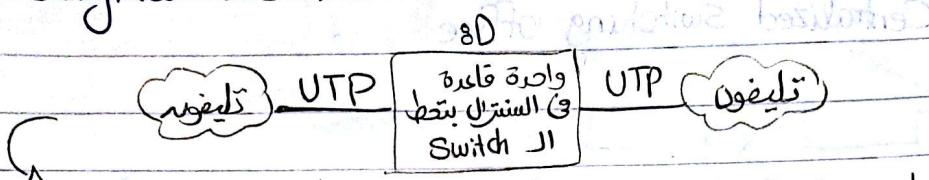


Unit (2) - B : Telephone Systems

1. Original PSTN:



Manual switching directly connected two local loops

- Due to microphone technology, audio BW was 4 kHz

2. Analogue Telephony:

* Transmitters:

Varied the electrical energy → inversely proportional to sound energy

• Early systems used local batteries. Eventually a "Common battery" model became prevalent

* Receiver:

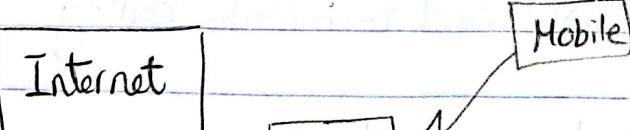
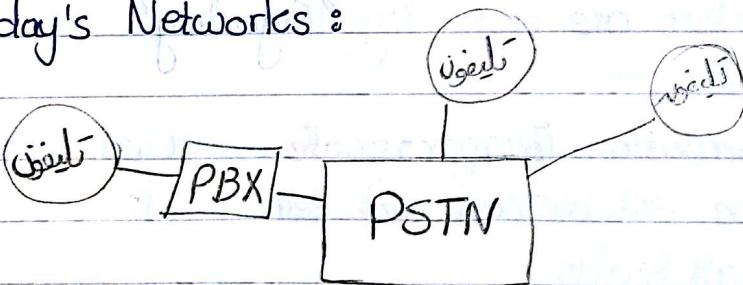
(transducer) recreated the sound

3. Telephony Equipment

↳ : V تليفونات شكلها حلو (Phone shape)

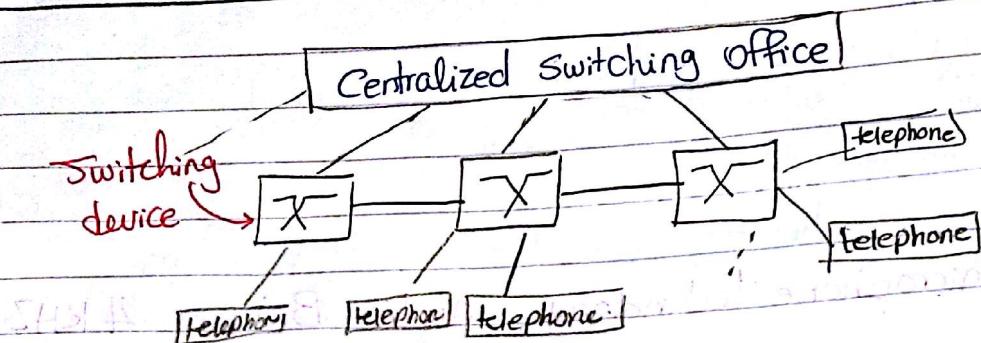
↳ (ليد ٤) زارين اقروه حلو و مسلسل

4) Today's Networks:



9

Module (2) : Modern Telephone network



* Automatic Switching:

* Automatic Switching:
عسان نعمل Automatic Sw. بدل ما است بتاعت السنترال روزن هى ال
ED Switch محتاجه components

Comm. between Subscriber & SW \leftarrow Addressing \leftarrow
 \uparrow Communication between switches \leftarrow



Module (3) : Switching and Signaling

* **Signaling**: Communication between Subscriber & Switch as well as between switches are done by "Signaling"

func:

- pass call information to appropriate switches so that a call can be established and terminated
 - tell users call status
 - initiate and terminate billing

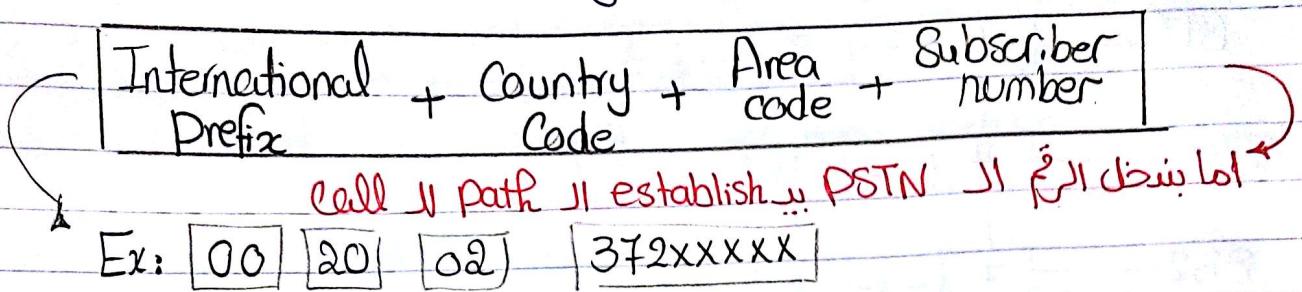
Notes : LE \rightarrow telephone

primary Center → Sentral

Secondary → Zay law masaln hñkalm mñtafza tanya

local loop \rightarrow link bank w ben sentral

- * Addressing in PSTN: ↗ رقم المتلقيون يعني
- ↳ Each Subscriber is assigned a unique number.

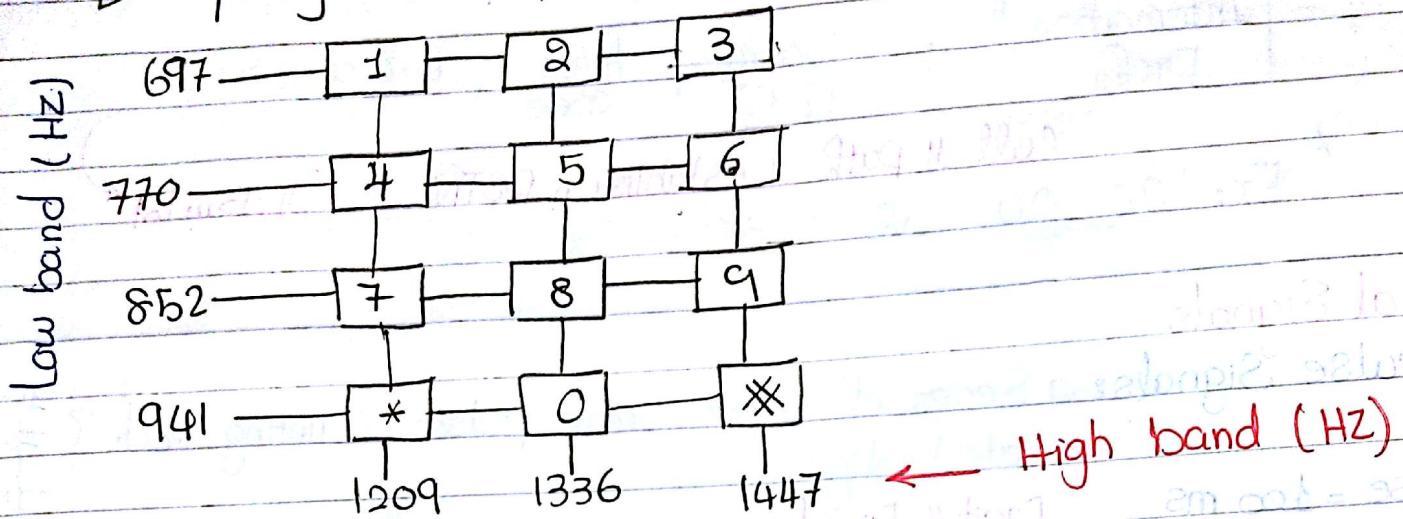


- * Dial Signals
- ↳ Pulse Signals: a Series of make/break pulses Counting each dialed digit
- 1 pulse = 100 ms
- Digit 4 Dialed
- next digit
- on hook
- off hook (inter-digit)
- 4 Breaks = Digit 4
- 2 pulses
- (لـ عايزيه نكتب 2 هـلـ بـقـر)

- * Signaling (Subscriber ↔ Switch) ↗ انت والسنترال
- ↳ In-band Signaling: use same channel to perform msg exchange between 2 devices

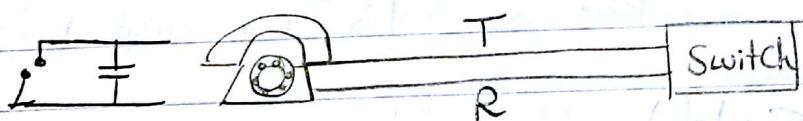
- ↳ Same Telephone channel Used To →
- transmit dial digit (pulse signals / Dual tone multi freq) from Subscriber to local switch. نقل الـ رقم الى المـنـطـرـال
 - transmit dial tone , ringing ... from local switch to Subscriber. المـنـطـرـال يـهـوـاـه تـلـيـفـونـك
- لـهـاـس
w~th~in
voic~e
chann~el

DTMF Tones (Dual Tone Multi Frequency) ↗
 ↗ frequency 1 + frequency 2 → Dialed digit



Harmonics يكونوا Row II no 0150 (600 & 1200 For ex.) اختيار ال frequencies بتساوي لـ vertical (600 & 1200 For ex.)

٣ سلайд فيها ٣ رسومات تحت بعضها لسيناريو ال Call



D Keda open circuit tal matna qafren el smaza

لما ينجز المكالمة ينجز المكالمة

لما النيلفون يبرن دا تفاه انه جه

* Signaling (Switch ↔ Switch)

Subscribers connected to different switches instead.

- Originating Switch Seizes "inter-switch trunk"
- Send "off-hook" Signal on trunk, requesting digit register (for address)
- Terminating switch send "off-hook followed by on hook" → ready
- Originating Switch send address

Signaling: Subscriber \leftrightarrow Switch. (Slide 31)

الكلمة الأولى بتحكى بيحصل ايصال ما اول ما تقبل بحد لخدمات اتصالونه بين

(1) Calling subscriber off-hook (seize) signal

\hookrightarrow رافضنا المسمى و 3malha tagz enna nt kalm.

(2) Identification of calling subscriber

السنترال هيرتعرق علر رقم المار هندرله او الـ allocate Storage وكم

(3) Dial tone \rightarrow انت يتسمع جرس

(4) Address digits \rightarrow فتكتب الرقم المار على تدخل بي

(5) Digit analysis and choice of outgoing Circuits

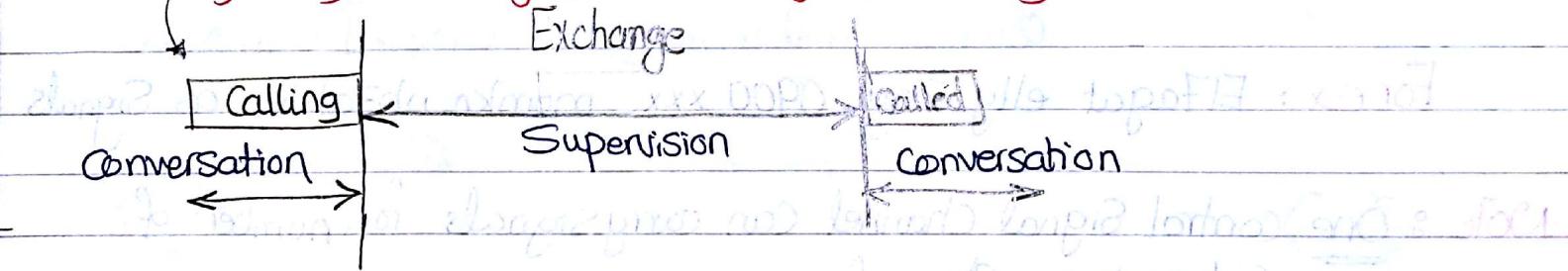
هنا هيسندى يتعامل بقى مع الارقام الى انت هما لا تدخلوا

(6) Switch-path set up

(7) Ringing Tone \rightarrow خلاص كل اتصالات انت يتسمع جرس او الـ يتكلمه تأليفونه بين

(8) Answer (off-hook) \rightarrow الـ يتقبل بسند على التحالف

(9) Disconnect ringing current & ringing tone \rightarrow السنترال هيفصل الجرس من عنه والرنين عنه وتتكلمو



(10) Disconnect equipment \rightarrow السنترال بعدها يقطع ما تطبعه ما ينزل

بسند

* Drawbacks of In-channel Signaling:

- Limited transfer rate
- Delay between Dialing & Connection

\hookrightarrow Soln? Use common channel Signaling

In-channel Signaling:

In-band →

- Uses same frequencies as voice signal
- Can go anywhere a voice signal can
- Impossible to set up a call on a faulty speech path.

Out-band →

- Means mat3m3sh as voice
- * Zay msalan mn central le central aw pulse fy international call
 - Voice signals don't use full 4kHz BW, narrow signal band within 4kHz used for control

Slower rate

extra electronics needed for voice and control signals

Common Channel Signaling:



For ex: Eltagat elly Zay 0900 xxx momkn ab3at ha as signals

Note: One control signal channel can carry signals for number of subscribers channels.

2 Modes

Associated

- Common channel
- Closely tracks inter-switch trunks

Non-Associated

- Additional nodes
- Effectively two separate networks

Signal System Number 7 → Common Signaling II dedicated

- Optimized for 64 kbit digital channel network
- Call Control, remote control, management, maintenance
- Reliable means of transfer of info in sequence

* Operate over and above 64 kbit
below

Network elements :

- 1) Signaling point (SP) → any point in network that can handle SS7 control msg
- 2) Signal transfer point (STP) → Signaling point can route control msgs
- 3) Control plane → establish & manage connections
- 4) Information plane → once connection is set up, info is transferred in information plane

* Signaling Network Structure (Measuring Parameters)

↳ STP Capacity

- No of Signaling Links that can be handled
 - Msg transfer time
 - Throughput capacity

↳ Network performance

- No. of SPs
 - Signaling delays

↳ Availability and reliability

- Ability of network to provide services in case of STP failure

* GSM Slide → Check file unit (1) / page 14

* Quality Measurement : Mean Opinion Score (MOS)

↳ MOS gives a numerical indication of perceived quality of media received after being transmitted & eventually compressed

5 - Perfect

4 - Fair → Cell phones range (voice still clear)

3 - Annoying

2 - Very annoying

1 - Impossible to communicate.

Note that :

Quality of Voice → MOS Rating

Quality of Service → probability of blocking.