How a telephone exchange (switch) works?

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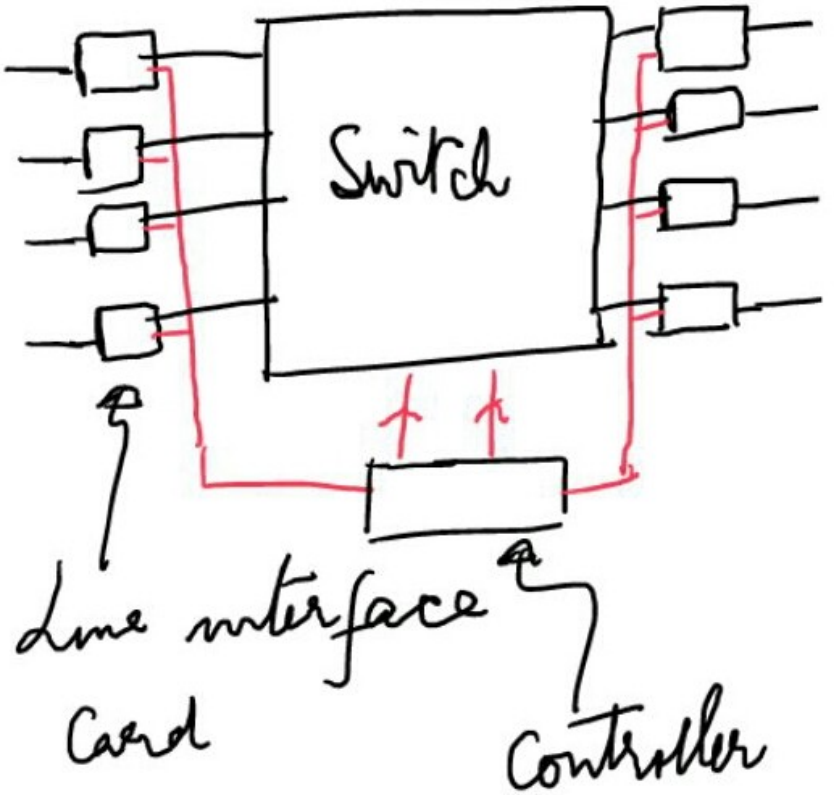
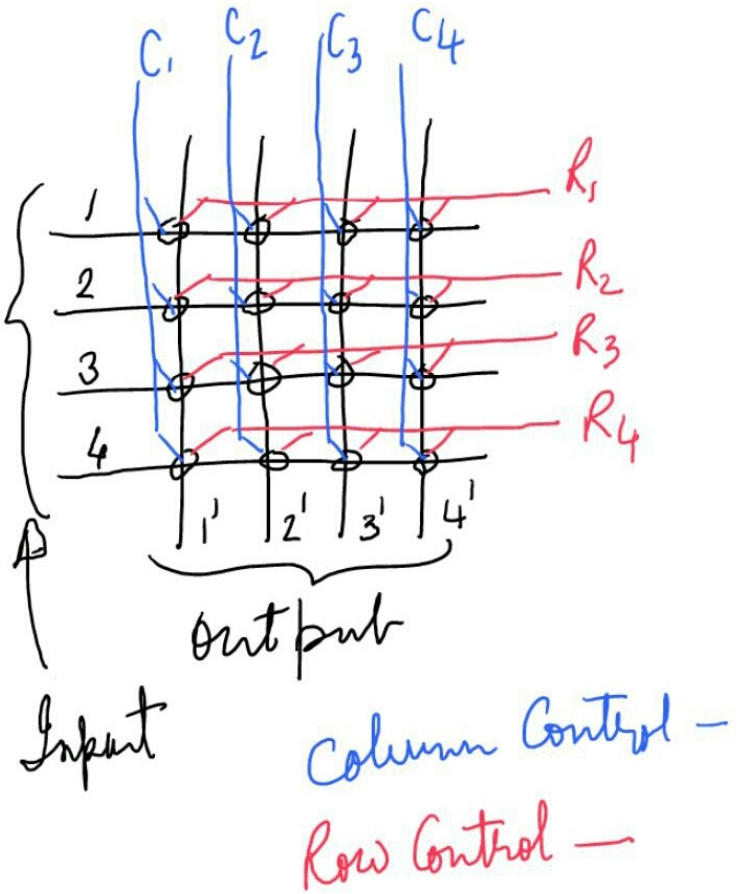
Basic components of exchange

- Line interface card
- Switch matrix
- Switch Control



Crossbar (space switch)

- Crosspoints for creating path between input and output
- Single input to multiple output (multicast possible)
- Each crosspoint – controlled by a relay
- Each crossbar control system – have status registers – keeping track of status of crosspoints.
- Activation of Row first, column second – snaps the crosspoint.



- Deactivation of row, does not changes the status.
- Path created for information flow.
- Deactivation of column deactivates crosspoint. Path broken.

- Crosspoint complexity – how the number of crosspoint grows with the number of input (output) ports.
- For crossbar, it is $O(N^2)$
- The above switch – strictly non-blocking switch
- It can be used for analog signal as well as digital signal.

Digital telephony

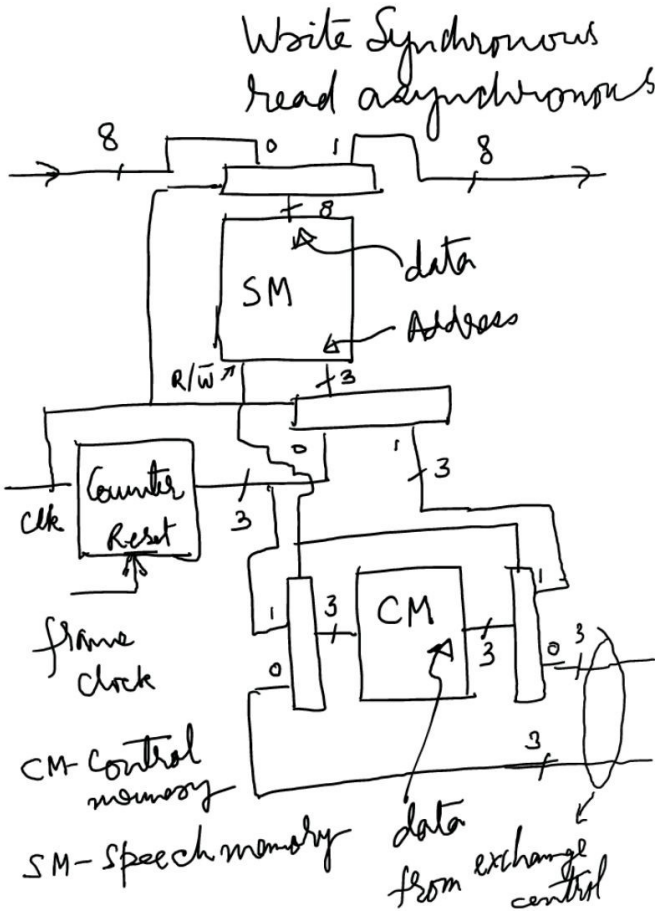
- At line card (if user have analog telephone)
  - analog to digital conversion (ADC) – from subscriber
  - Digital to analog conversion (DAC) – to subscriber
- In digital telephones – ADC/DAC functionality part of telephone instrument.
- Analog line card, digital line cards

Analog-Digital conversion

- Voice is limited to 3.6kHz
- Sampled at 8000 samples/sec
- Each sample is quantized to 256 level (needing 8 bits in digital representation)
- 64 kbps voice stream
- 1 byte every 125 μs
- In telephony, all kind multiplexing structures have frame duration of 125 μs.

Time Switch

- Voice samples from N users
- N octets in a 125 μs frame.
- Write in order, read in an order governed by input-output mapping (WCRA – write cyclic read acyclic)



- Write in an order governed by input-output mapping, read in order (WARC – write acyclic read cyclic)
- Time switch
- Control memory – decides the switching map.
- Switch control - Writes in the control memory.

Strictly non-blocking switches

- Both the above configurations – strictly non-blocking
- If input and output ports are free – path between them can always be setup.
- For large size switches – lot of hardware can be reduced – by allowing some blocking.

Blocking switches

- In some switch states,
  - even if input and output is free
  - still connection cannot be setup.
- We also have a variety – rearrangeably non-blocking switches
- If input and output is free
  - you can rearrange the existing paths in the switch while retaining the existing map
  - Thereafter one can always connect the input and the ouput.

Network

- Distributed large switch
- Made with smaller interconnected switches
- Has redundancy – whole switch never fails even if few smaller switches fail.

Current day scenario

- Link speeds are very high (goes upto 40 Gbps) – packets transmission time – small.
- Delay for sending a message from source to destination – much smaller now
- Voice, video – can be sent in realtime over packet switched network.
- Telephony has now evolved to use packet switching – VoIP (voice over IP)