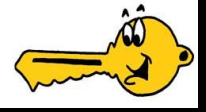
TSN: Lecture 24
Signalling

Topics Covered

- Signaling
- Functions of Signaling
- Supervisory Signaling
- Address Signaling



Signaling

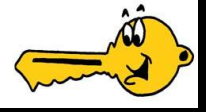
- (***definition***) The exchange of information between call components required to provide and maintain service
- (***examples***) Dialing digits, providing dial tone, accessing voice mail, sending a call waiting tone, *69, etc.

Functions of Signaling

- Supervisory Signaling
- Address Signaling
- Call Progress Signaling

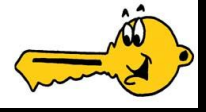
Supervisory Signaling

- Provides information on line or circuit condition
- "It [signaling] informs a switch whether a circuit (internal to switch) or a trunk (external to switch) is busy or idle; a called party is off-hook or on-hook…"



Supervisory Signals (cont'd)

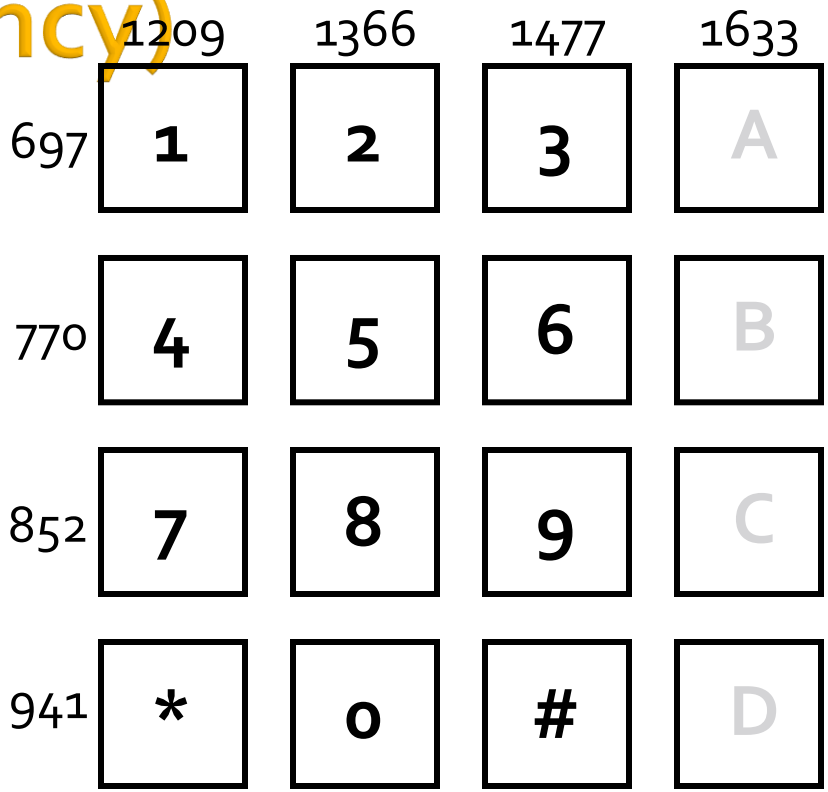
- Some supervisory signals:
  - Request for service - **off-hook**
  - Ready to receive address - **dial tone**
  - Call alerting - **ringing**
  - Call termination - **on-hook**
  - Request for operator - **hook-switch flash**
  - Called party station ringing - **ring back**
  - Network/called station busy - **busy tone**



Address Signaling

- Directs and routes a telephone call to the called subscriber
- If there is more than one switch involved in the call setup, signaling is required between switches (*interregister switching)*

Address Signaling: DTMF Signaling(dual tone multi frequency)



Call-Progress Signaling
(Audible - Visible)

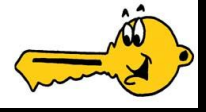
- Categorized by audio/visual signals sent in a forward and backward direction
- Forward Direction: A signal sent to your phone which tells it to ring

Call-Progress Signaling(cont'd)
(Audible - Visible)

- Backward Signaling:
  - Ringback - the distant telephone you are calling is ringing
  - Busyback - the called line is busy
  - ATB - All trunks are busy (sometimes a voice announcement is used)
  - Loud Warble - Telephone is off hook

Signaling Techniques

- In band signaling
- Out-of-band signaling
  - - CCS signaling
- E&M signaling
- MF signaling

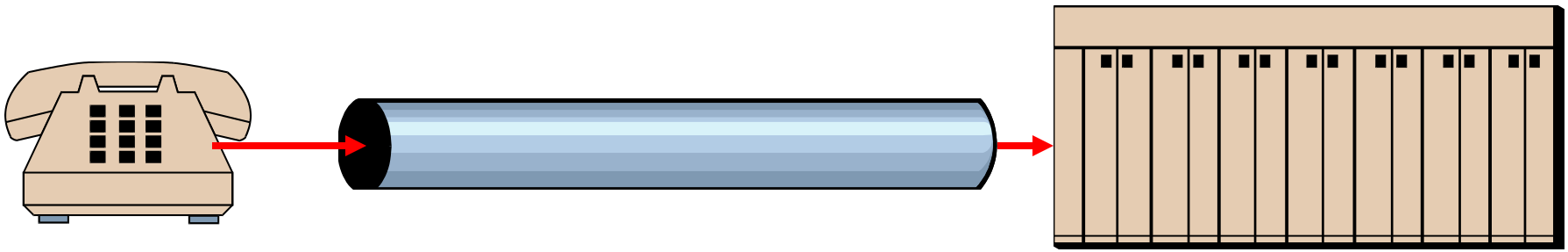


In - Band Signaling

- Signaling path = voice path
- Voice path clogged with signaling
- Busy calls, congestion, and "ring-no-answers" result in 20-35% of incomplete calls
- Slower call setup due to channel sharing

Signaling Techniques

- In-channel signaling



In-band

- SF Signaling (2600 Hz)
- MF Signaling
- DTMF Signaling

Out-of-band

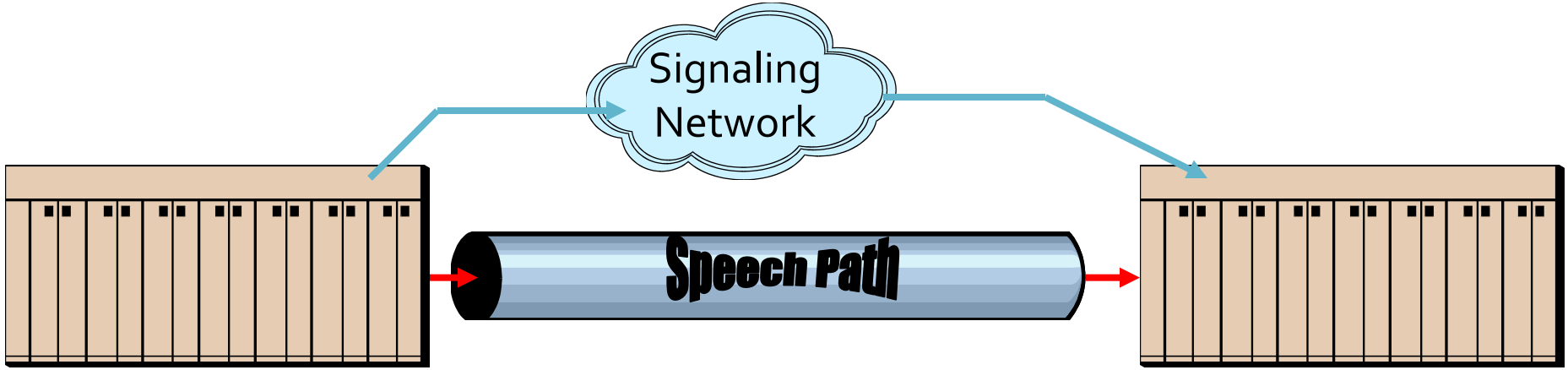
- DC Current (on-/off-hook
- Dial pulses (10 pps)
- 20 Hz Ringing voltage

Out - of - Band Signaling

- Signaling path done on a separate channel
- Voice path dedicated only to voice
- Much faster call setup and knockdown
- Led to SS7 and AIN

Signaling Techniques

- Common Channel Signaling (CCS)

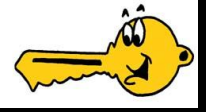


Dedicated data link between systems

- Trunk group associated
- Trunk group disassociated

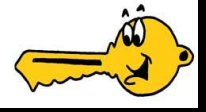
Advantages of CCS

- One signaling path needed per trunk group
- Faster and simpler to transfer information between control processors
- No possibility of interference with speech path
- Signaling can't be accessed by customer



Advantages of CCS

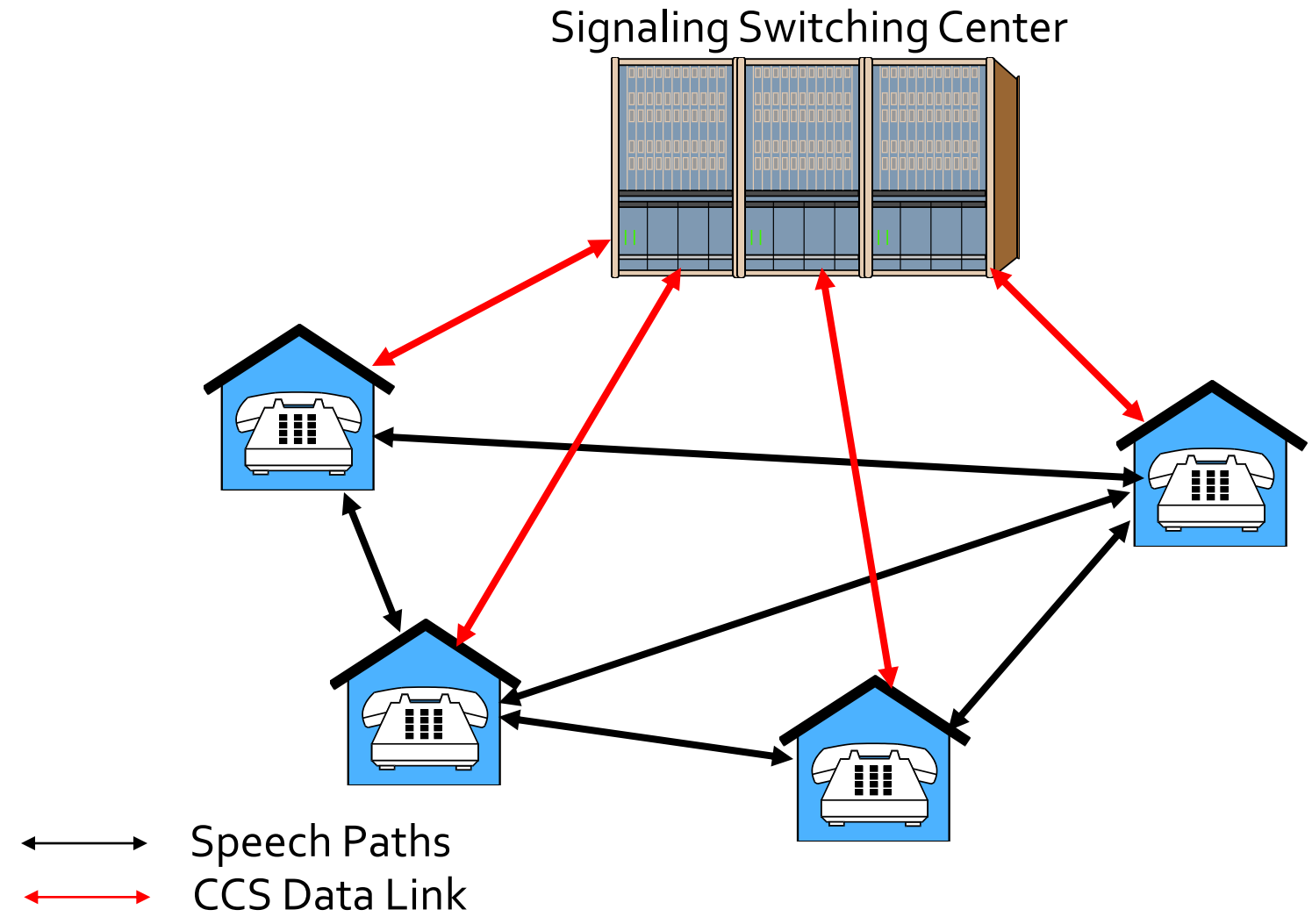
- Value-added services of a signaling control point
  - Shared processing for small offices
  - Allows centralized decision making (flow mgmt)
  - Permits Advanced Intelligent Network (AIN) services



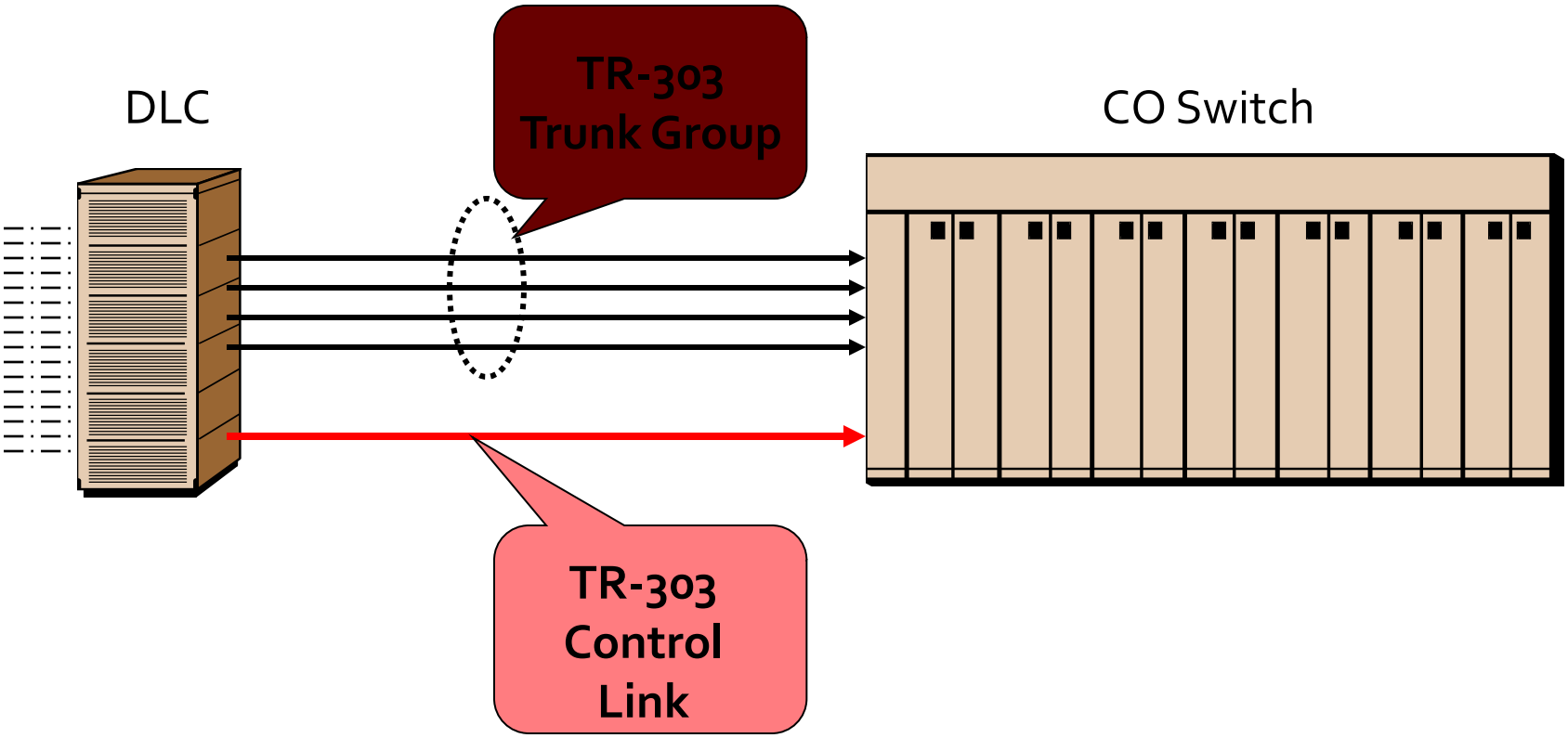
Disadvantages of CCS

- CCS links can be a single point of failure
- No inherent testing of speech path by call setup signaling
- CCS response time is critical

Trunk Group *Disassociated* CCS



Trunk Group *Associated* CCS



E&M Signaling

- Used mostly for trunk supervision on an analog network
- E-lead: carries signals to the switching equipment
- M-lead: carries signals away from the switching equipment

E&M Example

Direction		Condition at A		Condition at B	
Signal A to B	Signal B to A	M - Lead	E - Lead	M - Lead	E - Lead
On - Hook	On - Hook	Ground	Open	Ground	Open
Off - Hook	On - Hook	Battery	Open	Ground	Ground
On - Hook	Off - Hook	Ground	Ground	Battery	Open
Off - Hook	Off - Hook	Battery	Ground	Battery	Ground

MF Signaling

- Used primarily for interregister signaling
  - R 1 System
  - CCITT No. 5 Signaling Code
  - R 2 System Code

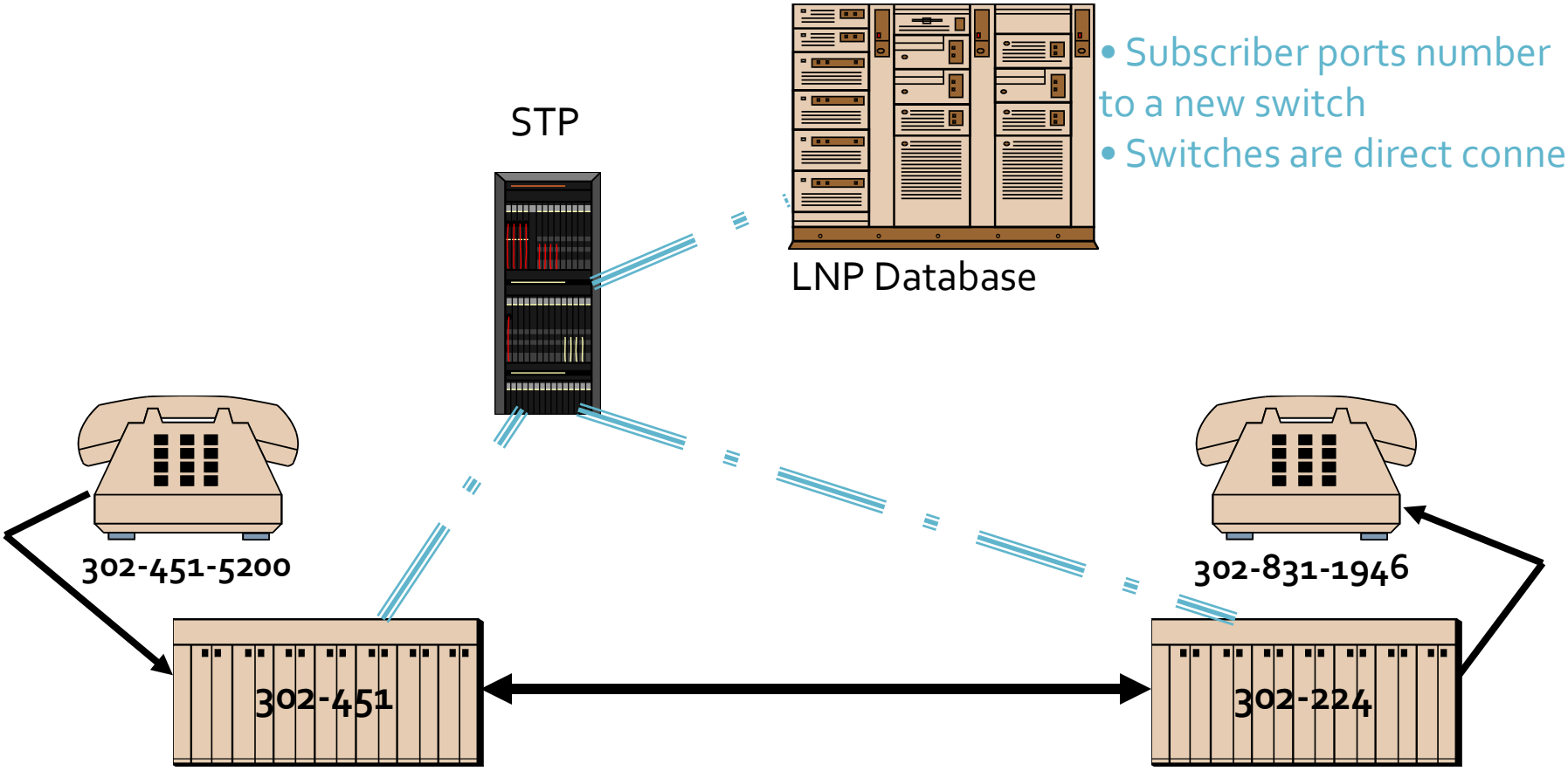
Signaling/Switching Dependence

- Signaling and Switching are closely tied. Signaling allows switching to automate the network.

Call Processing - Local Call

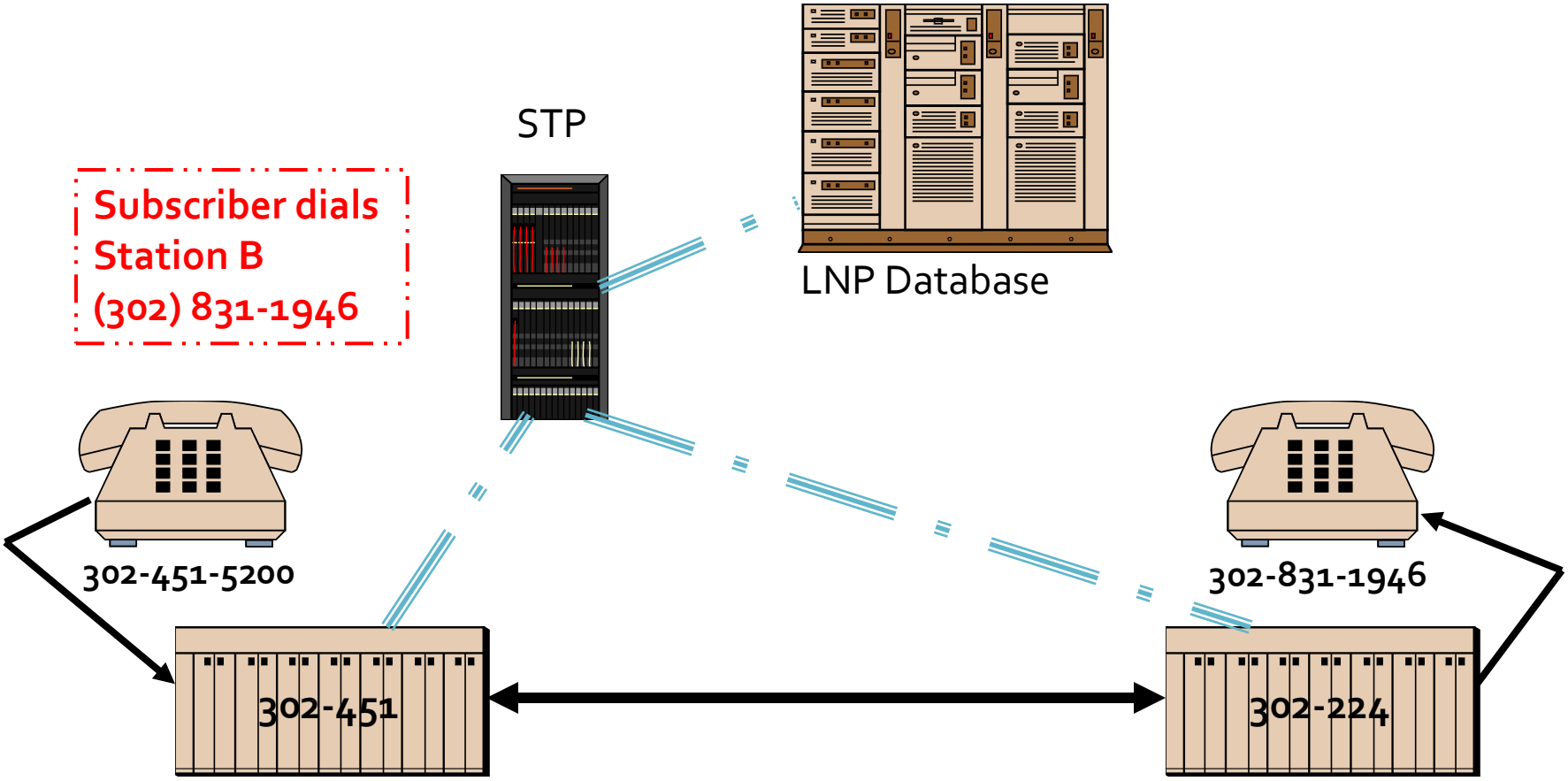
- Send dial-tone to calling station
- Collect dialed digits
- Translate digits to a called number
- Route call
- Prepare connection between stations
- Send ring voltage to called station / ring-back tone to calling station
- Detect off-hook by called station and cut-through the call
- Detect disconnect and terminate call

Call Flow - Common Case

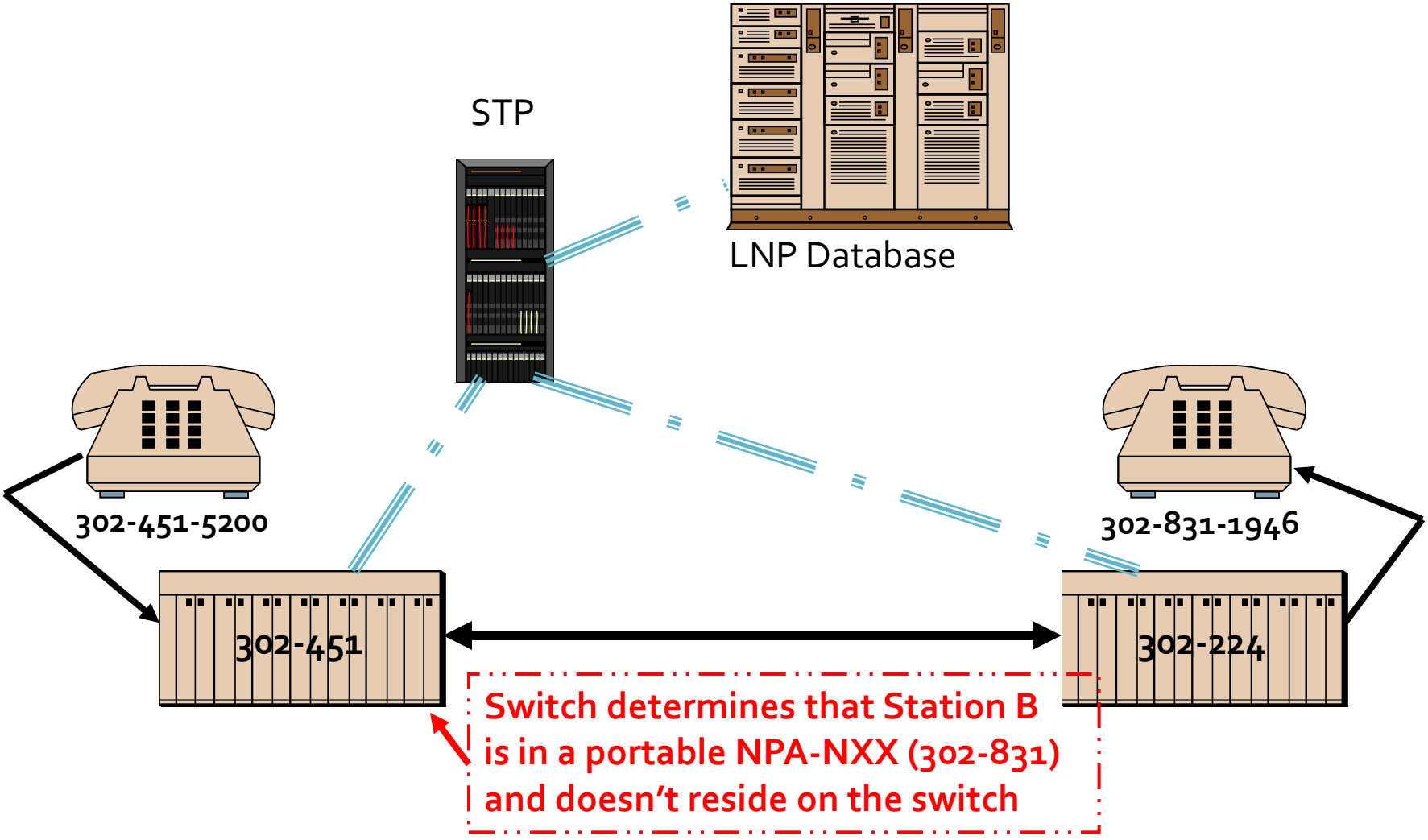


- Subscriber ports number to a new switch
- Switches are direct connected

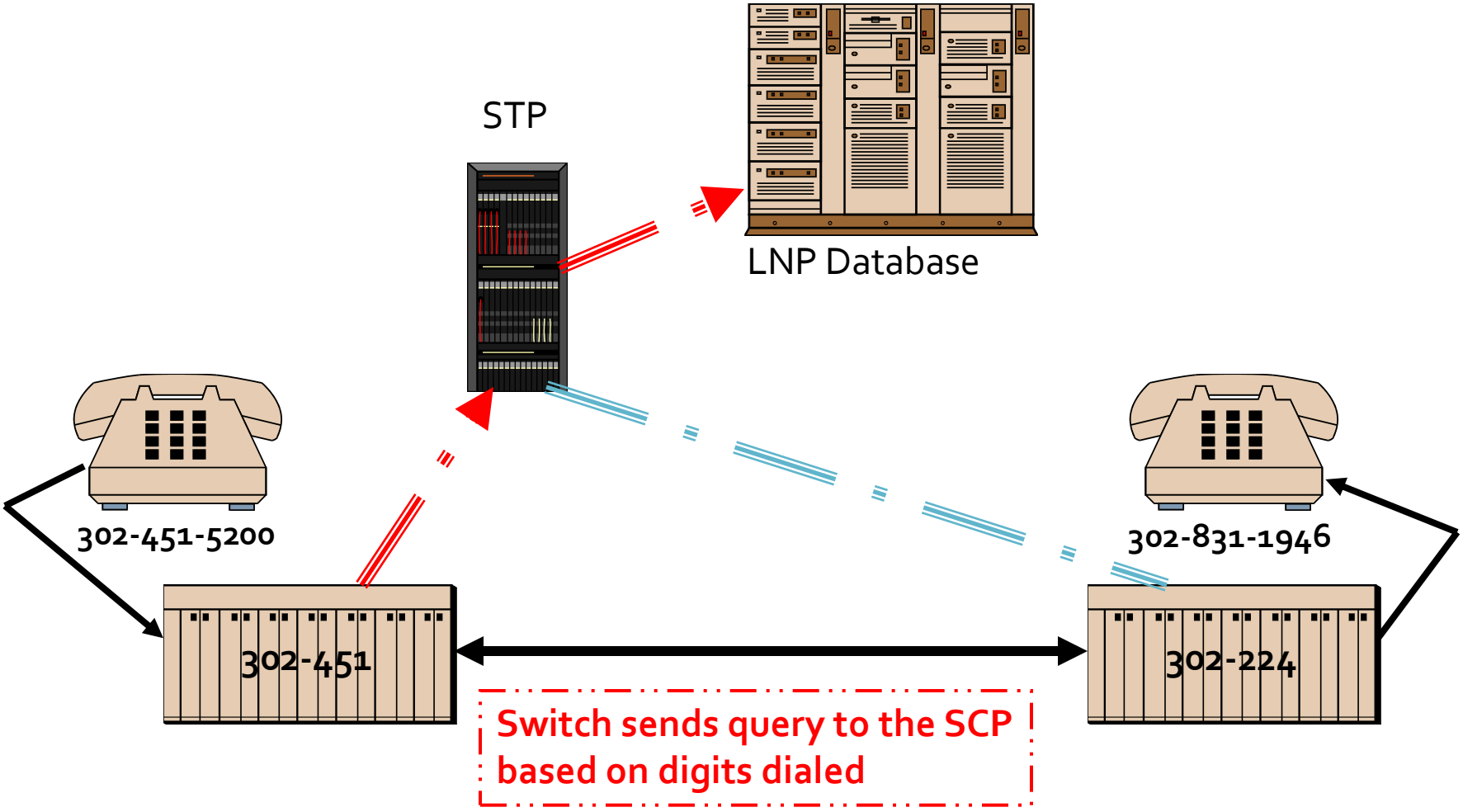
Call Processing (1)



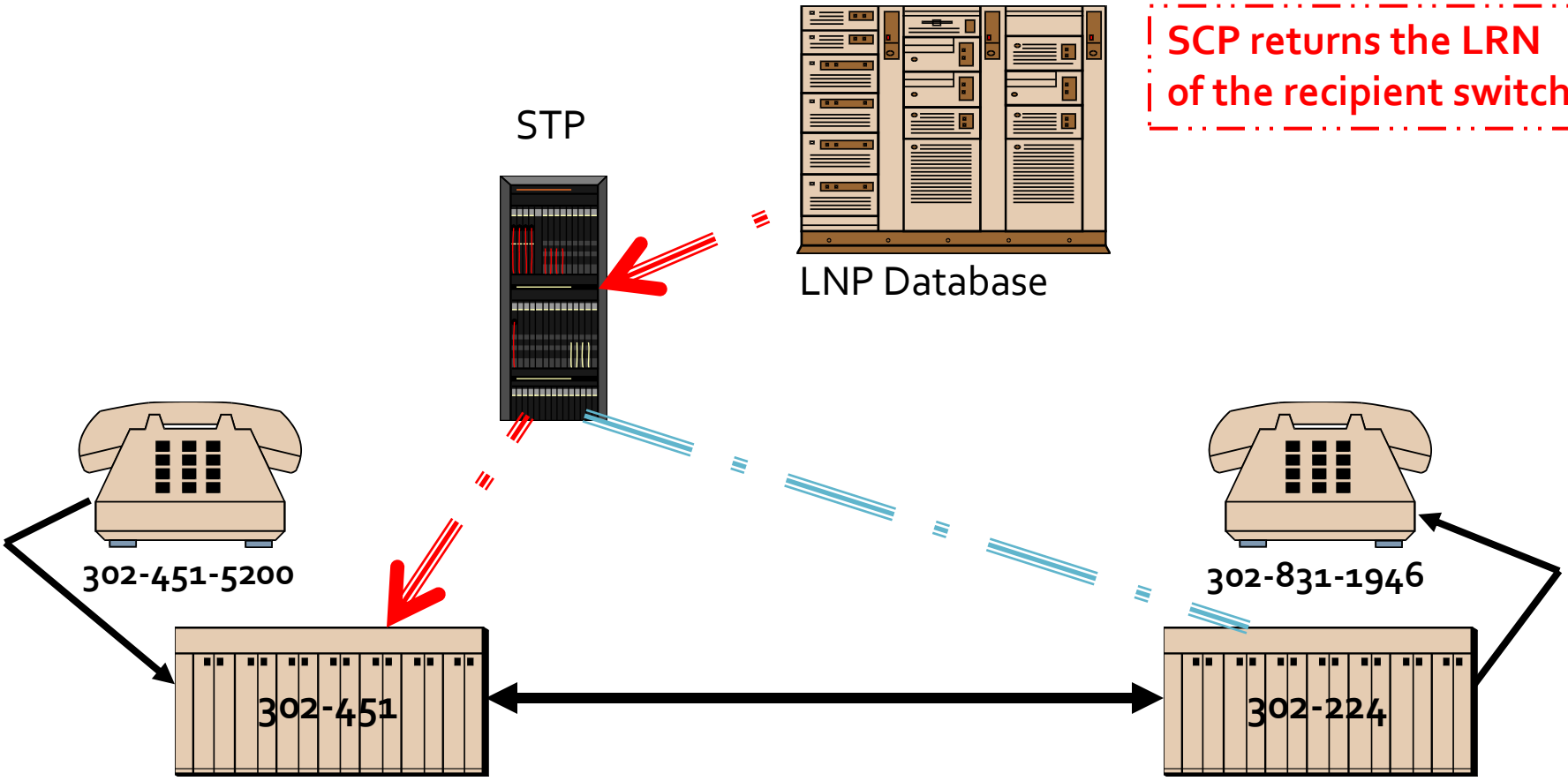
Call Processing (2)



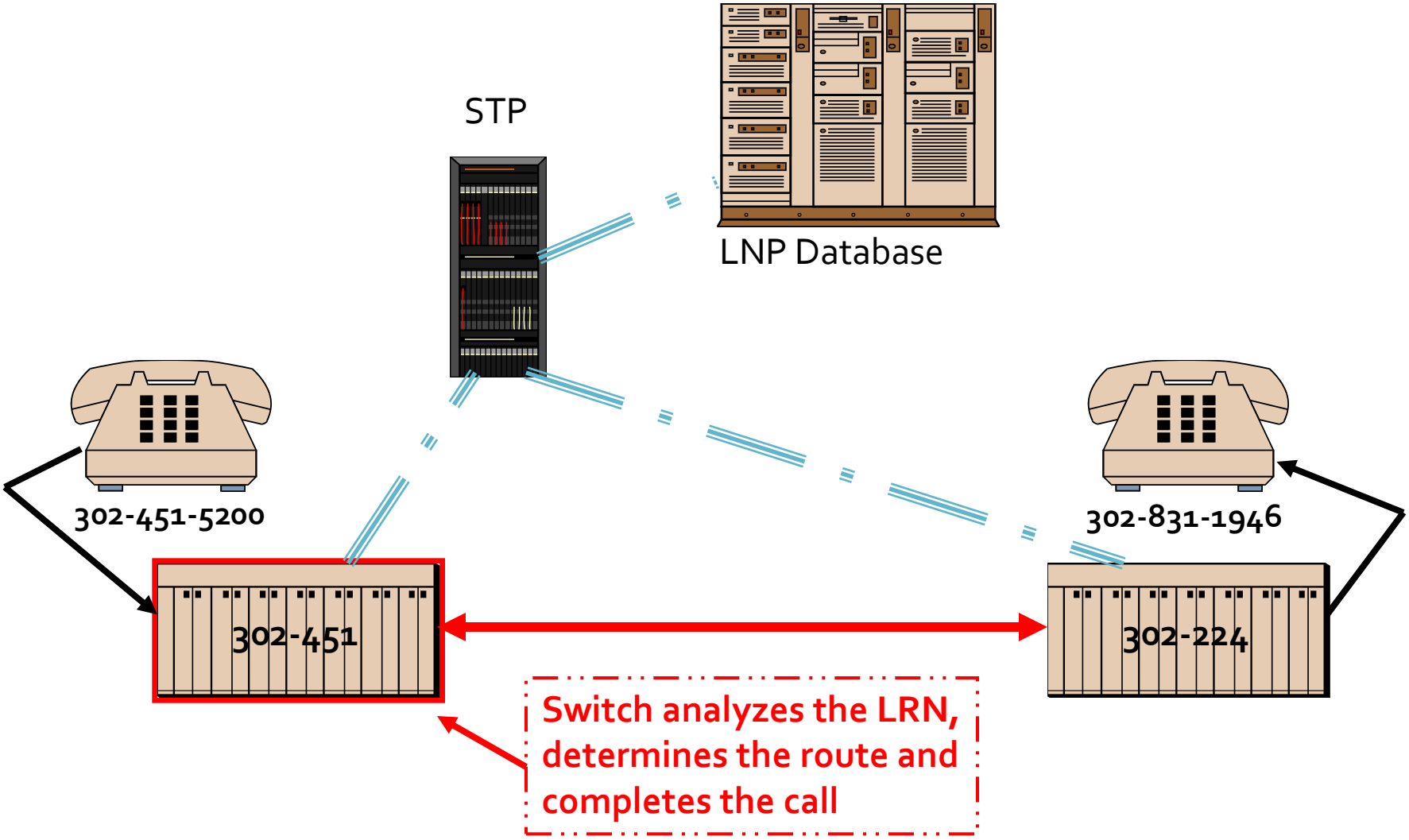
Call Processing (3)



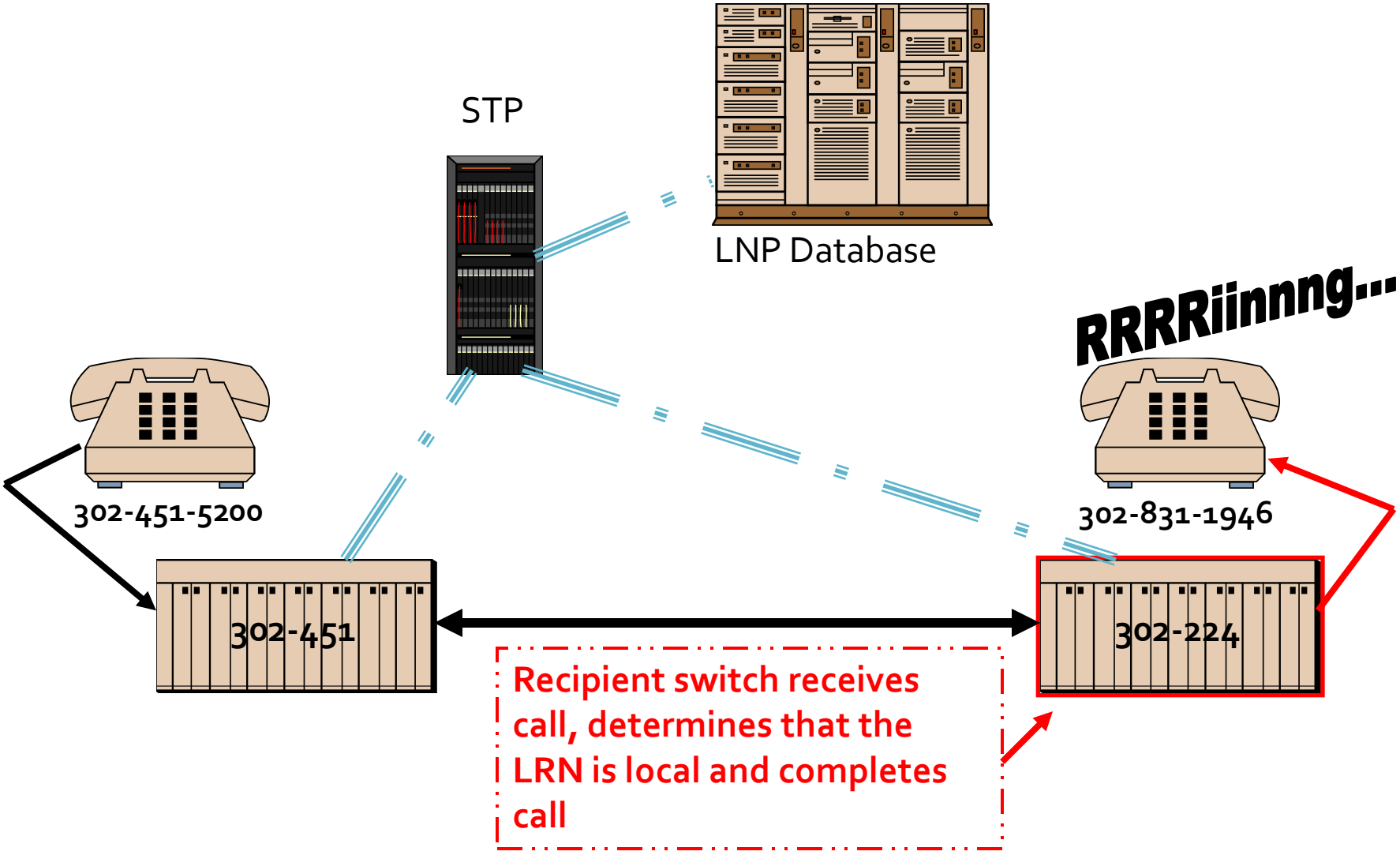
Call Processing (4)



Call Processing (5)



Call Processing (6)



Progression of Technology

- Electromechanical Switches
  - crossbar, step-by-step
- SPC with relays
  - AT&T/Lucent 1A ESS
- SPC with electronic switches
  - AT&T/Lucent 4 ESS
- Digital
  - AT&T/Lucent 5 ESS, Nortel DMSx00

A typical CO…way back

Early Switch Technology

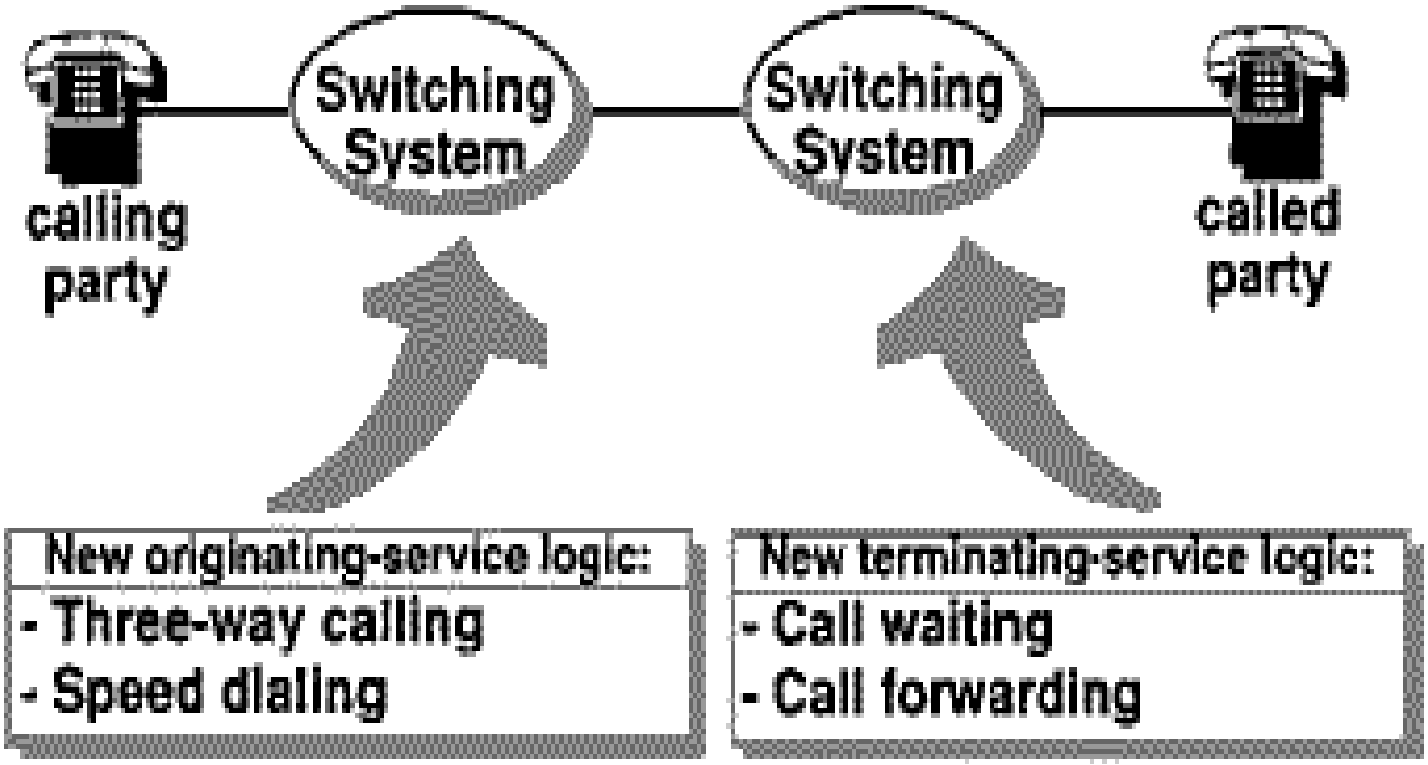
eighty four billion calls a year. Serving everyone from presidents and kings to scum of the earth. (snort) We realize that every so often you can't get an operator, for no apparent reason your phone goes out of order [plucks plug out of switchboard], or perhaps you get charged for a call you didn't make. We don't care.

Watch this -- [bangs on a switch panel like a cheap piano] just lost Peoria. (snort) You see, this phone system consists of a multibillion-dollar matrix of space-age technology that is so sophisticated, even we can't handle it. But that's your problem, isn't it ? Next time you complain about your phone service, why don't you try using two Dixie cups with a string. We don't care. We don't have to. (snort) We're the Phone Company."

Lily (Ernestine) Tomlin on Saturday Night Live

The OLD Way…

Plain Old Telephone Service (POTS)



How Did POTS work?

- All switching logic had to be “hard-wired”
- Analog transmission
- Pre-1960’s technology
- In - band signaling

Technology Limitations

- Switching systems were not easily scalable because changes had to be implemented in Hardware
- As systems were upgraded, services were not the same in all areas
- The existing technology was not able to handle the changing needs of callers

Technology Limitations(cont'd)

- As modems became popular the nature of calls changing from voice to data put a strain on the analog switches due to the variation in the length of calls. Data calls tend to be much longer than voice calls.

Something About Digital…

- "The North American PSTN will be entirely digital by the year 2000"
  - - Roger Freeman