Performance evaluation and enhancement of WLAN

(CMPT885 / ENSC835)

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Introduction to WLAN

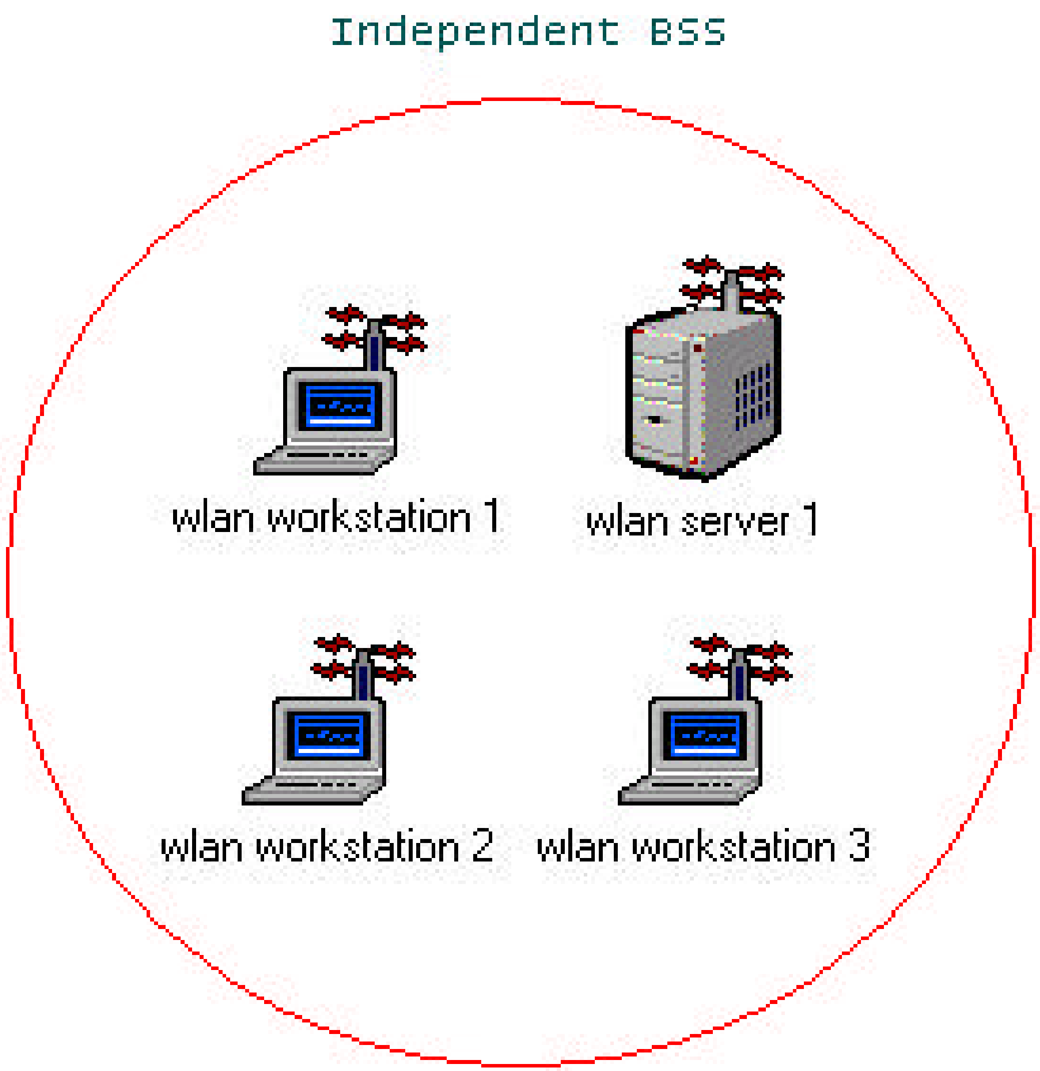
IEEE 802.11

- Defines both PHY layer and MAC layer
- Data rate: 1M, 2M, 5.5M, 11M
- Access model: DCF and PCF(optional)
- Adopts CSMA/CA as DCF
- Adopts RTS/CTS as PCF

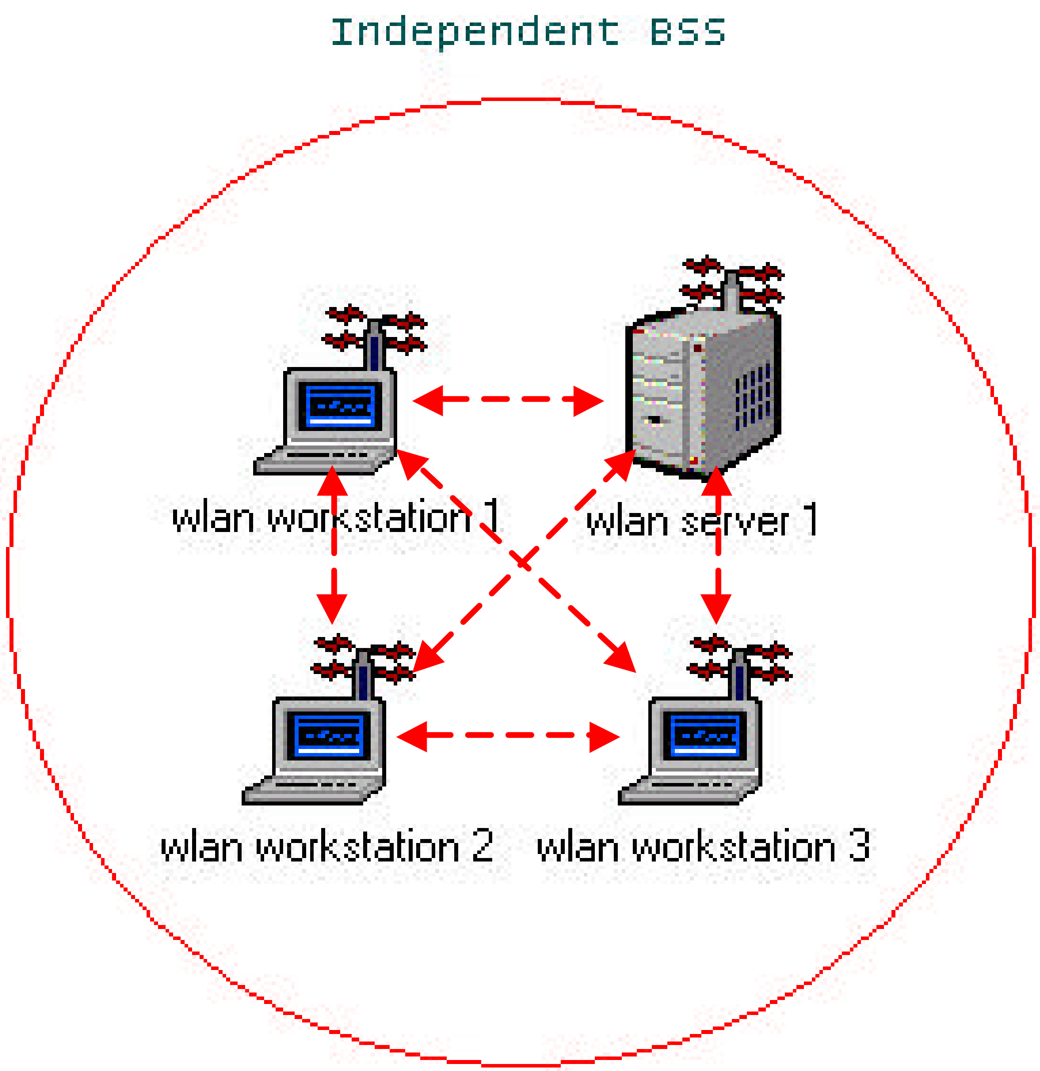
Some Problems of WLAN

- Media is error prone
- Carrier sensing is difficult
- Hidden terminal problem

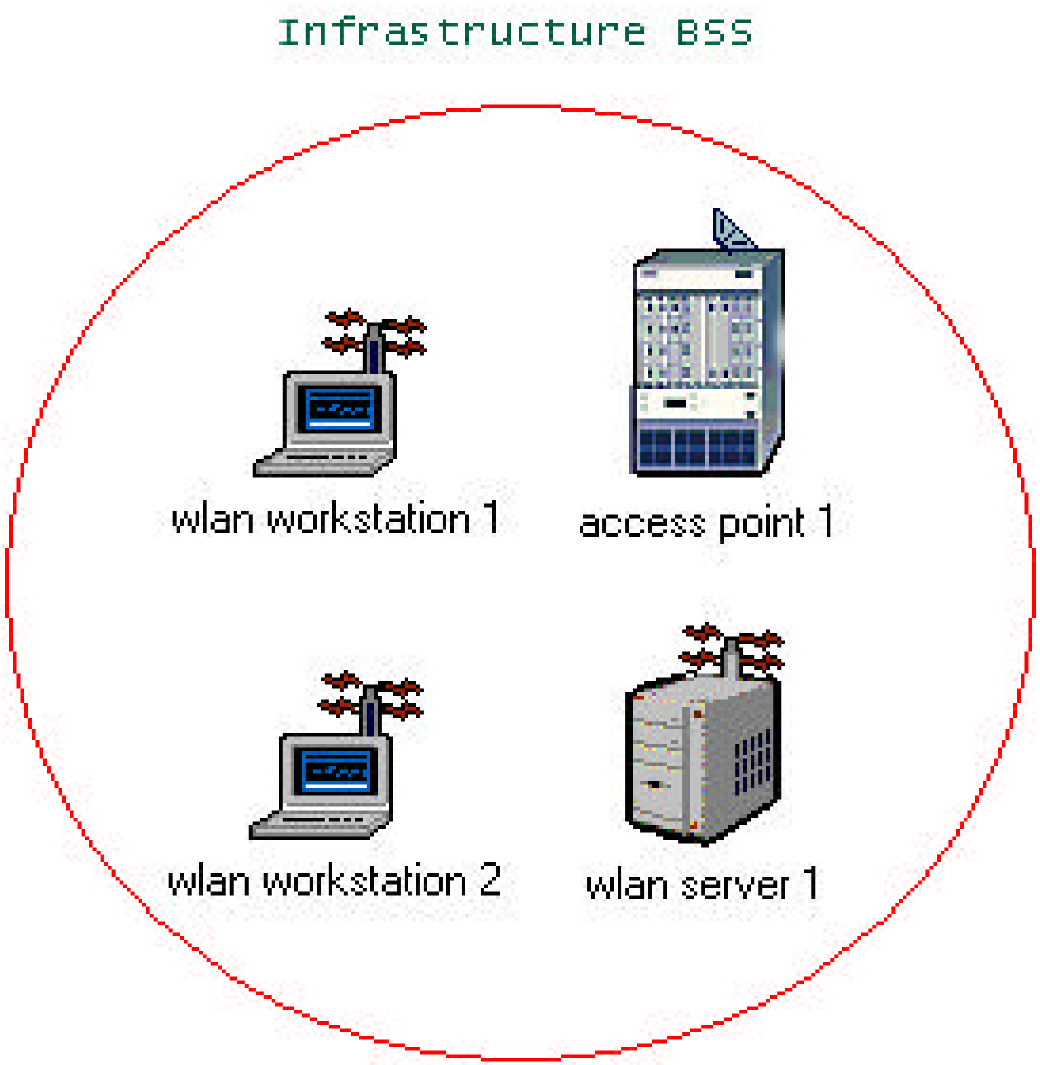
Introduction to WLAN
- WLAN Components: Independent BSS



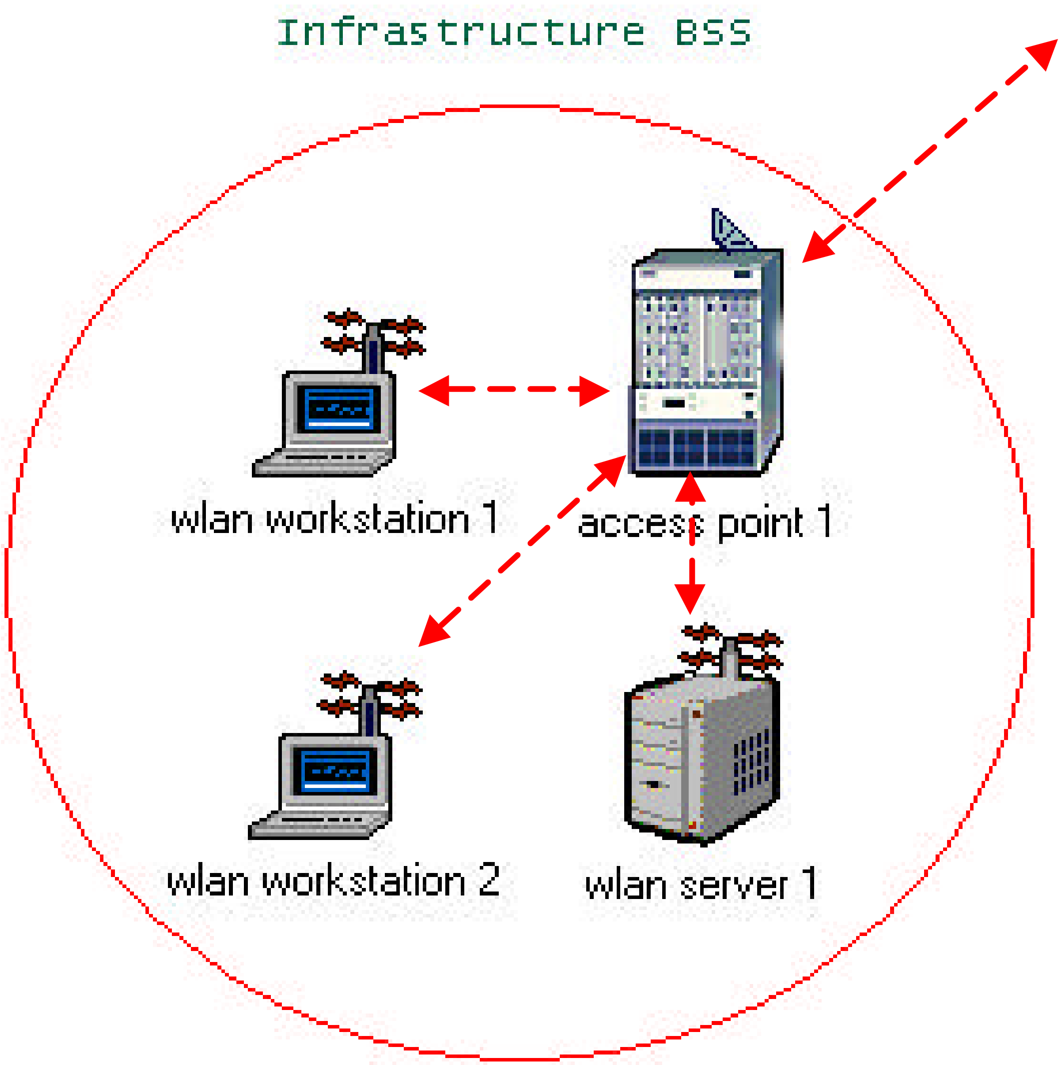
Introduction to WLAN
- Independent BSS Data Link

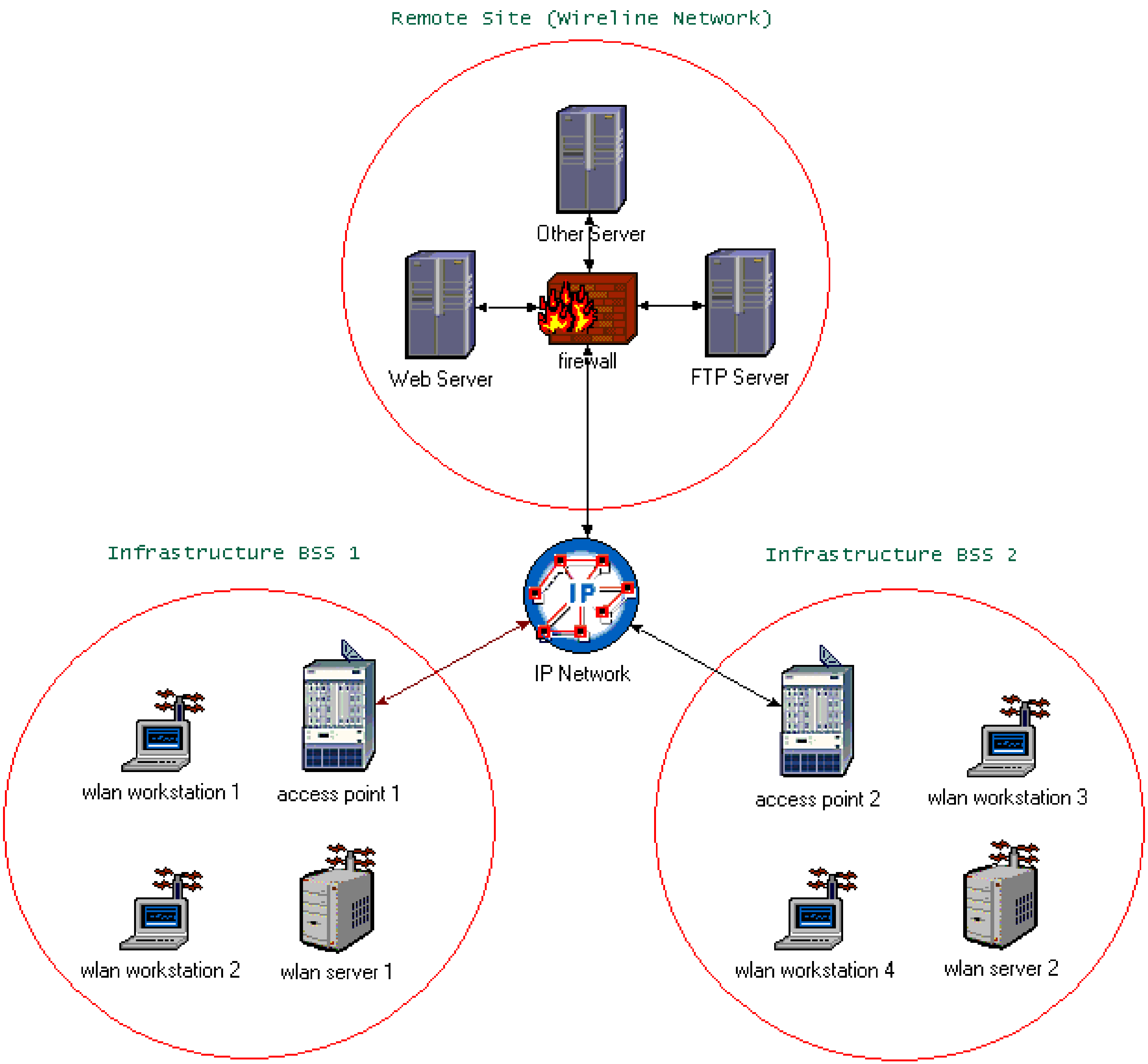


Introduction to WLAN
- WLAN Components: Infrastructure BSS



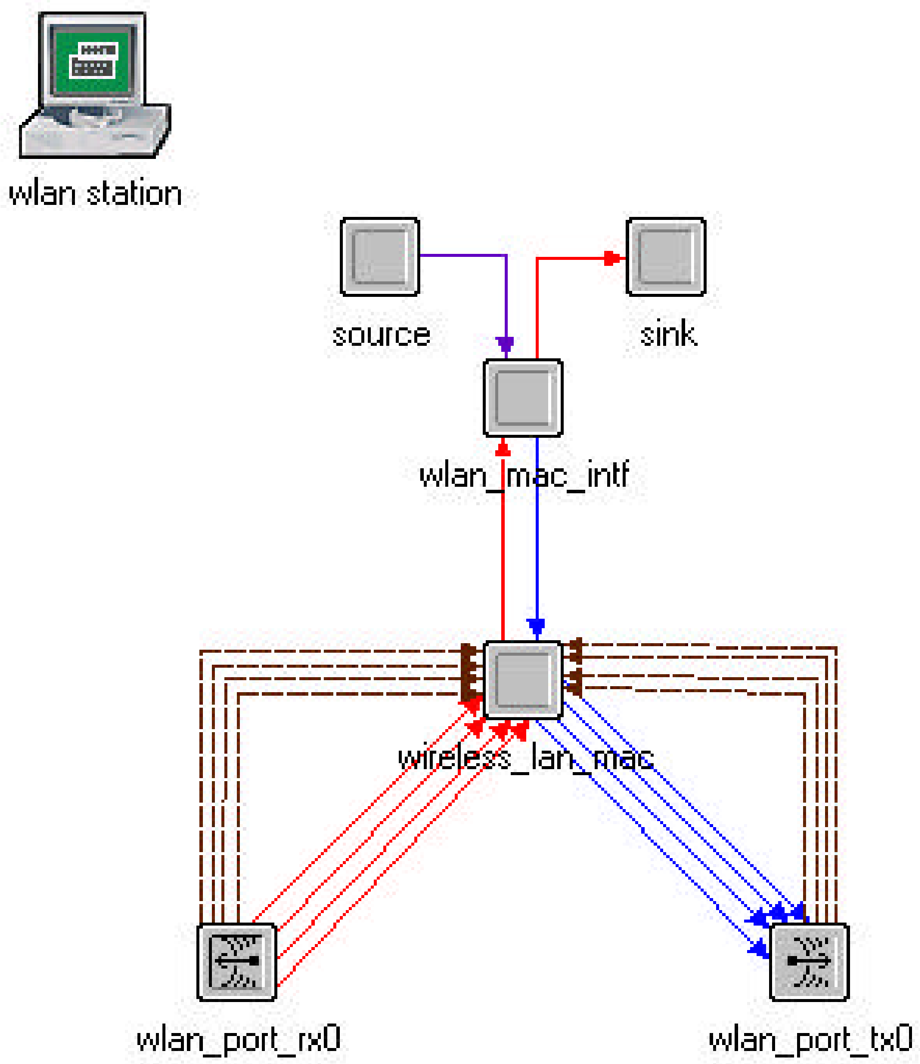
Introduction to WLAN
- Infrastructure BSS Data Link



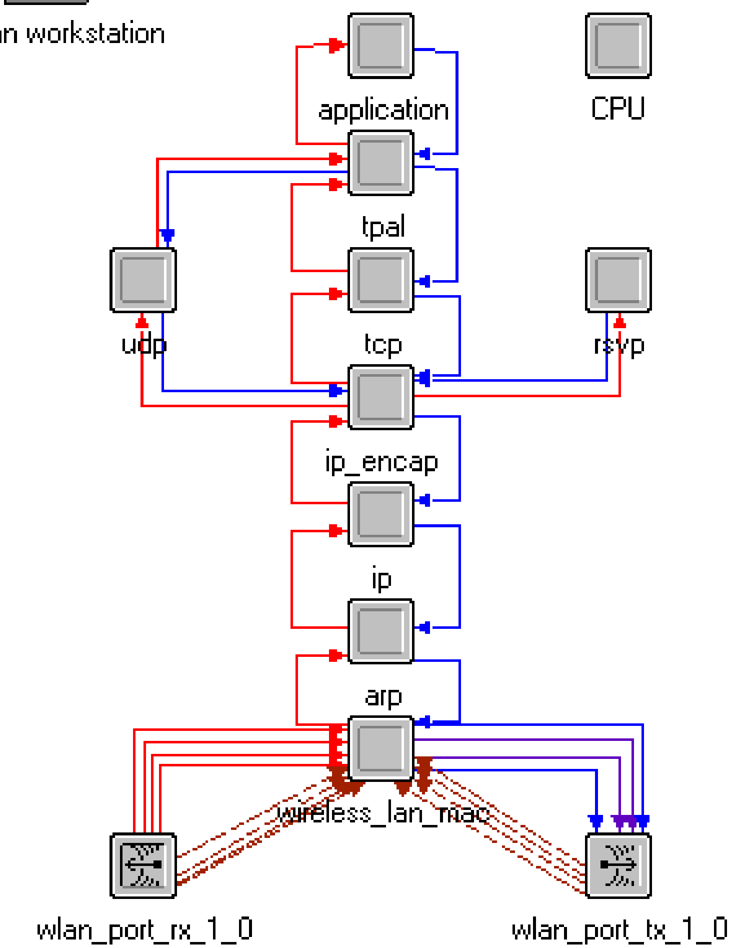


Remote Site (Wireline Network)
Other Server
Web Server
firewall
FTP Server
Infrastructure BSS 1
IP
IP Network
Infrastructure BSS 2
wlan workstation 1
access point 1
access point 2
wlan workstation 3
wlan workstation 2
wlan server 1
wlan workstation 4
wlan server 2

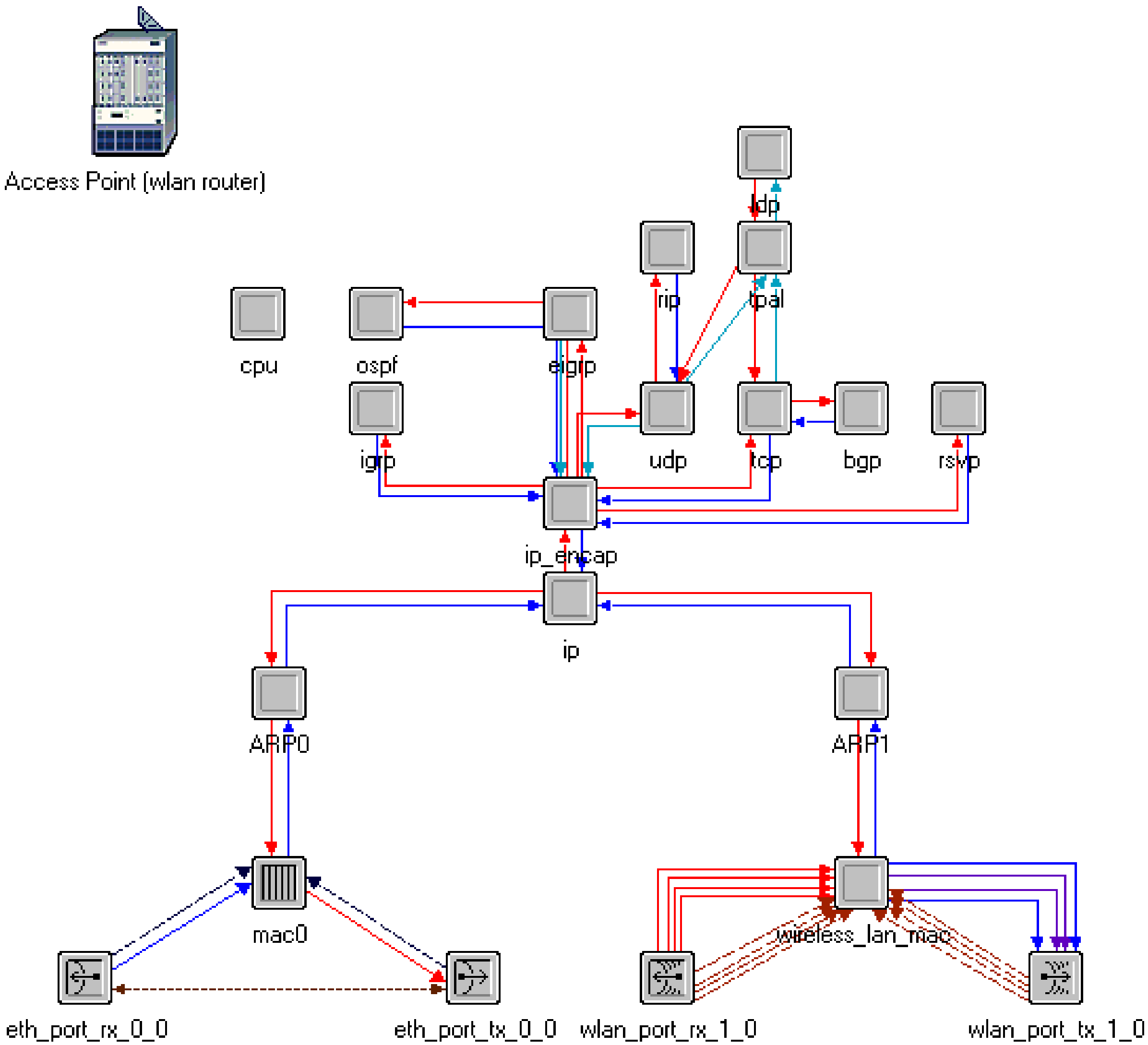
Introduction to WLAN
- OPNET Model: WLAN Station



Introduction to WLAN
- OPNET Model: WLAN Workstation/Server



Introduction to WLAN
- OPNET Model: WLAN Router



Performance enhancement
- Survey 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)

- o Reliable link-layer approach (AIRMAIL)
- o Split-connection approach (I-TCP, M-TCP)

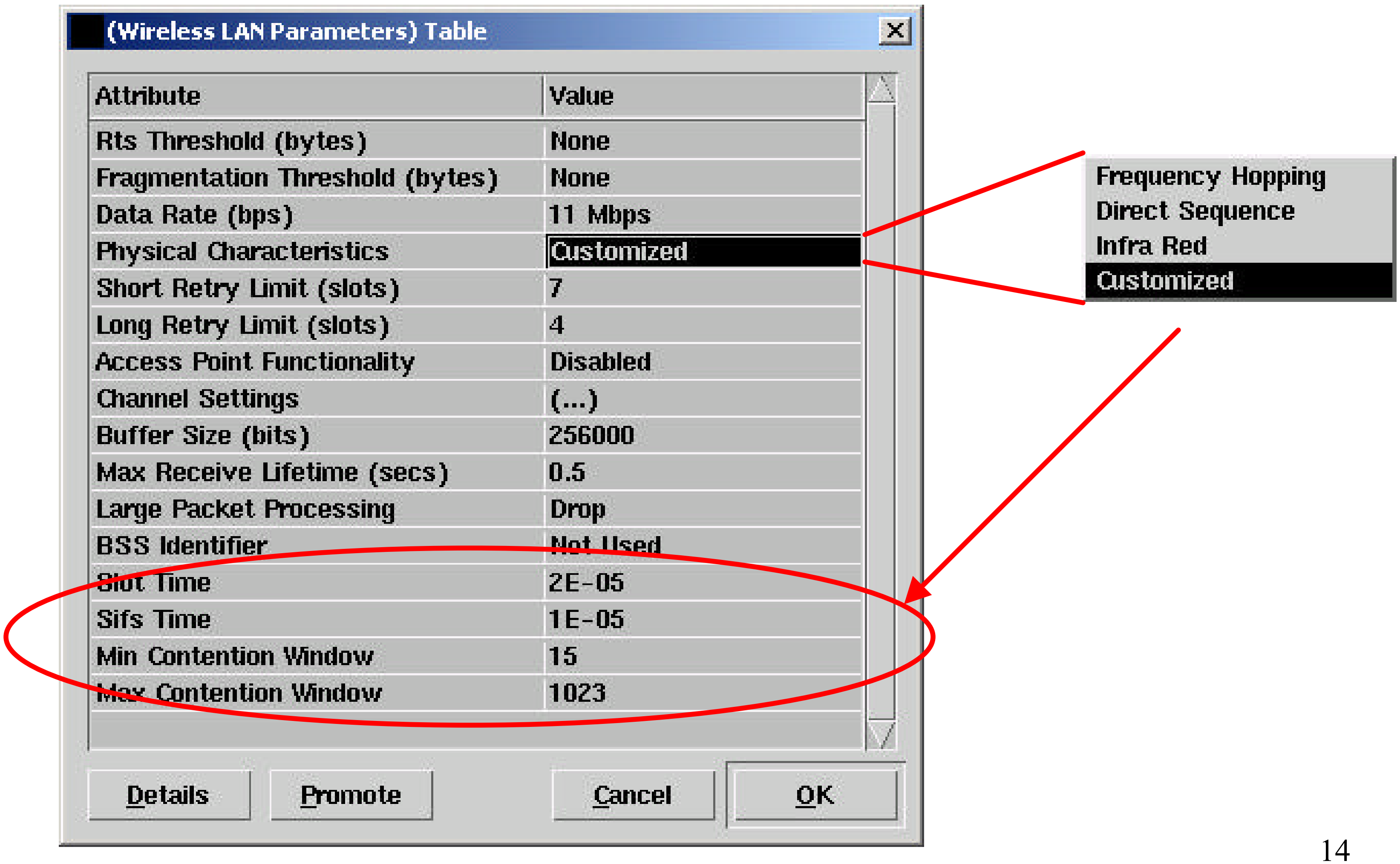
Implementation with OPNET

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

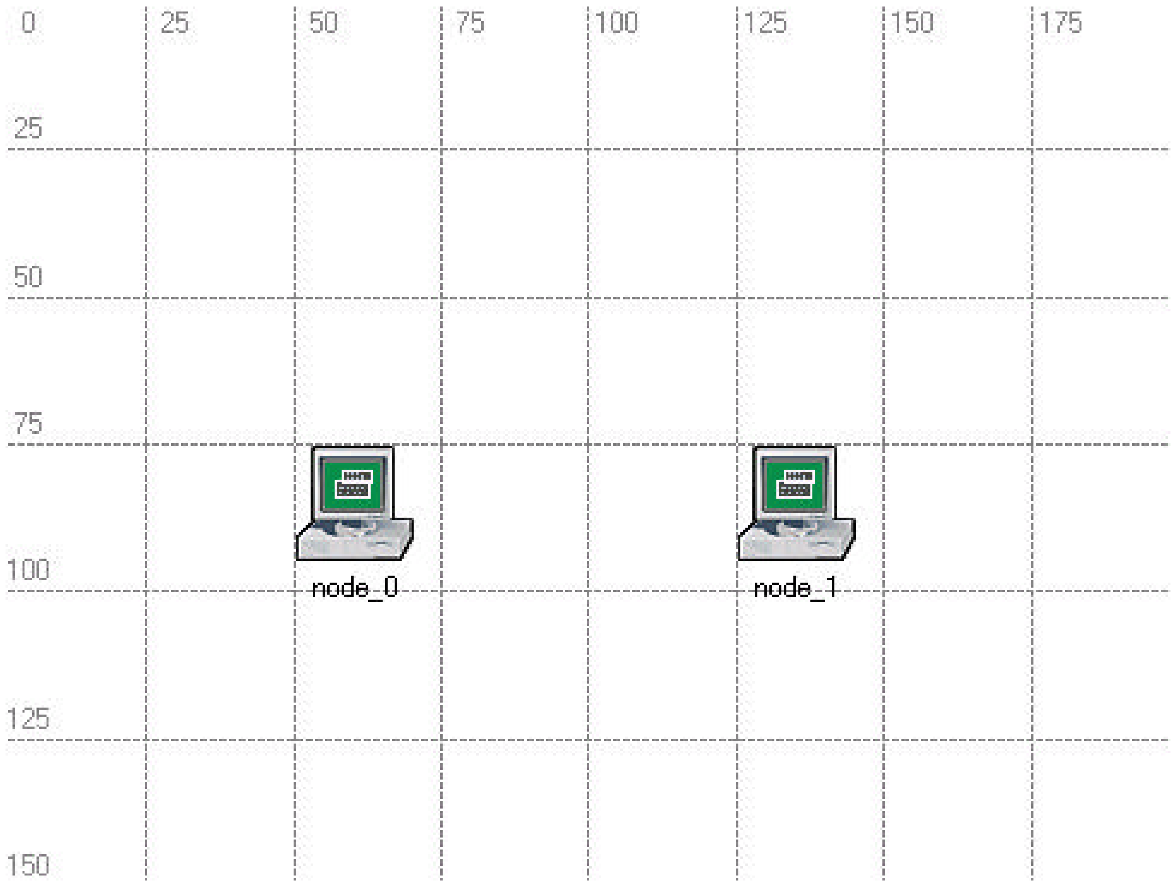
Implementation with OPNET

Part 1: PHY - Settings



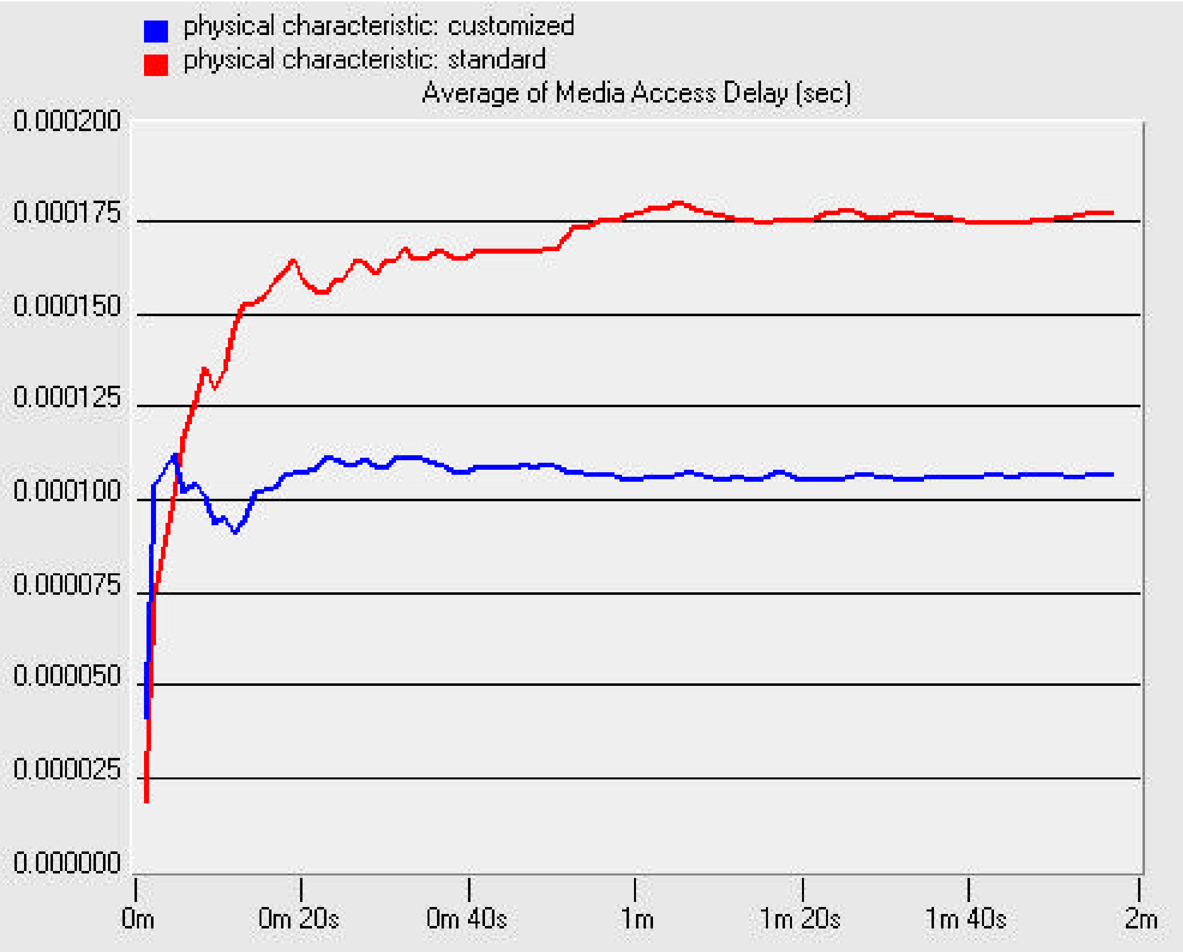
Implementation with OPNET

Part 1: PHY - Scenario



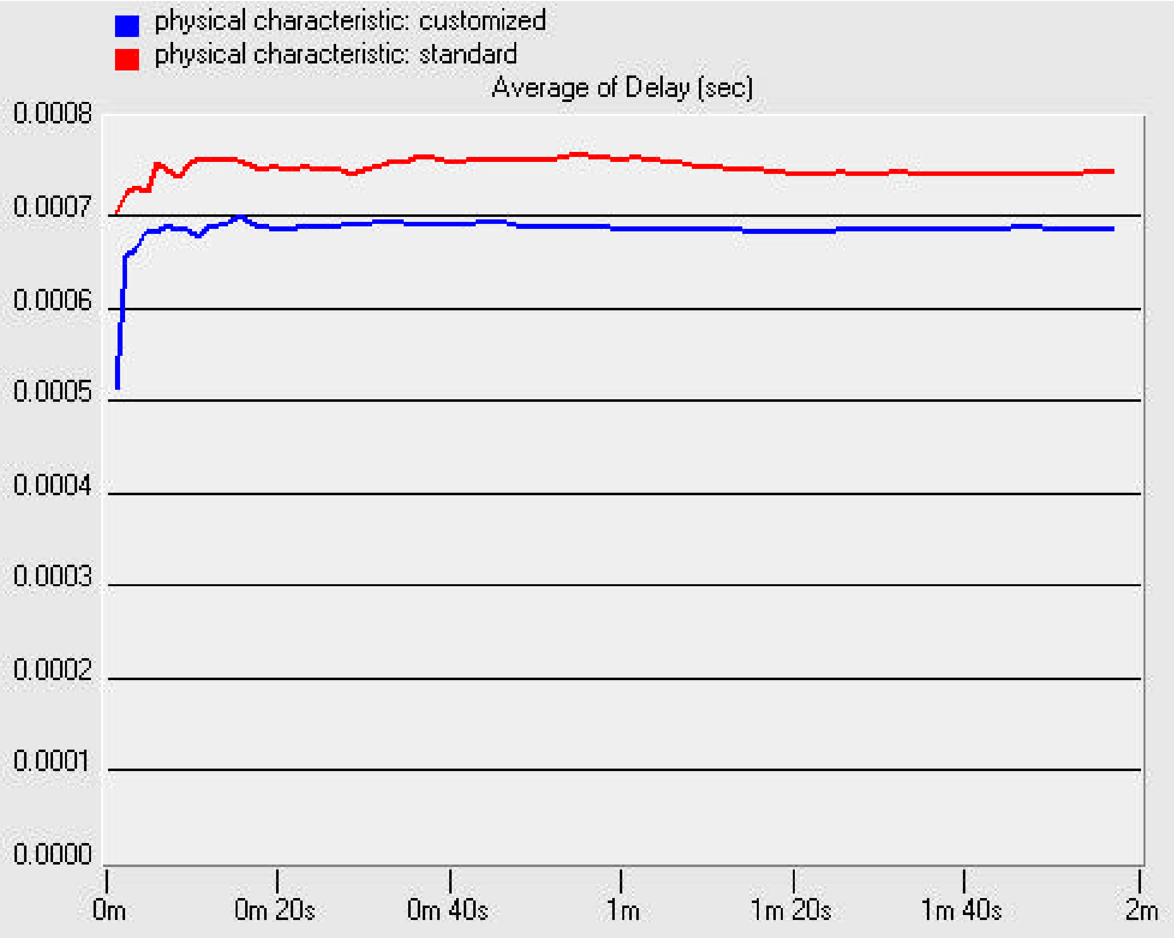
Implementation with OPNET

Part 1: PHY – Results 1



Implementation with OPNET

Part 1: PHY – Results 2



Implementation with OPNET

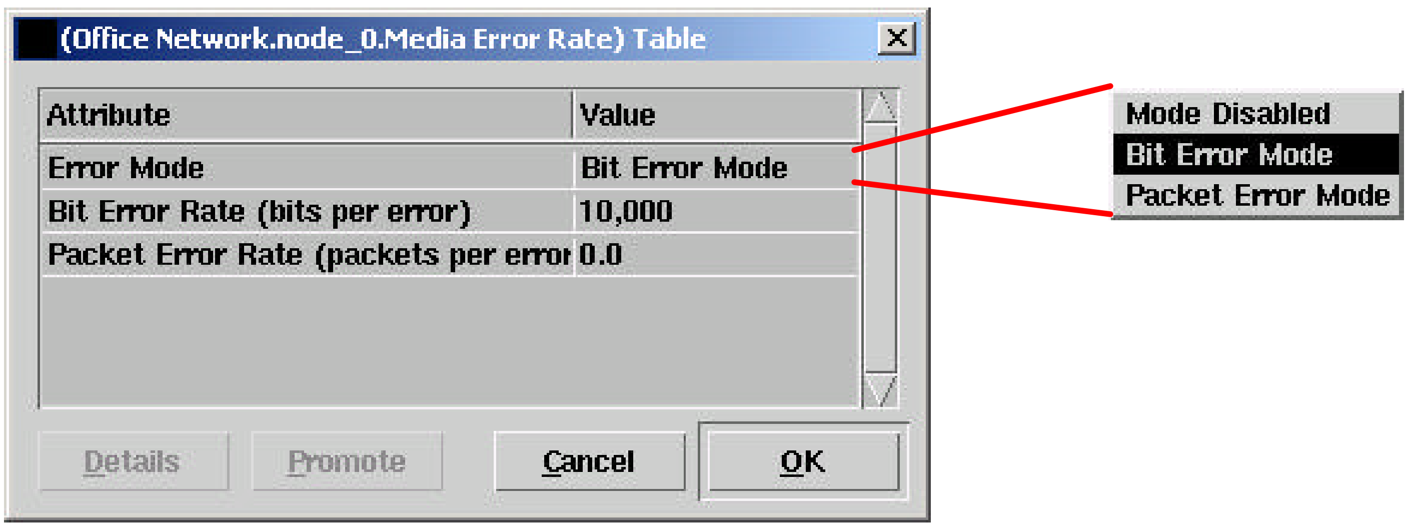
Part 2: WLAN Parameters

- 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

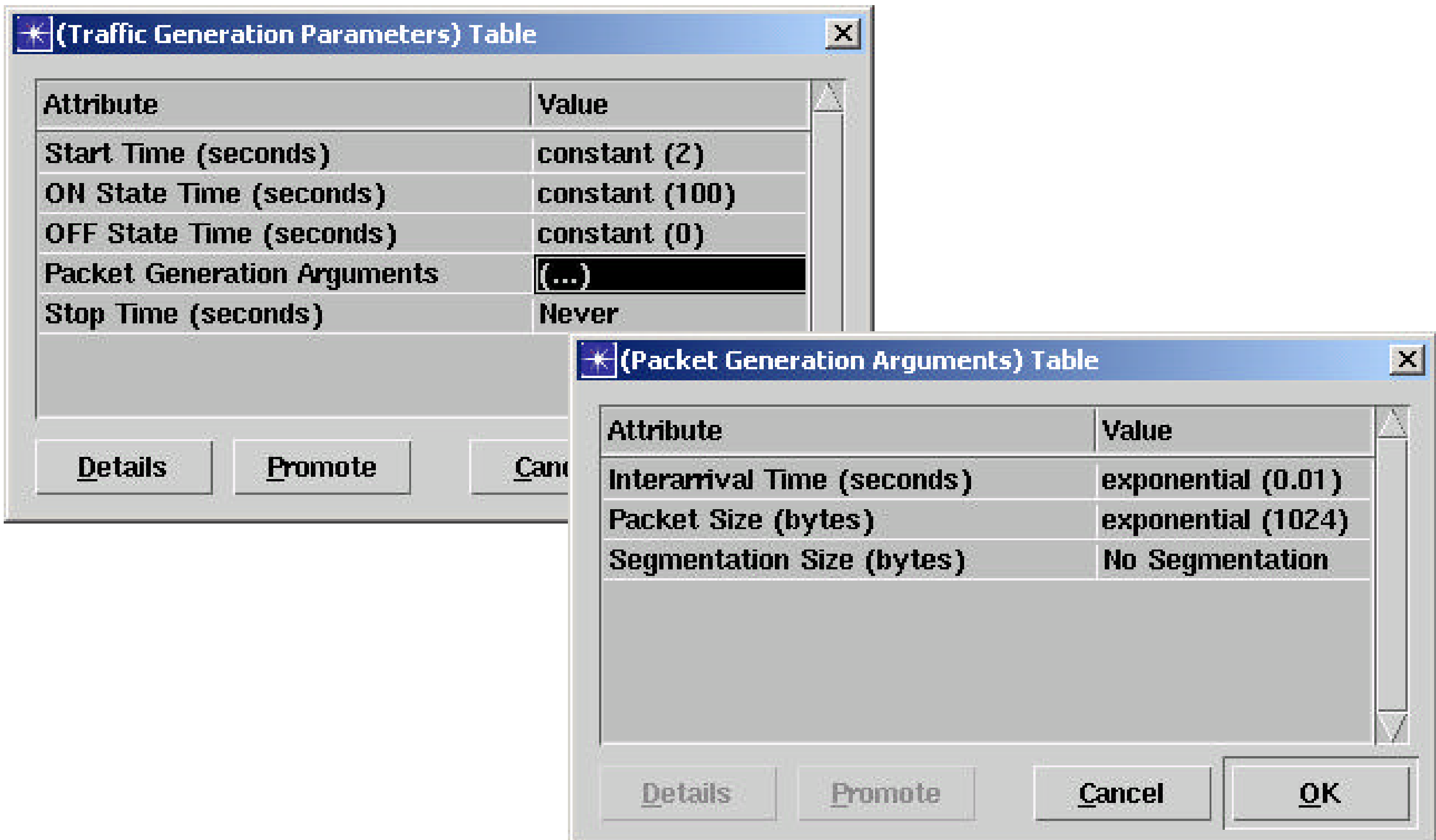
Implementation with OPNET

Part 2: WLAN Parameters – PEG



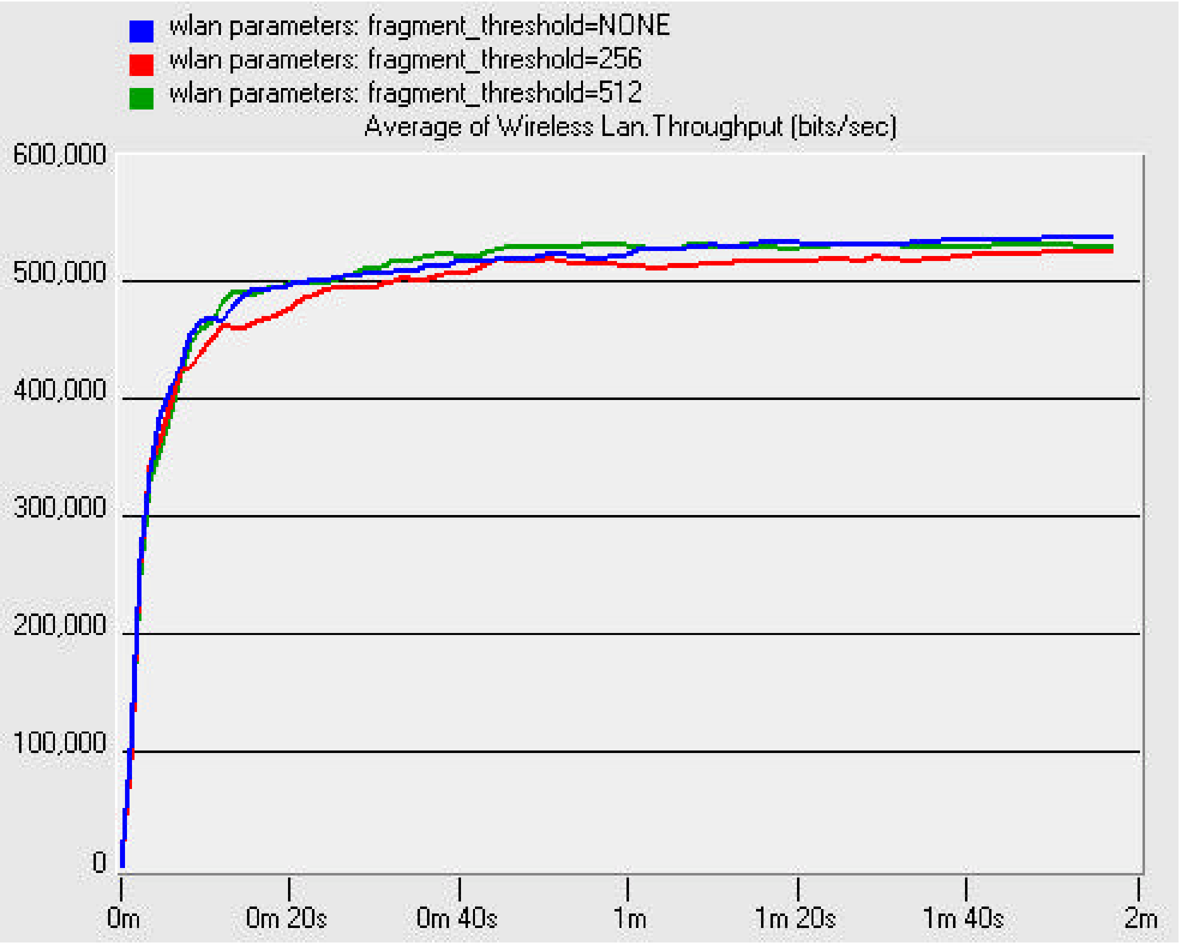
Implementation with OPNET

Part 2: WLAN Parameters – Settings



Implementation with OPNET

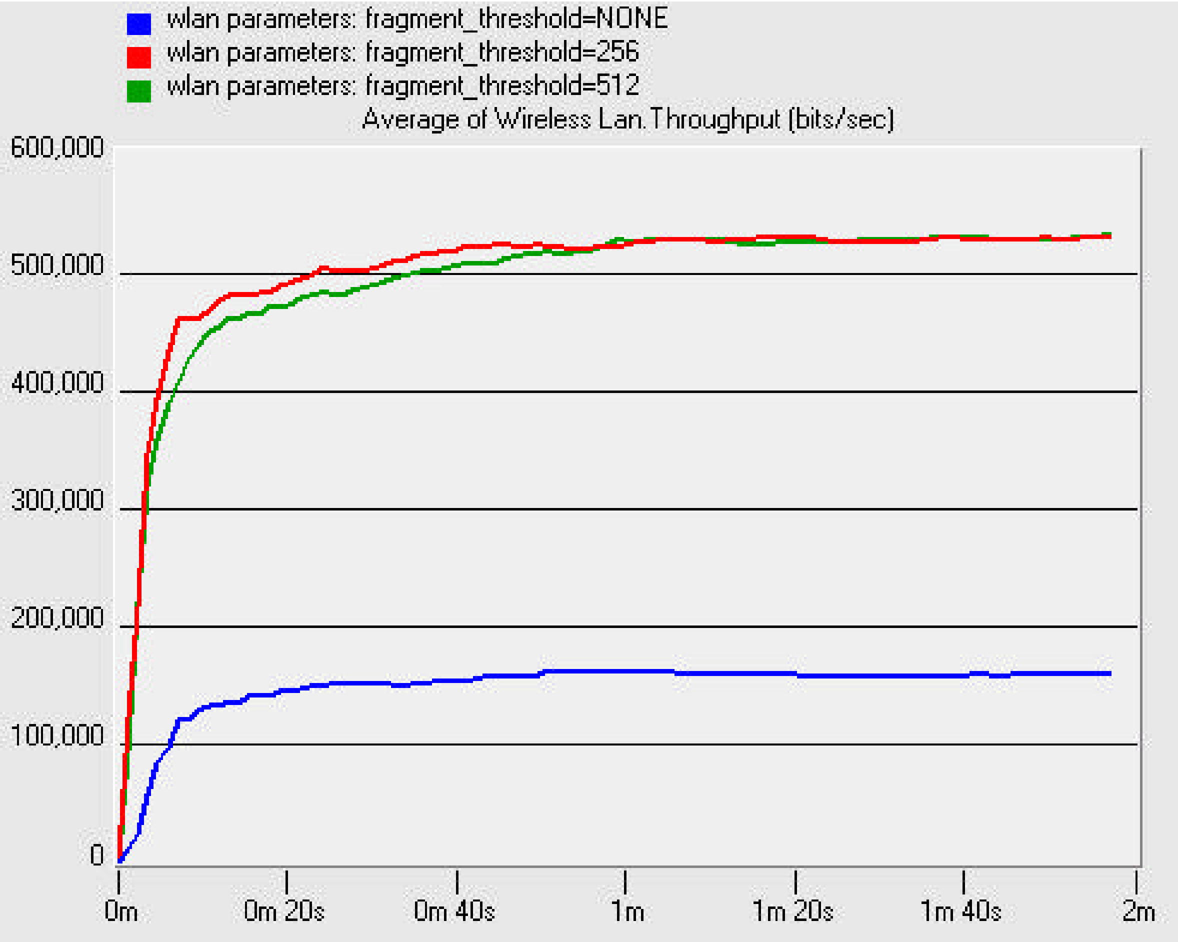
Part 2: WLAN Parameters – Results 1



Bits Error Rate = 1/50,000

Implementation with OPNET

Part 2: WLAN Parameters – Results 2



Bits Error Rate = 1/10,000

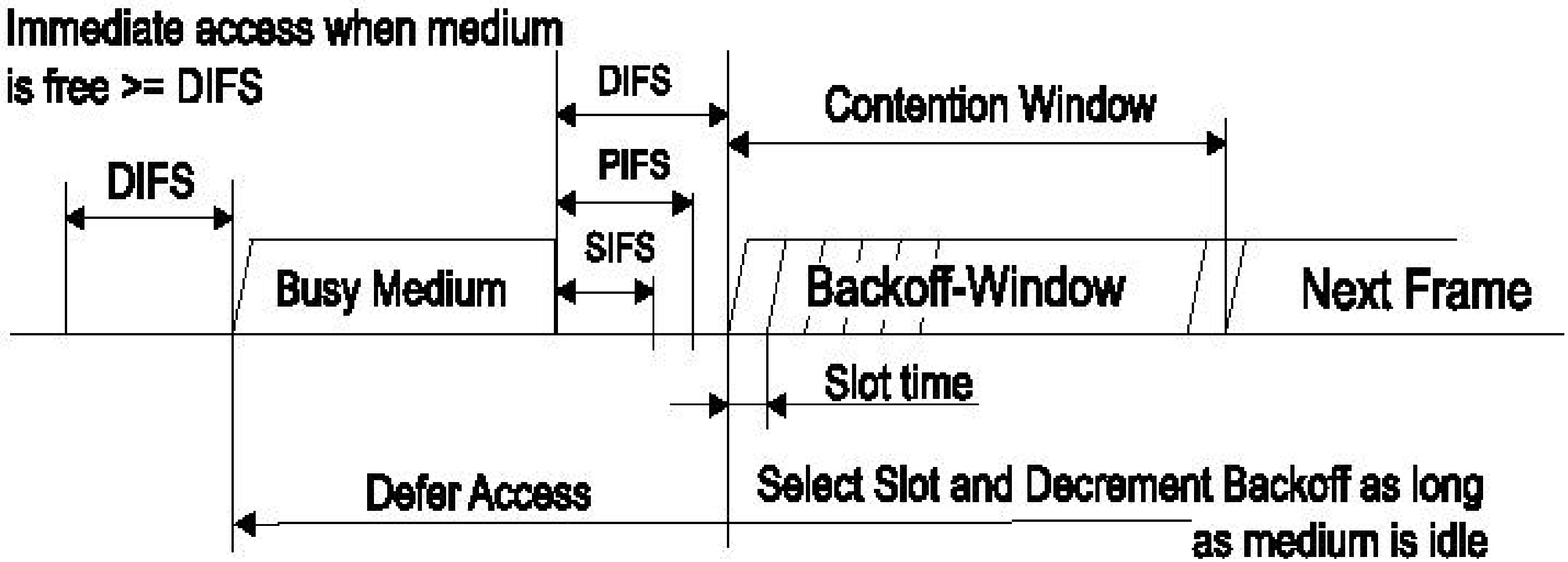
Implementation with OPNET

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

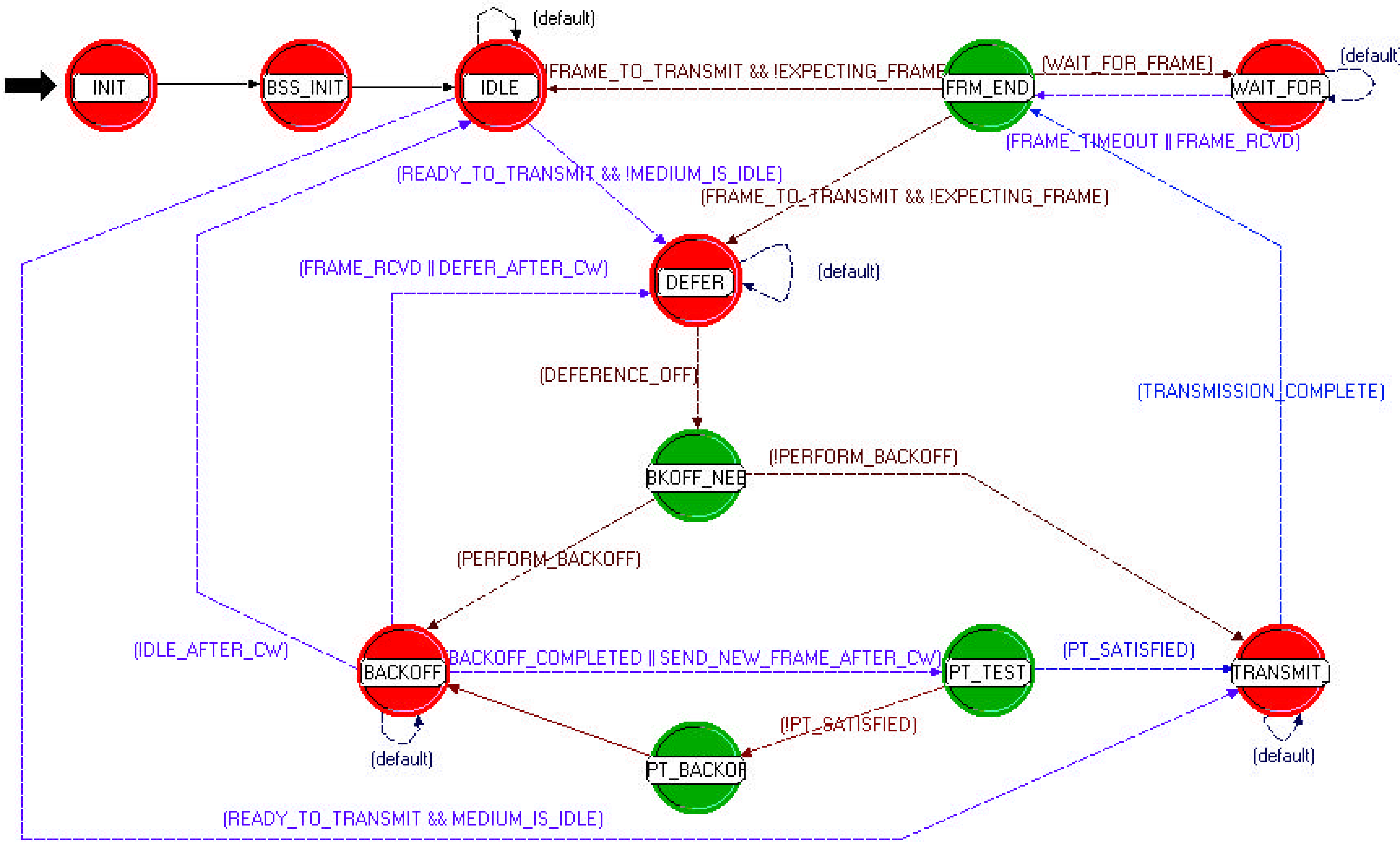
Implementation with OPNET

Part 3: Adaptive Backoff



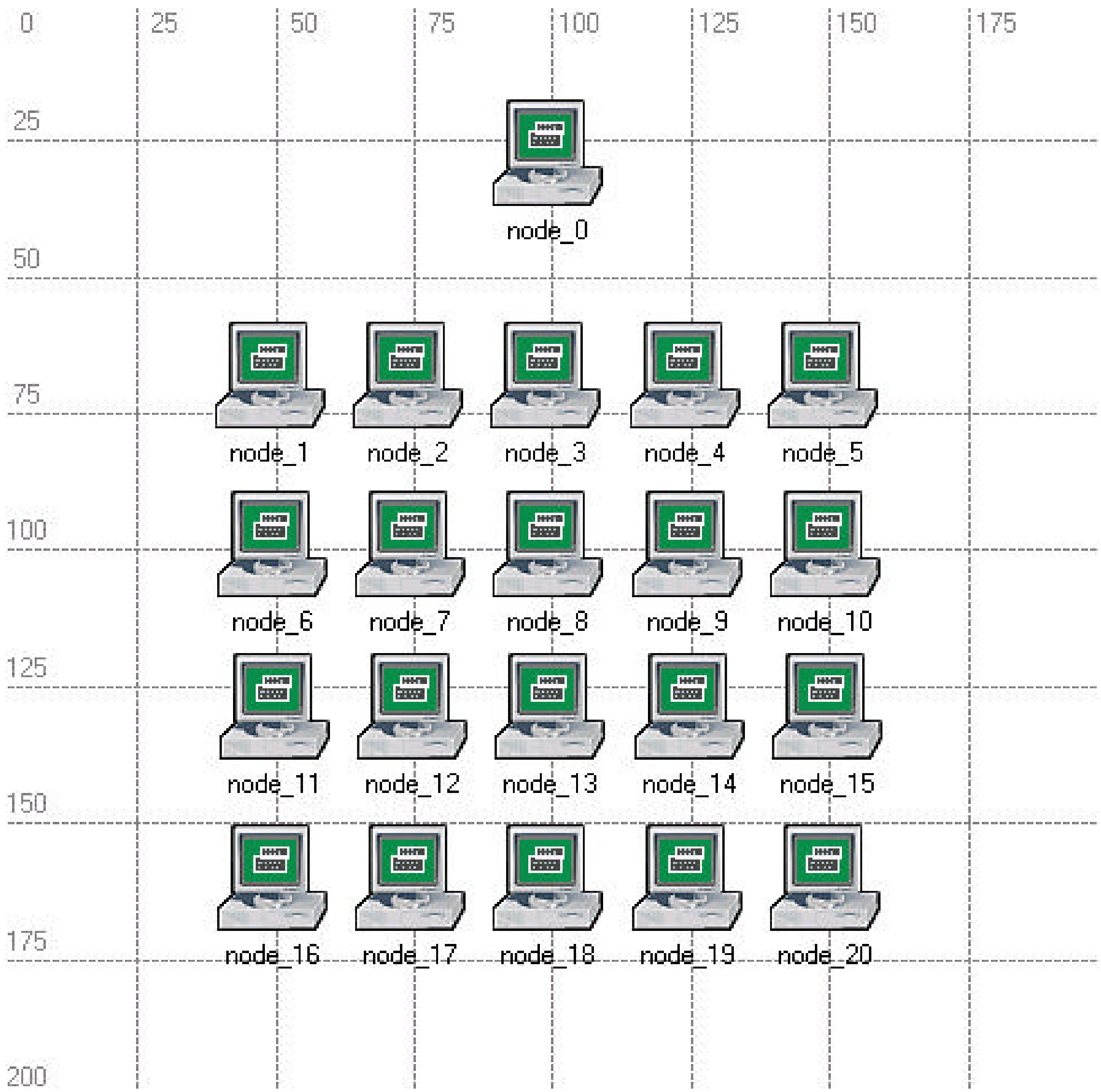
Implementation with OPNET

Part 3: Adaptive Backoff – Modified Model



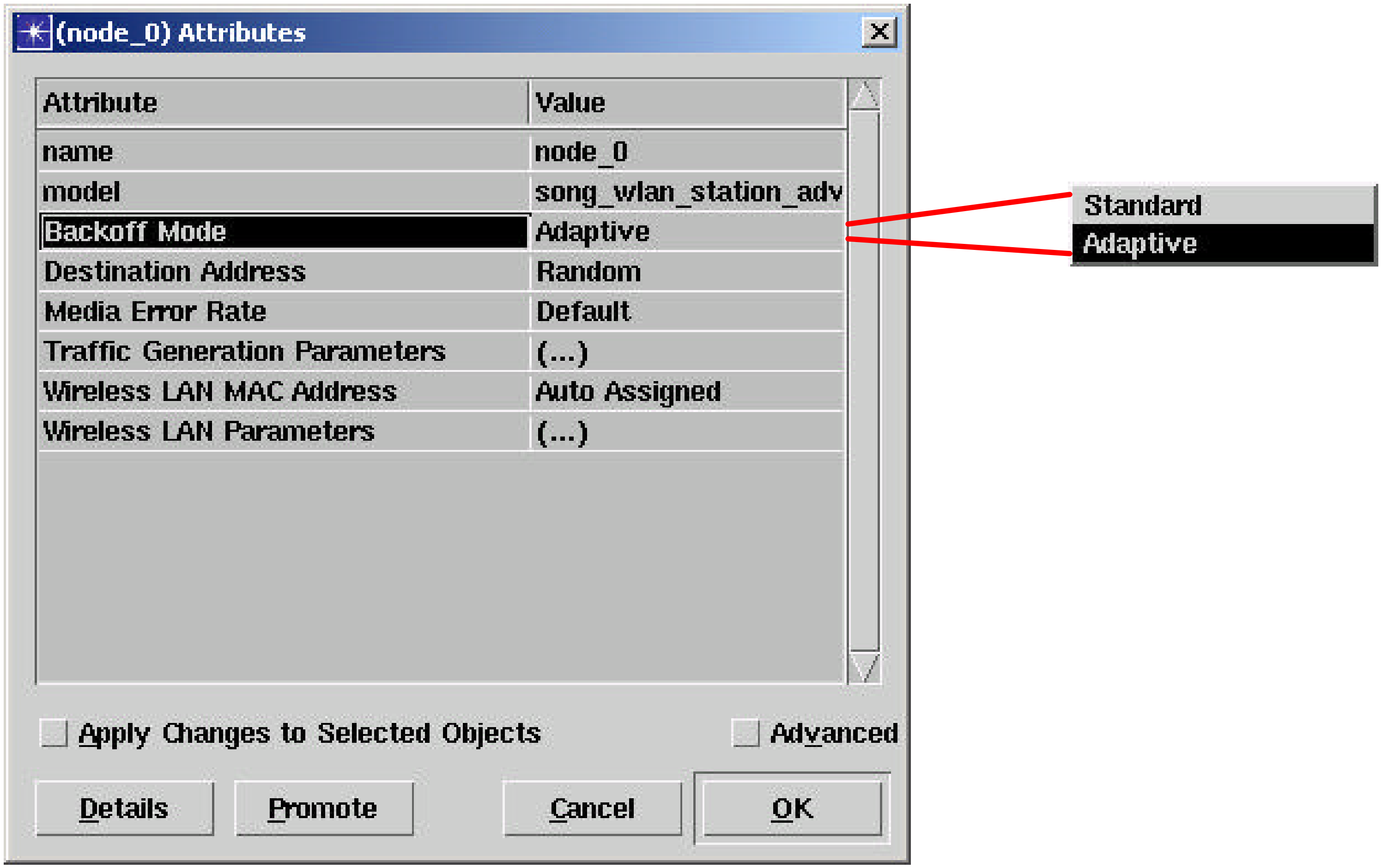
Implementation with OPNET

Part 3: Adaptive Backoff - Scenario



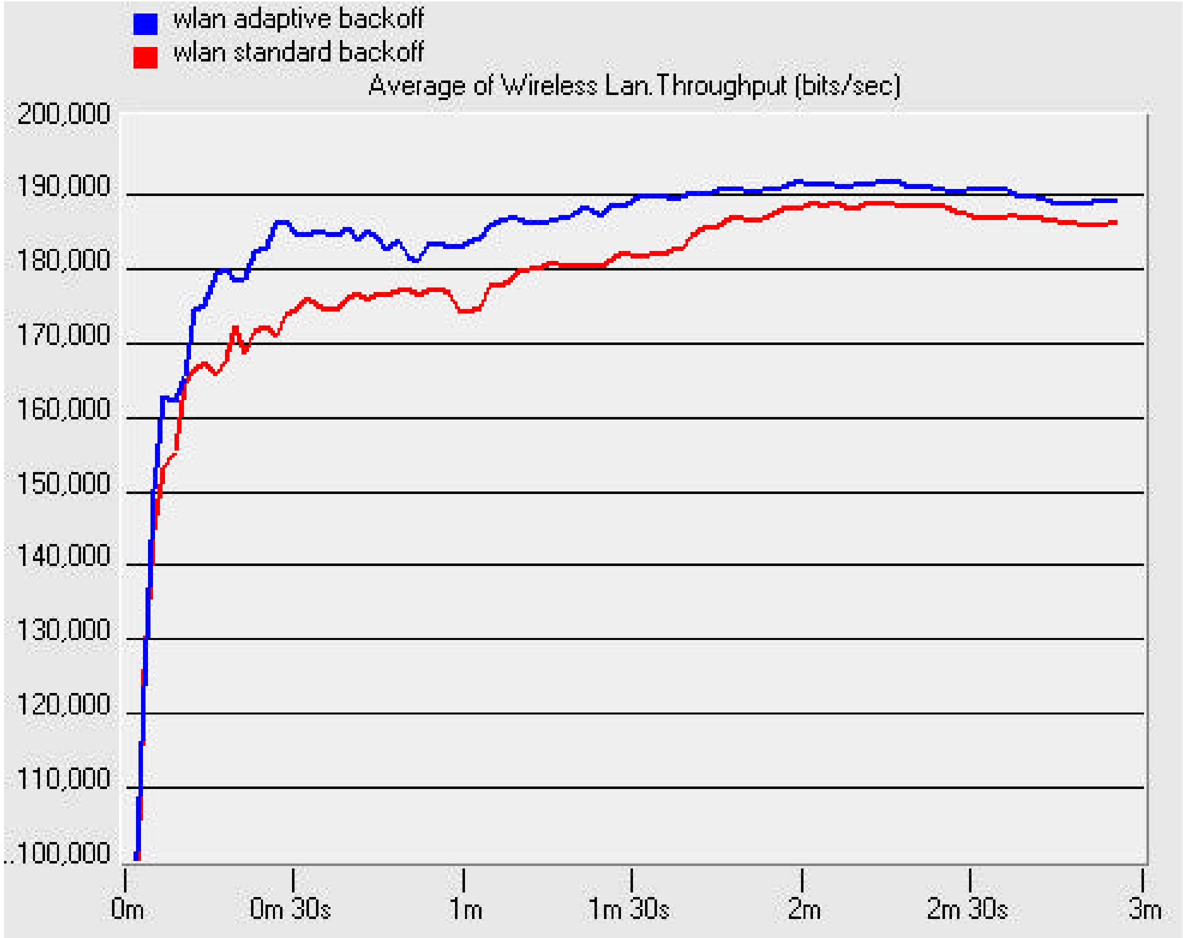
Implementation with OPNET

Part 3: Adaptive Backoff - Settings



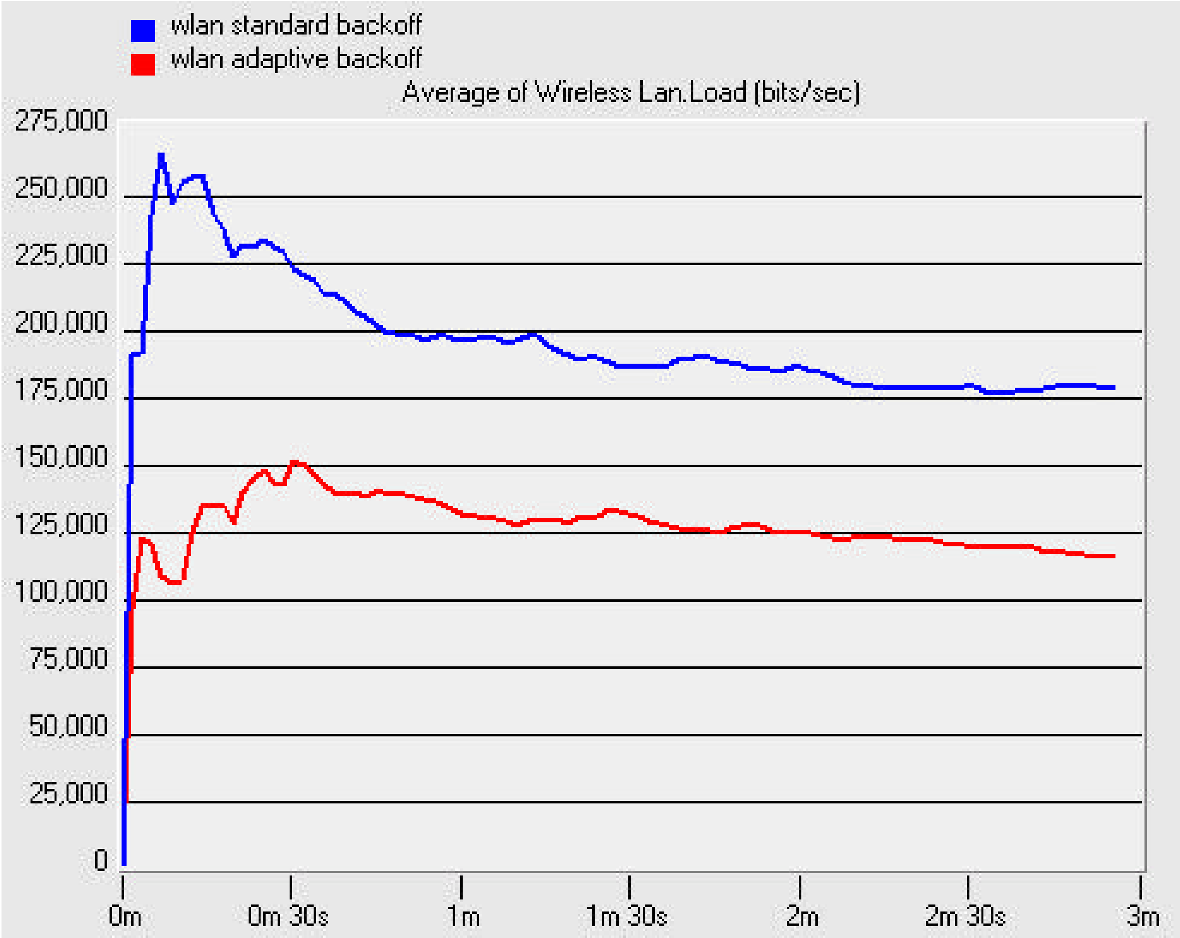
Implementation with OPNET

Part 3: Adaptive Backoff – Results 1



Implementation with OPNET

Part 3: Adaptive Backoff – Results 2



Implementation with OPNET

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)

❖ Still in progress …

References
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Thanks!

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