### Performance evaluation and enhancement of WLAN

(CMPT885 / ENSC835)

#### **Demo Plan**

Jiaqing (James) Song songs@acm.org Spring 2002

### **Contents of Demo**

- OPNET WLAN Models
- PHY Characteristics
- WLAN Parameters
- Adaptive Backoff
- SMART Snoop\*
- References

### **OPNET WLAN Models**











Application Config Profile Config

Task Config







song\_wlan\_ethernet\_router\_adv\_ss (fix) song\_wlan\_ethernet\_router\_adv\_ss (mob) song\_wlan\_station\_adv (fix)









song\_wlan\_station\_adv (mob) wlan\_ethernet\_router (mob) wlan\_ethernet\_router (fix) wlan\_eth\_bridge



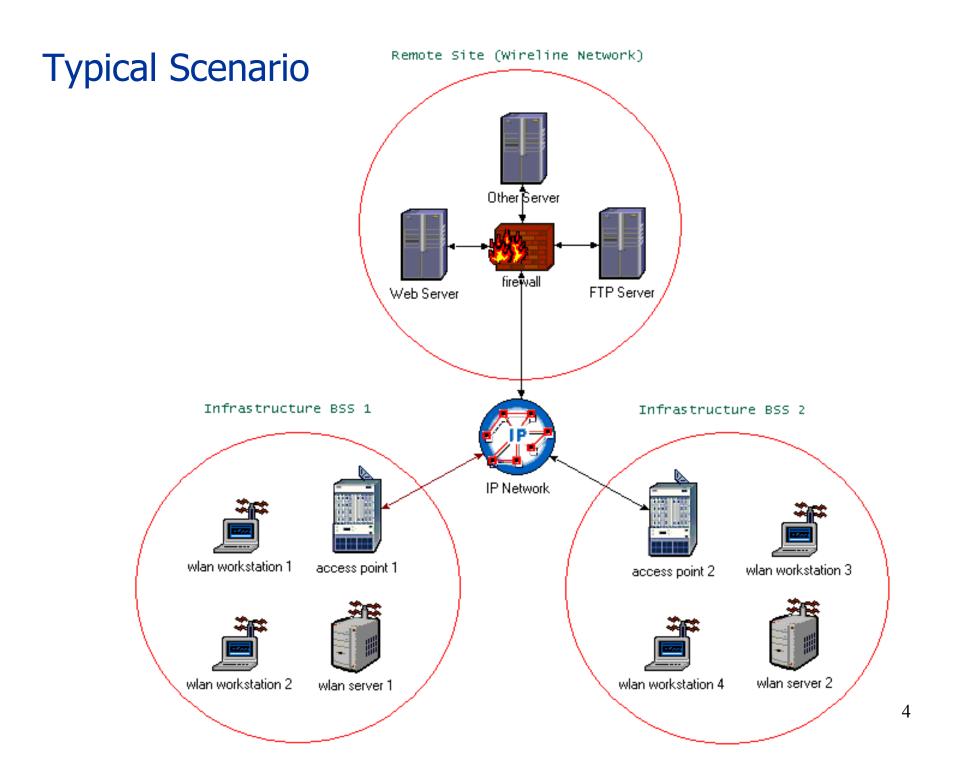






wlan\_wkstn (fix) wlan\_wkstn (mob) wlan\_server (fix) wlan\_server (mob)

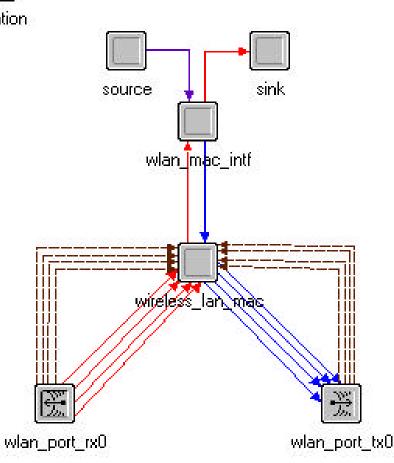




# OPNET WLAN Models - WLAN Station



wlan station



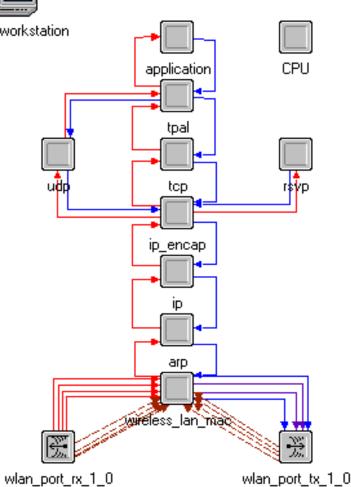
#### **OPNET WLAN Models** - WLAN Workstation/Server





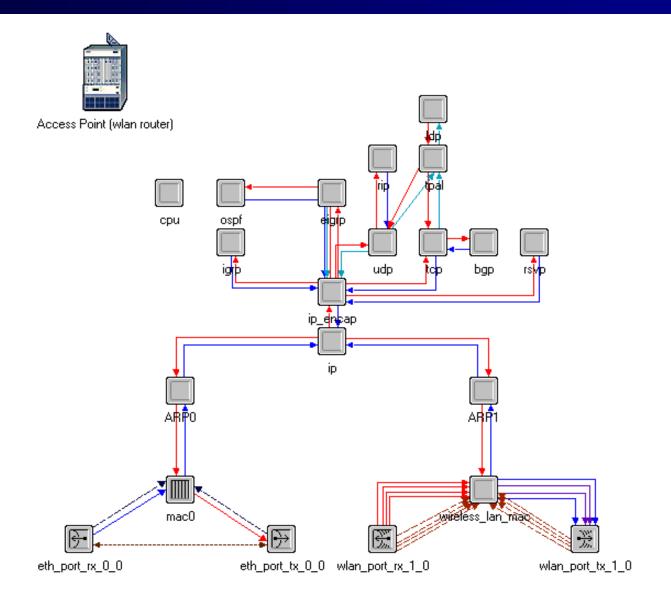
wlan server





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# OPNET WLAN Models - WLAN Router



### Performance enhancementSurvey of Methods

- Physical layer characteristics (slot time, SIFS)
- Tune up the WLAN parameters (Fragmentation threshold, RTS threshold, ...)
- Adaptive back-off protocol on MAC layer
- Proxy approach (snoop, SMART snoop protocol)
- Reliable link-layer approach (AIRMAIL)
- Split-connection approach (I-TCP, M-TCP)

#### Part 1: PHY Characteristics

- Analyze the effect of PHY characteristics
- PHY characteristics provided by OPNET model: Frequency Hopping, Direct Sequence, Infra Red
- OPNET does not provide customized PHY characteristics
- Add Slot Time, Sifs Time, Minimum Contention Window, Maximum Contention Window parameters into the OPNET node model

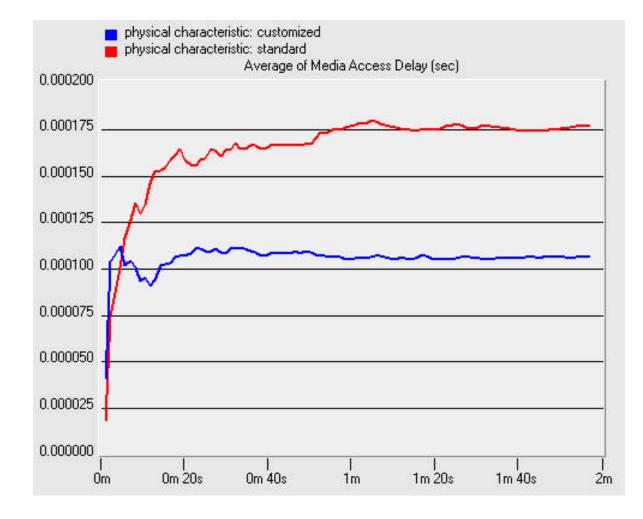
#### Part 1: PHY Characteristics - Customized Settings

ttribute	Value	
ts Threshold (bytes)	None	
ragmentation Threshold (bytes)	None	Frequency Hopping
)ata Rate (bps)	11 Mbps	Direct Sequence
hysical Characteristics	Customized	Infra Red
Short Retry Limit (slots)	7	Customized
ong Retry Limit (slots)	4	
ccess Point Functionality	Disabled	
hannel Settings	()	
luffer Size (bits)	256000	
lax Receive Lifetime (secs)	0.5	
arge Packet Processing	Drop	
ISS Identifier	Not Used	
Hot Time	2E-05	•
Sifs Time	1E-05	
lin Contention Window	15	
lex Contention Window	1023	

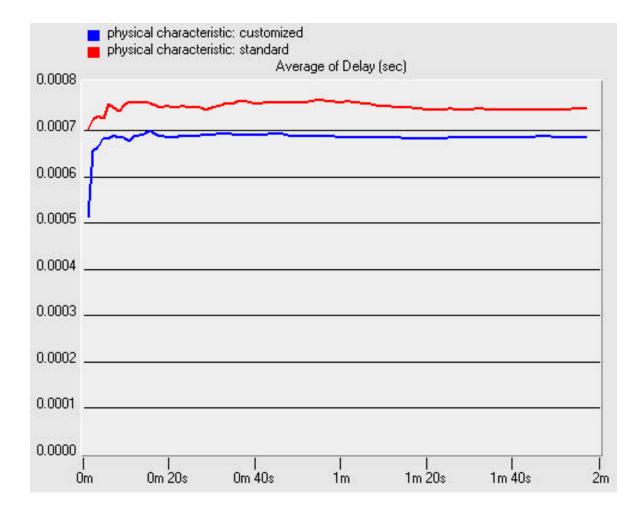
#### Part 1: PHY Characteristics - Scenario

0	25	50	75	100	125	150	175
25							
50							
75							
100					node_1	,	
125							
150							

#### Part 1: PHY Characteristics – Results of Customized SIFS (1)

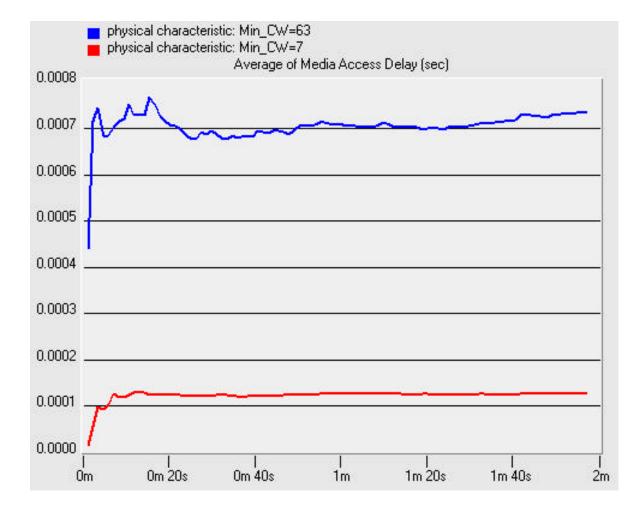


#### Part 1: PHY Characteristics – Results of Customized SIFS (2)

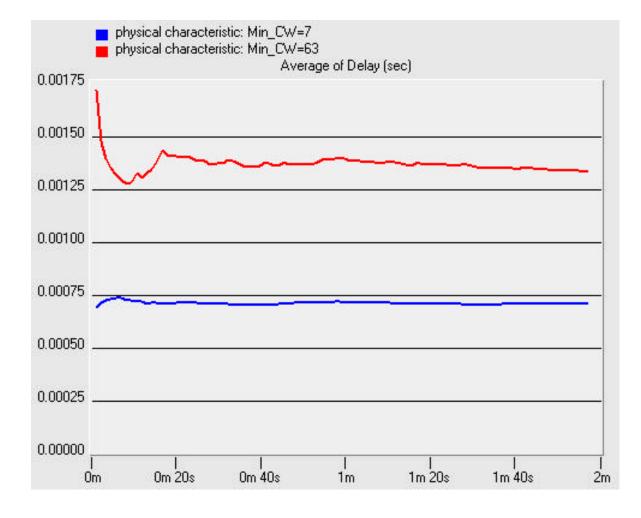


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#### Part 1: PHY Characteristics – Results of Customized Min CW (1)



#### Part 1: PHY Characteristics – Results of Customized Min CW (2)



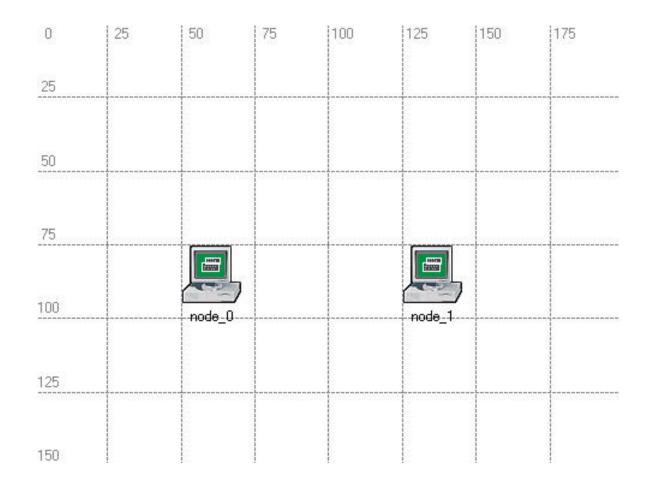
#### Part 2: WLAN Parameters

- Two important parameters: Fragmentation threshold, RTS/CTS threshold
- Proper fragmentation threshold can improve the wlan performance if the media error rate is high
- Too small fragmentation threshold will make the packet header occupy too much bandwidth
- RTS/CTS is used to deal with the hidden terminal problems

# Part 2: WLAN Parameters – Packet Error Generator

(Office Network.node_0.Media Erro	or Rate) Table	
Attribute	Value 🛆	Mode Disabled
Error Mode	Bit Error Mode	Bit Error Mode
Bit Error Rate (bits per error)	10,000	Packet Error Mode
Packet Error Rate (packets per e	rror 0.0	
Details Promote	<u>Cancel</u> <u>O</u> K	

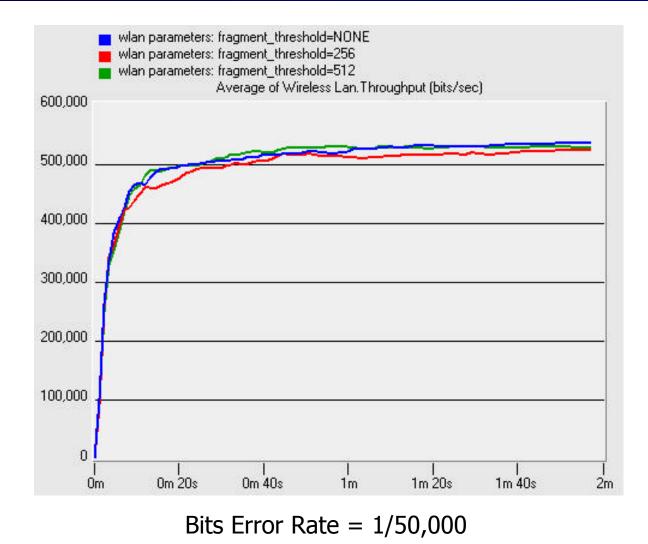
#### Part 2: WLAN Parameters - Scenario



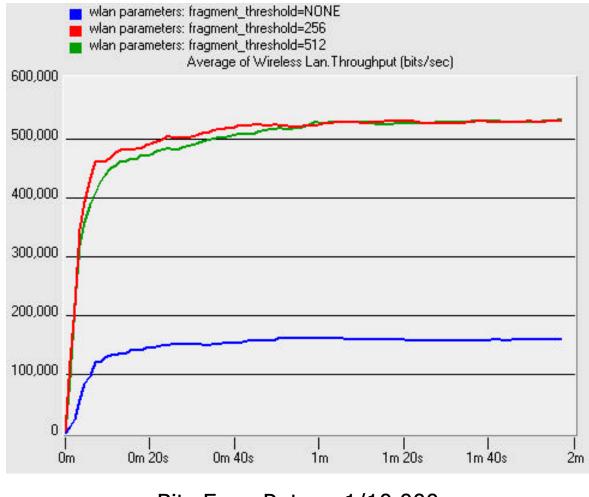
#### Part 2: WLAN Parameters – Settings

122 (2122) Di (2122)	Value	e 🗛	
Start Time (seconds)	cons	tant (2)	
ON State Time (seconds)	cons	tant (100)	
OFF State Time (seconds)	cons	tant (0)	
Packet Generation Arguments	()		
Stop Time (seconds)	Neve	er	
		(Packet Generation Arguments)	Table
		Attribute	Value
<u>D</u> etails <u>P</u> romote	<u>C</u> ance	Interarrival Time (seconds)	exponential (0.01)
	- 10 B	Packet Size (bytes)	exponential (1024)
		Segmentation Size (bytes)	No Segmentation

#### Part 2: WLAN Parameters – Results of Fragmentation Threshold (1)



#### Part 2: WLAN Parameters – Results of Fragmentation Threshold (2)

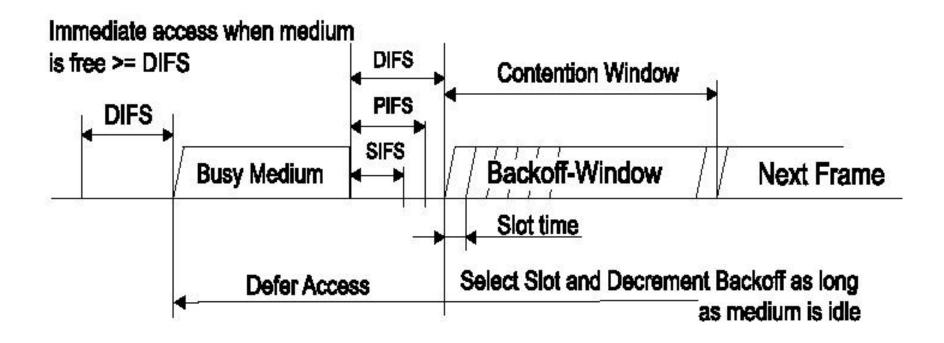


Bits Error Rate = 1/10,000

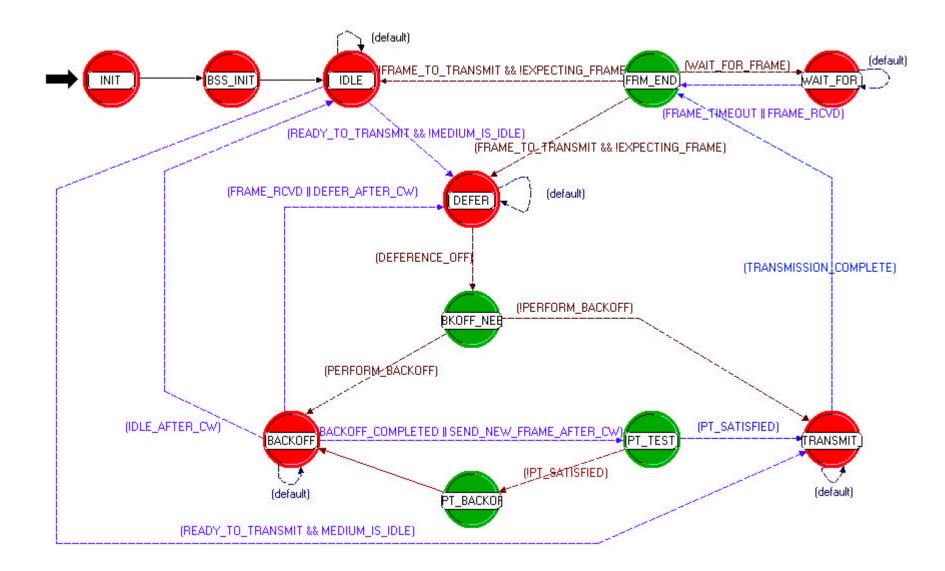
#### Part 3: Adaptive Backoff

- Named Distributed Contention Control (DCC)
- Can be executed on the top of pre-existent access scheduling protocol (DCF)
- For the adaptive reduction of contention in WLAN networks
- Estimate the channel's congestion level from the slots utilization rate
- High congestion level → Trigger the virtual congestion procedure → Do the Backoff without the cost of a collision

#### Part 3: Adaptive Backoff



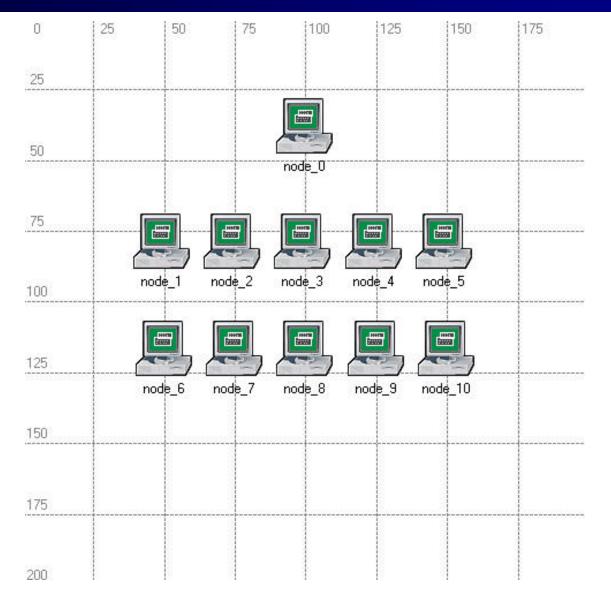
#### Part 3: Adaptive Backoff – Modified Model



#### Part 3: Adaptive Backoff - Settings

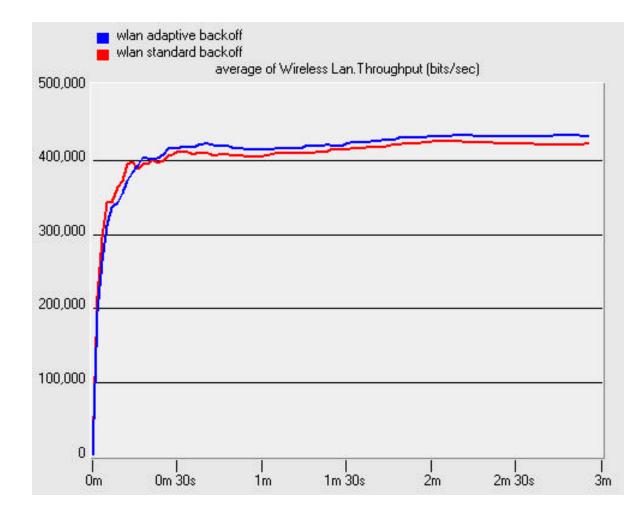
Attribute	Value 🛆	
name	node_0	
model	song_wlan_station_adv	Standard
Backoff Mode	Adaptive	Adaptive
Destination Address	Random	The pure
Media Error Rate	Default	
Traffic Generation Parameters	()	
Wireless LAN MAC Address	Auto Assigned	
Wireless LAN Parameters	()	

#### Part 3: Adaptive Backoff - Scenario with 11 Stations

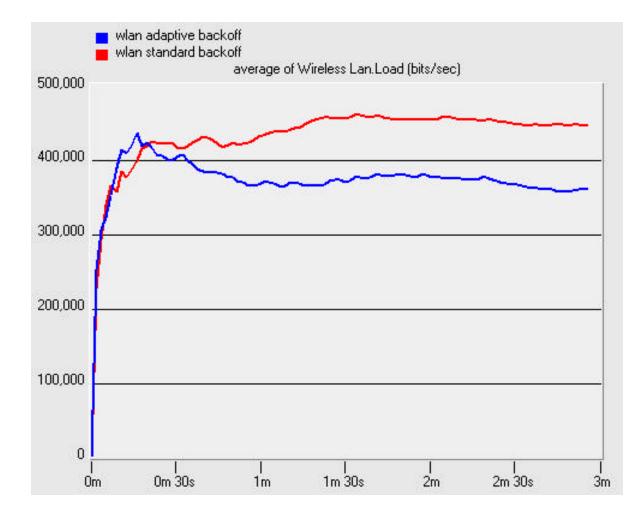


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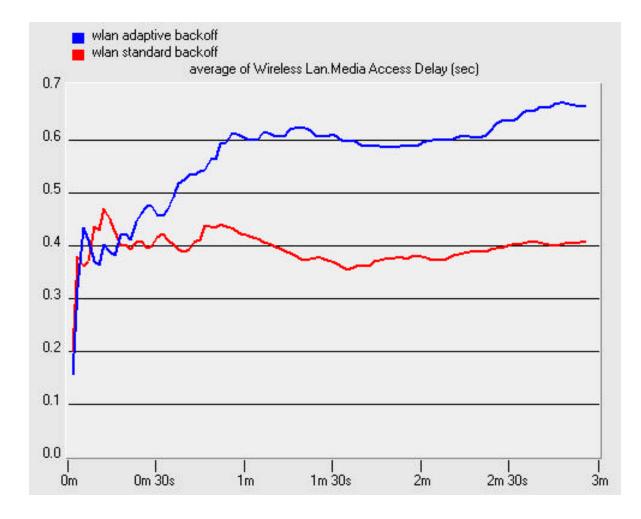
#### Part 3: Adaptive Backoff – Results of 11 Stations (1)



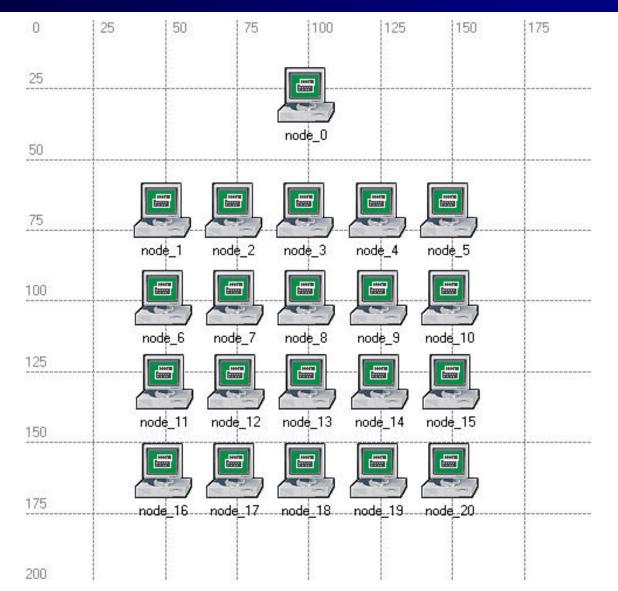
#### Part 3: Adaptive Backoff – Results of 11 Stations (2)



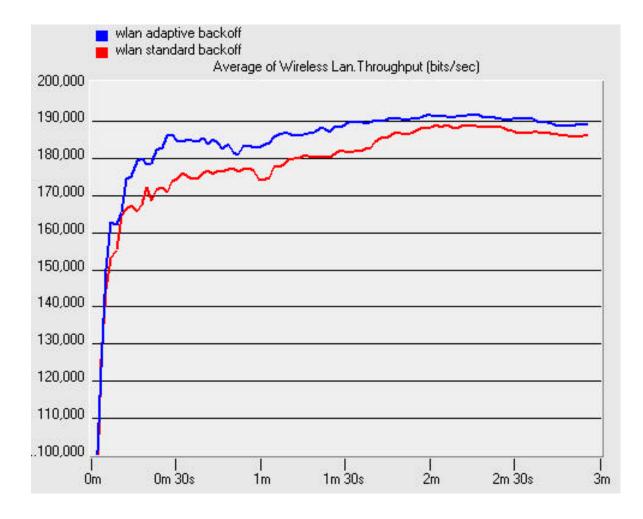
#### Part 3: Adaptive Backoff – Results of 11 Stations (3)



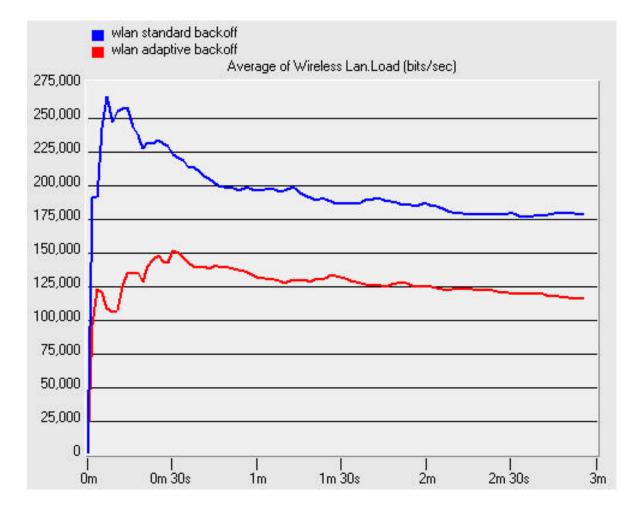
#### Part 3: Adaptive Backoff - Scenario with 21 Stations



#### Part 3: Adaptive Backoff - Results of 21 Stations (1)

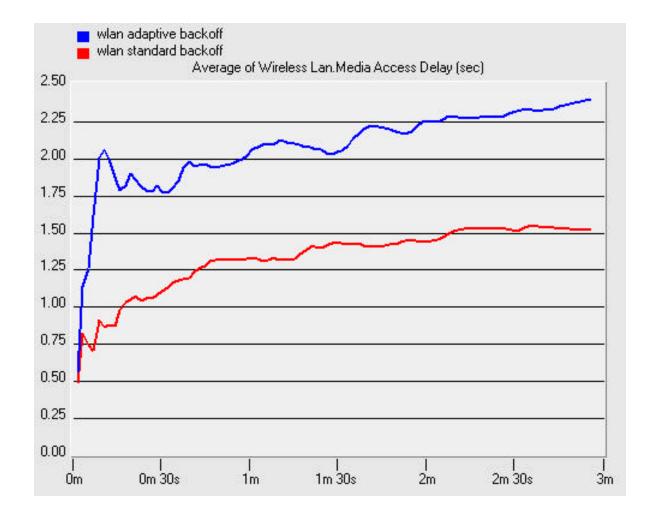


#### Part 3: Adaptive Backoff - Results of 21 Stations (2)

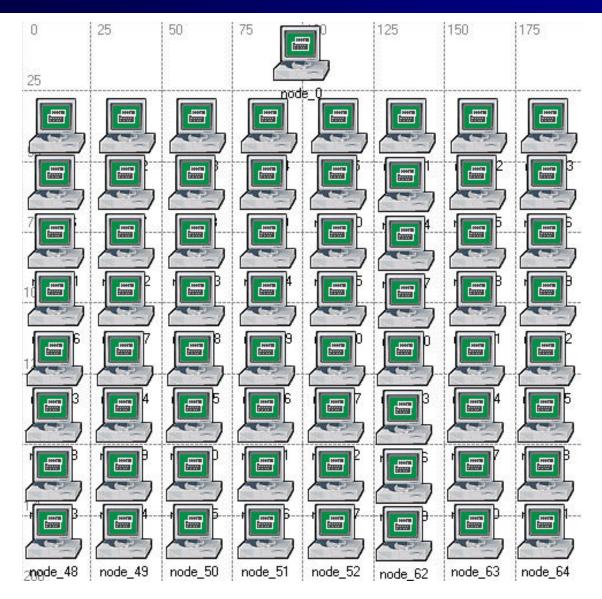


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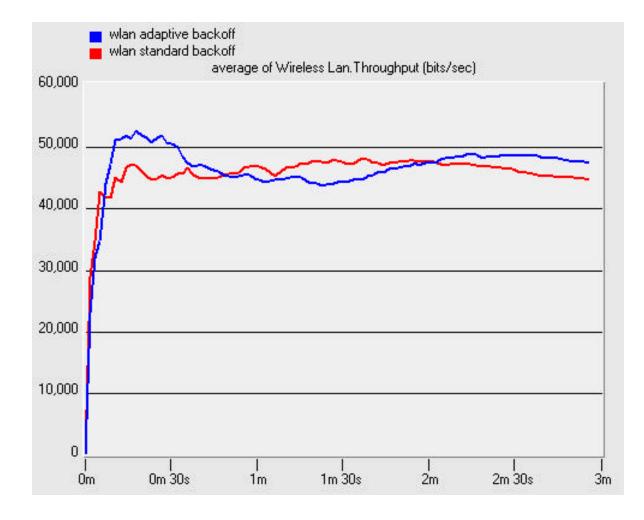
#### Part 3: Adaptive Backoff - Results of 21 Stations (3)



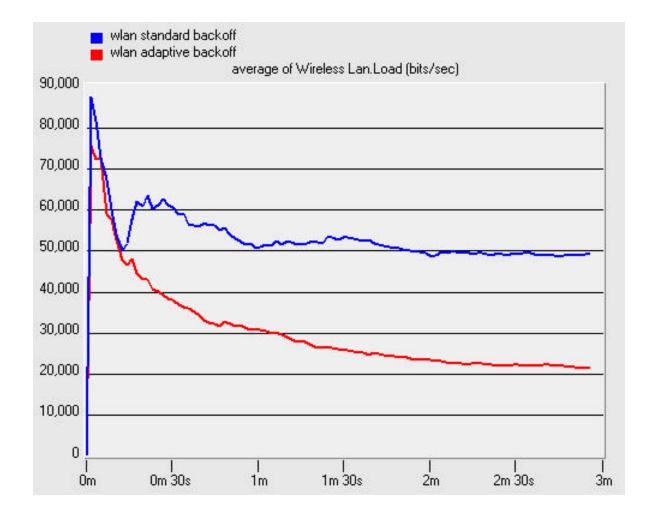
#### Part 3: Adaptive Backoff - Scenario with 65 Stations



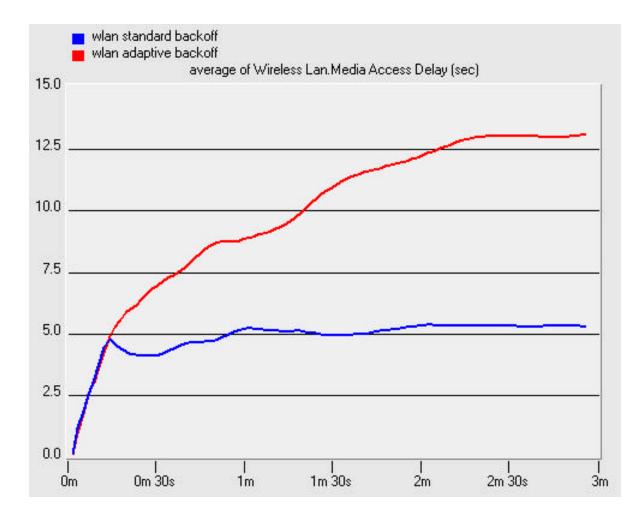
#### Part 3: Adaptive Backoff – Results of 65 Stations (1)



#### Part 3: Adaptive Backoff - Results of 65 Stations (2)



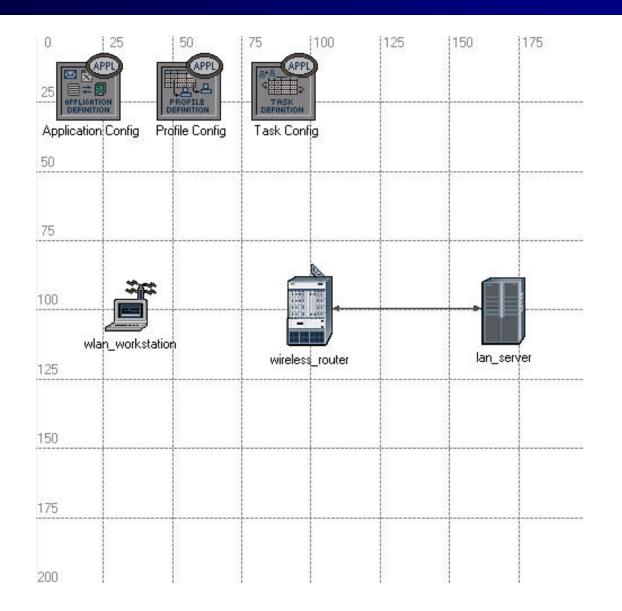
#### Part 3: Adaptive Backoff - Results of 65 Stations (3)



### Part 4: SMART Snoop\*

- TCP-aware link-layer scheme
- Makes the lossy link appear as a higher quality link with a reduced effective bandwidth
- Based on the Snoop protocol
- Use SMART strategy(Simple Method to Aid Retransmissions, it combines the best feature of Go-Back-N and Selective-Ack)
- SMART Snoop agency is in the Access Point

#### Part 4: SMART Snoop\* - Scenario



### Part 4: SMART Snoop\*

#### Notes:

- TCP issues are not included in IEEE802.11
- Part 1-3 already forms a completed project
- Part 4 requires too much work
- I choose to work on Part 4 because I want to take this valuable opportunity to learn something more about the networks



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### Thanks! (April 9, 2002)