Traffic Management for Satellite-ATM Networks

Rohit Goyal, Raj Jain,

Sonia Fahmy, Bobby Vandalore, Mukul Goyal

Department of Computer and Information Science

The Ohio State University

goyal@cis.ohio-state.edu

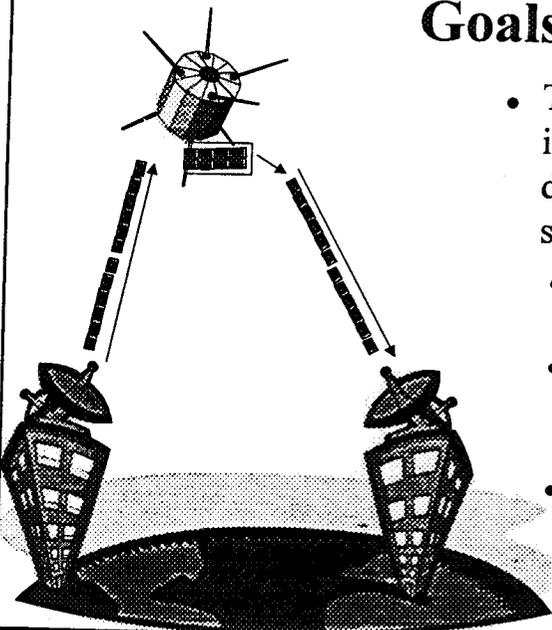Rohit Goyal. The Ohio State University   NASA Workshop'98

Acknowledgements

Rohit Goyal. The Ohio State University   NASA Workshop'98

Goals

- Traffic management issues for TCP/IP based data services over satellite-ATM networks
  - Discuss design issues for TCP/IP over ATM
  - Optimize the performance of TCP/IP over ATM for long delay networks
  - Evaluate ATM service categories for TCP/IP traffic

Rohit Goyal. The Ohio State University

NASA Workshop'98

ATM Service Categories for Data

- **Unspecified Bit Rate (UBR):** User sends whenever it wants. No guarantees made by network
- **Guaranteed Frame Rate (GFR):** User sends whenever it wants. Network guarantees a minimum frame rate, and fair usage of excess capacity. Needs frame delineation info
- **Available Bit Rate (ABR):** User follows network feedback. Network guarantees a minimum cell rate, and fair usage of excess capacity. Network guarantees cell loss ratio
- **Non-Real Time Variable Bit Rate (nrt-VBR):** User declares peak and average rates. Network guarantees cell loss ratio

**Designed for best effort and non-real time traffic**

Rohit Goyal. The Ohio State University

NASA Workshop'98

426

ATM Service Categories (contd.)

- **Real Time Variable Bit Rate (VBR):** User declares peak and average rates. Network guarantees cell delay, cell delay variation and cell loss ratio

- **Constant Bit Rate (CBR):** User declares peak rate. Network guarantees cell delay, cell delay variation and cell loss ratio

Designed for real time traffic
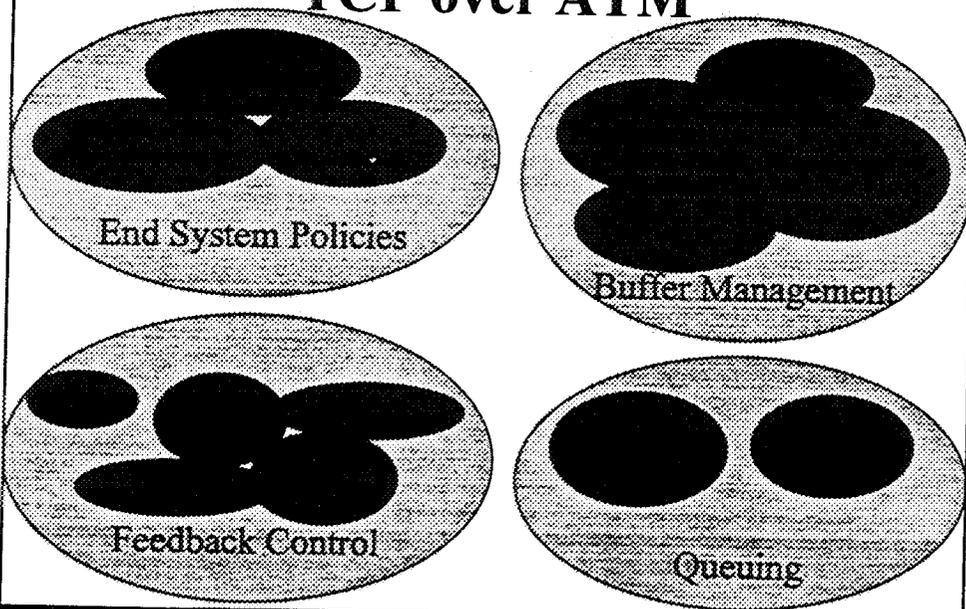
Satellite-ATM Deployment (Access Networks)

427
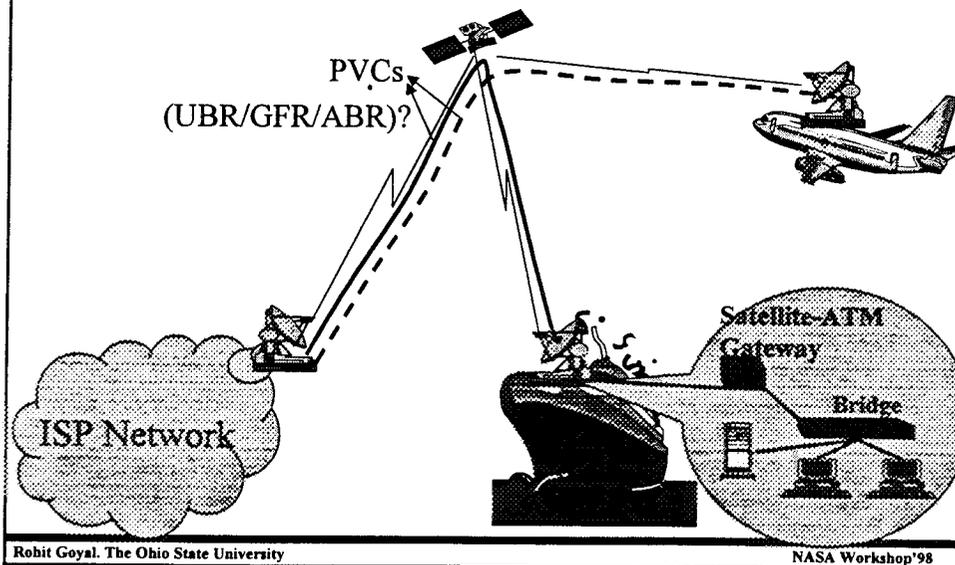
Satellite-ATM Deployment
(Backbone Networks)

VPs or PVCs
(UBR/GFR/ABR)?
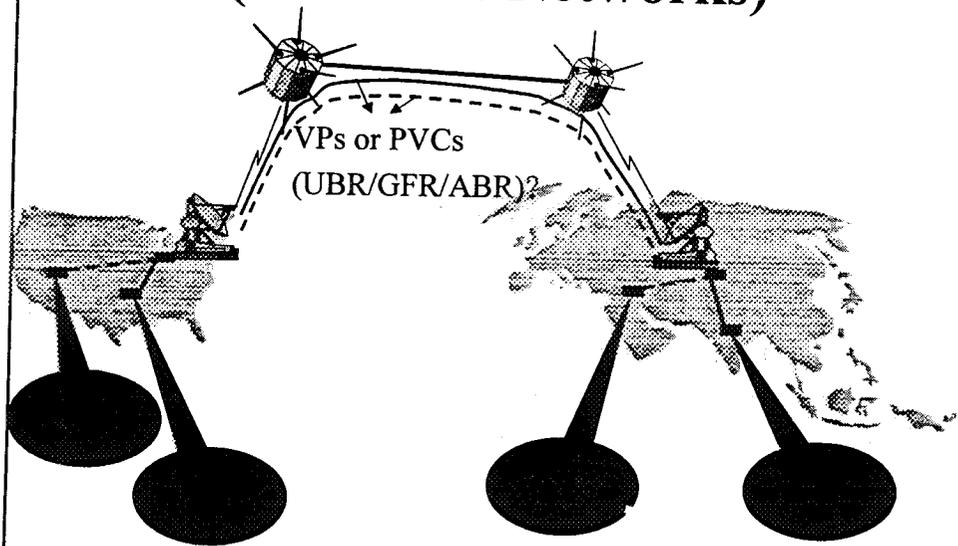
Rohit Goyal. The Ohio State University

NASA Workshop'98

TCP over ATM

End System Policies

Buffer Management

Feedback Control

Queuing

Rohit Goyal. The Ohio State University

NASA Workshop'98

Unspecified Bit Rate (UBR)

- Queuing: Single UBR queue
- Buffer Management
  - *Tail Drop*: Low efficiency, low fairness
  - *Early Packet Discard*: Low fairness
  - *Per-VC accounting*: High efficiency, high fairness
- End-system Policies
  - *Vanilla TCP*: Poor performance
  - *Fast Retrans. & Recov.*: Bad for long latency
  - *Selective Ack*: Good performance for long latency
- No control over sources $\Rightarrow$ Potentially Large queues in network

UBR with Guaranteed Rate (GR)

- Queuing:
  - Single queue with guaranteed minimum service rate
- Buffer management: Same as UBR
- End system policies: Same as UBR
- Improved performance of TCP due to guaranteed rate
- Cannot isolate traffic from different organizations
  - Will not work for backbone networks
  - May be OK for access networks

Guaranteed Frame Rate (GFR)

- Minimum rate guarantee for frames
- Complete frames are accepted or discarded in the switch
- Traffic policing is frame based
- Traffic conforming to MCR is served with low cell loss
- Traffic above MCR is served as best effort
- CLP=0 frames given higher priority than CLP=1 frames
- Network can optionally tag frames exceeding MCR (GFR.2)
- Good for backbone as well as access networks

GFR (contd.)

Queuing	Per-VC	FIFO
Buffer Management	Per-VC Thresholds	Global Threshold
Tag-sensitive Buffer Mgmt	2 Thresholds	1 Threshold

- Equal MCR allocation
  - Can do with FIFO and per-VC thresholds
- Unequal MCR allocation
  - Difficult to provide per-VC MCR with FIFO for TCP/IP traffic with high MCR allocation
  - Easy to provide per-VC MCR with per-VC queuing

Available Bit Rate (ABR)

- Queuing: Single ABR queue or per-VC queues
- Feedback Control:
  - *Bit Based*: Slow control, bad for long latency networks
  - *Explicit Rate*: Fast control, bounded buffer requirements
  - *Virtual Source/Virtual Destination*: Allows hop-by-hop control & isolates terrestrial switches from effects of satellite latency
- Buffer Management:
  - Less important with a good explicit rate scheme like ERICA+
  - Bounded buffer requirements (Constant × round trip delay × bandwidth) for zero loss for TCP/IP over ABR
  - UBR-like buffer requirements at the edges of the ABR network

UBR vs GFR vs ABR

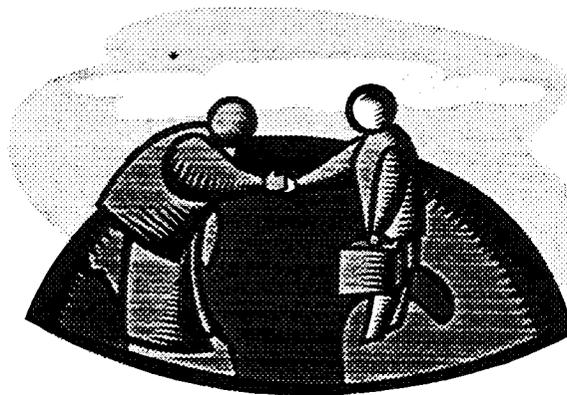| UBR	GFR	ABR
No guarantee.	Minimum rate + fair excess	
Unfair	Fair	
Queue in network		Queue at network edges
Simple for user		Good for provider
Same end-to-end or backbone		Good if end-to-end ATM

Summary

- Design issues for TCP over ATM
  - *End system policies*: Vanilla TCP, Fast Retr. Recov., *SACK*
  - *Feedback control*: Explicit rate, binary, end-to-end, VS/VD
  - *Buffer management*: tail drop, EPD, per-VC acc., tag sensitive
  - *Queuing*: Per-Class, per-VC
- **UBR**: No guarantees, poor performance
- **UBR w/ per-VC accounting**: Good efficiency+fairness
- **GR**: Cannot isolate different VCs
- *GFR*: Per-VC minimum rate guarantees
- **ABR**: Congestion shifted to edge of network
- **VS/VD**: Isolate terrestrial segments from satellite

Thank You