OPTICAL PACKET/BURST SWITCHING

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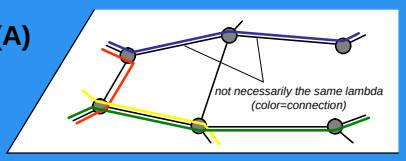
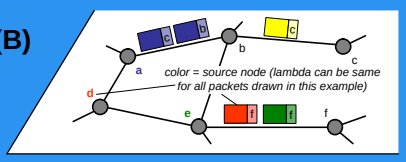
(A)



- end-to-end lambda connection
- semi-permanent: switch input to output lambda, for entire duration of connection
- overhead: signaling for set-up and tear-down of paths

(B)



- no permanent connection
- switch on packet-by-packet basis
- overhead: header per packet

Circuit Switching vs. Packet/Burst Switching

(A) Circuit switching:

- \+ guaranteed end-to-end optical path
- \+ simple optical cross-connects (OXCs)
- \- coarse granularity: full lambda
- \- rather static, (semi-)permanent

Þ ***suitable for (quasi-)static traffic***

(B) Packet/burst switching:

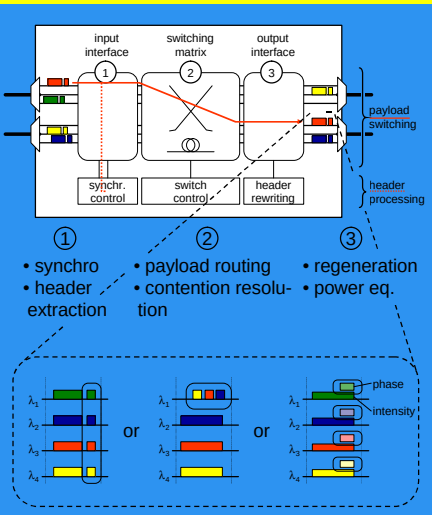
- \+ fine granularity (packets), only occupied if data is sent
- \+ no reservation, can easily deal with changing traffic pattern
- \- solve contention problem
- \- more complex OXCs

Þ ***promising for bursty traffic as in data driven networks***

Optical packet/burst switching

A packet/or burst switching node (i.e. OXC) typically consists of three architectural building blocks: an input interface, a switching matrix and an output interface. To date, the header processing is performed electronically, while the payload is switched transparently: optics for capacity and switching, electronics for routing and forwarding.

The header can be transported in-band (using the same wavelength), on a separate wavelength, or using an orthogonal channel.



Optical Packet Switching

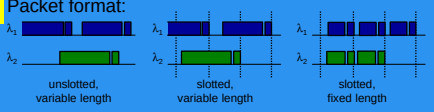
Packet format alternatives: fixed vs. variable length; slotted vs. unslotted

- *fixed:* fragmentation and reassemble
- *variable length:* long packets may block short ones
- *unslotted:* more complex operation of switch
- *slotted:* synchronisation needed

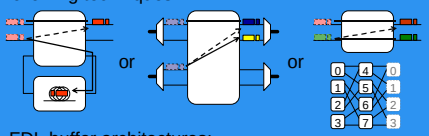
Contention resolution:

- *approach:* mimick RAM using fibre delay lines (FDLs); and/or exploit wavelength domain; or use deflection routing
- *architecture:* feed-forward or feed-back; single or multi-stage

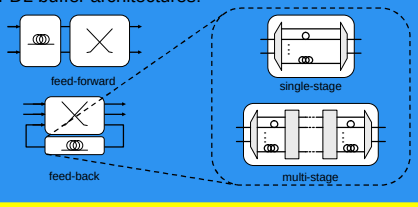
Packet format:

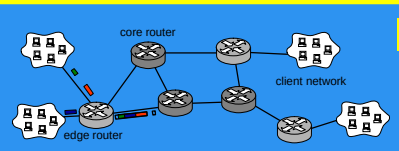


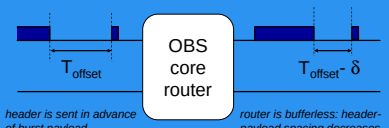
Contention can be solved using one or more of the following techniques:

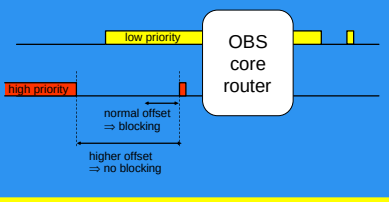


FDL buffer architectures:







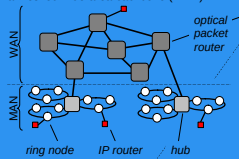


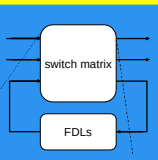
Optical Burst Switching

In OBS, edge routers aggregate traffic into variable length bursts that are sent unslotted. This limits the amount of processing in the core routers.
Header and data are seperated in time, by T_{offset}. This allows the switch to be correctly configured by the time the data arrives. The data burst can then pass through *transparently*.
Since OBS is *bufferless*, T_{offset} decreases by δ in every node. Clearly $T_{offset} > H \cdot \delta$ (H = number of hops, δ = header processing time).

Giving some bursts a higher T_{offset} than others, gives them lower blocking probability, thus enabling OBS to provide Quality of Service.

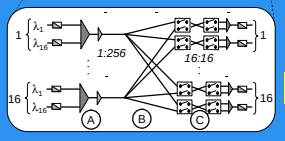
The DAVID network consists of two network parts:
- a ring-based metropolitan area network (MAN), where access is regulated by a MAC protocol
- a meshed wide-area backbone (WAN)



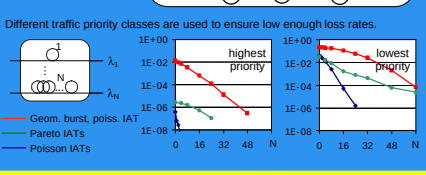


The Optical Packet Routers (OPRs) in the WAN have a recirculating buffer, while the optical path in the MAN is bufferless

switching matrix:
(A) wavelength multiplex. and pre-amplification
(B) coupler + interconnection shuffle
(C) space + wavelength selection



Different traffic priority classes are used to ensure low enough loss rates.



The DAVID project

DAVID = Data And Voice Integration over DWDM, European IST project

- optical packet switching: slotted operation, fixed length packets; header: in-band in backbone, control wavelength in metro
- metro and backbone networks, different network architecture in each of those network parts
- node architecture: switching matrix based on SOAs (semi-conductor optical amplifiers)

⇒ ***IBCN: study of node and network performance***

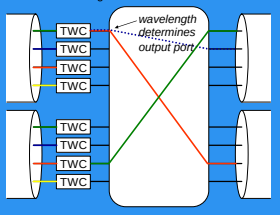
The STOLAS project

STOLAS = Switching Technology for Optical LAbel Switching, European IST project

- optical packet and burst switching
- metro and backbone networks, unified node and network concept
- node architecture: switching matrix based on passive wavelength routing using a phasar

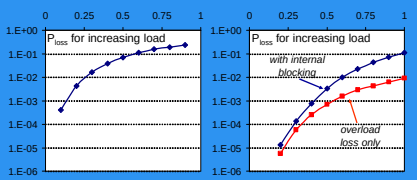
⇒ ***IBCN: study of node and network architectures***

Switching matrix = arrayed waveguide
Tunable wavelength converters set lambda to reach appropriate output port



STOLAS node has internal blocking: even when there is no overload (i.e. no more packets are offered for an output fibre than it has wavelengths), packet loss can occur.

Node performance evaluation shows that performance is considerably lower when the node is operated using the unslotted approach.



unslotted operation; 3 in/out fibres; 9 lambdas per fibre

slotted operation; 3 in/out fibres; 9 lambdas per fibre

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