First Video Streaming Experiments on a Time Driven Priority Network

Mario Baldi and Guido Marchetto

Politecnico di Torino

(Technical University of Turin)

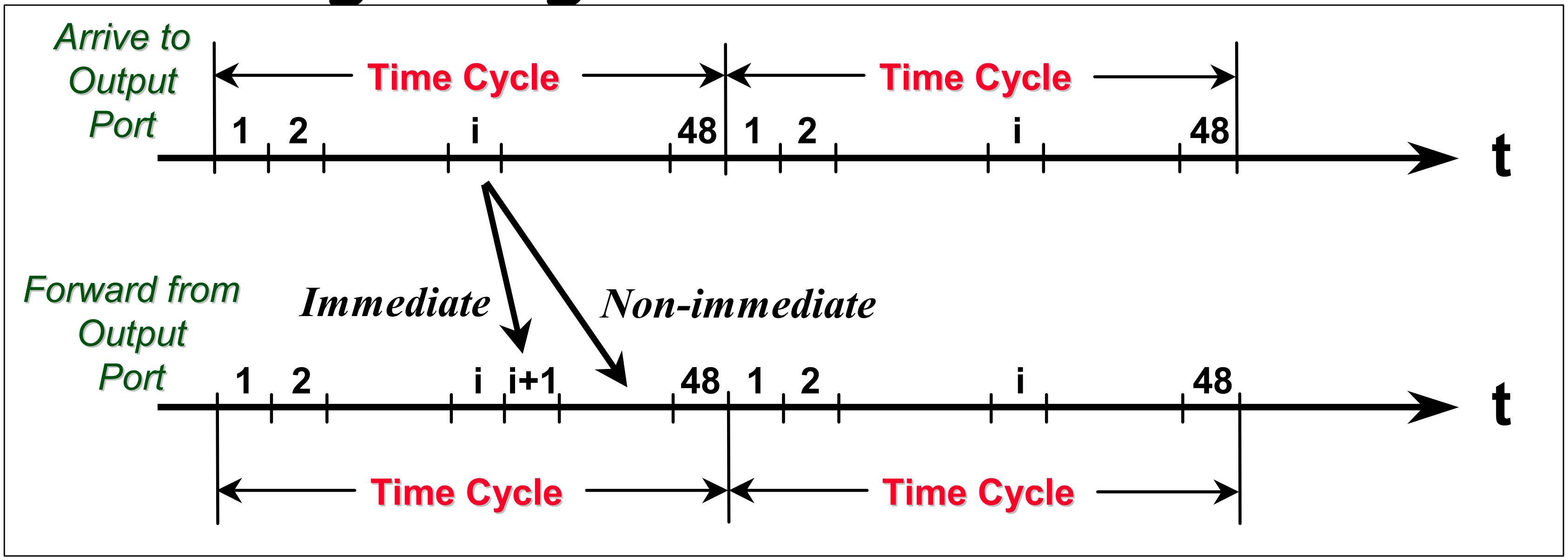
mario.baldi@polito.it

http://staff.polito.it/mario.baldi

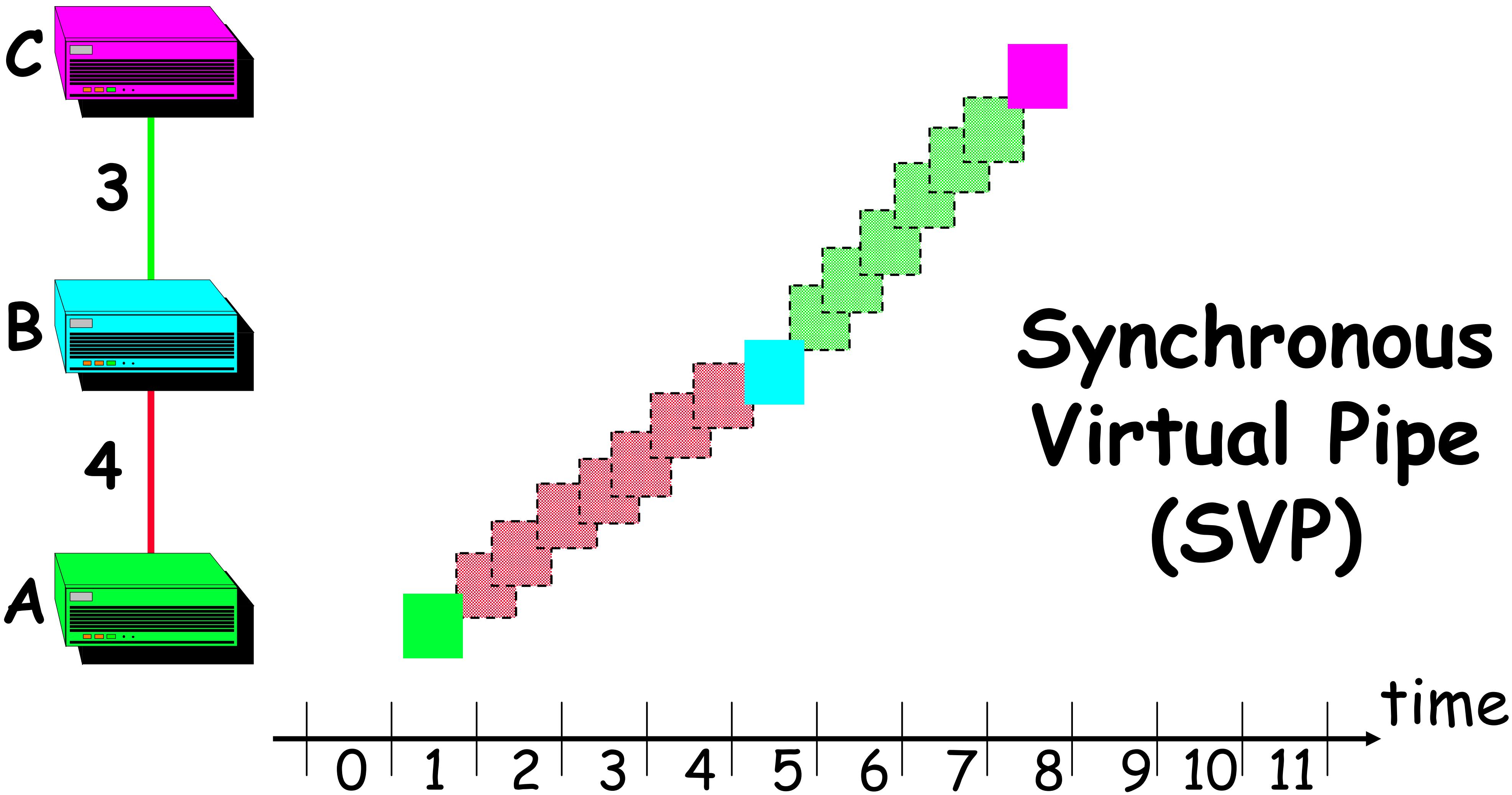
Time-Driven Priority (TDP)

Common Time Reference in packet switched networks

- Time frame (TF)
- Scheduling priority is driven by time
  - TDP packets get maximum priority at the beginning of TFs



Packet Forwarding and Resource Reservation



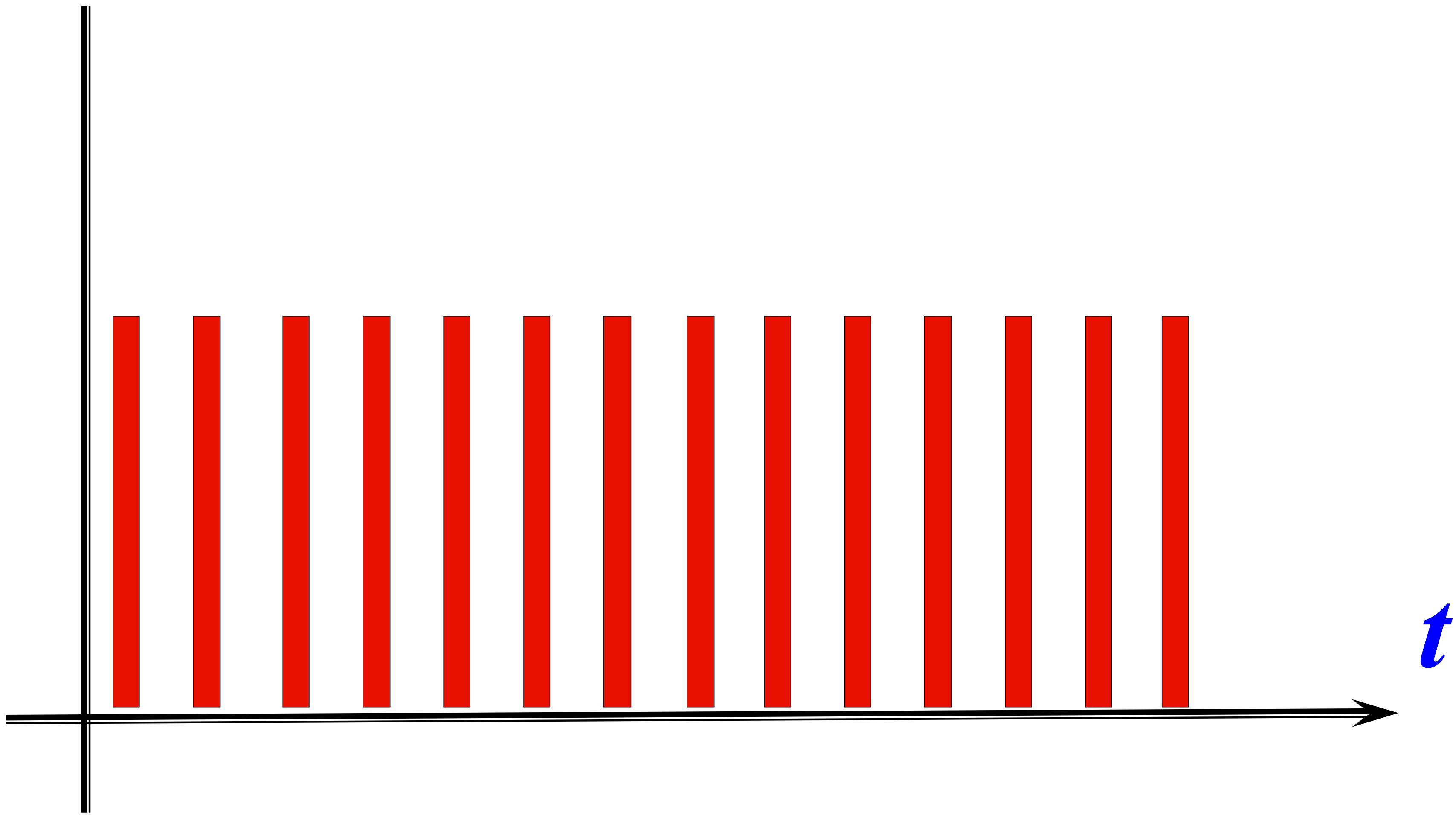
TDP Properties

- Upper bound on end-to-end delay
- Upper bound on jitter: 1TF end-to-end
- Minimal output buffer size
- No loss due to congestion

Deterministic *per-flow* quality of service (QoS) without per-flow complexity in network nodes

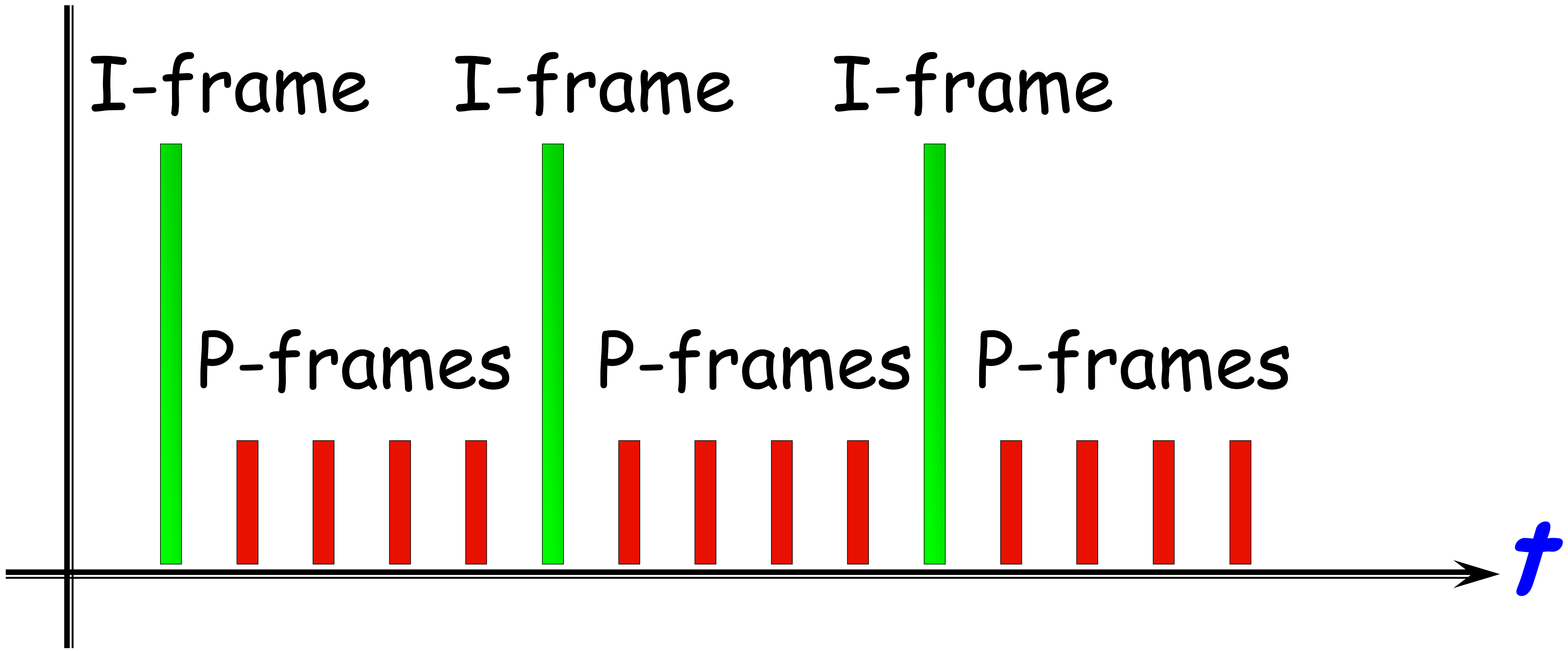
Periodic Bursty Traffic

- E.g. video and audio
  - Streaming and interactive

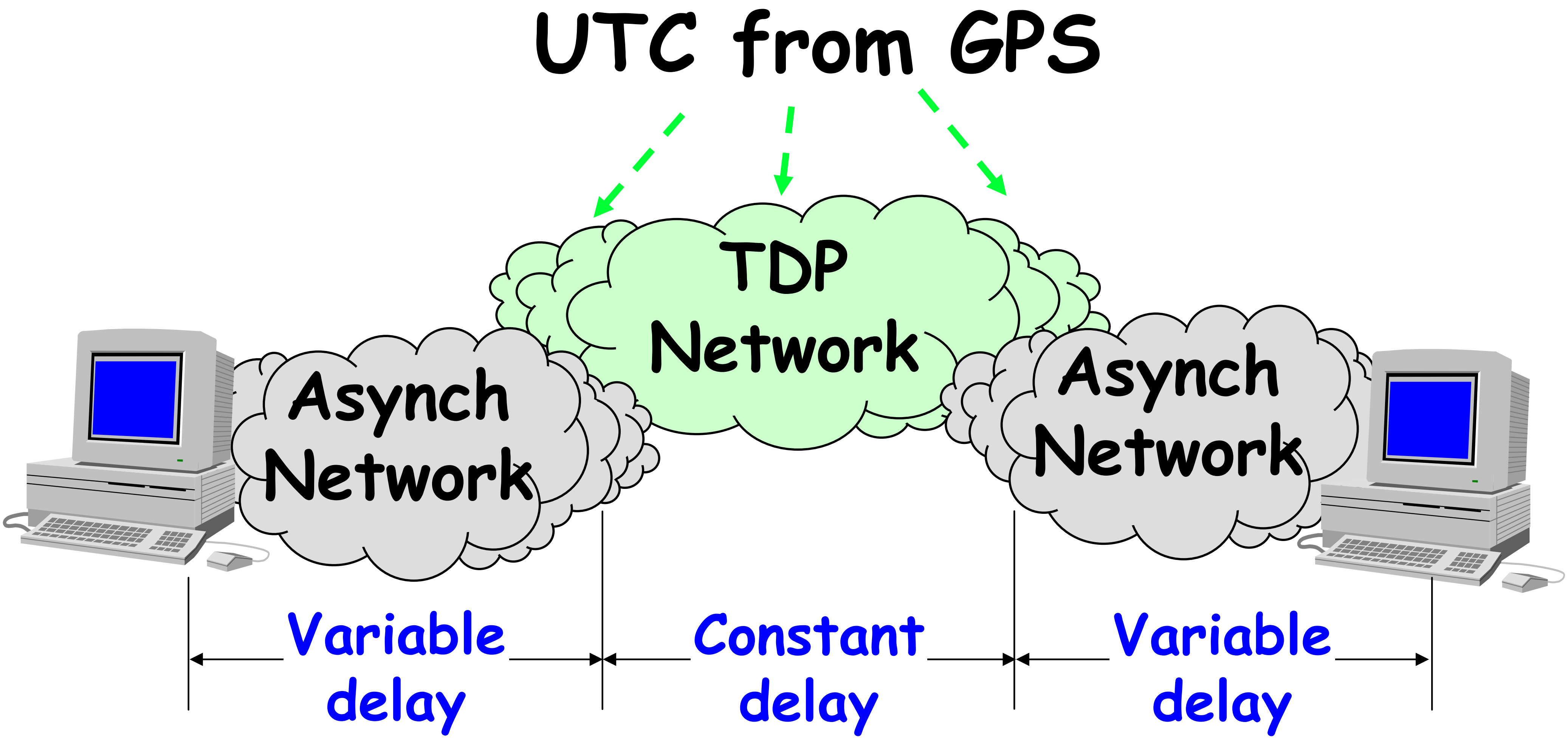


Complex Periodicity

E.g., MPEG video



Deployment Scenario



TDP Router Prototype

- PC-based
- Routing software: FreeBSD kernel

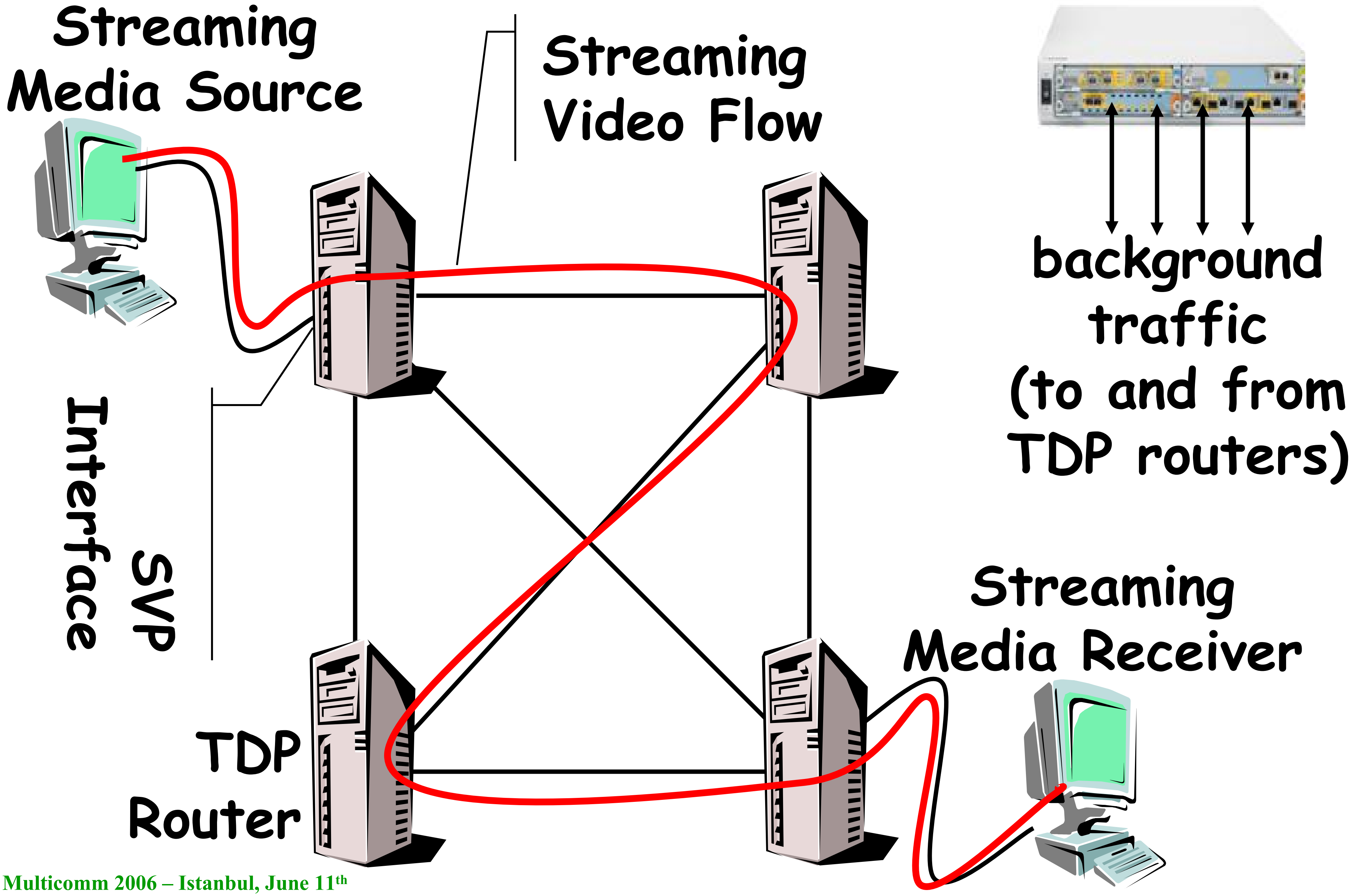
Main Components

- Output queuing module for TDP
  - Based on the ALTQ Module
- TDP scheduler on output links
- TDP classifier on input links from TDP routers
- TDP shaper on input links to non-TDP routers
  - *SVP Interface*
  - Based on the Dummynet module

Expetiments: Goals

- Visually show that
  - video transmission over TDP works
  - quality of service is deterministic and independent of other traffic
- Verify proper operation of router prototype

Experimental Set-up



System Parameters

- Link speed: 100 Mb/s
- TF duration: 250 μs
  - ~25 Kb/TF → ~3 KBytes/TF
- Time cycle: 160 TFs
- Video stream
  - MPEG
  - Rate: 10 Mb/s
  - Frame rate: 25 frames/s
  - Maximum frame size: 100 KBytes
  - Packet size: 1 KByte

Resource Reservation

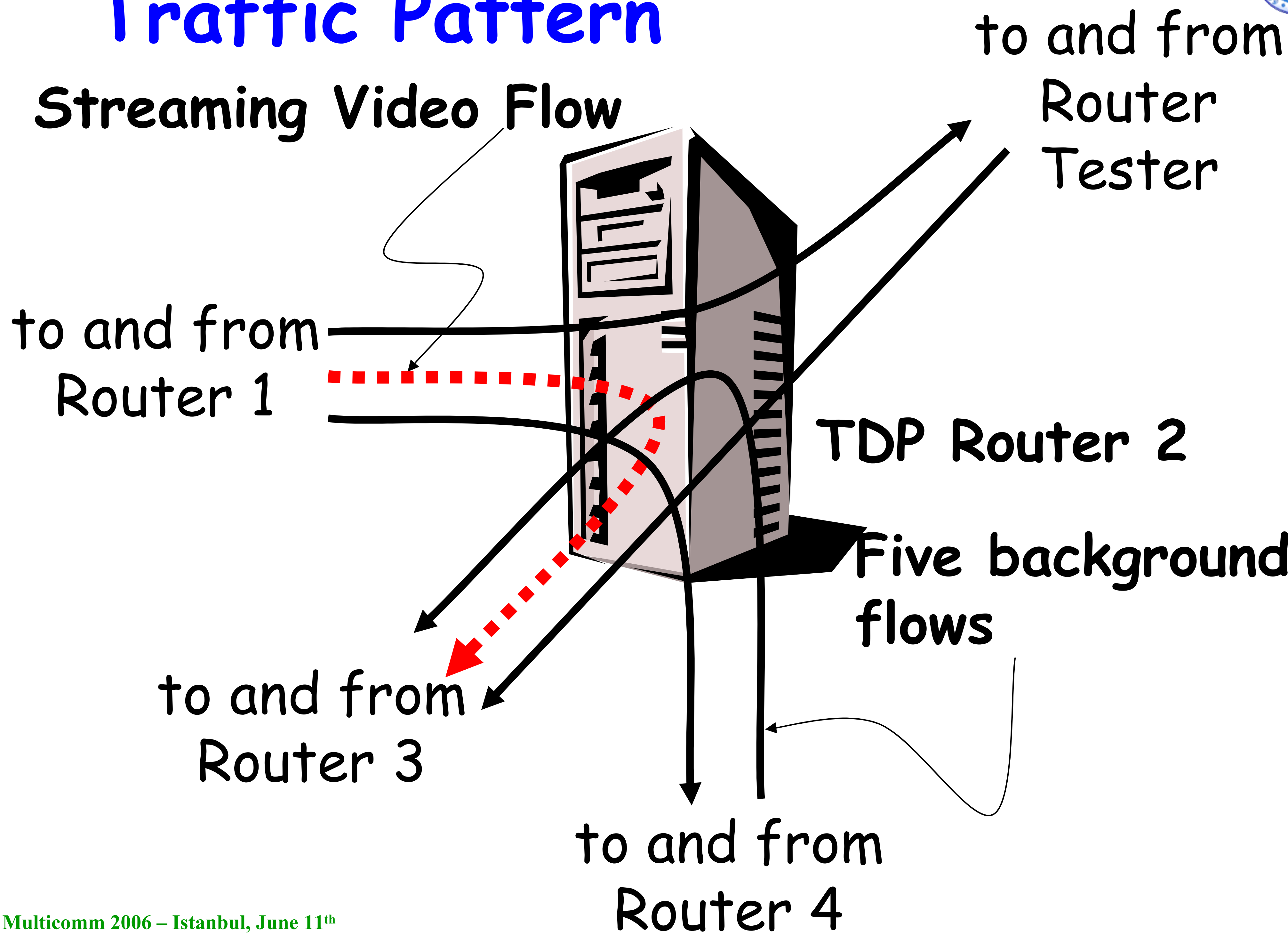
- 100 packets per time cycle
- Reservation of the first 34 TFs of the time cycle
  - Allocation of about 20 Mb/s (?!)
- About 80 Mb/s un-reserved on links traversed by the video flow

Background Traffic

Goal

- Fully load the network
- Maximize link contention

Traffic Pattern



Background Traffic

- Delay sensitive
  - Handled with TDP
    - Allocated remaining 124 TFs
  - 30 CBR flows at about 8 Mb/s
- Delay insensitive
  - Handled as best effort
  - Several 10 Mb/s flows

Video Streaming Client

- (Basically) no de-jitter buffer
  - 1 packet
- In order to visually “show” late jitter

Outcome

It works!!

No noticeable

- Quality degradation
- Delay

Relevance

- First experiments with TDP
- Delay sensitive traffic is about 90% of link capacity
  - Hardly achievable with QoS approaches currently envisioned for the Internet

Differentiated Services (DiffServ)

- Relies on overprovisioning
- Delay sensitive traffic should be around 20-30% of link capacity

Integrated Services (IntServ)

- High complexity → low scalability
  - No large percentage of delay sensitive traffic on high speed links
- Delay inversely proportional to allocated bandwidth
  - No large percentage of low rate delay sensitive flows
  - E.g., phone calls

Current Limitations

- Allocation based on maximum video frame size
- Overallocation
  - 20 Mb/s for a video flow with 10 Mb/s average rate
- Low reservation efficiency
  - Comparable to the IntServ approach

Future Improvements

- Reduce allocation and increase delay
  - Buffering at the SVP Interface
- Reduce allocation and admit loss
  - Forward “late” packets as non-pipelined
    - Best effort or DiffServ
    - Take into account perceptual importance
  - Future work

Future Improvements

- Optimal allocation and delay
  - Allocation with complex periodicity
    - Synchronize encoder for minimizing delay
  - Forward "late" packets as non-pipelined
  - Reservation aware encoding
  - Future work