



ITU Kaleidoscope 2013
Building Sustainable Communities

**PROPOSAL OF A SUB- λ SWITCHING
NETWORK AND ITS TIME-SLOT
ASSIGNMENT ALGORITHM FOR
NETWORK WITH ASYNCHRONOUS
TIME-SLOT PHASE**

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A label of contents

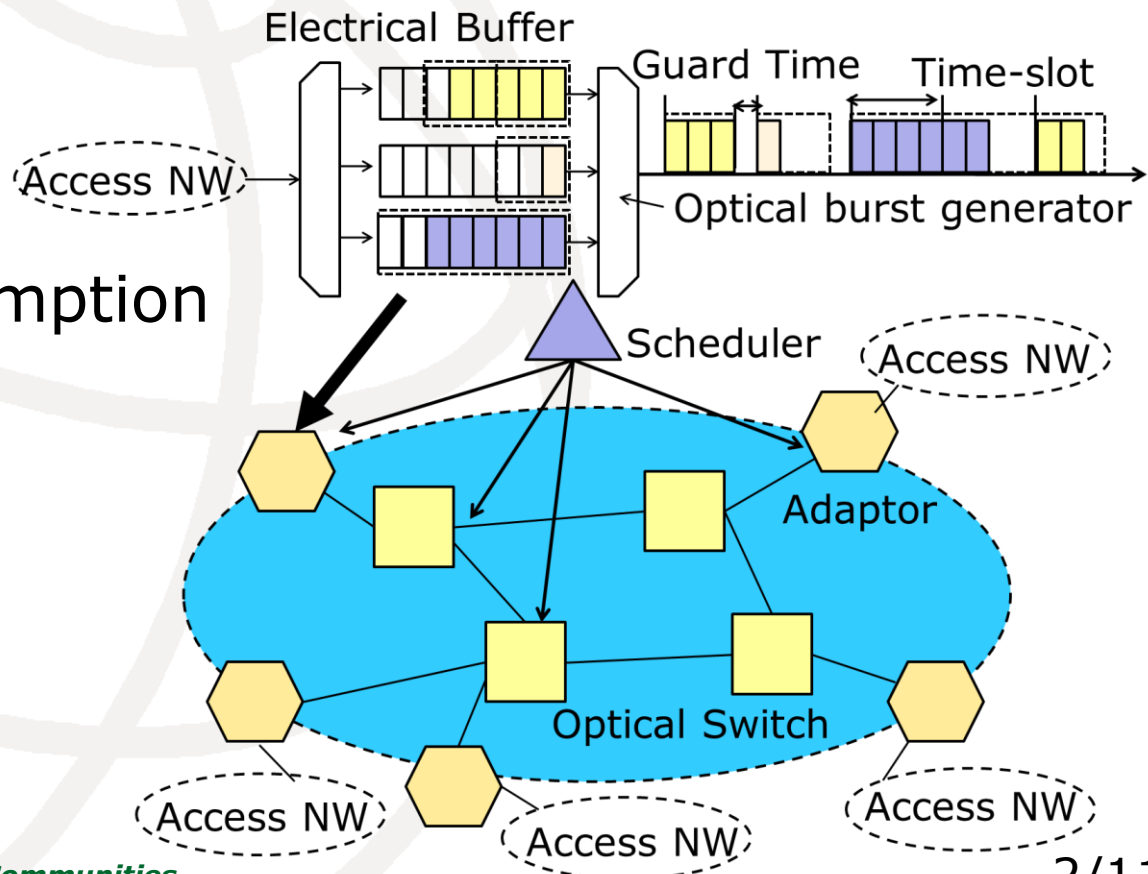
- ❑ Sub- λ switching network
- ❑ Multi-time-slot bonding
- ❑ Global-time-based scheduling
- ❑ Simulation analysis

Sub- λ switching network architecture

- All nodes are operated synchronously under a certain time-control mechanism
- The scheduler creates a schedule table, which controls the timing of optical time-slot switching

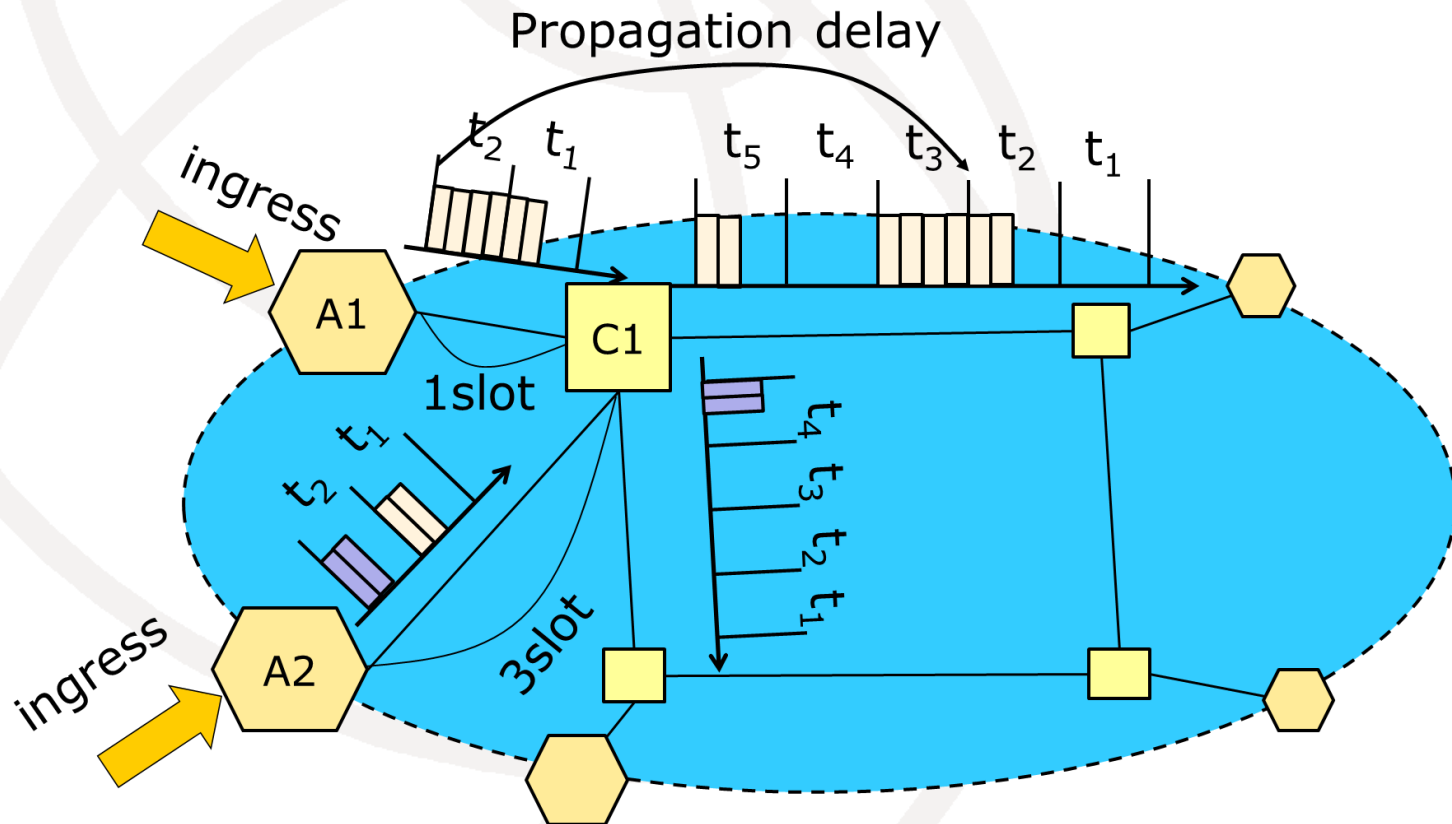
Merit

- Low power consumption
- fine granularity
- headerless



Time-slot flow in sub- λ switching network

- Time-slot arrive at the optical switch with a certain propagation delay



Operation technique multi time-slot bonding

- Multiple optical bursts to the same destination are allocated in the successive time slots without guard-time

single

Frame length

Time-slot



condense



Guard-time

Multi



Time

Problem

time-slot assignment

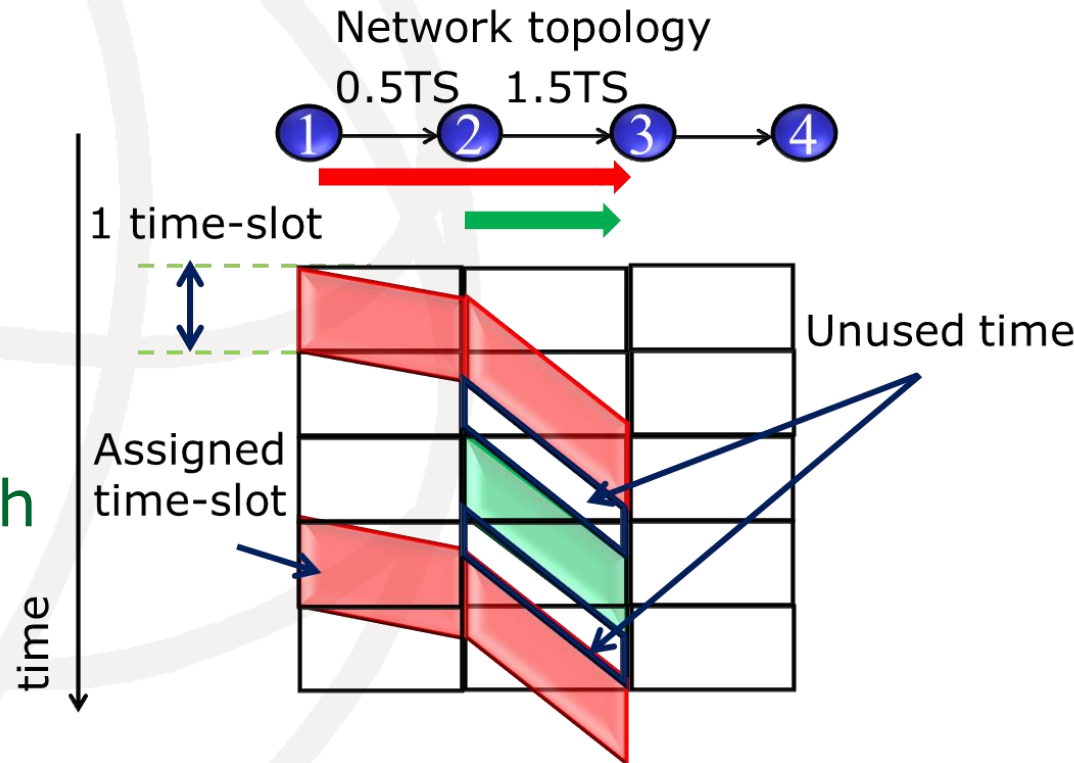
- ◉ We have to add fiber cable for one time-slot duration at worst case to adjust transmission delay (ex: around 2km fiber for a 10 μ s time-slot)

objective

- ▣ Reducing unused time

approach

- ▣ Scheduling algorithm under 1 time-slot length
- ▣ Delay shift packing algorithm

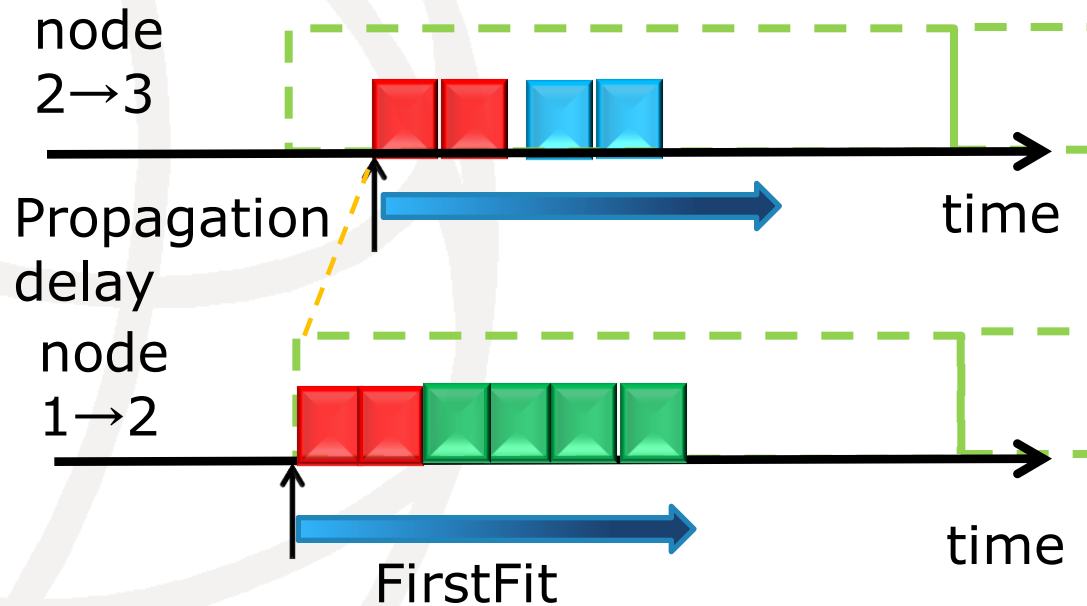
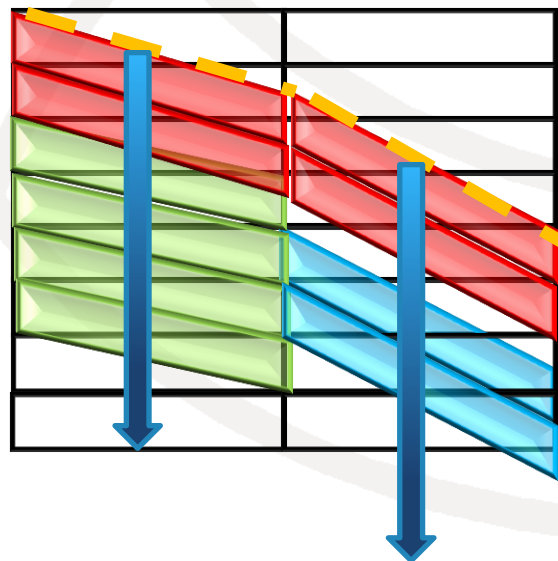


Approach

global-time-based scheduling

- Reference node is selected in the network
- We shift the time-slot-search start point by the value of propagation delay

Reference node

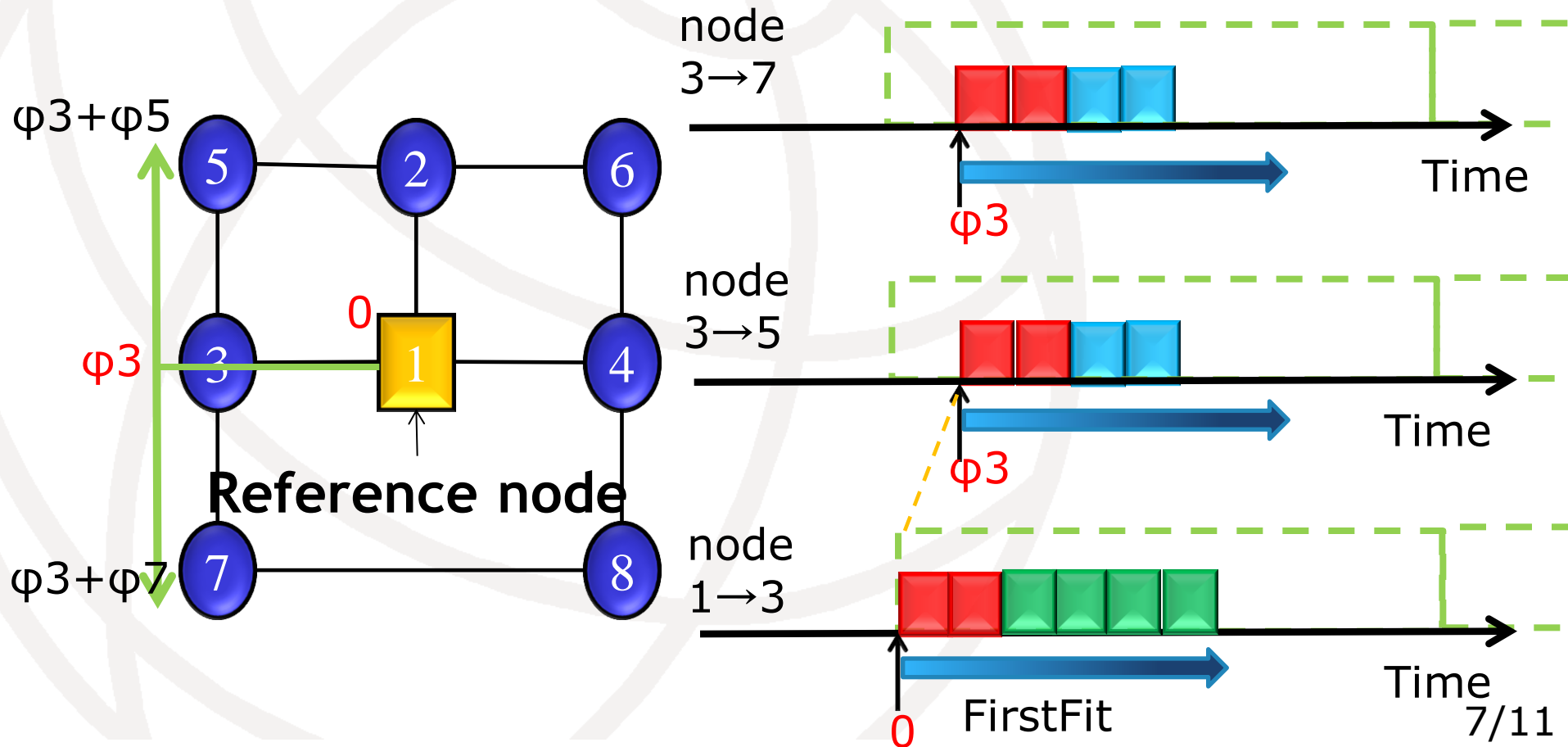


Time-slot-based optical burst allocation is efficient when empty time-slots are successive

Shift decision

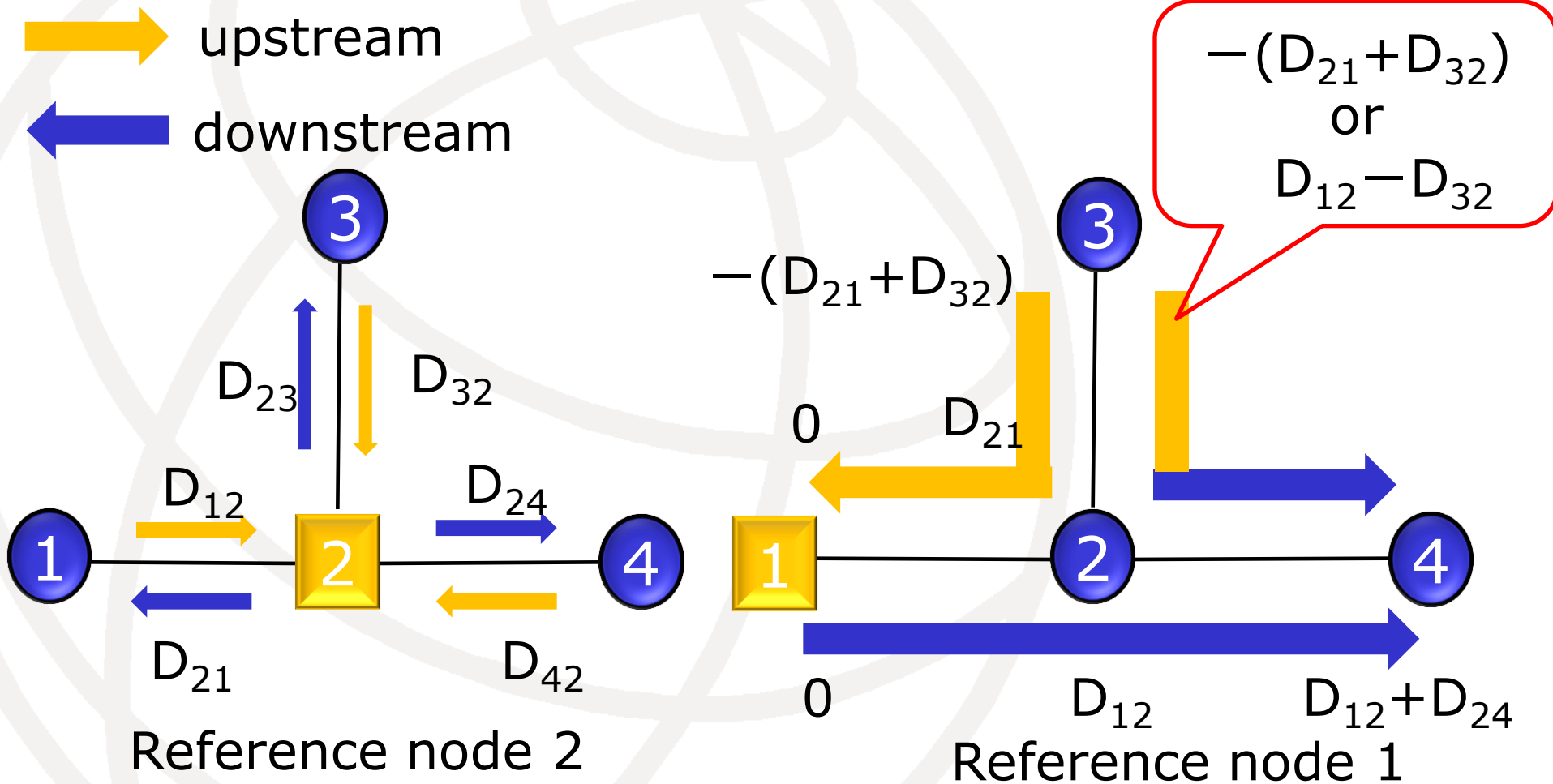
Shift : time-slot position in frame

- We preselect reference node in the network
- We calculate shift volume from propagation delay between node i and reference node



Shift lag

- We cannot calculate shift volume specifically in complicated network

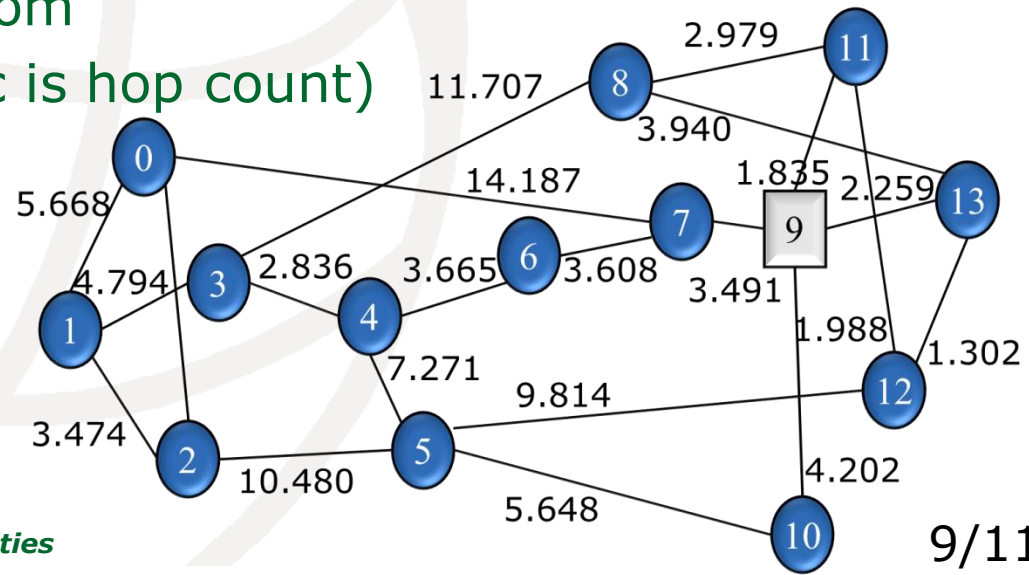


Simulation setup

- ⊙ Performance metric (increase ratio of minimum time-slot) = $\frac{T - T_{max}}{T_{max}}$
 - T: required number of time-slots determined using the time-slot assignment algorithm
 - T_{max}: required number of time-slots to accommodate all data on the most heavy link determined by routing

Simulation model

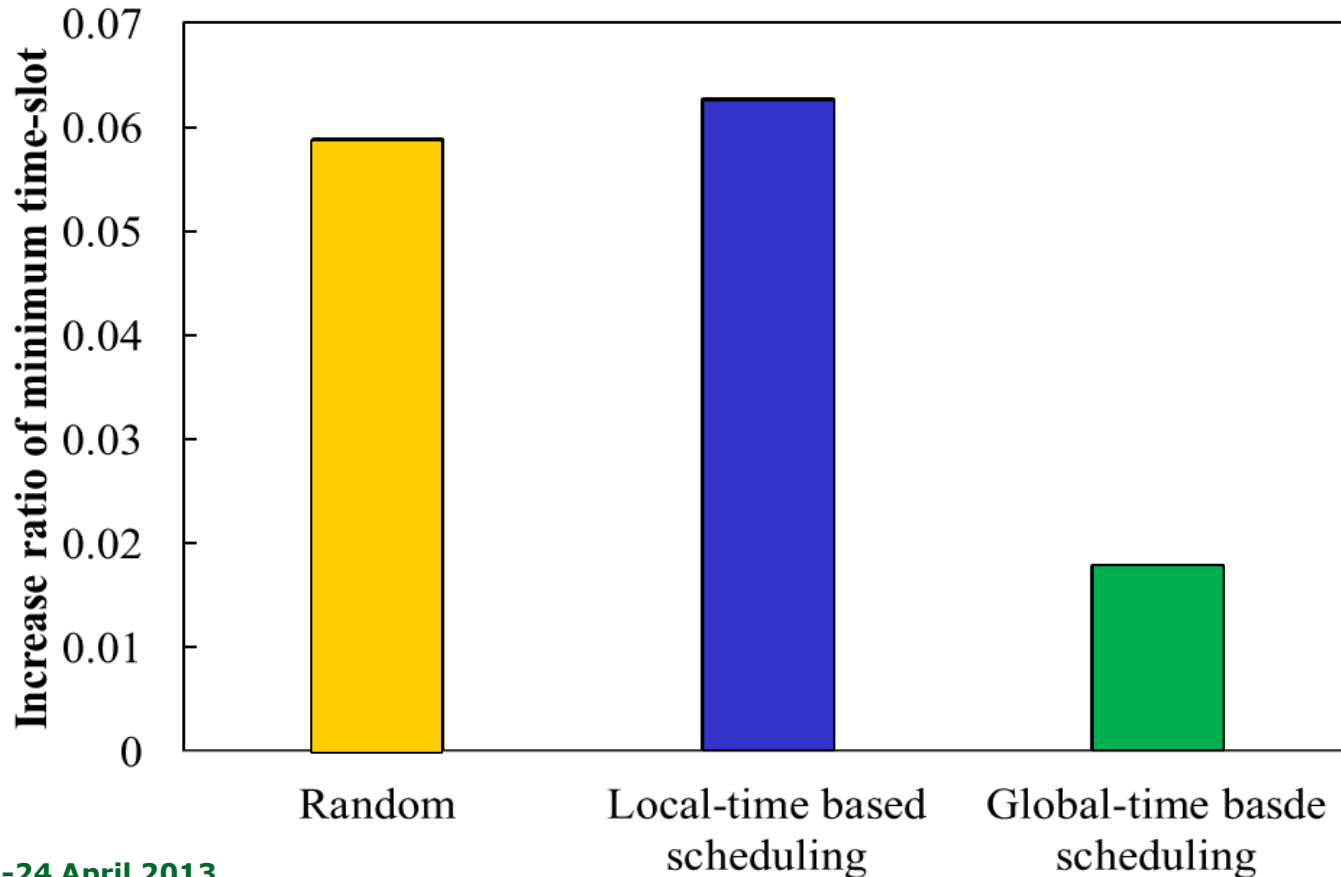
- Topology: NSFNET (the number on the link is propagation delay [ms])
- Traffic: 1 ~ 995 Mbps at random
- routing: shortest path (metric is hop count)



Result

- Global time based scheduling improve the effective time of network capacity

(local-time based scheduling: time-slot-search start point=0)



Conclusion

- We proposed a sub- λ switching network, which is all-optical, achieving finer granularity than a λ switching network
- We also proposed a multi-time-slot bonding technique and delay shift packing
- We simulated time-slot scheduling in NSFNET and demonstrated the efficiency of these algorithm