
WDM OPTICAL PACKET SWITCHING

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high speed networking issues

- The high speed packet networking bottlenecks: - **forwarding** - **transmission** - **switching** are stressed by the Internet deployment and the related growing demand for bandwidth.

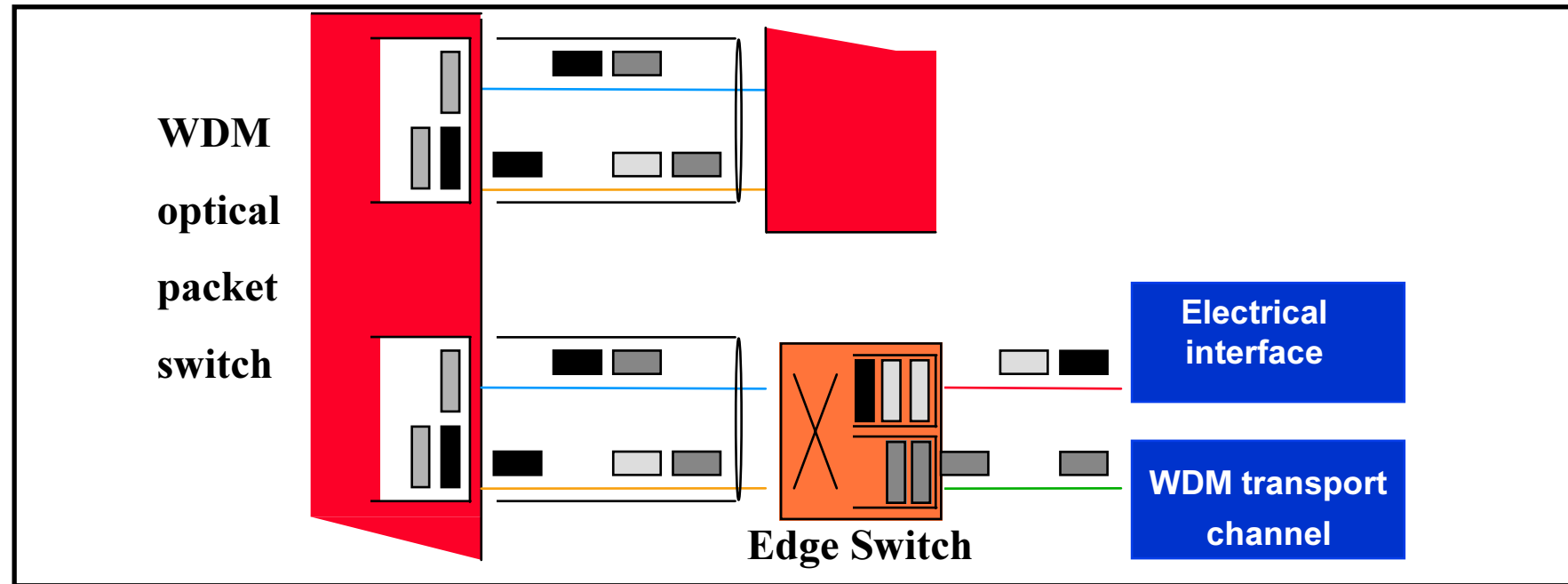
- ➔ **forwarding** : - main performance bottleneck that IP routers are facing
optimization of routing table encoding + parallelisation
- ➔ **transmission** : - WDM transport networks make affordable the optical fiber bandwidth incrementally: wavelength channel granularity + bit rate transparency
- ➔ **switching**: - current technology inherited from ATM and supercomputer industry
- lack of flexibility against WDM transmission capacity upgrading

Gigabit IP routers based on optical packet switching:

- § *switching capacity scaled on WDM transmission capacity*
- § *thorough decoupling between transmission and forwarding*

Interfacing issues & Wavelength Resource Management

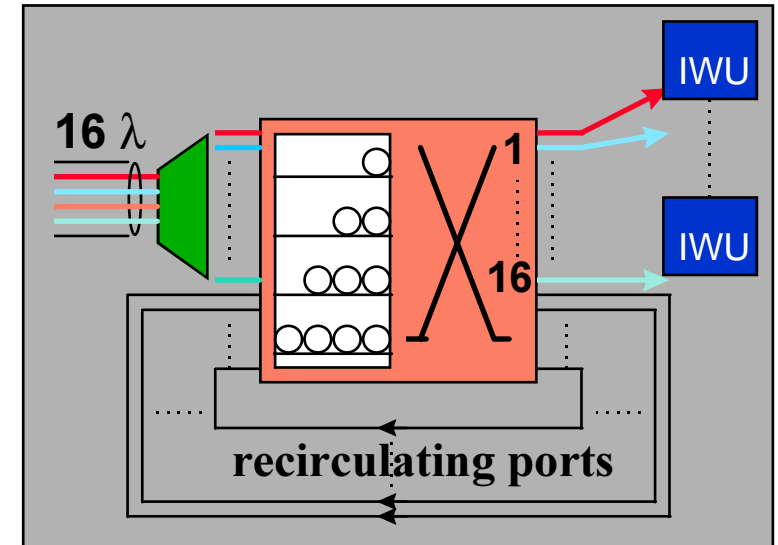
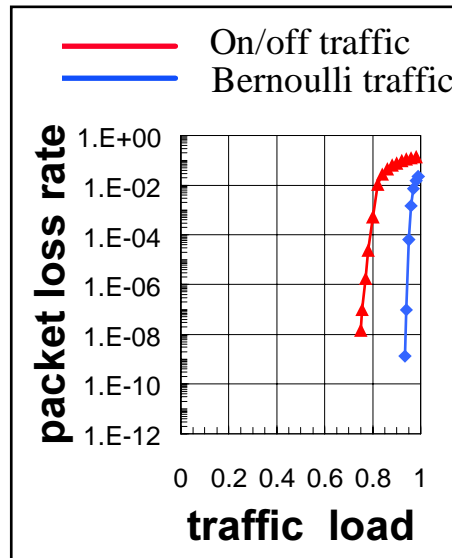
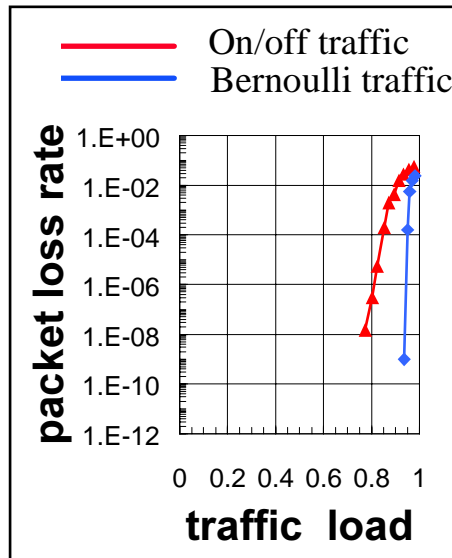
Direct interconnection of switches: - dynamic allocation of wavelength channels
- statistical multiplexing at the fiber bandwidth capacity level



Access to WDM transport network or electrical interface : ———> **edge switch**
packet delivery at the wavelength channel capacity level (sequence integrity preservation)

Contention Resolution: FIFO queuing

- on/off traffic source burstiness: 10



Core switch : $n_{\text{fibre}} = 4$ / $n_{\lambda} = 16$

Edge switch : $n_{\lambda} = 16$ / 16 recirculating ports

- **Switch architectures:** packet routing + queuing = two wavelength conversions
- **Contention resolution:** fiber delay line + wavelength encoding + recirculation

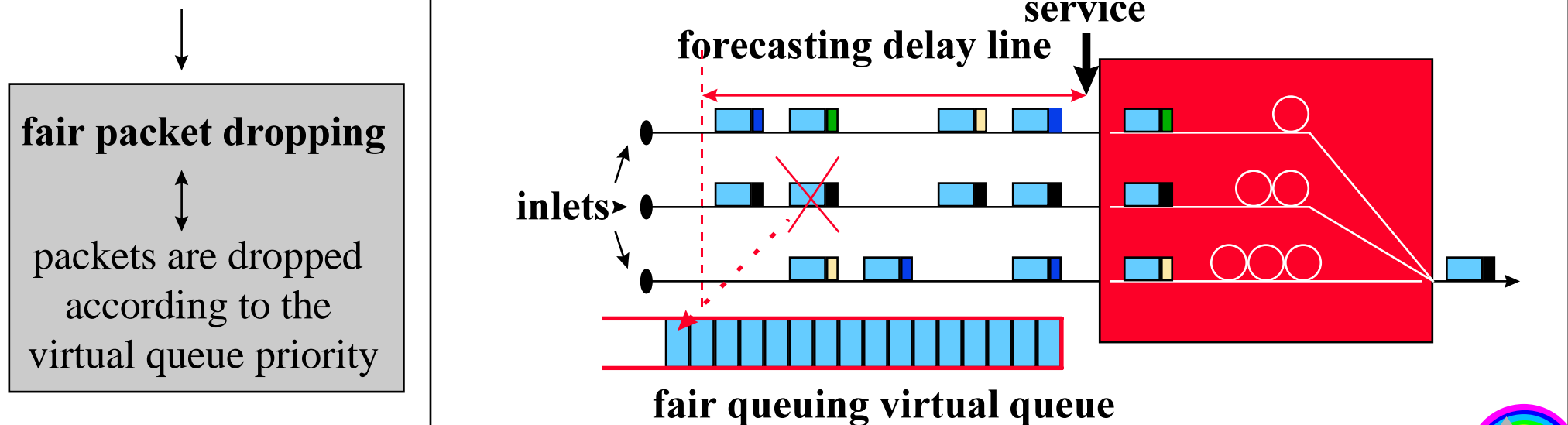
Optical Fair Queuing

Fair Queuing: fair sharing of the processing power of a server dedicated to a queuing system

↙ fair bandwidth sharing + traffic reshaping ↔ large electronic memories

Optical fair queuing issues:

- 'queuing packets' are no more available as they travel on delay lines.
- packets can only be delayed over a finite time window.



Fair Packet Dropping

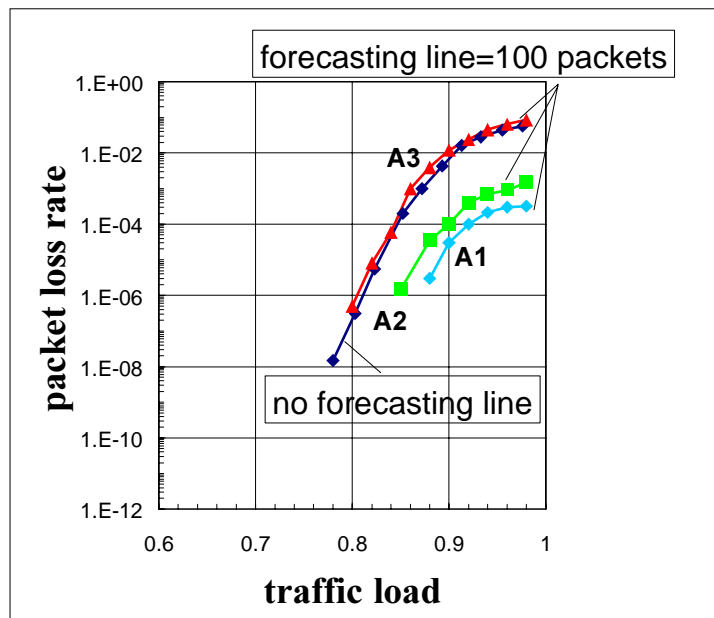
➔ **Optical switch:** interconnection of 4 fibers carrying 16 wavelengths.

➔ **Offered traffic:**

- source burstiness :10
- 3 aggregates of 12 connections per fiber.
- offered traffic load ratio per aggregate:

aggregate 1 → 0.07
aggregate 2 → 0.28
aggregate 3 → 0.65

- forecasting line length: 100 packets



Optical Packet Switching: - delay is not an issue.
- service differentiation on packet loss rate.