



**ENSC 833-3:NETWORK PROTOCOLS AND
PERFORMANCE**

**Final Project Presentations
Spring 2001**

**Implementation of IPv6's
TOS
over ATM Network**

Presented by

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Agenda

■ Introduction

- What is IPv6?
 - The IPv6 Frame Format
 - The Type Of Service (TOS) Field in IPv6 Frame
 - IPv6's TOS vs. ATM's Service Category
- Goals of our project



Agenda (cont.)

■ Implementation Details

- Opnet ATM Standard Node Model that Was Used and Modified
- Flow Chart of our Design
- Network Configuration
- Collected Results/Statistics



Agenda (cont.)

- Discussion
 - Difficulties Encountered
 - Alternative Approach
 - Future Work
 - What We Have Learned
- Questions and Answers
- References



Introduction: What is IPv6?

- IPv6 addresses many limitations that IPv4 has:
 - limited number of addresses (128 bytes vs. 32 bytes)
 - poor security (not addressed by IPv4 at all)
 - undefined service types (much better defined in IPv6).



Introduction: Type Of Service

- TOS 0-7: congestion controlled traffic (e.g. TCP)
- TOS 8-15: non-congestion controlled traffic (e.g. UDP)

Introduction:

IPv6's TOS vs. ATM's Service Category

	TOS	Description:	Suggested ATM Service Category:
Congestion-Controlled Traffic	0	uncharacterized traffic	UBR/ABR
	1	"filler" traffic (e.g., netnews)	UBR/ABR
	2	unattended data transfer (e.g., email)	UBR/ABR
	3	(reserved)	
	4	attended bulk transfer (e.g., FTP, NFS)	UBR/ABR
	5	(reserved)	
	6	interactive traffic (e.g., telnet, X)	UBR/ABR
	7	internet control traffic (e.g., routing protocols, SNMP)	UBR/ABR
Non Congestion-Controlled Traffic	8	The lowest Priority value (e.g., high-fidelity video traffic)	NRT-VBR
	9	...	NRT-VBR
	10	...	NRT-VBR/RT-VBR
	11	...	RT-VBR
	12	...	RT-VBR
	13	...	RT-VBR/CBR
	14	...	CBR
	15	The highest value (15) (e.g., low-fidelity audio traffic).	CBR



Introduction:

Goals of Our Project

- Develop a general traffic client node with "smart" packet switching mechanism by merging IPv6 and the Asynchronous Transfer Mode (ATM) as the protocol for the QoS enabled Internet.
- By examining the "Type Of Service" field in the IPv6 packets, different TOS packets are routed onto the appropriate SVC which has matching QoS parameters.

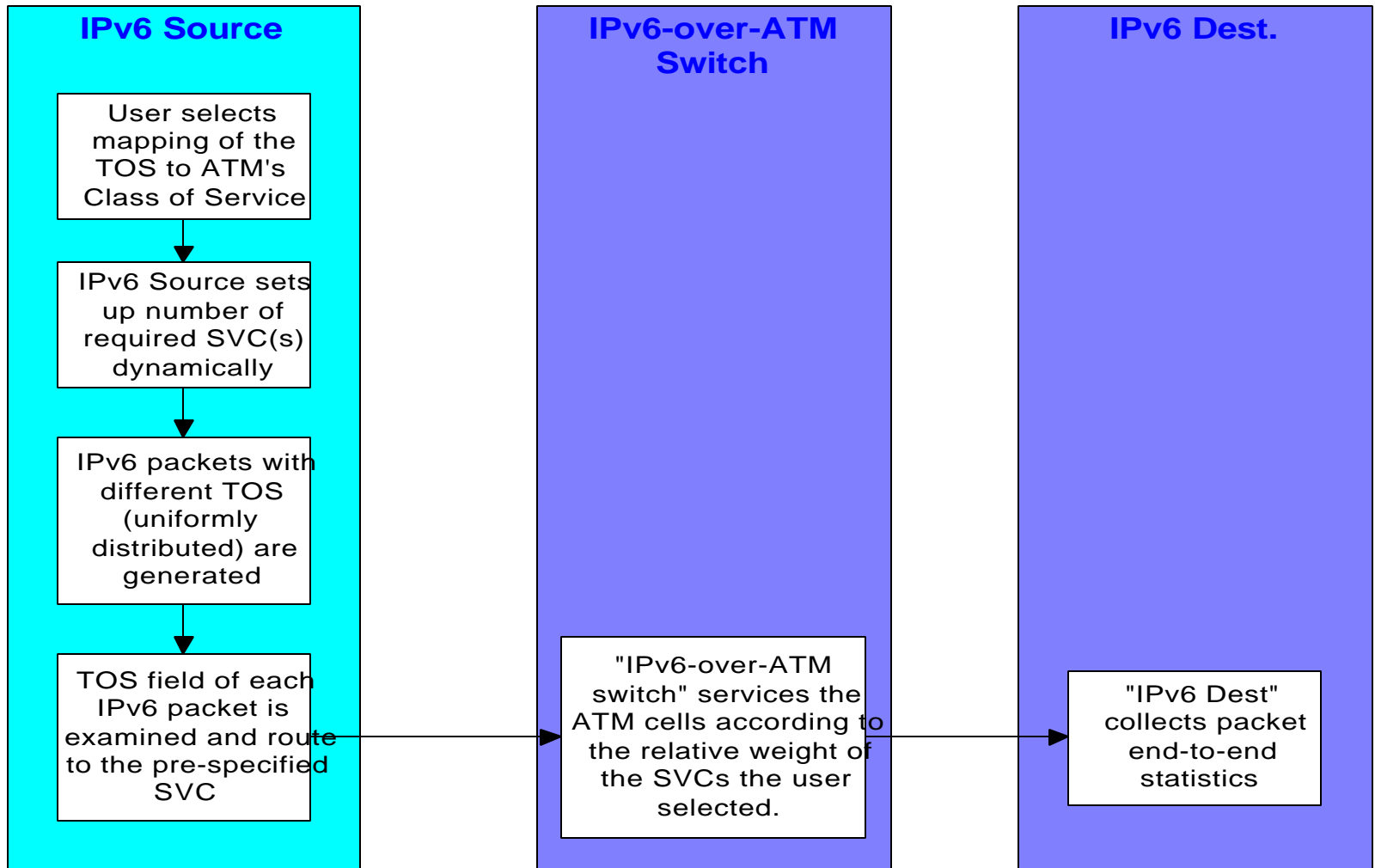


Implementation Details:

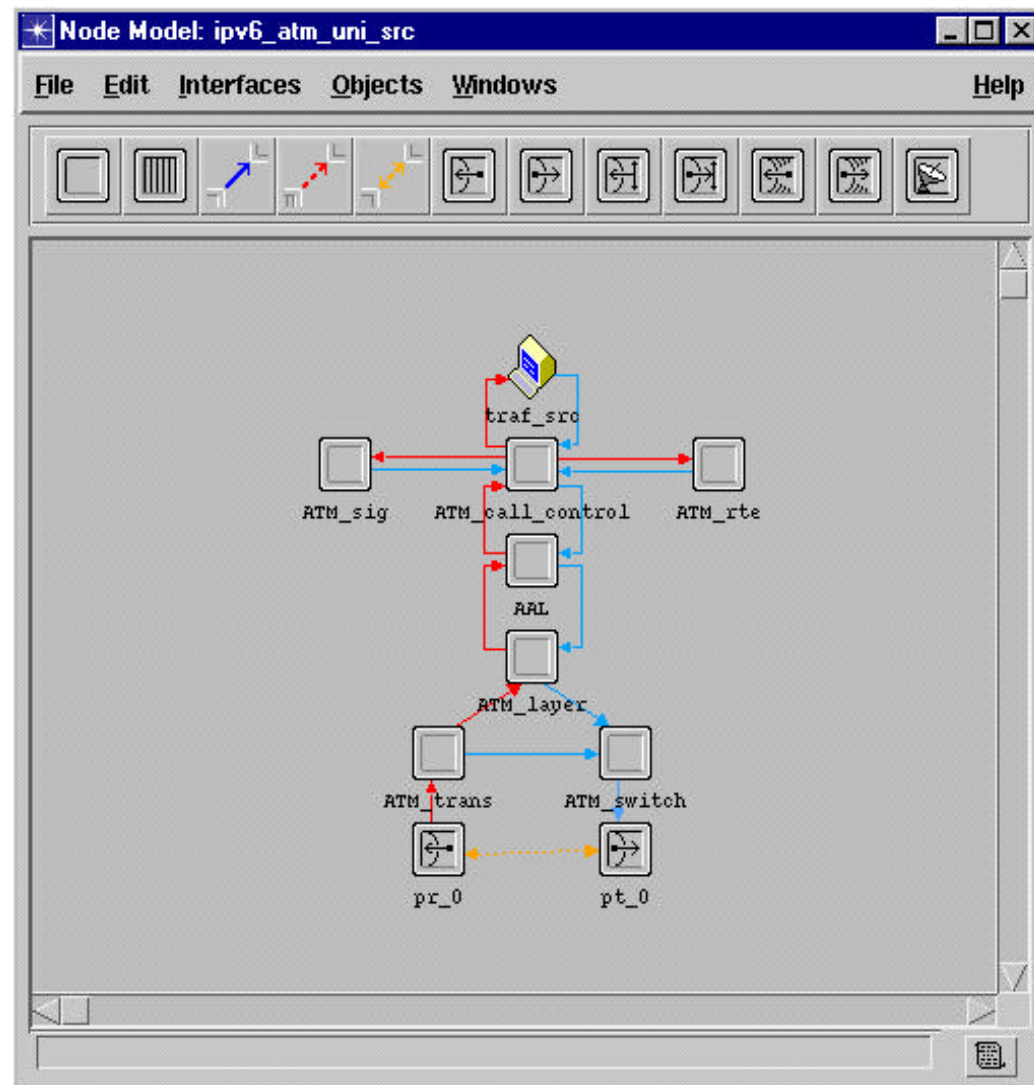
Opnet ATM Standard Node Model

- Project based on Opnet ATM standard model:
 - atm_uni_src,
 - atm_uni_dest.
 - atm4_crossconnect
- Model a raw packet generator and receiver running over ATM.
- Enhance model by making raw packet generator to generate IPv6 formatted packet, transmit packets via different SVC based on their TOS, etc...

Implementation Details: Flow Chart



Implementation Details: IPv6 Source



Implementation Details: IPv6 Source

The screenshot displays a configuration window titled "(IPv6 Source) Attributes" with several sub-dialogs for TOS mapping tables.

(IPv6 TOS Mapping) Table

mode	Congestion-Controlled Traffic	Non Congestion-Controlled Traffic
ATM	Default	Default

(Congestion-Controlled Traffic) Table

TOS = 0	TOS = 1	TOS = 2	TOS = 3	TOS = 4	TOS = 5	TOS = 6	TOS = 7
UBR	UBR	UBR	Reserved	ABR	Reserved	ABR	ABR

(Non Congestion-Controlled Traffic) Table

TOS = 8	TOS = 9	TOS = 10	TOS = 11	TOS = 12	TOS = 13	TOS = 14	TOS = 15
NRT-VBR	NRT-VBR	NRT-VBR	RT-VBR	RT-VBR	CBR	CBR	CBR

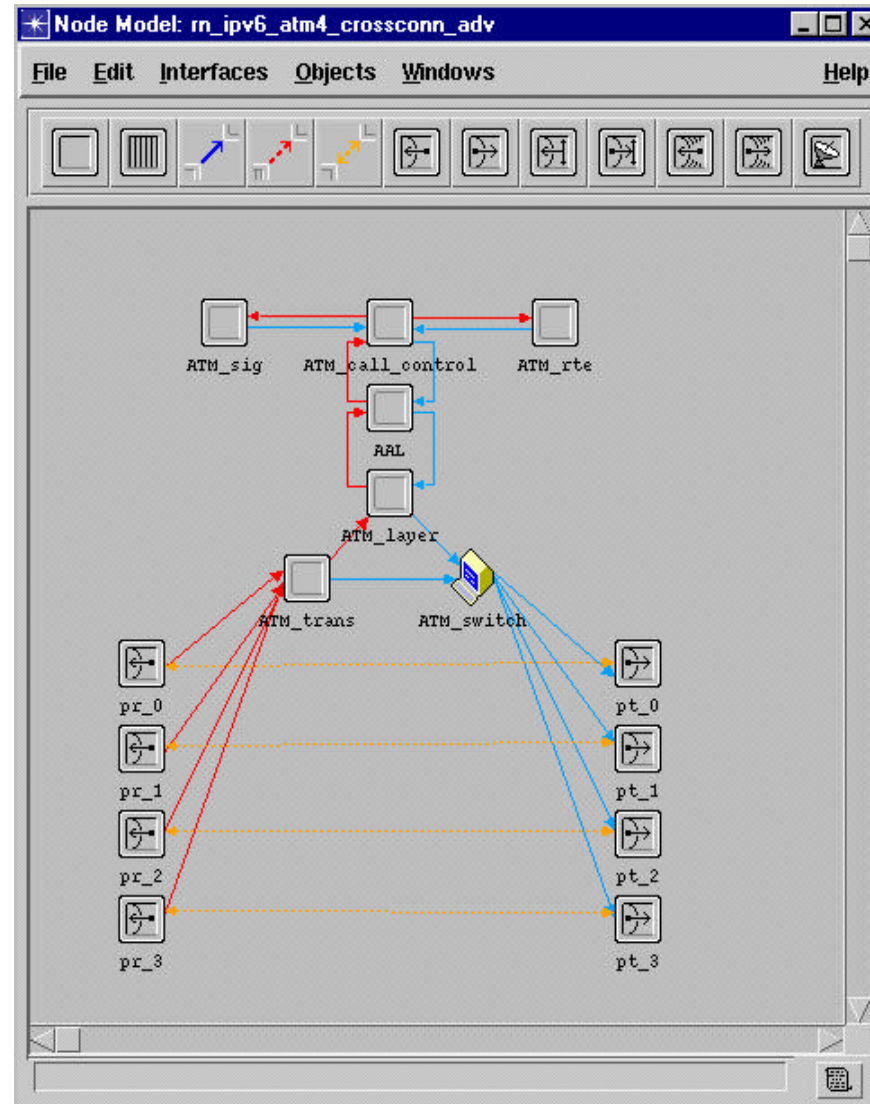
Buttons: Details, Promote, Delete, Cancel, OK

Application Configuration: IPv6 TOS Mapping (Default)

Apply Changes to Selected Objects Advanced

Buttons: Details, Promote, Cancel, OK

Implementation Details: IPv6-over-ATM Switch



Implementation Details: IPv6-over-ATM Switch

([IPv6-over-ATM Switch] Attributes)

Attribute	Value
ATM ABR Parameters	
ATM Active Failure Detection	
ATM Address	
ATM Connection Information	
ATM Passive Failure Detection Mode	Disabled
ATM Port Buffer Configuration	(...)
ATM QoS Priority Scheme	round-robin
ATM Routing Update Interval	15
ATM SSCOP Parameters	Default
ATM Segmentation Rate	Peak Cell
ATM Switching Speed	Infinity
ATM UPC Function	Discard Option
ATM VC Lookup Delay	1E-10
ATM VP Lookup Delay	1E-11

Apply Changes to Selected Objects
 Advanced

Details Promote Cancel OK

(ATM Port Buffer Configuration) Table

Queue Number	Queue Parameters	Category (None)	Traffic Parameters	QoS Parameters
Q1	(...)	CBR	default	CBR
Q2	(...)	RT_VBR	default	RT-VBR
Q3	(...)	NRT_VBR	default	NRT-VBR
Q4	(...)	ABR	default	ABR
Q5	(...)	UBR	default	UBR

5 Rows

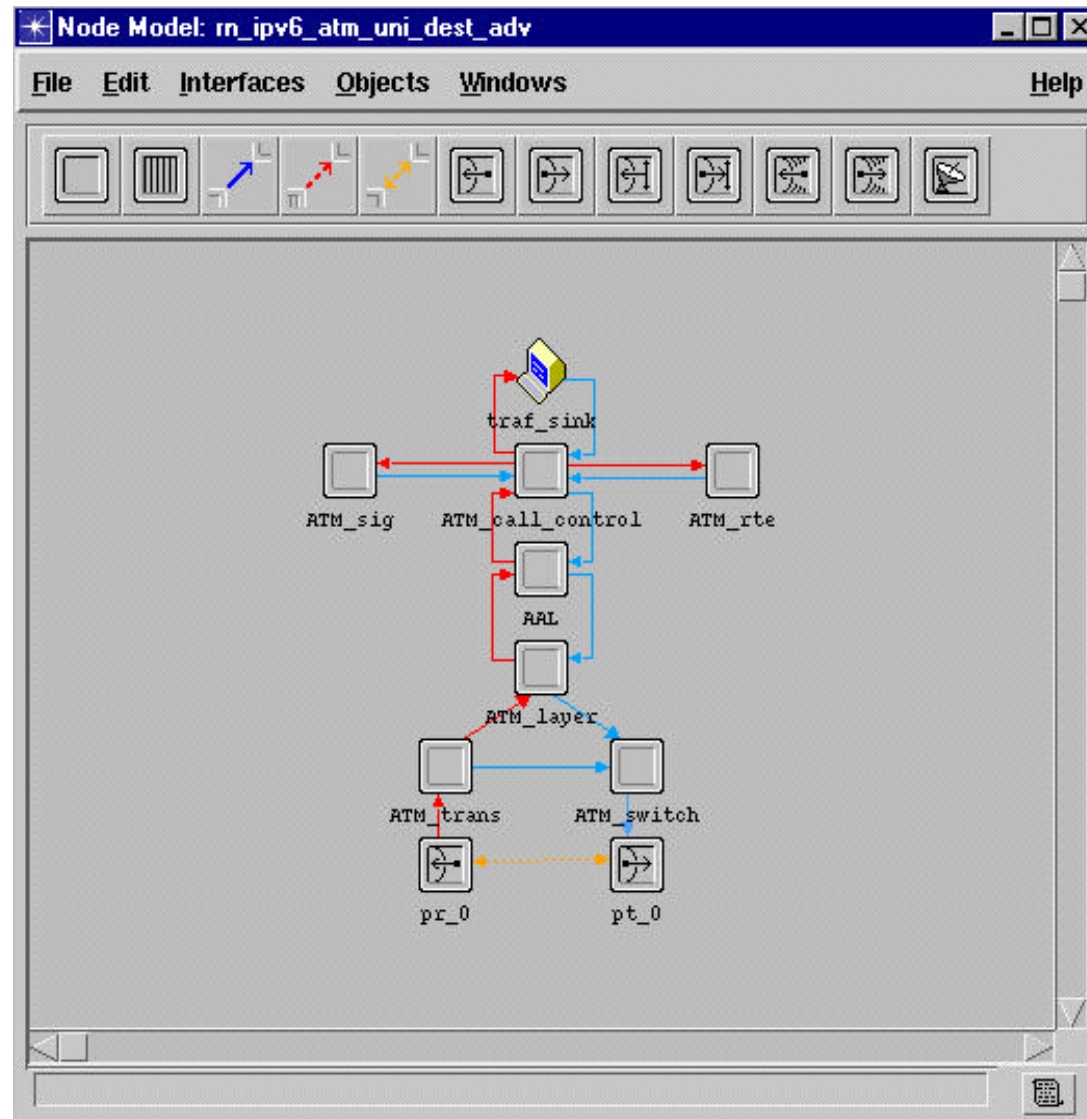
Details

(Queue Parameters) Table

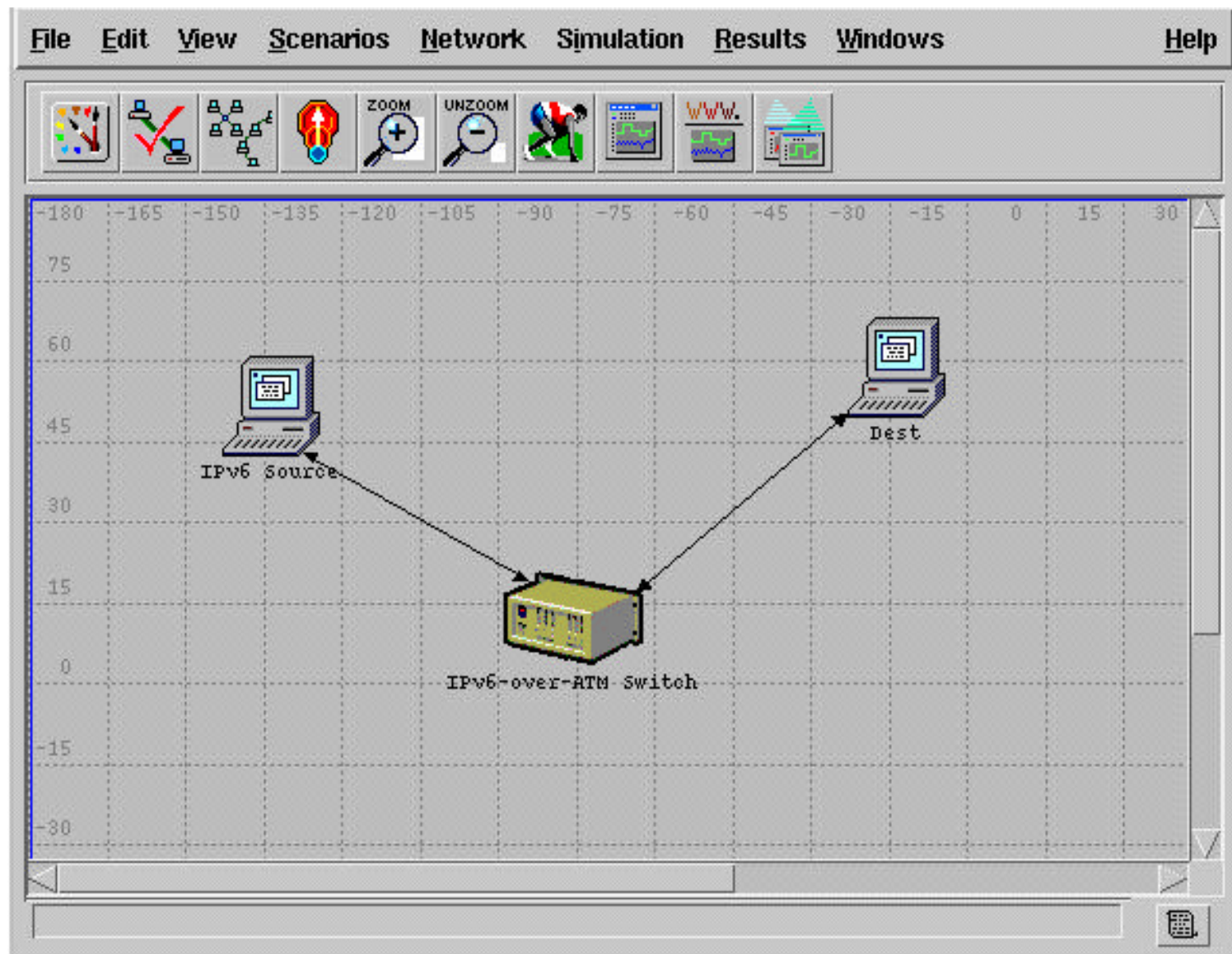
Attribute	Value
Max_Avail_BW (%Link BW)	60
Min_Guaran_BW (%Link BW)	60
Size (cells)	10000
EFCI Threshold (%Q Size)	50%

Details Promote Delete Cancel OK

Implementation Details: Destination



Implementation Details: Network Configuration



Implementation Details: Collected Results/Statistics

IPv6 TOS Mapping:

TOS:	0	1	2	3
SVC:	UBR	UBR	UBR	N/A
TOS:	4	5	6	7
SVC:	UBR	N/A	UBR	UBR
TOS:	8	9	10	11
SVC:	RT-VBR	RT-VBR	RT-VBR	RT-VBR
TOS:	12	13	14	15
SVC:	CBR	CBR	CBR	CBR

Total Packets Sent on Each SVC:

```

CBR      : 6864
NRT-VBR : 0
RT-VBR  : 6810
ABR     : 0
UBR     : 10326
=====
Total   : 24000
  
```

Total Packets Sent for Each TOS:

```

TOS = 0 : 1747
TOS = 1 : 1631
TOS = 2 : 1756
TOS = 3 : 0
TOS = 4 : 1800
TOS = 5 : 0
TOS = 6 : 1723
TOS = 7 : 1669
TOS = 8 : 1624
TOS = 9 : 1732
TOS = 10 : 1703
TOS = 11 : 1751
TOS = 12 : 1765
TOS = 13 : 1692
TOS = 14 : 1701
TOS = 15 : 1706
=====
Total   : 24000
  
```

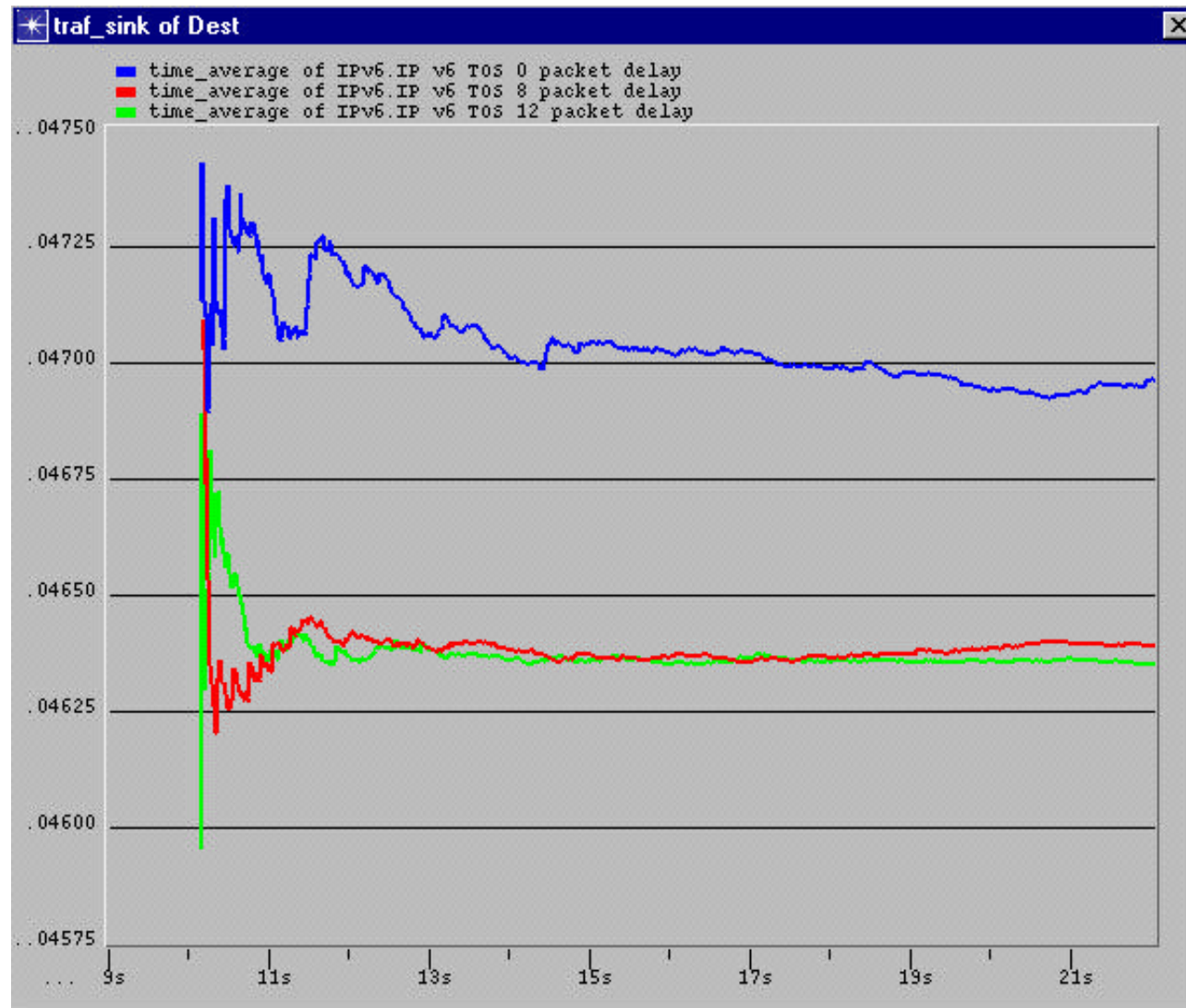
View Results

- Displayed Statistics
 - Global Statistics
 - Object Statistics
 - Dest
 - traf_sink
 - IPv6**
 - IP v6 TOS 0 packet delay
 - IP v6 TOS 1 packet delay
 - IP v6 TOS 10 packet delay
 - IP v6 TOS 11 packet delay
 - IP v6 TOS 12 packet delay
 - IP v6 TOS 13 packet delay
 - IP v6 TOS 14 packet delay
 - IP v6 TOS 15 packet delay
 - IP v6 TOS 2 packet delay
 - IP v6 TOS 3 packet delay
 - IP v6 TOS 4 packet delay
 - IP v6 TOS 5 packet delay
 - IP v6 TOS 6 packet delay
 - IP v6 TOS 7 packet delay
 - IP v6 TOS 8 packet delay
 - IP v6 TOS 9 packet delay

Statistics Stacked As Is This Scenario

Preview

Implementation Details: Collected Results/Statistics





Discussion

- Difficulties Encountered
- Alternative Approach
- Future Work
- What We Have Learned



Discussion:

Difficulties Encountered

- Standard ATM client model only establishes one class of service SVC. In our model, we have to dynamically create SVC connections as per user's selection.
- Add user configurable attribute to the client node to allow user to select mapping of TOS to ATM class of services.



Discussion:

Alternative Approach

- Use Opnet ATM standard model IPv4 over ATM as our baseline instead of raw packet generator over ATM which we employed in our project.
- Pros: Transport and Network layer (TCP/IPv4) already implemented, need only to incorporate IPv6 packet formats.
- Cons: Much more complicated model for beginners to Opnet to enhance compared with raw packet generator over ATM model.



Discussion:

Future Work

- Allow user to configure the QoS and traffic contract of the SVC (e.g. SCR, peak to peak cell delay variations).



Discussion:

What We Have Learned...

- Opnet Simulation Tool
- Mapping of IPv6 TOS to ATM class of services.
- Realize an upgrade of IP in which IP/ATM maybe able to provide service guarantees that IP alone cannot.



References

- [1] IP Next Generation Overview
- [2] IPv6: The New Internet Protocol
- [3] G. Armitage, M. Jork, P. Schulter, G. Harter, IPv6 over ATM Networks, RFC2492, January 1999.
- [4] Internet Protocol, Version 6 (IPv6) Specification. S. Deering, R. Hinden. RFC2460, December 1995.
- [5] Asynchronous Transfer Mode (ATM) Switching
- [6] Opnet ATM Model Description
- [7] Mahbub Hassan and Mohammed Atiquzzaman, Performance of TCP/IP Over ATM Networks, Artech House Publishers, 2000



Q & A

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