

Void-creating algorithms for fixed size packets in OPTICAL SWITCHING

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The connected world causes a bottleneck in the backbone

Cloud computing and (high definition) media services push bandwidth demands to unseen heights.

Nowadays optical fiber capacity is gigantic, but is used ineffectively, due to inflexible circuit switching.

Optical packet/burst switching is done at packet level, vastly improving the effective use of the fiber capacity.

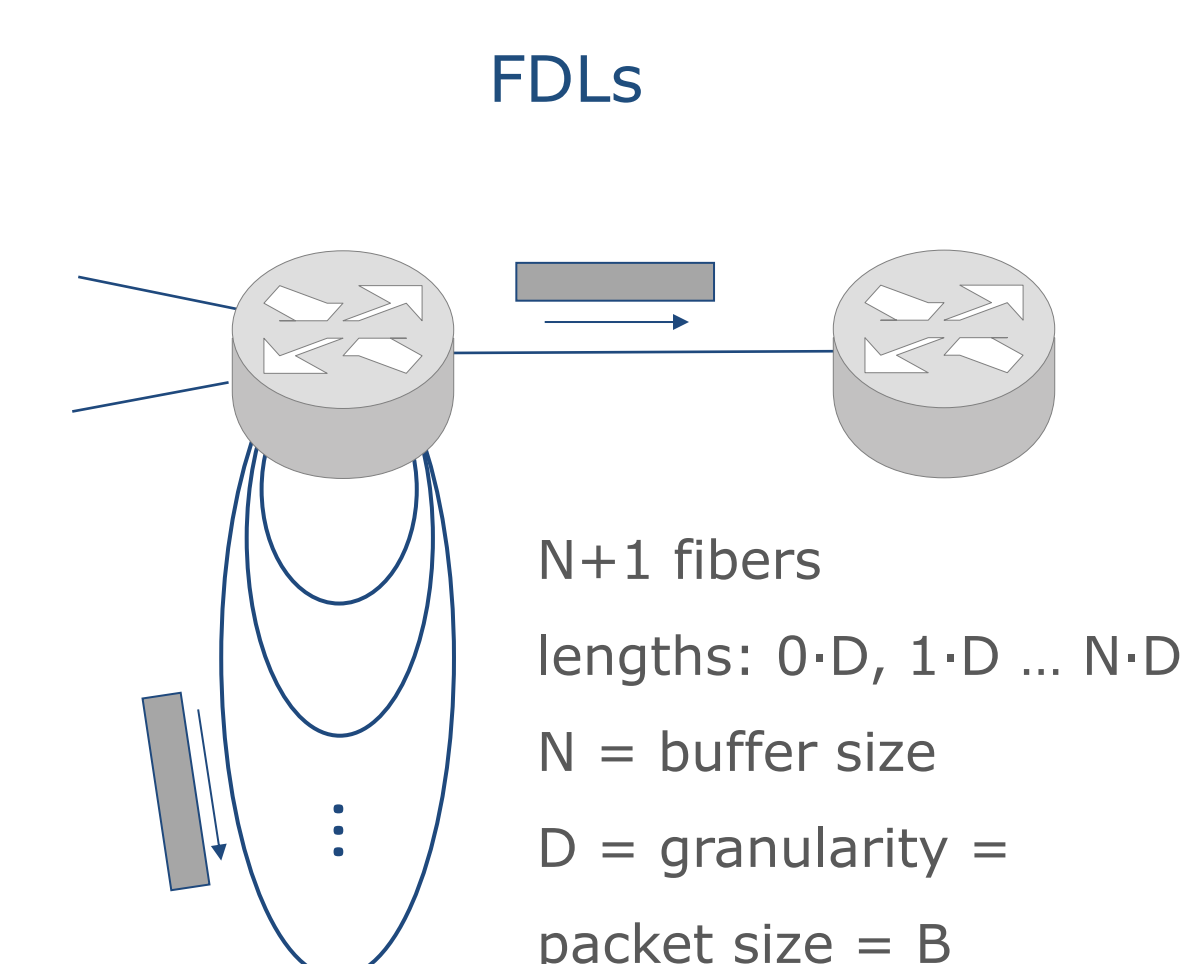
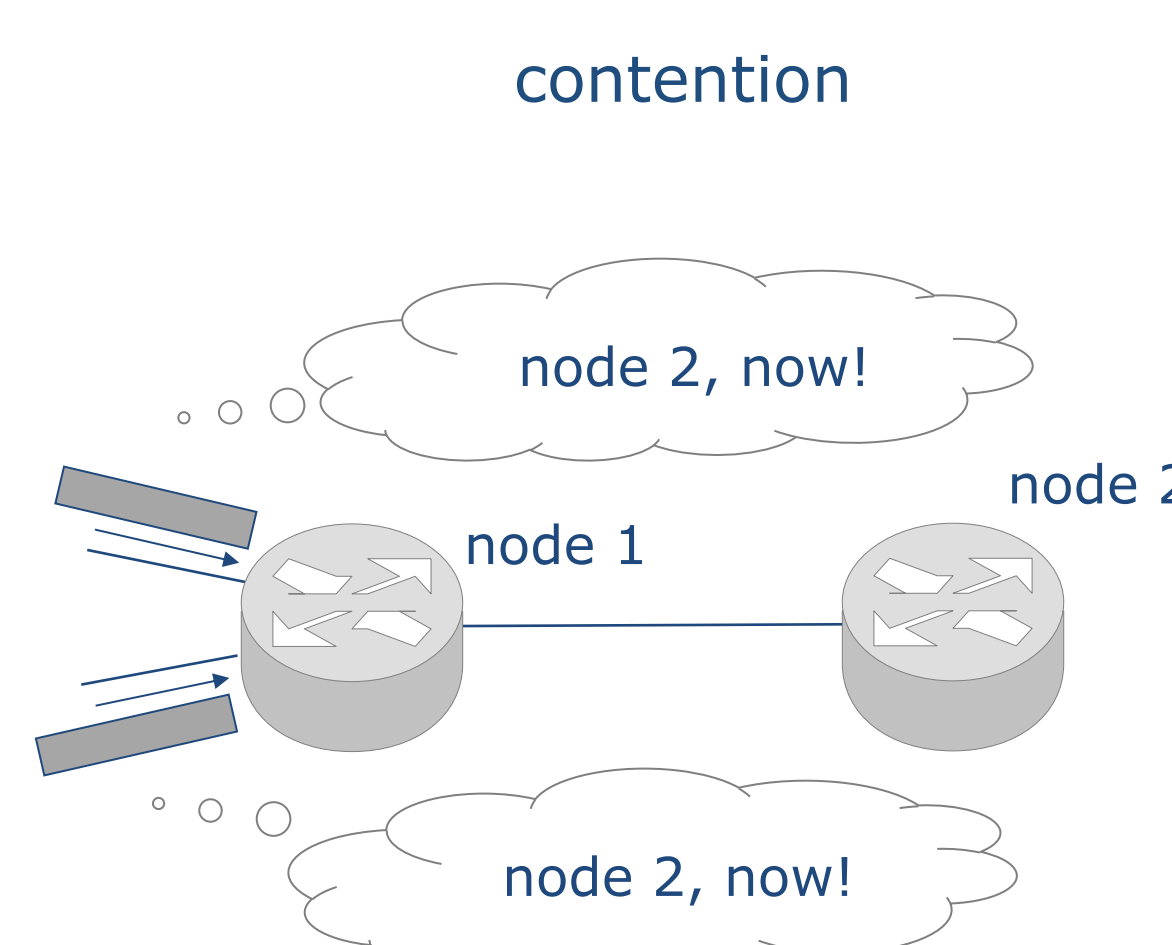


How to resolve contention like a boss

As network links are shared in optical packet/burst switching contention causes packet loss.

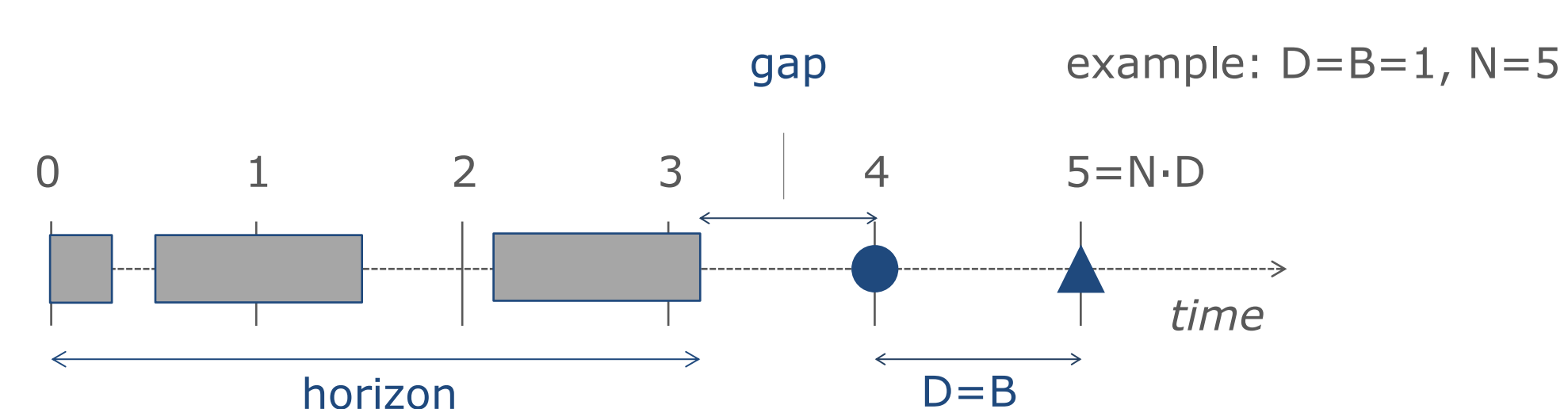
A method to buffer a contending packet is needed. Electronic buffering (RAM) is too slow for the optical speeds.

Fiber Delay Lines (FDLs) delay the contending packets, resolving the contention in the optical domain.



Prevent voids by creating them

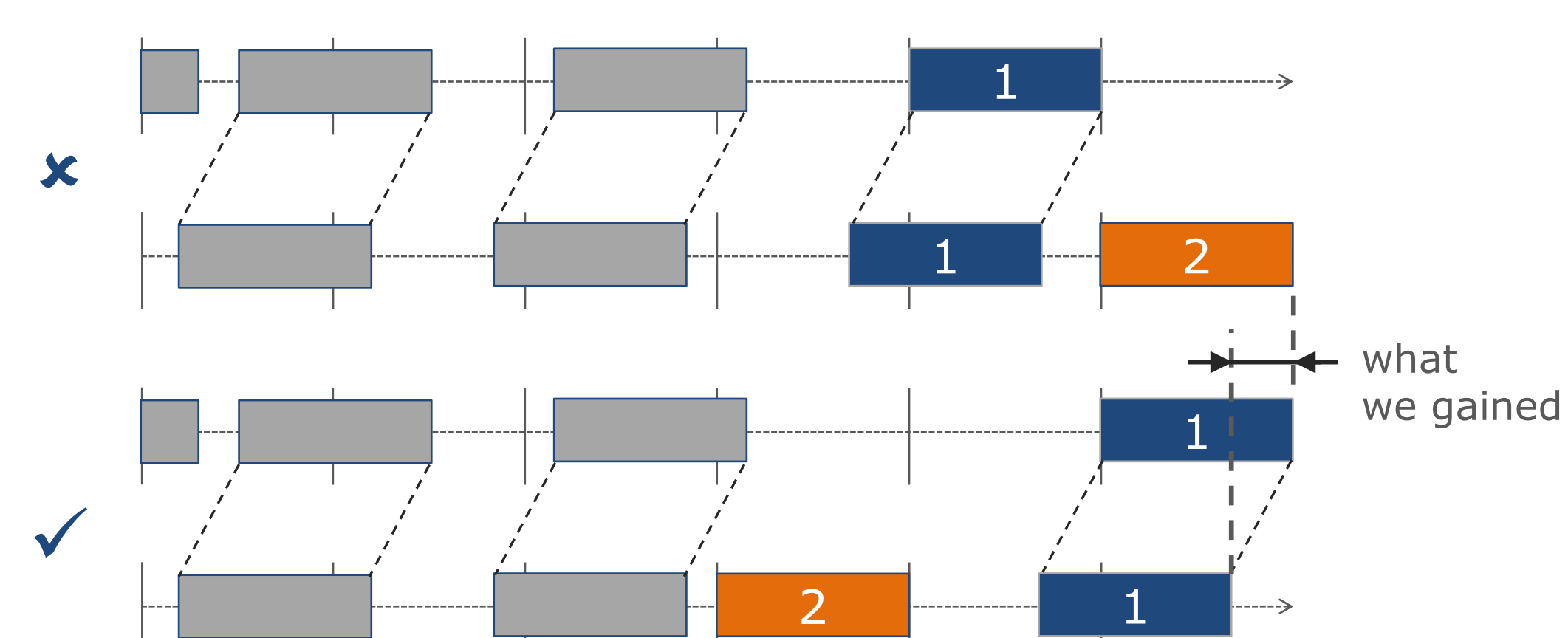
A **provisional schedule** shows the already scheduled packets and the FDLs at every arrival.



Existing algorithms always schedule on ●. In this way only unfillable voids are created (<B).

Void-creating algorithms dare to schedule on ▲ if advisable. This creates fillable voids (>B).

Filling a void results in an overall denser stacking and a lower packet loss.

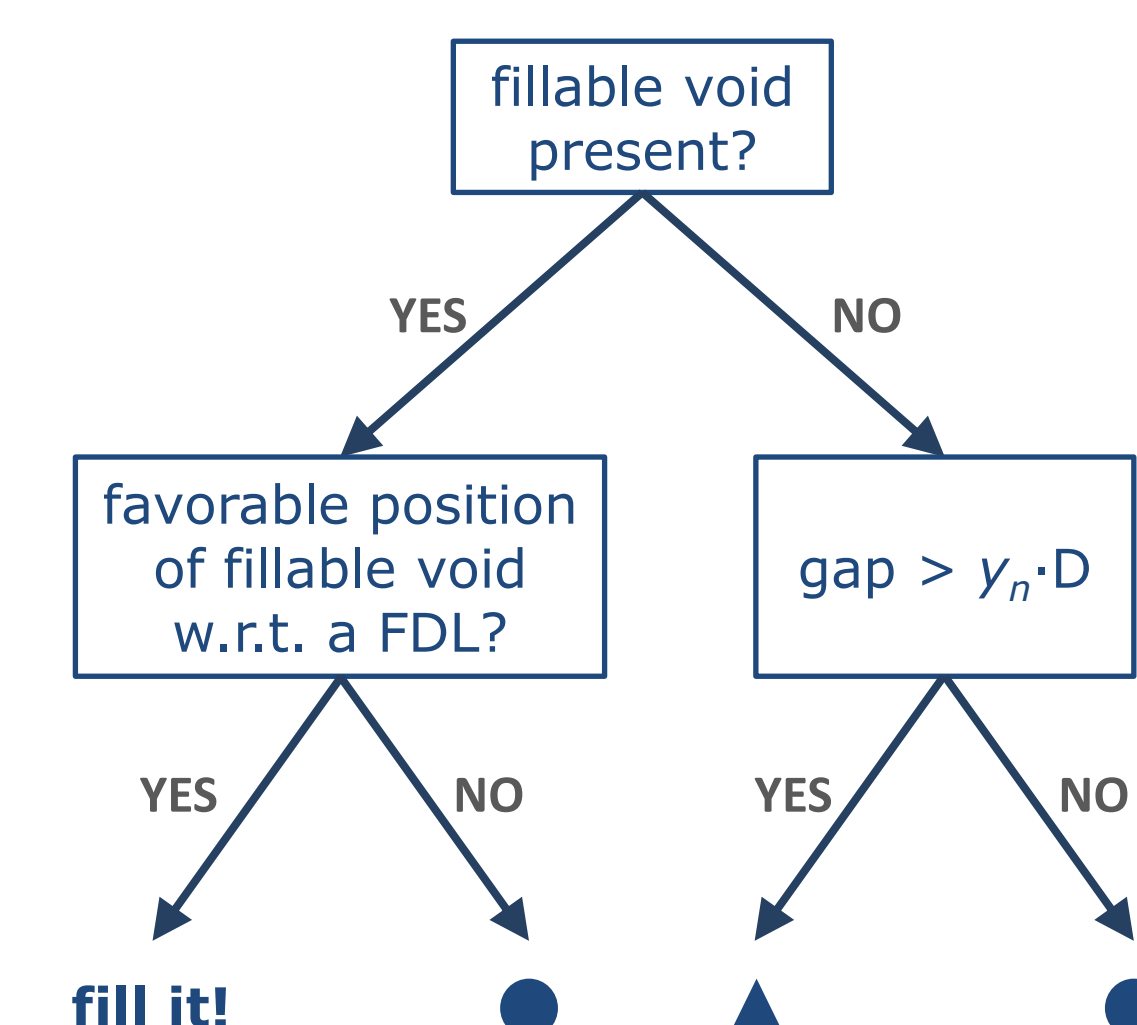


Optimizing the void-creating algorithm: mind the gap

Only fillable voids with a favorable position with respect to a FDL can be filled, which depends on the stochastic arrival process.

Chance of filling a void increases as both gap and horizon increase.

Use **gap thresholds** y_n ($n=1 \dots N-1$), one for each horizon index $n = \lfloor \frac{\text{horizon}}{D} \rfloor$. Optimize each y_n ($0 \leq y_n \leq 1$).



Packet loss is reduced drastically by creating fillable voids:

- : load = 80 %: 32 % reduction ☺
- -●- - : load = 60 %: 51 % reduction ☺☺

Monte Carlo simulation
Poisson arrivals, parameter λ
 $N = \text{buffer size} = 10$
load = $\lambda \cdot B$

