Telecommunication Networks and Services

Switching

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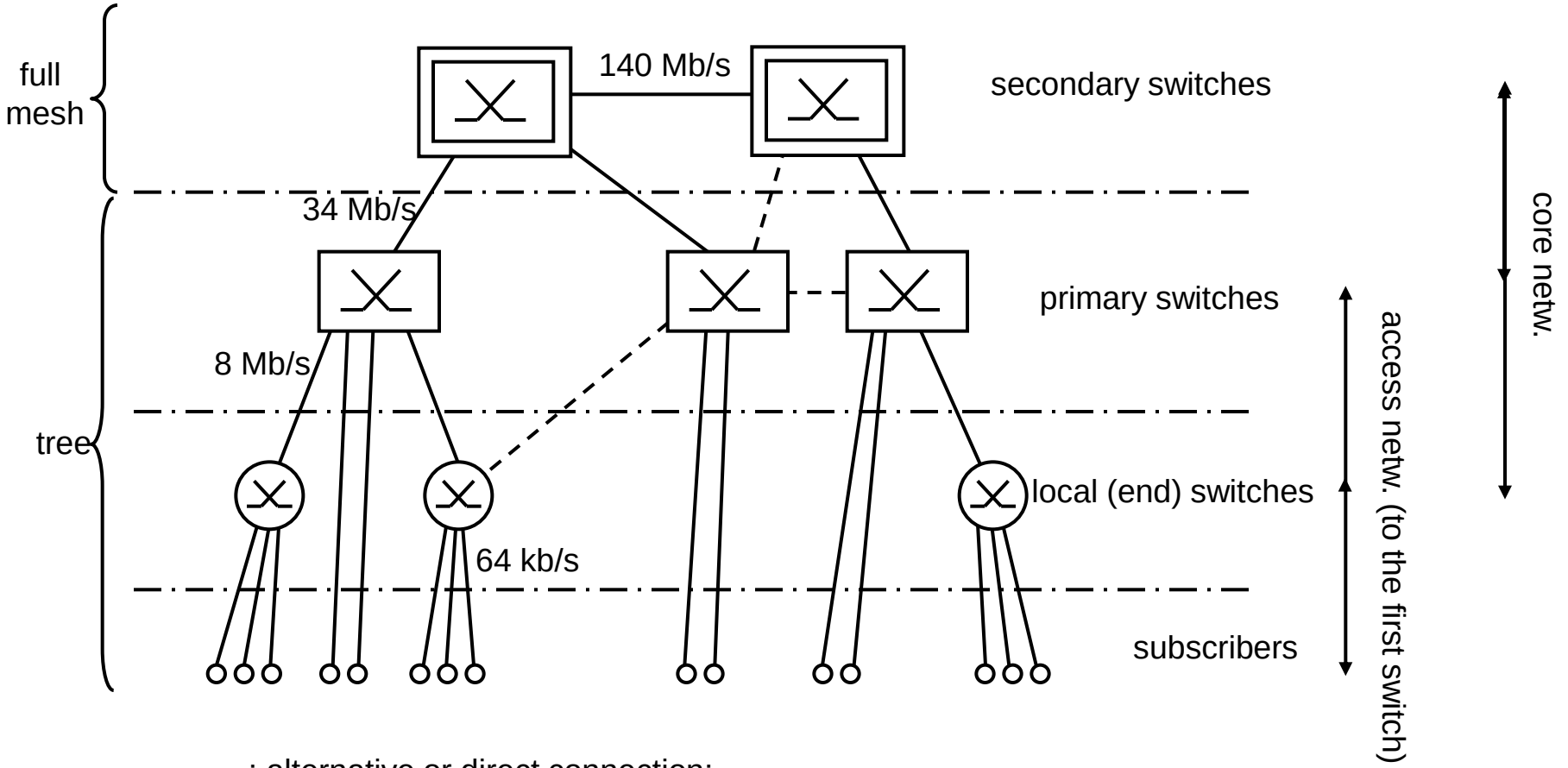
  - Voice digitalisation
- 2. Access to IP networks through telecommunication and cableTV networks
- 3. **Switching**
- 4. Mobile networks
- 5. Signalling

Topological overview of telecomm. networks

(repeated)

- Topology of Public Switched Telephony Network (Hungary)

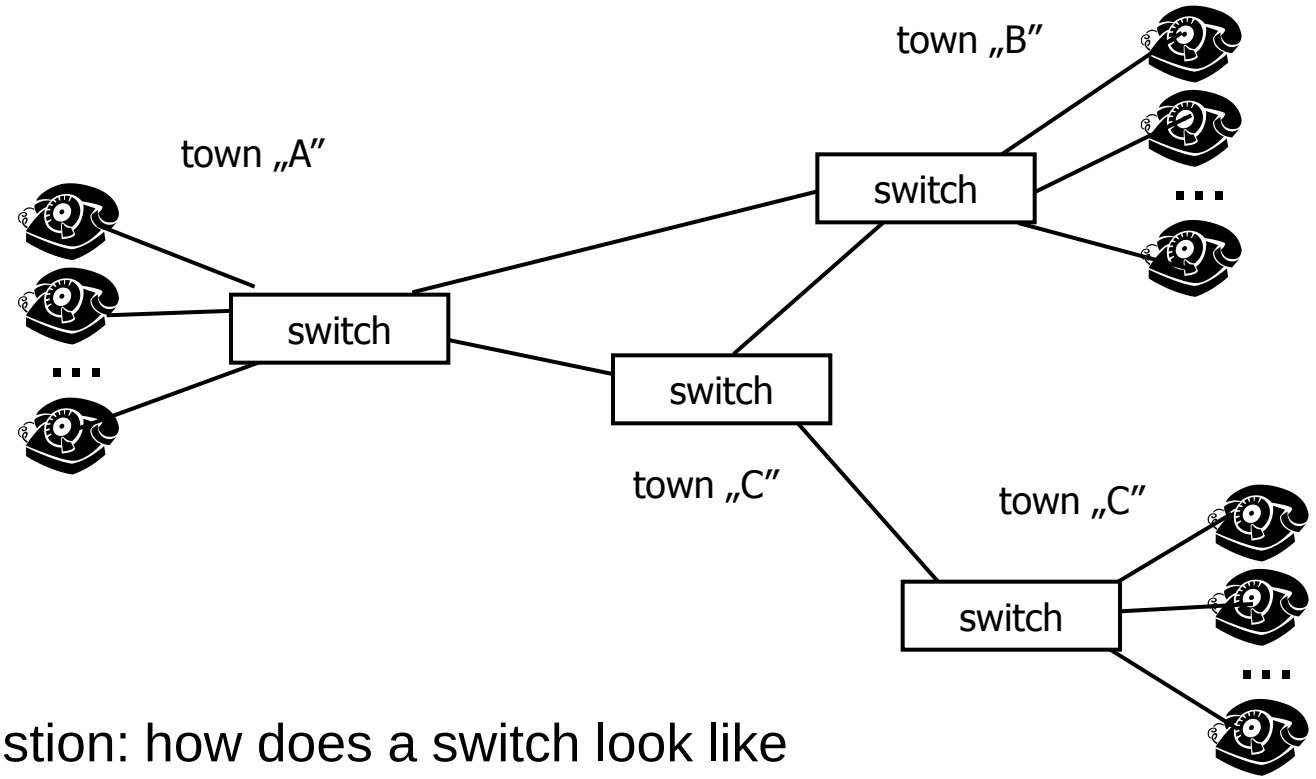


- - - - - - : alternative or direct connection:
goal: optimize routing, make the network more reliable (redundancy!)

Bit speeds are (typical) examples, other solutions are also possible

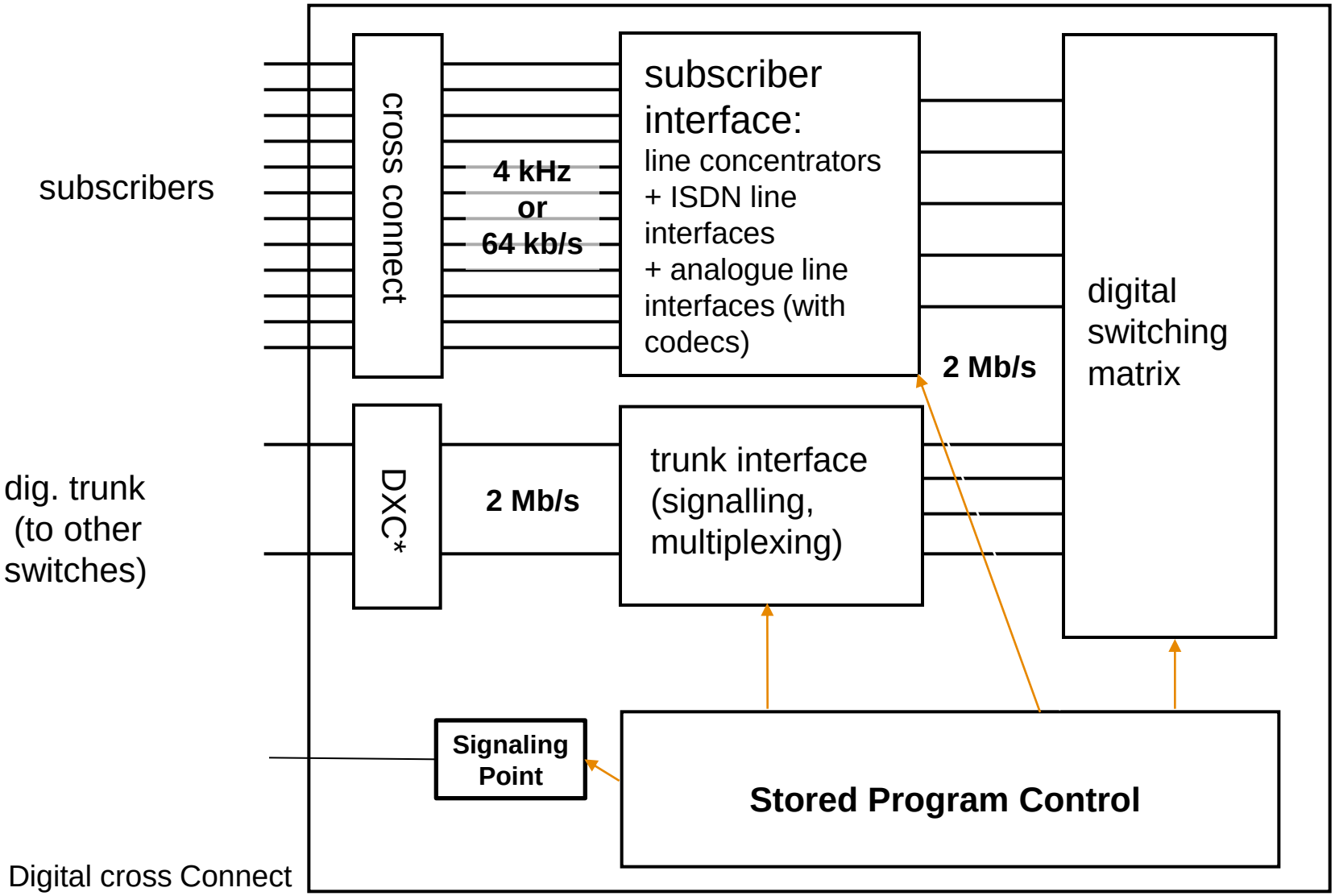
Architecture of switches

- A simplified model:



- Question: how does a switch look like internally?

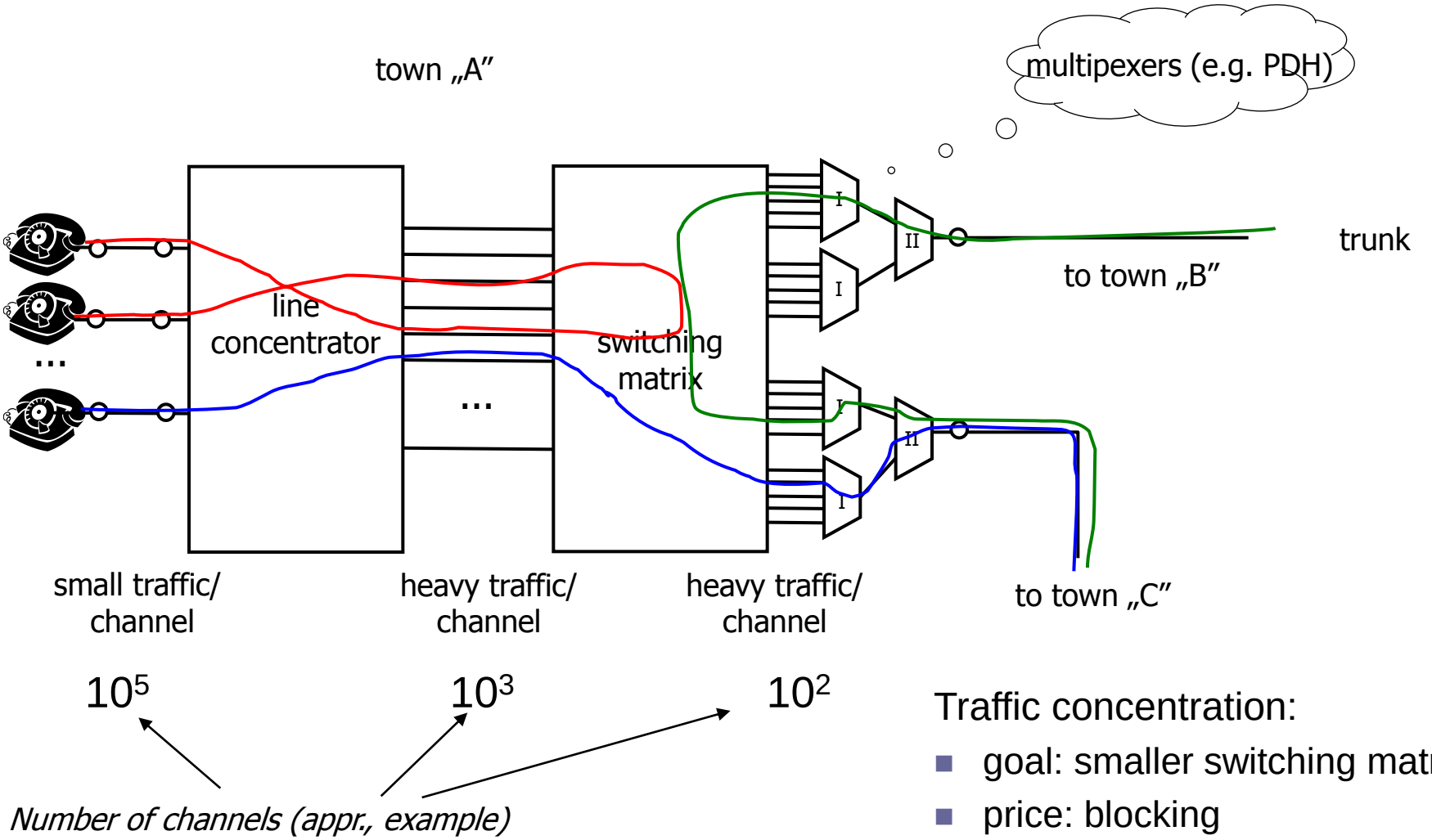
Internal structure of a SPC switch (block diagram)



*DXC: Digital cross Connect

Architecture of switches

- Block diagram of a switch (model)

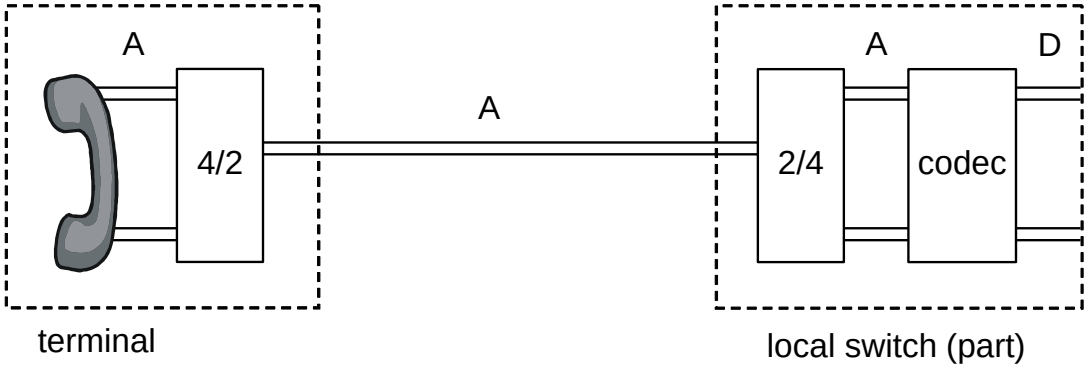


Traffic concentration:

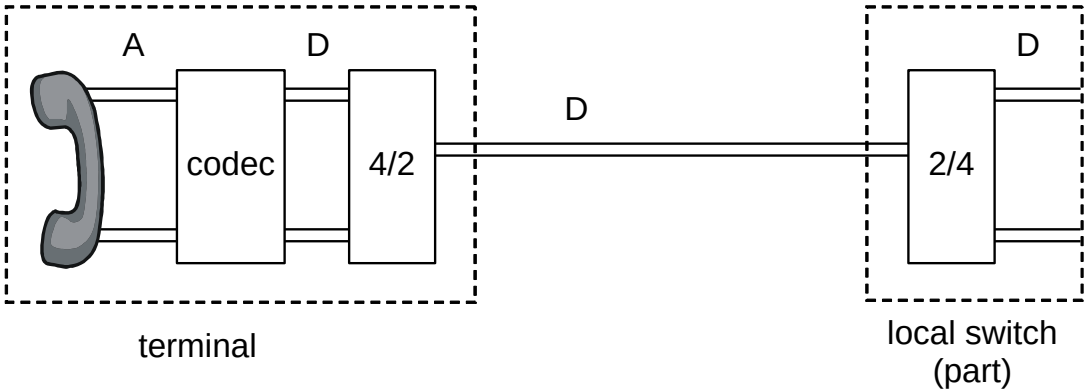
- goal: smaller switching matrix
- price: blocking

2/4 wire systems

- 4-wire system:
  - 2 wire pairs
  - on a wire pair: unidirectional signal flow
- 2-wire system
  - 1 wire pair
  - on a wire pair: bidirectional signal flow
- Codec: always 4-wire (because of its internal structure)
- Handset: 4-wire (microphone + loudspeaker)
- Subscr. loop: 2-wire (cheaper ☺)
- Signal processing inside a switch: 4-wire (simpler)



(a) analogue terminal



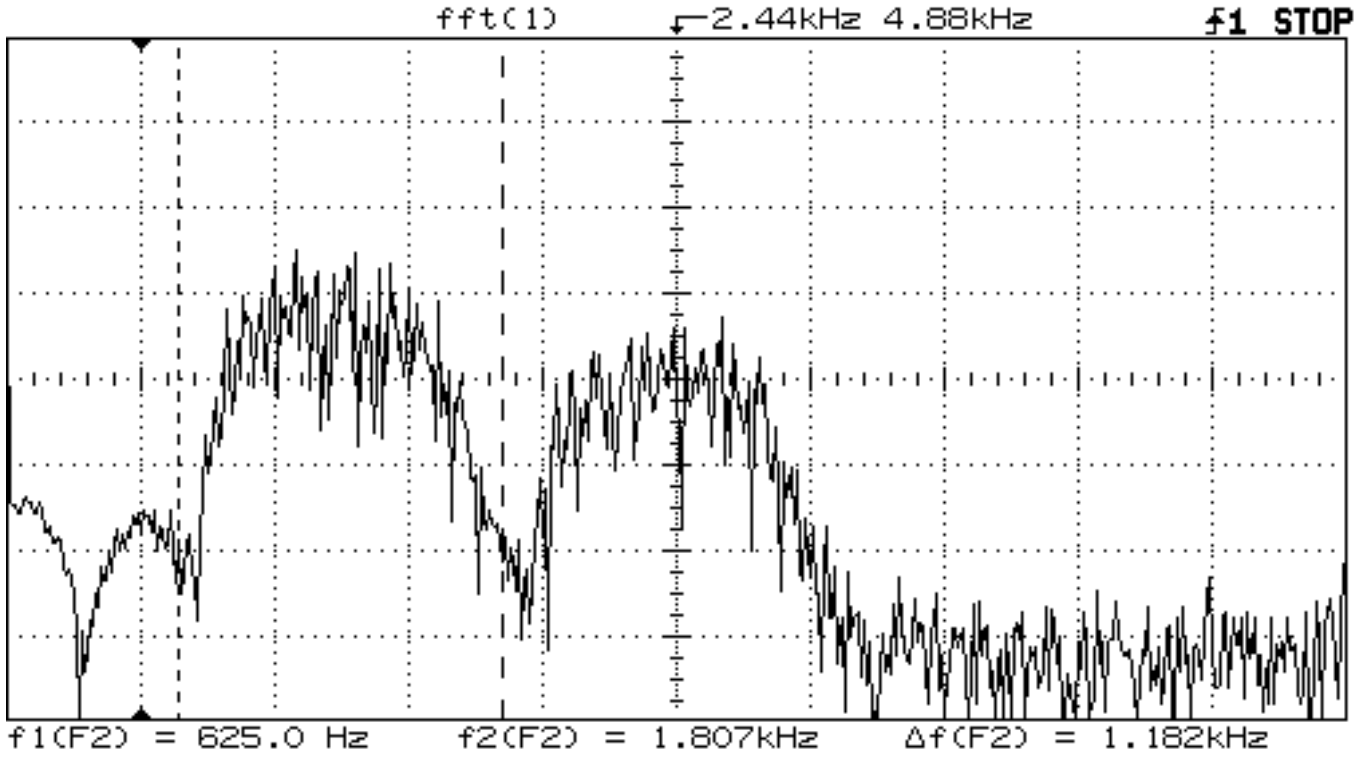
(b) digital terminal

Implementation of the 2/4 wire conversion

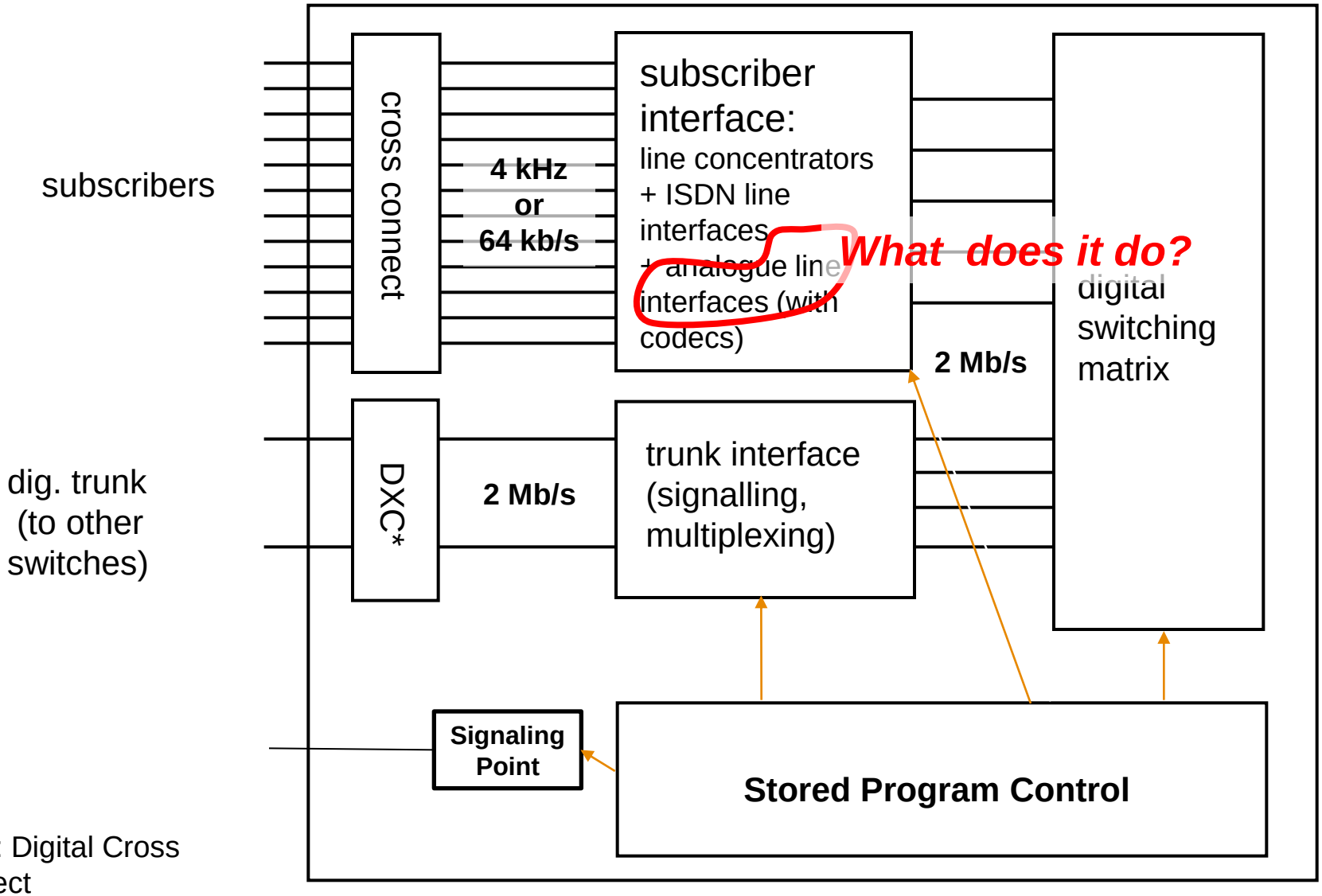
- Goal of 4/2 wire conversion:
  - full duplex communication on ***one*** wire pair
- Possible solutions:
  - separation in frequency domain
  - separation in time domain

Implementation of the 2/4 wire conversion

- Separation in frequency domain
  - separation by low pass / high pass filter pairs (splitter)
  - e.g. V.22 modem standard (for data transmission)



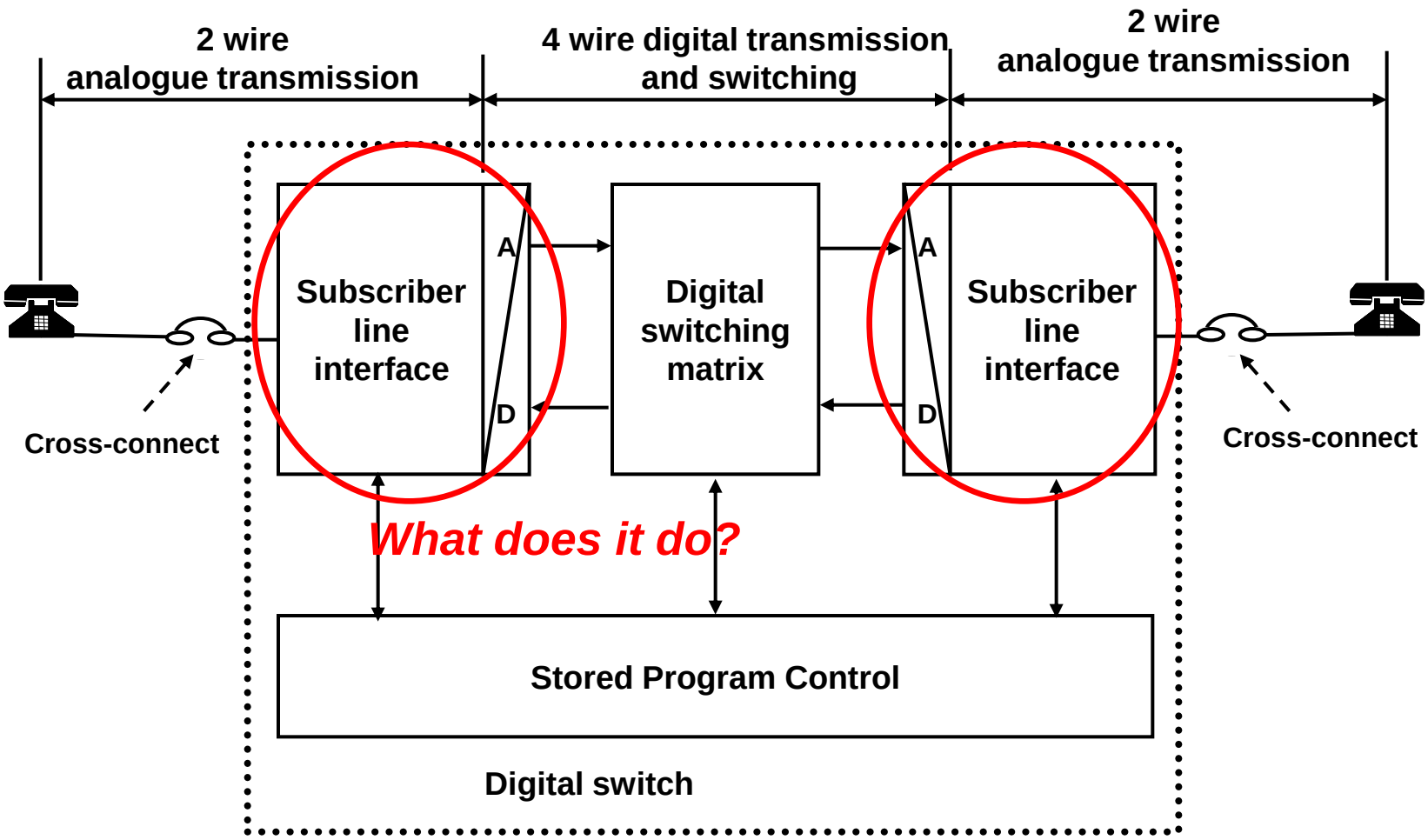
Internal structure of a SPC switch (block diagram)



*DXC: Digital Cross Connect

Subscriber line interface

- In ISDN: ET



BORSCHT

- ***B***attery feeding
- ***O***vervoltage protection
- ***R***inging
- ***S***upervision/signalling: (monitor if the loop is closed – when receiver is picked up)
- ***C***oding, decoding: A/D, D/A conversion (PCM)
- ***H***ybriding: 2/4 wire conversion
- ***T***esting (of the local loop)

Evolution of switches

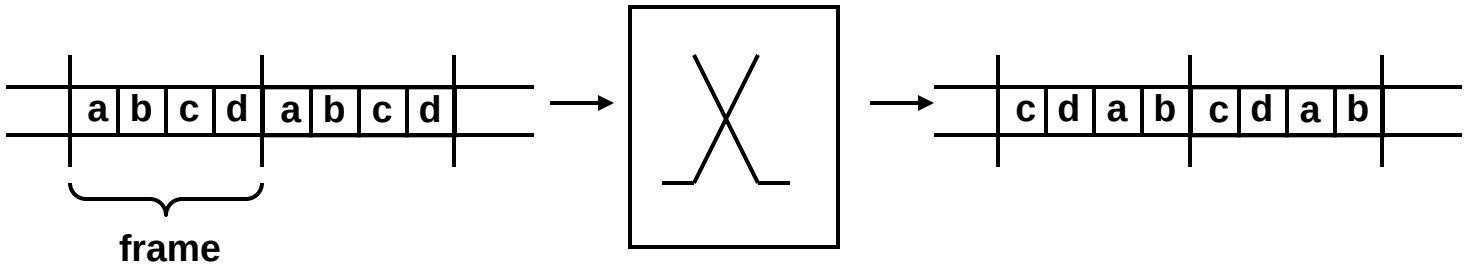
- Manual switches
- Electro-mechanical
  - Rotary
  - Crossbar
- Digital
  - **Stored Program Control (SPC)**
    - e.g.: pathfinding

Types of switching matrices

- Space division
- Time division

Time Division Switching, „T”

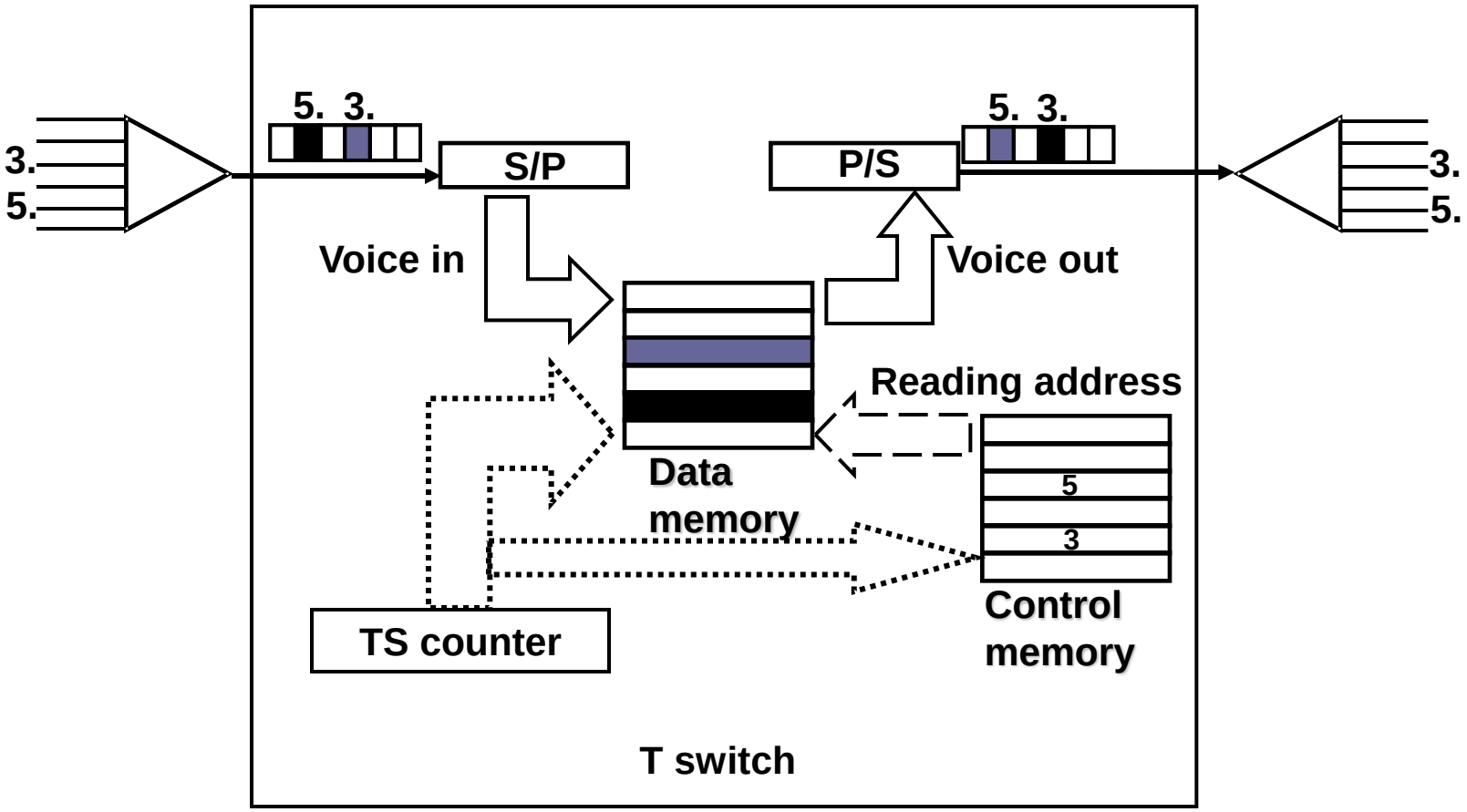
- Basic idea:



- Implementation: memory (cheap)
  - serial input, random output
  - random input, serial output
- 1 frame delay

Time Division Switching, „T”

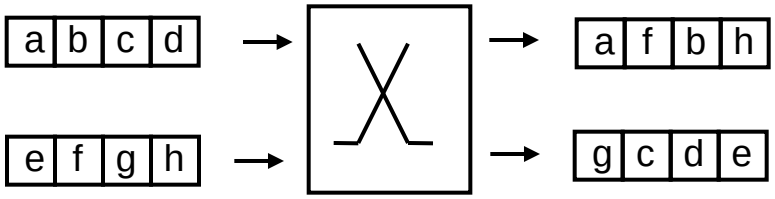
- Internal structure of a T switch



Time Division Switching, „T”

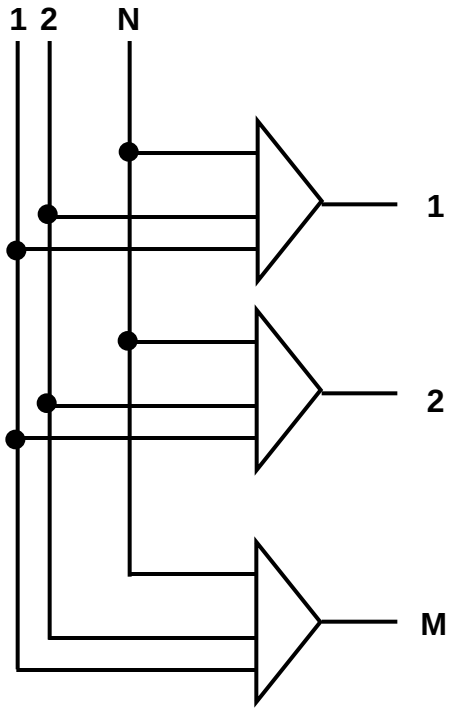
- The speed of the memory is finite: only several hundred or thousand time slots can be handled in a 125 μs long frame
  - What to do if there are more subscribers?

- Solution: space ***and*** time switch



space and time switch

Digital implementation of space switching



: multiplexer (one input to the output)

Control: Matrix memory

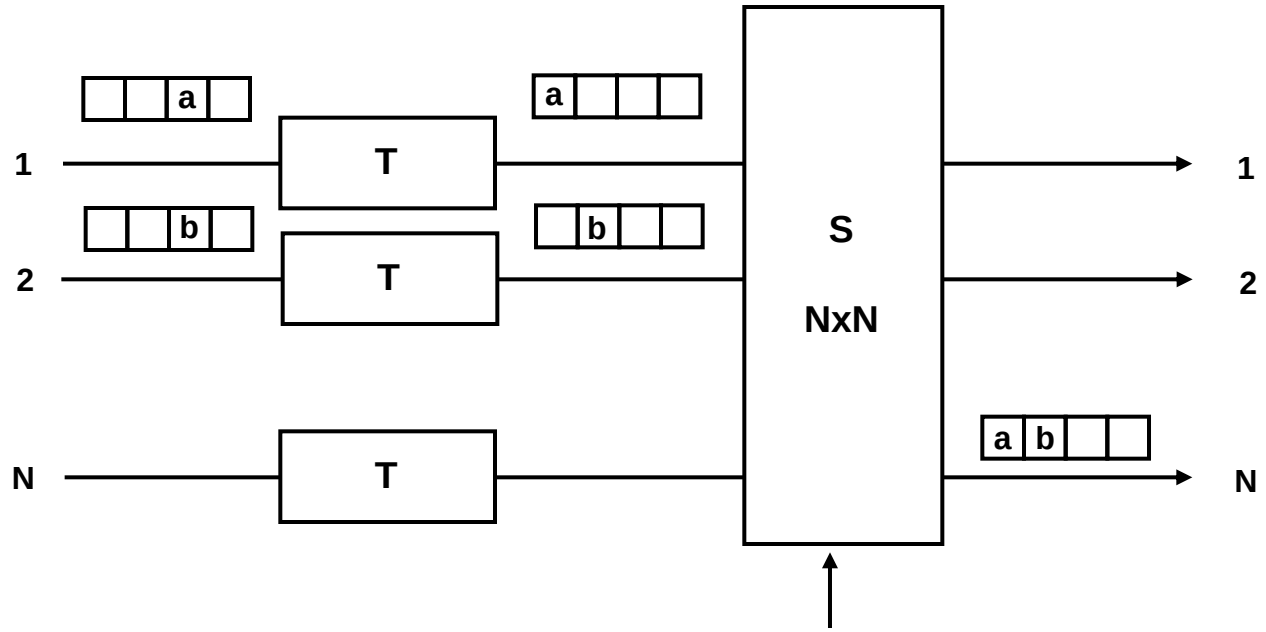
Rows ~ multiplexers (outgoing trunks)

Coloumns ~ Time Slots

- Price is proportional to the number of pins of the ICs

Space and time switching

- Implementation e.g.: TS switch

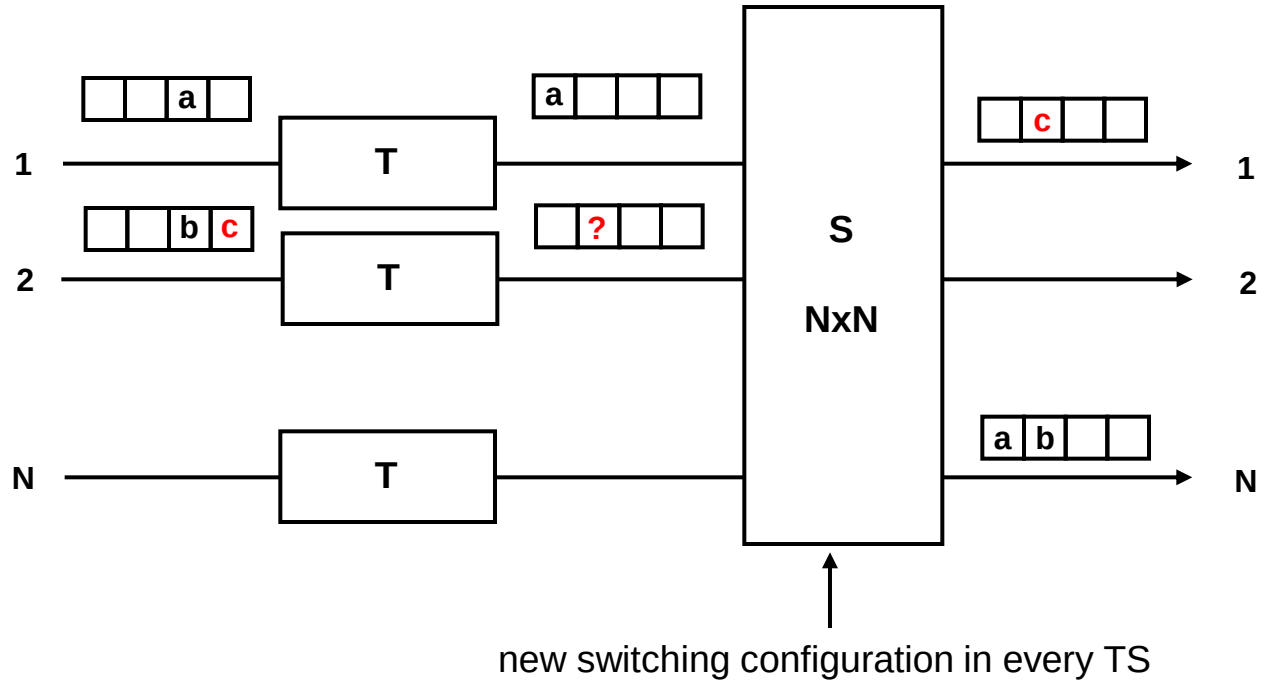


new switching configuration in every TS

- T module: Changes TS, but does not change trunk
- S module: changes trunk, but does not change TS

Space and time switching

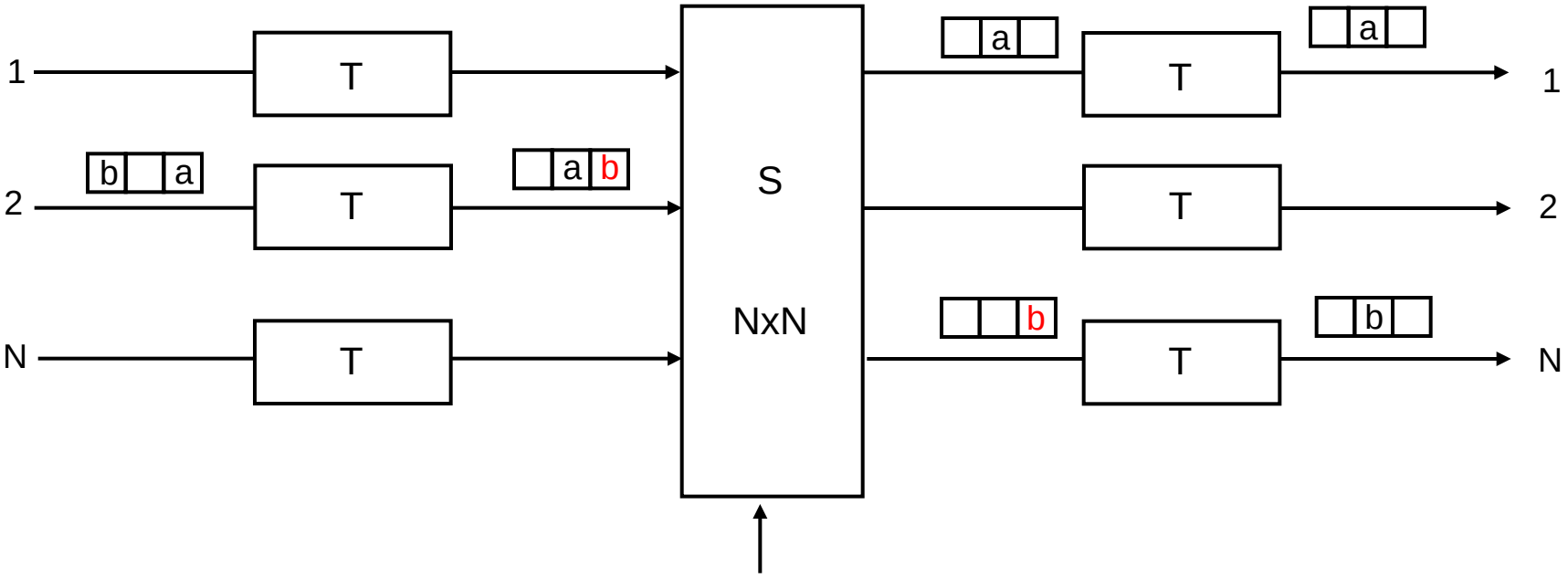
- But TS is not the best (though it is simple) :



- internal blocking even in a so simple situation

Space and time switching

- TST is better than TS



new switching configuration in every TS

- it can handle the previous blocking situation