eogogicsinc

Course ID	Course Title
SS7ARCH	**SS7/C7 Architecture and System Operation in Depth**
Course Duration	
4-5 days	

Related Courses

- SS7/C7: A Technology Overview (SS7C7-O, 2 days)
- SS7/C7 Protocols and System Operation (SS7C7, 3 days)

Aimed At

This course is aimed at the telecommunications engineers and engineering managers involved in the design, testing and operation of switched voice and data networks.

Group Size

5-25

Prerequisites

Those intending to take this course should have an understanding of the telecommunications systems in general and circuit switched and packet switched networks in particular.

Course In a Nutshell

Signaling System No. 7 (SS7), known as C7 outside North America, is a packet-based out-of-band signaling system that is used to implement circuit-switched telecommunications networks and supports both fixed-line and cellular networks. In recent years, additional SS7 functionality has been introduced to meet the needs of expanding telecom services.

In this course, you will learn the history of signaling and the progression of the technology through both in-band signaling and out-of-band signaling protocols. You will learn the key differences between the SS7 ITU-T and ANSI standards, connection and connectionless signaling services, and how SS7 supports cellular services such as subscriber roaming and packet-switched data services. Covered in depth are the complex level 4 protocols, newer and more advanced services such as Advanced Intelligent Network (AIN), and Transaction Capabilities Applications Part (TCAP) message structures and architecture. A typical course is four days long but can be shortened to three or expanded to five depending on the level of depth required.

Customize It!

Customize this course to your specific needs at little-to-no additional cost. We offer distinct versions tailored for:

- Network design and optimization engineers
- Equipment or application designers
- Less technical audiences such as managers, executives, business planners, sales and marketing specialists, and operations and support personnel

We can also tailor the course to cover the particular applications or aspects of the SS7 technology that are of interest to your group.

Learn How To
- Troubleshoot SS7 network problems.
- Monitor and evaluate SS7 network performance.
- Plan the integration and testing of new SS7 applications.
- Design new mobile network applications and services.

Course Outline

- **Signaling Overview**
  - What is Signaling?
    - Network Signaling Evolution
    - In-Band Signaling
    - Out-of-Band Signaling
  - Switching
  - Numbering Plans
  - Digit Analysis
  - Access T1/E1s
  - Pulse Code Modulation (PCM) Digital Voice
  - ISDN Overview
    - ISDN Basic Rate Interface (BRI)
    - ISDN Primary Rate Interface (PRI)
  - Common Channel Signaling (CCS)
  - Channel Associated Signaling (CAS)

- **Network Signaling Evolution**
  - The North American Signaling Architecture
  - Signaling System No 7
    - Pertinent Standards Organizations
    - SS7 Network Architecture
    - Telephone Set
    - Analog Telephone
    - Digital Telephone
    - Signaling
    - In-Band
    - Pulses or Audible Tones (DTMF) in Same Channel as Voice
    - Ripe for Toll Fraud
    - Digital Telephone - Signaling
    - ISDN/Out-of-Band
    - Private Branch Exchange (PBX)
    - Voice Coding
    - Pulse Code Modulation (PCM)
    - Uses 64K / Single Channel
    - a-Law Encoding (Europe)
    - mu-Law Encoding (North America
    - Adaptive Differential PCM (ADPCM)
    - Voice Band Data (VBD)
    - High Speed Modems
    - FAX

- VBD Detect in DSP Chip
- Private Branch Exchange (PBX)
- Switching
- Numbering Plans
- Digit Analysis
- Fast Busy before Number Completed
- Analyzes Digits as they are Keyed
- Options
- Premise
- PSTN
- VPN
- Private Network (Satellite, T1, VoIP, etc.)
  - History of Telecommunications Signaling
    - Private Branch Exchange (PBX)
    - Switching
    - Call Handling
    - Routing
    - Remote or Local Busy
    - Call Logging
    - Cost Allocation
    - Internal Billing
    - Billing Verification
    - 900/976 Toll Blocking
    - CENTREX
    - Connection to Telco
    - Physical Connections
    - Tie Lines
    - Physical Connections
    - Access T1/E1s
    - T1 PBX Interface Voice Applications
    - Pulse Code Modulation (PCM) Digital Voice
    - 64K Digital Voice
    - ųLaw (mu-Law) Encoded
    - ISDN Primary Rate Interface (PRI)
    - T1 Options for Voice/PBX
    - Line Coding
    - Framing
    - Super Frame (SF)
    - Extended Super Frame (ESF)
    - Bipolar N-zero Substitution (B8ZS)
    - Channelization
    - Channelized (Typical for PBX) vs
    - Non-Channelized (Typical for Router)
  - Clocking
    - Network
    - PBX
    - Loop-Timing
  - E1 PBX Interfaces

- E1 PBX Interface Voice Applications
- Pulse Code Modulation (PCM) Digital Voice
- 64K Digital Voice
- a-Law encoded
- ISDN Primary Rate Interface (PRI): 30B+D
- E1 PBX Interfaces
- E1 PBX Interface Data Applications
- Voice Band Data (VBD)
- Modem
- FAX
- nx64K Data
- E1 PBX Interfaces
- E1 Options for Voice/PBX
- Signaling
- Common Channel Signaling (CCS)
- Channel Associated Signaling (CAS)
- Line Coding - High Density Bipolar 3 (HDB3)
  - E1 PBX Interfaces
    - Channelization
    - Channelized (Typical for PBX) vs
    - Non-Channelized (Typical for Router)
    - Clocking
    - Network
    - PBX
    - Loop-Timing
  - BRI PBX Interfaces
    - ISDN Basic Rate Interface Applications:
    - Two Voice Lines for Home/Small Business/Branch Office
    - Two Voice Lines + Data Line for Home/Small Business/Branch Office
    - Dynamic Voice/Data for Home/Small Business/Branch Office
    - BRI PBX Interfaces
    - ISDN BRI Applications (continued) :
    - Data Only/64K (1B+D) LAN Interconnect or Internet/Intranet/Extranet
    - Data Only/128K (2B+D) LAN Interconnect or Internet/Intranet/Extranet
    - Data Only/16K (D Channel Only) Point-Of-Sale (POS) or Teller Machine
    - Switched Back-Up to T1/E1
    - BRI PBX Interfaces
    - Integrated Voice, Data and Video
    - Out of Band Signaling
    - Many Standard Hardware and Software Products
    - Offered/Tariffed by Almost All Carriers and Postal, Telephone and Telegraph Authorities (PTTs)
  - BRI PBX Interfaces

- o National/Local/Manufacturer "Flavors" and Variations
- o Analog/Analogue Interfaces:
  - Usually Found in "Legacy" Installations
  - Usually Preserved to Maintain Costs
  - NOT Common in New Installations
  - More Common at Small / Branch Locations
  - Analog/Analogue Interfaces May be Kept to Maintain Unique Features Not Present in Digital Systems:
  - Central Office/PBX Provided Dial Tone
  - Feature Buttons/Status Indicators Based upon Analog/Analogue System
- o Connection to Telco
  - Punch-Downs, Demarks and CSU/DSUs
  - Background
  - Connection to Telco
  - Inside the Central Office (CO)
  - Subsidiary Distribution Frames (SDFs) and Main Distribution Frames (MDFs)
- o Inside the Central Office (CO)
  - Digital Cross-Connect Systems (DCS/DACS)
  - Types
  - M0/1
  - M0/3
  - M1/3
  - Digital Cross-Connect Systems (DCS/DACS)
  - Signaling
  - In-Band
  - SS7/Out-of-Band
  - Switches
  - Intra-Network/Inter-Network Connections
  - Physical Connections
  - Fiber Optic Terminating System (FOTS)
  - Wave Division Multiplexing (WDM)/Photonic Layer
  - SS7
  - AIN
- o Other Devices and Systems
  - Channel Bank
  - Split-T CSU/DSU
  - Automatic Call Director (ACD)
  - Time Division Multiplexer (TDM)
  - Virtual Private Network (VPN)

- **SS7 Architecture**
  - o Service Switching Points (SSPs)
  - o Signal Transfer Points (STP)
  - o Service Control Points (SCPs)
  - o Intelligent Peripherals (IPs)
  - o Service Creation Environment (SCE)

- o Message Transfer Part Level 2 (MTP-2)
  - o Delimitation of Signal Units (L2 frames)
  - o Alignment of Signal Units
  - o Signaling Link Error Detection
  - o Signaling Link Error Correction by Retransmission
  - o Signaling Link Initial Alignment
  - o Error Monitoring and Reporting
  - o Link Flow Control
- o MTP-2 Header Fields
  - o Fill-In Signaling Units (FISU)
  - o Link Status Signal Units
  - o LSSU Use of Timers
  - o Zero Bit Insertion and Deletion
  - o Signal Unit Alignment
  - o Error Detection
  - o Error Correction
  - o Basic Error Correction (BEC)
  - o Terrestrial Links
  - o Signaling Link Initial Alignment
  - o Signaling Unit Error Rate Monitoring (SUERM)
  - o Processor Outage
  - o Flow Control
- o Message Transfer Part Level 3 (MTP-3)
  - o MTP-3 Header
- o Signaling Connection Control Part (SCCP)
  - o SSCP Protocol Classes of Service
  - o SSCP Protocol Classes of Service
  - o Routing Label
  - o Message Type Code
  - o Message Type Code: Connection Request
  - o Message Type Code: Connection Confirmation
  - o Message Type Code: Connection Refused
  - o Message Type Code: Connection Released (RLSD)
  - o Message Type Code: Connection Release Complete (RLC)
  - o SCCP Routing Control (SCRC)
  - o Routing vs Switching?
  - o SCRC Addressing
  - o Point Code Routing
  - o Subsystem Number (SSN) Routing
  - o Global Title (GT) Routing
  - o Global Title (GT) Translation
  - o Global Title (GT) Translation on GSM Network
  - o Calling Party Address (CgPA) and Called Party Address (CdPA)
  - o CgPA and CdPA Common Fields
  - o Routing Parameters and Values Example
- o SCCP Management (SCMG)

- **Telephony User Part (TUP) In Depth**

- TUP Header
- TUP Message Types
  - Initial Address
  - Initial Address With Additional Information
  - Subsequent Address
  - Subsequent Address With One Signal
  - General Forward Setup Information
  - Continuity Signal
  - Continuity Failure Signal
  - General Request
  - Address Complete
  - Charging
  - Switching Equipment Congestion Signal
  - Circuit Group Congestion Signal
  - National Network Congestion Signal
  - Address Incomplete signal
  - Call Failure Signal
  - Subscriber Busy Signal (electrical)
  - Unallocated Number Signal
  - Line Out Of Service Signal
  - Send Special Information Tone Signal
  - Access Barred Signal
  - Digital Path Not Provided Signal
  - Misdialed Trunk Prefix
  - Extended Unsuccessful Backward Setup Information
  - Answer Signal, Unqualified
  - Answer Signal, Charge
  - Answer Signal, No Charge
  - Clear Back Signal
  - Clear Forward Signal
  - Reanswer Signal
  - Forward Transfer Signal
  - Calling Party Clear Signal
  - Release Guard Signal
  - Blocking Signal
  - Blocking Acknowledgement Signal
  - Unblocking Signal
  - Unblocking Acknowledgement Signal
  - Continuity Check Request Signal
  - Reset Circuit Signal
  - Maintenance Oriented Group Blocking
  - Maintenance Oriented Group Blocking Acknowledgement
  - Maintenance Oriented Group Unblocking
  - Maintenance Oriented Group Unblocking Acknowledgement
  - Hardware Failure Oriented Group Blocking
  - Hardware Failure Oriented Group Blocking Acknowledgement
  - Hardware Failure Oriented Group Unblocking
  - Hardware Failure Oriented Group Unblocking Acknowledgement

- Circuit Group Reset
- Circuit Group Reset Acknowledgement
- Software Generated Group Blocking
- Software Generated Group Blocking Acknowledgement
- Software Generated Group Unblocking
- Software Generated Group Unblocking Acknowledgement
- Automatic Congestion Control Information
- Metering Pulse Message
- Operator Signal
- Subscriber Local - Busy Signal
- Subscriber Toll - Busy Signal
- Malicious Call Tracing Signal

- **ISDN User Part In Depth**
  - ISUP Services
    - Call Processing
    - Supplementary Services
    - Maintenance Functions
  - Bearers and Signaling
  - ISUP and the SS7 Protocol Stack
  - ISUP Message Flow
    - Message Timers
    - Circuit Identification Codes
    - Enbloc and Overlap Address Signaling
    - Circuit Glare
    - Continuity Test
    - Circuit Suspend and Resume
    - ISUP and Local Number Portability
    - ISUP–ISUP Tandem Calls
  - Interworking with ISDN
  - Supplementary Services
  - Additional Call Processing Messages
  - Maintenance Messages and Procedures
  - Signaling Mode Related to ISUP Trunks
  - Call Timers for Basic Call Example
  - Message Timers
    - T7 Awaiting Address Complete Timer
    - T8 Awaiting Continuity Timer
    - T9 Awaiting Answer Timer
    - T1 Release Complete Timer
    - T5 Initial Release Complete Timer
  - CIC Identifies Specific Circuit
  - DPC:CIC Is Unique Circuit Identifier
  - Enbloc Signaling
  - Overlap Signaling
  - Circuit Glare (Dual Seizure)
  - Continuity Test (COT)
  - ISUP Message Format

- o Initial (IAM) Message Format
- o Subsequent Address Message (SAM–ITU Networks Only)
- o Continuity Message (COT)
- o Address Complete Message (ACM)
- o Answer Message (ANM)
- o Release Message (REL)/Releace Complete (RELC)
- o Simple ISUP Message Flow
- o ISUP Suspend/Resume
- o ISUP-ISUP Tandem Calls
- o ISUP-ISDN Interworking
- o Supplementary Services
- o Calling Line Identification (CLI)
- o Call Forwarding
- o Maintenance Messages and Procedures
- o Circuit Ranges
- o Circuit States
- o Circuit Validation
- o Continuity
- o Blocking and Unblocking Circuits
- o Circuit Reset

- **Transaction Capabilities Application Part In-Depth**
  - o Components of a Standard Interface
  - o Message/Packet Types
    - o ANSI Packet Types
    - o ITU Packet Types
  - o Example ANSI/ITU Message Flows
  - o TCAP Transaction Identifiers
  - o ITU Transaction Sequence
  - o ANSI Transaction Sequence
  - o TCAP Message Structure
  - o Components of a Standard Interface
  - o Unidirectional Message Fields
  - o Begin Message Fields
  - o End Message Fields
  - o Continue Message Fields
  - o Abort Message Fields

- **Operations and Management Application Part (OMAP) in Depth**
  - o Identify
  - o Control
  - o Configure
  - o Manage
  - o Message Examples and Sequences

- **Intelligent Network Application Part (INAP) In Depth**
  - o IN Conceptual Planes
    - o Service Plane (SP):
    - o Global Functional Plane (GFP)

- o   Distributed Functional Plane (DFP)
- o   Physical Plane (PP)
- o   INAP Services
  - o   Single Number Service
  - o   Personal Access Service
  - o   Disaster Recovery Service
  - o   Do Not Disturb Service
  - o   Call Forward Service
  - o   Virtual Private Network Short Digit Extension Dialing Service

- **SS7 in the Wireless Network**
  - o   GSM Phase 1
  - o   GSM Phase 2
  - o   GSM Phase 2+
  - o   GSM Network Architecture
    - o   GSM Interfaces and Protocols Pertinent to SS7
    - o   Protocols Operating at Each Interface
    - o   Protocols Required for Functional Entities
    - o   MAP-n Protocols
    - o   SSNs used by Mobile Application Part (MAP)
  - o   Sample GSM <-> GSM Call Flows
  - o   Sample GSM <-> Wireline Call Flows

- **Equipment and Architecture**
  - o   Mobile Switching Center (MSC)
  - o   Service Switching Points (SSP)
  - o   SS7 Connectivity Software
  - o   Signaling Transfer Points (STP)
  - o   Service Control Points (SCP)/Adjunct Processors (AP)
  - o   Intelligent Peripherals (IP)/Service Nodes (SN)
  - o   Home Location Registers (HLR)/Visitor Location Registers (VLR)
  - o   Short Message Service Centers (SMSC)
  - o   Voice over IP (VoIP) Gateways

- **Course Summary**

How You Will Learn	• A highly qualified and experienced instructor will present this course in an interactive lecture format with frequent pauses to summarize key points and invite questions/discussion.
	• If you already know something about the technology, we will build on that. We'll compare and contrast what's familiar with what's new, making the new ideas easier to grasp as well as more relevant.
	• If your background is less technical, we will use meaningful examples and analogies to simplify the complex subject matter.
	• The participant handbooks will provide you with a structure to which you can add the information and insight provided in real-time, turning it into a valuable reference resource you can take back to your job.

Revised   *2Rnj/2Lr*