

**Virtual Circuit Provisioning in WDM
Networks**

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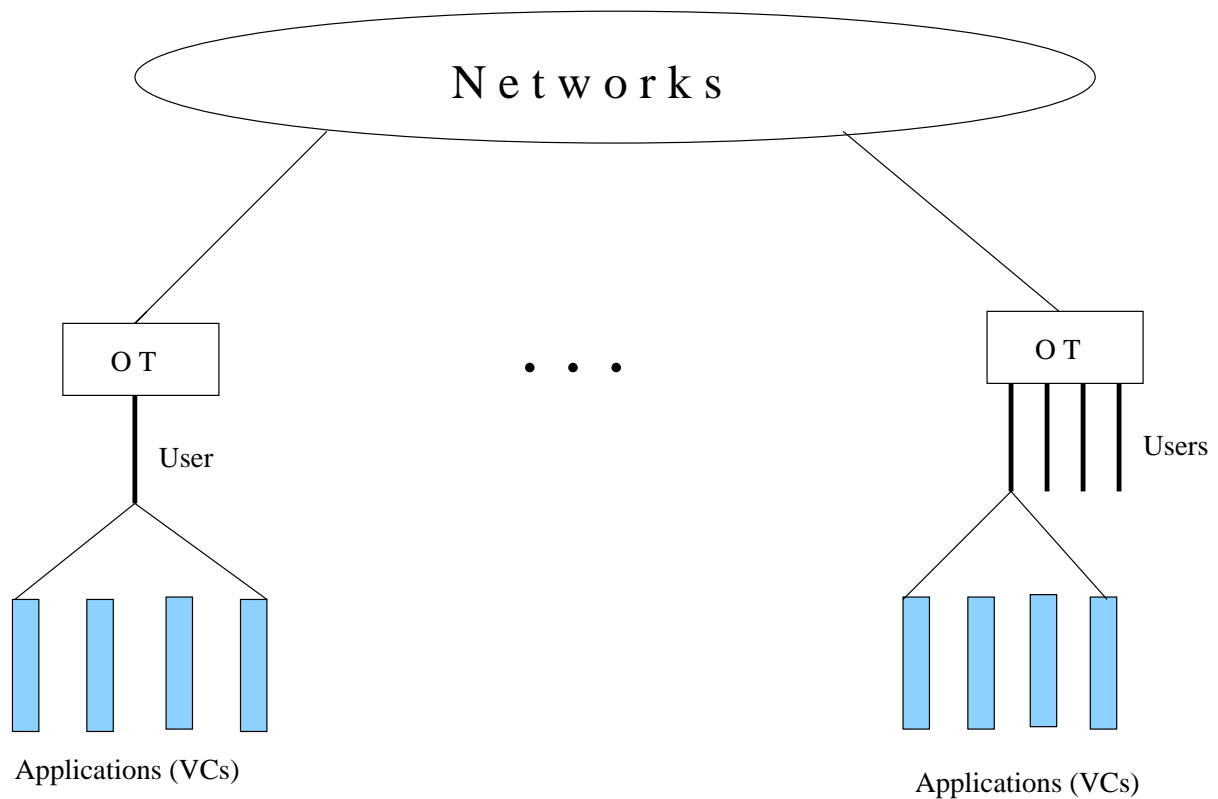
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Configuration



- **Difference: user needs -- network provides**
 - user: per VC provisioning
 - network: one wavelength connection

Facts and Observations

- Packet or burst level scheduling is needed
- Signaling is essential instead of random scheduling or fixed TDM slot assignment
- Turnaround time: software processing, roundtrip time (RTT), and tuning overhead
- Scheduling can fail, but multiples turn-around can be justified for a VC, e.g.,
 - typically, a few micro-second RTT and tuning combined, compared to min-second jitter requirement
- Pipelining is the proven technique to mask out the RTT and tuning
 - packets of individual real-time VC can not be pipelined, in-sequence delivery
 - packets from different VCs or from non real-time VCs can be pipelined

Signaling Overhead

- Per VC signaling information dissemination is not scalable, has to be per OT
 - per OT, $N \log N$ bits, 700 bits for $N=100$ and $V=20$, and $N \times N$ scheduling
 - per VC $NV \log N$ bits, 14K bits for $N=100$ and $V=20$, and $NV \times N$ scheduling
- Hierarchical scheduling is essential
 - VC level scheduling
 - transmission scheduling
- Advantages:
 - scalability
 - flexibility due to the de-coupling. Scheduling can be locally optimized

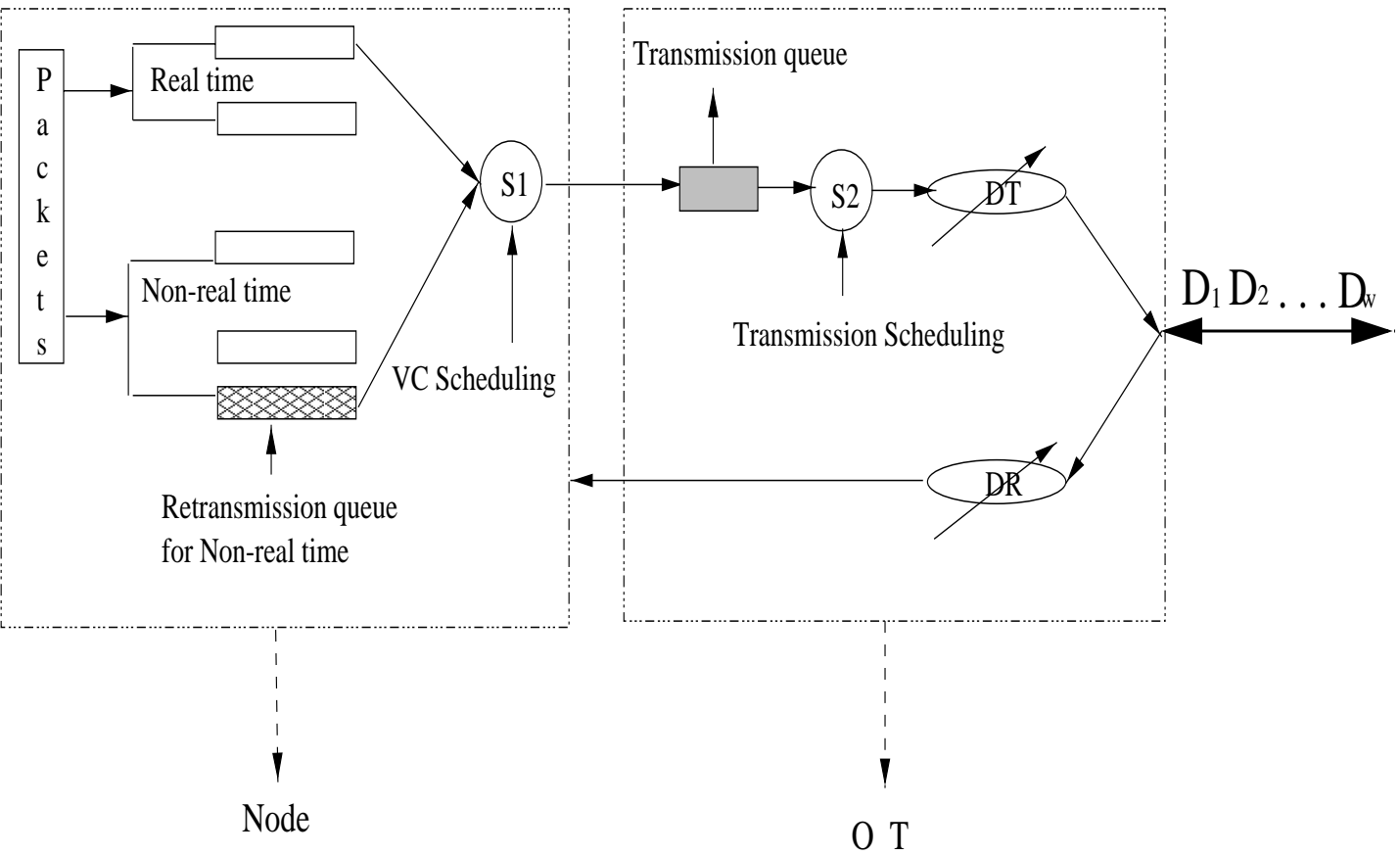
VC Scheduling

- HOL blocking for real-time VC
- Priority of real-time over non real-time VC
- Weighted fair scheduling vs. round robin
- ABR and UBR for non real-time VC

Transmission Scheduling

- Maximum matching vs. random scheduling
- Priority of real-time over non real-time VC
- Priority of re-transmitted real-time VC
- Preemption vs. non-preemption of re-transmitted non real-time VC
- Non real-time VC re-transmission queue

Two-Level Scheduling



Results

- Propagation vs. VCs
- Preemption vs. Non-preemption
- Re-transmission Queue Length