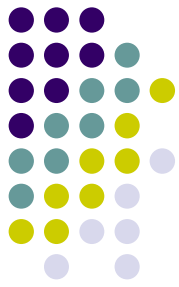


DWDM



 **Dense Wave Division Multiplexing**

 **SONET**

 **Course Wave Division Multiplexing**

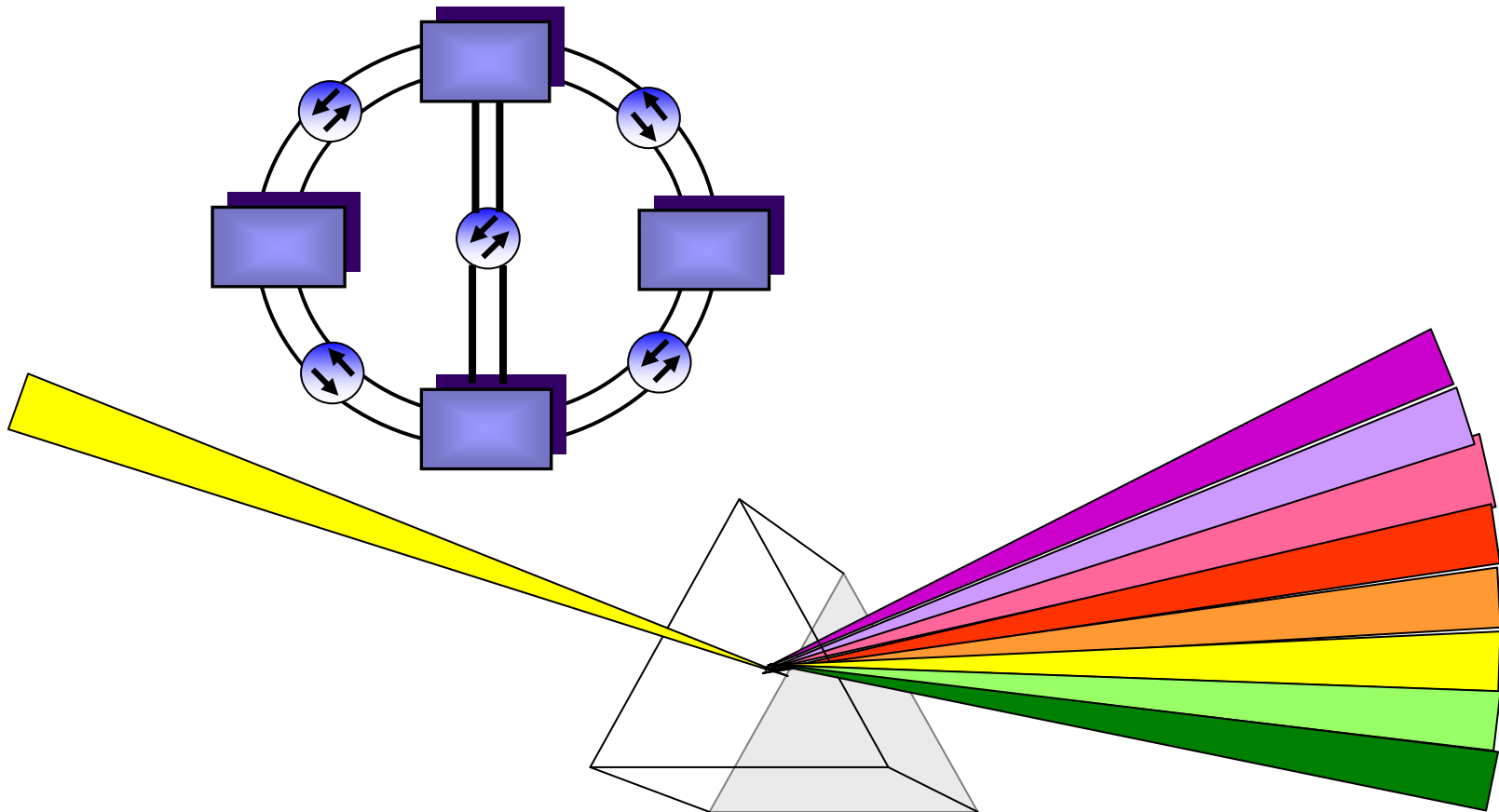
Engr. Mian Shahzad Iqbal
Lecturer
Department of Telecommunication
Engineering



Objectives

- Understand the basic of DWDM standards
- Know the features, applications and advantages of **Dense Wave Division Multiplexing**

Optical Transport Service (OTS)





What is Optical Networking?

- Optical Networking Definition:
 - is the utilization of fiber systems in the transfer and management of data from location to location across the fiber system.
- Categories of Optical Data Services:
 - Switched Services - protocol management
 - TLS/Gigabit Ethernet, Frame Relay, ATM...
 - Transport Services - protocol transport
 - Architectures - Point to Point or Ring
 - Delivery Method - ILEC, Network Integration or Hybrid
 - Protocols Transported

SONET

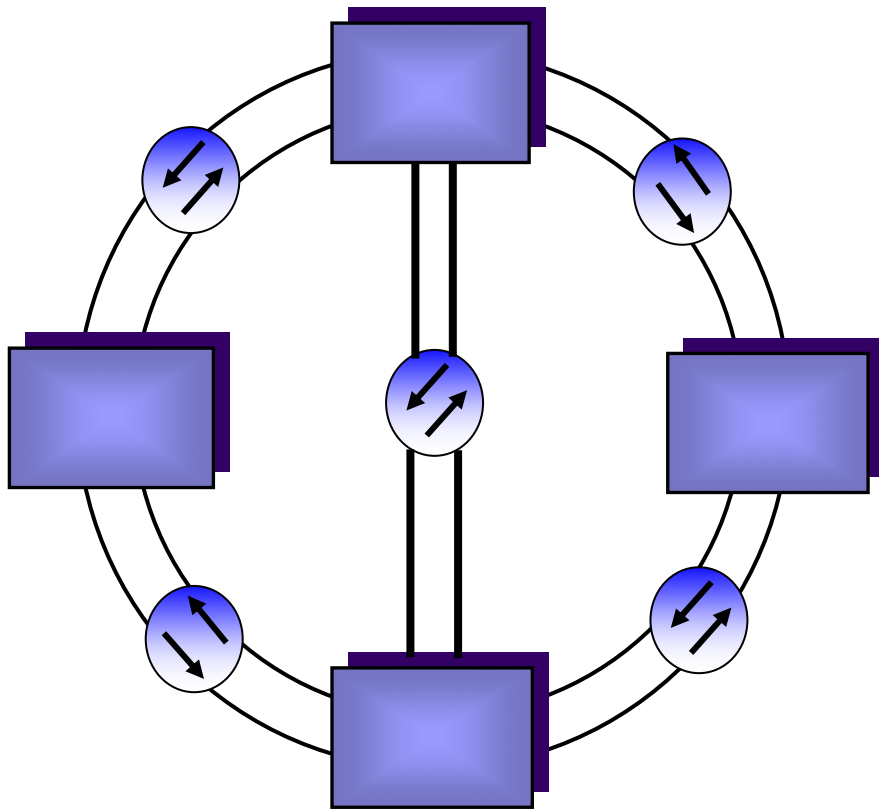


- Synchronous Optical Networking
- Method for communicating digital information using laser or LED over optical fiber
- SONET is in the CANADA and SDH in rest of the world
- SDH can be thought of superset of SONET



Optical Networking Technologies

Synchronous Optical Network (SONET)



A fiber-optic transmission system for high-speed digital traffic.

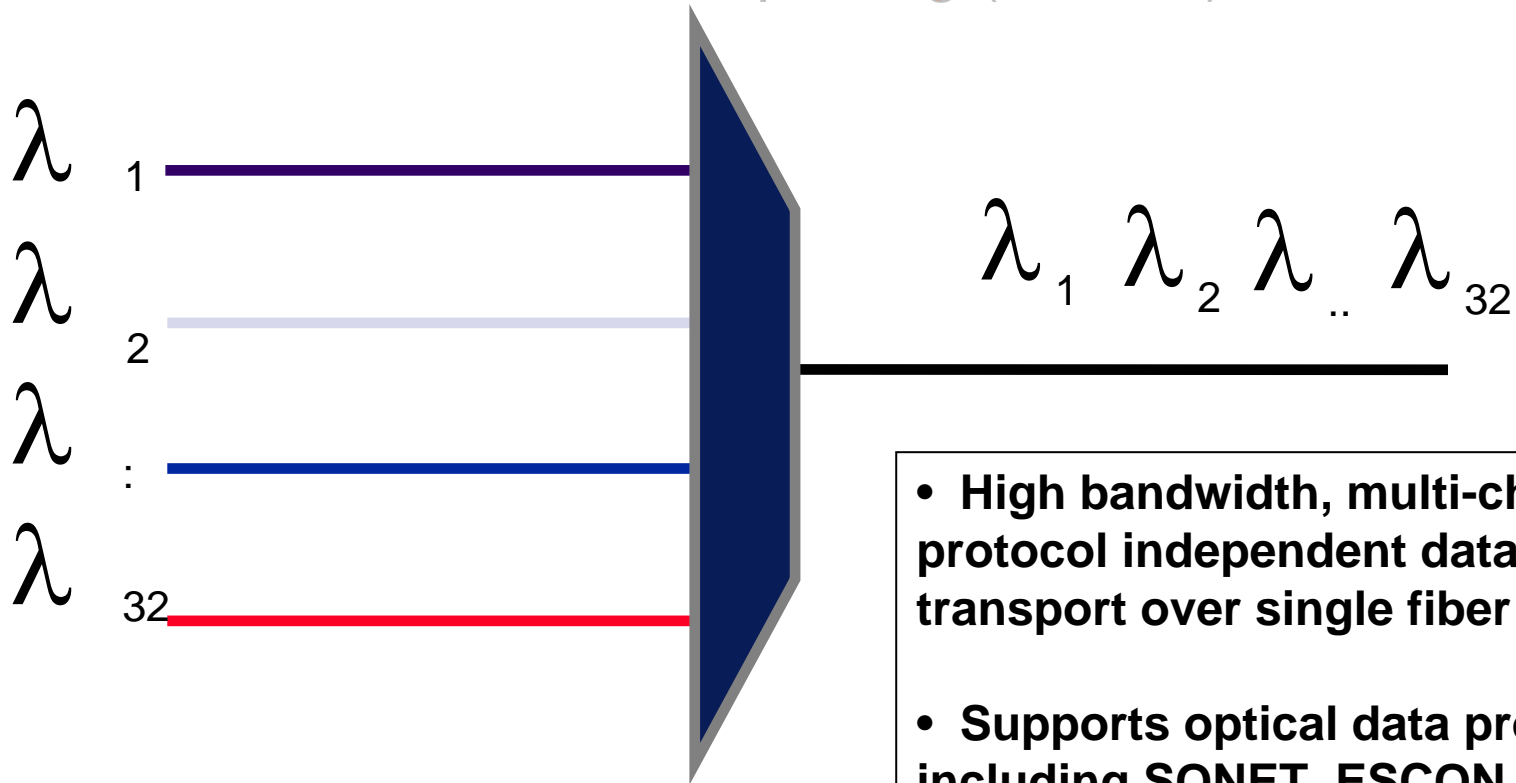
Ring and point to point architectures, standard OC interfaces and electrical DS1 and DS3 connections.

Optical Interfaces	
OC-3	155 Mbps
OC-12	622 Mbps
OC-48	2.48 Gbps

Optical Networking Technologies



Dense Wave Division Multiplexing (DWDM)



- High bandwidth, multi-channel, protocol independent data transport over single fiber pair
- Supports optical data protocols including SONET, ESCON, FICON, Fibre Channel, GigE, D1 Video, ETR/CLO, Fast Ethernet, ISC.

What is Dense Wave Division Multiplexing (DWDM) ?



Dense Wave Division Multiplexing is a technology that utilizes the properties of refracted light to both combine and separate optical signals based on their wavelengths within the optical spectrum.

The Greek letter lambda (λ), is often used to designate individual wavelengths.

DWDM allows for a more efficient use of existing fiber by providing multiple optical paths along a single pair of fibers

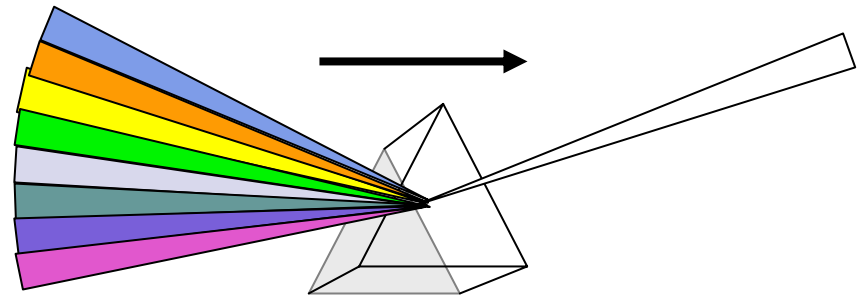
DWDM allows for a greater range of protocol transmission better suited than legacy network for data centric applications. (Eg. GigE, ESCON, Fibre Channel, D1 video, ISC)

What is Dense Wave Division Multiplexing (DWDM)?

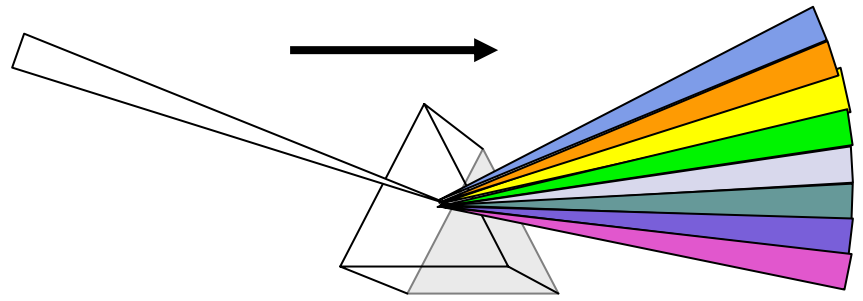


?

At Ingress: Multiple Optical signals of differing wavelengths are combined to form a single optical signal.



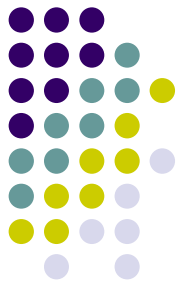
At Egress: A single Optical signals is refracted to separate multiple Optical signals of differing wavelengths.



DWDM



- DWDM system will be able to support 40 Gbps
- Wavelength upto 300 channels
- Resulting in 12Tbps over a single fiber
- Typical DWDM use lasers which have a bit rate of up to 10Gbps(OC-192/STM-64)
- Multiplex upto 240 wavelengths
- DWDM deployed usually 100 or 200 GHz spacing
- Distance of thousand KMs with amplification and regeneration
- Uses C band or L band



Capacity Enrichment with Optical Networking

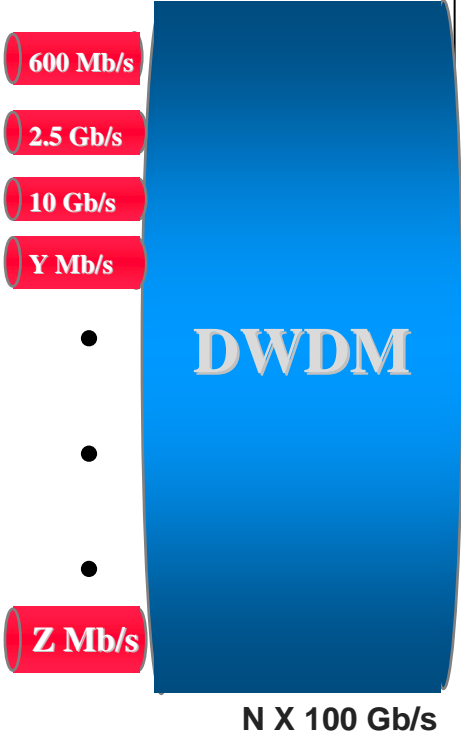
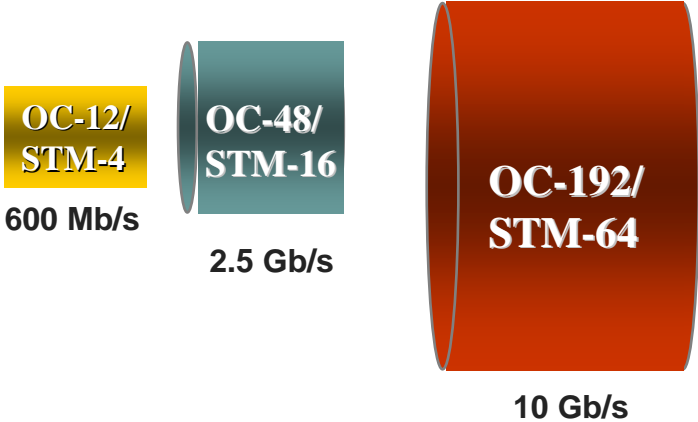
Any Speed-----Any Protocol

Traditional Capacity Expansions

More Fiber



Time Division Multiplexing



- Size of transport pipe dictated by bit rate
- Limited capacity growth potential
- Growth accomplished through infrastructure upgrades

- Size of transport pipe independent of bit rate
- Virtually unlimited capacity growth potential
- Growth accomplished within established infrastructure
- Optimum solution to keep pace with business growth

Benefits of DWDM



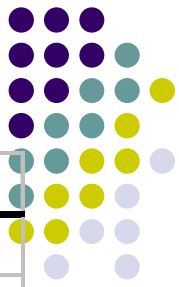
- Increases bandwidth (speed and distance)
- Does not require replacement or upgrade their existing legacy systems
- Provides "next generation" technologies to meet growing data needs
- Less costly in the long run because increased fiber capacity is automatically available; don't have to upgrade all the time



CWDM

- Coarse wavelength Division Multiplexing
- Suited of short haul transport of data ,video ,storage and multimedia services
- Area less than 50 Km ,no need of optical amplifier
- CWDM system uses bit rate of 2 Gbps(OC-48/STM-16)
- Multiplex upto 18 wavelengths

Protocol Speed Matrix



Protocol	Speed		Capacity
SONET OC3	155.52 Mbps	Synchronous	84 DS-1 or 3DS-3s
SONET OC3c	155.52 Mbps	Concatenated Synchronous	84 DS-1 or 3DS-3s
SONET OC12	622.08 Mbps	Synchronous	336 DS-1 or 12DS-3s
SONET OC12c	622.08 Mbps	Concatenated Synchronous	336 DS-1 or 12DS-3s
SONET OC48	2.48 Gbps	Synchronous	1344 DS-1 or 48DS-3s
SONET OC48c	2.48 Gbps	Concatenated Synchronous	1344 DS-1 or 48DS-3s
SONET OC192	9.95 Gbps	Synchronous	5376 DS-1 or 192DS-3s
SONET OC192c	9.95 Gbps	Concatenated Synchronous	5376 DS-1 or 192DS-3s
ESCON	200 Mbps	Distance Limitation 43km	
FICON	1 Gbps	Distance Limitation 100km	
Fibre Channel	1.0625 Gbps	Distance Limitation 100km	
ETR/CLO	8 Mbps	Distance Limitation 40km	
FDDI	100 Mbps		
ISC	1.06 Mbps	Distance Limitation 40km	
Fast Ethernet	100 Mbps		
Gigabit Ethernet	1 Gbps		
D1 Video	270 Mbps	uncompressed digital transmission	