ISDN User Part (ISUP)

- It is responsible for setting up and releasing trunks.
- It mainly deals with ISDN traffic but nowadays it provides signaling for ISDN and Non-ISDN traffic.
- ISUP benefits are: high-speed, increased signaling bandwidth and standardized message exchange.
- ISUP enables more call related information to be exchanged because it uses CCS.
- It consists of: call processing, supplementary services and maintenance functions.

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Bearers & Signaling:

- ISUP allows call control signaling to be separated from the circuit that carries the voice stream.
- The circuit that carries the voice stream is usually called voice trunk or bearer.
- The signaling component of the call is transported over SS7 signaling links.
- This means that call information is carried in 2 different paths:
  1) Signaling Path.
  2) Voice Path.
The relation between these 2 paths is called signaling mode. We have 2 different signaling modes (which were discussed in earlier tutorials):

1) Associated Signaling.
2) Quasi-Associated Signaling.

**ISUP & SS7 Protocol Stack:**
- ISUP resides at level 4 of the SS7 Protocol Stack.
- A connection exists between ISUP and MTP 3 to exchange network messages.
- A connection exists between ISUP and SCCP, used for end-end signaling.

**ISUP Message Flow:**
- Basic calls are divided into 3 phases:
  1) Call Setup
  2) Conversation
  3) Call Release
- ISUP is involved in Call Setup & Release phases.
Note:
- Continuity message (COT): is used for Continuity Test applied to test the voice path before being used by the users.
- Release Message (REL): sent to clear the call when subscriber goes on-hook.
- Release Complete Message (RLC): acknowledgement for the REL message.

**Message Timers:**
- ISUP uses timers as a safeguard to make sure that events occur when they should.
- Timers are set when a message is sent or received to ensure that the next intended action occurs.
- Example:
  1) **T7**: Starts when IAM is sent and stops when ACM is received. If it expires, circuit is released.
  2) **T8**: Starts when IAM is received and stops when COT is received. If it expires, a REL is sent to originating node.
  3) **T9**: Starts when ACM is received and stops when ANM is received. If it expires, circuit is released.
  4) **T1**: Starts when REL is sent and stops when RLC is received. If it expires, a REL is transmitted.
  5) **T5**: Starts also when REL is sent and stops when RLC is received. It is a longer duration than T1 to recover from non-responding circuits. If it expires, a RSC is transmitted.

**Circuit Identification Code:**
- ISUP uses a Circuit Identification Code (CIC) to identify each voice circuit.
- ISUP messages are sent including the CIC.
- CIC identifies a bearer circuit between 2 nodes.
- Nodes at each end of the trunk must define the same CIC for the same physical voice channel.
- CIC is unique to each DPC.
- CIC can be used many times throughout the network or even within the same SSP but it cannot be duplicated to the same destination.
- The combination of the CIC and DPC is what uniquely identifies each circuit.
- When a message is received with a CIC that is not defined at the receiving node, an unequipped Circuit Code (UCIC) message is sent. The UCIC message’s CIC field contains the unidentified code.

**Enbloc and Overlap Address Signaling:**

- The called party number (CdPN) is a primary key for a call throughout the network.
- ISUP transmits the CdPN using either: Enbloc Signaling or Overlap Signaling
  1) **Enbloc Signaling:** transmits the CdPN as a complete entity in the IAM message to set up a call. It is more efficient than overlap signaling.
2) **Overlap Signaling:** transmits the CdPN as portions in separate messages as digits are collected from the originator. Here, call setup can begin before all the digits have been collected. IAM contains the first digits and Subsequent Address Message (SAM) is used to transport the remaining digits.

![Diagram of Circuit Glare (Dual Seizure)](image)

**Circuit Glare (Dual Seizure):**
- Circuit Glare occurs when the node at each end of a two-way trunk attempts to set up a call over the same bearer at the same time.
- This occurs when an IAM for the same CIC is simultaneously sent from each end.
- When an IAM is received after sending n IAM for the same CIC, glare has occurred.
- **Resolving Glare:** when glare is detected, one node must back down and give control to the other end.
  - There are 2 methods that define which end takes control of the call:
    1) The node with the higher-numbered PC takes control of even number CICs and the node with lower-numbered PC takes control of odd number CICs. This allows each end to take control of approximately half the calls that have experienced glare.
    2) By prior agreement between the two nodes about which end will back down and which end will take control when glare occurs.
- Below is a figure that shows an example of a circuit glare, if the first method of resolving glare is used that SSP B will take control and SSP A will back down.
Avoiding Glare: glare conditions can be minimized by proper trunk selection algorithms at both ends. There are 2 methods that define trunk selection algorithms:

1) Trunk selection is performed in ascending order at one end and in descending order at the other end.
2) One end uses the “Most Idle” trunk selection and the other uses the “Least Idle” trunk selection.

ISUP Message Format:

- The user data portion of the MTP3 SIF contains the ISUP message.
- The following are the different fields that define the message.
  - **CIC**: Identifies the circuit for which the message is related.
  - **Message Type**: For ex. IAM, ACM etc
  - **Mandatory Fixed Part**: Required message parameters that are of fixed length.
  - **Mandatory Variable Part**: Required message parameters that are of variable length. It contains the length of the parameter and the contents.
  - **Optional Part**: Optional fields in the message but are not mandatory. It contains; parameter name, parameter length and parameter content.
**ISUP & LNP:**

- Local Number Portability (LNP) is the concept of having phone numbers that remain the same for the subscriber, regardless of whether the subscriber changes service providers or geographic location.
- There are 3 different types of LNP:
  1) **Service Provider Portability:** Enables a subscriber to select a new local service provider while keeping his or her existing telephone number.
  2) **Service portability:** Enables subscribers to change the type of service they have while keeping their telephone numbers. For example, if a subscriber changes from a Plain Old Telephone Service (POTS) line to an Integrated Services Digital Network (ISDN) service.
  3) **Location portability:** Enables a subscriber to move from city to city, or even state to state, while maintaining the same telephone number.
- **LNP is achieved using Local Routing Number (LRN)**
  - The end-office switches in the rate center have a table identifying all NPA-NXXs (area code/office code), which have numbers in them that have been ported.
  - If a specific number is not provided in the database, the SSP must initiate a query to determine whether the number has been ported or not.

- **Number Portability Administration Center (NPAC):**
  - Responsible for receiving requests from recipient carriers for the porting of telephone numbers.
  - Coordinates the porting of the number by:
    1) Sending the data to the donor network.
    2) Confirming the request has been accepted.
    3) Downloading the ported number data (which is the new LRN for the telephone number and other routing information) to all of the other networks connected to that NPAC.
• **Local Service Order Administration (SOA):**
  - Processes a subscriber’s order and tracks the order through completion.
  - Provides all departments with a single record location regarding a service order.
  - Coordinates and tracks service order activities.

• **Local Service Management System (LSMS):**
  - Interface between carrier networks and NPAC.
  - Responsible for collecting porting data and downloading it to LNP databases within its own network at periodic intervals.

• **LNP Database (LNP):**
  - Maintains LNP data.
  - Could be an SCP or an Integrated STP.

• **Wireless LNP**
  - Each subscriber is assigned to a home mobile switching center (MSC), which falls within a specific wireline rate center.
  - If a mobile subscriber calls a wireline number, the billing is determined by the distance from the MSC to the wireline number.
  - The wireless subscriber’s mobile identification number (MIN) has been used for determining the home MSC and how they would be billed for calls when roaming.
  - The MIN is also used for identifying the carrier providing the wireless services. The first six digits of the MIN identify the service provider for that subscriber.
  - This means the MIN can no longer be used for call processing, because the MIN cannot be ported.
  - Wireless networks rely on the MIN for call processing, billing, and virtually every transaction related to a mobile subscriber.
  - The wireless industry has elected to change the identification of mobile subscribers by assigning two numbers:
    1) Mobile directory number (MDN)
    2) The mobile station identifier (MSID) can use the MIN format, but the MSID is not portable.

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