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# *PSTN Signaling Mechanism*

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These slides are from the text book:

"IP Telephony: The Integration of Robust VoIP Services" by Bill Douskalis, Hewlett-Packard, 2000. ISBN: 0-13-014118-6.

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# Overview of SS7

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- ◆ Implemented as a packet-switched network
- ◆ Is a common channel, out of band signaling network, however may traverse on links that carry voice traffic

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Fundamental signaling capabilities:

- » *establishing and terminating calls between subscribers*
- » *accessing back-office systems to obtain subscriber information related to completion of a call*
- » *accessing back-office systems for customer billing information*
- » *accessing back-office systems for translation of toll-free numbers, toll-numbers, and other advanced network features*
- » *supporting mobile network features, such as wireless roaming and authentication*
- » *supporting local number portability (LNP)*
- » *providing advanced features such as call forwarding, caller identification, etc.*

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# SS7 Network Topology

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- ◆ SSP (Service Switching Point): local exchange that provides telephone service
  - » *manages individual circuits and trunks connected to other exchanges*
  - » *communicate with other SSPs for setup and termination of calls*
  - » *also interfaces to back-office functions (called FCAPS) for failure, configuration, billing, performance monitoring, and security*
  - » *are assigned point codes (PC), or IDs to uniquely identify them in SS7 network*
  - » *PCs are 24-bit quantities in North America*
- ◆ STP (Signaling Transfer Point): computers with embedded router functionality
  - » *receive signaling messages from local or other SSPs and route them to their ultimate destinations*
  - » *provides function of Global Title Translation (GT), such as for toll-free 800 and toll 900 numbers. If it cannot perform GT translation, it forwards the request to an STP with translation capability*

## SS7 Network Topology (cont)

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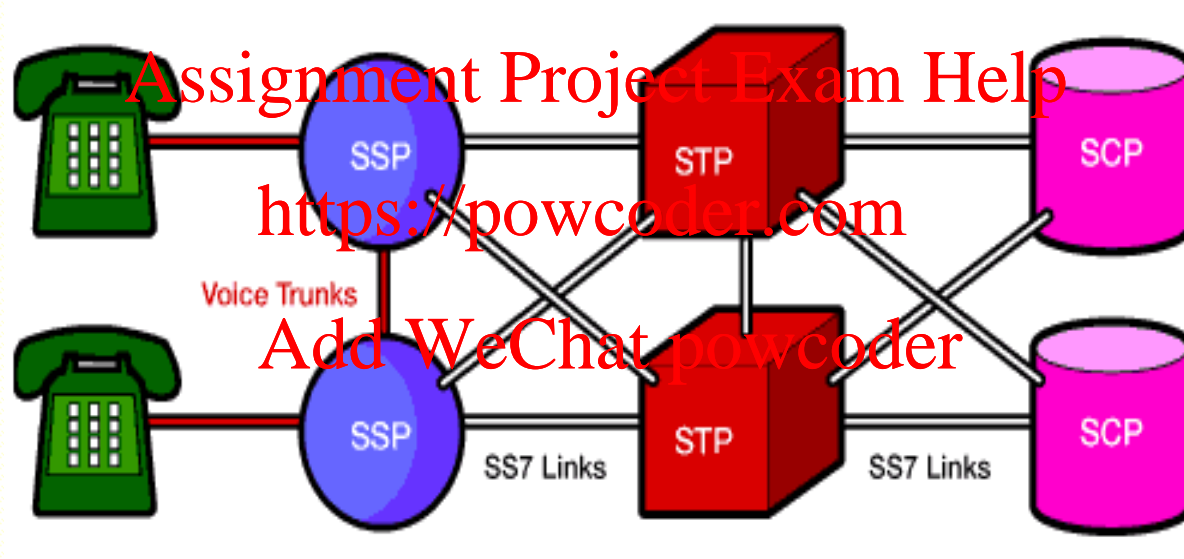
- ◆ SCP (Service Control Point): computer/network attached to STP
  - » contains information necessary to process an incoming call to an exchange
  - » translation of all fixed or all mobile numbers (SCP accesses SCP using TCAP through its local STP asking for a translation, a new routing number)
  - » billing and credit card information
  - » routing information for numbers ported (moved) to another carrier when subscriber selects a different long distance company - using services of transactions capability application part (TCAP) of SS7, through a process called local number portability (LNP) query
  - » a typical SS7 network must contain a minimum of one SCP

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## *SS7 Network Topology (cont)*



## *Basic signaling steps*

- ◆ User dials a number
- ◆ Originating local exchange (OLE) analyzes the digits to determine where to find the terminating exchange (TE)
- ◆ If TE is different from LE, the SSP identifies the voice trunk used to connect the call to adjacent exchange
- ◆ SSP signals the adjacent exchange about its intent to place a call on this trunk, by sending a signal through its local STP
- ◆ The message send to adjacent STP; if adjacent local exchange hosts called party it is the TE and signaling terminates; if not, signaling proceeds through multiple intermediate exchanges to reach TE.
- ◆ Each intermediate exchange needs to select an outbound trunk .
- ◆ If a single exchange is both local and TE, no SS7 signaling is necessary, and SSP connects the two subscribers through its voice switches

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# SS7 Protocol Stack

Message Transfer Part –

Level 1: defines the physical, electrical, and functional characteristics of the digital

signaling link

» *E-1 (2048 kb/s; 32 64kb/s channels), DS-1 (1544 kb/s; 24 64kb/s channels), V.35 (64 kb/s), DS-0 (64 kb/s)*

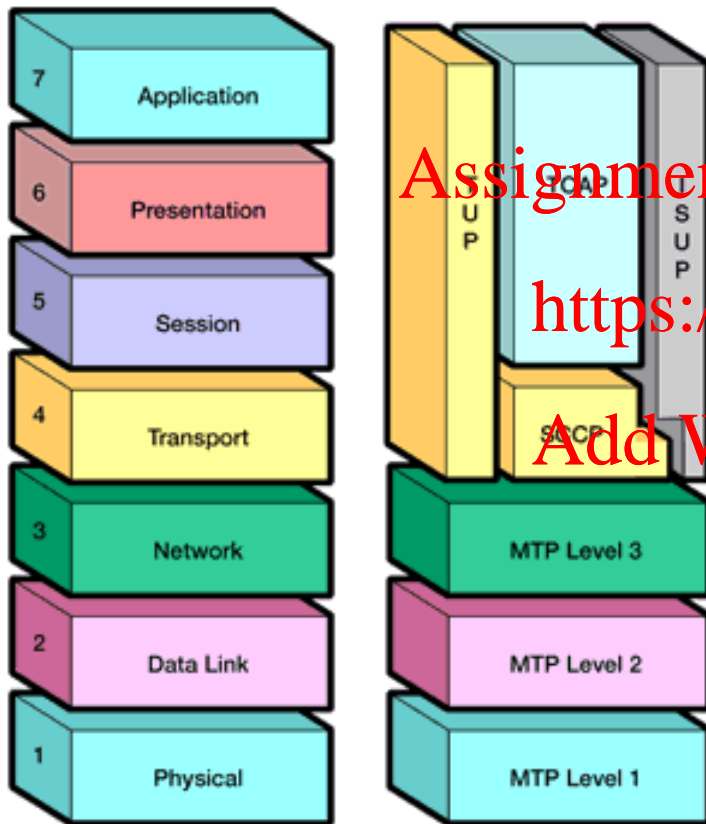
Level 2: ensures accurate end-to-end

transmission of a message across a signaling link

» *implements flow control, message sequence validation, and error checking*

Level 3 provides message routing between signaling points in the SS7 network

» *re-routes traffic away from failed links and signaling points and controls traffic when congestion occurs*



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## SS7 Protocol Stack (cont.)

### ISDN User Part (ISUP):

- » defines the protocol used to set-up, manage, and release trunk circuits that carry voice and data between a calling party and a called party
- » calls that originate and terminate in the same switch do not use ISUP signaling

### Telephone User Part (TUP):

- » In some countries (e.g., China, Brazil), TUP is used to support basic call setup and tear-down

### Signaling Connection Control Part (SCCP):

- » provides connectionless and connection-oriented network services
- » provides global title translation (GTT) capabilities above MTP Level 3
- » SCCP translates GT into a destination point code and subsystem number that uniquely identifies an application at the destination signaling point
- » SCCP is used as the transport layer for TCAP-based services



## SS7 Protocol Stack (cont.)

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### Transaction Capabilities Applications Part (TCAP):

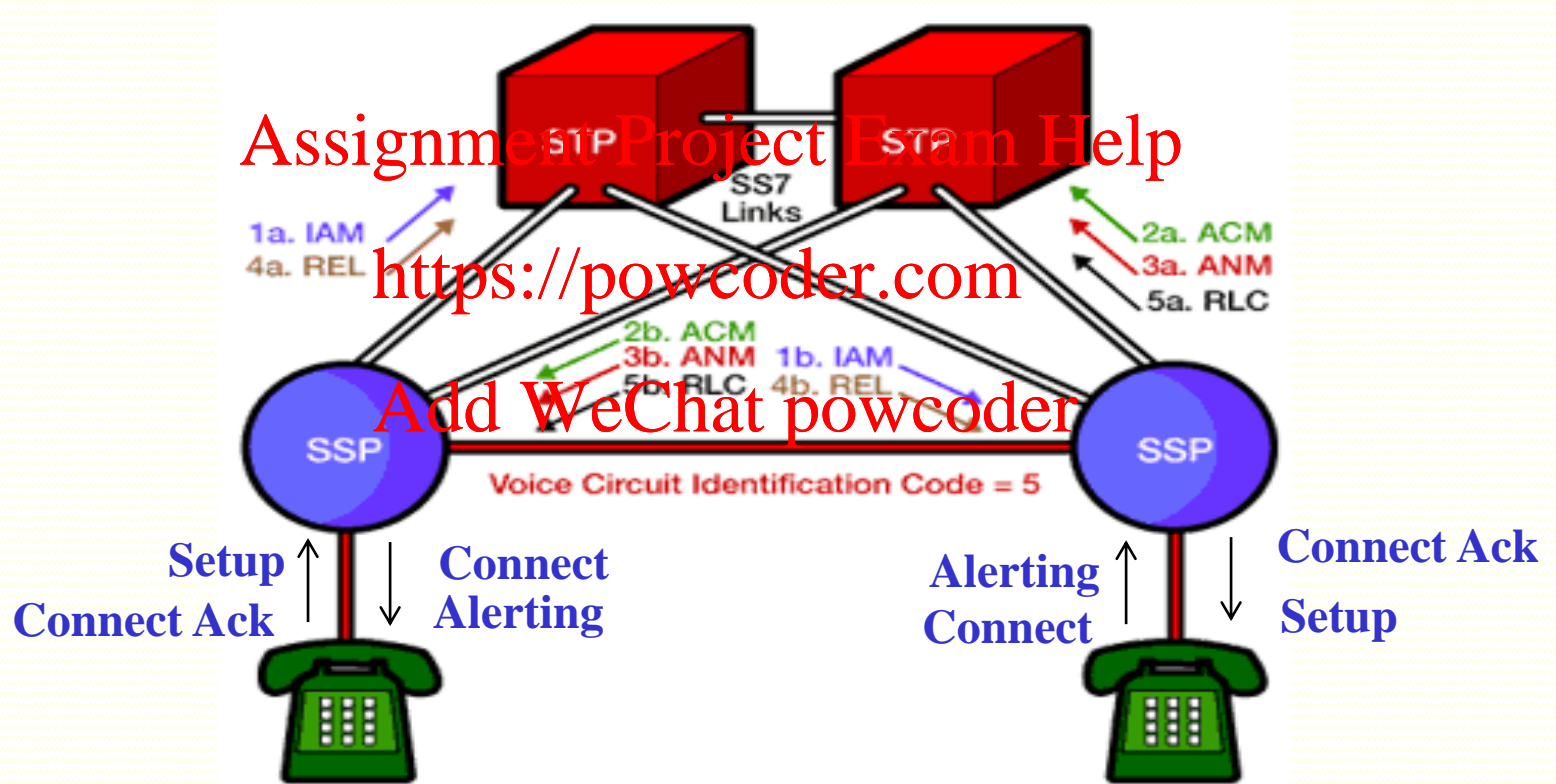
- » *supports the exchange of non-circuit related data between applications across the SS7 network using the SCCP connectionless service*
- » *Queries and responses sent between SSPs and SCPs are carried in TCAP messages*

- SSP sends a TCAP query to check the personal identification number (PIN) of a calling card user
- TCAP carries Mobile Application Part (MAP) messages sent between mobile switches and databases to support user authentication, equipment identification, and roaming

### Operations, Maintenance and Administration Part (OMAP):

- » *OMAP services may be used to verify network routing databases and to diagnose link problems*

# *SS7 Call Setup and Termination with ISDN Signaling*



# SS7 Call Setup and Termination with ISDN Signaling (cont)

SETUP msg: calling party starts the process of call establishment by sending SETUP to the local exchange

The originating SSP transmits an ISUP initial address message (IAM) to reserve an idle trunk circuit from the originating switch to the destination switch (1a)

» *The IAM includes the originating point code, destination point code, circuit identification code (circuit "5"), dialed digits and, optionally, the calling party number and name*

» *IAM is routed via the home STP of the originating switch to the destination switch (1b)*

The destination switch examines the dialed number, determines that it serves the called party, and that the line is available for ringing

» *rings the called party line*

» *receives an ALERTING message from the called party that it has been notified of an incoming call*

» *transmits an ISUP address complete message (ACM) to the originating switch (2a) (via its home STP) to indicate that the remote end of the trunk circuit has been reserved*

» *The STP routes the ACM to the originating switch (2b) which rings the calling party's line*

# SS7 Call Setup and Termination with ISDN Signaling (cont)

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When the called party picks up the phone,

- » *it sends a Connect message to the network*
- » *the destination switch terminates the ringing tone and transmits an ISUP answer message (ANM) to the originating switch via its home STP (3a). The STP routes the ANM to the originating switch (3b) which verifies that the calling party's line is connected to the reserved trunk and, if so, initiates billing.*

If the calling party hangs-up first,

- » *it sends a Disconnect message to the network*
- » *the originating switch sends an ISUP release message (REL) to release the trunk circuit between the switches (4a). The STP routes the REL to the destination switch (4b). If the called party hangs up first, or if the line is busy, the destination switch sends an REL to the originating switch indicating the release cause (e.g., normal release or busy).*

# SS7 Call Setup and Termination with ISDN Signaling (cont)

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Upon receiving the REL,

» the destination switch disconnects the trunk from the called party's line, sets the trunk state to idle, and

» transmits an ISUP release complete message (RLC) to the originating switch (5a) to acknowledge the release of the remote end of the trunk circuit. When the originating switch receives (or generates) the RLC (5b), it terminates the billing cycle and sets the trunk state to idle in preparation for the next call.

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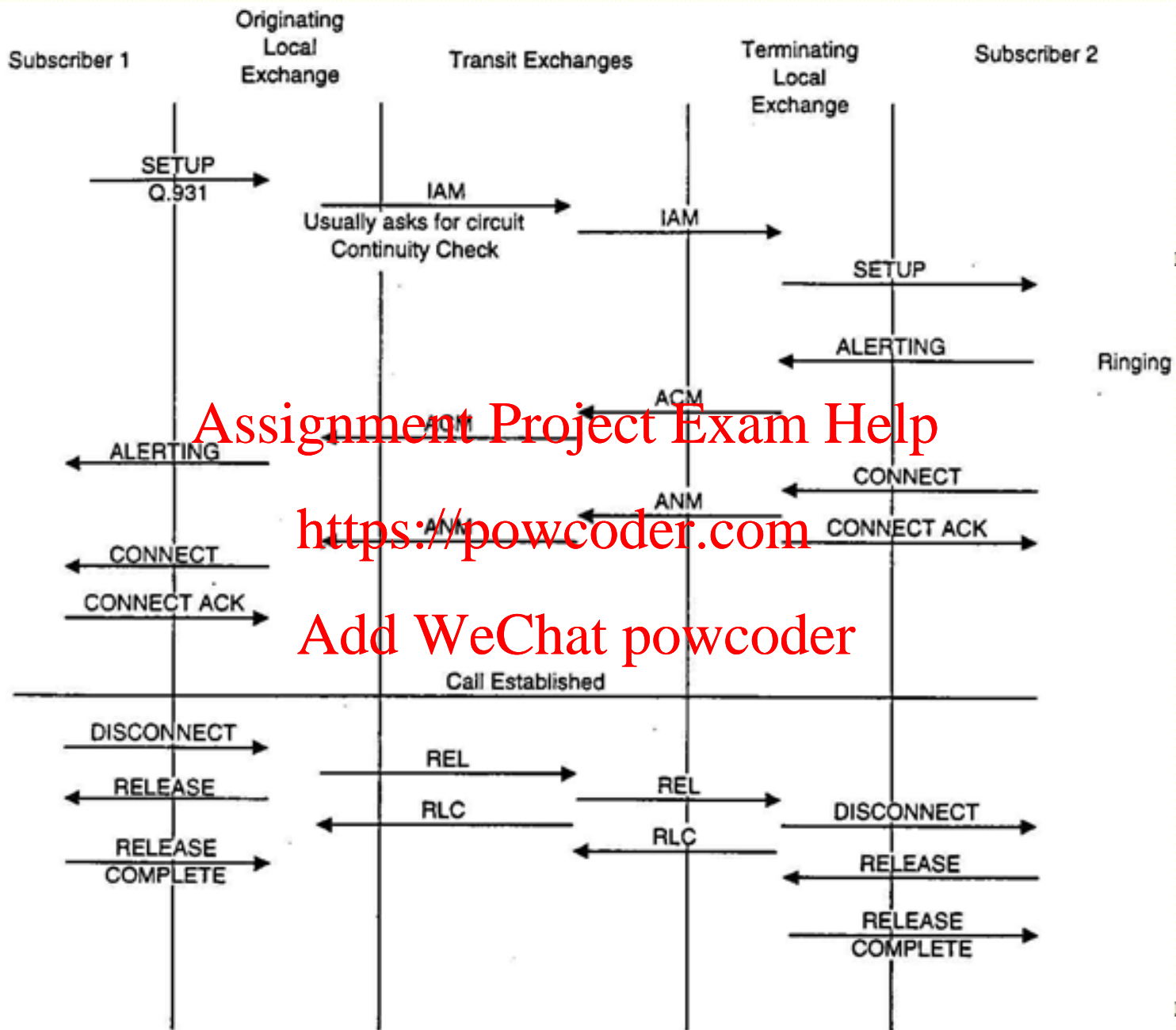
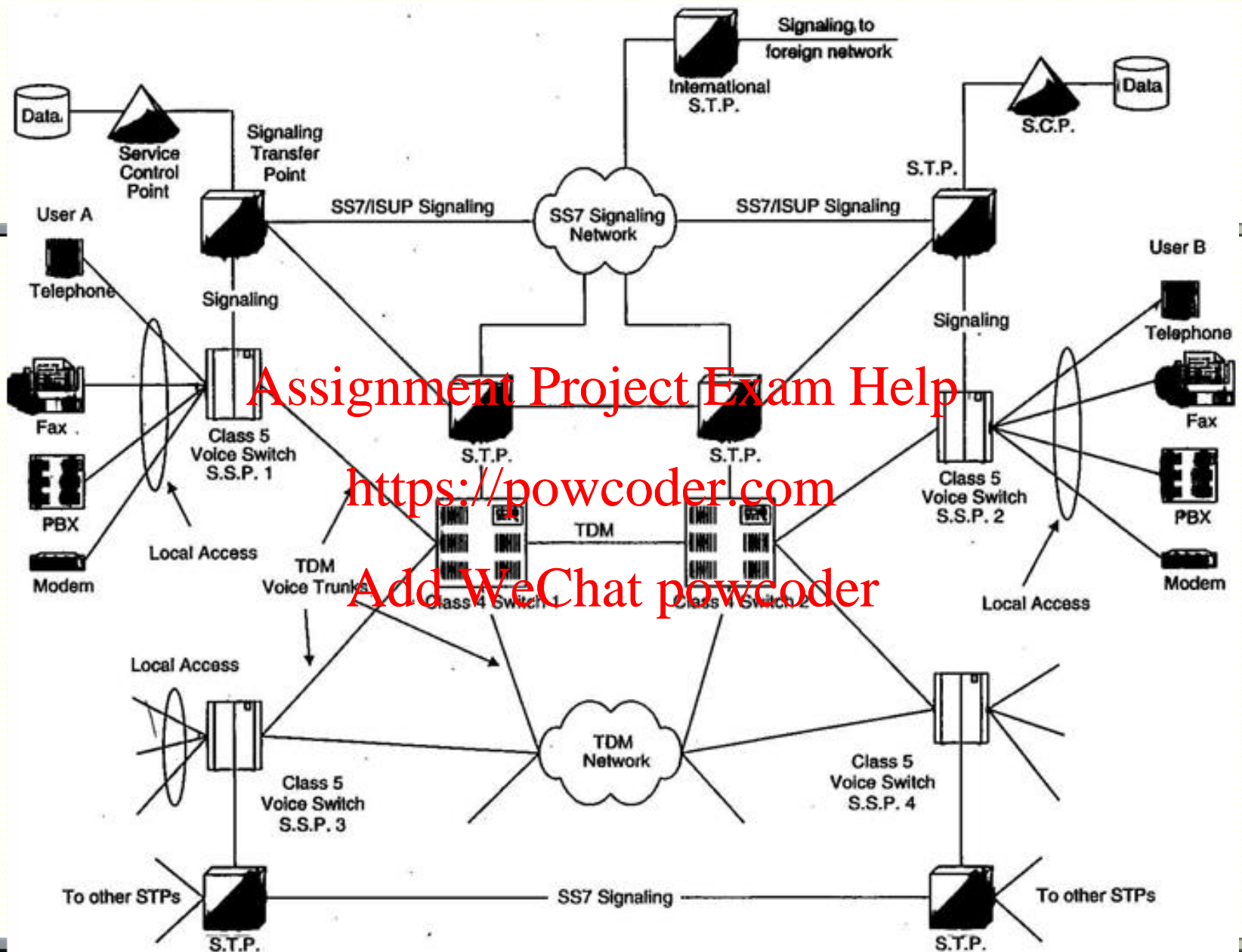
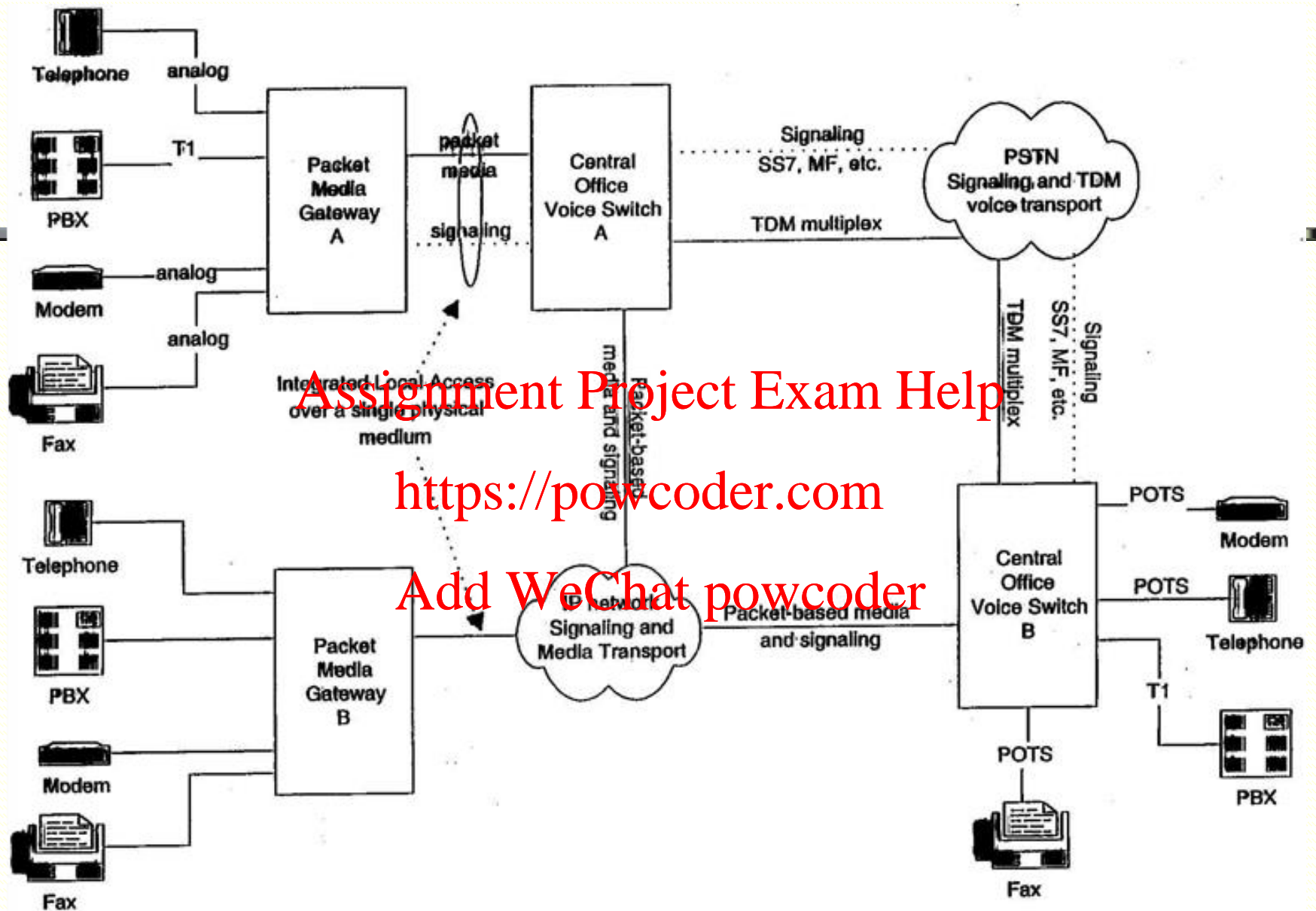


FIGURE 3.13 SS7 Call Setup and Termination With ISDN Signaling





**FIGURE 3.1(b)** Simplified view of SS7 component topology



PSTN-to-IP Network Architecture