

Chapter 2

Signaling System 7 (SS7) Evolution, Architecture & Applications



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Chapter 2

Objectives

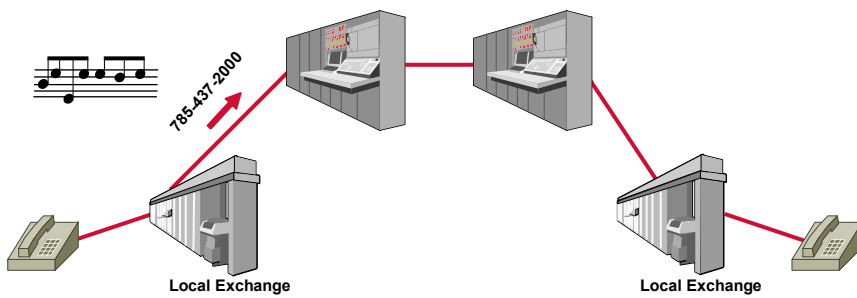
At the completion of this section you will:

- **Know why SS7 has been deployed in telecommunications networks**
- **Understand the architecture of typical SS7 networks**
- **Appreciate the different types of applications that rely on SS7**

SS7 Topics

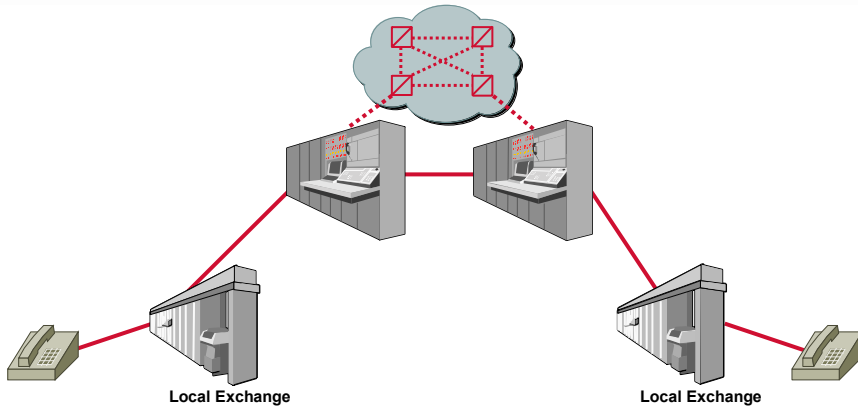
- Signaling Evolution
- Network Architecture
- Applications

Signaling Evolution Pre-Common Channel Signaling



Link-by-Link Seizure and Outpulsing
Per-Trunk Signaling Equipment
Long Post-Dialing Delays
Susceptibility to Fraud

Signaling Evolution 1976 – AT&T Introduces Common Channel Interoffice Signaling

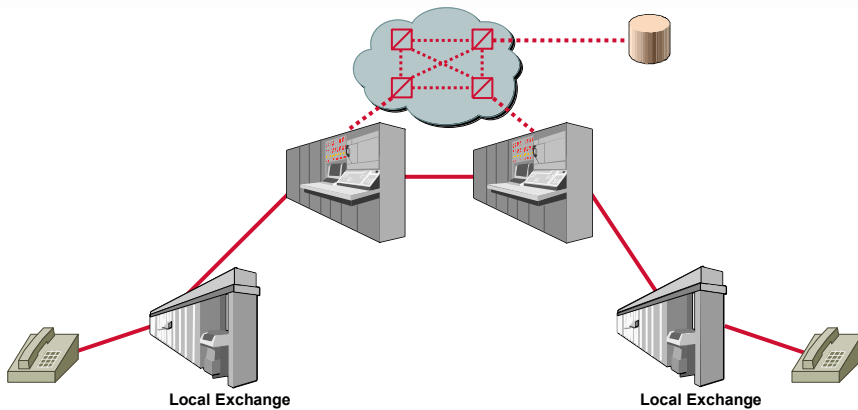


Separate Network Dedicated to Signaling
Out-of-Band Call Establishment
Eliminate Per-Trunk Signaling Equipment
Faster Call Setup

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Signaling Evolution 1980-Centralized Database Services



Calling Card
800
Virtual Private Network

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Signaling Evolution

Today-Widespread SS7 Deployment



--- Most major carriers interconnect using SS7

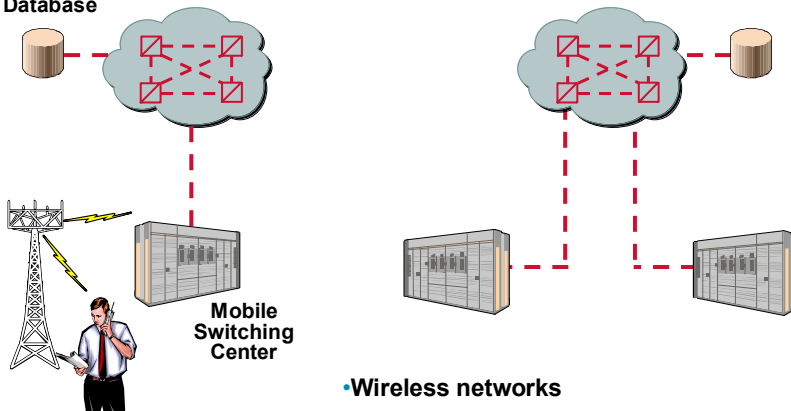
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SS7 Evolution

Widespread Deployment

Location Database



- Wireless networks
- Within and between international networks

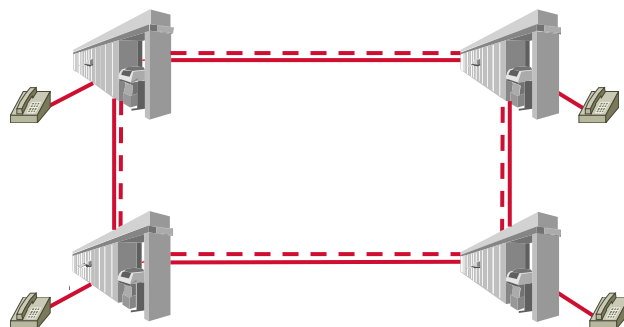
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SS7 Topics

- Signaling Evolution
- **Network Architecture**
- Applications

SS7 Network Architecture



— Voice/Data Trunks
- - Signaling Links

Associated Signaling

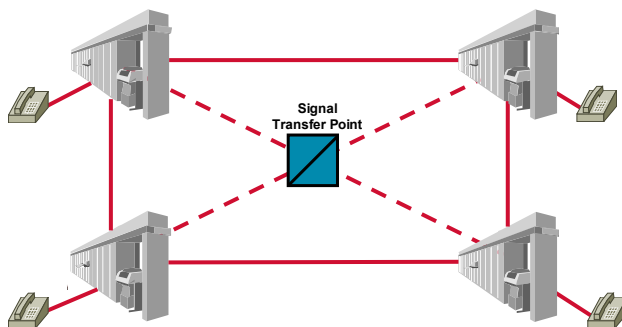
Service Switching Point (SSP)

A switching system (e.g., DMS-100, 5ESS, GTD-5, AXE, EWSD), including any remote modules hosted by it, that is equipped with SS7 hardware, software, and signaling links



SSP

SS7 Network Architecture

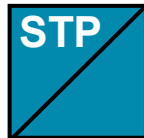


Quasi-associated Signaling

— Voice/Data Trunks
- - Signaling Links

Signal Transfer Point (STP)

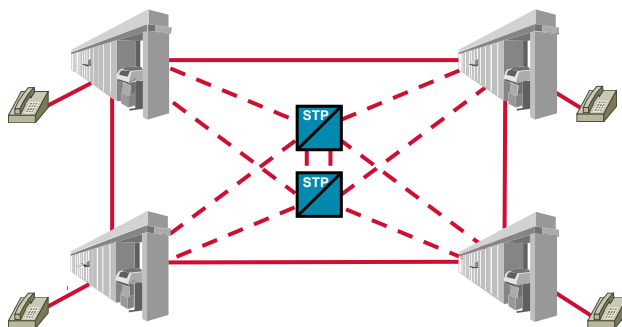
High-speed, ultra-reliable, special-purpose packet switch for signaling messages in the SS7 network



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SS7 Network Architecture



Mated STP Pairs to Improve Reliability

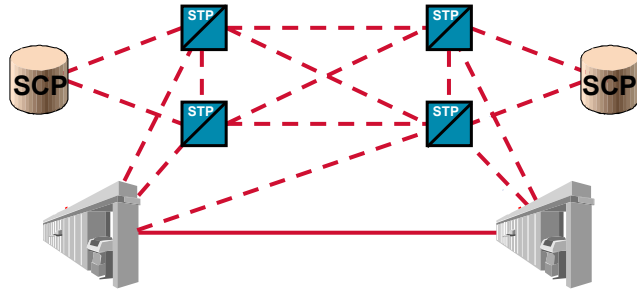
— Voice/Data trunks
- - - Signaling Links

STP = Signal Transfer Point

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SS7 Network Architecture

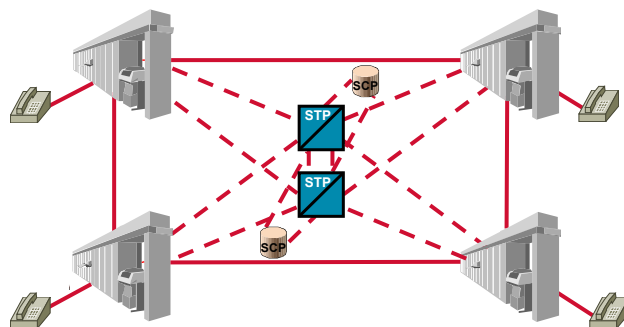


Fully Interconnected Separate Signaling Network

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SS7 Network Architecture



Centralized Database Services

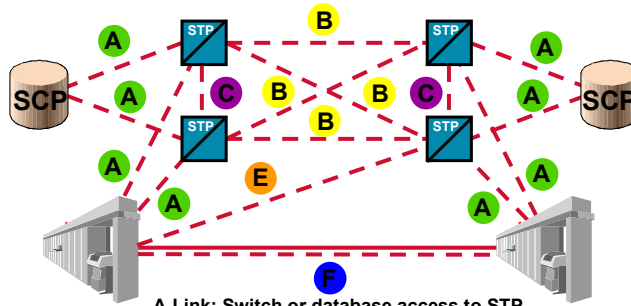
— Voice/Data trunks
- - Signaling Links

SCP = Service Control Point
STP = Signal Transfer Point

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SS7 Network Architecture



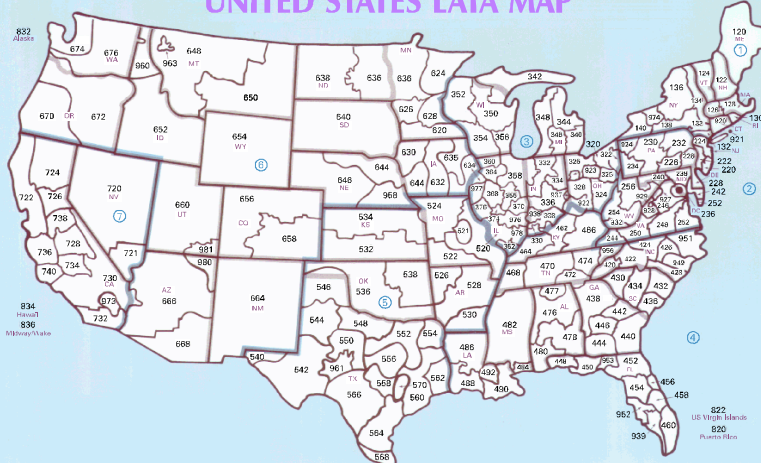
- A-Link:** Switch or database access to STP
- B-Link:** Interconnects STP pairs in different regions
- C-Link:** Connects mated STP pairs
- D-Link:** SS7 Network Interconnect
- E-Link:** Connects switch to STP in another region
- F-Link:** Associated signaling (direct switch-to-switch)

SCP = Service Control Point

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UNITED STATES LATA MAP



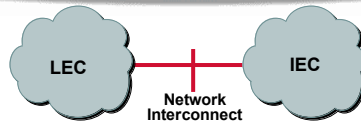
* LATA - Local Access Transport Area

900-numbered LATAs are served by Independent Telcos

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Network Interconnect/Feature Group Access



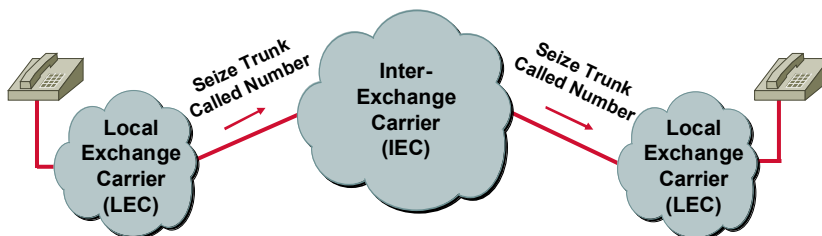
FEATURE GROUP A - No uniform access code (local number)
Two-stage dialing
No Automatic Number Identification(ANI)
No answer supervision

FEATURE GROUP B - Uniform access code
Two - stage dialing
ANI provided if connected directly to originating office
Answer supervision

FEATURE GROUP D - Uniform access code(1+; 101XXXX+)
One - stage dialing
ANI provided
Answer supervision

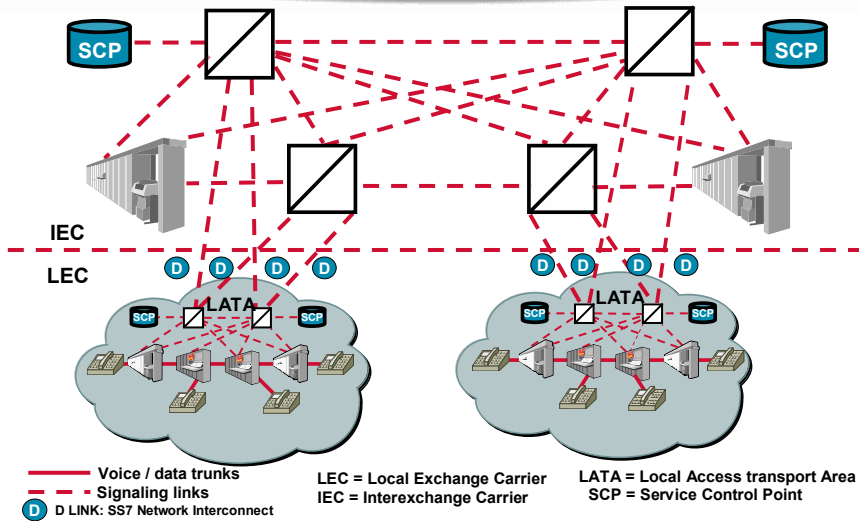
SS7 Network Interconnect is an enhancement to Feature Group D for LEC - to - IEC connections

Access Fees



- LEC charges IEC for originating and terminating access
- Makes IECs single largest customer of LECs
- Single largest expense for IECs

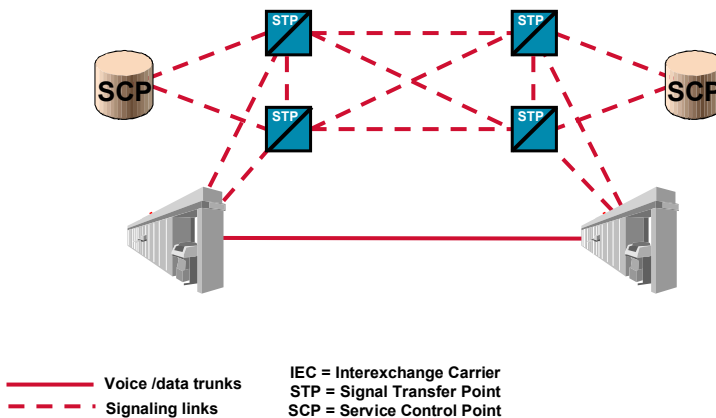
SS7 Architecture LEC-IEC Network Interconnect



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IEC SS7 Architecture Regional STPs Based on Network Traffic



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SS7 Topics

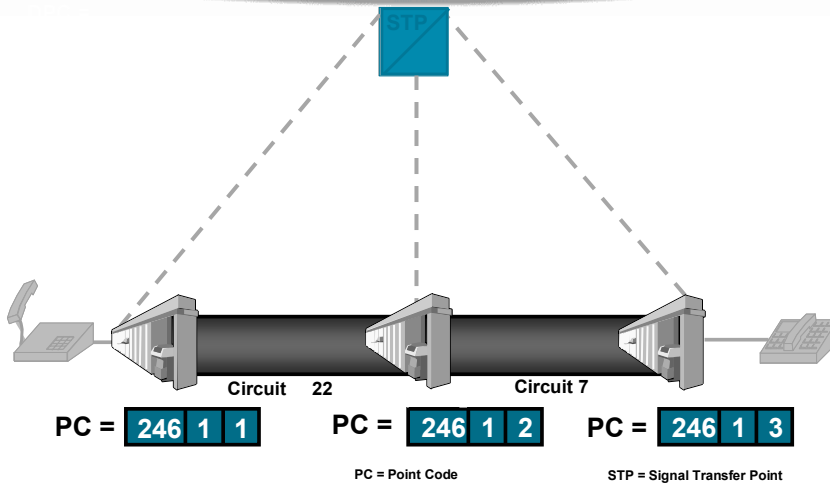
- Signaling Evolution
- Network Architecture
- **Applications**

SS7 Applications

- **Circuit-Switched Call Control**
- **Call Related Supplementary Services**
 - e.g. CLASS
- **Centralized Data Base Services**
 - e.g. 800
- **Intelligent Network**

Circuit-Switched Call Establishment

Each SS7 Endpoint has a Unique Point Code

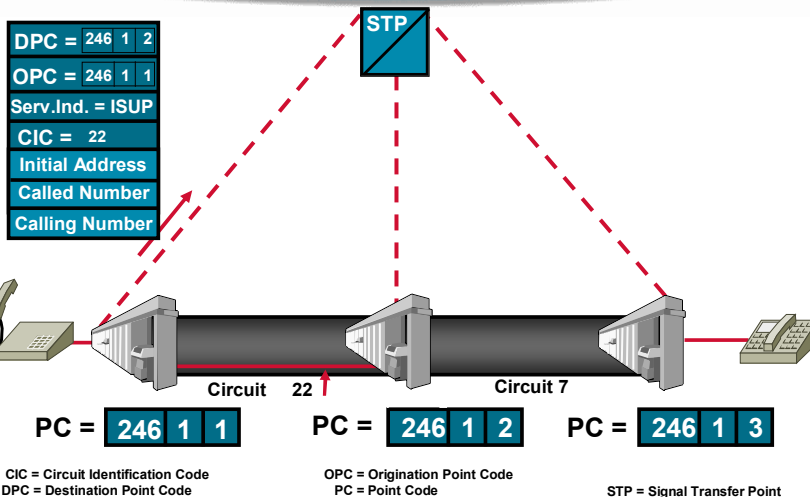


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Circuit-Switched Call Establishment

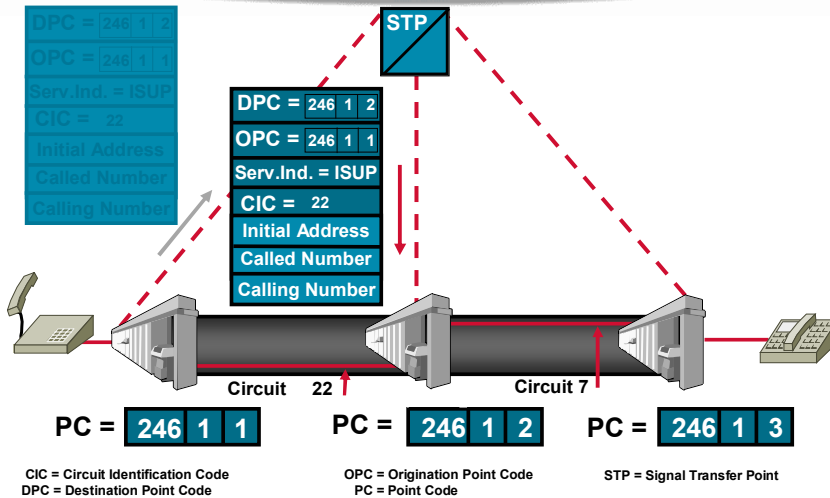
Using Initial Address Message



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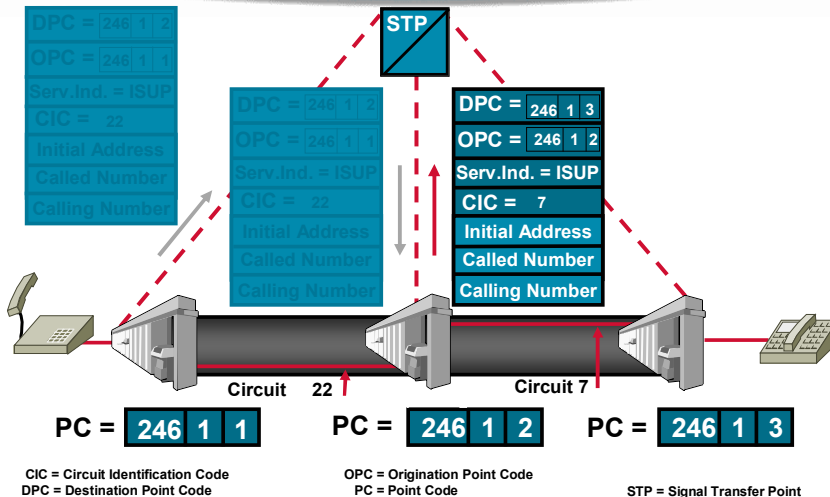
Circuit-Switched Call Establishment Using Initial Address Message



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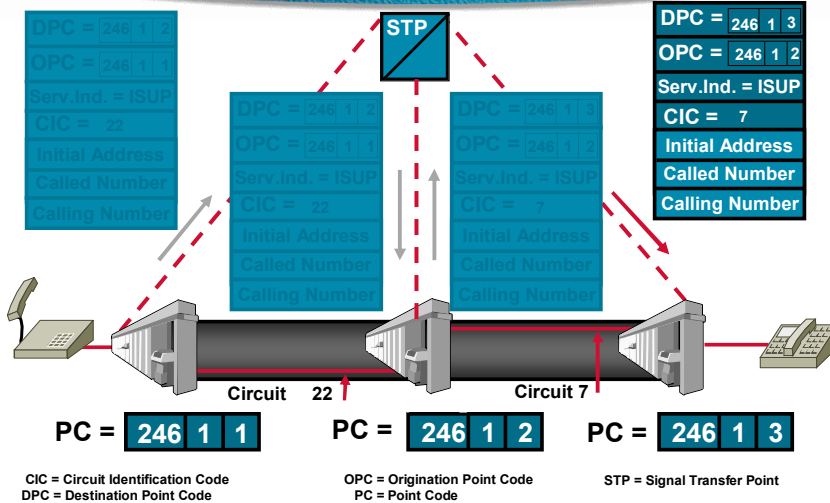
Circuit-Switched Call Establishment Using Initial Address Message



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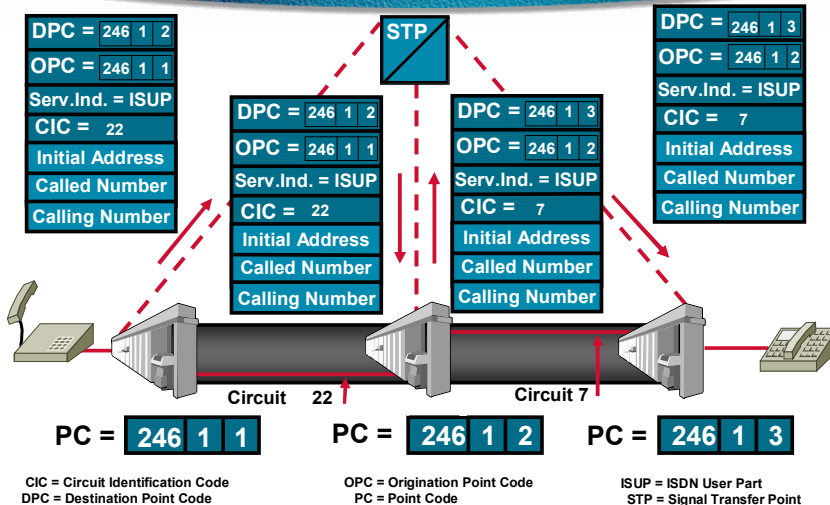
Circuit-Switched Call Establishment Using Initial Address Message



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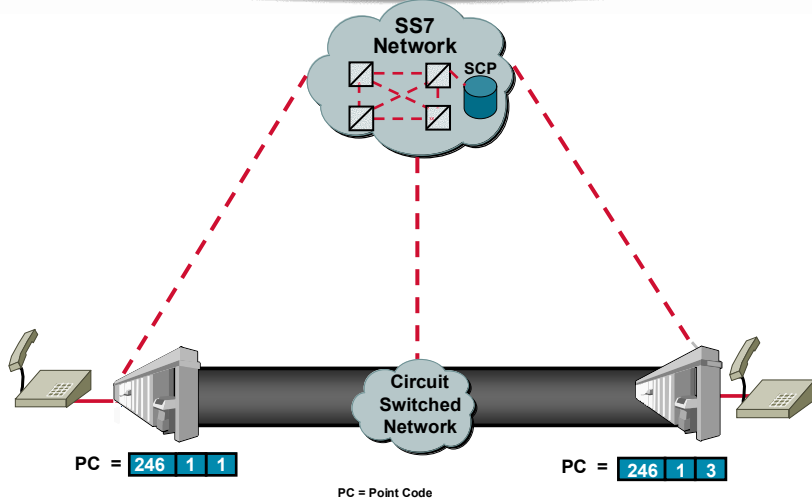
Circuit-Switched Call Establishment Using Initial Address Message



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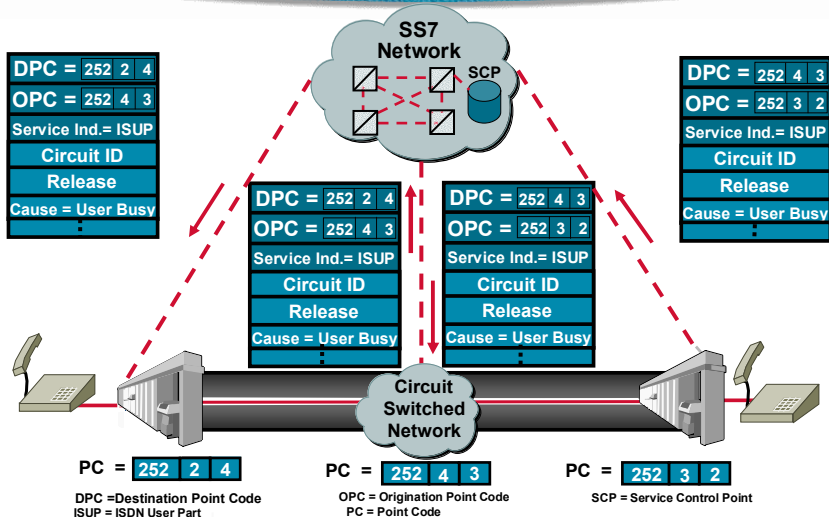
Generalized Network Configuration



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SS7 Network Efficiency Local Busy Indication



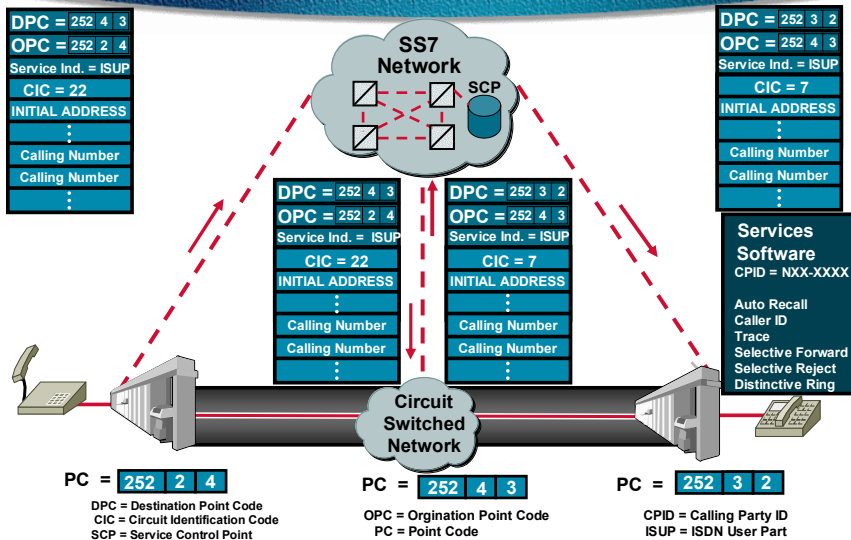
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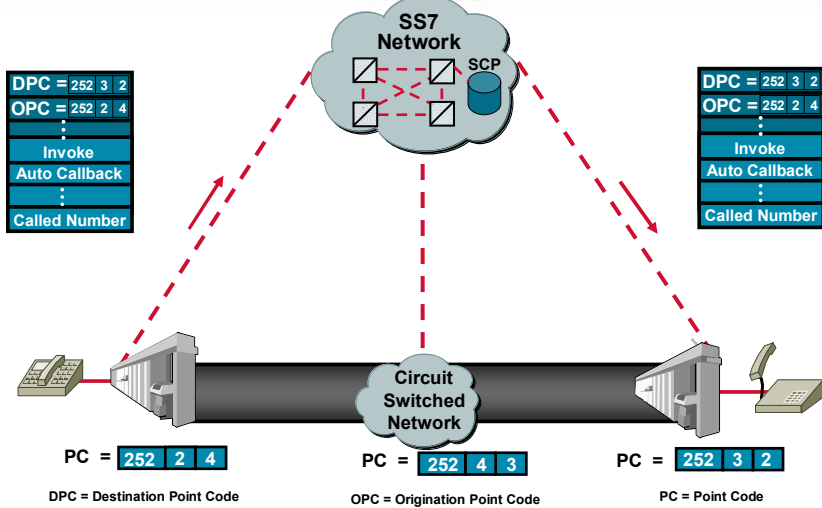
SS7 for Inter-Switch Services

- Automatic Recall
- Automatic Callback
- Caller ID
- Caller ID Blocking
- Customer Originated Trace
- Selective Call Forwarding
- Selective Call Rejection
- Selective Call Acceptance
- Selective Call Ringing

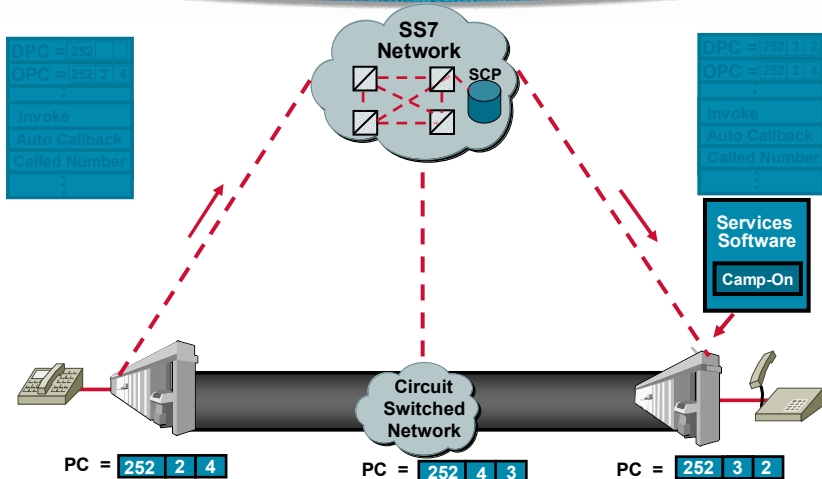
SS7 for Inter-Switch Services Most Services Based on Calling Party ID



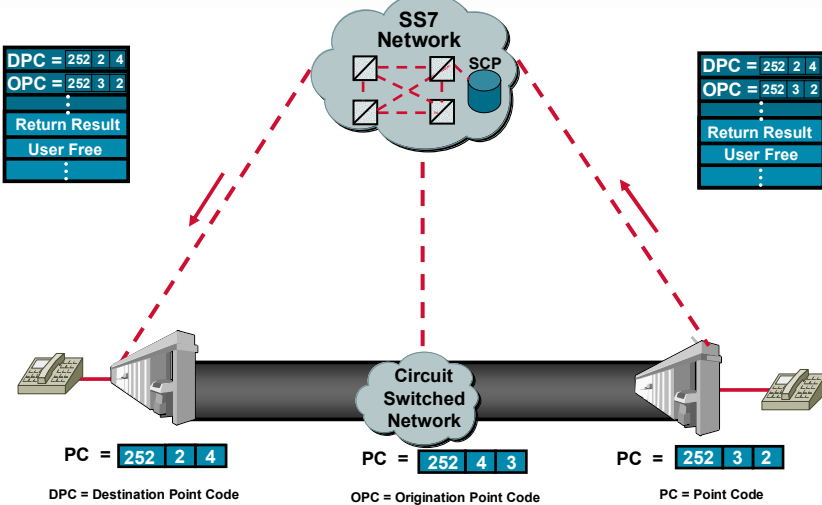
SS7 Support for Inter-Switch Services Auto CallBack – Initial Request



SS7 Support for Inter-Switch Services Auto Callback-Initial Request



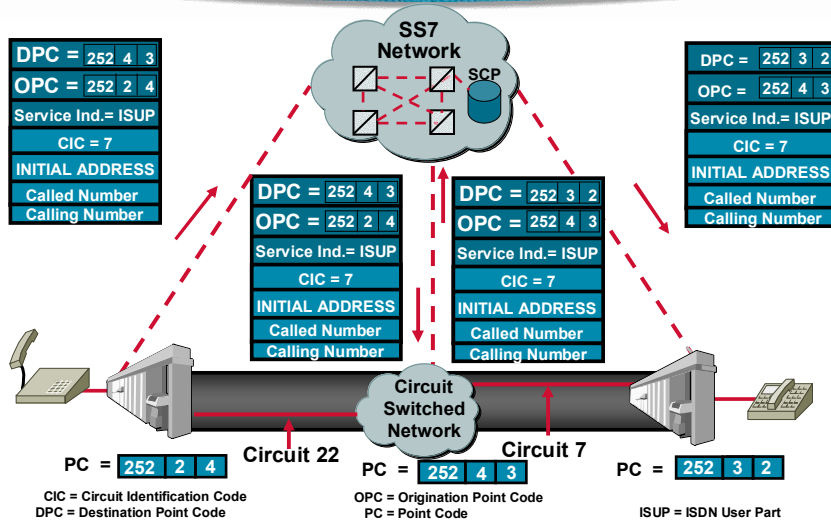
SS7 Support for Inter-Switch Services Auto Callback - User Free



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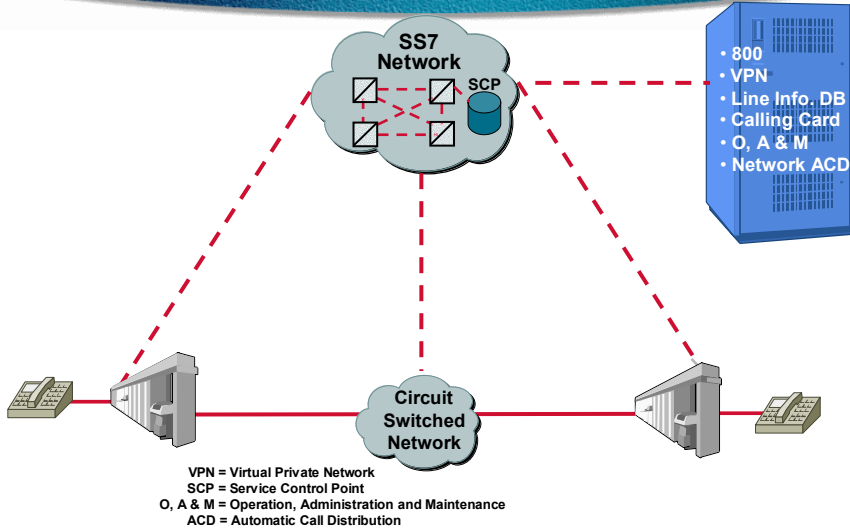
SS7 Support for Inter-Switch Services Auto Callback - Complete Call



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SS7 Applications Centralized Services

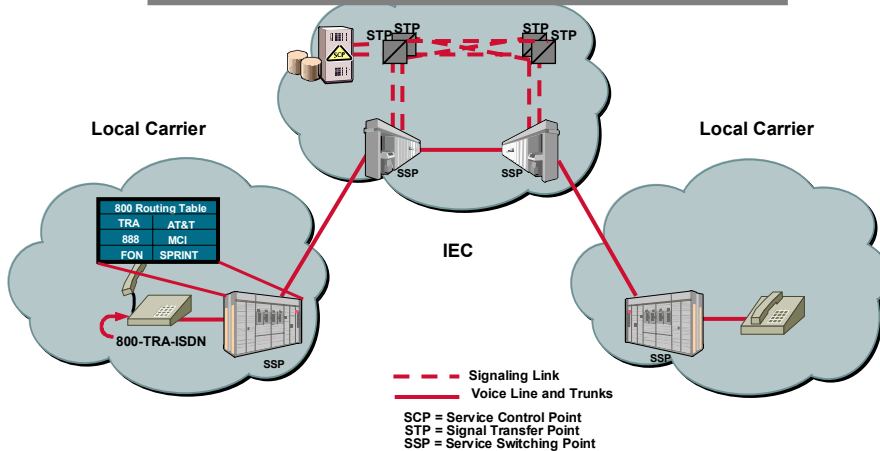


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800 Service (Before May, 1993)

Step 1 : Local Switch (SSP) does lookup to determine Interexchange Carrier based on NXX

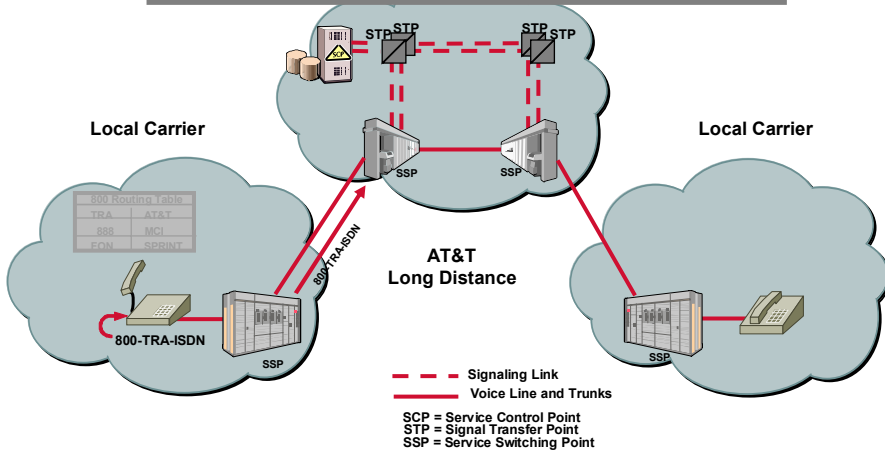


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800 Service (Before May, 1993)

Step 2 : Local Carrier Switch (SSP) Passes Dialed 800 Digits to AT&T Switch (SSP)

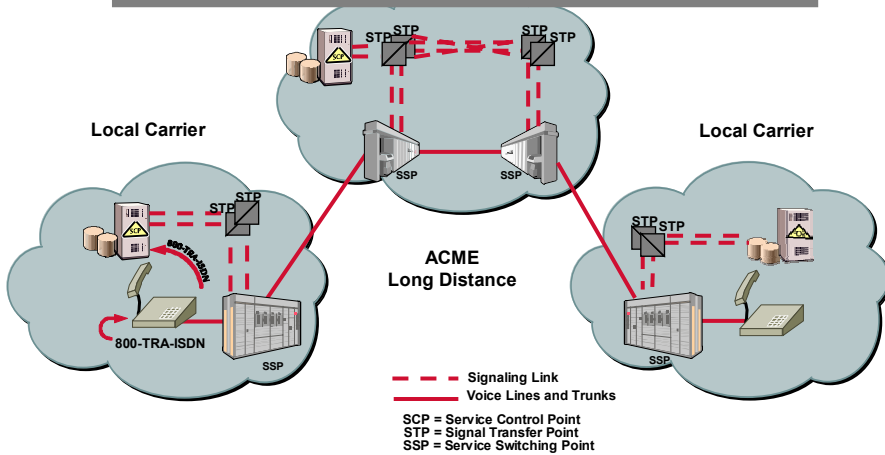


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800 Portability (Beginning May, 1993)

Step 1: Dialed "800" triggers local switch (SSP) to suspend call processing and query local database (SSP) for subscribed 800 service carrier

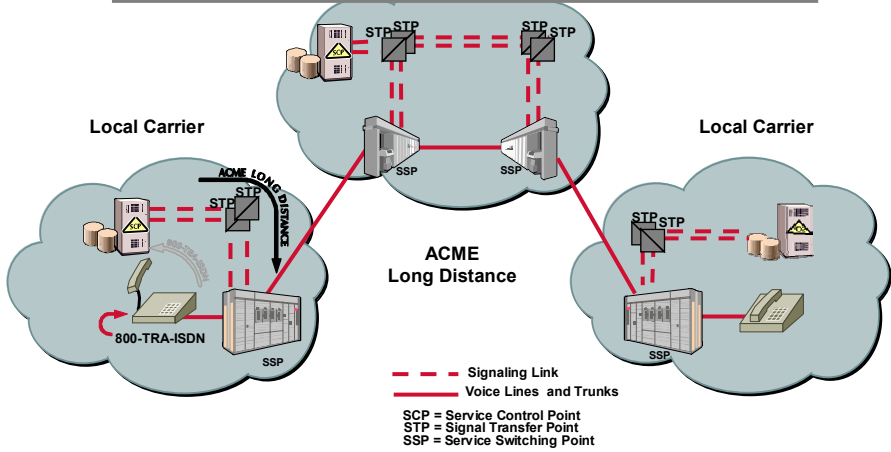


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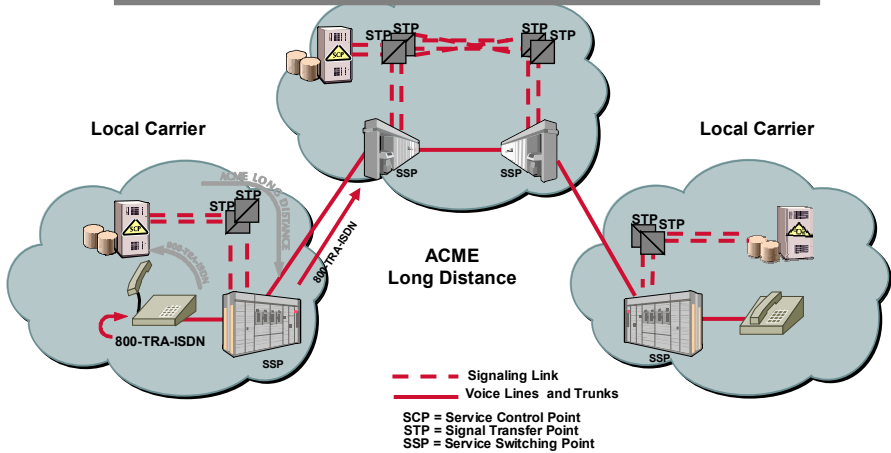
800 Portability (Beginning May, 1993)

Step 2 : Local carrier database (SCP) responds that this 800 customer uses ACME Long Distance service



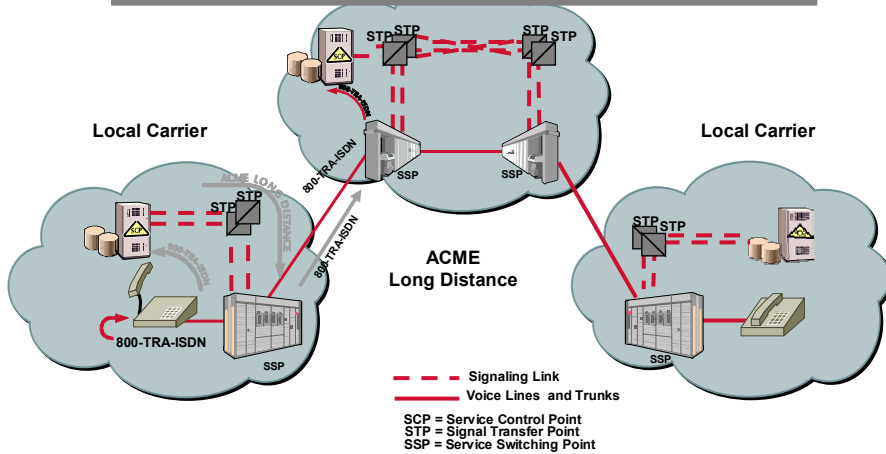
800 Portability (Beginning May, 1993)

Step 3 : Local carrier switch (SSP) passes dialed 800 digits to ACME Long Distance switch (SSP)



800 Portability (Beginning May, 1993)

Step 4 : Dialed "800" triggers long distance switch (SSP) to suspend call processing and query ACME database (SCP) for routable number

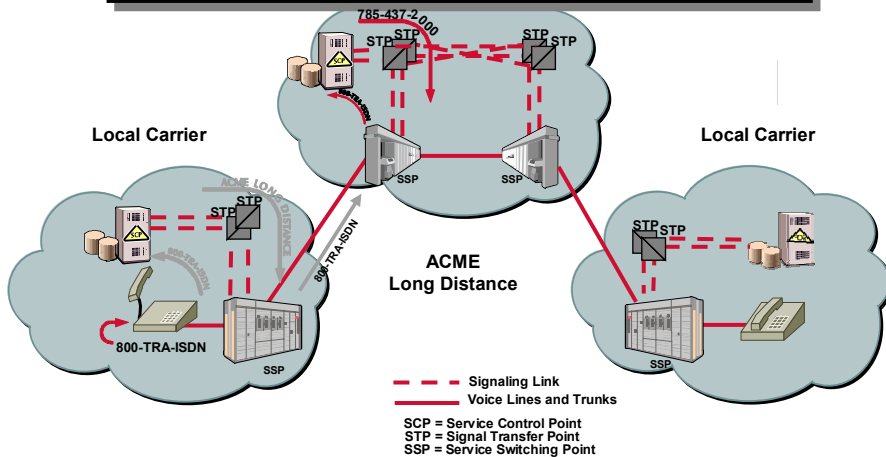


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800 Portability (Beginning May, 1993)

Step 5 : ACME database (SCP) responds that 800-TRA-ISDN is a virtual address for 785-437-2000

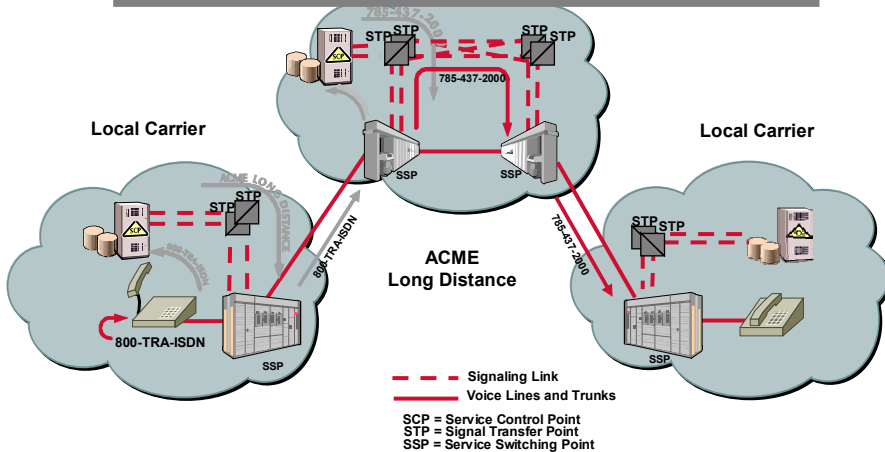


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800 Portability (Beginning May, 1993)

Step 6 : ACME switches (SSPs) and local switches (SSPs) complete the call Using standard Signaling System 7 messages

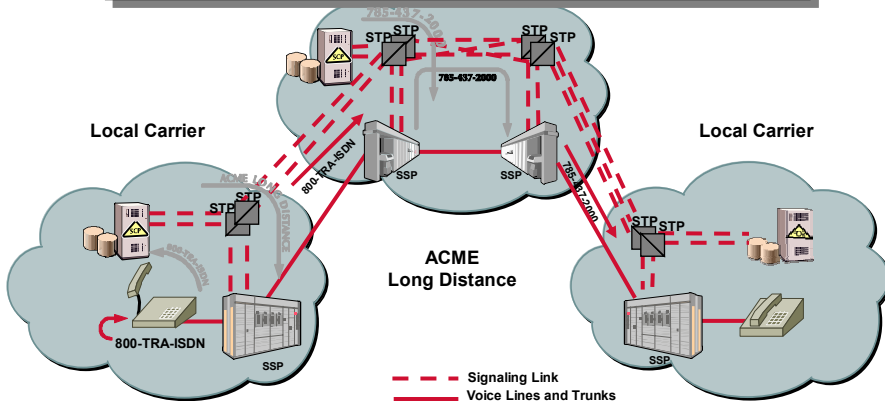


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800 Portability (Beginning May, 1993)

Signaling links between Local - Carrier and Long Distance Carrier STPs to reduce Post - Dial Handoff Delay for 800 and other Calls



Note: SS7 Interconnect Links required to meet FCC Mandate of Post Dial Delay less than 5 second

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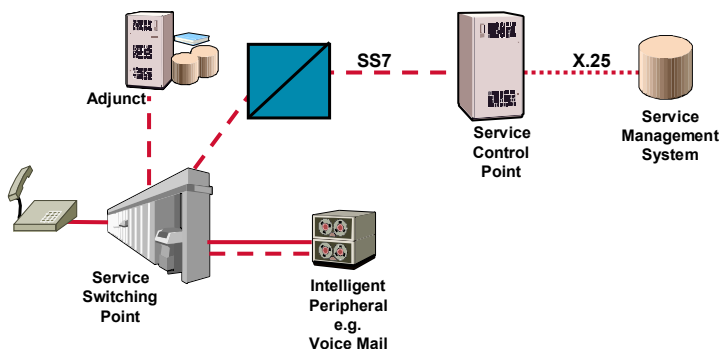
Databases for Portable 8xx (Toll Free) Services

- Master Database which maps 8xx numbers to designated Carriers is administered NeuStar, Inc., which took over this function from Lockheed in November, 1999
- Updates sent from Master Database to Regional Bell Company and other Local Telephone Company databases every 15 minutes
- Interexchange carriers still maintain databases that translate 8xx numbers to routable numbers
- Customers may specify percentages of 8xx traffic directed to multiple Interexchange Carriers

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SS7 Applications Intelligent Network



- SS7 Provides the Underlying Transport for IN Services
- Initial Network-Based IN Services are those Currently Associated with SS7: 8XX, VPN, Calling Card, . . .

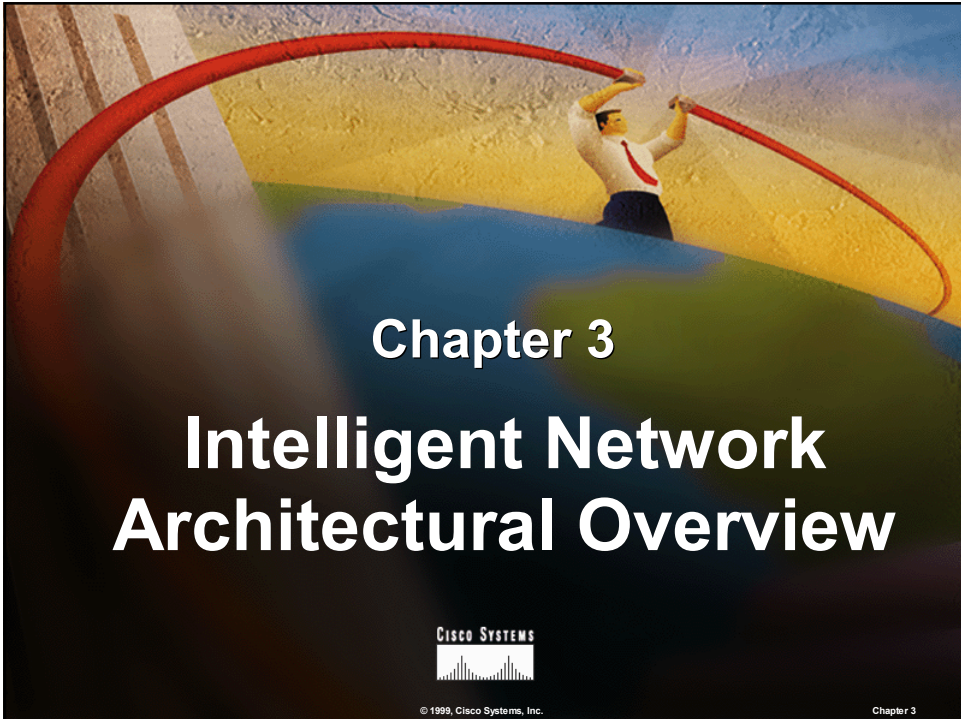
VPN = Virtual Private Network

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Signaling System #7 Evolution, Architecture and Applications Summary

- **SS7 is used to improve network efficiencies and, probably more importantly, to support network-based services**
- **SS7 supports 100% of the signaling traffic in the AT&T, MCI WorldCom and Sprint networks**
- **800 portability drove widespread deployment of SS7 in LEC networks**
- **Interconnection of LEC and IEC SS7 Networks supports services like 800 Portability and Nationwide Caller ID**
- **SS7 Network Architecture has been designed to provide extremely reliable transport of signaling information**
- **SS7 plays a fundamental role in the “Intelligent Network”**



Objectives

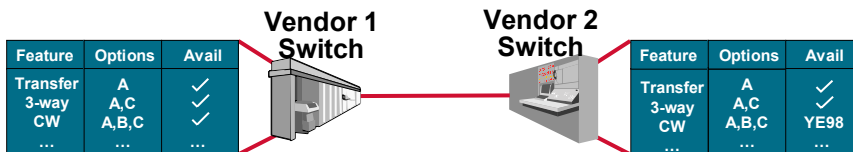
At the completion of this section you will:

- **Understand why Intelligent Networks have been deployed**
- **Know the different network elements defined by the Advanced Intelligent Network (AIN) specifications**
- **Be familiar with typical services deployed using AIN**

In Architecture Topics

- IN Definitions and Motivations
- Advanced Intelligent Network Architecture
- Services at a Glance

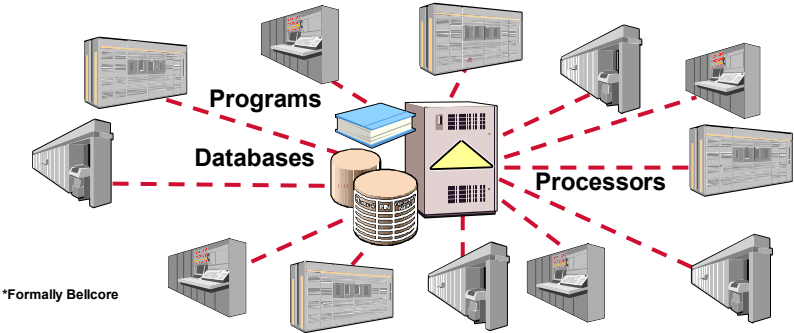
Network Services Prior to Intelligent Networks



- Multi-vendor network of tremendously complex switching systems
- Long development cycles and expensive switch software upgrades
- Long and expensive process of network upgrade
- Lack of ubiquity in terms of feature performance and availability

Intelligent Networks

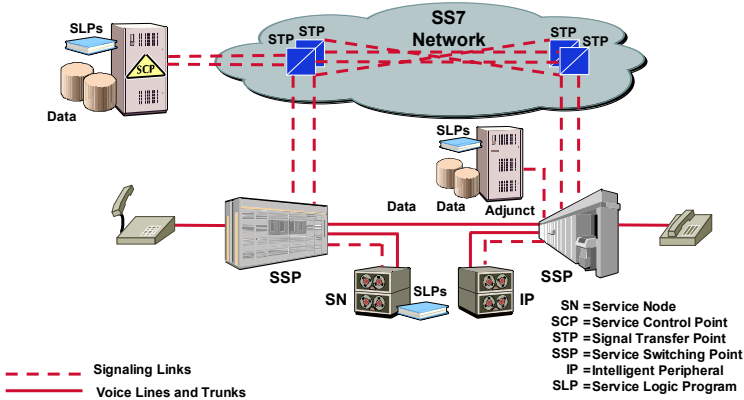
Centralized software and application data shared among different switches using standard interfaces for common features



Key Motivations

Respond Rapidly to Customer Needs

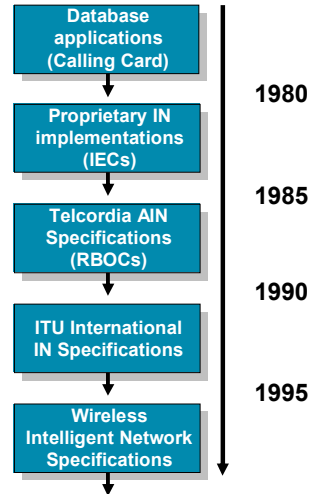
- Service Customization
- Service Creation
- Service Introduction



Intelligent Network Specifications

- Initial database services evolved into propriety IN implementations (IECs)
- Telcordia (formerly Bellcore) defined Advanced Intelligent Network (AIN) specification for the RBOCs
- The ITU, using AIN as a baseline, continues to define international IN standards
- Wireless Intelligent Network specifications are evolving based on ITU standards

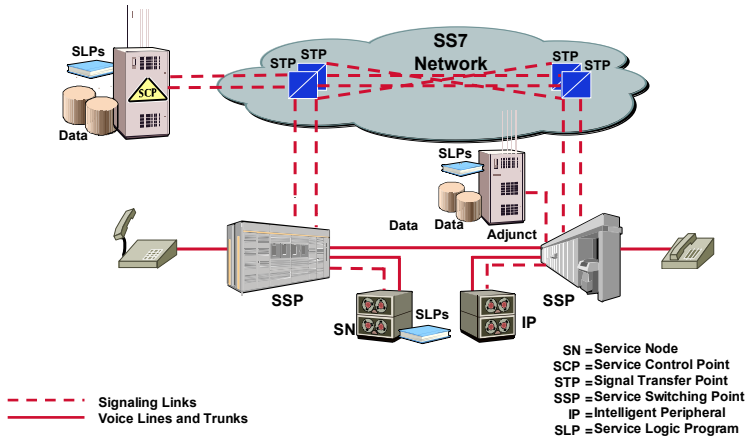
IEC = Inter-Exchange Carrier
ITU = International Telecommunications Union
RBOC = Regional Bell Operating Company



In Architecture Topics

- IN Definitions and Motivations
- **Advanced Intelligent Network Architecture**
- Services at a Glance

Advanced Intelligent Network (AIN)



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Service Switching Point (SSP)

A switching system (such as DMS-100, 5ESS, GTD-5, AXE or EWSD), including any remote modules hosted by it, that is equipped with SS7 hardware, software, and signaling links
For AIN, certain events occurring in processing a call (such as analyzing dialed digits with a toll-free dialing code or for Local Number Portability) will trigger suspension of call processing while communication occurs with another processor (either an SCP or adjunct)



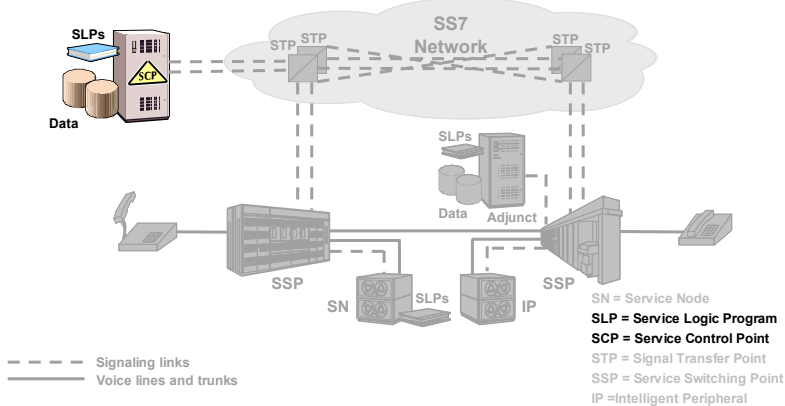
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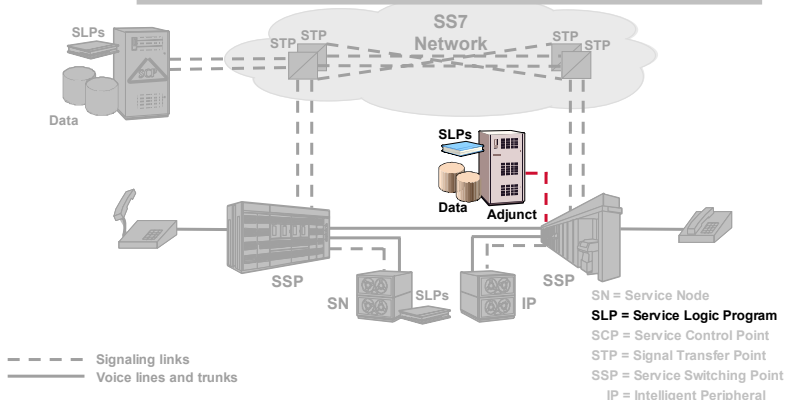
Service Control Point (SCP)

A highly reliable computer and database system which runs Service Logic Programs to provide customer services through Service Switching Points



Adjunct

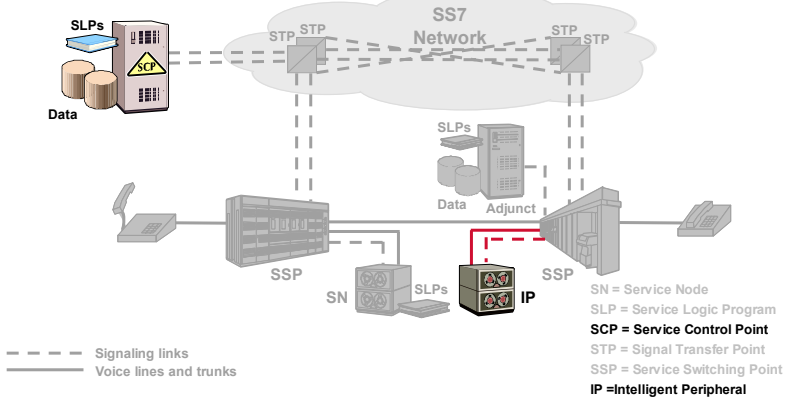
A highly reliable computer and database system which executes Service Logic Programs (SLPs) to provide additional customer services through a switch (SSP). Unlike an SCP, uses a high-speed message connection to the switch such as Ethernet and is therefore preferred to an SCP for message-intensive applications



Intelligent Peripheral (IP)

An AIN resource node which is controlled by external service logic typically resident on an SCP. The IP may contain resources to facilitate customer interaction such as:

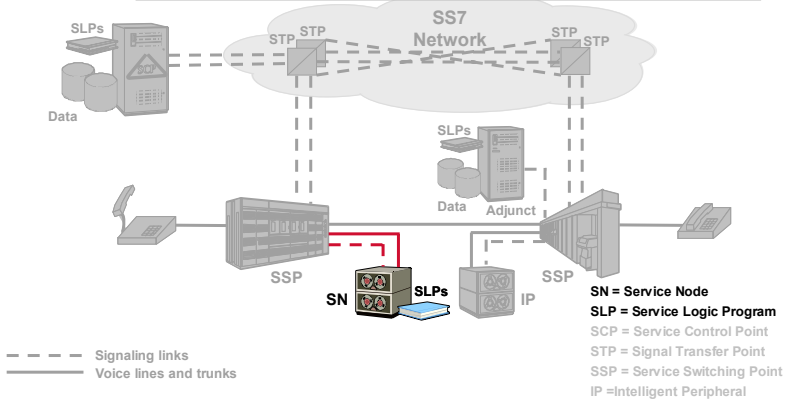
- Voice storage
- Fax storage
- Voice prompting
- Tone decoders
- Voice synthesis
- Conference circuits



Service Node (SN)

An AIN network element to provide new customer services. An SN supports autonomous service logic and may contain resources to facilitate customer interaction such as:

- Voice storage
- Fax storage
- Voice prompting
- Tone decoders
- Voice synthesis
- Conference circuits



Service Management System (SMS)

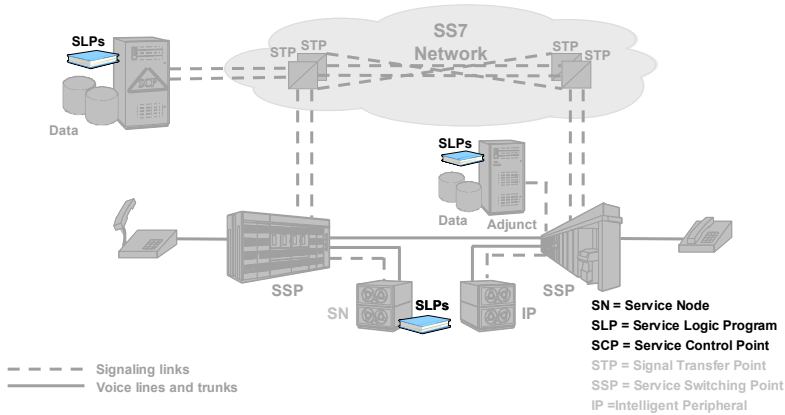
- **A sophisticated, reliable processing system that supports the OAM&P (Operations, Administration, Maintenance, and Provisioning) needs of Intelligent Networks**
- **The SMS is typically connected to SCPs, Intelligent Peripherals, and other network elements via X.25 or other standard data communications link**

Service Creation Environment (SCE)

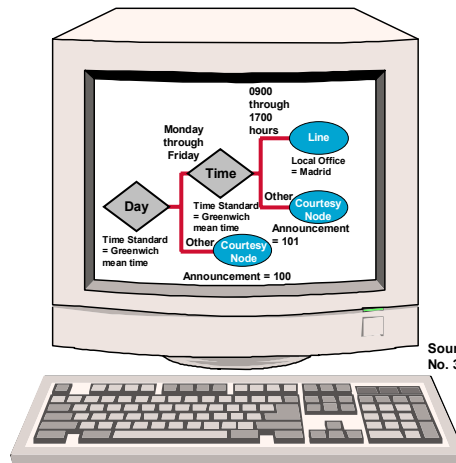
- **A set of tools employed for the development of new services and applications that run in an Intelligent Network**
- **Service software created with an SCE and associated data are typically loaded into network elements via an SMS**

Service Logic Program (SLP)

A program that runs in an SCP, adjunct or SN to Direct call processing to provide a customer service (e.g., 800 translation, calling card verification)

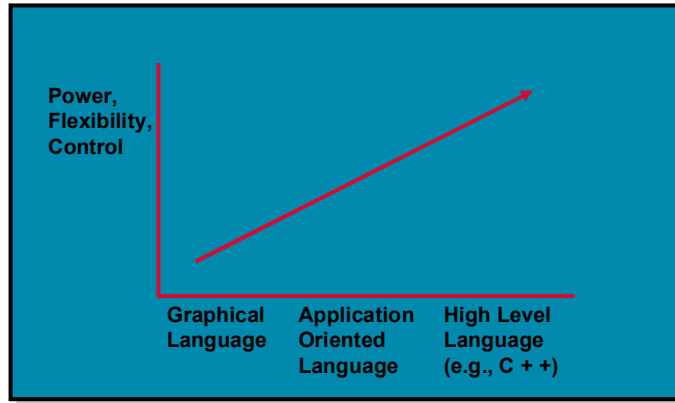


Service Creation Station



Source: AT&T Technical Journal, Vol 70, No. 3-4, Summer 1991, p. 62

Service Creation Languages Type vs. Capability



In Architecture Topics

- IN Definitions and Motivations
- Advanced Intelligent Network Architecture
- **Services at a Glance**

How Big is the Market?

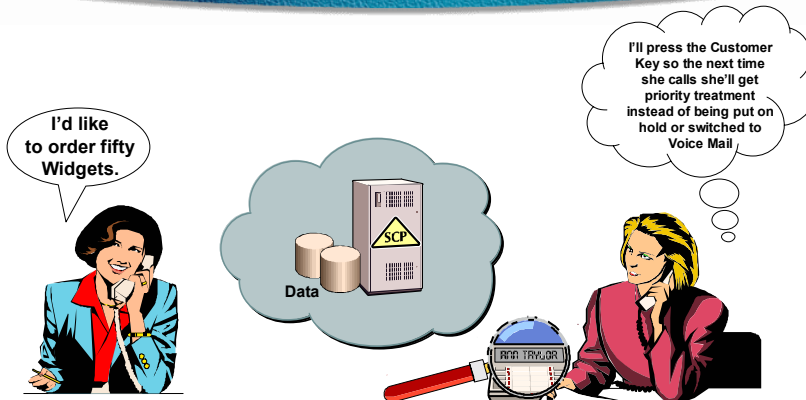
U.S. IN Service Revenues (\$B) ¹	
Toll Free (8xx)	19.8
Calling Card ²	7.4
VPN	2.8
Calling Name	2.2
Voice Mail ³	1.5
Wireless ⁴	0.7
Other	0.3

Worldwide IN Product Revenues (\$B) ⁵	
1998	5.0
2000	7.5
2003	14.4
2007	27.0

- 1: Source: Bell Atlantic (1997)
- 2: Frost & Sullivan
- 3: IDC/Link
- 4: Insight Research
- 5: Communications Industry Researchers

VPN = Virtual Private Network

AIN Incoming Call Management for Small Business



Huge opportunity to sell both Services and Customer Premises Equipment to Small Businesses

SCP = Service Control Point

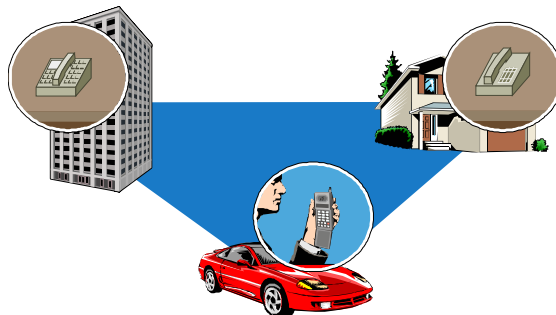
AIN Service Caller ID with Call Announcer



"The Tin Man from Acme Home Siding" is calling.
Press 1 to accept the call
Press 2 to send to voice mail
Press 3 to play "No Solicitations" announcement

Subscriber hears distinctive ring if caller identifies themselves, hears caller recording, then chooses among call handling options

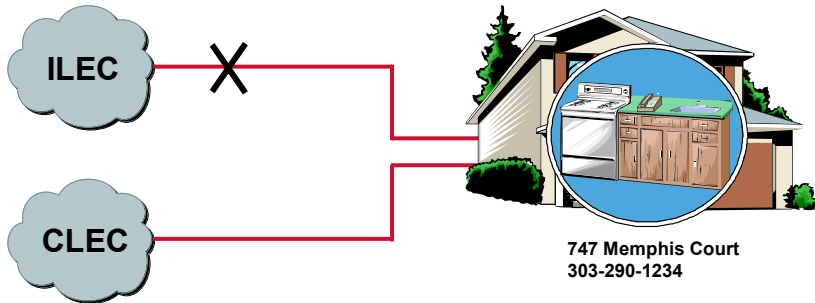
AIN Services Single Number Service



Provides a Single Contact Number for routing calls to any set of wireless or wireline phones specified by the subscriber

Local Number Portability Draft Definition

Allowing subscribers to switch local service providers without switching telephone numbers



LEC = Local Exchange Carrier
ILEC = Incumbent LEC
CLEC = Competitive LEC

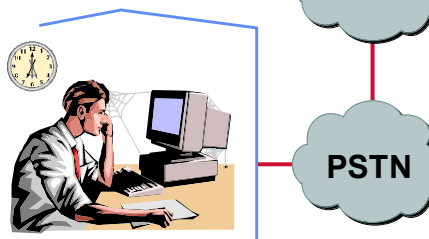
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AIN Services Internet Call Congestion Relief

Avg. Duration of US Call (minutes)*	
Standard voice	3.7
Internet	23.0



Application provides intelligence to divert call to the ISP and off of the circuit switched network as soon as possible, minimizing the number of circuits in the call path

ISP = Internet Service Provider
PSTN = Public Switched Telephone Network

*U S West, 1997

Cisco Systems

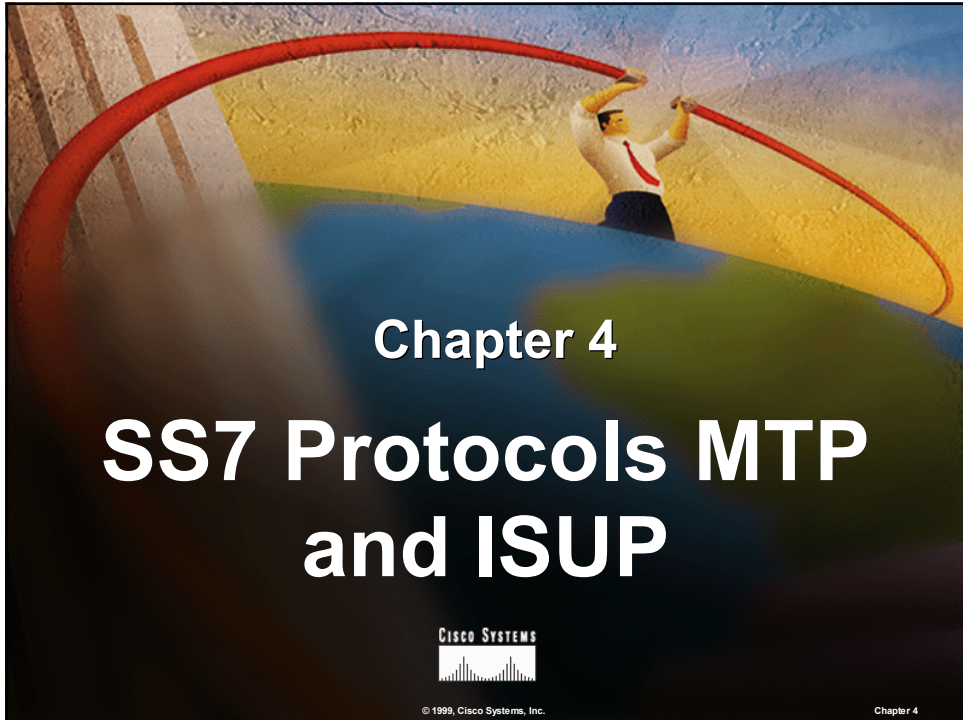
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AIN Architectural Overview Summary

- **AIN gives Network Service Providers increased control over the services offered in their networks**
- **Service Control Points and Adjuncts connect to the SSP via a data link and provide instructions directing call processing**
- **Intelligent Peripherals and Service Nodes are connected SSP via a voice path and a data link and directly control the call**
- **A Service Logic Program is the software running in an AIN network element that directs call processing to provide a customer service**
- **LECs, IECs, CAPs, Cable Companies and Wireless Providers are using Intelligent Networking as a way to efficiently introduce new services into their networks**

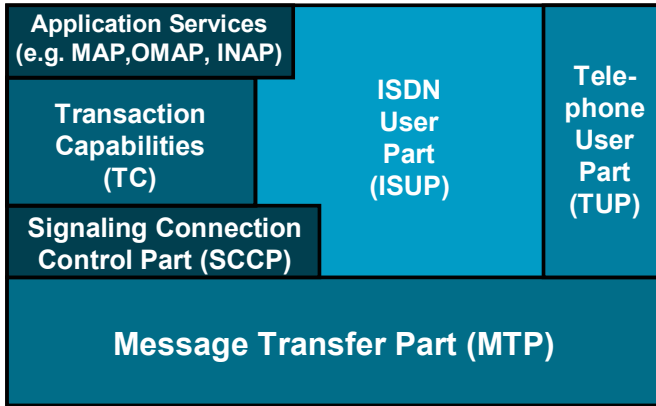
SSP = Service Switching Point
LEC = Local Exchange Carrier
IEC = Interexchange Carrier
CAP = Competitive Access Provider



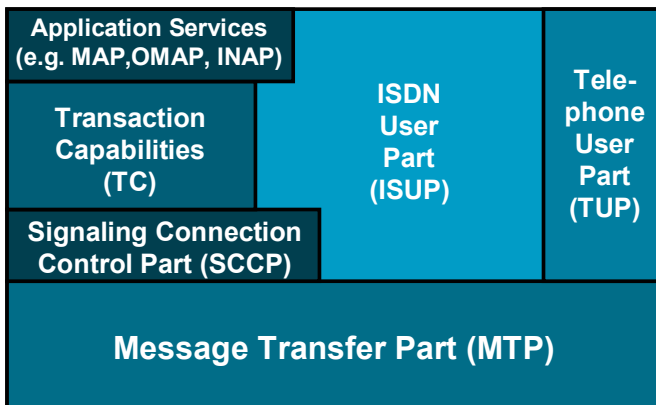
SS7 Protocol Topics

- **Protocol Architecture**
- **Message Transfer Part**
- **ISDN User Part**
- **Signaling Connection Control Part**
- **Transaction Capabilities**

SS7 Protocol Architecture



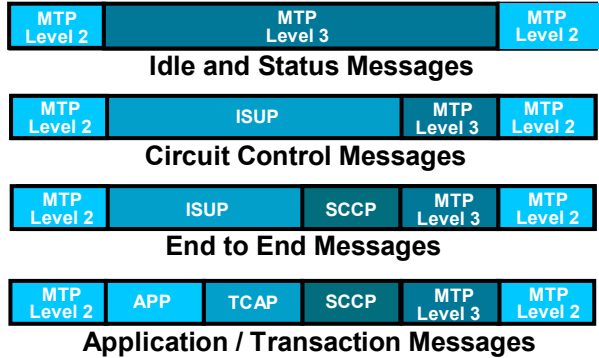
SS7 Protocol Architecture SS7 Alignment with OSI Layers



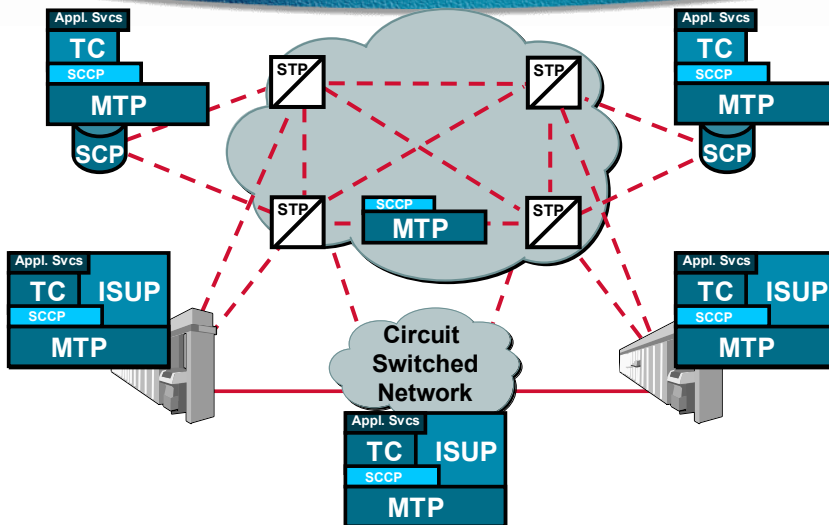
OSI Layer

- 7 Application
- 6 Presentation
- 5 Session
- 4 Transport
- 3 Network
- 2 Data Link
- 1 Physical

SS7 Layered Architecture Bit Stream



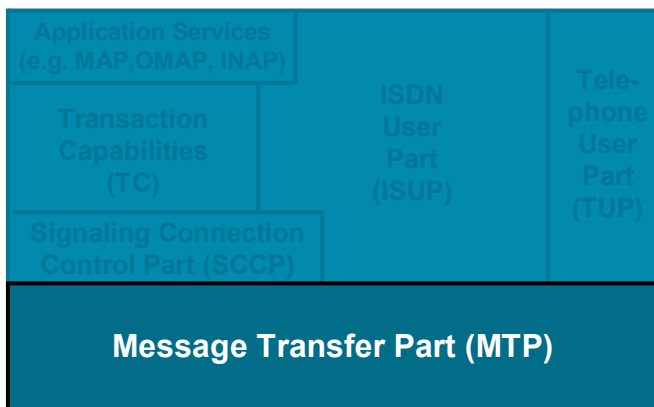
SS7 Protocol Deployment



SS7 Protocol Topics

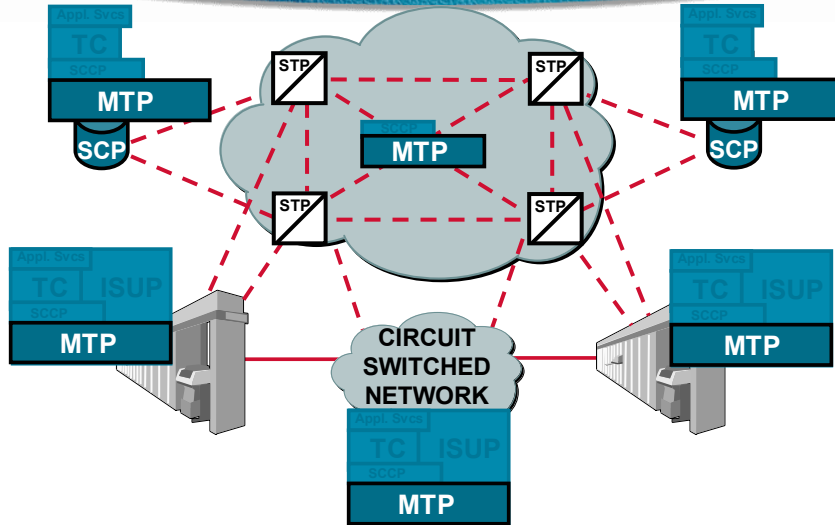
- Protocol Architecture
- Message Transfer Part
- ISDN User Part
- Signaling Connection Control Part
- Transaction Capabilities

SS7 Protocol Architecture



**Reliable Transport and Delivery of Signaling Messages
Across the SS7 Network**

SS7 Protocol Deployment Message Transfer Part (MTP)



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Message Transfer Part Objective Provide a Reliable Network for Transfer of Signaling Messages

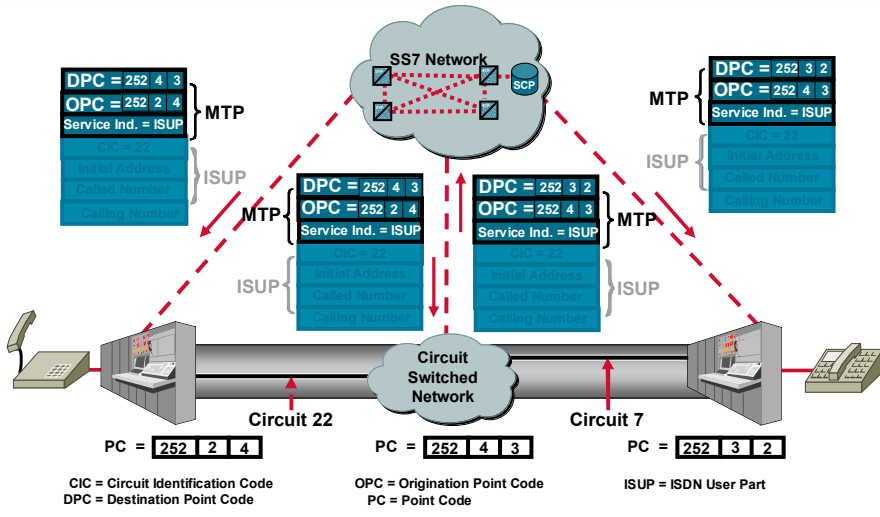
- Define address scheme for message routing
- Reliable message transport
 - Sequence integrity
 - Retransmission
 - Flow control
- Signaling network management
 - Congestion management
 - Traffic rerouting around failures

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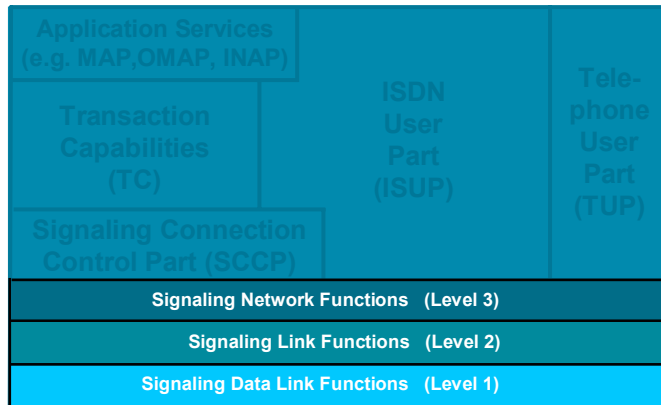
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Circuit-Switched Call Establishment Using Message Transfer Part



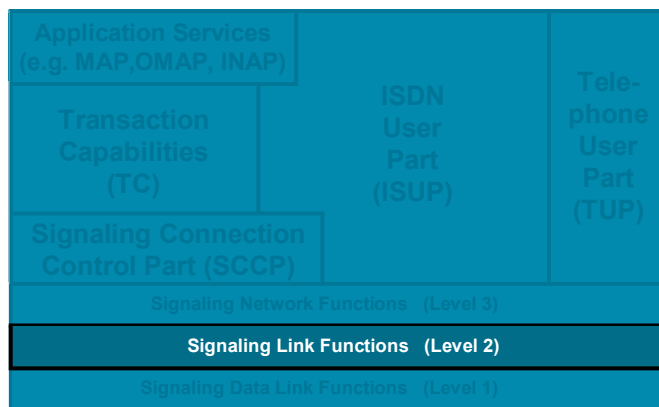
Message Transfer Part Objective: Reliable Transport and Delivery of Signaling Messages Across the SS7 Network



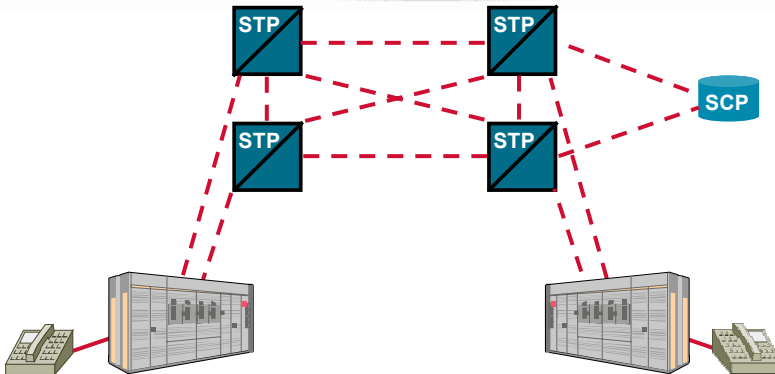
Signaling Data Link

- **64 Kb/s Digital Link is Standard**
 - **1.5 Mb/s and 56 Kb/s used currently in the U.S.**
 - **Minimum Bit Rate is 4.8 Kb/s**
 - **Analog Link is permitted**
- **May be Individual Data Link or a Channel in a Multiplex System (e.g. a DSO Time Slot in a DS1)**

Message Transfer Part Objective: Reliable Transport and Delivery of Signaling Messages Across the SS7 Network



Signaling Link



- Reliable Transport of Information on Individual Link
- Each of the 12 Links illustrated here is managed individually

Signaling Link Functions

- Initial Alignment
- Signal Unit Delimitation and Alignment
- Error Detection and Correction
- Signaling Link Error Monitor
- Flow Control

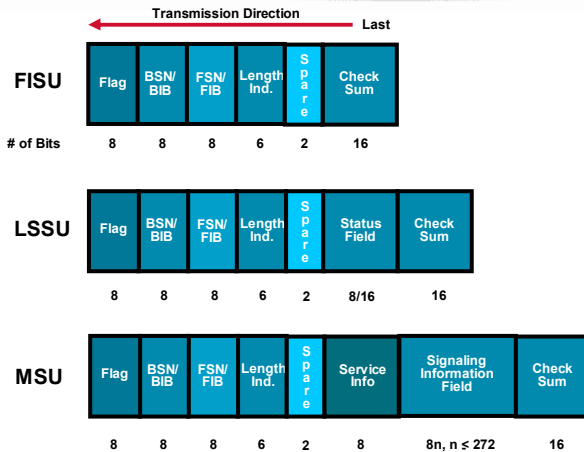
SS7 Signal Units

Messages from higher level protocols are delivered over data links in Signal Units.

There are three types of Signal Units:

- Fill-In Signal Unit (FISU)
 - No payload, constant quality check, acknowledgements
- Link Status Signal Unit(LSSU)
 - End point status and alignment
- Message Signal Unit (MSU)
 - Standard, routed, application payload envelope

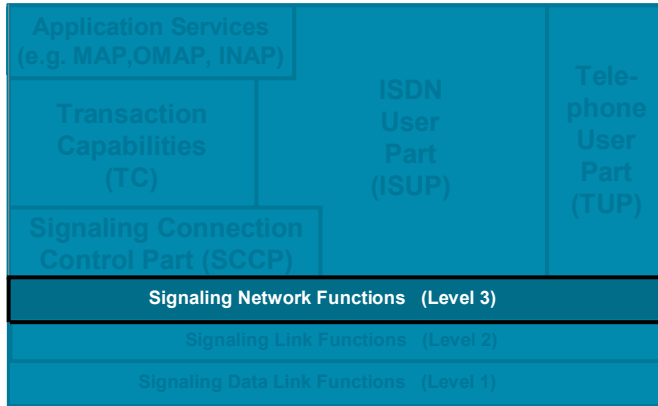
SS7 Signal Units



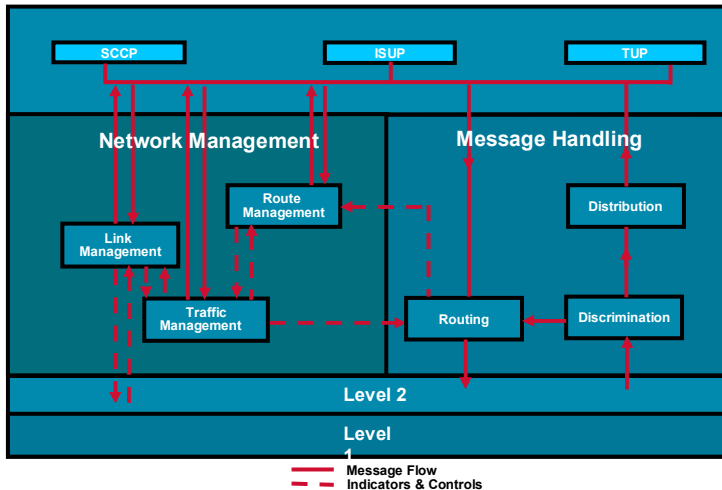
BSN = Backward Sequence Number
FSN = Forward Sequence Number

BIB = Backward Indicator Bit
FIB = Forward Indicator Bit

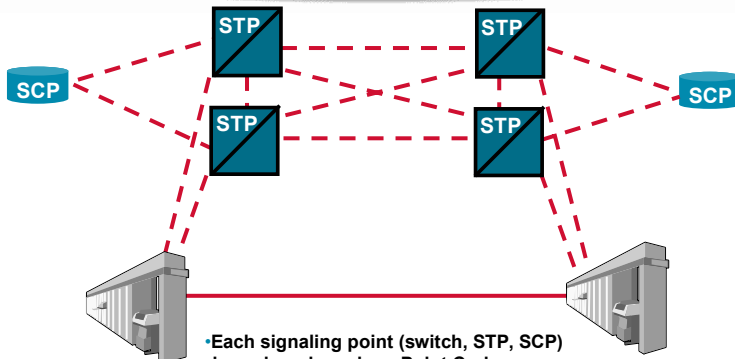
Message Transfer Part Objective: Reliable Transport and Delivery of Signaling Messages Across the SS7 Network



Signaling Network Functions

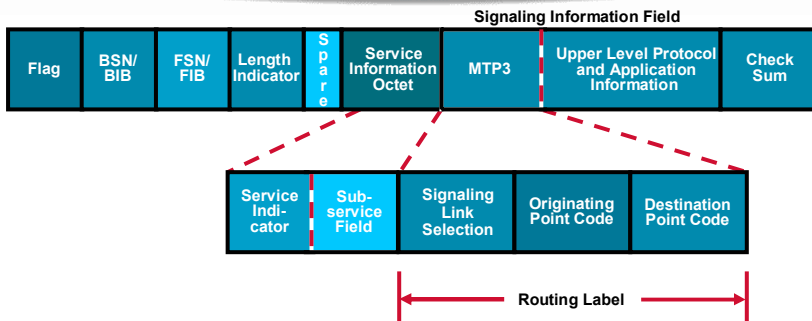


SS7 Message Routing



- Each signaling point (switch, STP, SCP) is assigned a unique Point Code
- MTP routes strictly on Point Codes
- Routing tables at higher layers identify Destination Point Code based on User Layers address (e.g., telephone number)

SS7 MTP3 Routing Information



- Service Information Octet:
 - Higher level protocol user (e.g., ISUP, SCCP, Network management)
 - Message priority (for congestion)
 - Network Indicator (e.g., national vs. international)
- Routing Label
 - Information to deliver message to destination point

ISUP = ISDN User Part

SCCP = Signaling Connection and Control Part

BSN = Backward Sequence Number

BIB = Backward Indicator Bit

FIB = Forward Indicator Bit

FSN = Forward Sequence Number

North American vs International Routing Labels

International Routing Label



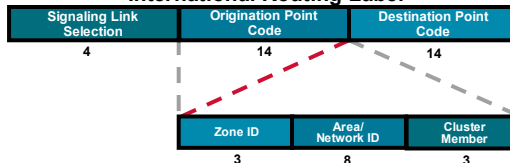
North American Routing Label



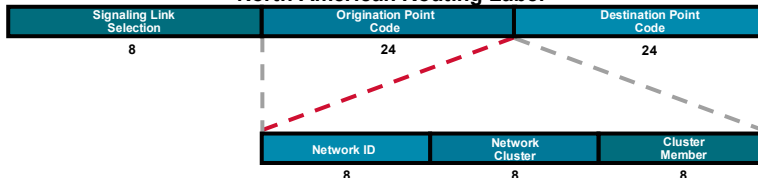
Note: Numbers indicate size of field in bits

North American vs International Routing Labels

International Routing Label



North American Routing Label



Note: Numbers indicate size of field in bits

North American Point Code Assignments



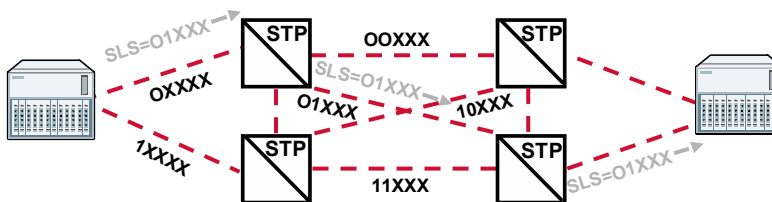
Administered by Telcordia* Technology, Inc as an agent of ANSI T1

- **Large Networks: > 150 Signaling Points**
 - Given unique Network ID
- **Small Networks: <150 Signaling Points**
 - Network ID = 1,2,3, or 4
 - Given unique Network Cluster number
- **Point Code Blocks: No STP function**
 - Network ID = 5, Network Cluster = 1-13
 - Blocks of four Cluster Member numbers

ANSI = American National Standards Institute
STP = Signal Transfer Point

*Formerly Bellcore

Signaling Link Selection

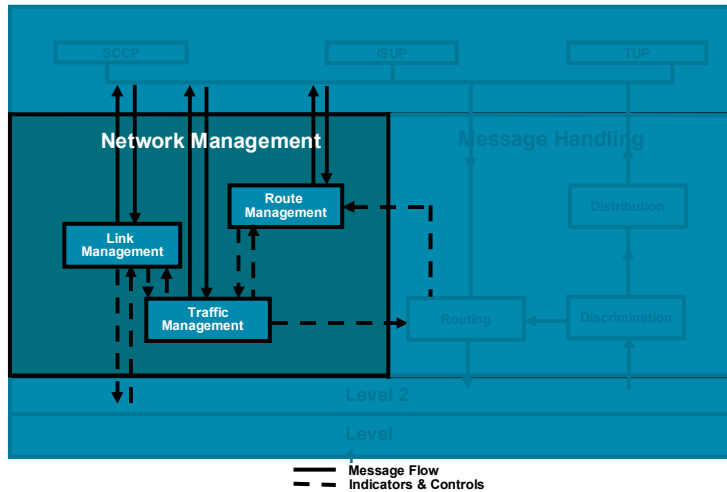


- Once the DPC has been analyzed, the SLS field is used to determine the specific outgoing link
- Higher layer protocol (ISUP, SCCP, etc.) supplies MTP with SLS value that:
 - Changes across different calls to balance the load across link's and STPs, or
 - Remains constant for a given call to ensure sequenced delivery

DPC = Destination Point Code
SLS = Signaling Link Section
MTP = Message Transfer Part

SCCP = Signaling Connection Control Part
ISUP = ISDN User part
STP = Signal Transfer Point

Signaling Network Functions

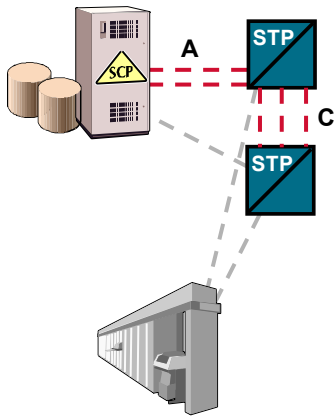


Signaling Network Management

- **Traffic Management**
 - Control Message Routing, Includes Modifying the Route when necessary to maximize the probability of Message Delivery
 - When Re-routing, minimize Lost, or Duplicated or Out-of-Sequence Messages
 - Flow Control
- **Link Management**
 - Control locally connected Signaling Links
 - Restore Failed Links
 - Report on Link Availability
- **Route Management**
 - Report on Availability or Congestion Status of Signaling Routes
 - Relates to Quasi-Associated Signaling only

SS7 Link Sets

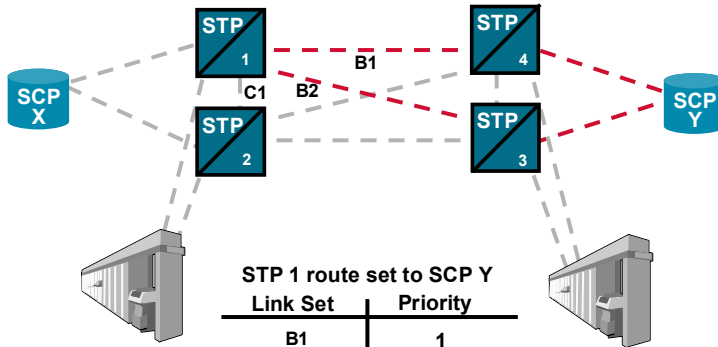
A link set is all of the signaling links directly connecting two signaling points



- A-link set containing 2 links
- C-link set containing 3 links

SS7 Route Set

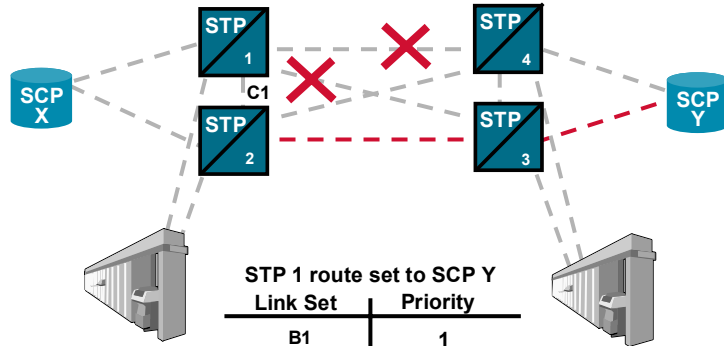
A signaling route set is all of the routes from a signaling point to a particular destination



STP 1 route set to SCP Y

Link Set	Priority
B1	1
B2	1
C1	2

SS7 Route Set

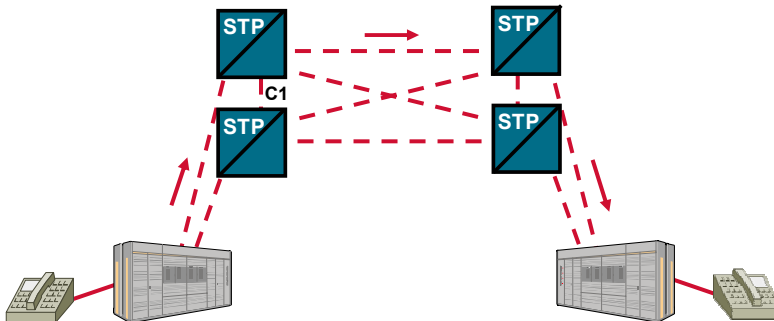


STP 1 route set to SCP Y

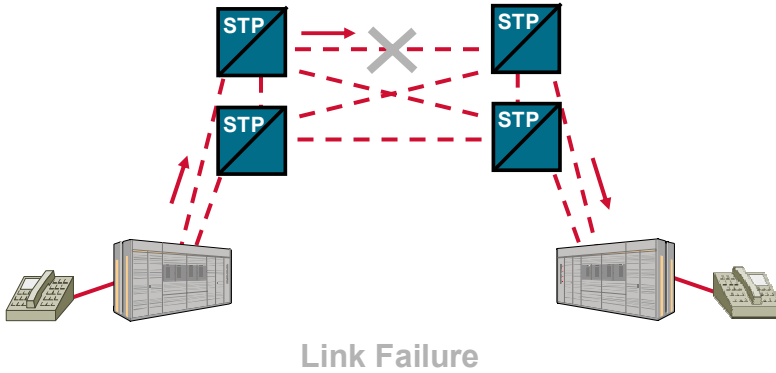
Link Set	Priority
B1	1
B2	1
C1	2

A signaling route set should be unavailable for less than 10 minutes per year

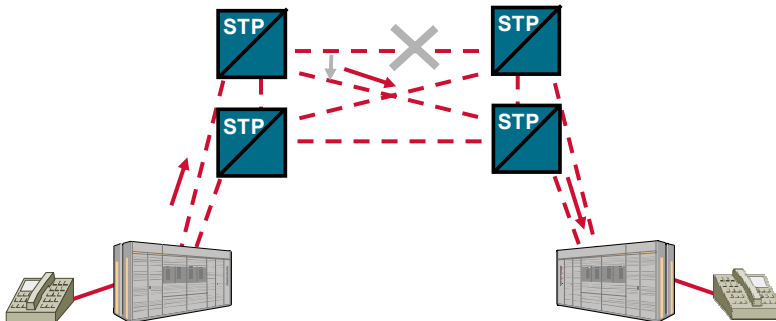
Traffic Management Changeover / Changeback



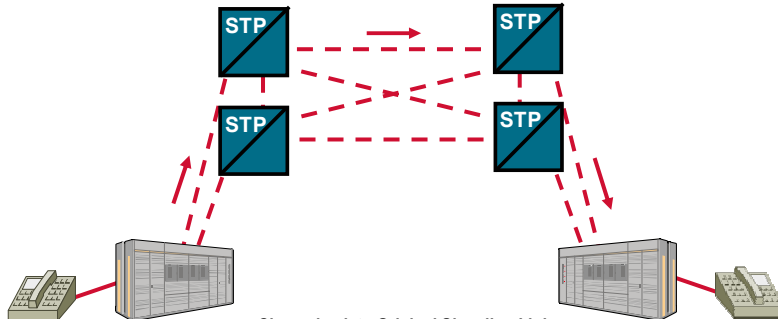
Traffic Management Changeover / Changeback



Traffic Management Changeover / Changeback



Traffic Management Changeover / Changeback



- Changeback to Original Signaling Link
- Maintain Traffic Balance
- Message Buffering, Synchronization and Retransmission minimize Lost, Duplicated or Out-Of-Sequence Frames

Signaling Network Management Functions

Traffic Management

- Changeover
- Changeback
- Forced Rerouting
- Controlled Rerouting
- Signaling Point Restart
- Management Inhibiting
- Flow Control

Link Management

- Link Activation
- Link Set Activation
- Automatic Allocation for Signaling Terminals and Data Links

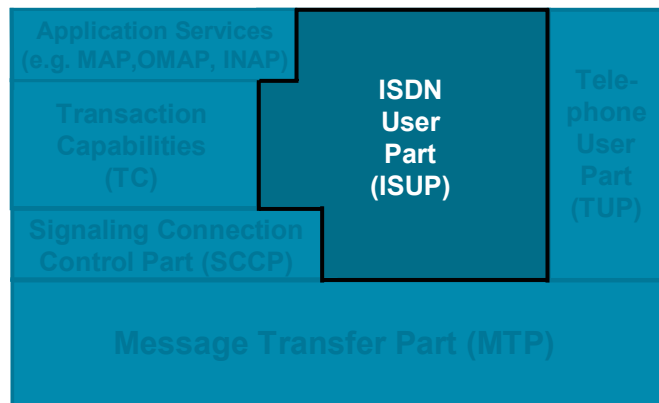
Route Management

- Transfer- Controlled
- Transfer- Prohibited
- Transfer- Allowed
- Transfer- Restricted
- Route Set Test
- Route Set Congestion Test

Message Transfer Part - Summary

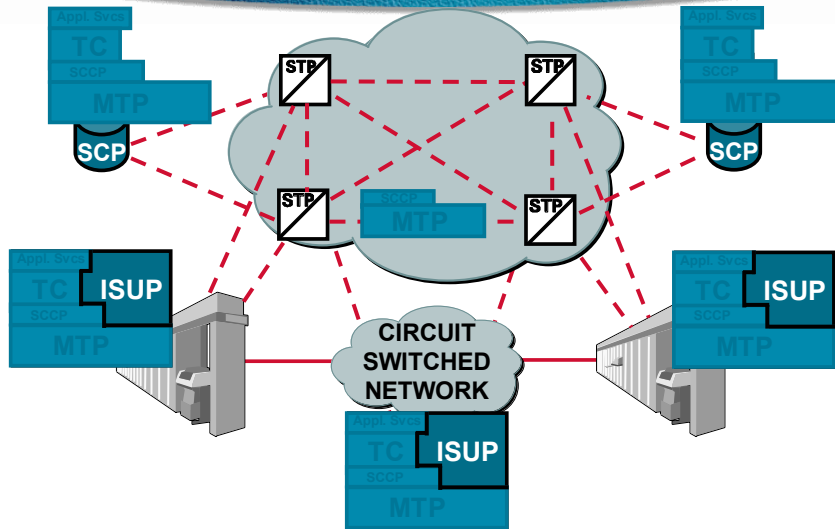
- The MTP is responsible for the **Reliable Transport of Signaling Messages across the SS7 Network**
- The MTP includes **Level 1, Level 2, and Level 3 Functions**
- **MTP Routing is based on the use of Point Codes which are assigned to each Signaling Point**
- The MTP does not examine **Telephone Numbers or any other User Layer Address**
- **Load Sharing minimizes Congestion**
- **Congestion and failure status plus rerouting capabilities enhance reliability**

SS7 Protocol Architecture



Set Up and Tear Down All Circuit-Switched Calls

SS7 Protocol Deployment ISDN User Part (ISUP)



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ISDN User Part Objectives

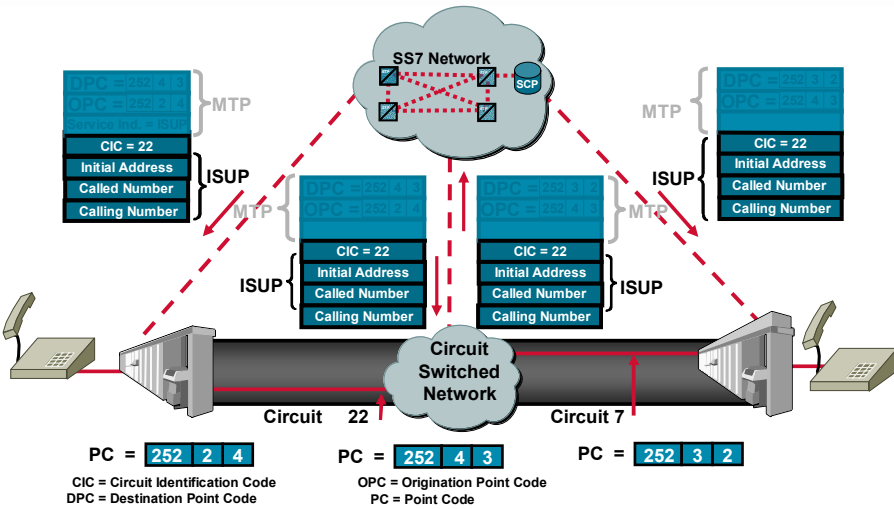
- **Set up and tear down all circuit-switched Calls**
 - Non-ISDN
 - ISDN
- **Provide support for supplementary voice services**
- **Interwork with Q.931/932 for end-to-end ISDN**

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Circuit-Switched Call Establishment Using ISDN User Part (ISUP)

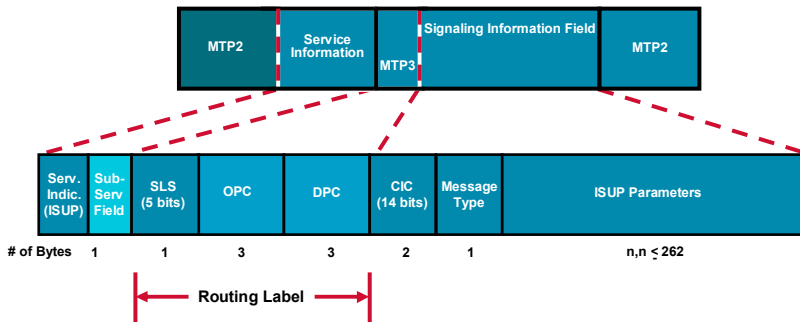


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ISUP Message Format (ANSI)



BSN = Backward Sequence Number
FSN = Forward Sequence Number
DPC = Destination Point Code

BIB = Backward Indicator Bit
FIB = Forward Indicator Bit
OPC = Originating Point Code

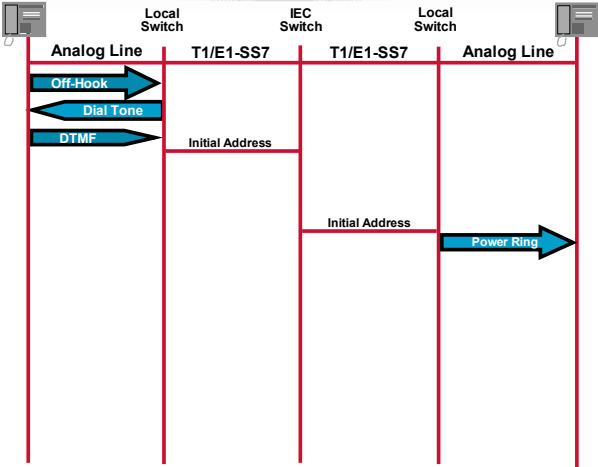
SLS = Signaling Link Selection
CIC = Circuit Identification Code
MSU = Message Signaling Unit

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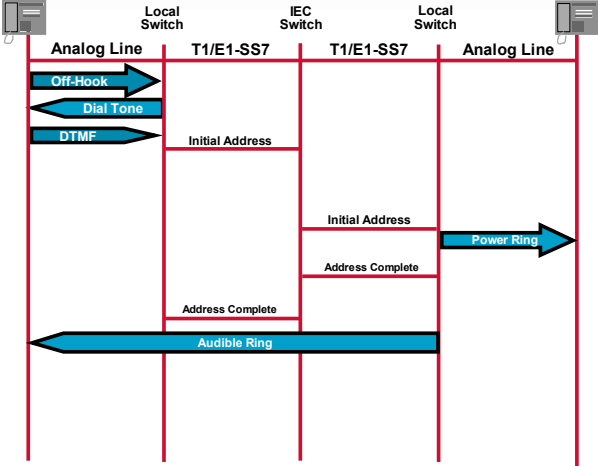
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ISUP Call Setup



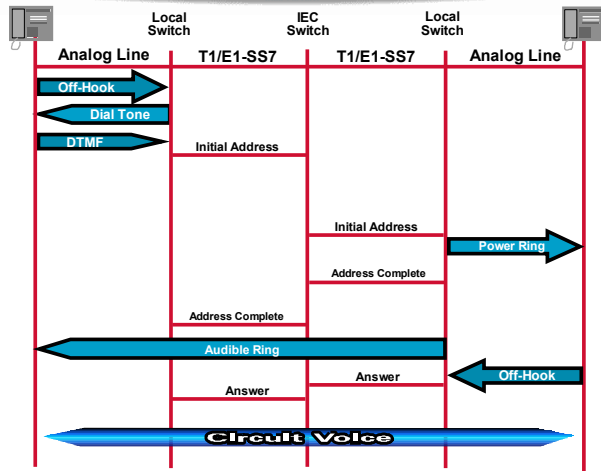
IEC = Inter-Exchange Carrier

ISUP Call Setup (continued)



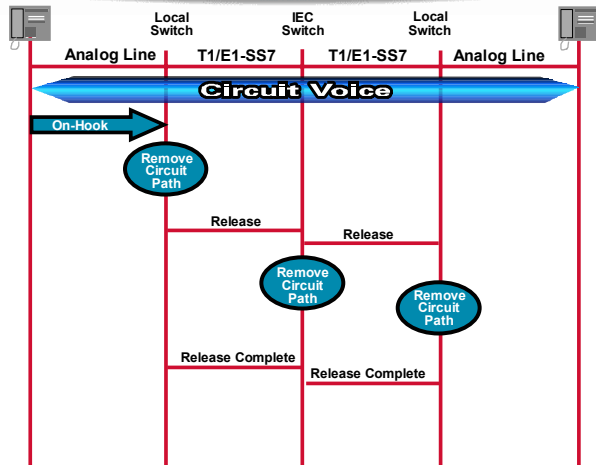
IEC = Inter-Exchange Carrier

ISUP Call Setup (continued)



IEC = Inter-Exchange Carrier

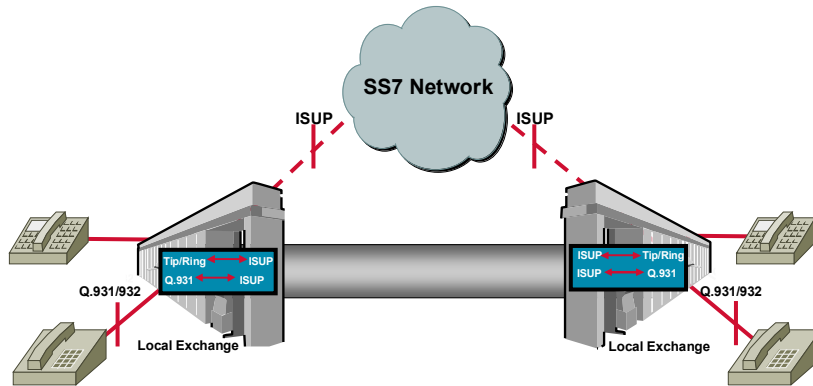
ISUP Call Release



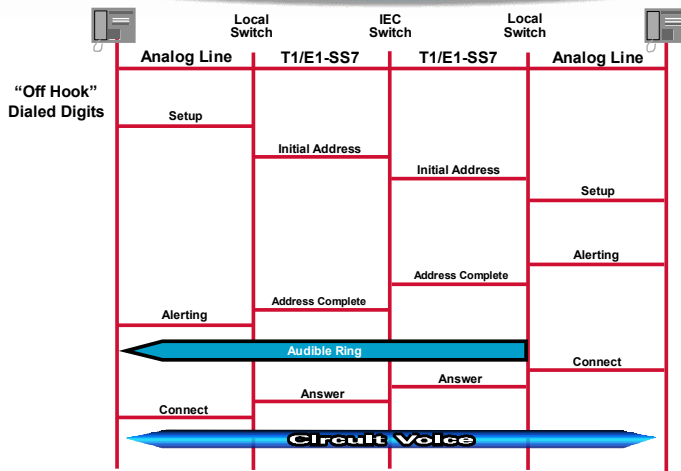
Release procedure can be initiated by either end office

IEC = Inter-Exchange Carrier

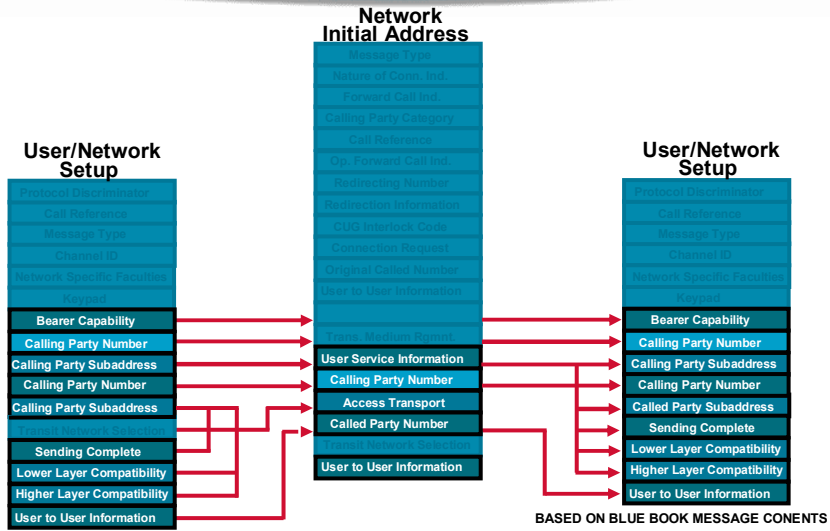
ISUP Interworks with Access Protocols to Establish End-to-End Connections



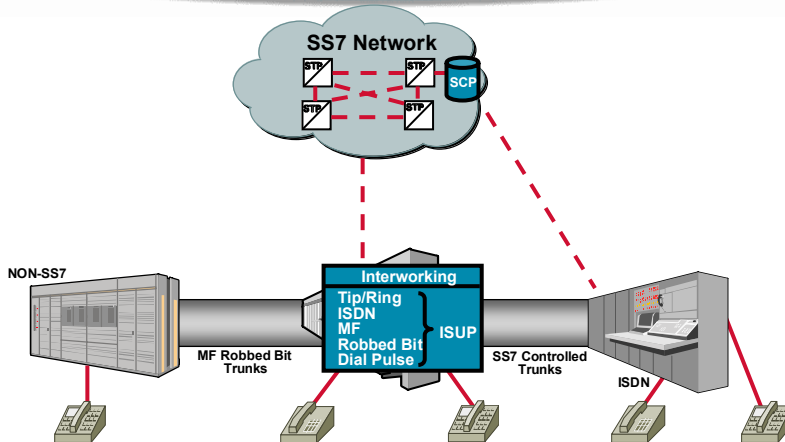
ISUP Interworking with Q.931



Q.931/ISUP Interworking Example



SS7 Interworking



ISUP Procedures have been defined for Interworking with all Signaling Types

Telephone User Part

- **Basic Call Control, originally supported only analog circuits**
- **Deployed internationally, with many country and network specific versions**
- **Most TUP networks are evolving to ISUP for features, network interconnection**

ISDN User Part - Summary

- **ISUP defines the messages, parameters and procedures for circuit-switched call control**
- **ISUP provides the information transport and signaling support for several supplementary services**
- **ISUP interworks with Q.931/932 for end-to-end ISDN**