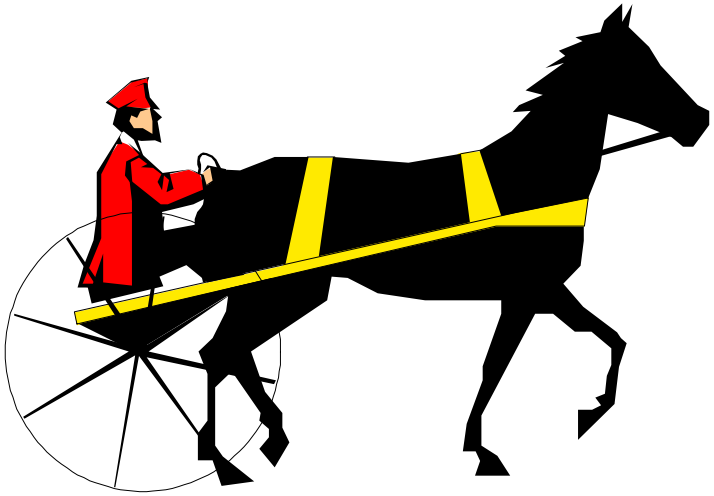
94-0883
The OSU Scheme



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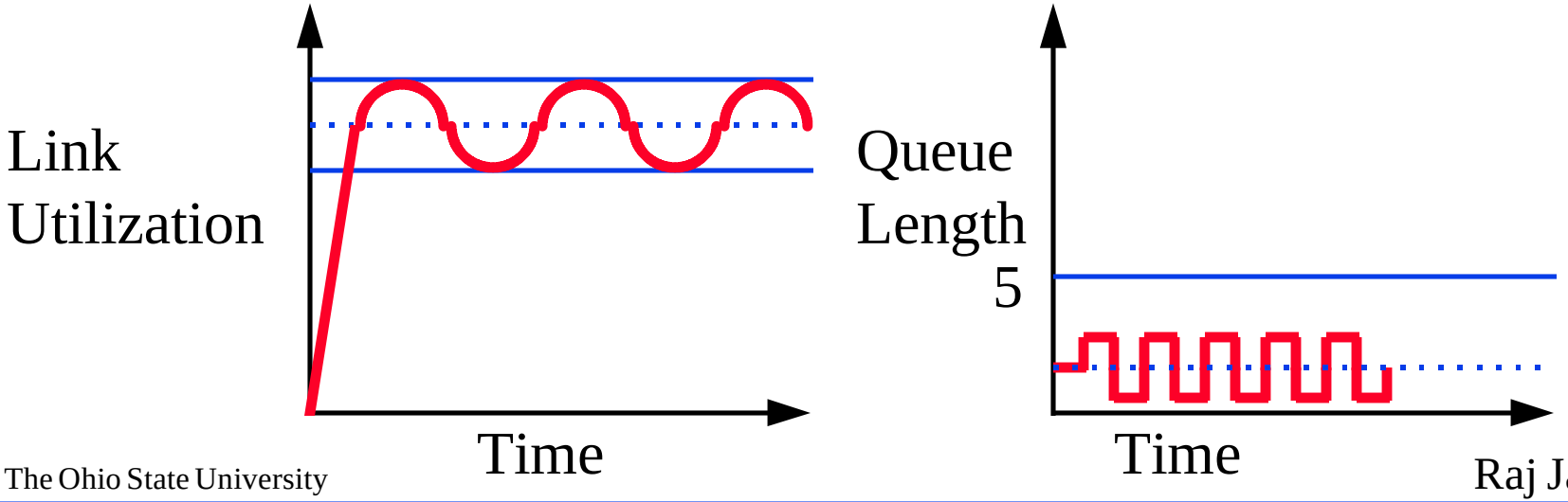
- Features
- Scheme
- Simulation results

Design Features

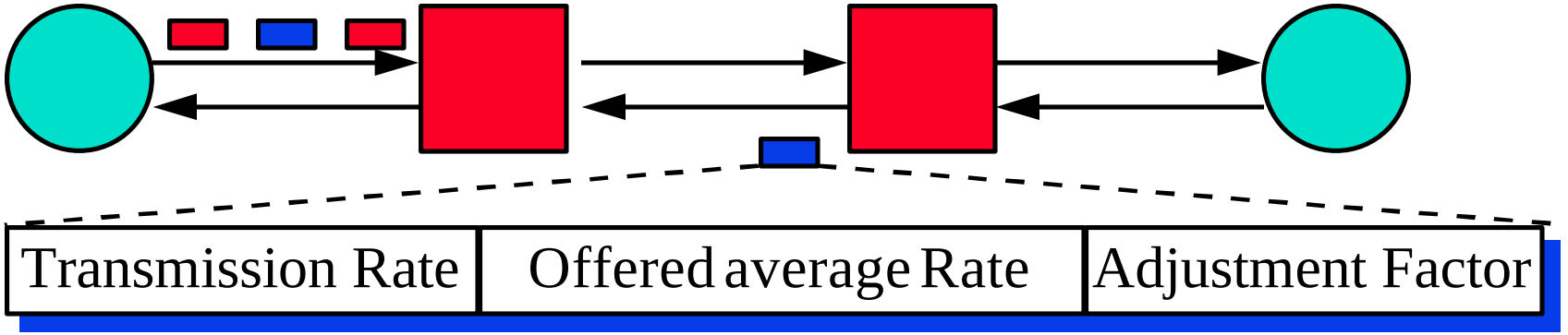
- Congestion Avoidance
  - High throughput
  - Low delay
  - Operation independent of buffers



Design Features

- Works for bursty traffic
- Fairness: Analytically proven
- Measured overload/load at switch/source
- Bounded oscillations $\Rightarrow$ Good for VBR
- Parameters: Few, insensitive, easy
- Bipolar feedback
- Several options: BECN
  Precise fairness computation

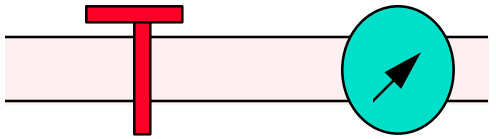
The OSU Scheme



- The sources periodically send a control cell
- The switches measure load over a period
- The switches specify reduction factor in cell
- The destination returns the cell to the source
- The source adjusts the transmission rate

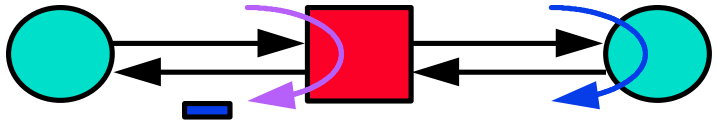
Control Cell Format

- Transmitted Cell Rate (TCR)=1/Inter-cell time
- Offered average cell rate (OCR)



TCR OCR

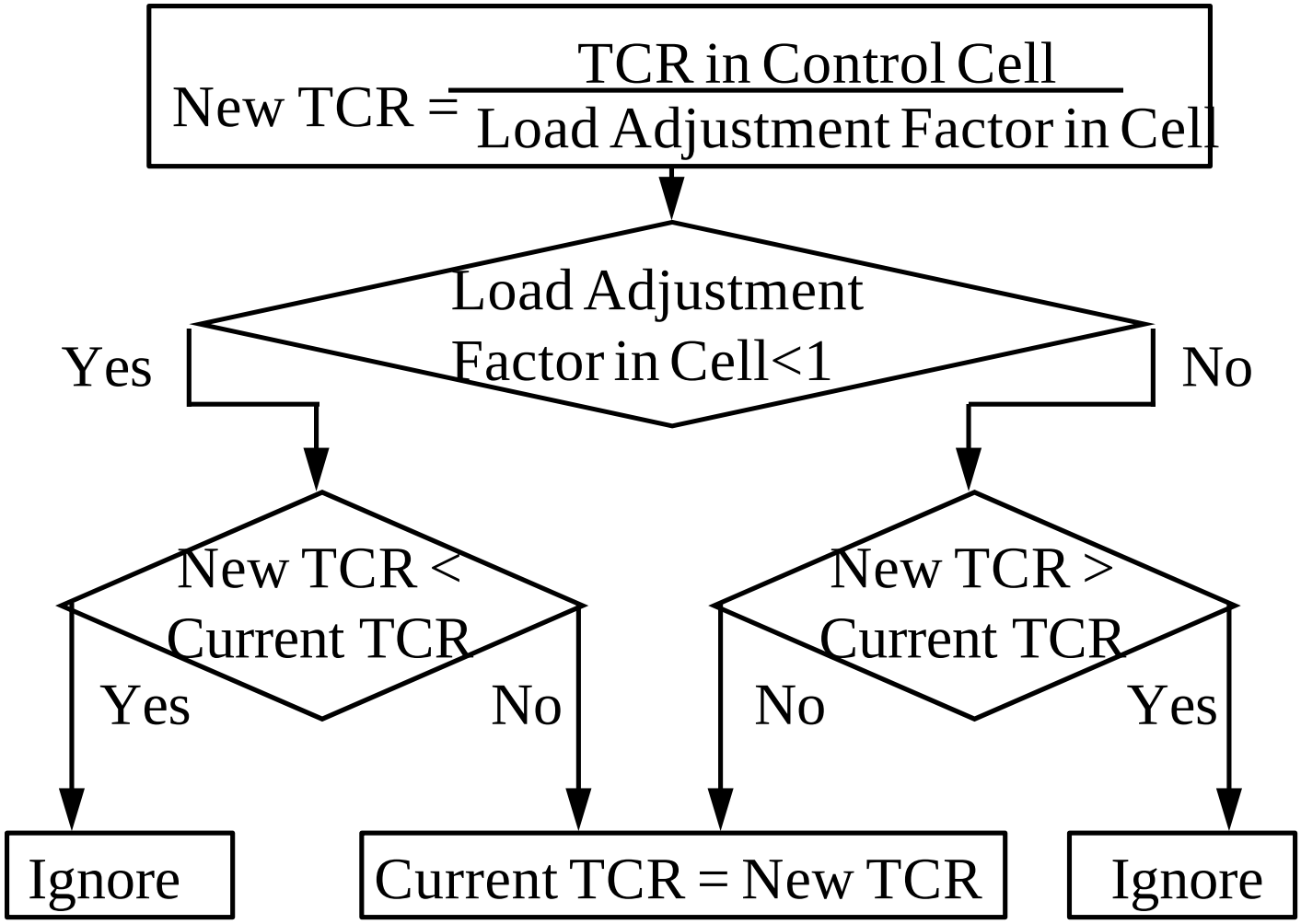
- Load adjustment factor: $TCR_{New} = TCR/LAF$
- Averaging interval
- For BECN option: FECN/BECN bit
  Timestamp (when sent by the source)



Source Algorithm

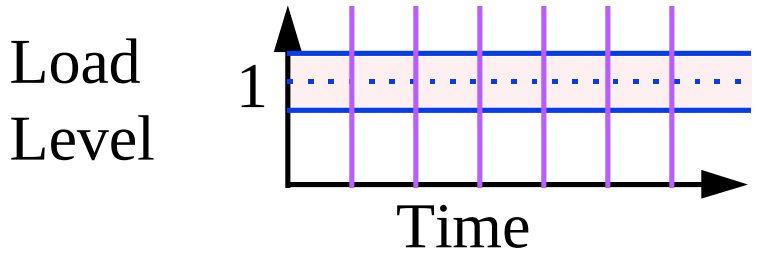
- Arbitrarily select: Initial TCR
  Averaging interval T
- Send sells at inter-cell time = 1/TCR
- Send control cells every T
- On receiving a control cell:
  - T ← Averaging interval from cell
  - Execute LAF algorithm

Source LAF Algorithm

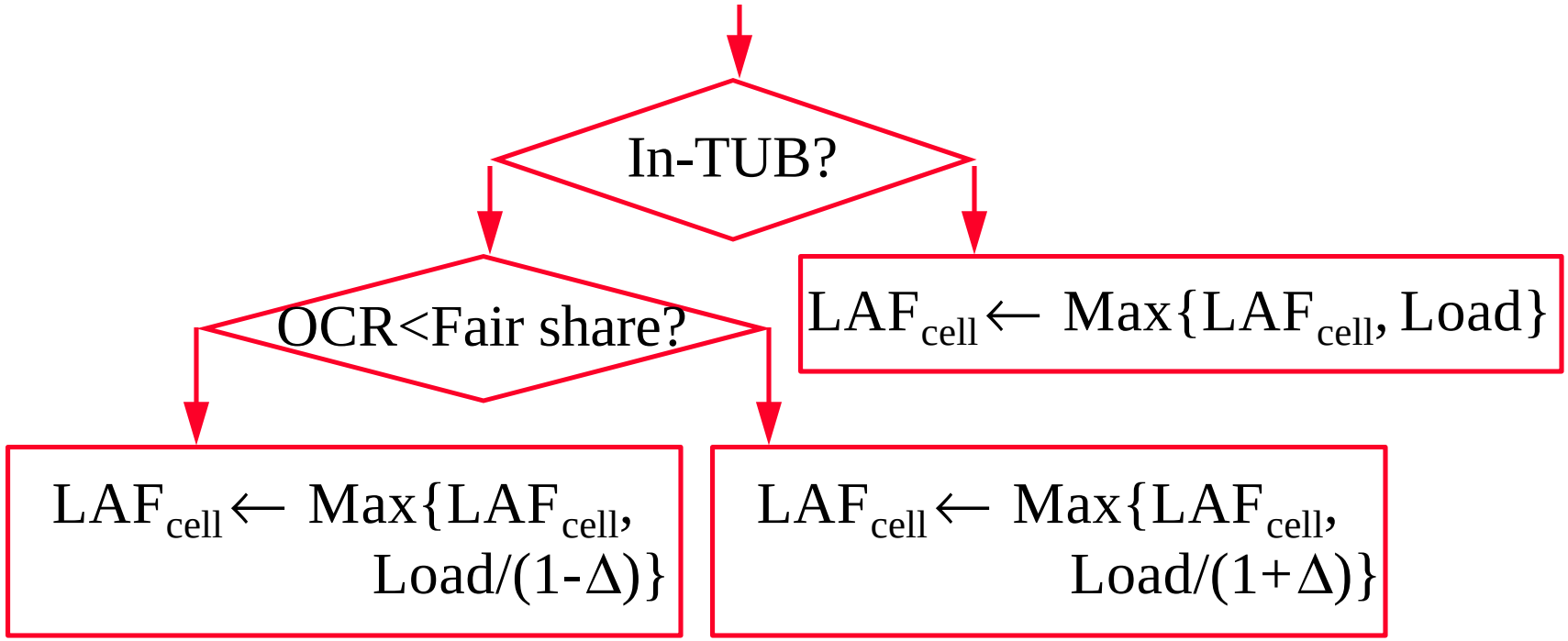


Switch LAF Algorithm

- Parameters:
  - Averaging interval T
  - Target utilization band (TUB): $U(1\pm\Delta)$
- Compute Target # of cells per T at U
- Count cells received over T
- Load = Received/Target
- $T_{cell} \leftarrow Max\{T_{cell}, T\}$
- $LAF_{cell} \leftarrow Max\{LAF_{cell}, Load\}$

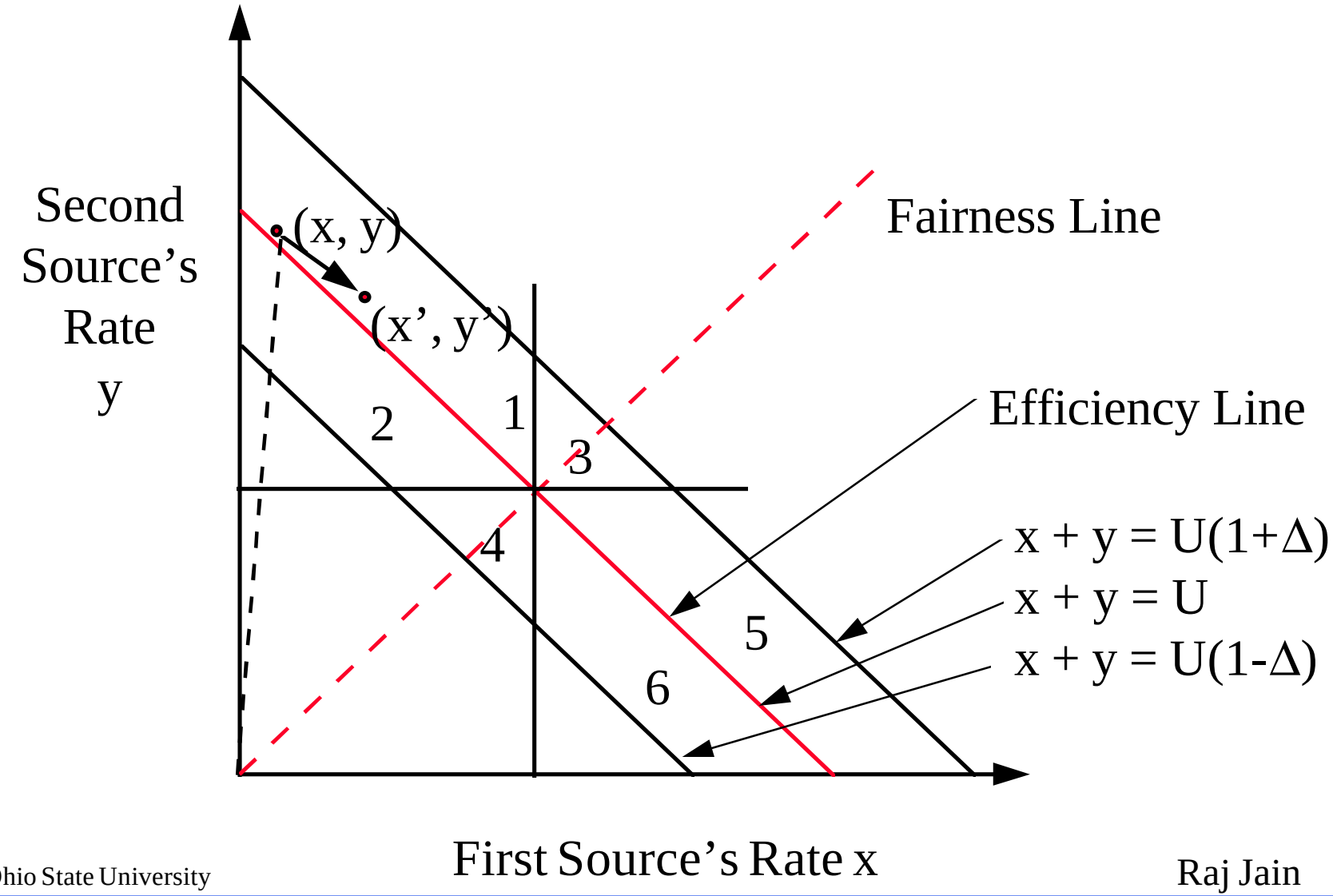


The TUB Algorithm

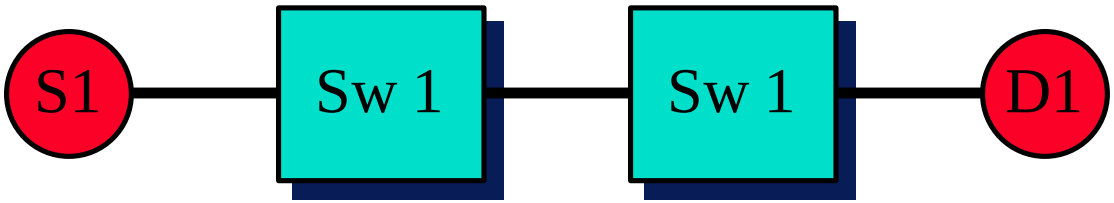


- Fair share = Target rate/# of active VCs
- Analytically proven:
  Fair and Closed (remain in TUB)

Proof

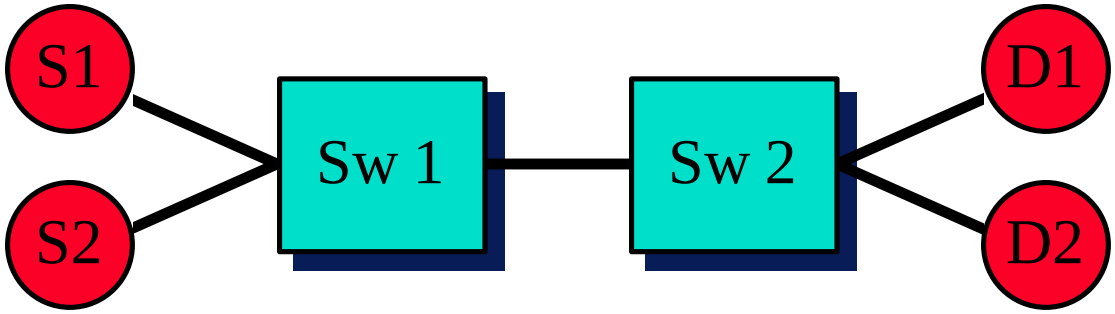

Second Source's Rate y
(x, y)
(x', y')
Fairness Line
Efficiency Line
1
2
3
4
5
6
x + y = U(1+Δ)
x + y = U
x + y = U(1-Δ)
First Source's Rate x

Single-Source Configuration



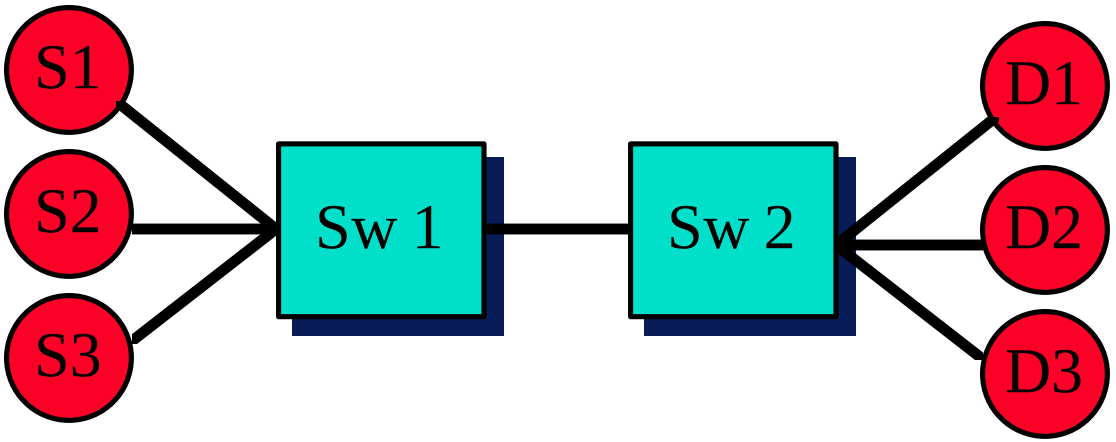
- All links 150 Mbps, 1 km
- Max-min optimal: 150 Mbps
- TUB = 0.90 (1 ± 0.1)
- Averaging interval = 150 μs

Two-Source Configuration



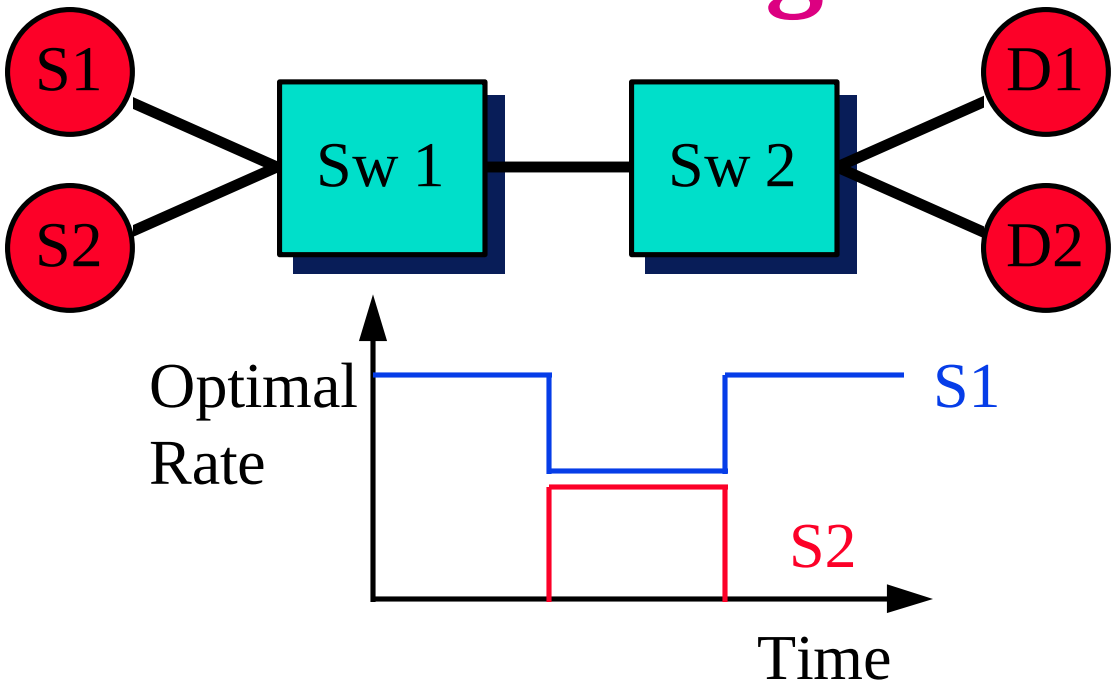
- All links 150 Mbps, 1 km
- Max-min optimal: 75 Mbps
- TUB=0.90(1 ± 0.1)
- Averaging interval = 150 μs

Three-Source Configuration



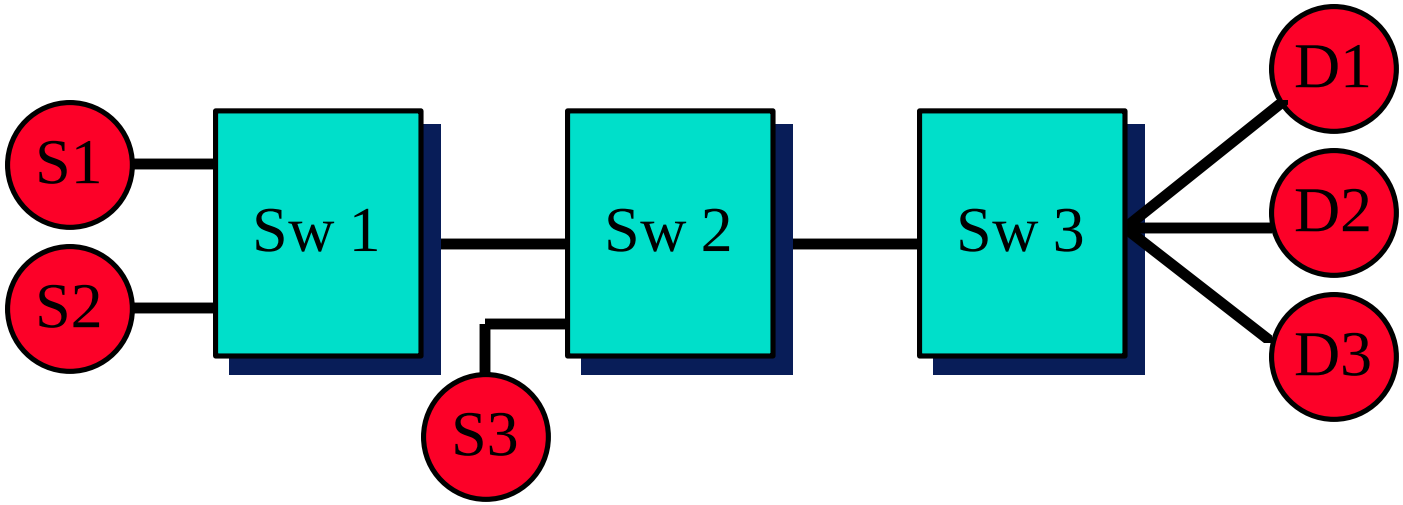
- All links 150 Mbps, 1 km
- Max-min optimal: 50 Mbps
- TUB=0.90(1 ± 0.1)
- Averaging interval = 150 μs

Transient Configuration



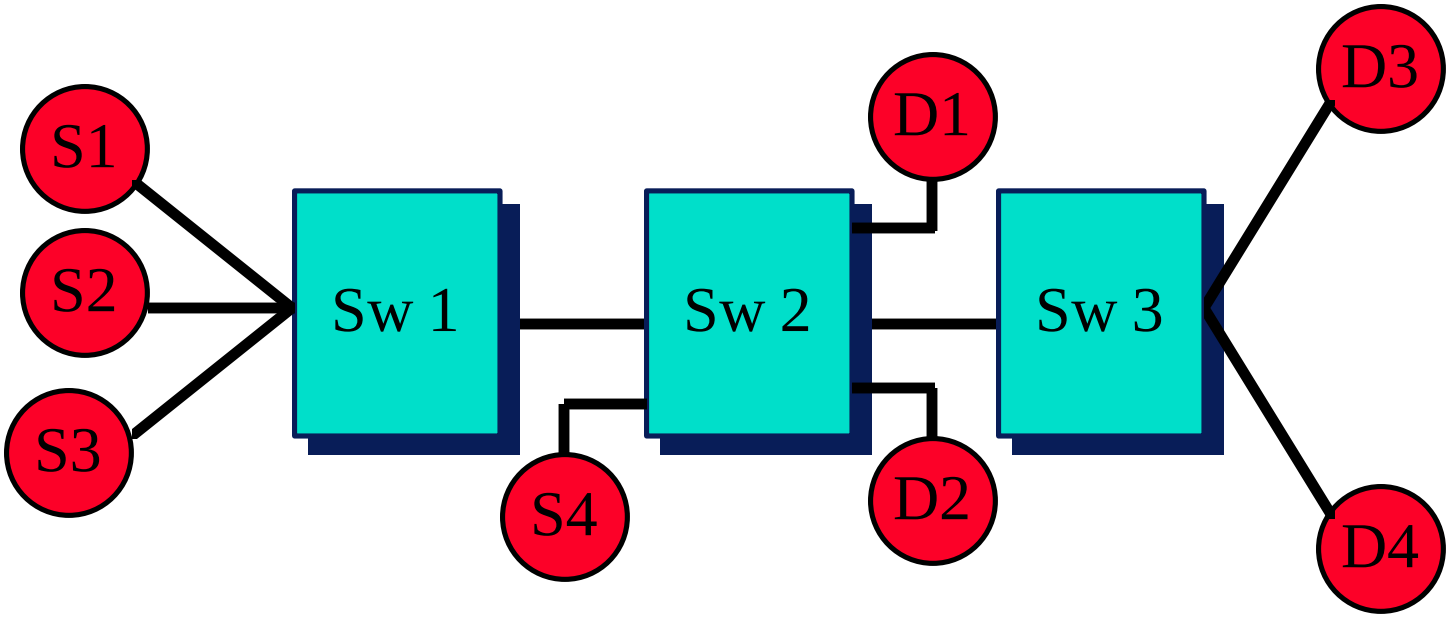
- All links 150 Mbps, 1 km
- TUB=0.90(1 ± 0.1)
- Averaging interval = 150 μs

Parking Lot Configuration



- All links 150 Mbps, 1 km
- Max-min optimal: 50, 50, 50 Mbps
- TUB=0.90(1 ± 0.1)
- Averaging interval 150 μs

Upstream Configuration



- All links 150 Mbps, 1 km
- Max-min optimal: 50, 50, 50, 100 Mbps
- TUB=0.90(1 ± 0.1)
- Averaging interval = 150 μs

VC Cell Rates

Link Utilization

Queue Length

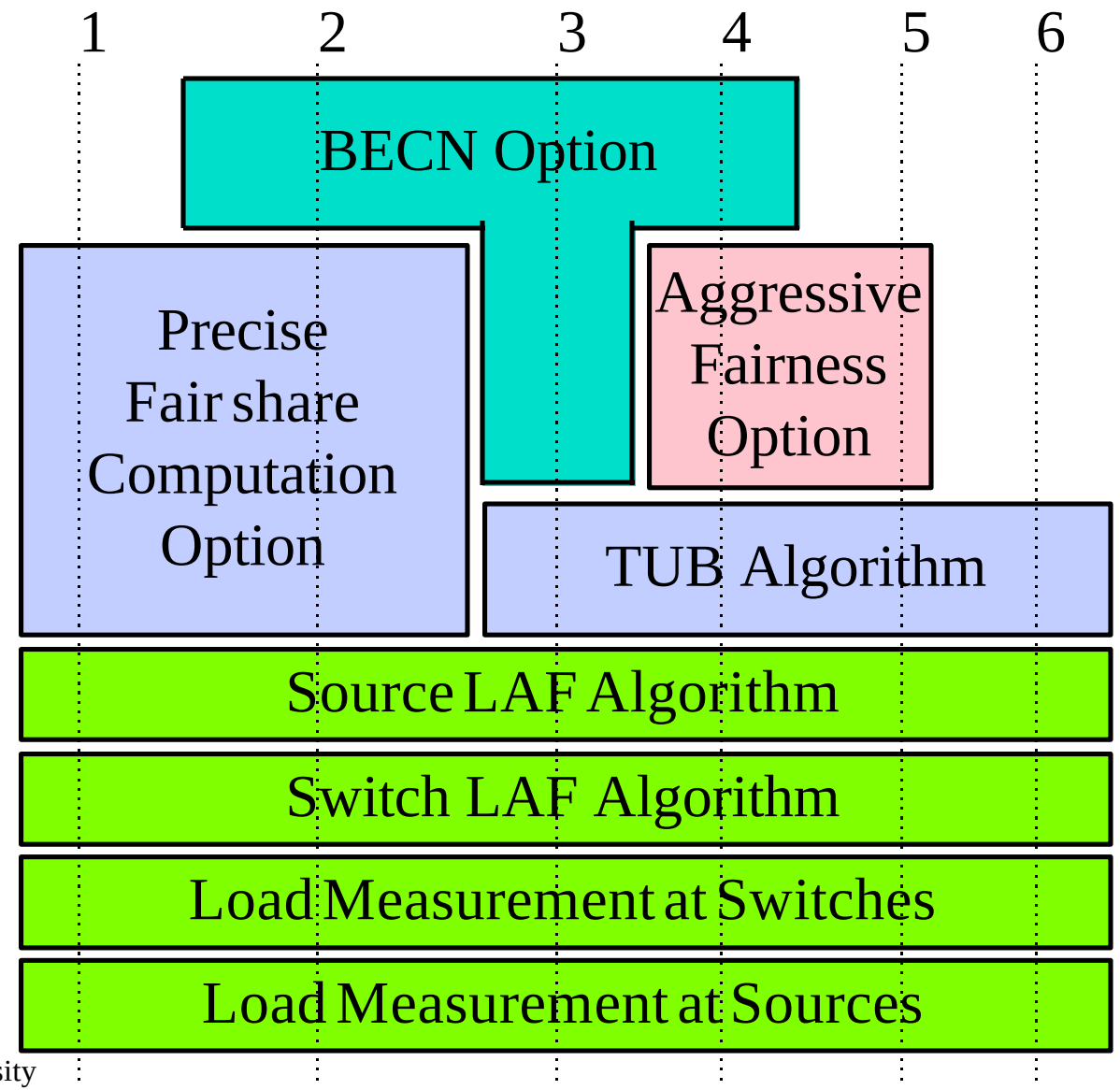
Queue Size with Startup at PCR/10

VC Cell Rates in WAN Configuration

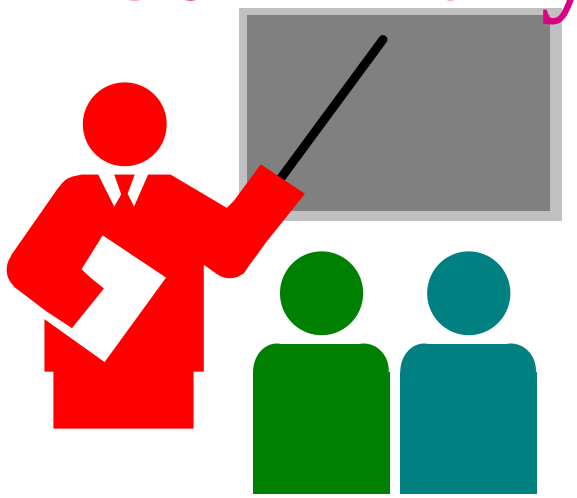
Queue Size with WAN Configuration

VC rates with Train Traffic

Family Portrait



Summary



- Design Principles: Input rate overload, Feedback-control relationship, TCR/OCR specification, TUB fairness
- Features: High throughput, Low delay, Avoidance, Bipolar
- Basic Scheme: Source/switch LAF algorithm
- Options: Thoroughly tested all variations