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Guaranteed Rate for Improving TCP Performance on UBR+ over Terrestrial and Satellite Networks

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Overview

❑ What is Guaranteed Rate (GR) Service?

❑ Effect of Guaranteed Rate on UBR performance

❑ Results for LAN, WAN, and Satellite Networks

Goal
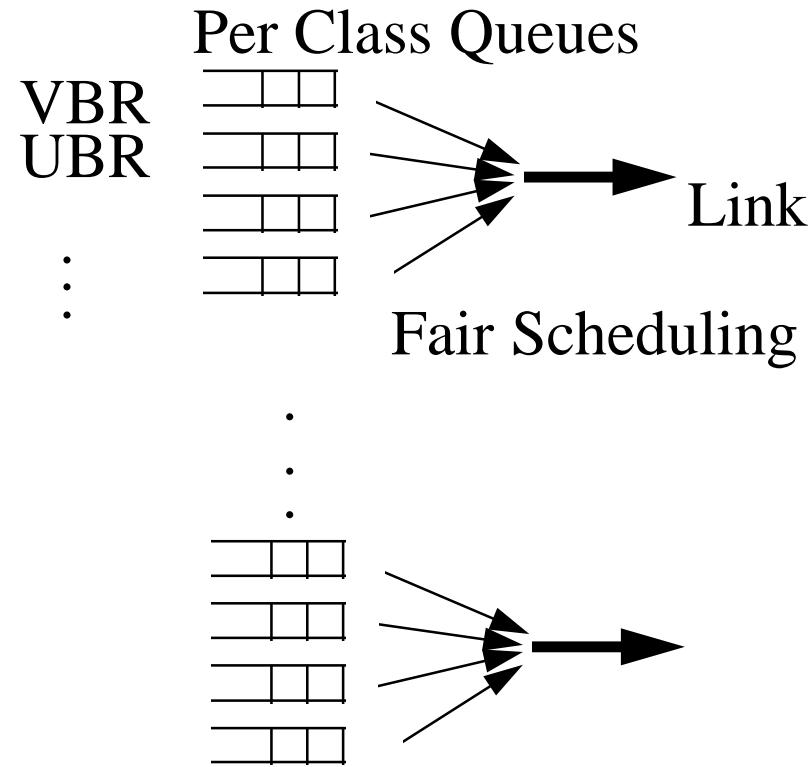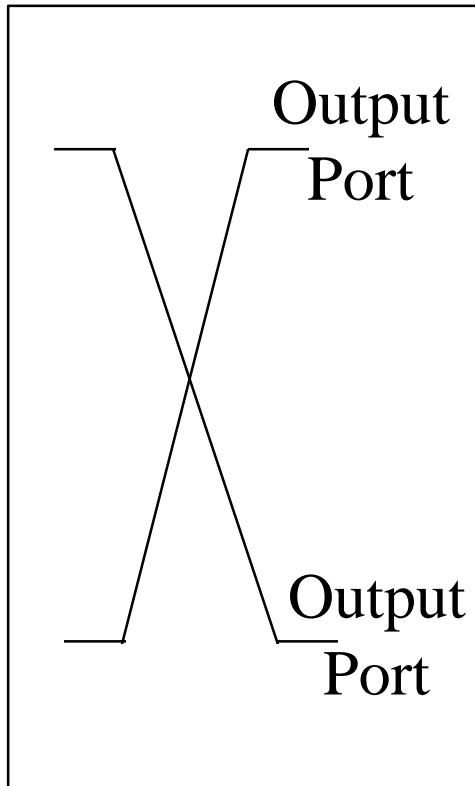
❑ Q: Will UBR work if the available bandwidth varies significantly?

❑ All past results have assumed no VBR background. Fixed link capacities.

❑ If UBR is starved, the connections may timeout.

❑ Q: Does reserving minimum bandwidth for UBR help? If so, how much?

GR vs GFR

| GR	GFR
per-class reservation	per-VC reservation
per-class scheduling	per-VC accounting/scheduling
No new signaling	Need new signaling
Can be done now	In TM4+
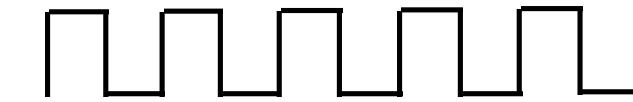
❑ Note: Typo in Contribution. Replace "Guaranteed Rate" in line 5 of Introduction by "Guaranteed Frame Rate" (twice).

Guaranteed Rate Model

Per Class Queues

VBR
UBR

Output Port

Output Port

Link

Fair Scheduling

- W/o GR, VBR has strict priority over UBR
- With GR, UBR gets GR + left over

Available UBR Capacity

VBR on/off pattern

GR = 0.0
Strict Priority

GR = 0.1

GR = 0.5

Guaranteed rate to VBR Guaranteed rate to UBR Available rate for UBR

Efficiency Without GR

Config-uration	# of Srcs	Buffer (cells)	VBR period (ms)	UBR	EPD	Selective Drop
LAN	5	1000	300	0.71	0.88	0.98
LAN	5	3000	300	0.83	0.91	0.92
LAN	5	1000	100	0.89	0.97	0.95
LAN	5	3000	100	0.96	0.95	0.96
LAN	5	1000	50	0.97	0.93	0.93
LAN	5	3000	50	0.95	0.97	0.97
WAN	5	12000	300	0.42	0.43	0.61
WAN	5	36000	300	0.55	0.52	0.96
WAN	5	12000	100	0.72	0.58	0.70
WAN	5	36000	100	0.95	0.97	0.97
WAN	5	12000	50	0.97	0.65	0.73
WAN	5	36000	50	0.97	0.98	0.98

❑ UBR can sustain short outages.

❑ Efficiency degrades significantly for long outages.

Fairness without GR

Config-uration	# of Srcs	Buffer (cells)	VBR period (ms)	UBR	EPD	Selective Drop
LAN	5	1000	300	0.21	0.20	0.20
LAN	5	3000	300	0.95	0.99	0.99
LAN	5	1000	100	0.21	0.20	0.99
LAN	5	3000	100	0.91	0.93	0.96
LAN	5	1000	50	0.20	0.21	0.96
LAN	5	3000	50	0.93	0.99	1.00
WAN	5	12000	300	0.99	0.97	0.82
WAN	5	36000	300	0.88	0.97	0.63
WAN	5	12000	100	0.99	0.96	0.93
WAN	5	36000	100	1.00	0.88	0.89
WAN	5	12000	50	0.92	0.98	0.97
WAN	5	36000	50	1.00	0.97	0.80

❑ In LAN cases, less fairness if UBR is starved.

Efficiency
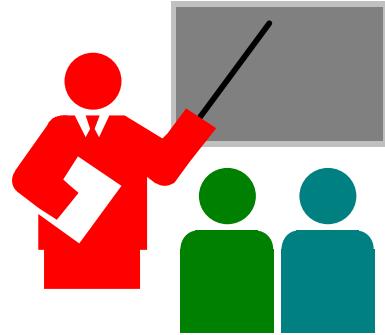
	TCP\GR	EPD			Selective Drop			No EPD		
		0.50	**0.10**	**0.00**	**0.50**	**0.10**	**0.00**	**0.50**	**0.10**	**0.00**
Satellite	Reno	0.41	0.30	0.23	0.34	0.32	0.23	0.86	0.53	0.43
	Sack	0.92	0.94	0.91	0.93	0.89	0.87	0.90	0.92	0.88
	Vanilla TCP	0.75	0.78	0.73	0.81	0.76	0.79	0.85	0.78	0.83
WANs	Reno	0.96	0.84	0.64	0.81	0.71	0.45	0.96	0.83	0.50
	Sack	0.93	0.80	0.54	0.99	0.85	0.78	0.94	0.88	0.64
	Vanilla TCP	0.96	0.81	0.56	0.97	0.84	0.74	0.95	0.88	0.76
LANs	Reno	0.60	0.62	0.68	0.76	0.81	0.73	0.48	0.48	0.39
	Sack	0.88	0.79	0.91	0.94	0.90	0.94	0.63	0.75	0.64
	Vanilla TCP	0.63	0.67	0.71	0.81	0.82	0.82	0.65	0.48	0.40

Highly unfair

Fairness

		EPD			Selective Drop				
	TCP\GR	0.10	0.00	0.50	0.10	0.00	0.50	0.10	
Satellite	Reno	0.74	0.99	0.85	0.96	0.99	0.86	0.85	0.94
	Sack	0.98	0.88	1.00	0.96	0.91	0.94	0.88	0.94
	Vanilla TCP	1.00	0.92	0.99	0.94	1.00	0.93		
WANs		0.95	0.78	0.96	0.77	0.72	0.95		
		0.96	0.89	0.89	0.80	0.85	0.88		
	Vanilla TCP	0.84	0.78	0.90	0.94	0.81	0.88	0.96	0.89
LANs	Reno	0.88	0.83	0.63	0.98	0.82	0.82	0.67	0.81
	Sack	0.89	0.82	0.49	0.93	0.71	0.69	0.53	0.51
	TCP	0.83	0.59	0.94	0.89	0.65	0.76	0.64	0.59

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Summary

❑ Guaranteed rate is helpful in WANs.

❑ For WANs, the effect of GR=0.1 is more than that obtained by EPD, SD, or FBA

❑ For LANs, guaranteed rate is not so helpful. Drop policies are more important.

❑ For Satellites, end-system policies seem more important.