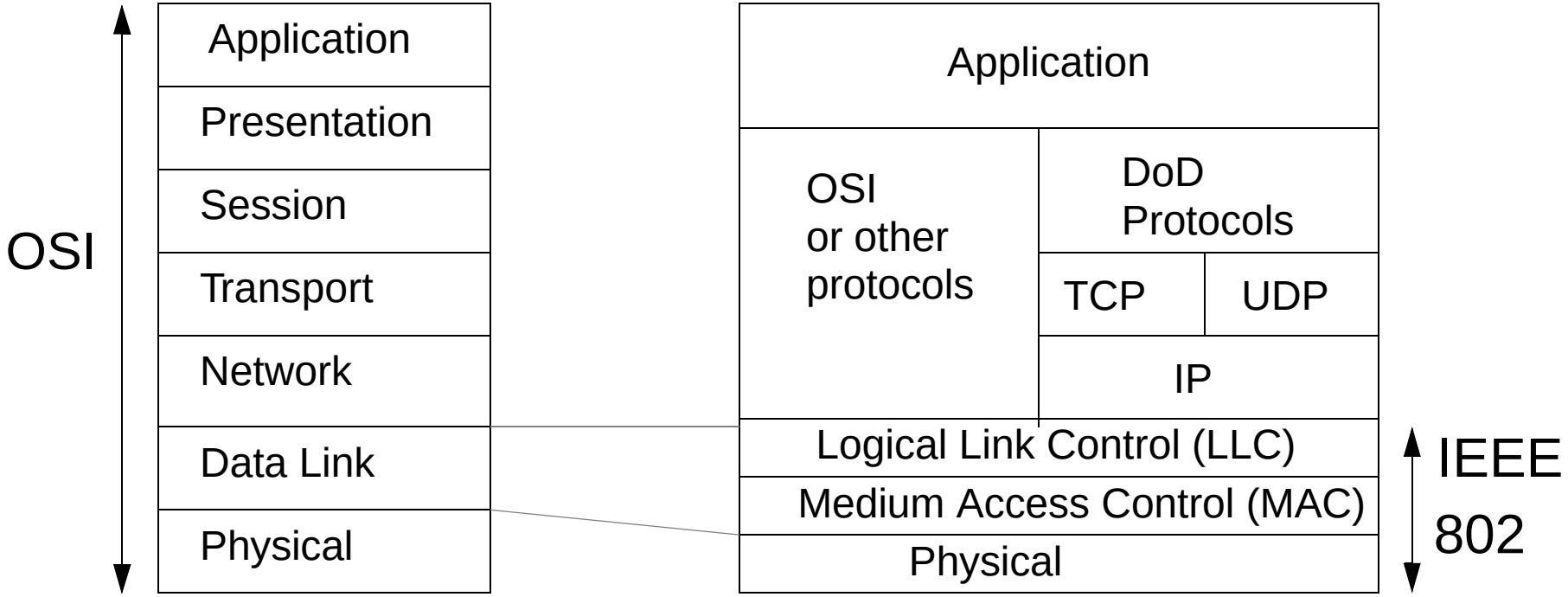
Review of “Legacy” LANs: IEEE 802.{2,3,5} MACs

Medium Access Control Methods (MACs)

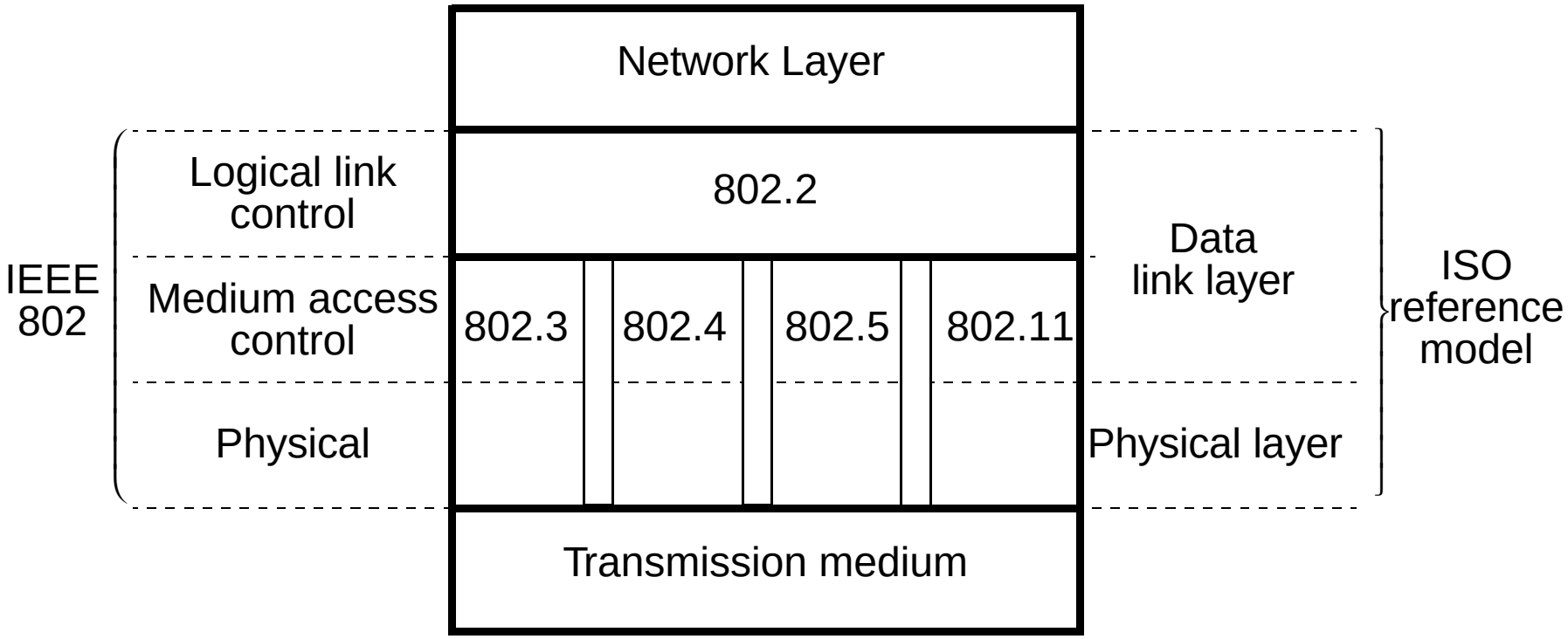
- Most LANs use shared transmission media. Hence need a mechanism to control access for one station at a time.
- Most common methods are:
  - CSMA/CD - Carrier-Sense-Multiple-Access with Collision Detection. (Bus)
  - Control token. (Ring or bus)
- MAC protocols permit the transmission of a MAC frame in broadcast mode to a specific station address.
- Above the MAC there must be a data-link protocol which uses the MAC service for transmission of its data frame.
- IEEE 802 series of standards includes many MAC protocols for different types of LAN plus a data-link protocol (LLC) which is common to all of them.

IEEE 802 and OSI Reference Models



IEEE 802.x LANs use common LLC plus different MAC and physical layers.

IEEE 802 Protocols



802.2 = Logical link control protocol
802.3 = CSMA/CD
802.4 = Token bus
802.5 = Token ring
802.11 = Wireless
} Medium access control protocols

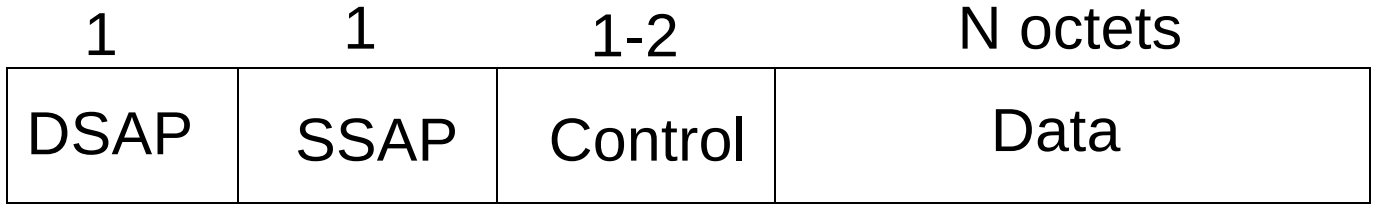
- IEEE 802.x LANs use common LLC plus different MAC and physical layers.

IEEE 802.x Standards

- The LLC and MAC combined are equivalent to the OSI data-link functional definition.
  - Plus the multiplexing of many users (ports) within a station by the LLC. The OSI D-L service does not include multiplexing.
- Split into the two sub-layers because of:
  - The shared access problem which does not apply to point-point links.
  - Desire to use a common LLC sub-layer and specialise the MAC only to the physical topology and access method.
- Network layer, for a single LAN, not significant because there is no routing to be done (Not covered by 802 standards).
- When LAN is part of an Internet, network layer more siginificant (e.g. Internet Protocol) and is covered in Wide-Area Networks.

Logical Link Control (IEEE 802.2)

- Uses services of a MAC sublayer for physical addresses and access to shared medium. MAC also does frame delimiting and FCS functions.
- Normally provides connectionless, unacknowledged mode.
- But other options:
  - Acknowledged CL
  - CO mode.
- Similar to HDLC, with above restrictions in function, plus ...
- Address field identifies SAP (Service Access Point) or port in source (SSAP) and destination (DSAP) stations, not physical address of station. Hence LLC layer can multiplex many ports.

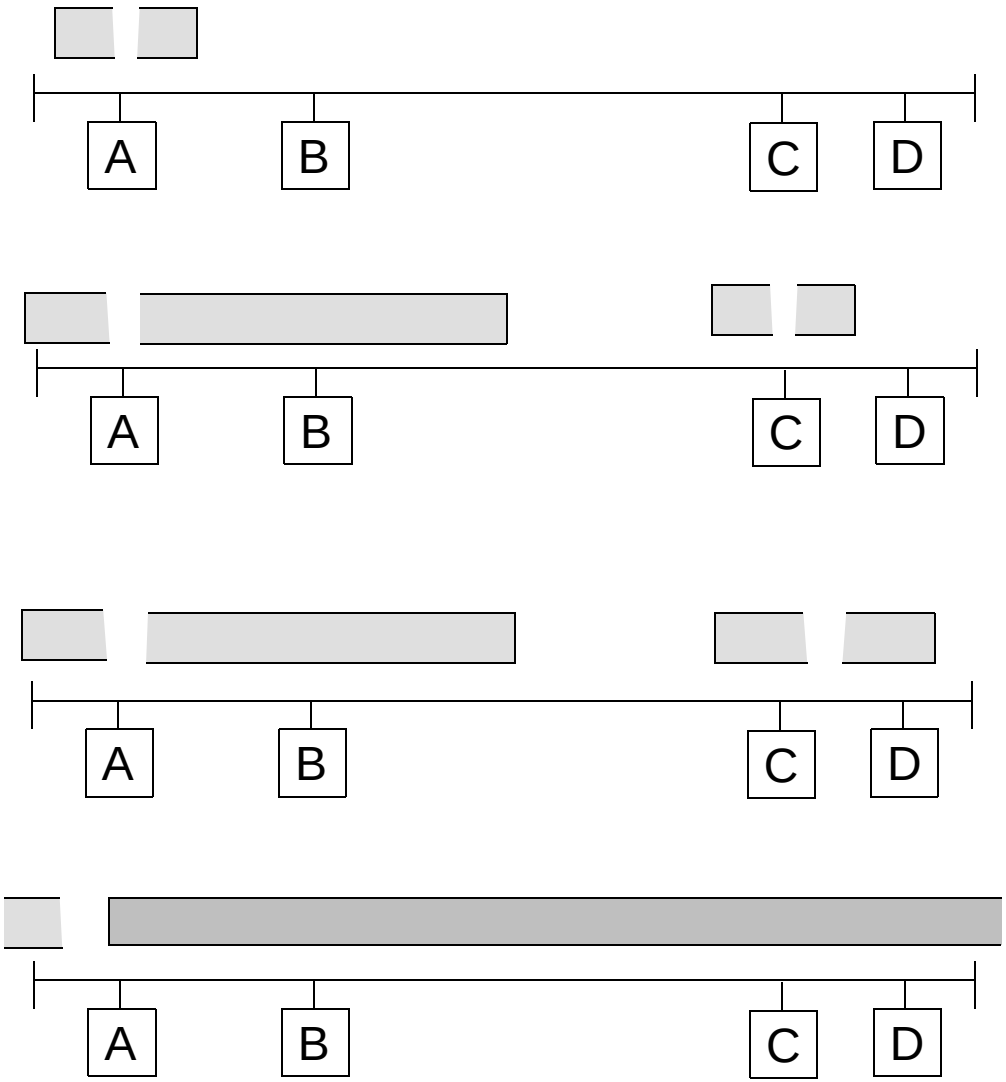


- N depends on limit on underlying MAC frame.

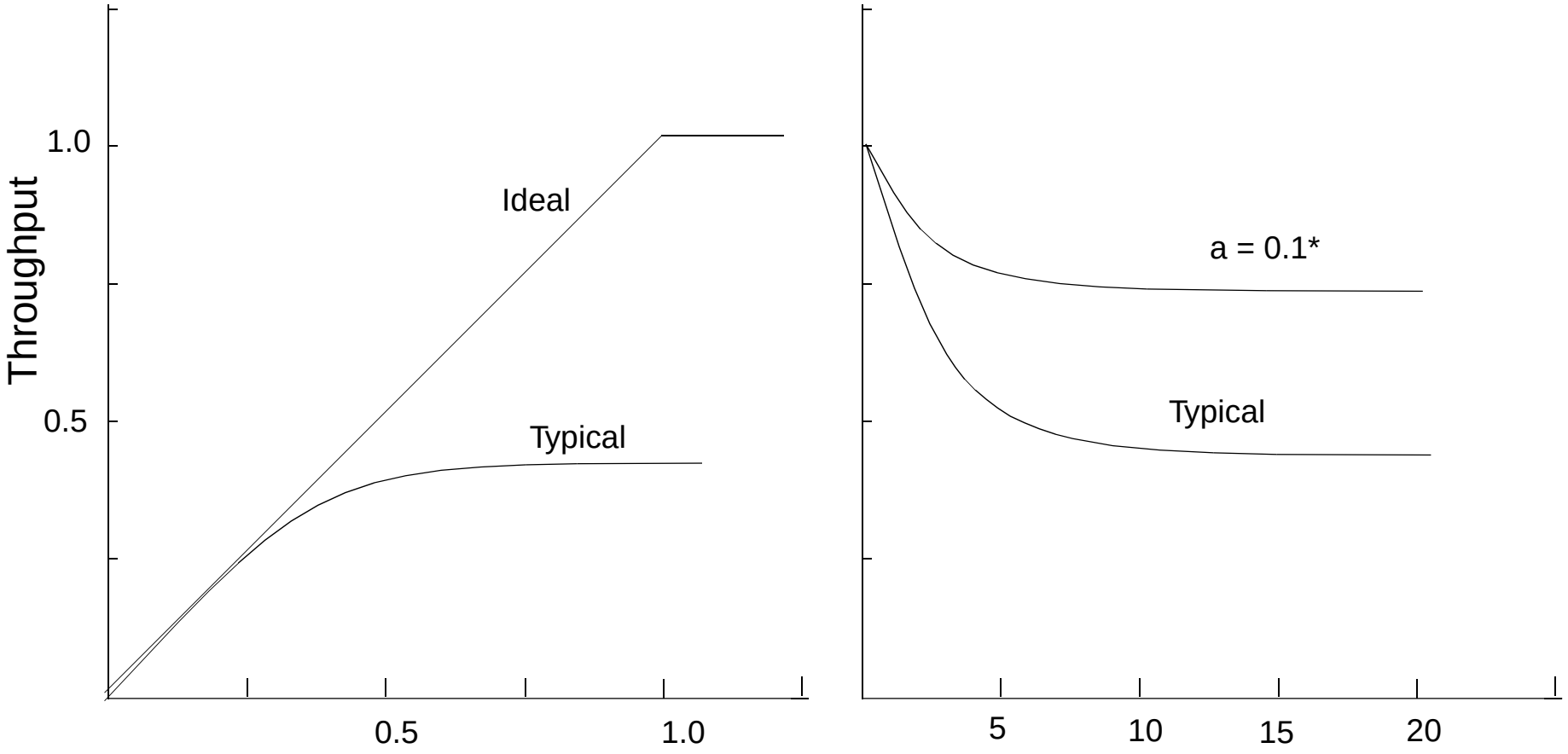
LLC Frame

Ethernet MAC (CSMA-CD, 802.3): Collisions

- CSMA-CD: Carrier Sense Muliple Access with Collision Detection.
- "Party-line" MAC protocol:
  - Listen before talking.
  - Back off (carrier detect) or transmit (no carrier detect).
- Attempts to eliminate collisions.
- But propagation time is counteractive; frames from A and C collide, so:
- Listen while talking and abort if necessary.
- Collisions require time to clear entire (unbridged) segment before new transmission can start.

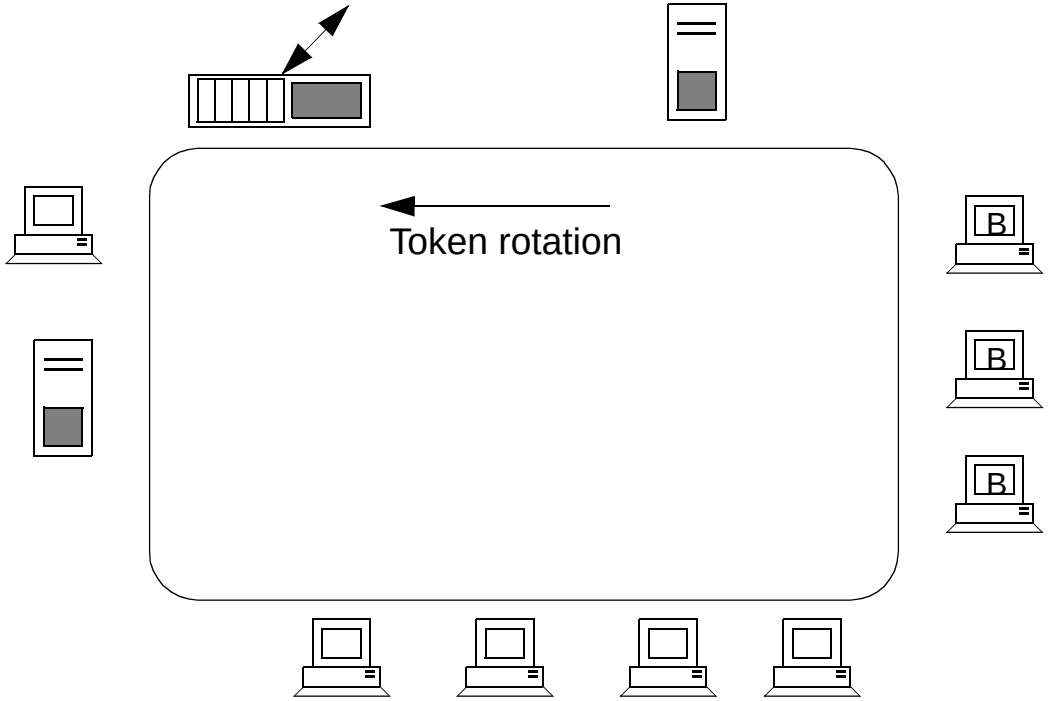


Ethernet Throughput



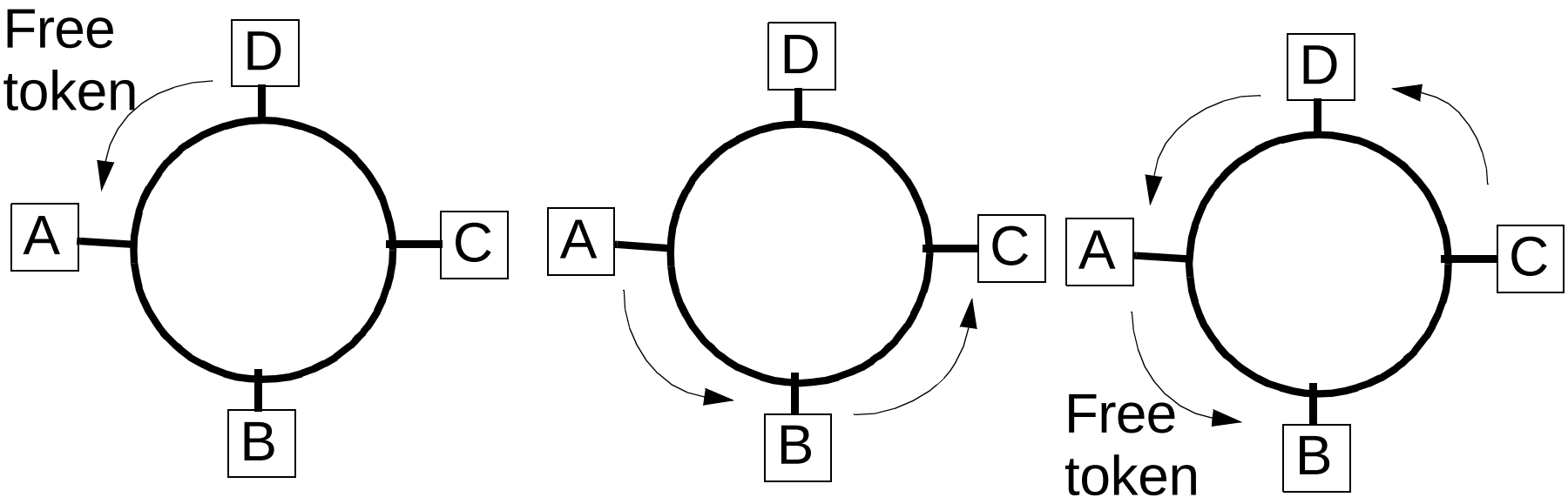
* a = $\frac{\text{Max propagation time on segment}}{\text{Average duration of frame}}$

Token Ring Topology



- Stations transmit only on receipt of token.
- No collisions.

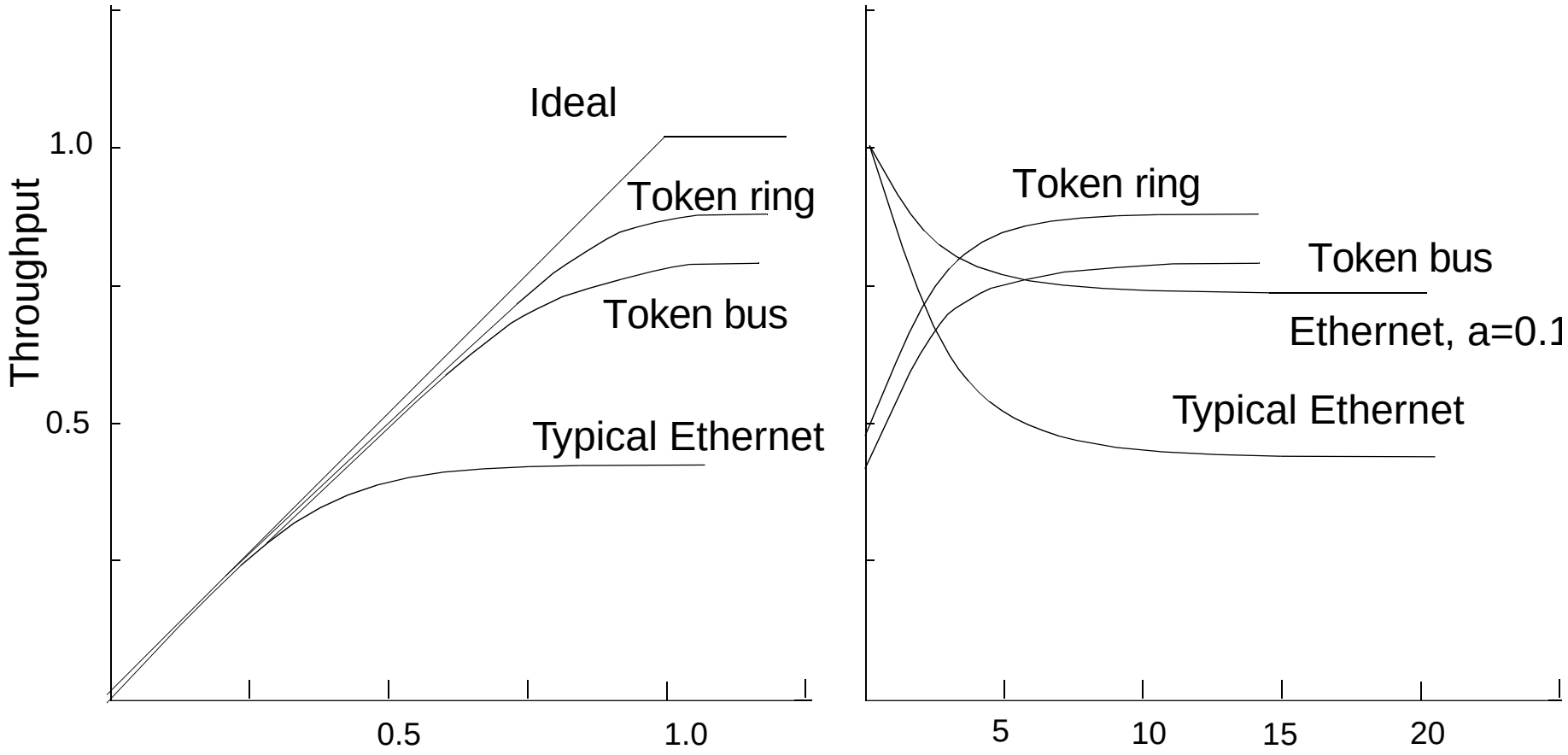
Token Passing (Single priority)



- A waits for free token.
- Changes it to SOF, appends data frames addressed to C (and/or others).
- B repeats frames with minimal delay.
- C copies frames addressed to it.
- A sees own header return, sends free token, does not repeat frames.
- **OR** (early release)

  A sends free token after completing frame transmission.

Comparative Performance



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802.5 Token Ring Characteristics

- Station interfaces and MAC protocol are much more complex than CSMA-CD.
- Repeaters are active. Contention is non-destructive.
- Token holding time is limited to limit access delay.
- With only a few active stations, time lost in:
  - idle token circulation;
  - new token release after header returns.
- Not readily scalable to very high speeds.
- With the cost of 16 Mb/s interfaces and medium, throughput is still less than 16 Mb/s because transmission medium is shared by all stations.
- Segmentation, using 802.1D bridges, required to boost total capacity, as with 802.3.
- Priority can be used to provide degree of non-homogeneous access but all interfaces are the same.