1 Nodal Delay Calculation

To calculate the nodal delay for transmitting a 1500-byte file over long-range wireless and twisted-pair cable, we consider the transmission delay and propagation delay for each medium. Nodal delay is the sum of these two delays.

1.1 Given Data

- File size: 1500 bytes = $1500 \times 8 = 12000$ bits
- Distance: 1 km = 1000 m
- Wireless:
  - Transmission rate: 2 Mbps = 2×10^6 bits/s
  - Propagation speed: 3×10^8 m/s
- Twisted-pair cable:
  - Transmission rate: 100 Mbps = 100×10^6 bits/s
  - Propagation speed: 2×10^8 m/s

1.2 Nodal Delay Formula

$$\text{Nodal delay} = \text{Transmission delay} + \text{Propagation delay}$$

- Transmission delay: $\frac{\text{File size}}{\text{Transmission rate}}$
- Propagation delay: $\frac{\text{Distance}}{\text{Propagation speed}}$

1.3 Wireless

- **Transmission delay**:

$$\frac{12000 \text{ bits}}{2 \times 10^6 \text{ bits/s}} = 0.006 \text{ s} = 6 \text{ ms}$$

- **Propagation delay**:

$$\frac{1000 \text{ m}}{3 \times 10^8 \text{ m/s}} = 3.333 \times 10^{-6} \text{ s} = 0.003\,333 \text{ ms}$$

- **Nodal delay**:

$$6 \text{ ms} + 0.003333 \text{ ms} \approx 6.003 \text{ ms}$$

1.4 Twisted-pair Cable

- **Transmission delay**:

$$\frac{12000 \text{ bits}}{100 \times 10^6 \text{ bits/s}} = 0.00012 \text{ s} = 0.12 \text{ ms}$$

- **Propagation delay**:

$$\frac{1000 \text{ m}}{2 \times 10^8 \text{ m/s}} = 5 \times 10^{-6} \text{ s} = 0.005 \text{ ms}$$

- **Nodal delay**:

$$0.12 \text{ ms} + 0.005 \text{ ms} = 0.125 \text{ ms}$$

1.5 Final Answer

- Wireless nodal delay: 6.003 ms
- Twisted-pair nodal delay: 0.125 ms