

# Traffic Management over Satellite ATM Networks: A Status Report

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- ❑ Traffic Management for ATM over Satellite Document
- ❑ New NASA Project on Traffic Management
- ❑ Our Recent Studies
- ❑ December TM Meeting

# ATM over Satellite Document

- Scope:
  - OSU and Non-OSU Studies
  - ABR, UBR, GFR
  - TCP and non-TCP Traffic
  - LEO, MEO, and GEO
- Joint Work with NASA Lewis (Tom vonDeak)

# Table of Contents

- ❑ Introduction: Challenges
- ❑ ABR Service over Satellites
- ❑ UBR Service over Satellites
- ❑ TCP/IP over ATM Over Satellites
- ❑ Conclusions

# Introduction: Challenges

- ❑ Delay: Long-delay, Delay Variation (e.g., Doppler, orbital movement, handovers, ...)
- ❑ Errors
- ❑ Bandwidth Limitations
- ❑ Resource Limitations:  
On-board processing and memory
- ❑ Special Access Methods: DAMA, Beam Hopping

# ABR Over Satellites

- ❑ Switch Algorithms
- ❑ Parameter Selection
- ❑ Buffer Sizing
- ❑ Bursty WWW Sources
- ❑ ABR with VBR Video Background
- ❑ Point-to-Multipoint Connections
- ❑ Multipoint-to-point Connections
- ❑ Virtual Source Virtual Destination
- ❑ Features for Long Delay Paths: BECN

# UBR Over Satellites

- ❑ Buffer Sizing
- ❑ Drop Policies
- ❑ UBR+
- ❑ Guaranteed Rate
- ❑ Guaranteed Frame Rate Service
- ❑ Voice over UBR+?

# TCP Over ATM over Satellites

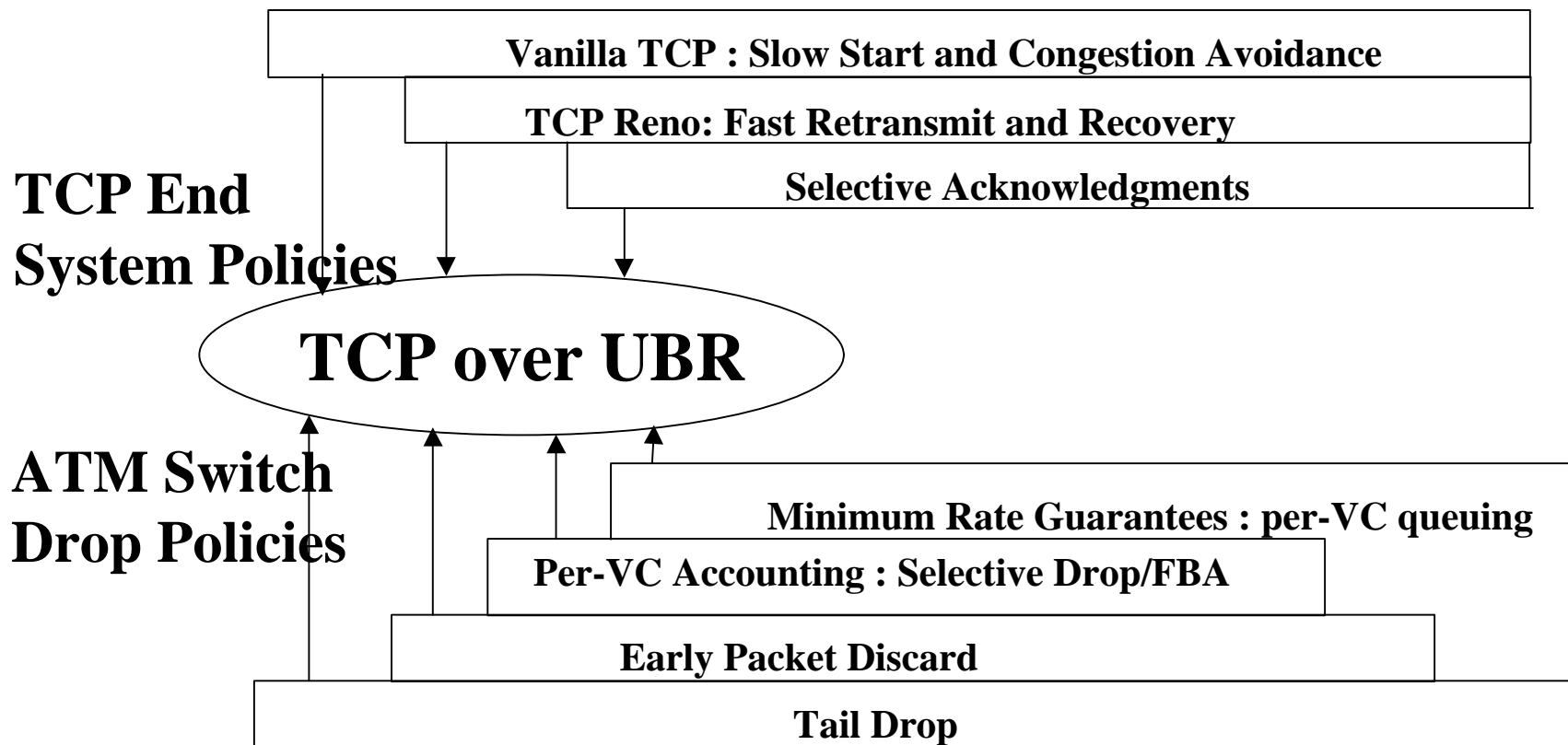
- ❑ TCP over ABR
  - Buffer Sizing
  - Worst case Behavior
- ❑ TCP over UBR
- ❑ TCP Enhancements: Slow Start, Fast Retransmit Recovery, New Reno, Selective Acknowledgement
- ❑ Effect on Long-delay paths



# TCP/IP over UBR

- ❑ New project at OSU sponsored by NASA Lewis Research Center
- ❑ Very comprehensive study of TCP/IP over UBR: existing mechanisms, new mechanisms, parameter selection
- ❑ Includes TCP mechanisms, end systems, switches, buffers, traffic patterns, and UBR enhancements.
- ❑ Time Frame: December 1, 1997-November 30, 98

# Policies



# Policies

## End-System Policies

		No FRR	FRR	New Reno	SACK + New Reno	
		Switch Policies	No EPD			
Plain EPD						
EPD	Selective Drop					
	Fair Buffer Allocation					

# Issues

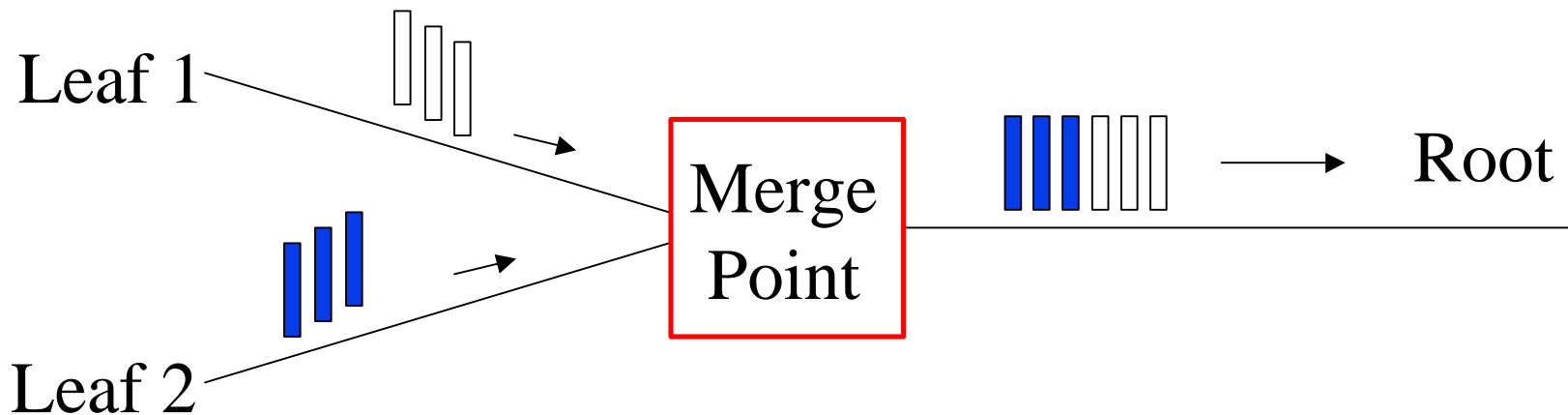
1. Analyze Standard Switch and End-system Policies
2. Design Switch Drop Policies
3. Quantify Buffer Requirements in Switches
4. UBR with VBR Background
5. Performance of Bursty Sources
6. Changes to TCP Congestion Control
7. Optimizing the Performance of SACK TCP

# Our Recent Studies

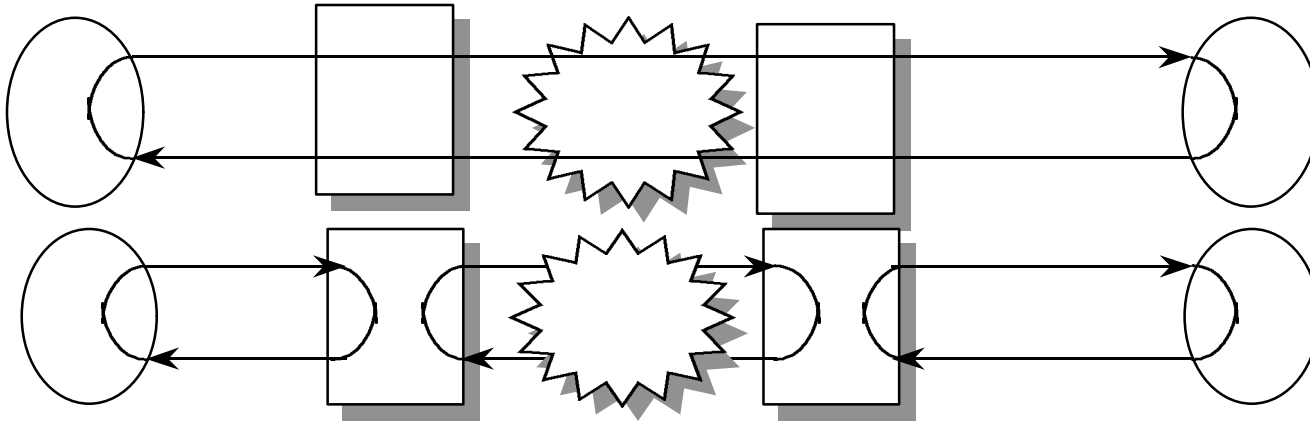
- ❑ Multipoint-to-point connections
- ❑ Virtual Source/Virtual Destination
- ❑ Guaranteed Frame Rate Service
- ❑ Queue Control Functions

# Multipoint-to-Point VCs

- ❑ More than one concurrent sender
- ❑ Traffic at root  
=  $\Sigma$  traffic originating from leaves
- ❑ Source-based fairness:  
N-to-one connection = N one-to-one connections  
 $\Rightarrow$  max-min fairness among sources



# Virtual Source / Virtual Destination (VS / VD)



- ❑ Segments the end-to-end ABR control loop.
- ❑ Coupling between loops is implementation specific.
- ❑ VS/VD can help in buffer management across the network.
- ❑ ABR switches separated by non-ATM network could also implement VS/VD.

# Guaranteed Frame Rate (GFR)

- UBR with minimum cell rate (MCR)  
⇒ UBR+
- Frame based service
  - Complete frames are accepted or discarded in the switch
  - Traffic shaping is frame based.  
All cells of the frame have  $CLP = 0$  or  $CLP = 1$
  - All frames below MCR are given  $CLP = 0$  service.  
All frames above MCR are given best effort  
( $CLP = 1$ ) service.



# Queue Control Function

- ❑ Most ABR switch algorithms allocate 90 to 95% of available capacity to active flows
- ❑ The % allocated can be a function of the queue length
- ❑ Target rate =  $f(q) \times \text{fn}\{\text{current load, link rate, Higher priority (CBR, VBR) load}\}$   
 $f(q)$  is the queue control function.
- ❑ Several different functions were compared to find the simplest most effective function.

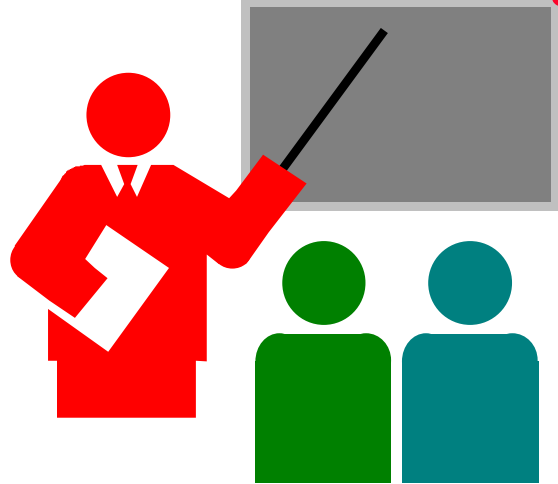
# December TM Meeting

- ❑ Guaranteed Frame Rate:  
    New conformance definition
- ❑ TCP over ABR
- ❑ ABR Policing
- ❑ Multipoint-to-point
- ❑ Virtual Source /Virtual Destination
- ❑ Queue Control Functions
- ❑ Plans for TM 5.0: December 1998

# TM Joint Meetings

- ❑ Test: Performance Testing
- ❑ API: ABR
- ❑ Network Management: Traffic Profiles, Accumulative QoS Parameters
- ❑ RMOA: Requirements for Video, Shaping for MPEG2
- ❑ RBB: ADSL dual latency
- ❑ VTOA: Effect of Buffering VBR Voice
- ❑ CS\_RA: ADSL Signaling, VC Merging, Soft Connection Reroute

# Summary



- ❑ Document on TM on Satellite ATM Links
- ❑ New NASA project on TCP/IP over UBR
- ❑ Recent OSU work on Multipoint-to-point, VS/VD, Queue control, GFR
- ❑ TM group is working on GFR and TM5.0

# Our Contributions and Papers

- ❑ All our contributions and papers are on-line:  
<http://www.cis.ohio-state.edu/~jain/>  
See “Recent Hot Papers” for tutorials.
- ❑ "A switch algorithm for ABR multipoint-to-point connections," ATM Forum/97-1085, December 1997,  
<http://www.cis.ohio-state.edu/~jain/atmf/a97-085.htm>
- ❑ "Per-VC Rate Allocation Techniques for ABR Feedback in VS/VD Networks" ATM Forum/97-1086, December 1997, <http://www.cis.ohio-state.edu/~jain/atmf/a97-1086.htm>

# Contributions (Cont)

- ❑ "Design and Analysis of Queue Control Function for Switch Schemes," ATM Forum/97-1087, December 1997, <http://www.cis.ohio-state.edu/~jain/atmf/a97-1087.htm>
- ❑ "GFR -- Providing Rate Guarantees with FIFO Buffers to TCP Traffic" ATM Forum/97-0831, Sep 1997, <http://www.cis.ohio-state.edu/~jain/atmf/a97-0831.htm>
- ❑ "Fairness for ABR multipoint-to-point connections," ATM Forum/97-0832, Sep 1997, <http://www.cis.ohio-state.edu/~jain/atmf/a97-0832.htm>