UNIT – V (Lecture 3)

MULTIPLEXING AND MULTIPLE ACCESS

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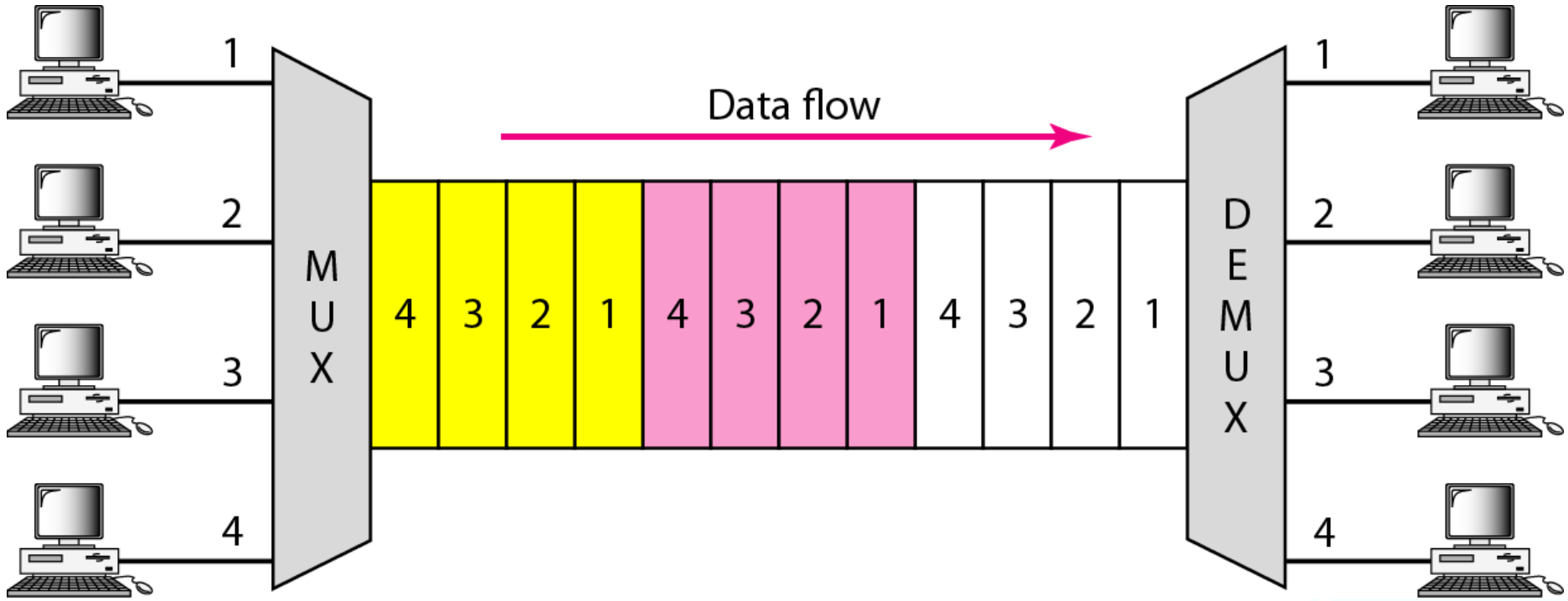
Multiplexing

- Frequency-Division Multiplexing
- Wavelength-Division Multiplexing
- **Synchronous Time-Division Multiplexing**
- **Statistical Time-Division Multiplexing**

Time-division multiplexing (TDM)

TDM is a digital multiplexing technique for combining several low-rate digital channels into one high-rate one.

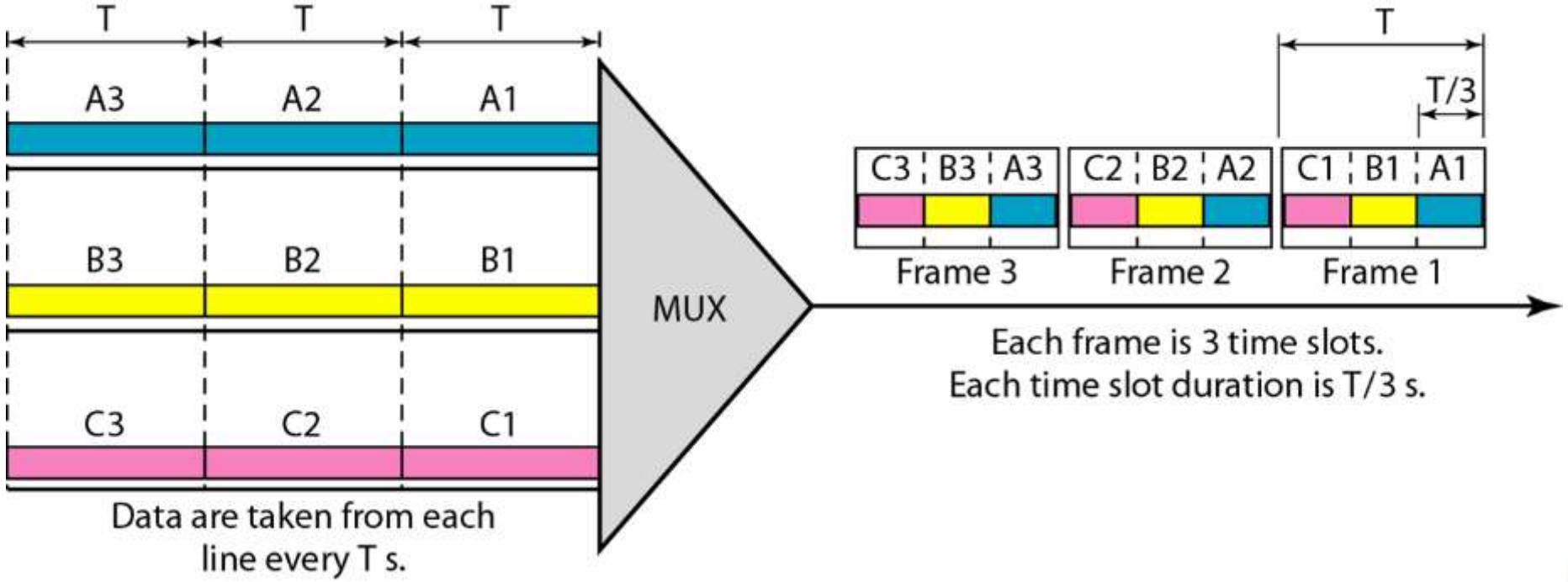
Time-division multiplexing (TDM)



Synchronous time-division multiplexing

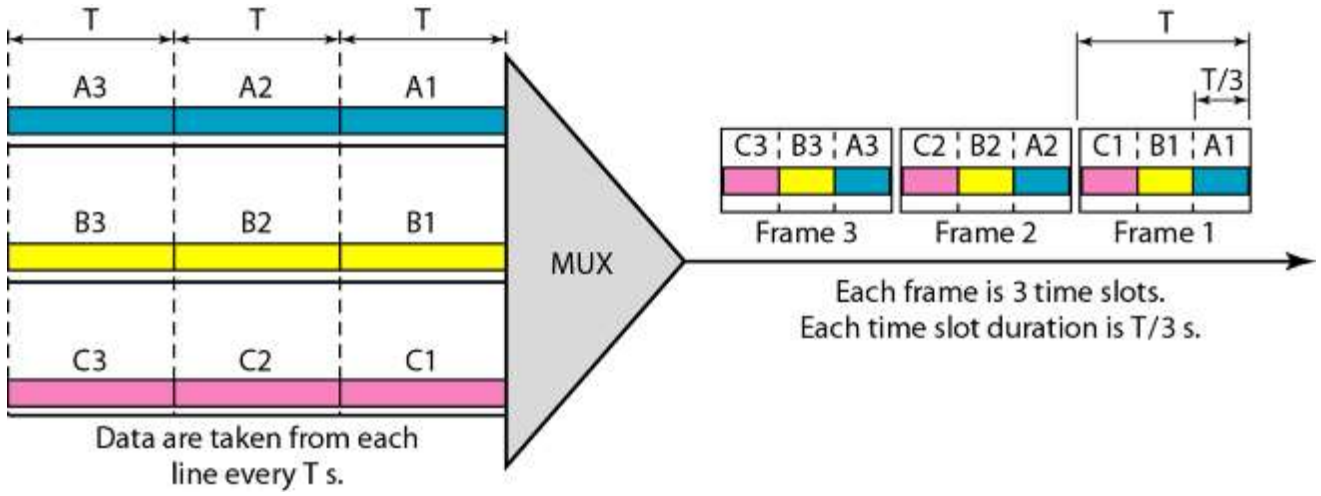
In synchronous TDM, the data rate of the link is *n* times faster, and the unit duration is *n* times shorter.

Synchronous time-division multiplexing



Example 1

In Figure below, the data rate for each input connection is 3 kbps. If 1 bit at a time is multiplexed (a unit is 1 bit), what is the duration of (a) each input slot, (b) each output slot, and (c) each frame?



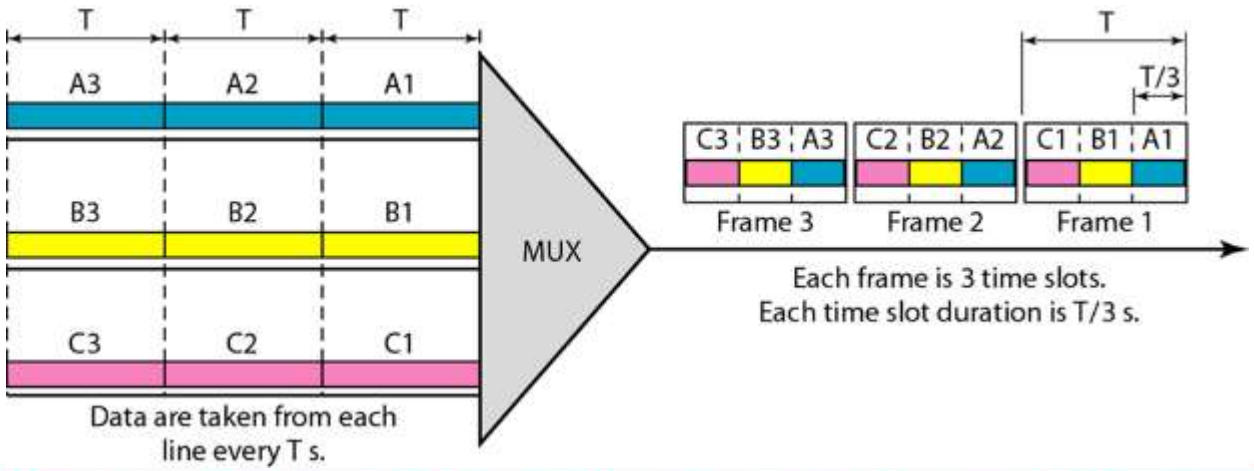
Example 1

Solution

a. The data rate of each input connection is 1 kbps. This means that the bit duration is 1/1000 s or 1 ms. The duration of the input time slot is 1 ms (same as bit duration).

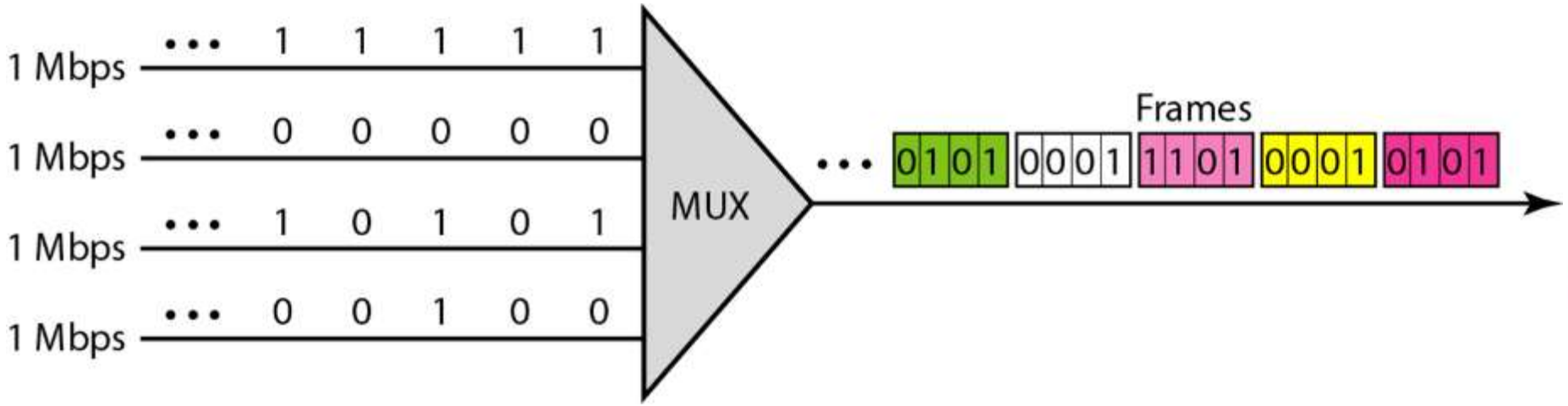
b. The duration of each output time slot is one-third of the input time slot. This means that the duration of the output time slot is 1/3 ms.

c. Each frame carries three output time slots. So the duration of a frame is 3 × 1/3 ms, or 1 ms. The duration of a frame is the same as the duration of an input unit.



Example 2

Figure below shows synchronous TDM with a data stream for each input and one data stream for the output. The unit of data is 1 bit. Find (a) the input bit duration, (b) the output bit duration, (c) the output bit rate, and (d) the output frame rate.

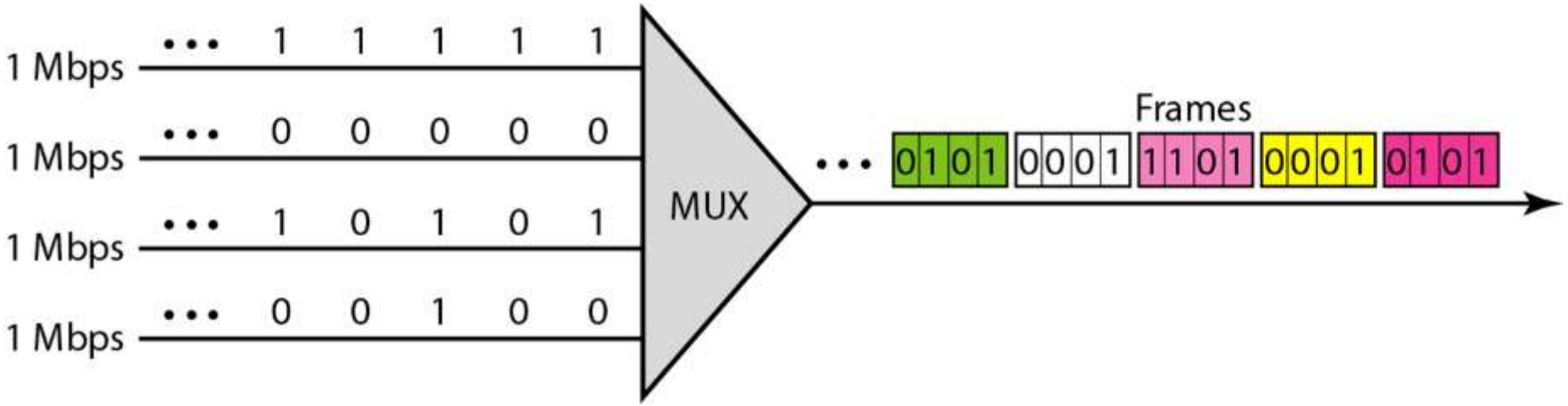


Example 2

Solution

a. The input bit duration is the inverse of the bit rate: 1/1 Mbps = 1 μs.

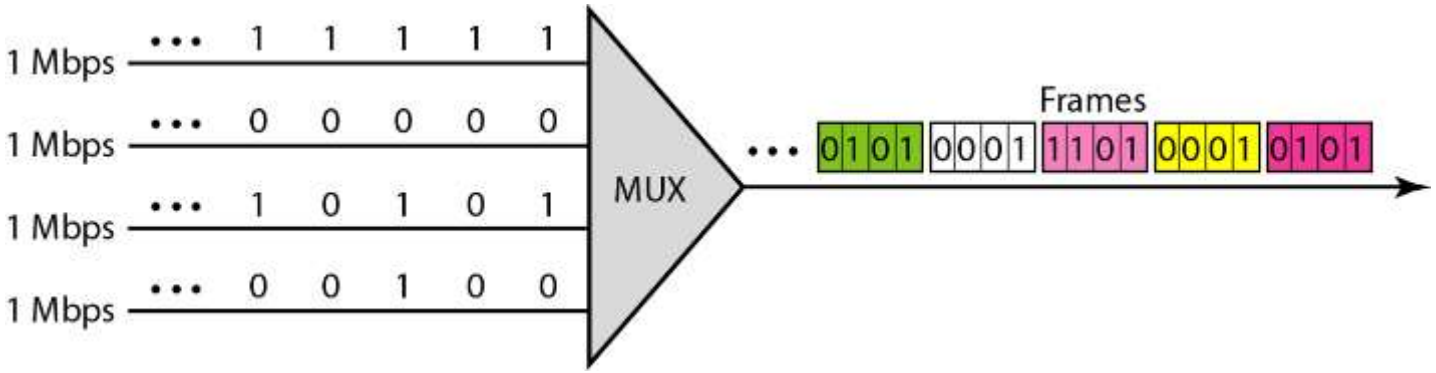
b. The output bit duration is one-fourth of the input bit duration, or ¼ μs.



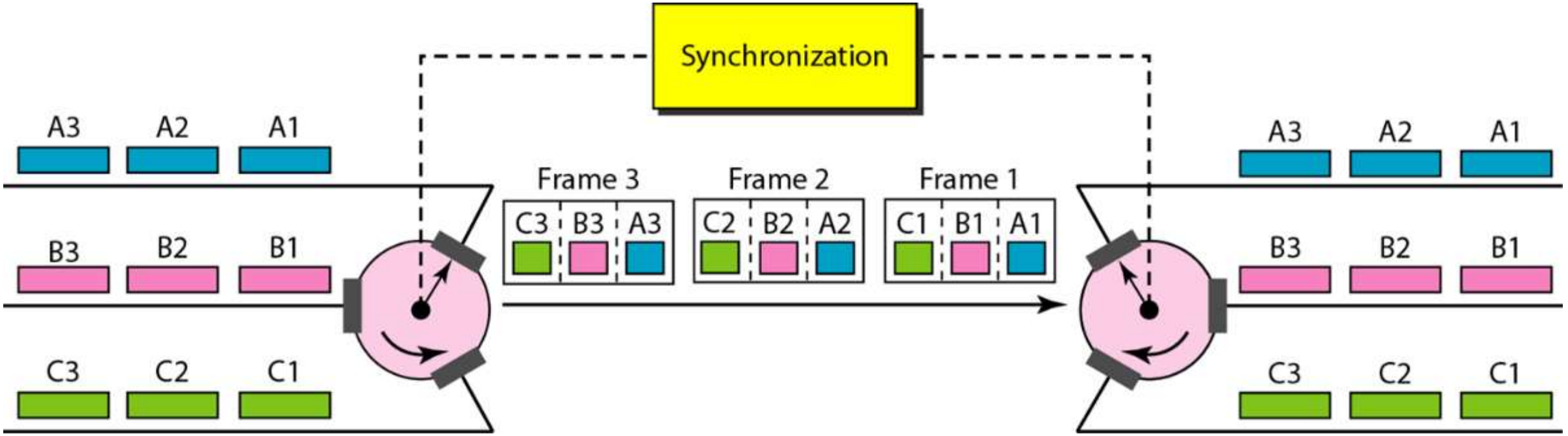
Example 2

c. The output bit rate is the inverse of the output bit duration or 1/(4μs) or 4 Mbps. This can also be deduced from the fact that the output rate is 4 times as fast as any input rate; so the output rate = 4 × 1 Mbps = 4 Mbps.

d. The frame rate is always the same as any input rate. So the frame rate is 1,000,000 frames per second. Because we are sending 4 bits in each frame, we can verify the result of the previous question by multiplying the frame rate by the number of bits per frame.

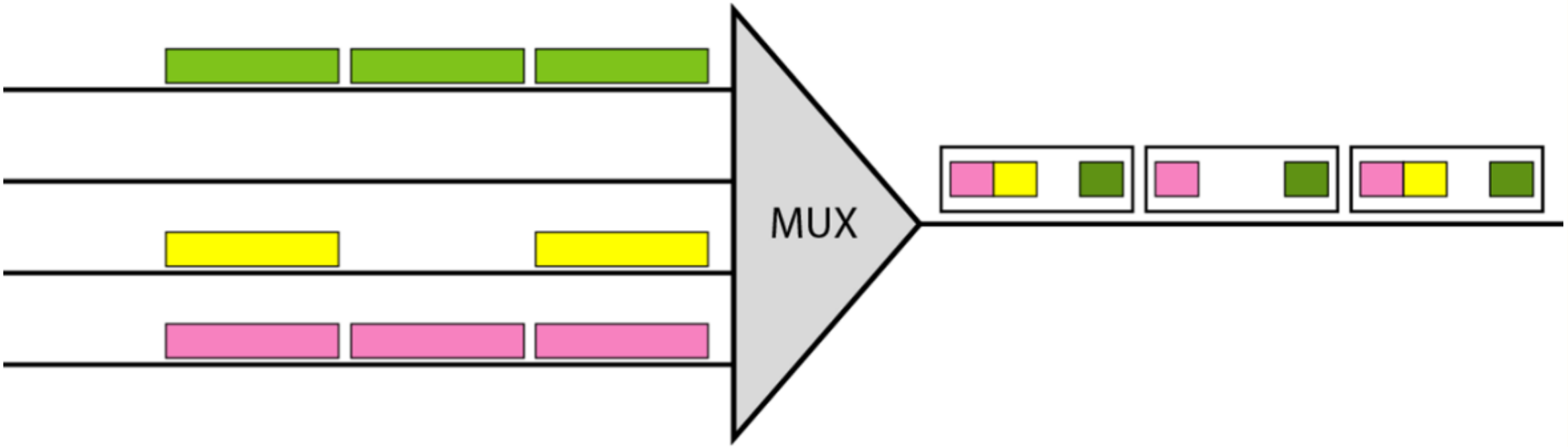


Interleaving



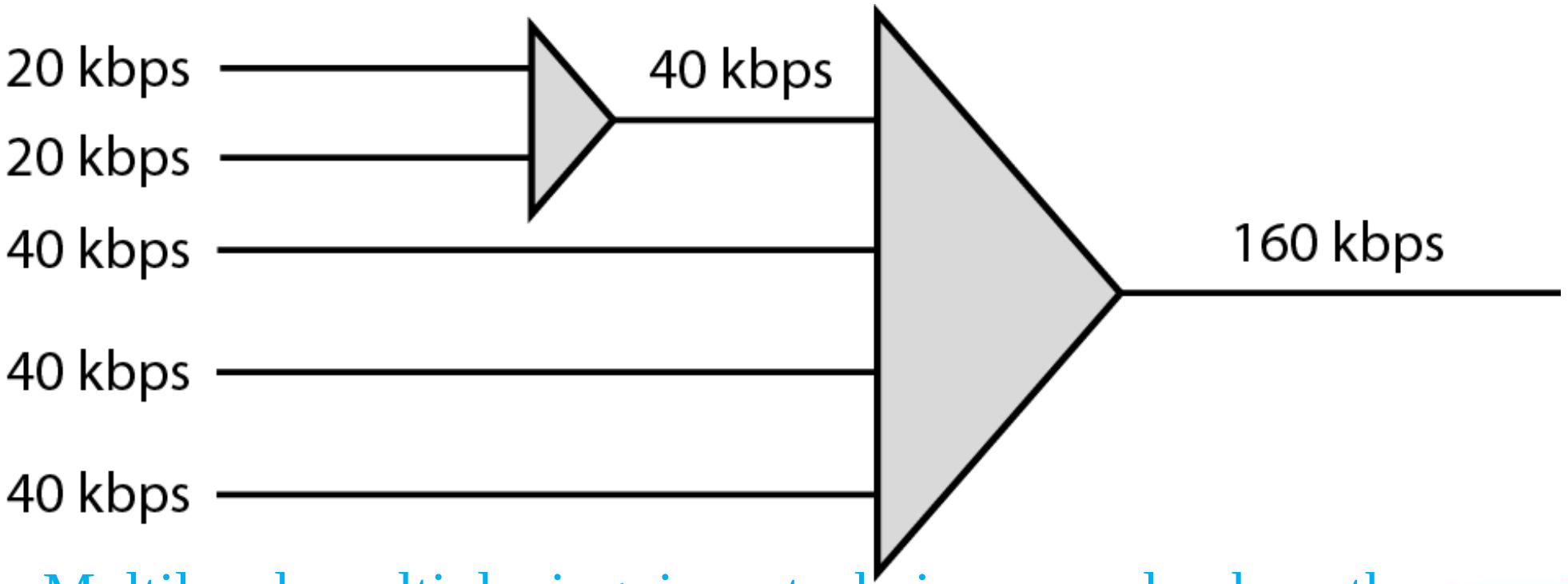
- TDM can be visualized as two fast-rotating switches.
- The switched are synchronized and rotate at the same speed, but in opposite direction.
- This process is called interleaving.

Empty Slots



- If a source does not have data to send, the corresponding slot in the output frame is empty.
- Figure above shows that one of the input has no data to send and one slot in another input line has discontinuous data.

Multilevel Multiplexing



- Multilevel multiplexing is a technique used when the data rate of an input line is multiple of others.