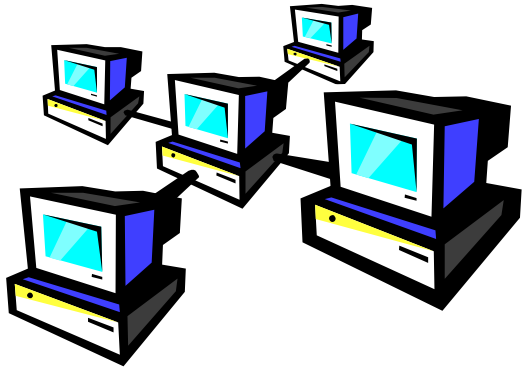
High Speed LANs

Introduction

- rapid changes in technology designs
- broader use of LANs
- new schemes for high-speed LANs
- high-speed technologies:
  - Fast and Gigabit Ethernet
  - Fibre Channel
  - High Speed Wireless LANs



Characteristics of Some High-Speed LANs

	Fast Ethernet	Gigabit Ethernet	Fibre Channel	Wireless LAN
Data Rate	100 Mbps	1 Gbps, 10 Gbps, 100 Gbps	100 Mbps - 3.2 Gbps	1 Mbps - 54 Mbps
Transmission Media	UTP, STP, optical fiber	UTP, shielded cable, optical fiber	Optical fiber, coaxial cable, STP	2.4-GHz, 5-GHz microwave
Access Method	CSMA/CD	Switched	Switched	CSMA/Polling
Supporting Standard	IEEE 802.3	IEEE 802.3	Fibre Channel Association	IEEE 802.11

Description of CSMA/CD

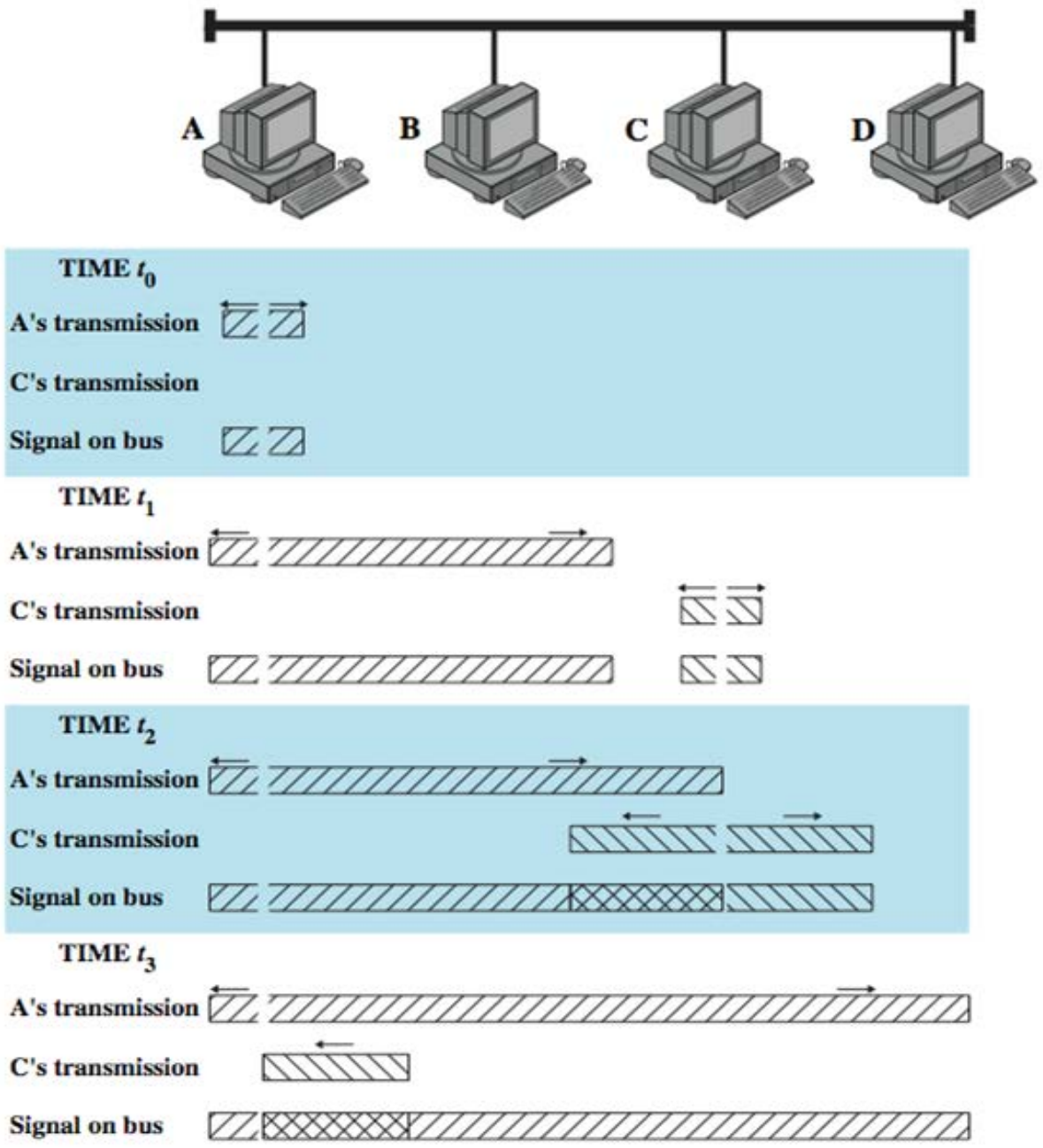
1.If the medium is idle, transmit; otherwise, go to step 2.

2.If the medium is busy, continue to listen until the channel is idle, then transmit immediately.

3.If a collision is detected during transmission, transmit a brief jamming signal to assure that all stations know that there has been a collision and then cease transmission.

4.After transmitting the jamming signal, wait a random amount of time, referred to as the **backoff**, then attempt to transmit again (repeat from step 1).

CSMA/CD Operation



10Mbps Specification (Ethernet)

	10BASE5	10BASE2	10BASE-T	10BASE-FP
Transmission medium	Coaxial cable (50 ohm)	Coaxial cable (50 ohm)	Unshielded twisted pair	850-nm optical fiber pair
Signaling technique	Baseband (Manchester)	Baseband (Manchester)	Baseband (Manchester)	Manchester/on-off
Topology	Bus	Bus	Star	Star
Maximum segment length (m)	500	185	100	500
Nodes per segment	100	30	—	33
Cable diameter (mm)	10	5	0.4 to 0.6	62.5/125 μm

IEEE 802.3 10-Mbps Physical Layer Medium Alternatives

	10BASE5	10BASE2	10BASE-T	10BASE-FP
Transmission medium	Coaxial cable (50 ohm)	Coaxial cable (50 ohm)	Unshielded twisted pair	850-nm optical fiber pair
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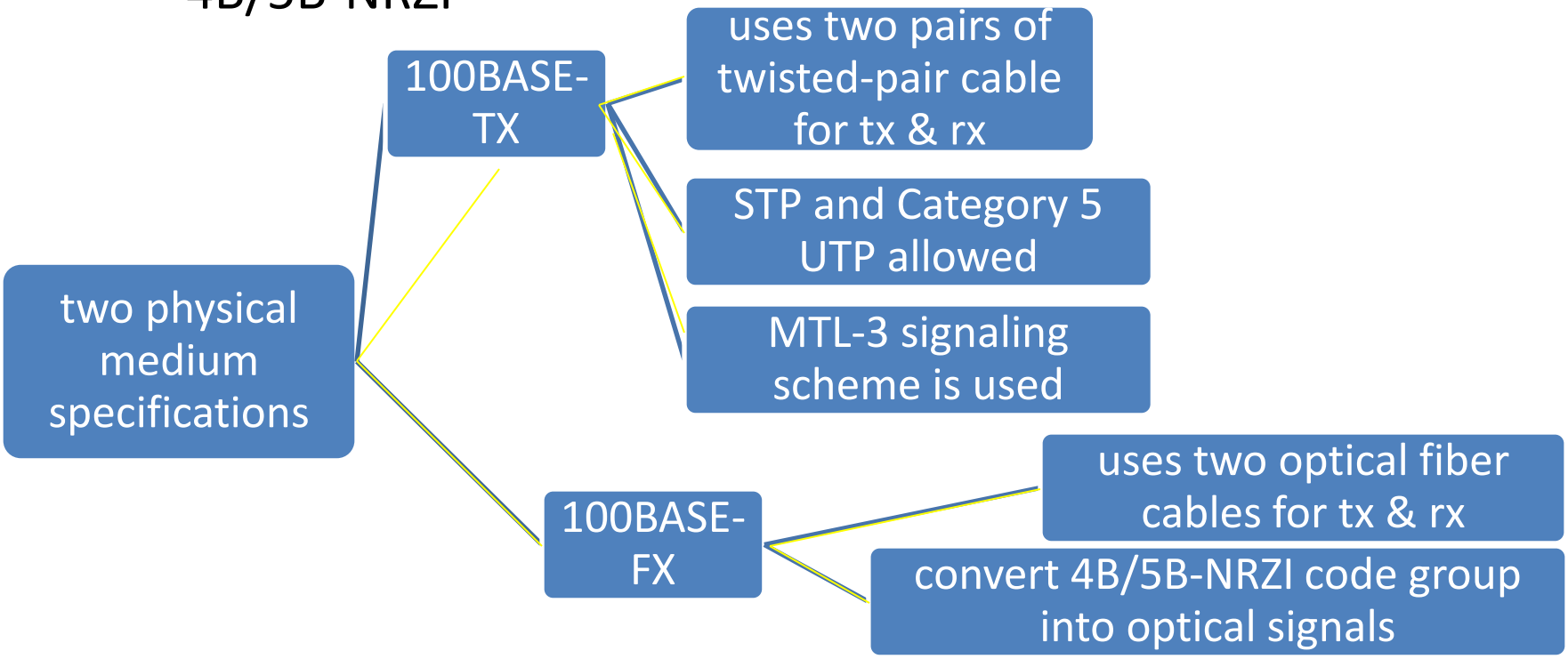
100Mbps Fast Ethernet

	100BASE-TX		100BASE-FX	100BASE-T4
Transmission medium	2 pair, STP	2 pair, Category 5 UTP	2 optical fibers	4 pair, Category 3, 4, or 5 UTP
Signaling technique	MLT-3	MLT-3	4B5B, NRZI	8B6T, NRZ
Data rate	100 Mbps	100 Mbps	100 Mbps	100 Mbps
Maximum segment length	100 m	100 m	100 m	100 m
Network span	200 m	200 m	400 m	200 m

100BASE-X

- uses a unidirectional data rate 100 Mbps over single twisted pair or optical fiber link
- encoding scheme same as FDDI
  - 4B/5B-NRZI



100BASE-T4

- 100-Mbps over lower-quality Cat 3 UTP
  - takes advantage of large installed base
  - does not transmit continuous signal between packets
  - useful in battery-powered applications
- can not get 100 Mbps on single twisted pair
  - so data stream split into three separate streams
  - four twisted pairs used
  - data transmitted and received using three pairs
  - two pairs configured for bidirectional transmission
- use ternary signaling scheme (8B6T)

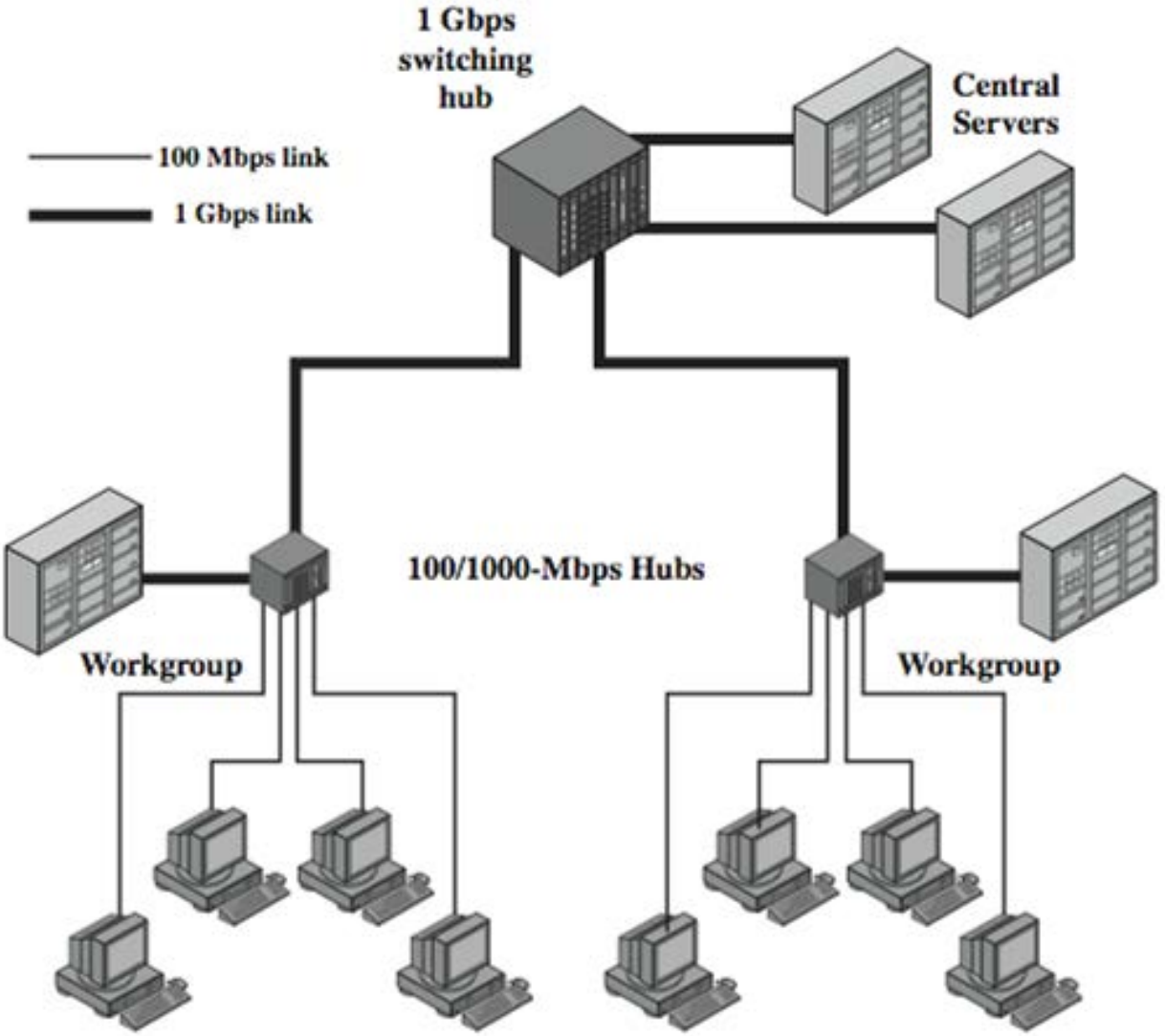
Full Duplex Operation

- traditional Ethernet half duplex
- using full-duplex, station can transmit and receive simultaneously
- 100-Mbps Ethernet in full-duplex mode, giving a theoretical transfer rate of 200 Mbps
- stations must have full-duplex adapter cards
- and must use switching hub
  - each station constitutes separate collision domain
  - CSMA/CD algorithm no longer needed
  - 802.3 MAC frame format used

Mixed Configurations

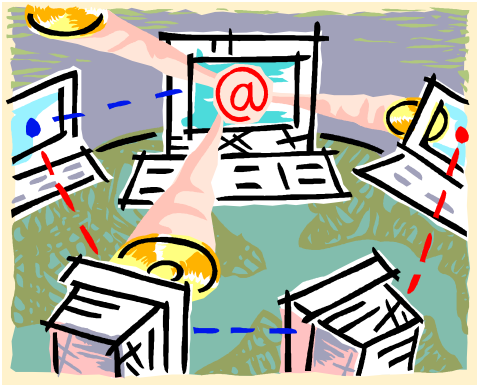
- Fast Ethernet supports mixture of existing 10-Mbps LANs and newer 100-Mbps LANs
- supporting older and newer technologies
  - stations attach to 10-Mbps hubs using 10BASE-T
  - hubs connected to switching hubs using 100BASE-T
  - high-capacity workstations and servers attach directly to 10/100 switches
  - switches connected to 100-Mbps hubs use 100-Mbps links
  - 100-Mbps hubs provide building backbone
  - connected to router providing connection to WAN

Gigabit Ethernet Configuration

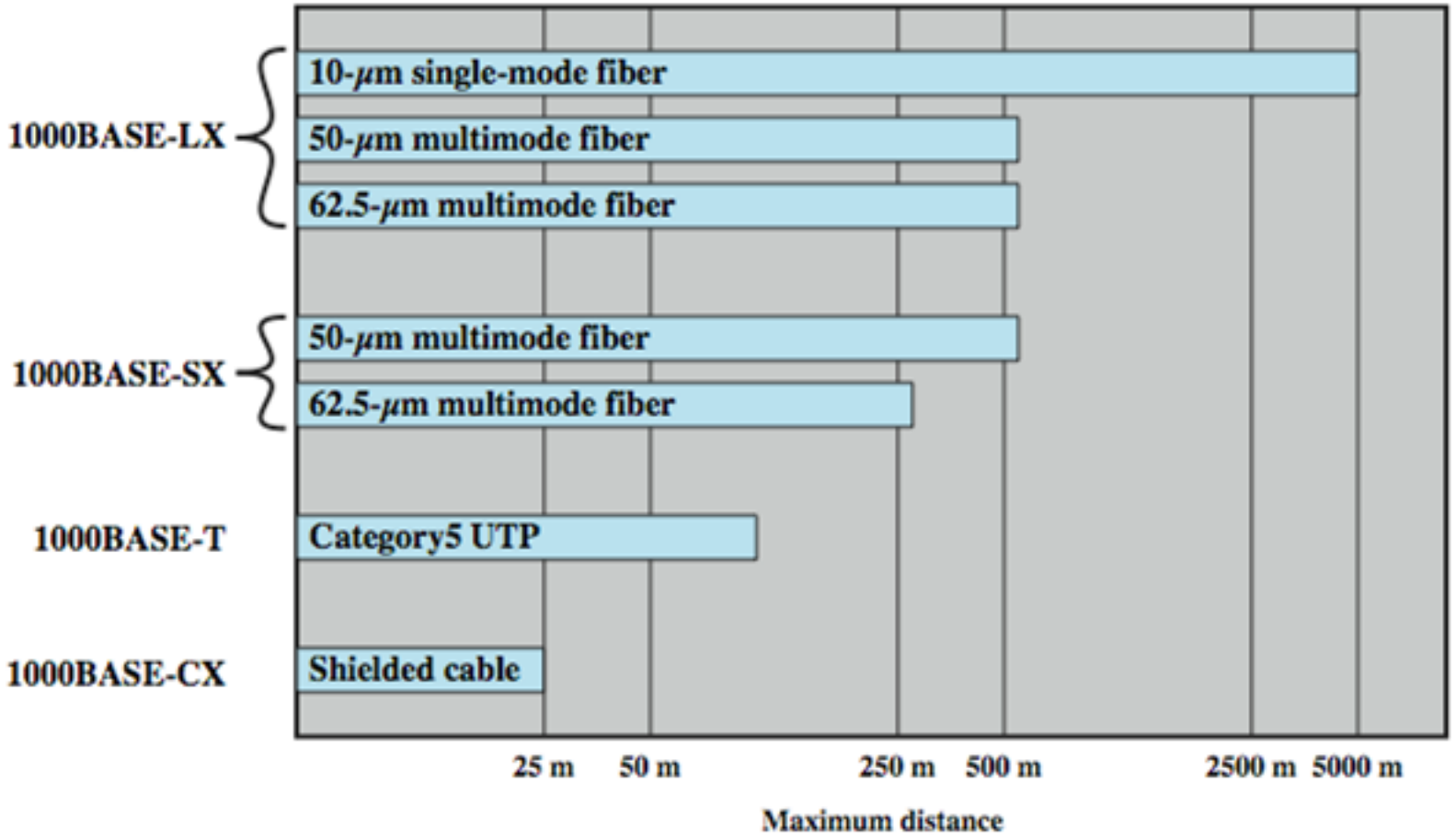


Gigabit Ethernet - Differences

- carrier extension
  - at least 4096 bit-times long (512 for 10/100)
- frame bursting
- not needed if using a switched hub to provide dedicated media access



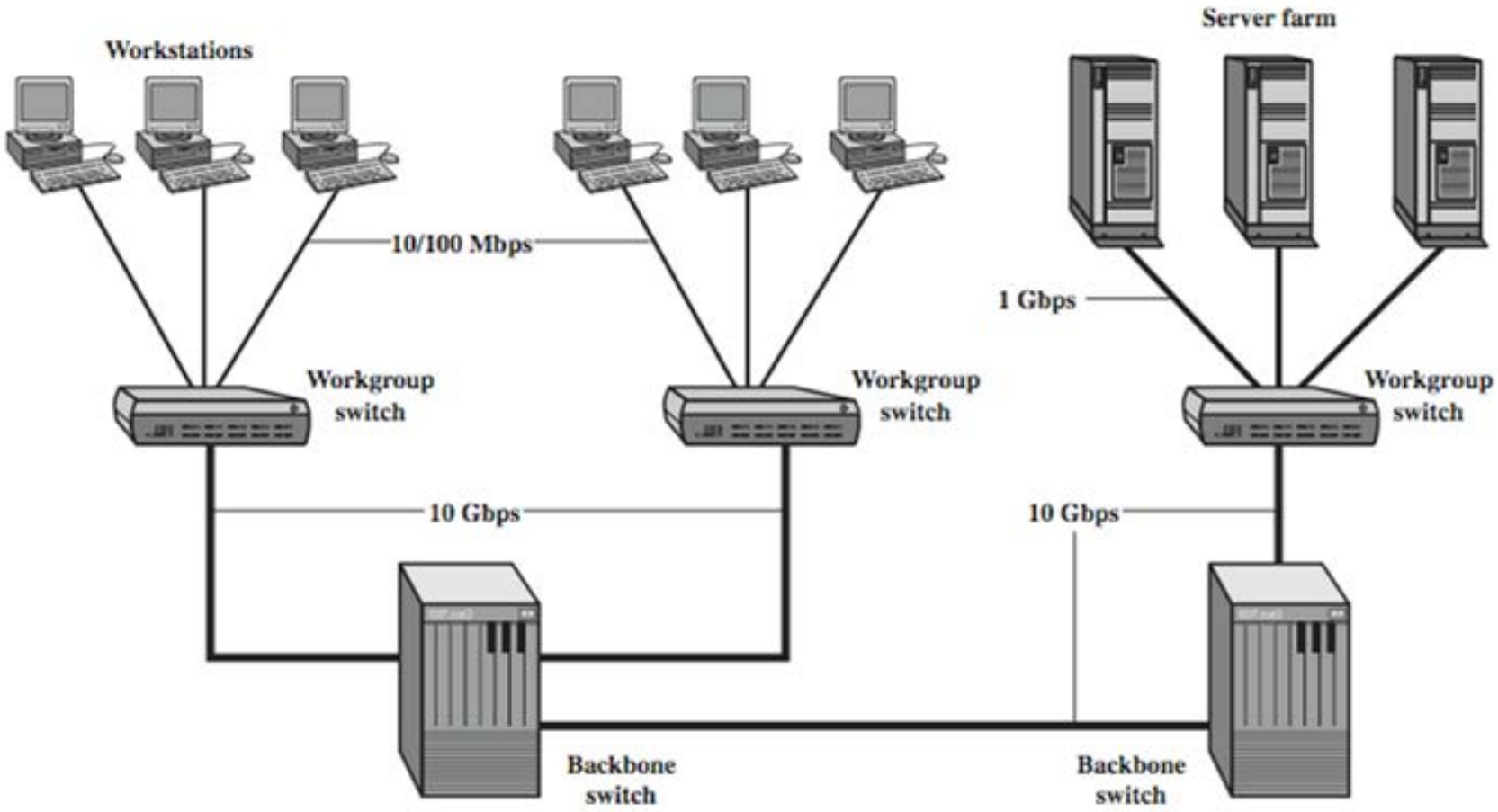
Gigabit Ethernet – Physical



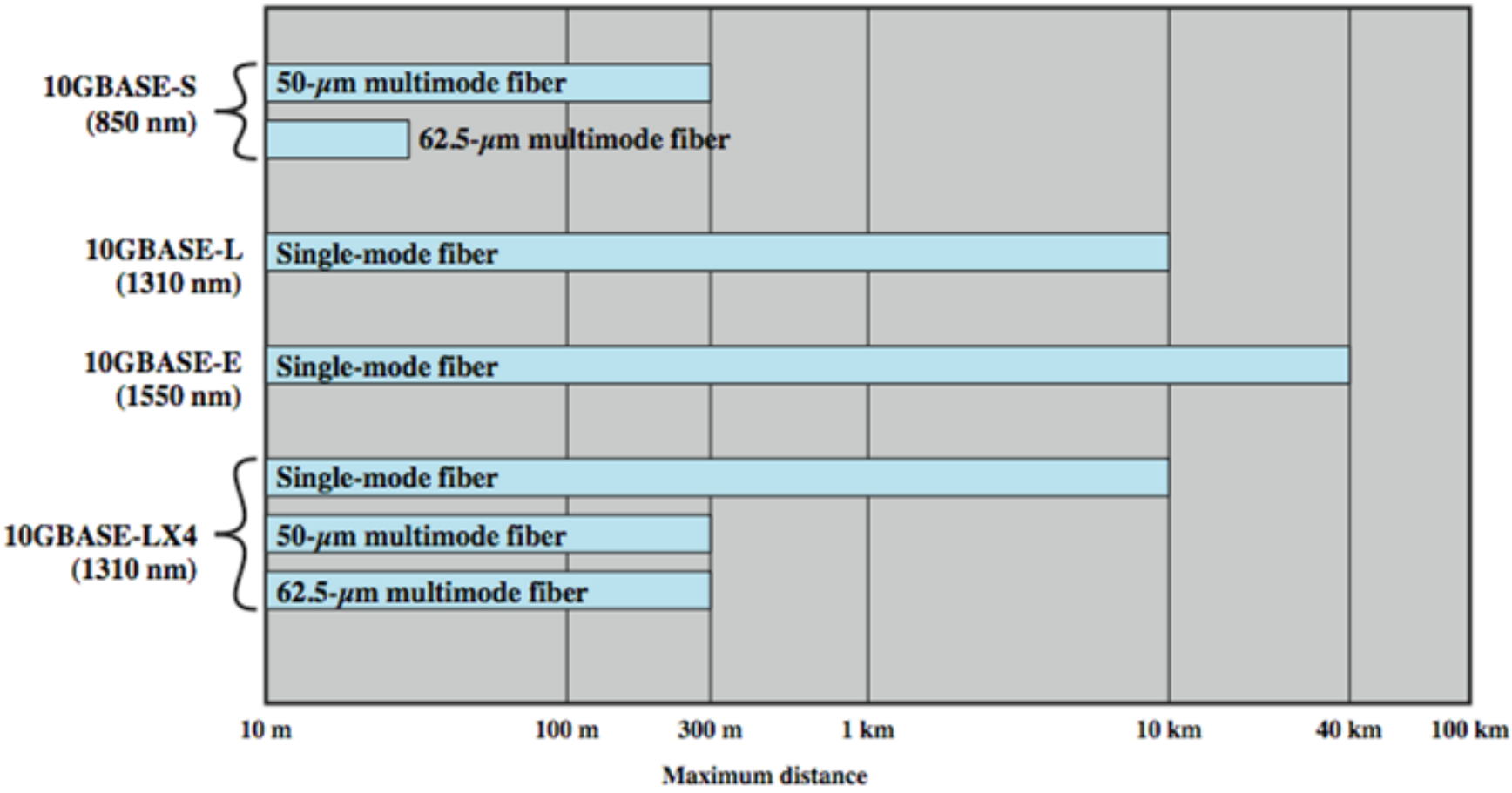
10Gbps Ethernet

- growing interest in 10Gbps Ethernet
  - high-speed backbone use
  - future wider deployment
- alternative to ATM and other WAN technologies
- uniform technology for LAN, MAN, or WAN
- advantages of 10Gbps Ethernet
  - no expensive, bandwidth-consuming conversion between Ethernet packets and ATM cells
  - IP and Ethernet together offers QoS and traffic policing approach ATM
  - have a variety of standard optical interfaces

10Gbps Ethernet Configurations



10Gbps Ethernet Options



100-Gbps Ethernet

- preferred technology for wired LAN
- preferred carrier for bridging wireless technologies into local Ethernet networks
- cost-effective, reliable and interoperable
- popularity of Ethernet technology:
  - availability of cost-effective products
  - reliable and interoperable network products
  - variety of vendors

100Gbps Ethernet

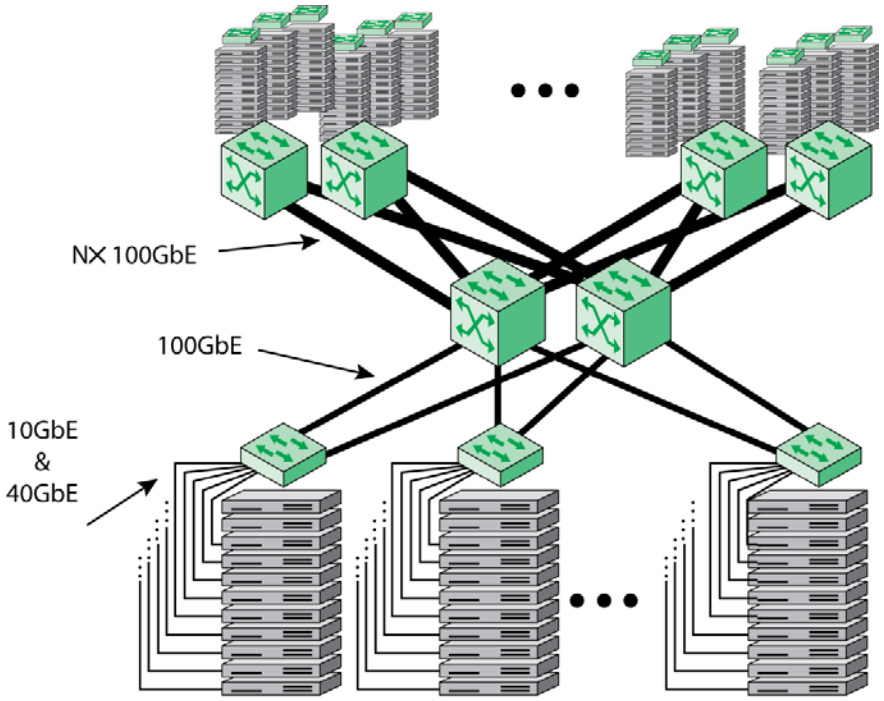
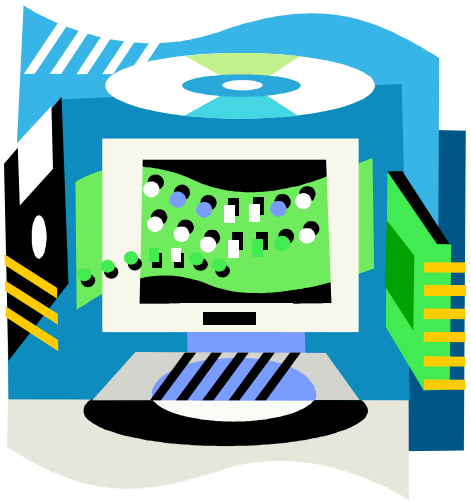


Figure 16.8 Example 100-Gbps Ethernet Configuration for Massive Blade Server Site

Multilane Distribution

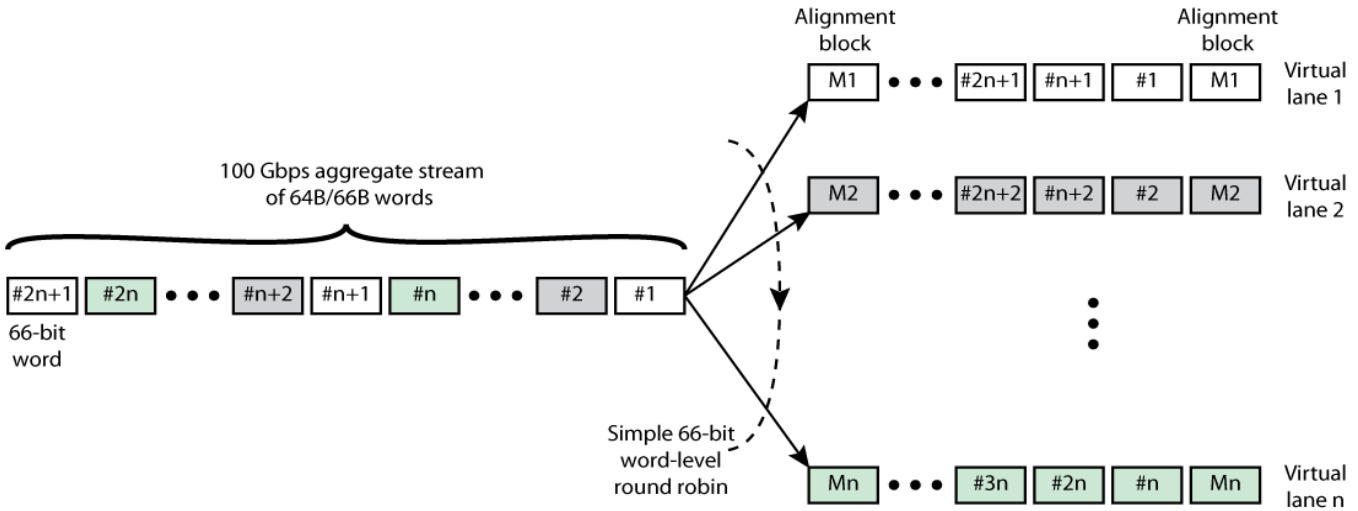
used to achieve the required data rates

- multilane distribution:
  - switches implemented as multiple parallel channels
    - separate physical wires

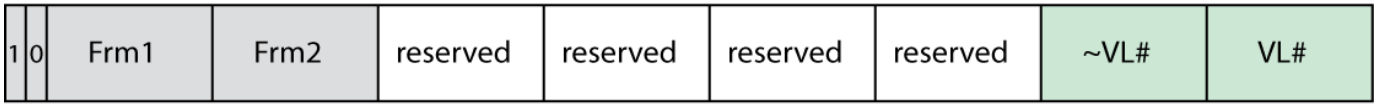


- virtual lanes:
  - if a different number of lanes are actually in use, virtual lanes are distributed into physical lanes in the PMD sublayer
  - form of inverse multiplexing

Multiline Distribution for 100Gbps Ethernet



(a) Virtual lane concept



(b) Alignment block

Figure 16.9 Multilane Distribution for 100-Gbps Ethernet

Media Options for 40-Gbps and 100-Gbps Ethernet

	40 Gbps	100 Gbps
1m backplane	40GBASE-KR4	
10 m copper	40GBASE-CR4	1000GBASE-CR10
100 m multimode fiber	40GBASE-SR4	1000GBASE-SR10
10 km single mode fiber	40GBASE-LR4	1000GBASE-LR4
40 km single mode fiber		1000GBASE-ER4

Naming nomenclature:

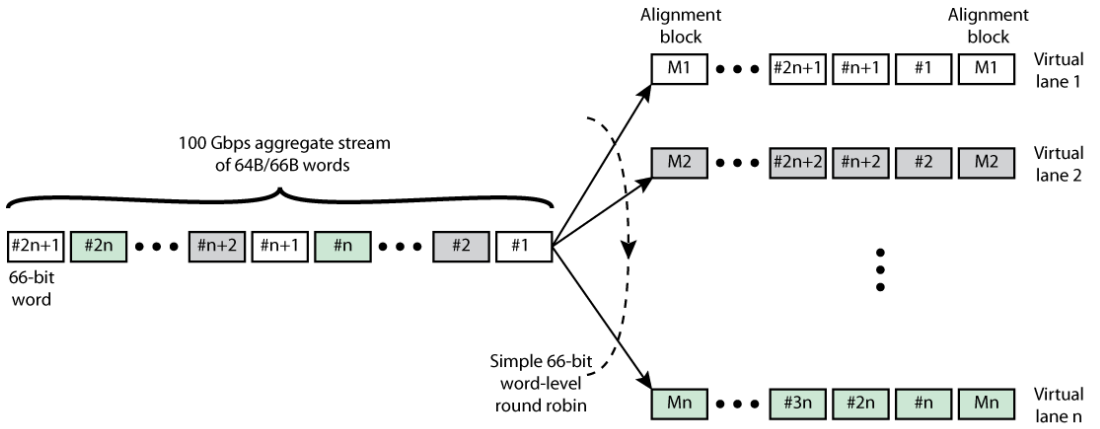
Copper: K = backplane; C = cable assembly

Optical: S = short reach (100m); L - long reach (10 km); E = extended long reach (40 km)

Coding scheme: R = 64B/66B block coding

Final number: number of lanes (copper wires or fiber wavelengths)

Multilane Distribution for 100 Gbps Ethernet



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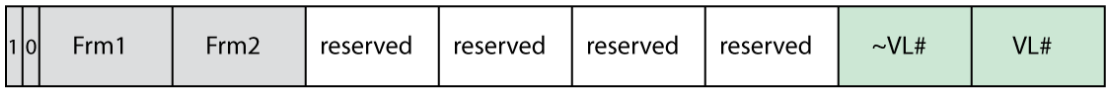

(b) Alignment block

Figure 16.9 Multilane Distribution for 100-Gbps Ethernet

A VLAN Configuration

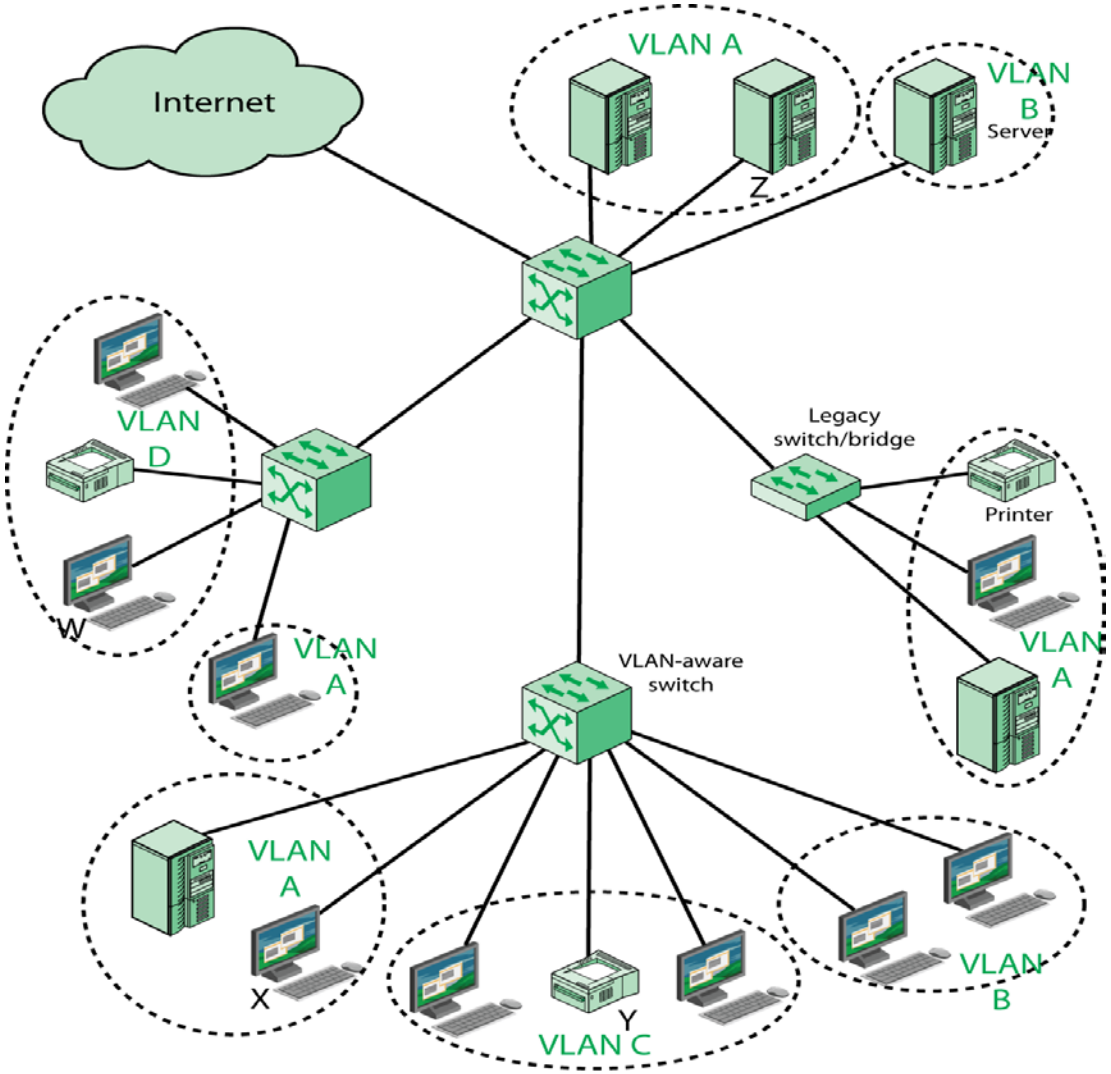

Figure 16.11 A VLAN Configuration

Summary

- traditional Ethernet
- high speed LANs emergence
- Ethernet technologies
  - CSMA & CSMA/CD media access
  - 10Mbps Ethernet
  - 100Mbps Ethernet
  - 1Gbps Ethernet
  - 10Gbps Ethernet
- multilane distribution
- IEEE 802.1Q VLAN standard