switch and the initialization of an Inter-Switch Link (ISL). Upon completion students are able to:
• Describe the features of the Fibre Channel World Wide Name and discuss when it is exchanged.
• Identify three well-known servers and their function on the Fibre Channel switch.
• Diagram the initialization steps required to bring up a link between a node and the switch.
• Define what information is exchanged during FLOGI, PLOGI and PRLI.
• Describe the process for registering for state change notifications and identify what types of devices typically register to receive notifications.
• Define the usage of RSCN frames.
• Describe the difference between Hard Zoning, Soft Zoning and Broadcast Zoning.
• Discuss the industry complications surrounding zoning between different switch vendors.
• Diagram the process of initializing an (ISL) between two switches from two different vendors.
• List the variables which help determine which switch becomes the Principle Switch during ISL creation.

Behaviour in a Fibre Channel Arbitrated Loop
This section covers the behavior of a Fibre Channel Loop as defined by FC-AL-2 standard. Basic loop architecture and subsequent behavior is investigated. Trace analysis is used to further examine the loop initialization process. Upon completion students are able to:
• Identify the address structure for a Loop device.
• Explain the difference between a Public Loop and a Private Loop.
• Explain the LIP process including all stages of Loop initialization (LISM, LIFA, LIPA, LIHA, LISA, LIRP, LILP).
• Explain how Fairness may be built into the Loop.
• Describe the overall process for sending frames including the Open/Close functions and credit distribution on the Loop.

FC-4 Fibre Channel Upper Layer Protocol (ULP)
This section covers the actual mapping of SCSI commands, data and status into Fibre Channel Frames as defined by FCP-SCSI. A short review of basic SCSI terminology and behavior is included. Trace analysis covers various SCSI commands (e.g. Read, Write, Inquiry, Test Unit Ready) carried over Fibre Channel as a transport layer. Upon completion students are able to:
• Describe what SCSI information is supplied during Process Login.
• Describe the three phases of a basic SCSI operation and how they are mapped into Fibre Channel Information Units.
• Identify the contents of FCP_CMD, FCP_DATA, FCP_RSP and FCP_CONF frames.
• Explain the significance of the FCP_XFR_RDY frame including when it is used.
• Map and diagram SCSI Read, Write and Task Management functions to Fibre Channel exchanges.

10 Gigabit Fibre Channel
This section discusses the changes to the FC-0 and FC-1 layers of Fibre Channel to support 10 Gigabit fibre Channel transmission. A basic discussion of industry acceptance and the current status of 10 Gigabit Fibre Channel is also conducted. Upon completion students are able to:
• Identify the encoding scheme used for 10 gigabit Fibre Channel transmissions.
• Identify the control (special) characters used for 10 gigabit Fibre Channel signaling.
• List the classes of service supported by 10 gigabit Fibre Channel.
• Explain some of the common approaches (XAUI, XGMII) vendors are using to achieve 10 gigabit Fibre Channel transmission.

ExperTeach Gesellschaft für Netzwerkkompetenz mbH
Waldstr. 94 • D-63128 Dietzenbach
Phone +49 6074 4868-0 • Fax +49 6074 4868-109
info@experteach.de • www.experteach.de

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