Networking Fundamentals teaches the basic concepts and terminology of networking and is designed to prepare students for the CompTIA Network+ Certification Exam. The text covers media types and standards and how data is encoded and transmitted. Students are also introduced to the terminology and basic concepts of each network operating system. The Open Systems Interconnection (OSI) model is introduced in the first chapter, revisited throughout the textbook, and then examined in detail in Chapter 17, A Closer Look at the OSI Model. A complete chapter is dedicated to TCP/IP and another to subnetting. While this edition was copyrighted in 2005, it remains a solid book for coverage of Networking Fundamentals. When Server 7 is published and marketed by Microsoft, there will be updates available on rmroberts.com until the rewrite of the Networking Fundamentals text.

This outline is provided as a basic outline. You may download the outline in PDF format or Word format and adjust it to your needs. Just add days, dates, times and you’re in business.

Course Outline (Textbook) Basics Include:

**Chapter 1  Definition of a Network**

  Definition of a Network
  Advantages of Networking
  Disadvantages of Networking
  Network Classifications – LAN, MAN, and WAN
  Network Topologies
  Bus Topology
  Star Topology
  Ring Topology
  Mesh Topology
  Wireless Topology
  Hybrid Topology
  Basic Administration Network Models
  Client/Server Network
  Peer-to-Peer Network
  Network Operating Systems (NOS)
Network Communications
  How Data is Packaged
  Network Connectivity

Protocols
  NetBIOS
  NetBEUI
  TCP/IP
  FIR
  IPX/SPX
  ATM

Network Media and Devices
  Media
  Network Interface Card
  Repeater
  Hub
  Gateway
  Bridge
  Brouter

Standards and Organizations
  IEEE
  ISO
  W3C
  CERN
  UL
  EIA
  TIA
  ANSI

Laboratory Activity – Identifying a Workstation’s IP Configuration Settings

Chapter 2  Network Media – Copper Core Cable

Network Media

Analog and Digital Signals
  Frequency
  Attenuation
  Interference
  Latency
Data Transmission
  Bandwidth
  Baseband
  Broadband
    Simplex, Full-Duplex, and Half-Duplex Communication

Electronic Terms
  Direct Current and Alternating Current
  Resistance and Impedance
  Reflected Loss
  Crosstalk

Copper Core Cables
  Coaxial Cable
  Twisted Pair

IEEE 802.3 and 802.5 Standards
  IEEE 802.3
  IEEE 802.5

ARCnet Standard

Wiring Faults
  Short
  Open
  Ground
    Reversed, Crossed and Split Pairs

Laboratory Activity – Making a Straight-Through Patch Cable

Chapter 3  Fiber-Optic Cable

Characteristics of Fiber-Optic Cable
  Security
  Immunity to Electromagnetic Interference
  Weight and Size
  Safety
  Bandwidth
  Corrosion and Water Resistance
  Greater Distances

The Nature of Light

Fiber-Optic Cable Construction

Fiber-Optic Cable Transmission Characteristics
  Attenuation

IEEE 802.3 Standards

Fiber Distributed Data Interface (FDDI)

Fiber-Optic Cable Connectors
Fiber-Optic Cable Installation and Troubleshooting
- Installing Connectors
- Making a Fusion Shape
- Using Fiber-Optic Cable Meters

Laboratory Activity – Fiber-Optic Connector Identification

Chapter 4  Wireless Technology
- Electromagnetic Waves
  - Radio and Microwave Transmission
  - Infrared Transmission
  - Radio Interference
- Antenna Styles
  - Omni
  - Dipol
  - Yagi
  - Flat Panel
  - Parabolic
- Radio Wave Transmission Techniques and Networking
- Radio Waved-Based Transmission Techniques
- Radio Wave-Based Networking
  - The IEEE 802.11 Standard
  - IEEE 802.11 Access Method
  - New IEEE Wireless Standards
- Bluetooth
- Cellular Technology
- Microwave Transmission and Networking
- Infrared Transmission and Networking
- Advantages and Disadvantages of Wireless Technology
- Wireless Security
  - 802.1X Authentication
  - 802.1X Encryption
  - Wi-Fi Protected Access

Laboratory Activity – Installing an Infrastructure Mode Wireless Network

Chapter 5  Digital encoding and Data Transmission
- Digital Encoding and Transmission
- Data Packaging and Transmission
  - Parity Checks
  - Cyclic Redundancy Check (CRC)
  - Segmentation and encapsulation
Connection-Oriented and Connectionless Communication
Circuit Switching/Packet Switching

Data Codes
  ASCII
  BCD
  EBCDIC
  Unicode
  HTML

Protocol Frame Structures
  UPD Frame Structure
  Ethernet Frame Structure

Data Encoding, Transmission, and the OSI Model
  Application Layer
  Presentation Layer
  Session Layer
  Transport Layer
  Data Link Layer
  Physical Layer

*Laboratory Activity – Ethereal Protocol Analyzer*

**Chapter 6  Network Operating Systems and Network Communications**
Common Network Operating System Traits
Network Operating Systems and Hardware Protocols
  Ethernet
  AppleTalk
  Token Ring
  Token Bus
  ARCnet

Network Operating Systems and Networking Protocols
  NetBIOS
  NetBEUI
  IPX/SPX
  TCP/IP

*Laboratory Activity – Installing Client Service for Netware*

**Chapter 7  Microsoft Network Operating Systems**
A Brief History of Microsoft Network Operating Systems
Common Windows Server Administrative Components
  User Account
  Group Account
Security Policy
Network Share
Disk Management
Administrative Tools

Window NT
Window NT Network Administrative Models
The Domain Model
Windows NT Administration

Active Directory
Windows 2000/2003 Administration
Major Differences in Windows Server 2003

POSIX
Interoperability
Gateways and Services
Microsoft Operating System Client Configuration

Laboratory Activity – Adding Users to Windows Server 2003

Chapter 8 Novell Network Operating Systems

A Brief History of NetWare
Novel Kernel and NetWare Loadable Modules (NLM)
NetWare Process
NetWare Console
  Console Commands
  Servetop
  ConsoleOne
  Monitor
NetWare File Systems
eDirectory
  eDirectory Organization
  eDirectory Tree Structure
NetWare Security
NetWare 6 Administration
NetWare Connectivity and Interoperability
  Novel Client
  Native File Access Pack (NFAP)
  Web-Based Access

Laboratory Activity – Installing the Novell Client
Chapter 9  UNIX/Linux Operating Systems

UNIX
Linux
  Linux Advantages
  Linux Disadvantages
  Copyright and Copyleft
UNIX/Linux Basics
  LILO and GRUB
  Shells
  Commands
  File Systems
  File Structure
  Common Files and Directories
  File and Directory Security
  Network Authentication
  File and Print Sharing
  Remote Access Features
X Window System
Interoperability
  Samba
  Windows and NFS
MAX OS X Server
  Laboratory Activity – Adding a New User in SuSE Linux

Chapter 10  Introduction to the Server
Server Types and Services
  Thin Servers
  Thin Client Servers
  Server Classification by Number of CPUs
Major Server Components
  Case
  Hot-Swap Components
  Power Supply
  Motherboard
  BIOS
  Central Processing Unit (CPU)
  Small Computer Systems Interface (SCSI)
System Resources
  Interrupt Request (IRQ)
  Direct Memory Access (DMA) Channel
Input/Output (I/O) Port
Memory Address Assignment

RAID Systems

External Storage Systems
  Network-Attached Storage (NAS)
  Storage Area Network (SAN)

Fibre Channel
  Fibre Channel Point-to-Point Topology
  Fibre Channel Arbitrated Loop Topology
  Fibre Channel Fabric Switched Topology

Laboratory Activity – Using the DiskPart Command Interpreter

Chapter 11 TCP/IP Fundamentals

IP Addressing
  Network Class
  Subnet Mask
  Reserved IP Addresses
  Viewing IP Configuration Settings

Domain Name System (DNS)
  Internet Corporation for Assigned Names and Numbers (ICANN)
  Fully Qualified Domain Name (FQDN)
  DNS Structure and Operation
  Hosts and Lmhosts Text Files

The IP, TCP, and UDP Protocols
  Relationship to the OSI Model
  Frame Formats

Assigning IP Addresses
  Windows Internet Naming Service (WINS)
  Dynamic Host Configuration Protocol (DHCP)
  DHCP Lease
  Automatic Private IP Addressing (APIPA)
  Bootstrap Protocol (BOOTP)

TCP/IP Ports and Sockets

TCP/IP Troubleshooting Utilities
  Netstat
  Nbstat
  Ping
  Tracert or Traceroute
  ARP
  Nslookup
The IPv6 Standard
  Loopback Address
  IPv6 MAC Address

_Laboratory Activity – Configuring a DHCP server_

**Chapter 12  Subnetting**

The Binary Number System
Dotted Decimal Notation
Subnetting
  A Closer Look at Subnets
  Advantages of Subnetting
  Disadvantages of Subnetting
Virtual LAN (VLAN)
Preventive Maintenance

_Laboratory Activity – Subnet Mask Calculator_

**Chapter 13  ATM and VoIP**

Voice and Audio Signals
  Signal Conversion
  Latency

Video
  Compression
Multimedia Transmission Protocols
  X.25
  Frame Relay
  ATM
  VoIP

_Laboratory Activity – NetMeeting_

**Chapter 14  Web Servers and Services**

Internet, Intranet, and Extranet
  Internet
  Intranet
  Extranet
Domain Name and URL Resolution
Web Servers
  Apache HTTP Server
  Internet Information Service (IIS)
Web Browsers
Web Site Communications
  Extensible Markup Language (XML)
  SOAP
  FrontPage Extensions
File Transfer Protocol (FTP)
  Anonymous FTP
E-mail
  SMTP
  Post Office Protocol (POP)
  Internet Message Access Protocol (IMAP)
  HTTP E-Mail
  Multipurpose Internet Mail Extensions (MIME)
  E-mail Address Format
  E-Mail Structure
  Mail Filter
  Mail Gateway

Laboratory Activity – Installing Internet Information Services (IIS)

Chapter 15  Remote Access and Long Distance Communications
  Introduction to Telecommunications Systems
  Remote Connection Technologies and Media
    Public Switched Telephone Network (PSTN)
    ISDN
    Cable Internet Service
    Satellite
    T-Carrier
    FDDI
    SONET
    X.25
    Frame Relay
  Dial-Up Networking
    Dial-In Only
    Dial-Out Only
    Full-Service
    Remote Desktop Protocol
    Remote Access Protocols
  Virtual Private Networks (VPN)

Laboratory Activity – Routing and Remote Access Service (RRAS)
Chapter 16  Network Security

Hackers, Crackers, and Intruders

Common Network Security Breaches
- Unprotected Network Shares
- Social Engineering
- Open Ports
- Zero Configuration (Zerocof)
- Denial of Service (DoS)
- Man in the Middle (MITM)
- Spoofing
- Trojan Horse
- E-mail Attachments
- Macro Virus
- Worm
- Phishing
- Administrator Laziness

Security Methods and Protocols
- Encryption
- Secure Sockets Layer (SSL)
- Secure HTTP
- IP Security (IPSex)
- SSH
- SCP

Wireless Security
- Wireless Access Point Authentication
- Media Access Control (MAC) Filter
- Wired Equivalency Privacy (WEP)
- Wi-Fi Protected Access (WPA)
- Wi-Fi Protected Access 2 (WPA2)
- 802.11i
- 802.1x

Authentication Protocols
- Password Authentication Protocol (PAP)
- Challenge Handshake Authentication Protocol (CHAP)
- Kerberos

Security Implementations
- Software Installation Patches
- Administrator Account
- User Account Passwords
- Other Password Security Measures
Firewall
Packet Filter
Application Gateway
Circuit-Level Gateways
Proxy Server
Securing Remote Access
Physical Security

Security Tools
Netstat Utility
Audit Tools
Self-Hack Tools
Protocol Analyzer
Packet Sniffer
System Backups

Laboratory Activity – Security Even Monitoring

Chapter 17  A closer Look at the OSI Model

History and Purpose of the OSI Model
The OSI Layers
   Application Layer
   Presentation Layer
   Session Layer
   Transport layer
   Network Layer
   Data Link Layer
   Physical Layer

The Encapsulation Process
The OSI Model and the Major Protocol Suites
   TCP/IP Protocols
   Novell IPX/SPX Protocols
   AppleTalk
   AppleShare IP

Request For Comments (RFC)

Laboratory Activity – Ethereal OSI Model Exploration

Chapter 18  Maintaining the Network

Monitoring the Server and Network
   Establishing a Baseline
   Monitoring Tools
Chapter 19  Fundamentals of Troubleshooting the Network

Troubleshooting Procedures
1. Establish the Symptoms and Potential Causes
2. Identify the Affected Area
3. Establish What Has Changed
4. Select the Most Probable Cause
5. Implement and Action Plan and Solution Including Potential Benefits
6. Test the Result
7. Identify the Results and Effect of the Solution
8. Document the Solution and Process

Troubleshooting the Network Infrastructure
- The Windows 98 Boot Process
- The Windows NT Family Boot Process
Dual Boot Systems
Troubleshooting Windows NT-Based Operating Systems
Troubleshooting the Network Infrastructure
Windows XP Network Diagnostic Utility
Network Cable Tester
Tone Generator and Tracer
Fiber-Optic Cables
NIC Loopback Test
Indicator Lights
Network Analyzers
Protocol Analyzer
Wireless Network Tester/Analyzer
Troubleshooting the Server
Troubleshooting the Most Common Network Problems
The User Cannot Log On to the Network/Computer
Loose Connections
The User Cannot Access a Share
The user Cannot Print to the Network Printer
The Printer is Printing Gibberish
The User Cannot Access the Internet
The User’s Computer Has a Virus or Worm
Troubleshooting with Event Viewer and System Monitor
Troubleshooting with TCP/IP Utilities
Ping
Tracert
Netstat
Nbstat
ARP
Ipconfig
Nslookup

Laboratory Activity – Network Diagnostics

Chapter 20 Designing and Installing a New Network
Needs Assessment and Design
Physical Network Structure
Security
Application
Organizational Structure
Fault Tolerance and Data Integrity
Network Design Tools
Developing a Timeline
Installation
Implementation
Documentation
Training
Specifications for Network Design
   Architectural Design Elements
   Standards Organizations
   ANSI/TIA/EIA Standards
   Network and Computer Electrical Requirements

BICSI
   Laboratory Activity – Designing a Small Network

Chapter 21  Network + Certification Exam Preparation
The Network+ Certification Exam
Preparation Strategy
   1. Review and Analyze the Exam Objectives
   2. Match Exam Objective to Resource Material
   3. Identify and Practice laboratory Activities that Match the Exam Objectives
   4. Take Practice Exams
   5. Review Problem Areas
   6. Retake Practice Exams
   7. Schedule and Take the Network + Certification Exam

Network + Certification Practice Exam
   Domain 1 – Media and Topologies
   Domain 2 – Protocols and Standards
   Domain 3 – Network Implementation
   Domain 4 – Network Support

Scoring the Exam

Chapter 22  Employment in the Field of Networking Technology
Information Technology Industry Careers
   Network Support Specialist
   Network Administrator
   Systems Analyst
   Consultant
   Technical Salesperson
   Web Administrator
   Programmer
Career Information Sources
General and College Education
Certification
  CompTIA Certifications
  Microsoft Certifications
  Novell Certifications
  Cisco Certifications and Training
  Other Certifications
Employment
  Job Search Ideas
  Preparing a Resume
  Preparing for the Interview
  Personal Appearance at the Interview
  Information to Bring to the Interview
  The Job Interview
  Testing at the Interview

Appendix A – List of Acronyms
Appendix B – Binary Math
Appendix C – Number Conversion Table
Appendix D – Table of ASCII Characters
Appendix E – Protocol Family Encapsulations

Recommended Textbook, Student Workbook, Instructor Manual, and Complete Classroom and Reference Materials (http://www.g-w.com)

Networking Fundamentals, by Richard M. Roberts
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