

1. Switching Networks

- Communication Network
 - Switching Network
 - Broadcast Network
- Switching Networks
 - Circuit-switching networks
 - Packet-switching networks

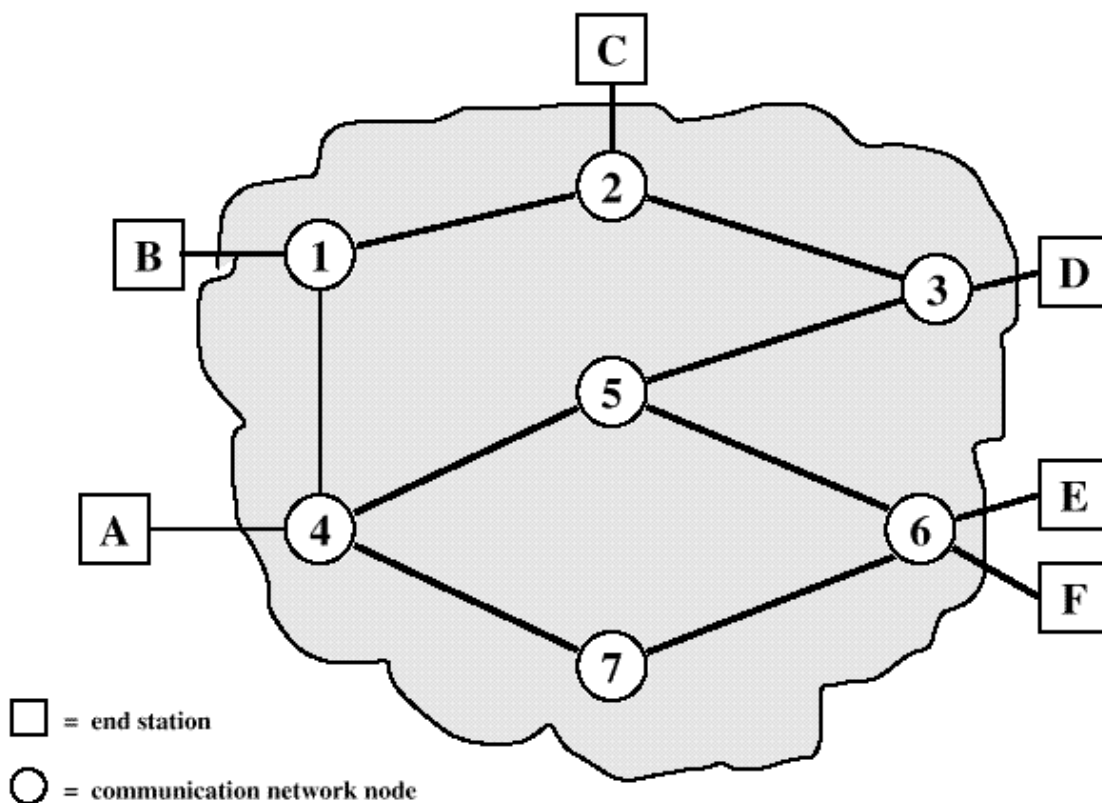


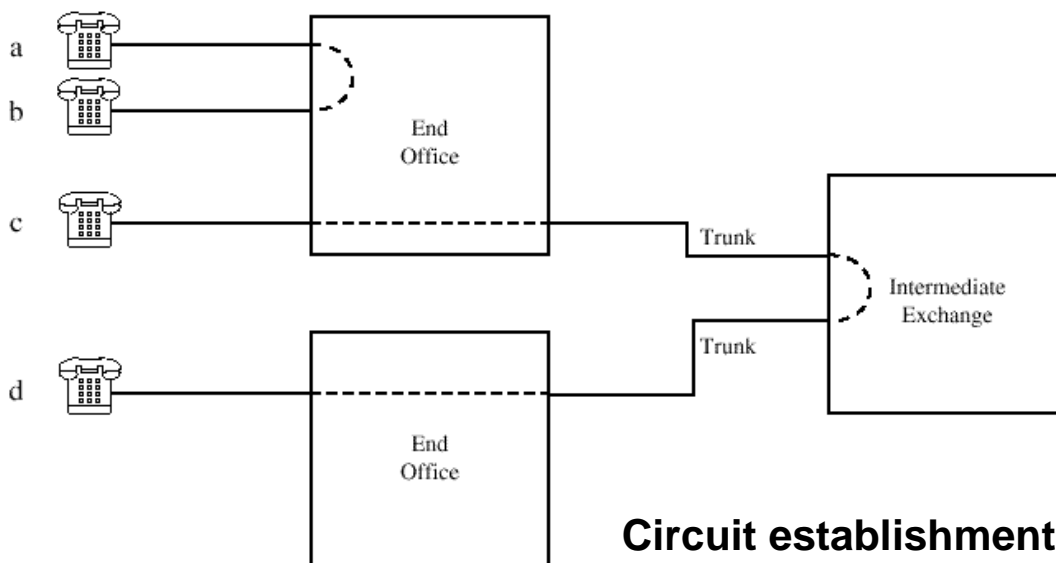
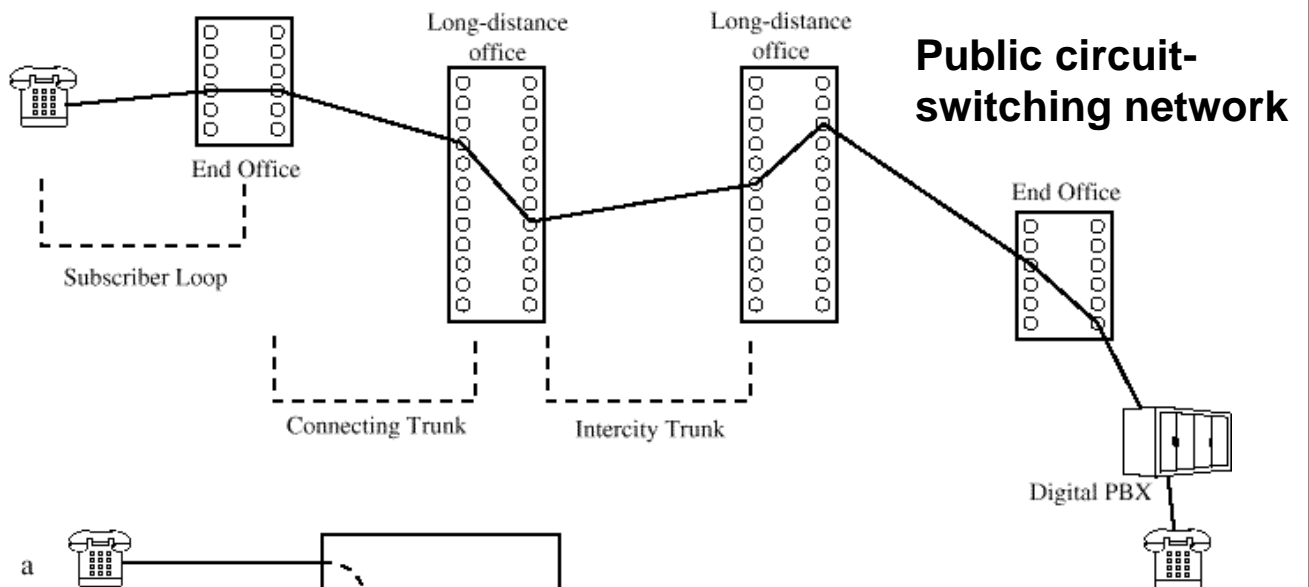
Figure 8.1 Simple Switching Network

2. Circuit-Switching Networks

- During communication, a dedicated communication path exists between sender and receiver; e.g., telephone system.
- Communication involves 3 phases:
 - Circuit establishment: “Call request” propagates, hop by hop through network, to establish a dedicated link (channel in each component link in some path from sender to receiver)
 - Data transfer: continuous transfer; either analog or digital signal
 - Circuit disconnect: “circuit disconnect” signal to deallocate the links
- Disadvantages:
 - Both stations need to be simultaneously ready
 - In efficient use of link capacities, especially with bursty intermittent traffic
- Advantages
 - Low delay once circuit is established

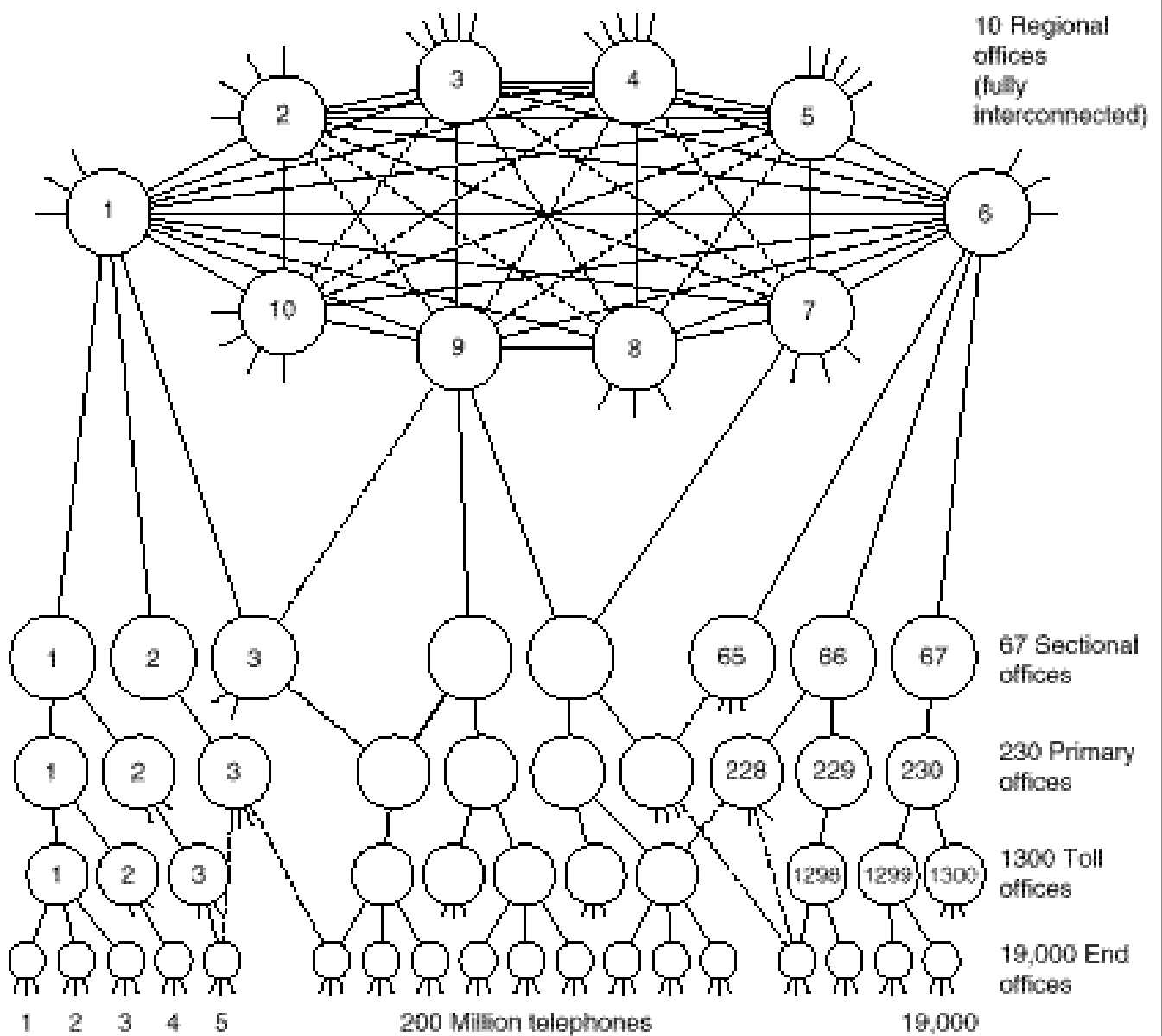
- **Public telephone network**

- Best-known example of a circuit-switching network
- Four generic architectural components
 - Subscribers - Devices that attach to the network
 - Local loop - The link between the subscriber and the network (end office). Also called subscriber loop
 - Exchanges - Switching centers in the network. End offices, long-distance offices, ...
 - Trunks - Links between exchanges. Carry multiple voice channels using by FDM or synchronous TDM



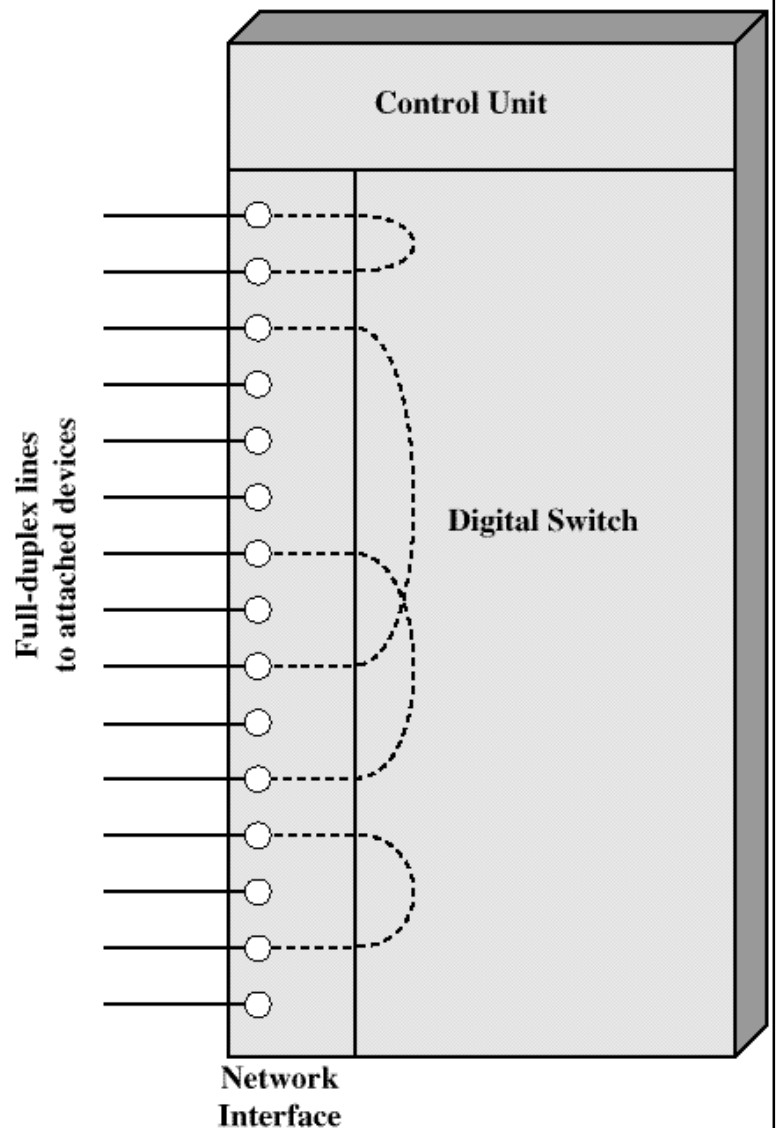
Circuit establishment

AT&T telephone hierarchy



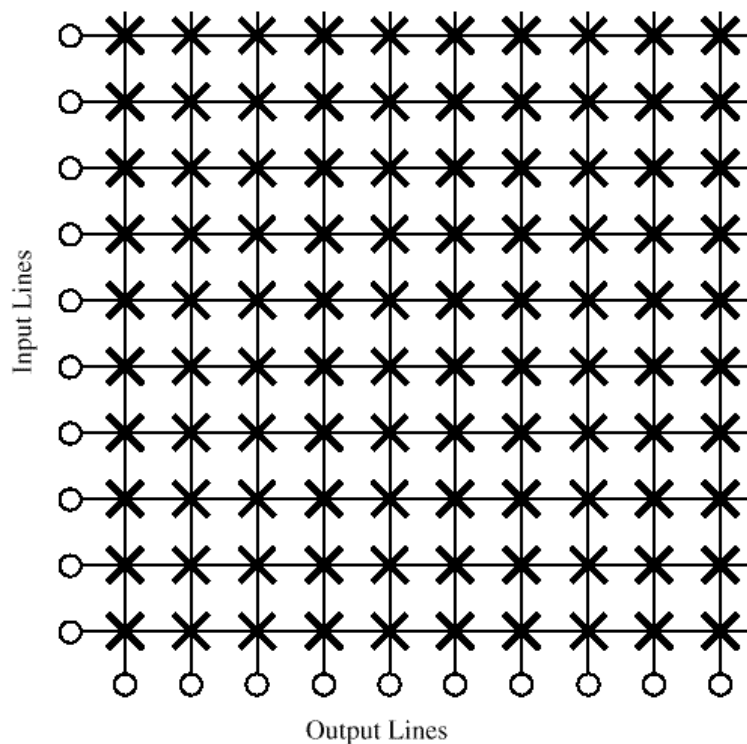
3. Switching Concepts

- Single circuit-switched node network
 - A collection of stations attached to a central switching unit
 - The central switch establishes a dedicated path between any two devices that wish to communicate
 - Digital switch
 - Establishes a dedicated path between any two devices
 - Control unit
 - Establishes, maintain, and tear down the connection
 - Network interface
 - (circuit) switch
 - Blocking
 - Nonblocking



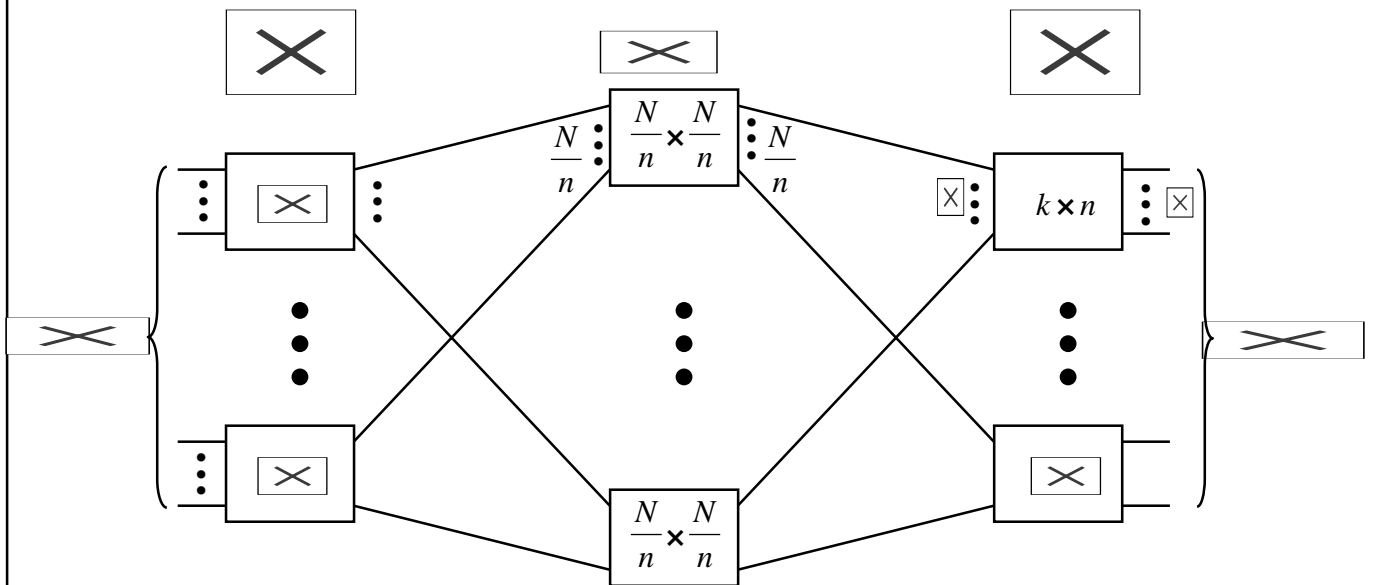
- Space-division Switching

- Signal paths between pairs of devices are divided in space
- Example switch:
 - Crossbar
 - Clos network
 - Benes network, etc
- Crossbar switch
 - High bandwidth
 - High cost: $O(N^2)$



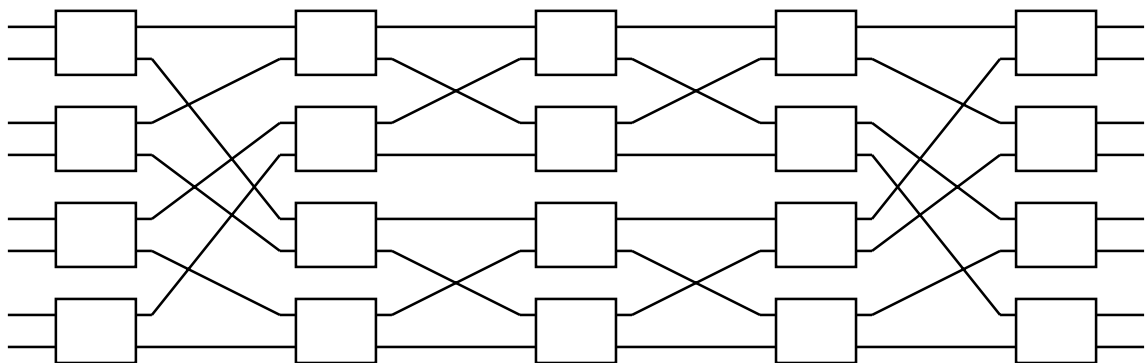
– Clos network

- 3-stage switch, Nonblocking
- Cost: $O(N^{1.5})$

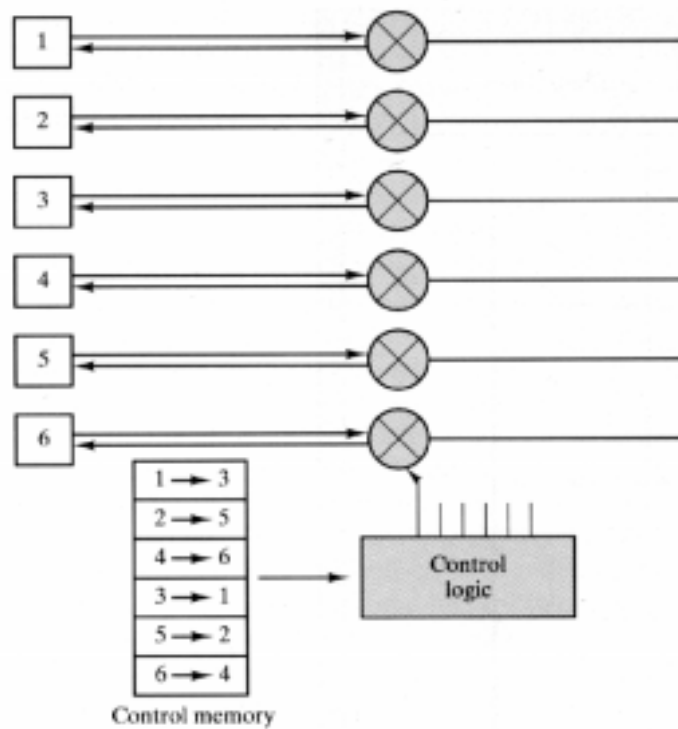
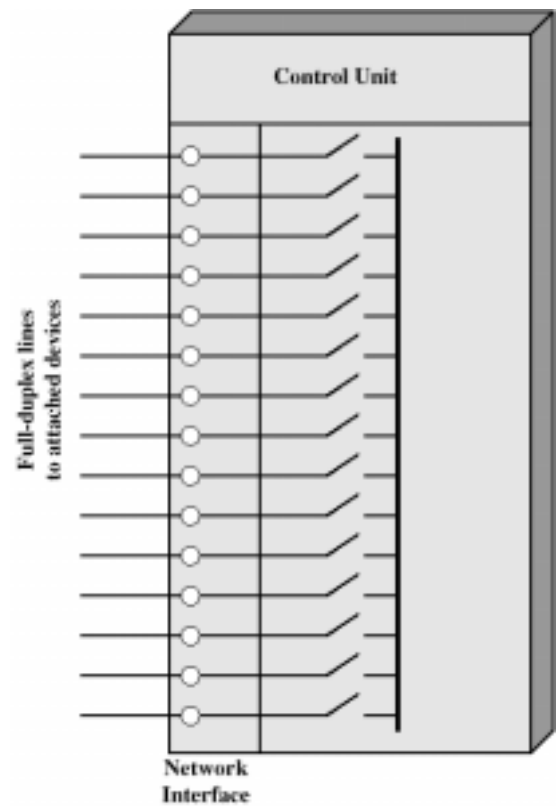


– Benes network

- Rearrangeable
- Cost: $O(N \log N)$



- Time-division Switching
 - TDM bus switching



Control of a TDM bus switch

- TSI (Time-Slot Interchange)
 - Operates on a synchronous TDM stream of time slots (channels) by interchanging pairs of slots
 - To allow the interchange of any two slots, the incoming data in a slot are stored until they can be sent out on the right channel
 - An incoming TDM frame is written sequentially, slot by slot, into the data store (RAM buffer). An outgoing TDM frame is created by reading slots from memory in an order dictated by the mapping table

