Department of Electronics & Telecommunication Engineering
Jnan Chandra Ghosh Polytechnic

Semester – 4

UNIT -6

BASIC TELEPHONY

(Electronic Exchange: Space division switching, time division switching, block diagram of electronic exchange)

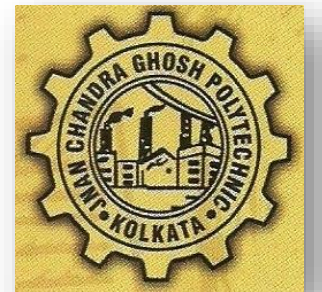Smt. Kaberi Chatterjee Polley (Lecturer)

ECE- Class-5

In this class we will cover the following topic:

Electronic Exchange-

1. Space division switching

2. Time division switching

3. Block diagram of electronic exchange

Numbering plan of Telephone Networks-

1. Numbering plan

2. National Schemes & International Numbering)

Electronic Exchange

Telephone Exchange:

A **telephone exchange** is a **telephone** system located at service centers (central offices) responsible for a small geographic **area** that provided the switching or interconnection of two or more individual subscriber lines for calls made between them, rather than requiring direct lines between subscriber stations

Electronic Telephone Exchange : Electronic Telephone Exchange is constituted by a time switch adapted to exchange connections between extensions and between an office line and an extension, a control device for controlling the exchange connection operation by the time switch, and interface circuits each connected to the highway of the time switch for exchanging communication signals between time switches of corresponding terminal devices through the highway.

Following type of Exchanges will be discussed –

1. Space Division Switching
2. Time Division Switching
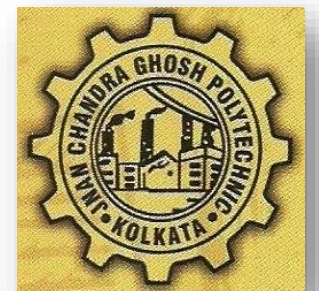
Space Division Switching

- Transfer signal from a given input to a specific output (same for any switch).

- Provide a separate physical connection between inputs and outputs.

- Signal paths are physically separate from one another (divided in space).

- Like a mechanical switch, or semi-conductor gate that can be enabled or disabled by a control unit.

- Developed for analog environment.

- Switching is instantaneous.

- Popular implementation is Cross point switch.
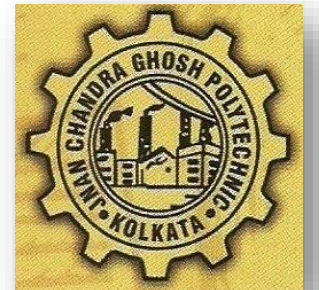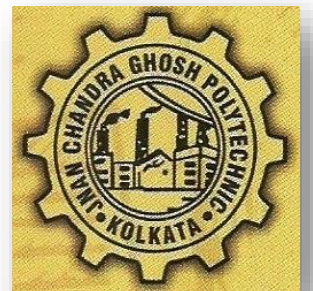
Space Division Switching

Space Division Switching

- crossbar switch N x N

N input lines

N^2 crosspoints
at most N used

N output lines
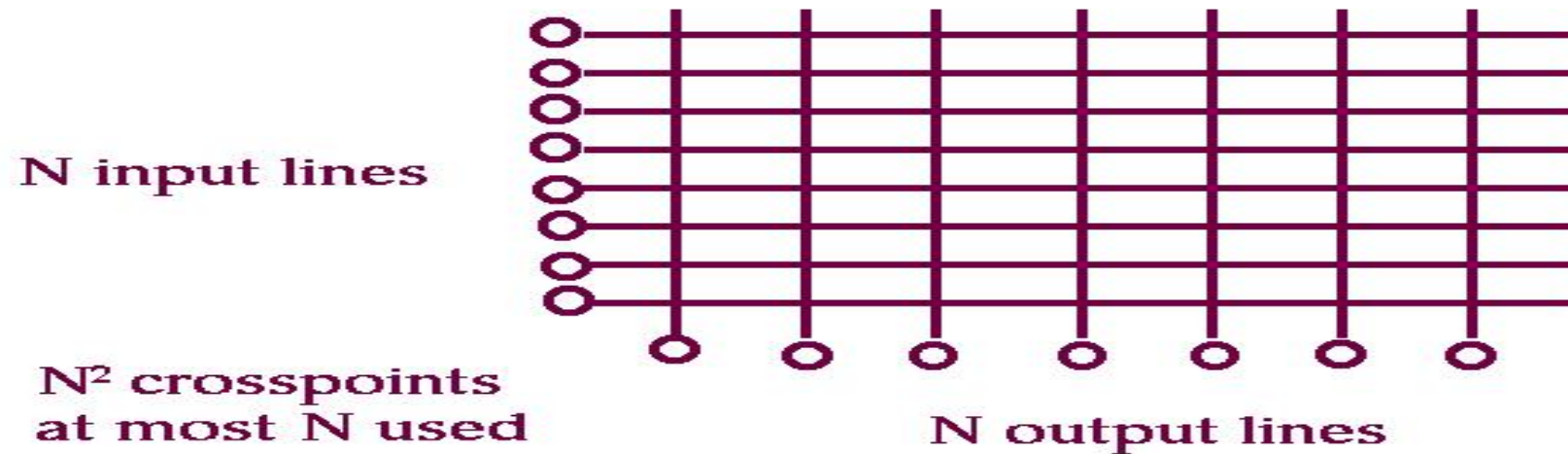
Cross Bar Switch :
- No of cross-points grows as square of number of stations.
- Loss of cross-point prevents connection.
- Inefficient use of cross-points-
  - I.   All stations connected , only a few cross points in use.
  - II. Statistically only 25% cross points are used at any time.
  - III. Non Blocking
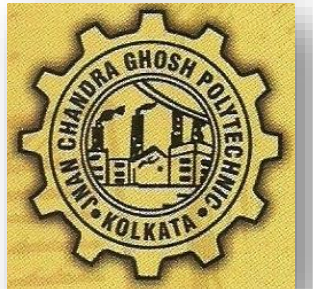
Space Division Switching
(Advantage & Disadvantage)

- The advantage of Space-division switching is that it is instantaneous.

- The disadvantage of Space-division switching is that the number of cross points required to make space-division switching acceptable in terms of blocking.
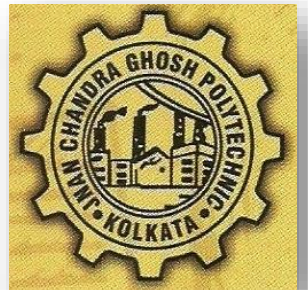
Time Division Switching

- In time division switching, sampled values of speech signals are transferred at fixed intervals.

- Time division switching comes under digital switching techniques, where the Pulse Code Modulated signals are mostly present at the input and the output ports. A digital Switching system is one, where the inputs of any PCM highway can be connected to the outputs of any PCM highway, to establish a call.

- The incoming and outgoing signals when received and re-transmitted in a different time slot, is called **Time Division Switching.** The digitized speech information is sliced into a sequence of time intervals or slots. Additional voice circuit slots, corresponding to other users are inserted into this bit stream of data. Hence, the data is sent in time frames.
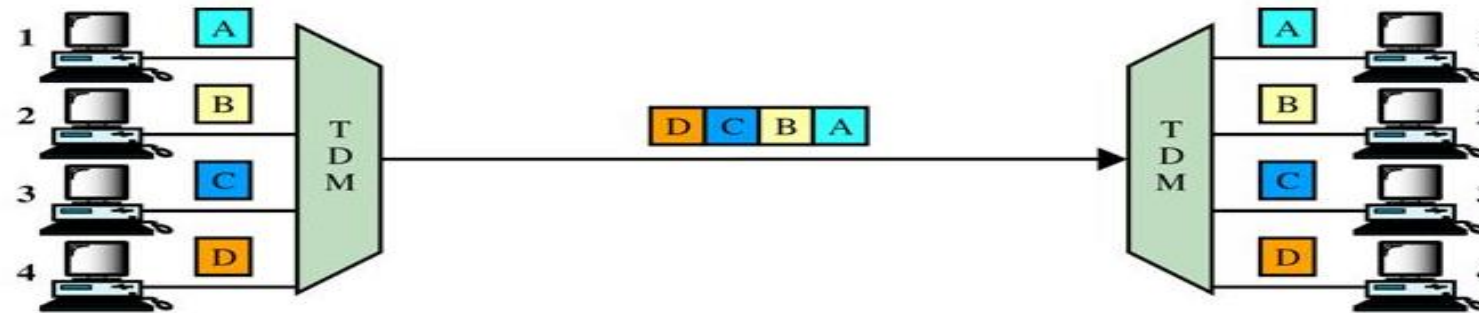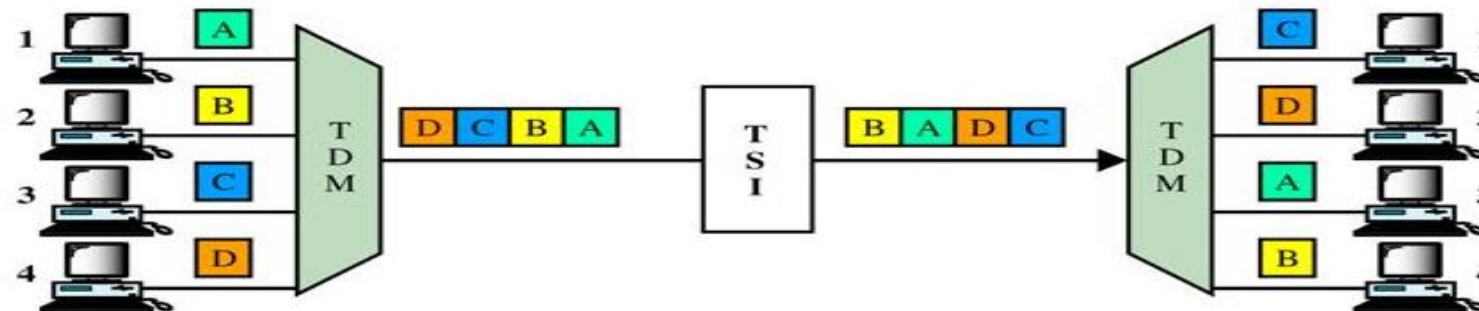
Time Division Switching

Time –Division Switching uses time-division multiplexing to achieve switching.
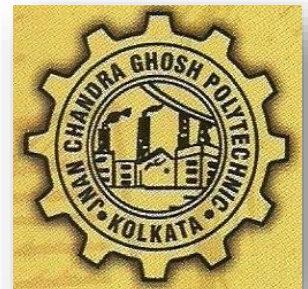
Two Methods used are :
1. Time-slot interchanging (TSI) changes the order of the slots based on the desired connection.
2. TDM bus.
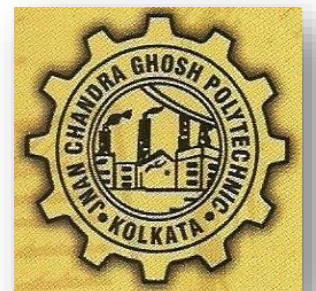

a. No switching

b. Switching

Comparison between SDS & TDS

SWITCHING TECHNIQUES		
SL. No.	Space Division Switching	Time Division Switching
1	Developed for analog environment, but has been carried over into digital communication	Used in digital transmission
2	Requires separate physical paths for each signal connection	Utilizes multiplexing to place all signals onto a common transmission path
3	uses metallic or semiconductor "gates"	Bus must have higher data rate than individual I/O lines
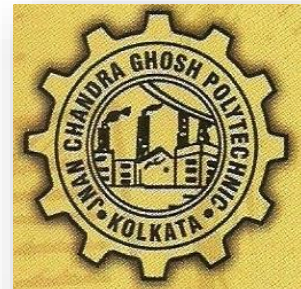
SDS & TDS Combinations

❑ Sometimes Space-division and Time-division switching systems are combined to take advantages of the best of both.

❑ Combining the two results in switches that are optimized both physically (the number of cross points and temporarily (the amount of delay).

❑ Multistage switches of this slot can be designed as Time-Space-Time Switch (TST).
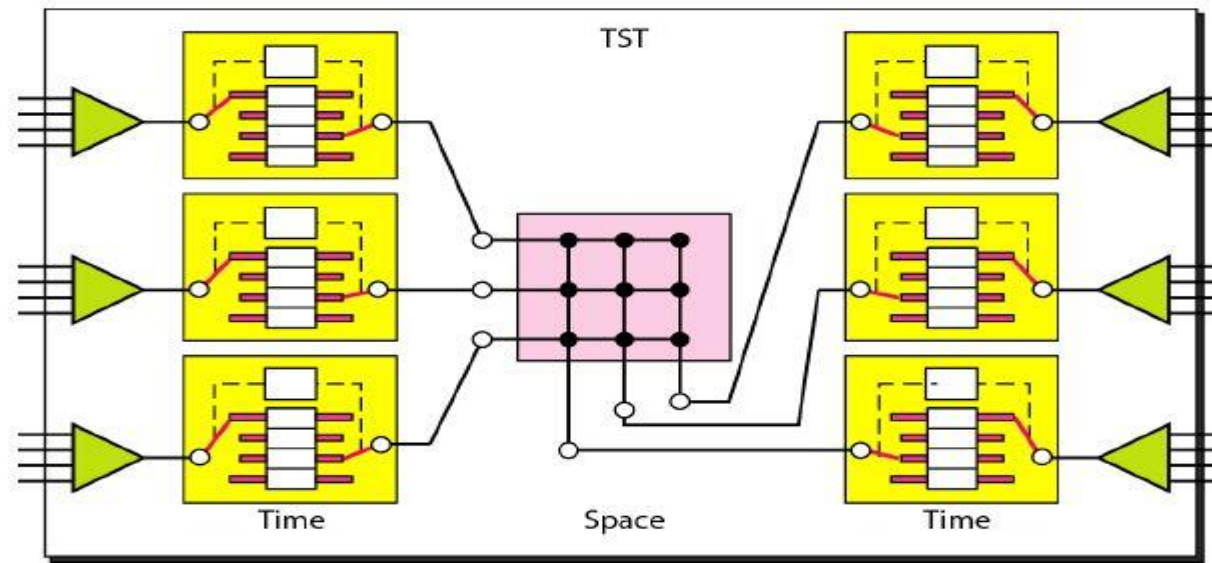
Initially the electronic exchanges used the transistor a switching element. But with further technological advancements, integrated circuits took over. The controls in this system are computer controlled. These advanced systems usually comprise four major blocks as shown in.
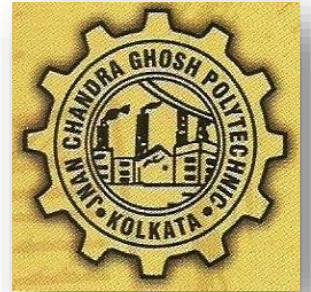
- Connection unit (Interface Unit)
- Switching networks
- Control unit
- Maintenance unit
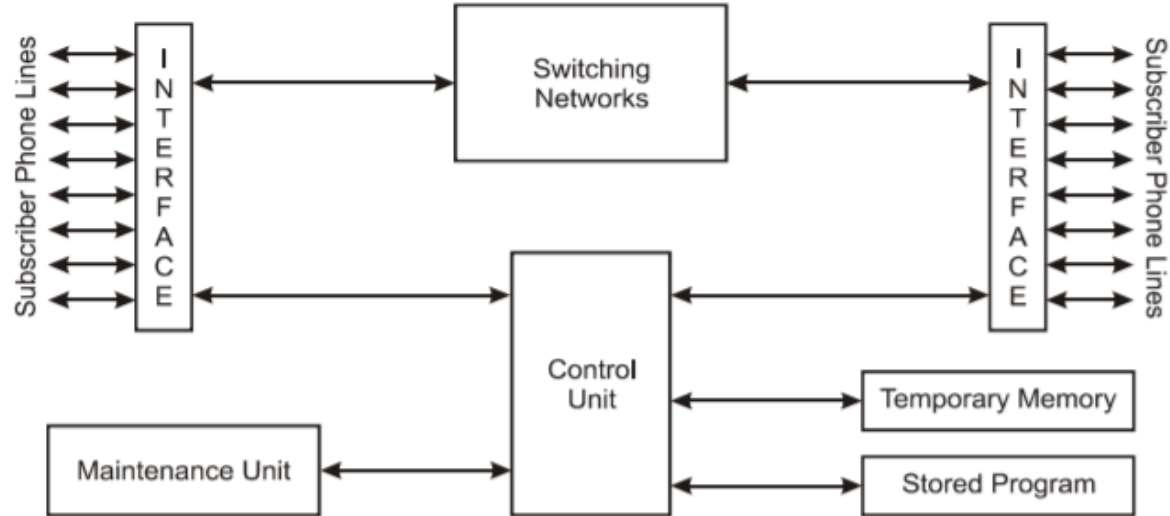
Block Diagram of Electronic Exchange
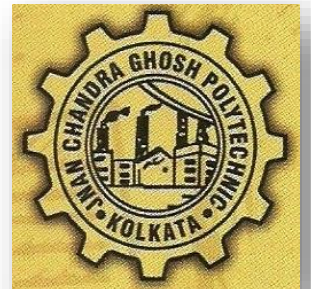
Let us discuss the functions of these units in brief:

❑ **Interface or connection unit** : Interface block represents the connection unit. It performs the job of providing interface between subscribers and the switching networks. On the one end, the subscriber lines are connected to the connection unit while the other end is connected to the switching network. The connection unit is also connected to the control unit, which monitors all the actions of the exchange.

The major functions of the **Interface or connection unit** are:

- 72 Fundamentals of Electronic Communication.
- Providing battery supply to subscriber lines.
- Converting analog speech signals received from callers in to digital form
- Feeding various tones to subscriber (dial, busy, ringing tone etc.)
- Play recorded announcements.

❑ **Switching Network**: It is the largest sub-system in size comprising many electronic switches performing routing of call from one interface unit to another, i.e. it carries out the function of establishing connection between calling and called subscriber. This switching facilitates transmission of speech signal between the two points. It is controlled by a control unit.

❑ **<u>Control Unit</u>:** The entire system is controlled by this centralized unit. It monitors and controls all the activities of the exchange. It is basically an electronic controller in the form of microprocessor, microcontroller, microcomputer or advance computer. With the advances in technology, the capacity of controllers has improved and along with monitoring the switching operations, it can handle many more other functions that the subscribers demand. Mostly, the control unit operates on the principle of Stored Programme Control, commonly termed as SPC. In this scheme, all the switching procedures to set up a call are already stored in the memory files known as programme modules. The processor handling the call accesses this programme and executes it.
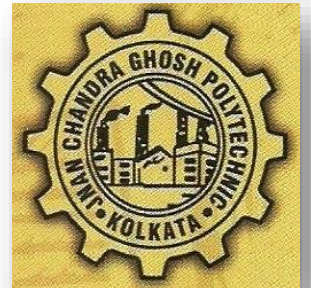
The main functions of the control unit are:

- **Call set up**: This includes monitoring of subscriber lines through connecting unit to detect new calls, releasing subscriber lines after call completion, and receiving and transmitting the dialled digits;

- **Making and Breaking the call**: Issuing the instruction to switching networks to connect the calling subscriber to the called subscriber and disconnecting it after call completion;

- **Supervision**: This covers identification of type of subscriber; detection of error condition; confirming the fault and determining its location; and controlling alarm circuits

- **Charging:** This covers handling the subscribers accounts; counting the number of metered charges; registering the duration of each call and charging it as per the type of the call i.e. Local, STD , ISD.
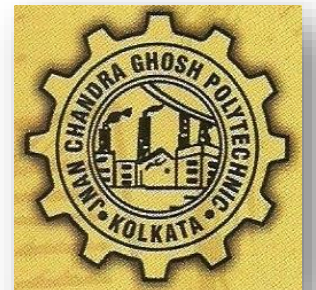
The Advantages of Electronic Exchanges are

- The electronic exchange allows handling of analog as well as digital signals. This improves speed and quality of data transmission as well as allows facilities like Internet Connectivity.

- It requires less maintenance since there are no mechanical or electromechanical switches.

- Since there are no physical wire links involved, the installation and maintenance of these exchanges is cost and time effective.

- Capacity of these exchanges can be easily expanded since only electronic switching boards need to be added which do not occupy large space.

- Possibility of using time division switching reduces the physical space and hardware involved.
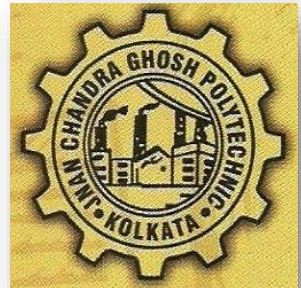
Numbering plan of Telephone Networks
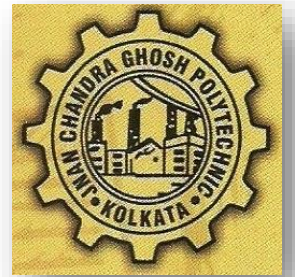## (National Schemes & International Numbering)
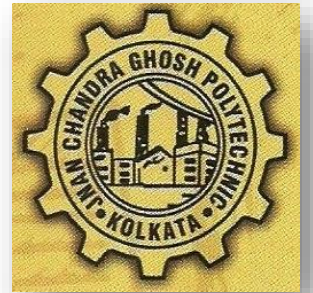
- **A numbering plan** is a telecommunication scheme through which telephone numbers are assigned to subscribers and telephony endpoints.

- Each telephone number is an address assigned to an endpoint in a network through which a designated subscriber can be reached.

- Depending on the local telephony requirements and network, a numbering plan can follow a number of strategies.

- A numbering plan is also known as a telephone numbering plan.

- A numbering plan can be generally divided into open and closes numbering plans.

- An open numbering plan can assign various numbers of digits and may allow local calls to be dialed without the area code or allow variance in numbers of digits.

- A closed numbering plan has a set number of digits to every telephone number where caller must always dials the full National Significance Number (NSN) when placing a call.

- Numbering plans, in many cases, most significantly depend on the geographical zone of the subscriber:
  > A fixed number of area codes is allotted depending on the state, city or region.
  > Any user dialing from within a network must first specify the area code if dialing outside their local zone.
  > Not only public switched telephone networks (PSTNs) but private telephone networks employ numbering plan schemes as well.

Telephone Numbering Plans

❑ The numbering plan in telecom sectors for a country is an <u>important fundamental plan</u> that requires careful , thorough and judicious reviews to constantly meet the country's requirements as the telecommunications network grows and new developmental challenges surface.

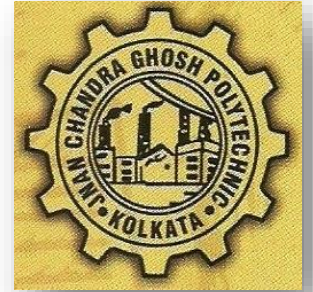❑ International Numbering Plans

❑ National Numbering Plans.
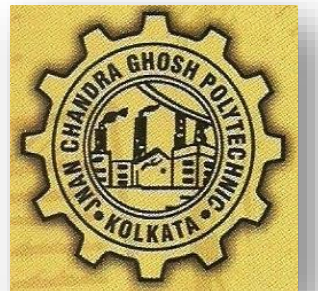
International Numbering Plans

- International Numbering Plan (INP) is specialized in world wide telecommunications related numbering plans in globally.

- An international numbering plan or world numbering plan has been explained by Committee for International Telephony and Telegraphy (CCITT) in recommendations of this E.160-E.163.

- CCITT was created in 1956 & renamed ITU-T in 1993, designated E.164 for comprehensive numbering plan.

- For International numbering plan world divided into nine (9) regions.

- Maximum 12-15 digits for telephone numbers , including country calling code , area codes & subscribers number or destination number.

- The ITU-T recommends for the sequence "00" as a standard for international call prefix implemented by many country (Ex. US, India...) but not all of them (Ex "0" used by Samua, "000" by Uganda & "001" used by Hong Kong).

International Numbering Plans

Format for International Numbering Plan (INP)

ITU Template for number plans:-

|............................15 digits (max)

Country code (CC)	Area Code (AC)	Directory/Subscriber Number	
		Central Office Code	Destination Number
1-3/4	1-3	1-3	1-4

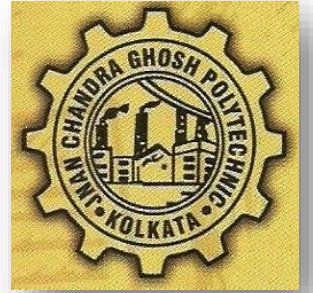|---------National Number (9-12 digits)------------|

(Rule of CCITT)

- The International Telecommunication Union (ITU) has established a comprehensive numbering plan, designated E.164, for uniform interoperability of the networks of its member state or regional administrations.
- It is an open numbering plan, however, imposing a maximum length of 15 digits to telephone numbers.

National Numbering Plans
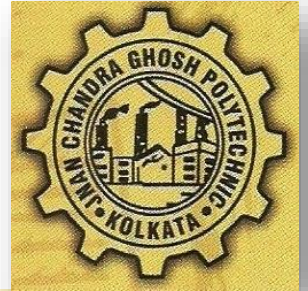
× The **National Numbering Plan (NNP)** provides a set of rules and guidelines for the use and assignment of numbers to telephone services delivered over the Public Networks.

× This is defined for only national level numbering (Ex. India).

× The Plan also describes the assignment of numbers to international services, trunk service, emergency services and special services such as voice mail and **IN** services.

× The National Numbering Plan is one of the Fundamental Plans along with Switching, Routing, Transmission, Charging and Synchronization Plans.

... by ITU-T

National Numbering Plans
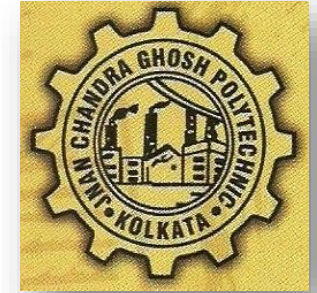
Format for National Numbering Scheme:

× Every national number that contain different three part of the telephone number.

|-------------- Subscriber Number--------------|

Area/Trunk Code	Exchange code	Line Number
1-3 digits	1-3 digits	2-4/5 digits

○ National numbering system can be divided in to area code, Exchange code & line number.
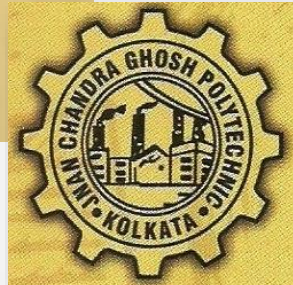
National Numbering Plans

Explanation of Key Word of National Numbering Scheme:

* **Area code:** can be defined by using the region geographically in which that area come. Its variable number for a particular country.
* It also known as Numbering Plan Area (NPA) codes in US. In the UK, they were known as subscriber trunk dialing (STD) codes.

* **Exchange code:** its length up to 3 digits identifies the Exchange office within the area code, which are unique to each telephone exchange within an NPA. The remaining four digits are the specific station number assigned to each telephone.

* **Line Number:** The subscriber number is the number assigned to a line connected to one customer's equipment.
* The first few digits of the subscriber number typically indicate smaller geographical areas or individual telephone exchanges. In mobile networks they may indicate the network provider.

Conclusion

- Numbering plan used for identify the unique subscriber by using it's unique number DOT (Department of Telecommunication) controlling all the telecommunication or telegraph based rules & controlling in INDIA.

- Consultative Committee for International Telephony and Telegraphy (CCITT) or ITU-T controlling all the telecommunication or telegraph based rules & controlling in WORLD Zone.

Q & A

THANK YOU