Technologies and Services to Enable Voice Over IP

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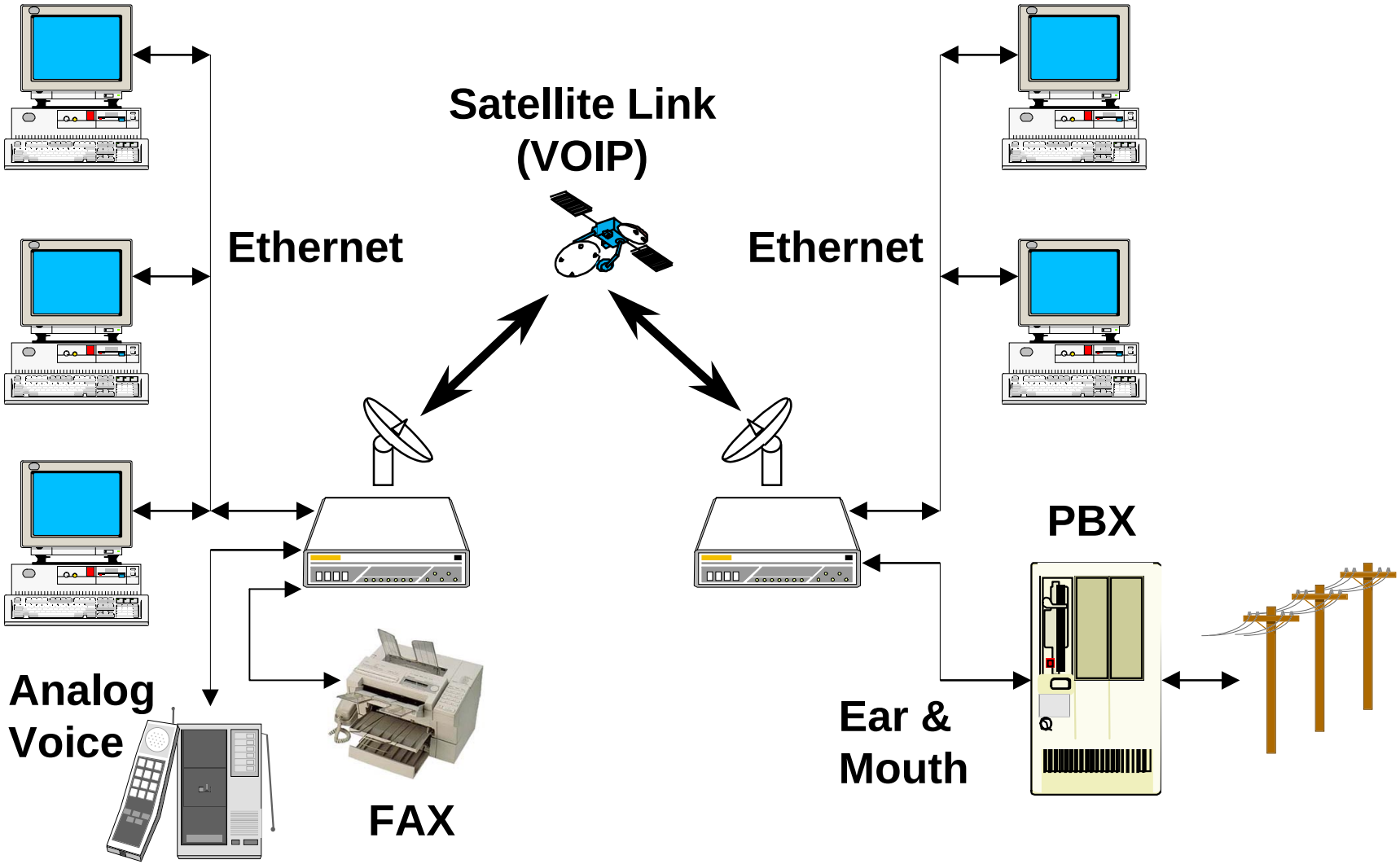
Outline

- Voice over IP
- VOIP Demonstration
- Video over IP
- ATM and Packet-Over-SONET comparisons
- Research Plans
- The Future

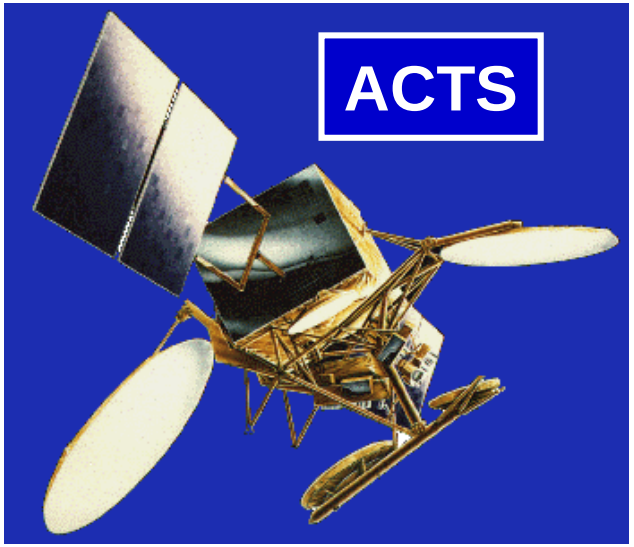
VOIP Characteristics

- ITU-T standard H.323, Packet based multimedia communications systems
- Compression
  - 8 - 11 kbps
  - Silence Suppression
- QoS Mechanisms
  - *Precedence Bits*
  - RSVP
  - ATM User Network Interface (UNI) v 3.0, 3.1, 4.0

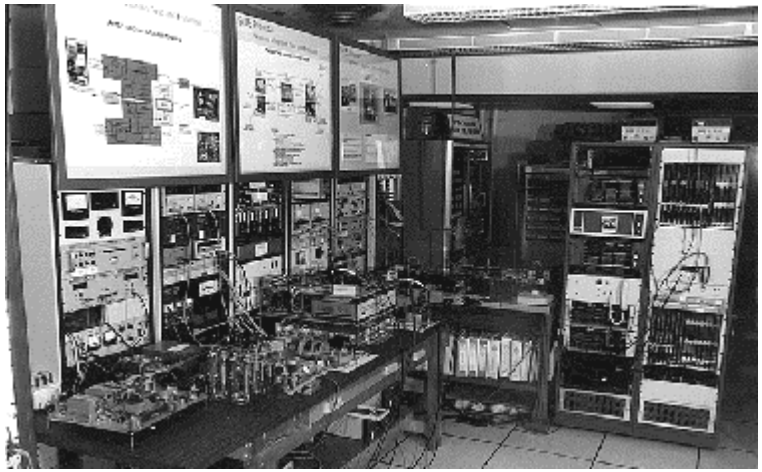
VOIP Demonstration Configuration



Satellite Link and Emulated Links



Ku-Band Ground Station



Ka-Band Testbed

Adtech SX/14 Channel Simulator

Current VOIP Deployments

Video over IP (IP/TV)

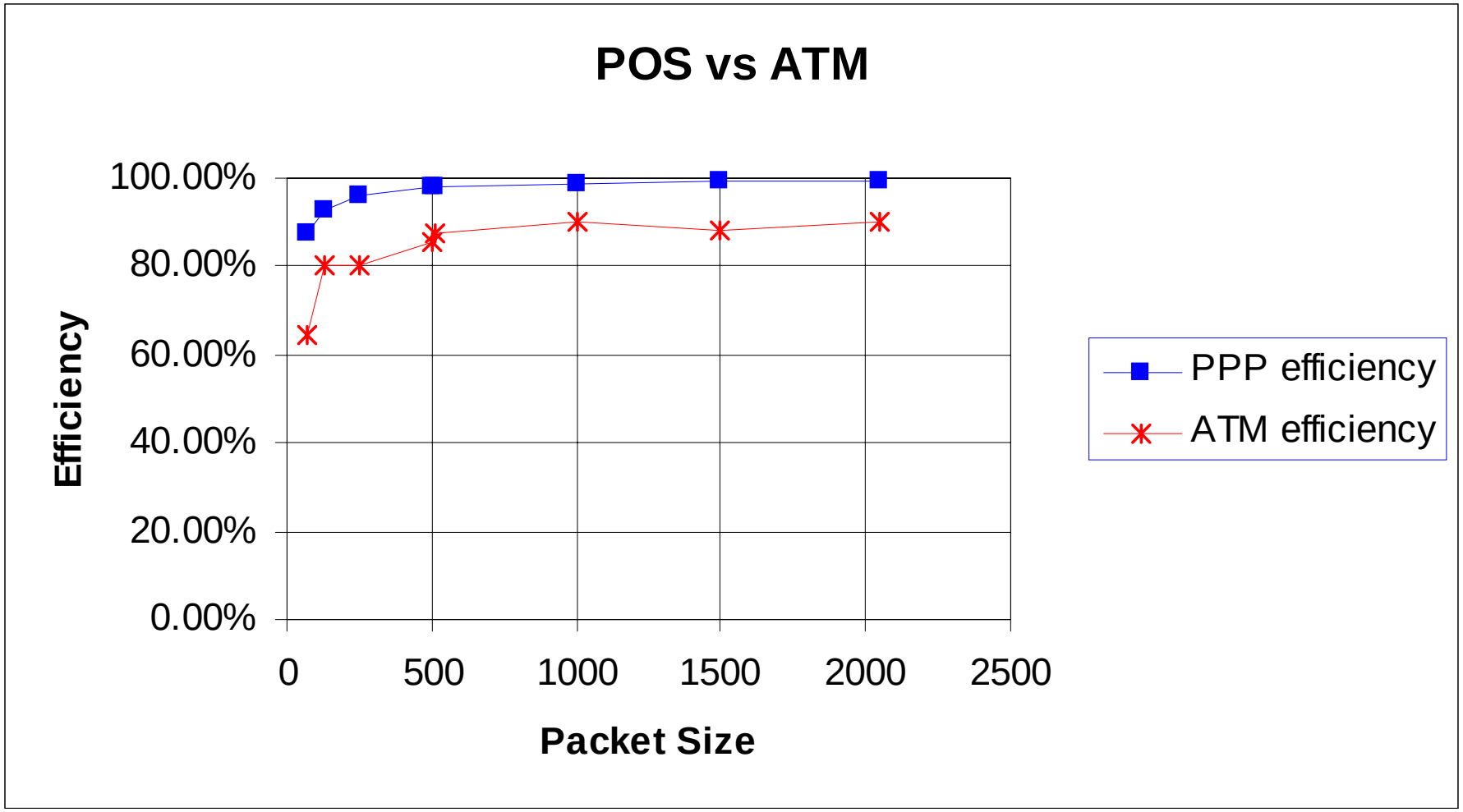
- Video Formats
  - ITU Recommendation H.261 - Video codec for audiovisual services at p x 64 kbit/s
  - MPEG-1
  - Vxtreme
- Network Interoperability
  - IP-based
  - IETF IP Multicast
- Current Uses
  - Management broadcasts, training programs, university classes and business TV

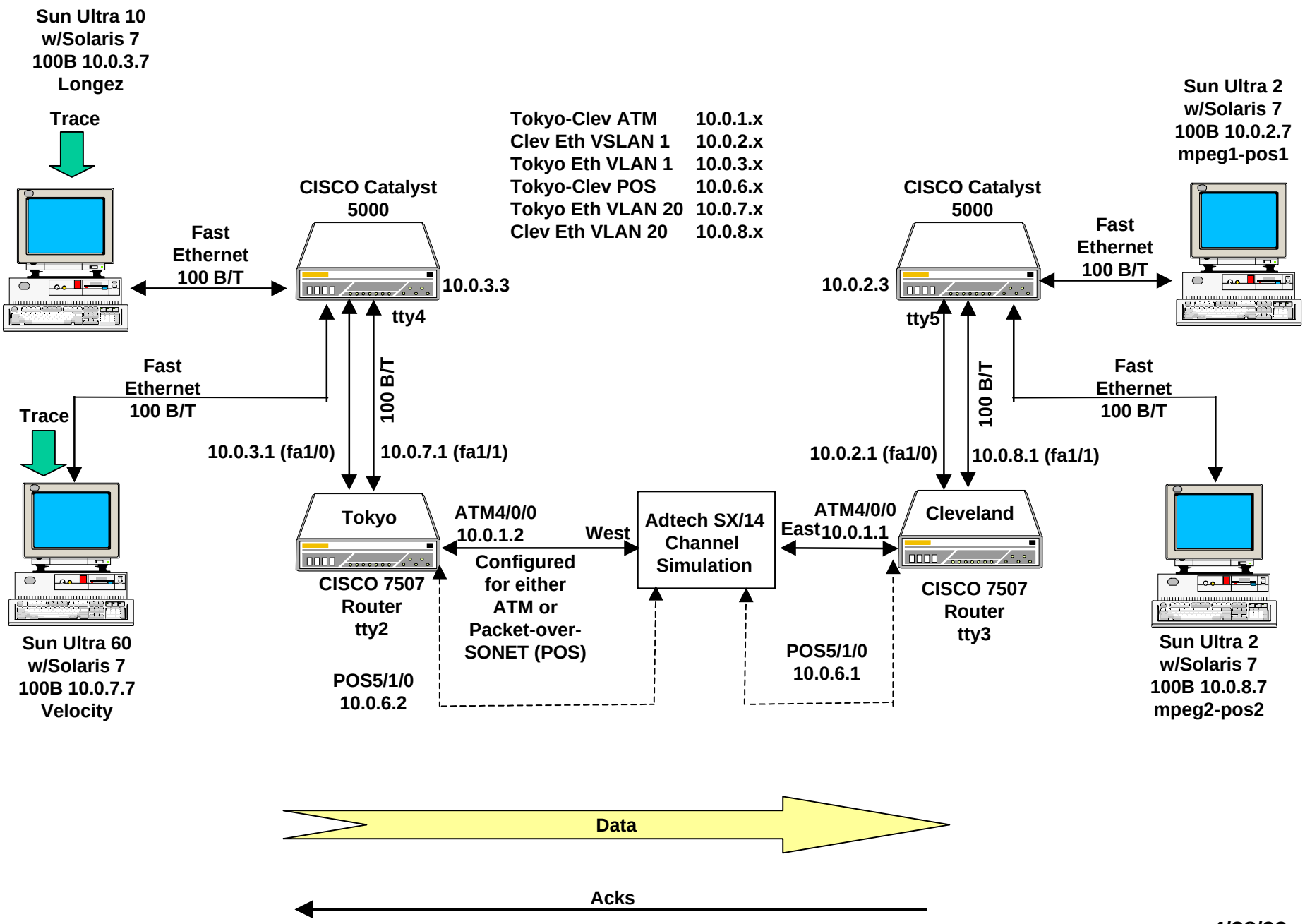
POS and ATM Comparisons

POS versus ATM

- Determine Bandwidth Efficiency of ATM and POS
  - Cell vs Packet overhead
  - Processing requirements
- Compare QoS capabilities of ATM and POS
  - PNNI
  - *Differentiated Services*
  - RSVP

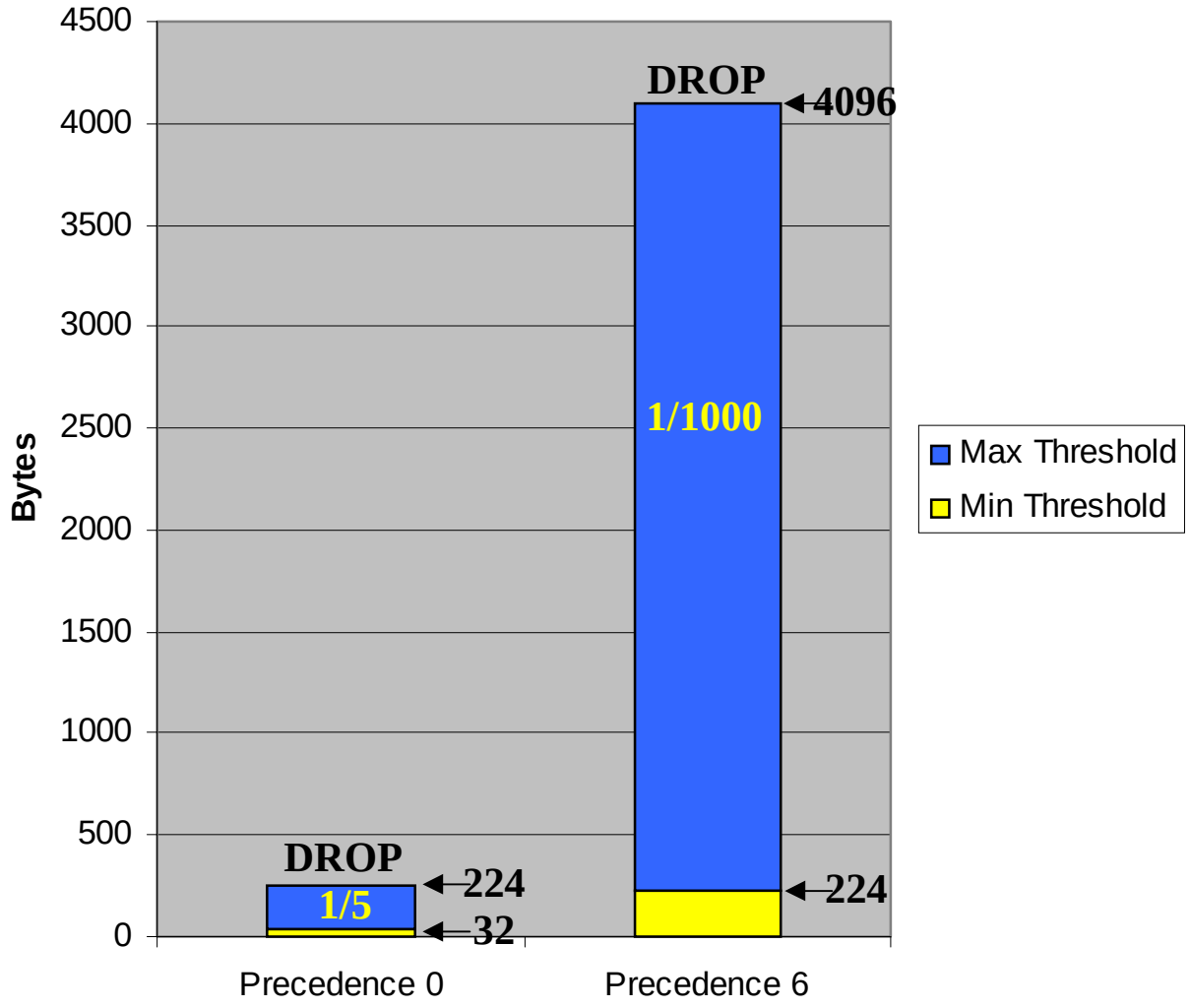
Theoretical Max. ***IP*** BW Efficiency




Sun Ultra 10
w/Solaris 7
100B 10.0.3.7
Longez
Trace
Fast
Ethernet
100 B/T
CISCO Catalyst
5000
10.0.3.3
tty4
Tokyo-Clev ATM 10.0.1.x
Clev Eth VSLAN 1 10.0.2.x
Tokyo Eth VLAN 1 10.0.3.x
Tokyo-Clev POS 10.0.6.x
Tokyo Eth VLAN 20 10.0.7.x
Clev Eth VLAN 20 10.0.8.x
Sun Ultra 2
w/Solaris 7
100B 10.0.2.7
mpeg1-pos1
CISCO Catalyst
5000
10.0.2.3
tty5
Fast
Ethernet
100 B/T
Fast
Ethernet
100 B/T
Trace
100 B/T
10.0.3.1 (fa1/0)
10.0.7.1 (fa1/1)
10.0.2.1 (fa1/0)
10.0.8.1 (fa1/1)
100 B/T
Fast
Ethernet
100 B/T
Tokyo
ATM4/0/0
10.0.1.2
West
Adtech SX/14
Channel
Simulation
East
ATM4/0/0
10.0.1.1
Cleveland
CISCO 7507
Router
tty2
Configured
for either
ATM or
Packet-over-
SONET (POS)
CISCO 7507
Router
tty3
Sun Ultra 60
w/Solaris 7
100B 10.0.7.7
Velocity
POS5/1/0
10.0.6.2
POS5/1/0
10.0.6.1
Sun Ultra 2
w/Solaris 7
100B 10.0.8.7
mpeg2-pos2
Data
Acks

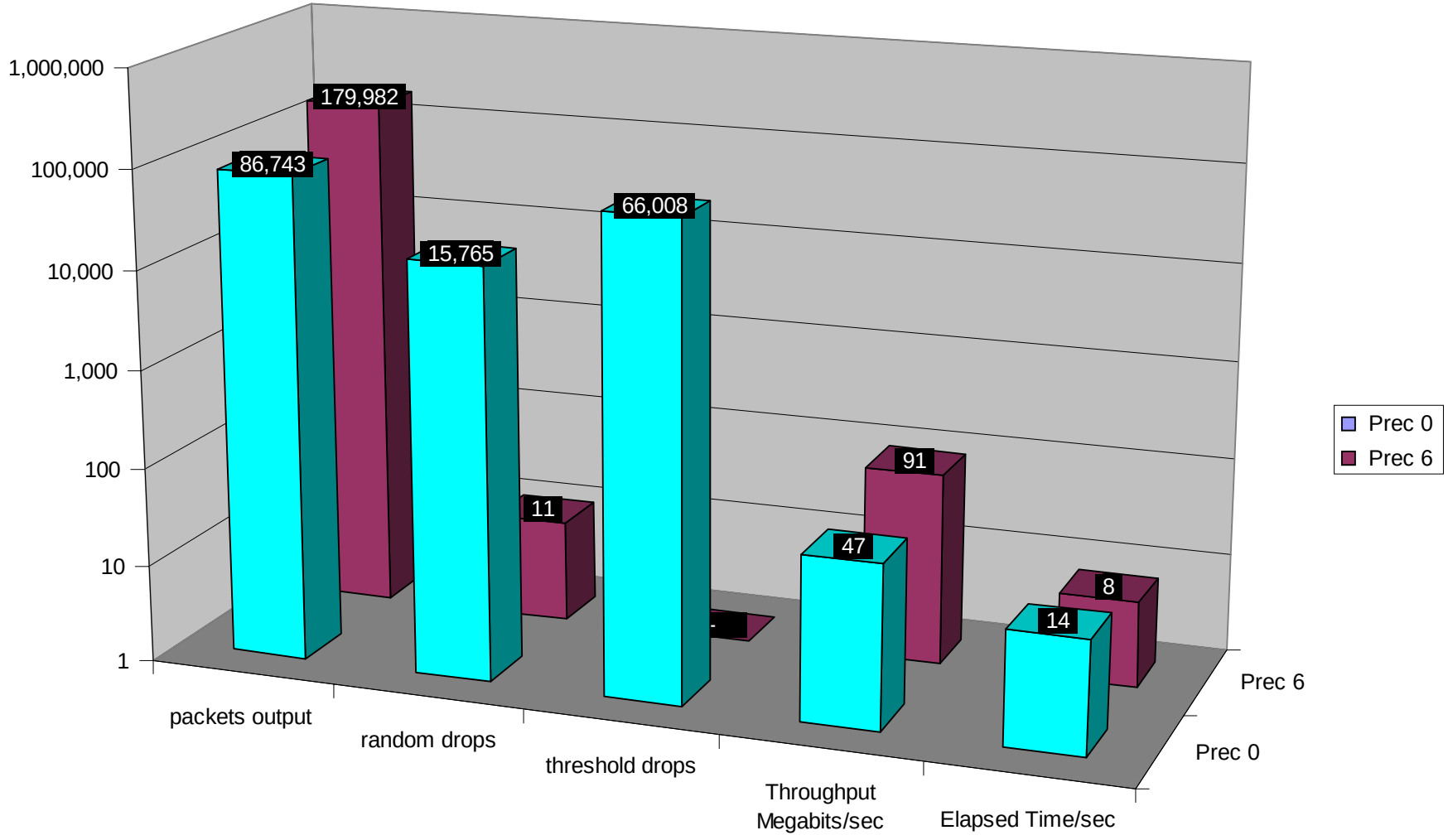
4/28/99

Queue Sizes


4500
4000
3500
3000
2500
2000
1500
1000
500
0
Bytes
DROP
4096
1/1000
DROP
224
1/5
32
224
Precedence 0
Precedence 6
Max Threshold
Min Threshold

POS UDP prec 0 prec 6

Precedence 0: 32 min threshold, 256 max threshold, 1/5 mark weight
Precedence 6: 224 min threshold, 4096 max threshold, 1/1000 mark weight



ATM UDP prec 0 prec 6

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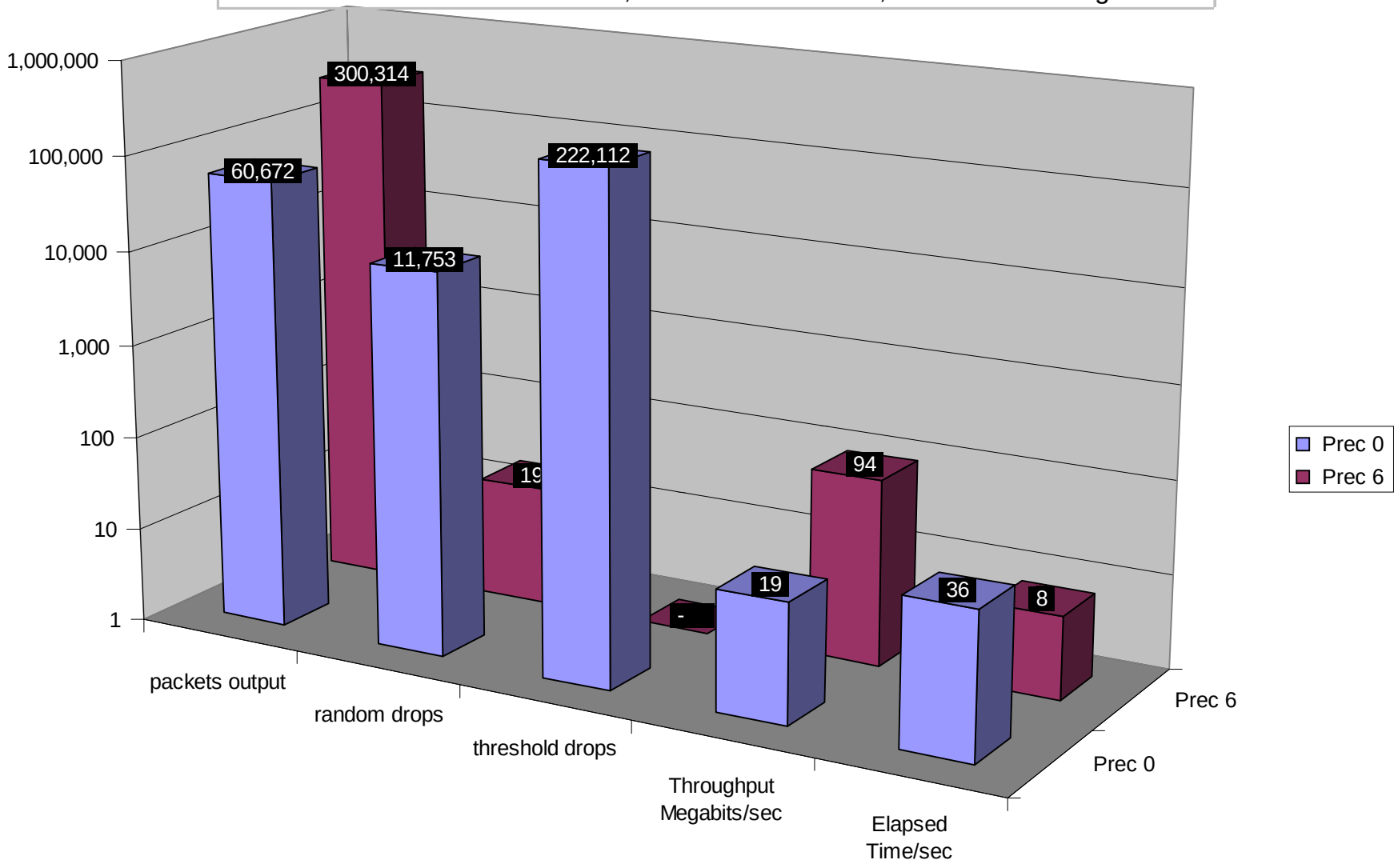
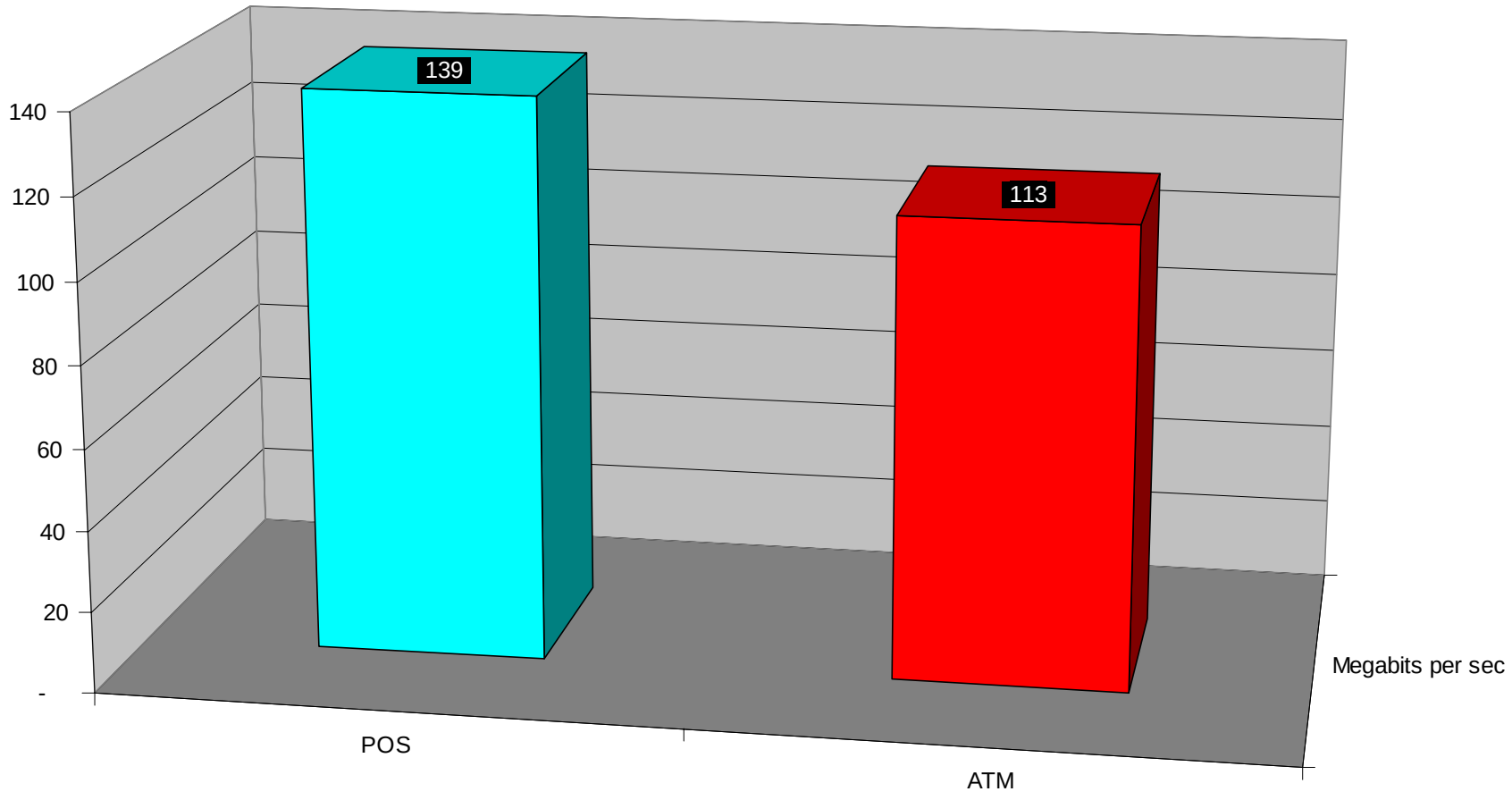


POS/ATM goodput UDP
(Two Sources)



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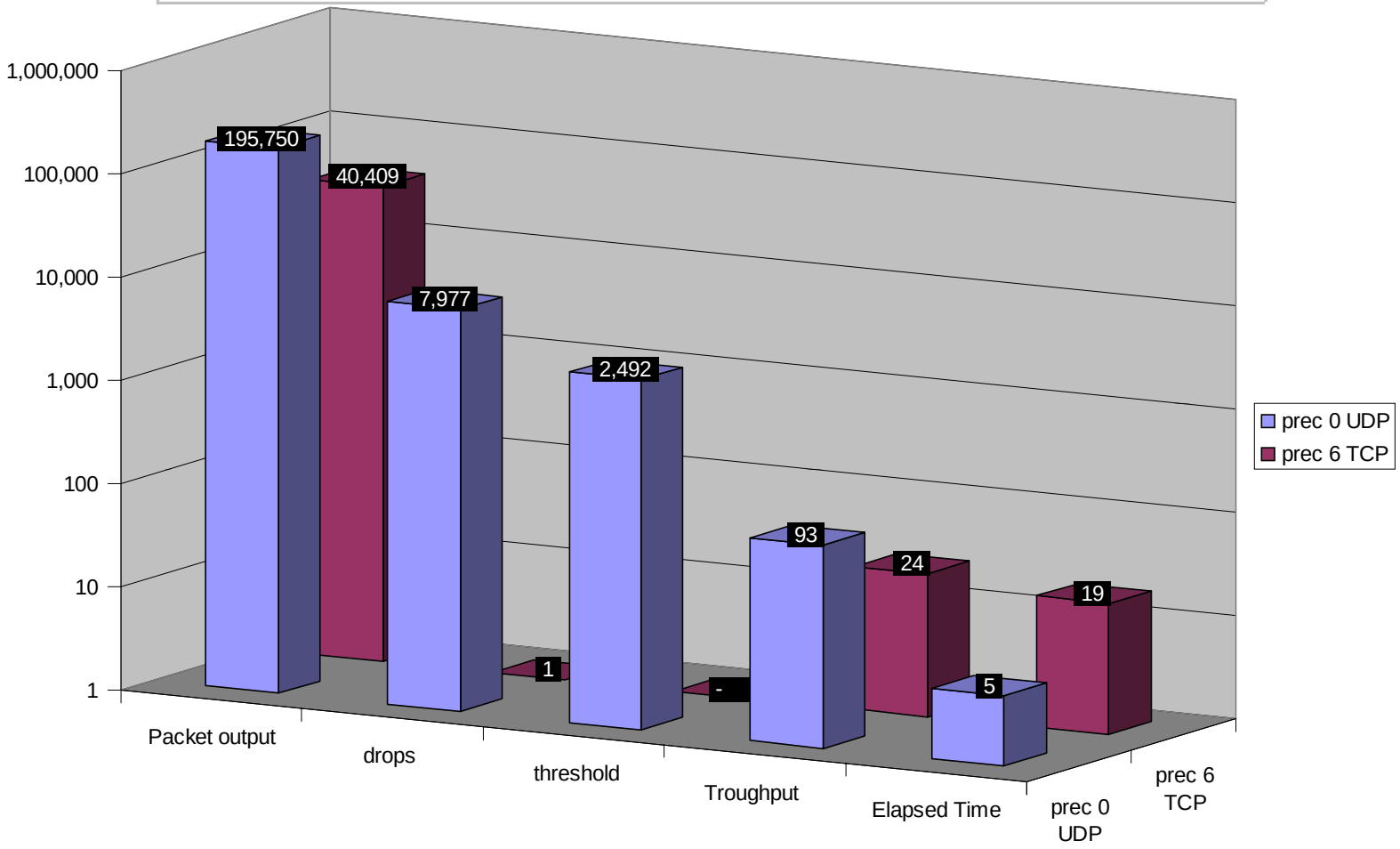

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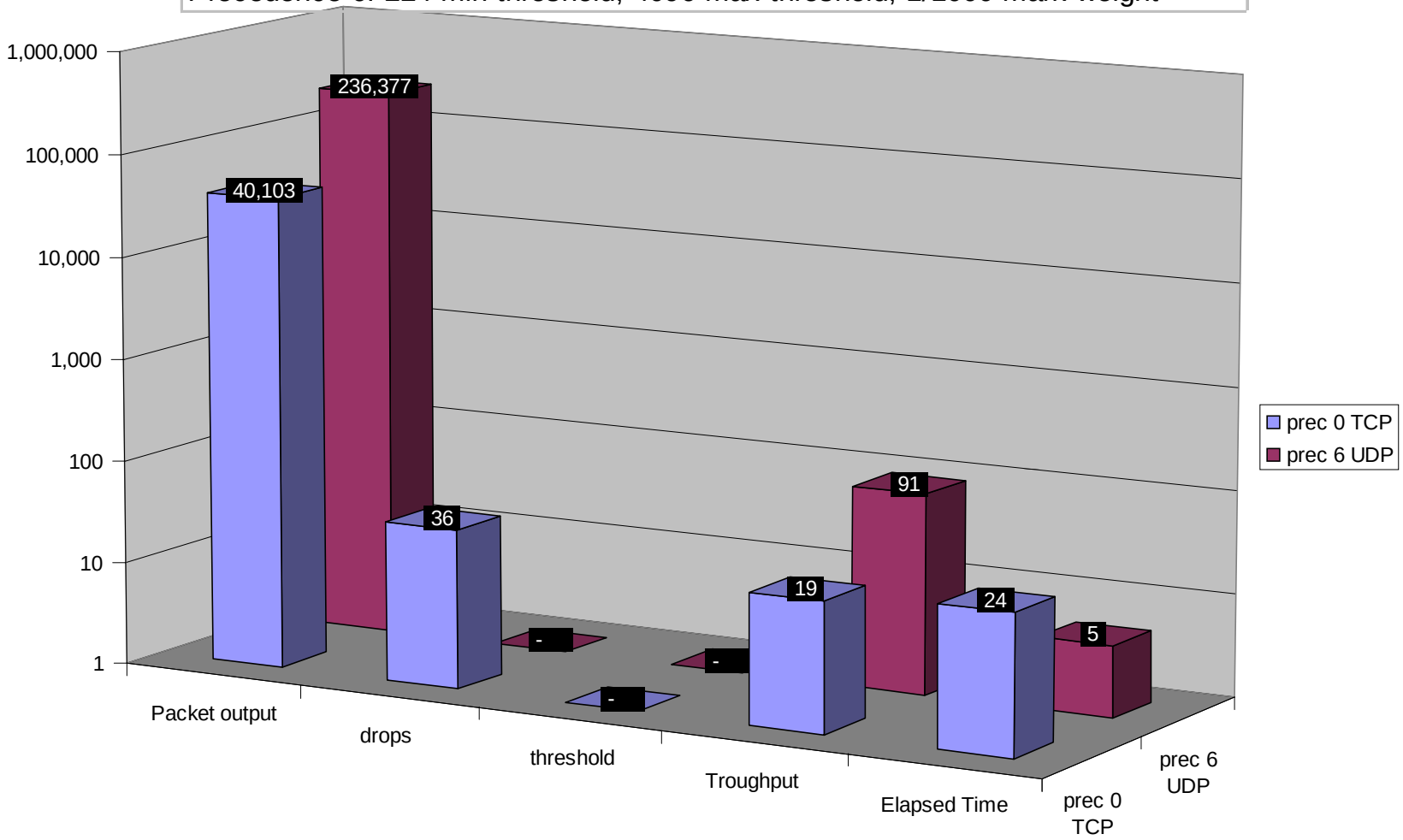

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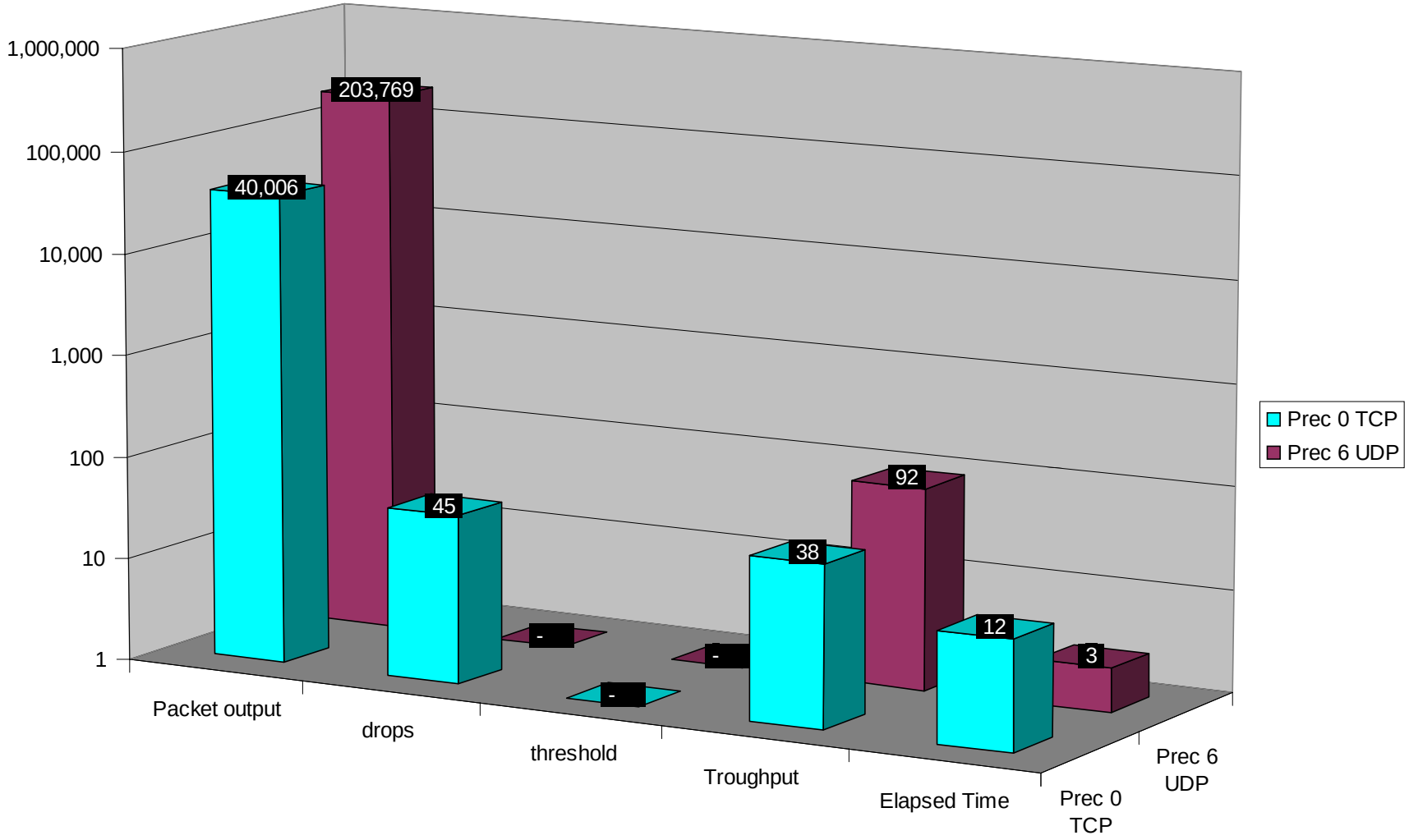

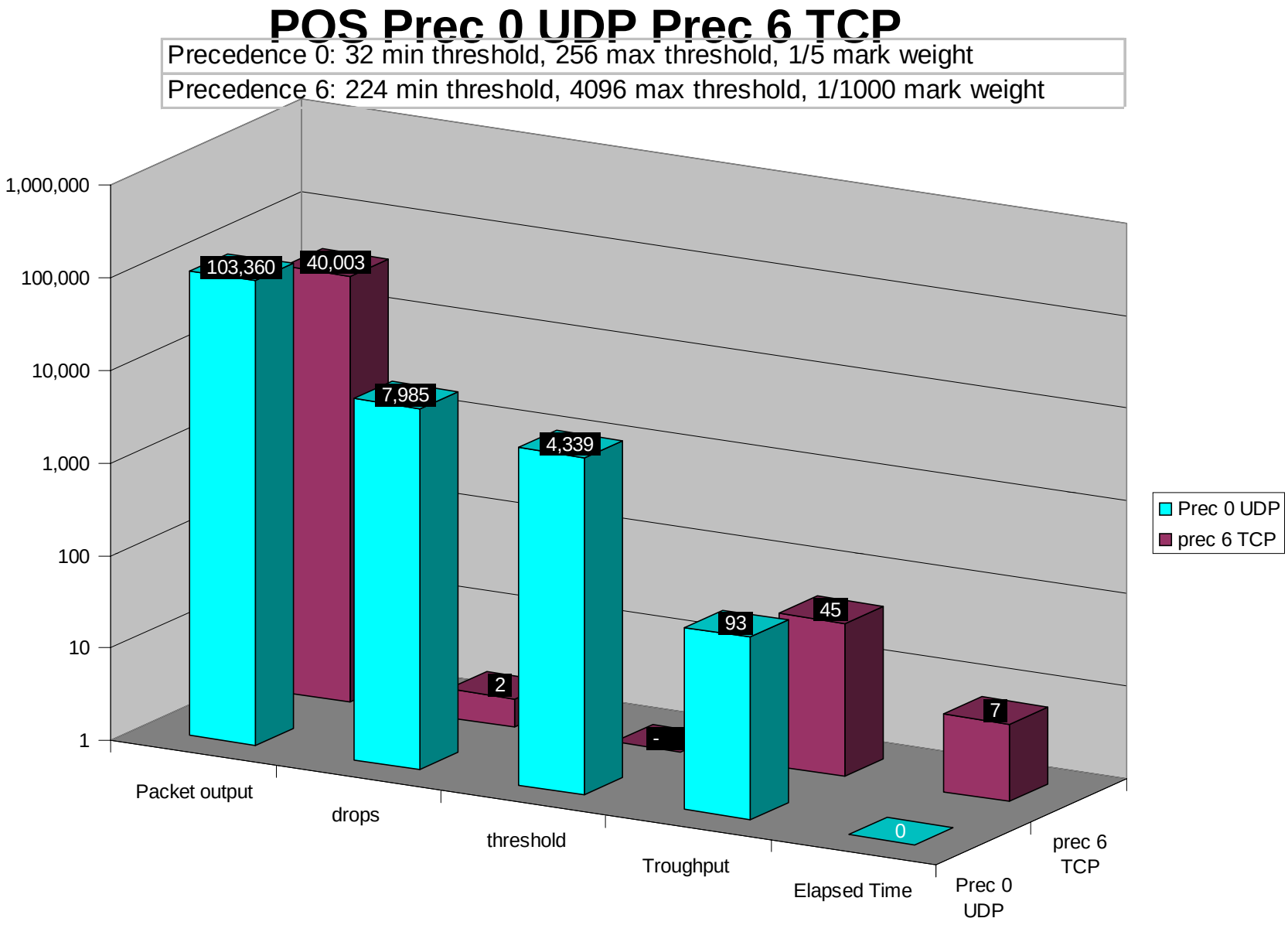
POS Prec 0 UDP Prec 6 TCP
Precedence 0: 32 min threshold, 256 max threshold, 1/5 mark weight
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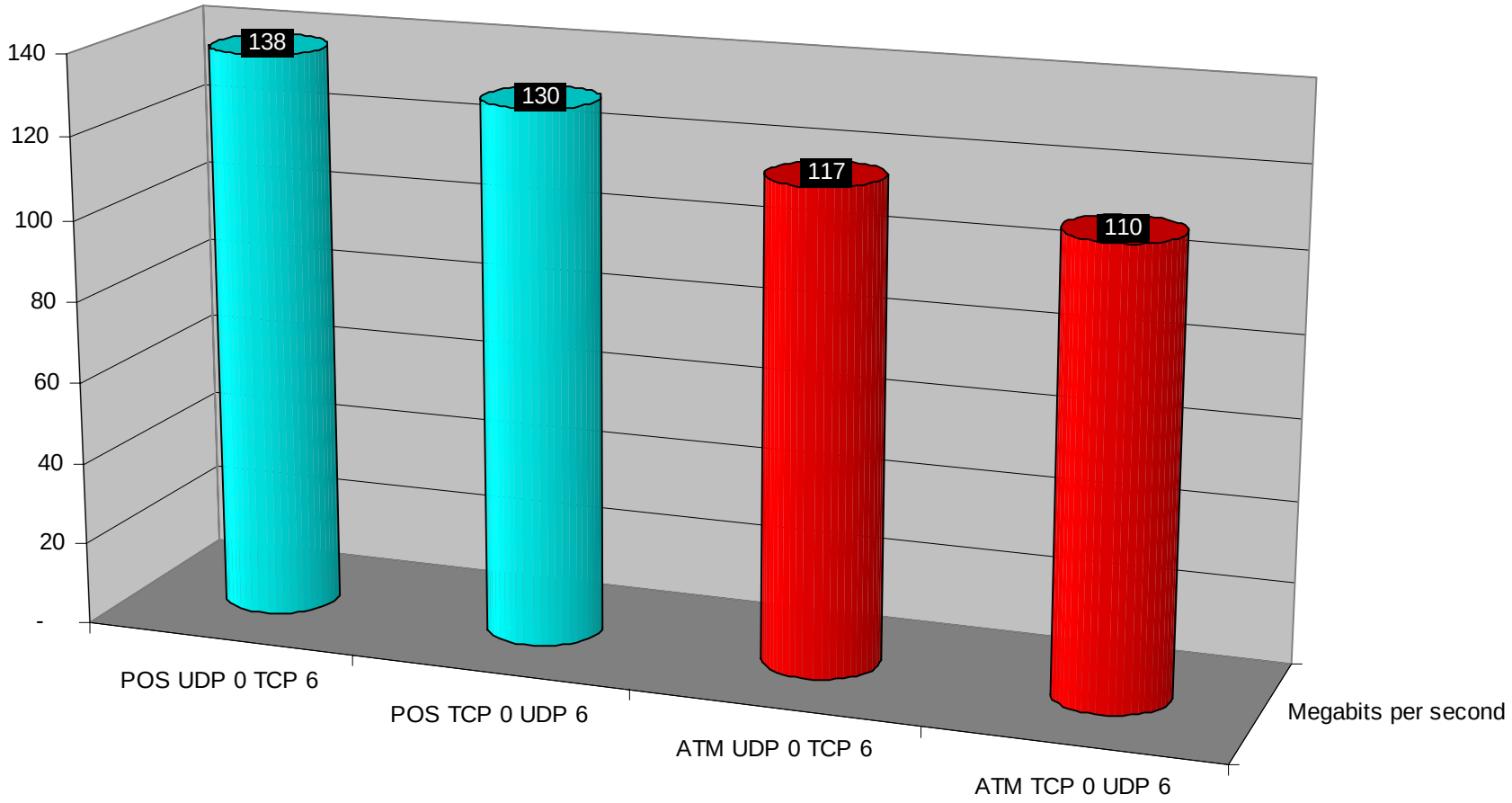
1,000,000
100,000
10,000
1,000
100
10
1
103,360
40,003
7,985
2
4,339
-
93
45
0
7
Packet output
drops
threshold
Troughput
Elapsed Time
Prec 0 UDP
prec 6 TCP
Prec 0 UDP
prec 6 TCP

POS/ATM UDP/TCP
Goodput



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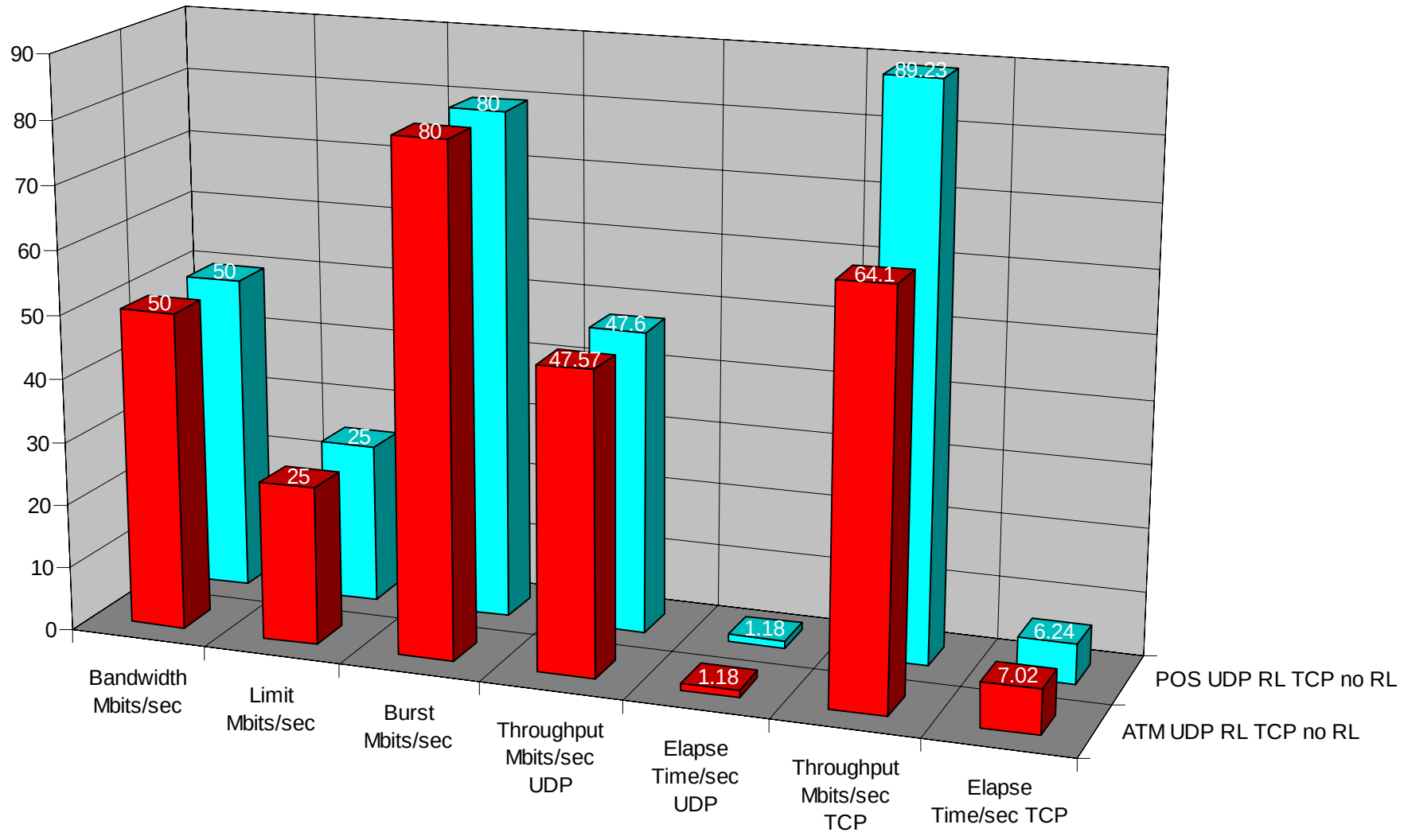
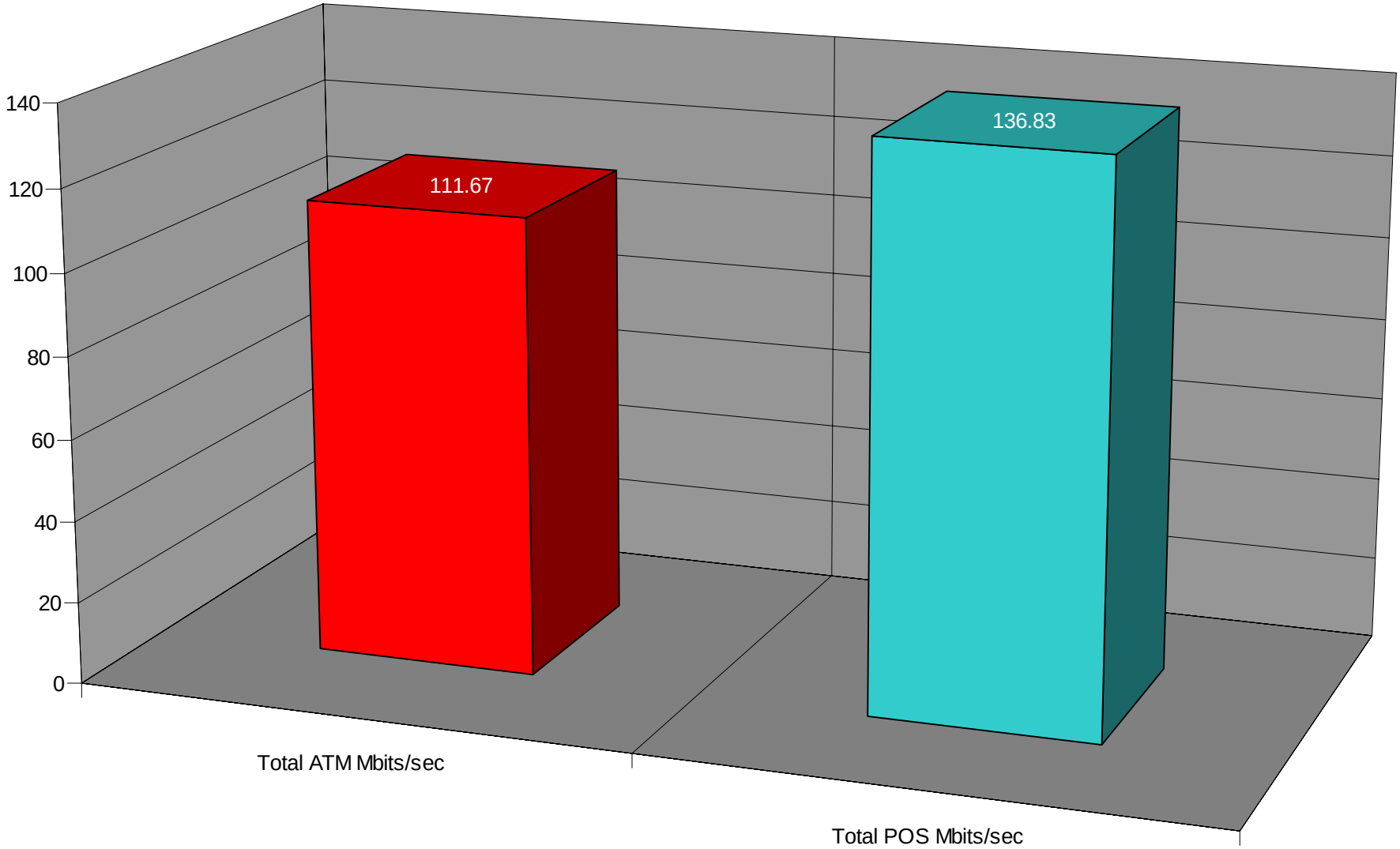
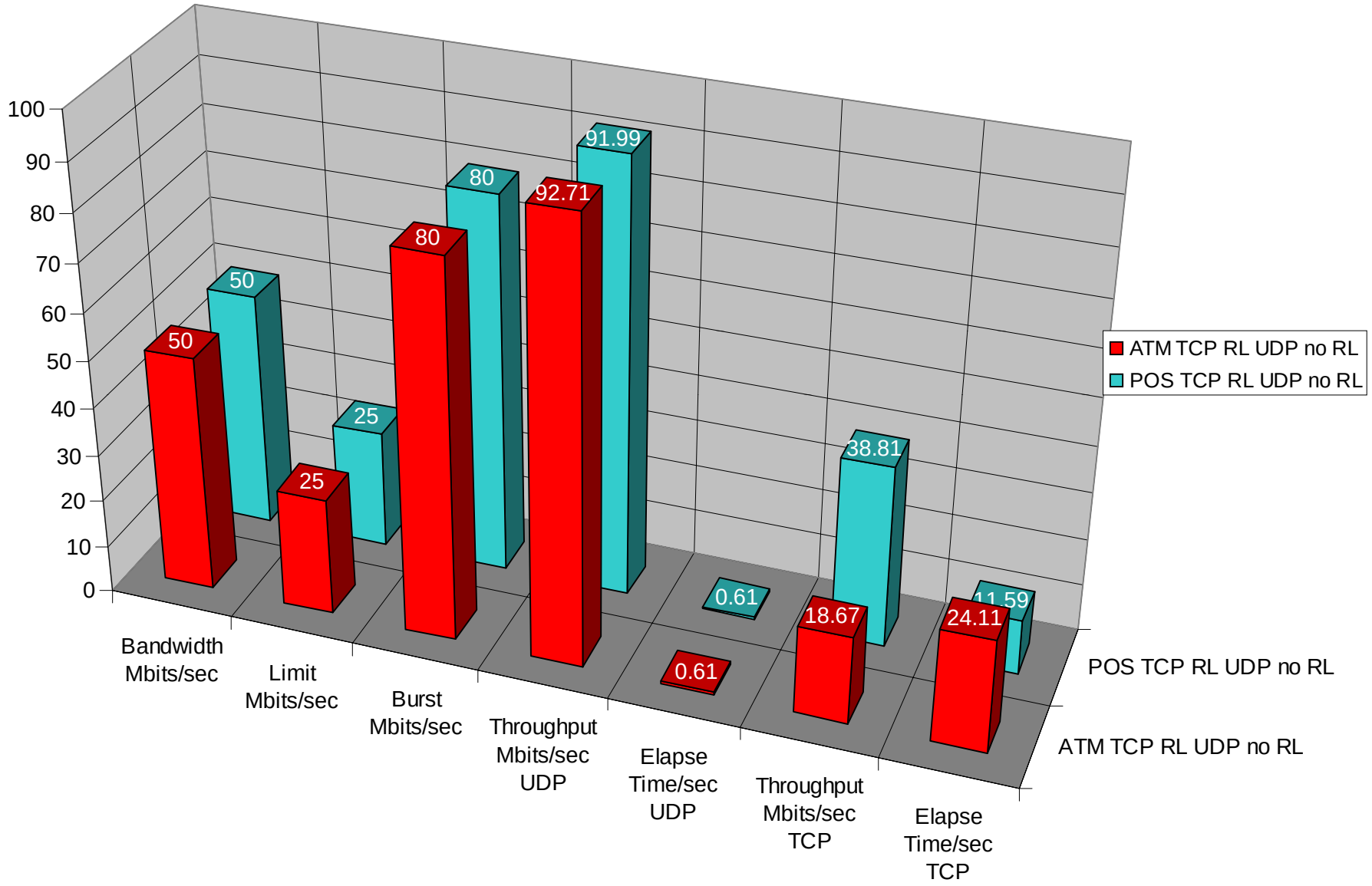
Committed Access Rate
UDP Rate Limited TCP no Rate Limit



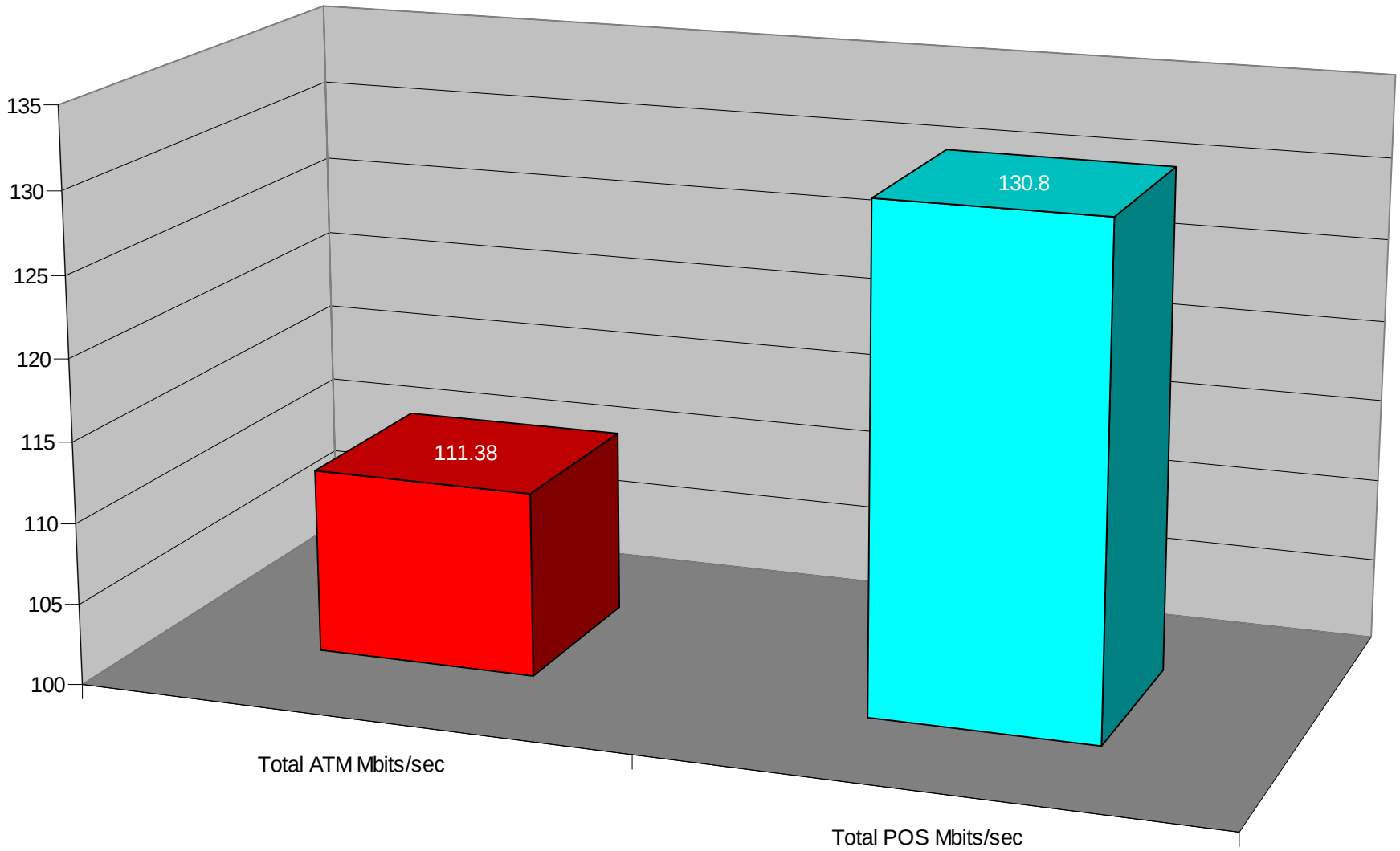
POS vs ATM Tput w/UDP Rate Limit



Commite Access Rate
TCP rate limited UDP no Rate limit



POS vs ATM Tput w/TCP Rate Limit



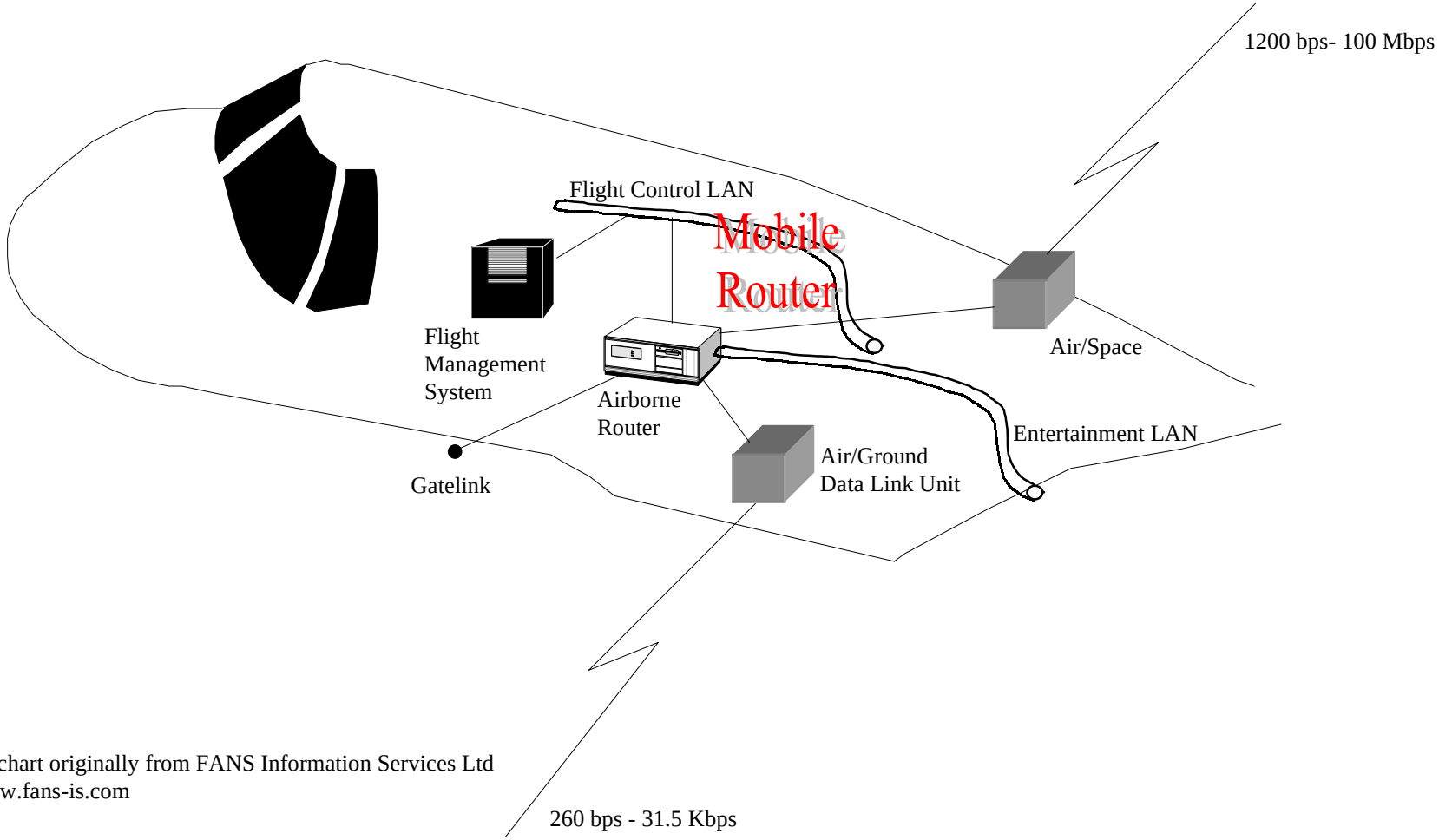
Research Plans

- Add FAX and IP to In-Space Internet Testbed
- Add satellite delay to TCP tests
  - Need to obtain proper TCP stack operation in high delay environment
- Run differentiated services experiments using weighted random early detection (WRED)
- Run differentiated services experiments using per-flow WRED

Tomorrow

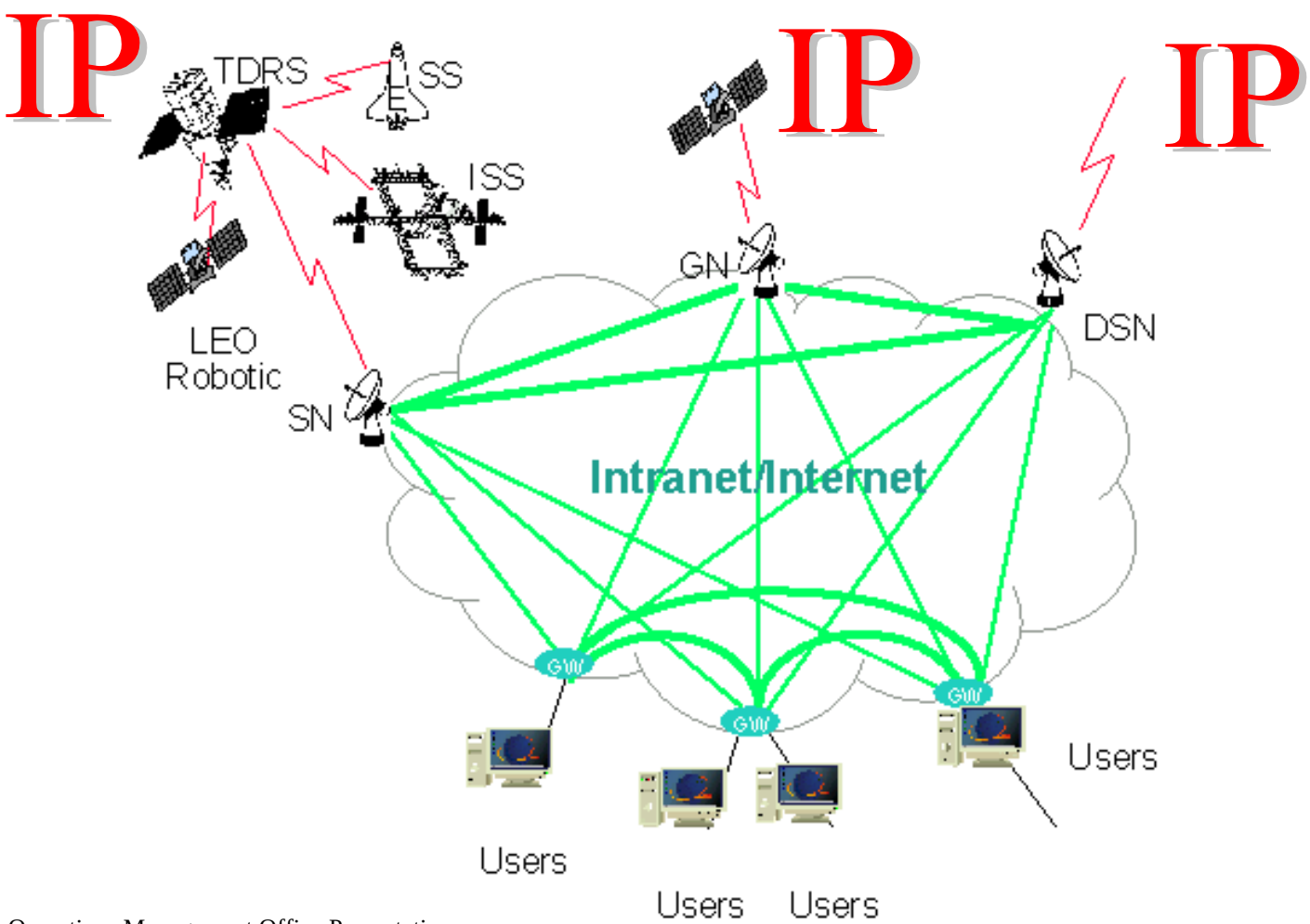
It's closer than you think.

Airborne Router



Enhance chart originally from FANS Information Services Ltd
http://www.fans-is.com

NASA Network Tomorrow



From Space Operations Management Office Presentation
http://www.csoconline.com/sec_02/SOMO_Presentation/index.htm

END

The following charts provide details and may be used to answer questions.

Single Flow TCP Buffer Requirements

TCP Required Buffer Size

Max Throughput Mbps	RTT msec	*Required Buffer Size bytes
10	20	25,000
50	20	125,000
100	20	250,000
534	20	1,335,000
10	550	687,500
50	550	3,437,500
100	550	6,875,000
534	550	36,712,500

* Rounded down to prevent self-congestion

ATM and POS Max IP BW Efficiency

pkt size bytes	PPP overhead bytes	PPP efficiency %	ATM overhead bytes	ATM efficiency %	OC3 IP PPP pps	OC3 IP ATM pps	OC3 IP PPP Avail BW	OC3 IP ATM Avail BW
68	10	87.18%	28	64.15%	240,000	176,604	130.56	96.07
128	10	92.75%	16	80.50%	135,652	117,736	138.91	120.56
256	10	96.24%	32	80.50%	70,376	58,868	144.13	120.56
500	10	98.04%	28	85.76%	36,706	32,110	146.82	128.44
512	10	98.08%	16	87.82%	35,862	32,110	146.89	131.52
1000	10	99.01%	8	89.85%	18,535	16,819	148.28	134.56
1500	10	99.34%	36	88.44%	12,397	11,038	148.77	132.45
2048	10	99.51%	16	89.86%	9,096	8,214	149.03	134.58
4096	10	99.76%	32	89.86%	4,559	4,107	149.40	134.58
9180	10	99.89%	36	90.21%	2,037	1,840	149.60	135.10