ENSC-833
Wireless Ethernet Performance

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Mar 29, 2001

Outline

- Brief Introduction of Wireless Ethernet (802.11b)
- Project Goals & Planning
- Actual Implementation and Results
- Summary

What is Wireless Ethernet?

- IEEE 802.11b
- Currently supports up to 11 Mbps wireless links
- Range up to 300ft radius for wireless links
- Competes mostly with HomeRF, and a bit with HomePNA & Bluetooth. It is gaining huge popularity recently.

Wireless Ethernet: 3 Phys

- Frequency Hop Spread Spectrum
  - 2.4 GHz band, 1 & 2 Mbps transmission
  - 2GFSK, 4GFSK
  - hop over 79 channels (NA)
- Direct Sequence Spread Spectrum
  - 2.4 GHz band, 1 & 2 Mbps transmission
  - DBPSK, DQPSK
  - 11 chips Barker sequence
- Baseband IR
  - Diffuse infrared
  - 1 and 2 Mbps transmission, 16-PPM and 4-PPM

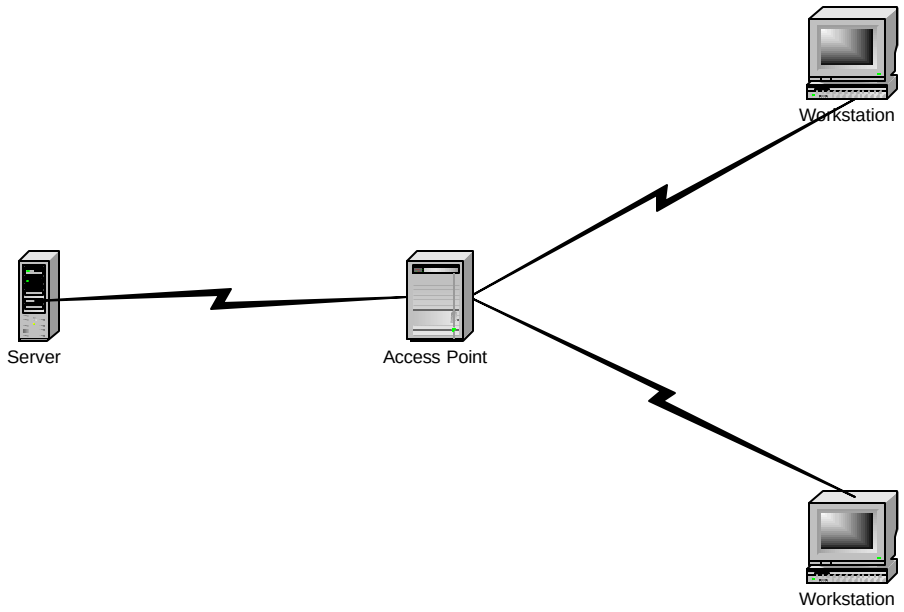
What Do We Use?

- We use OPNET as the simulator
- OPNET comes with WLAN model library
- The models implement all 7 layers of OSI

What Do We Want to Do?

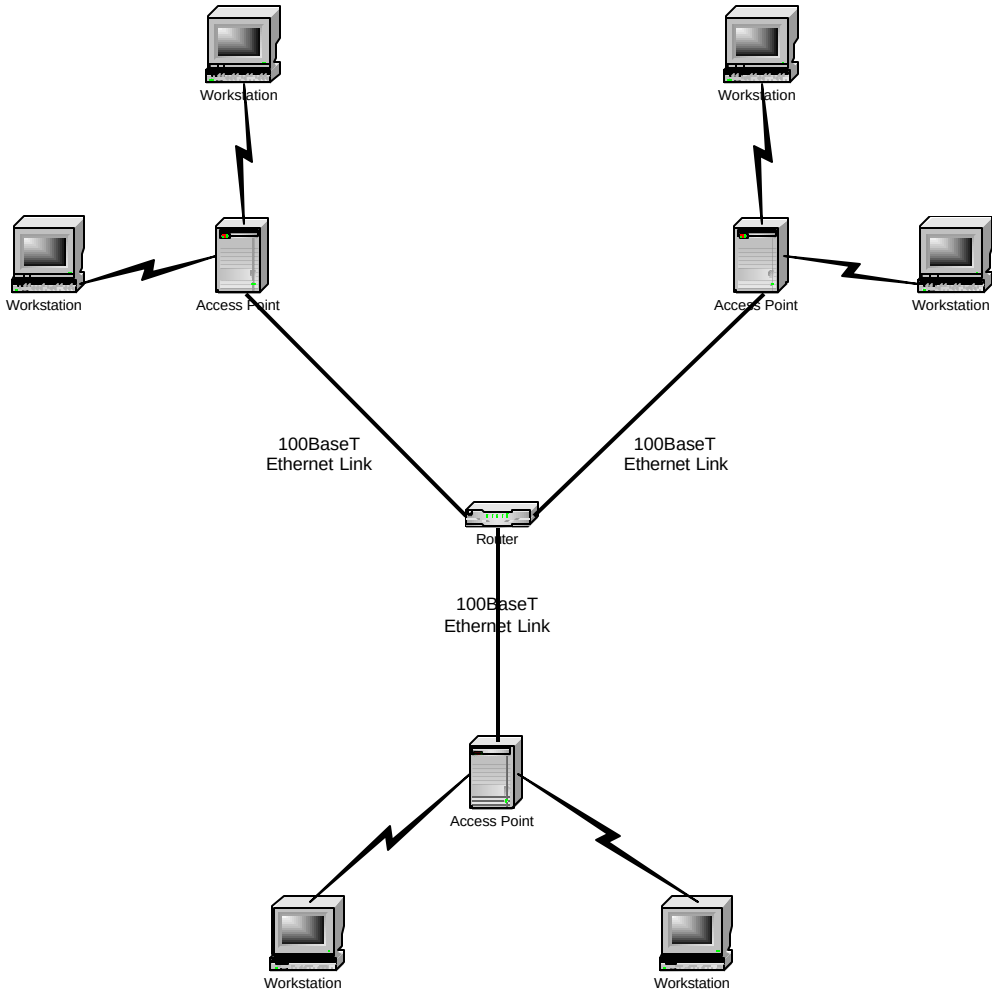
- Learn more about OPNET
- Implement networks using the WLAN models
- Enable trace-driven simulations
- Establish a stable network for benchmark comparison
- Implement different MAC protocols and compare performance

WLAN Intro: Simple Scenario



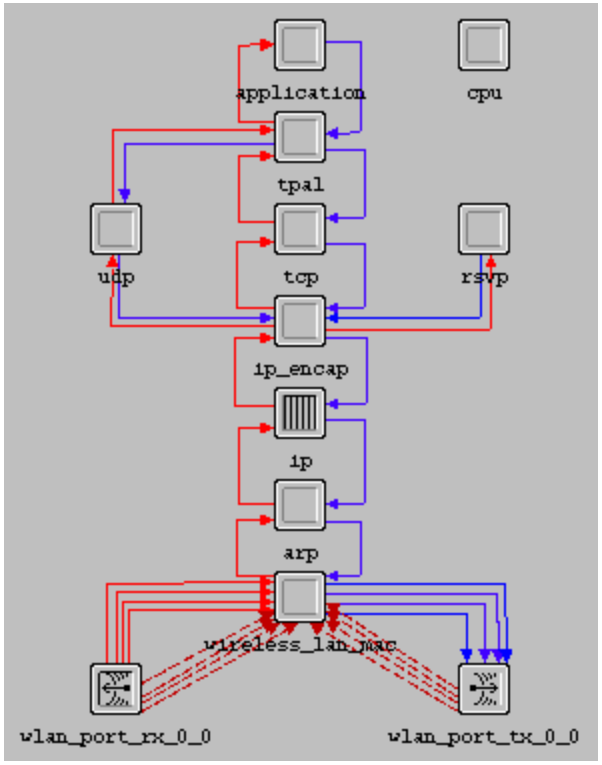
- An Access Point is not necessary (Ad Hoc)
- Access Point acts as a router for local subnet

WLAN Intro: Complex Scenario

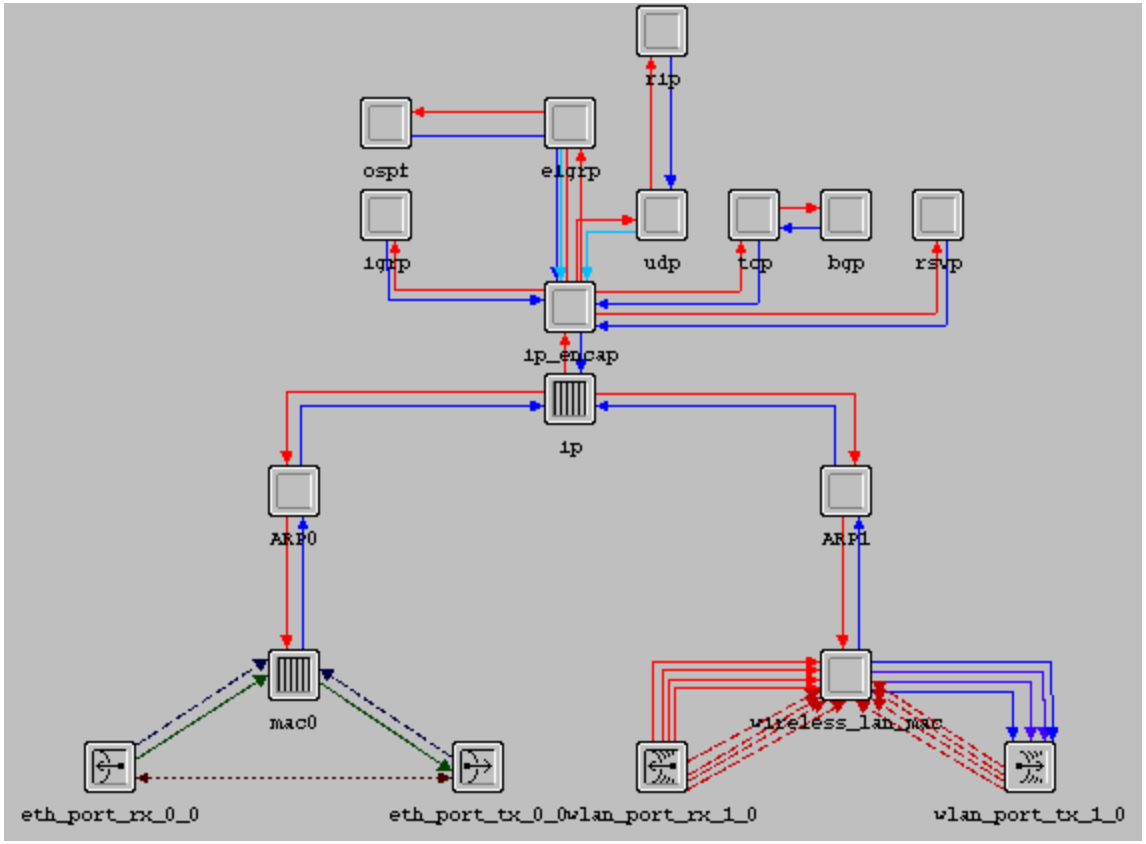


OPNET WLAN Node Models

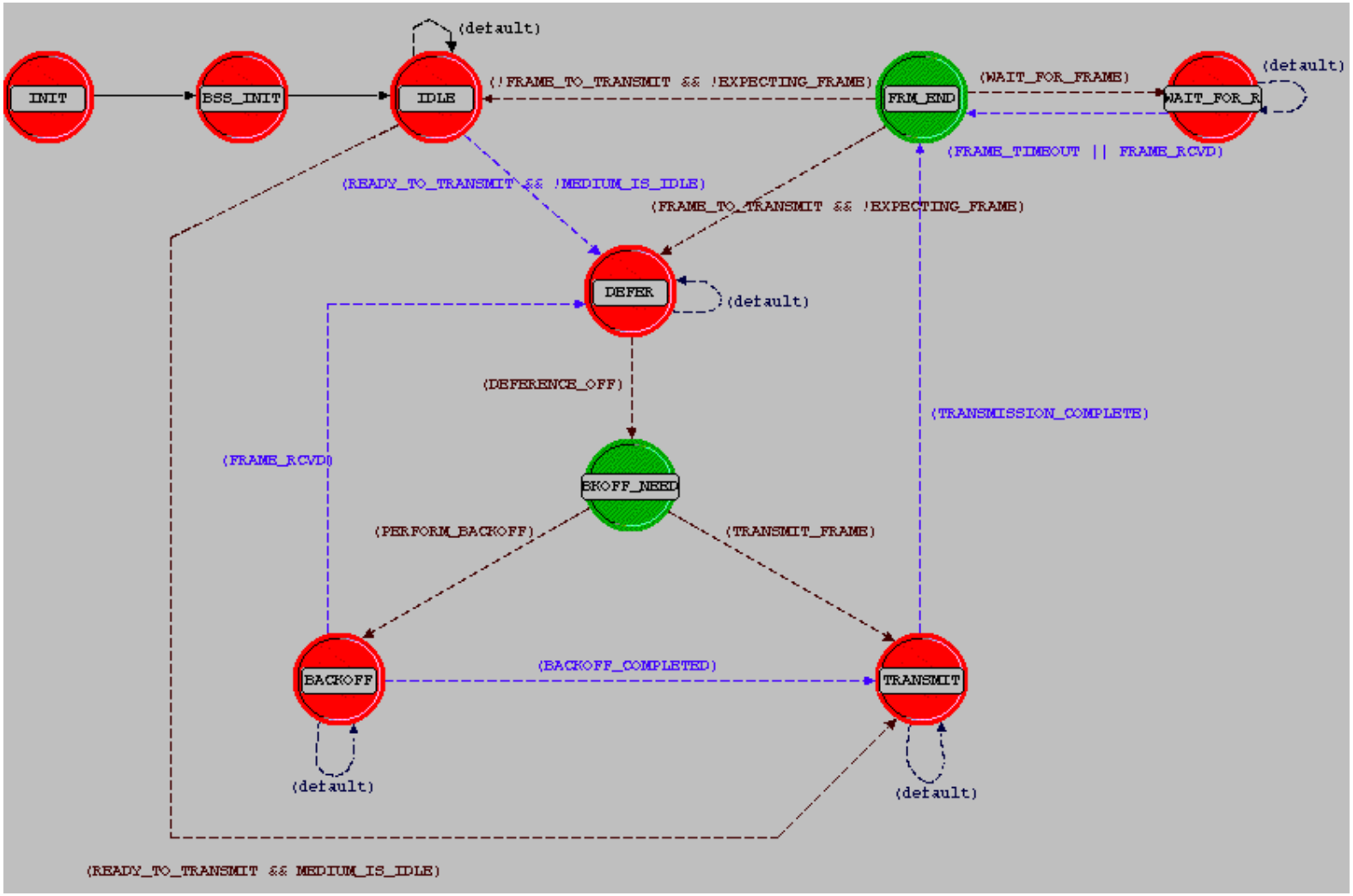
- Workstation



- Access Point



OPNET WLAN Process Model for MAC



MAC

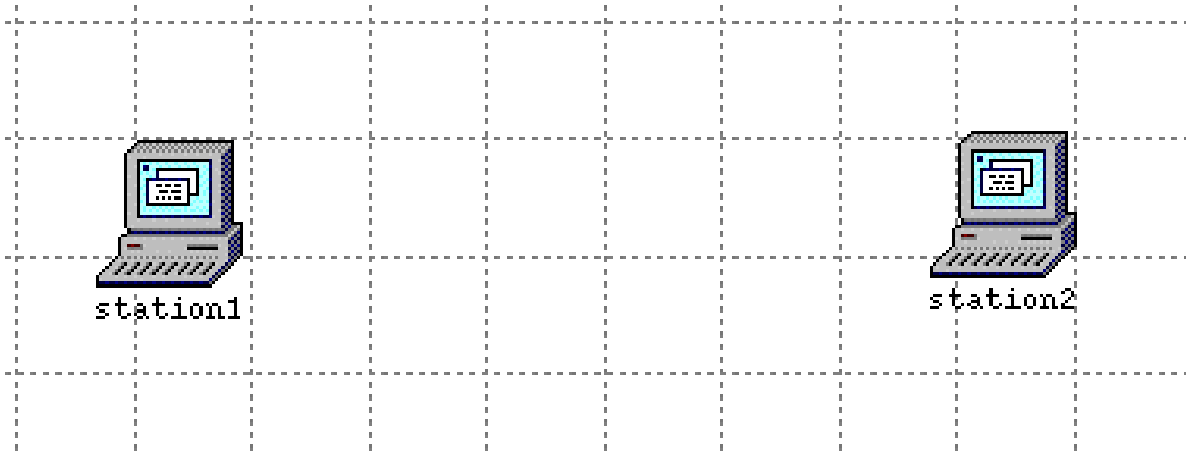
- Stations wait until medium is free (defer)
- After deferral, select random time to transmit (backoff)
- Binary exponential growth of backoff window
- Backoff timer elapses only when medium is free

WLAN Simulation Parameters

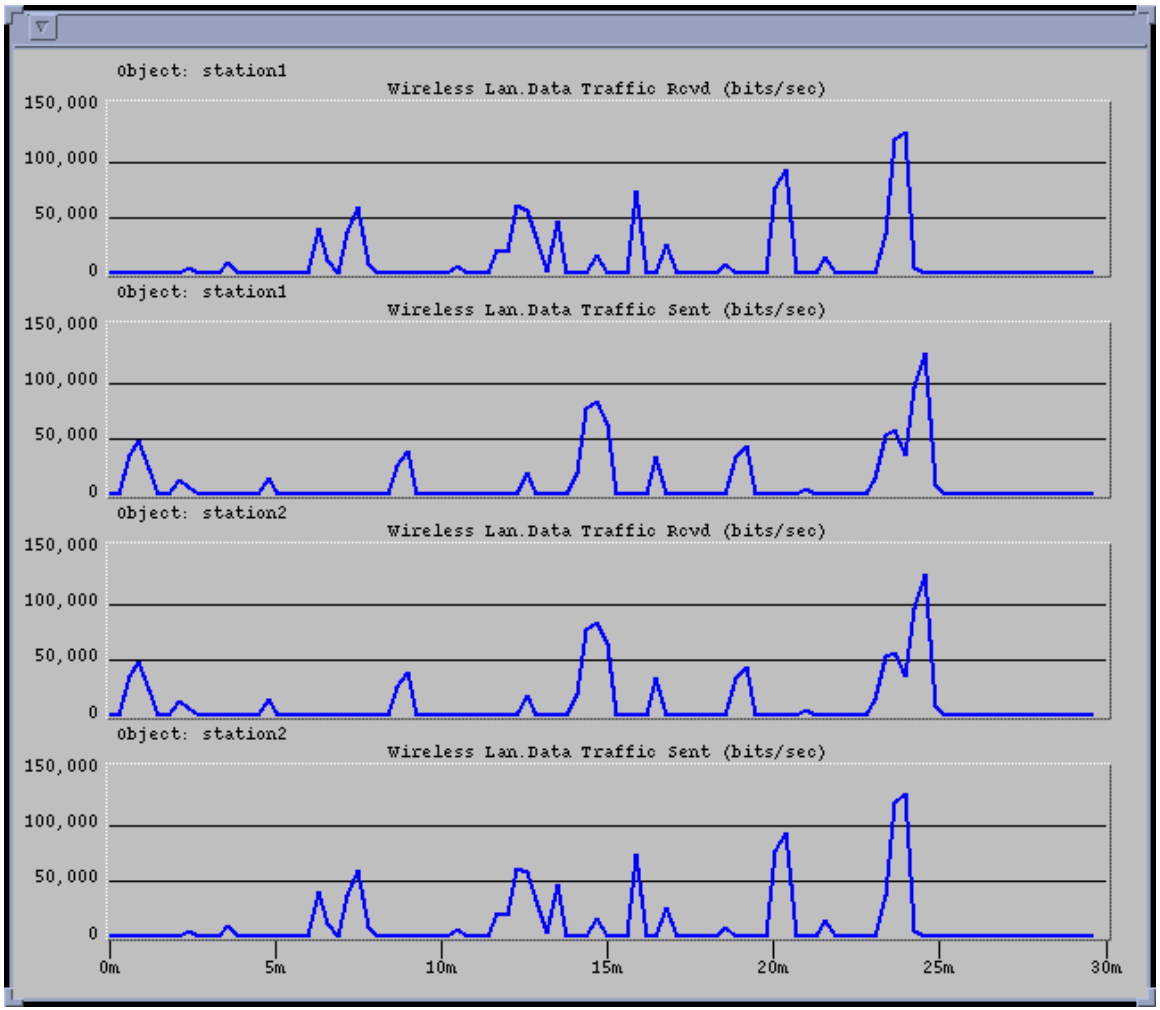
- Data Rate : 11 Mbps
- Physical Characteristics : Direct Sequence
- Buffer Size : 256000 bits
- Max Receive Lifetime : 0.5 sec
- Mac address : Assigned as needed

WLAN 1: Simple Network

- Trace-driven traffic through network
- 1 simple subnet
- Network has no access point



WLAN 1: Simple Network (cont'd)

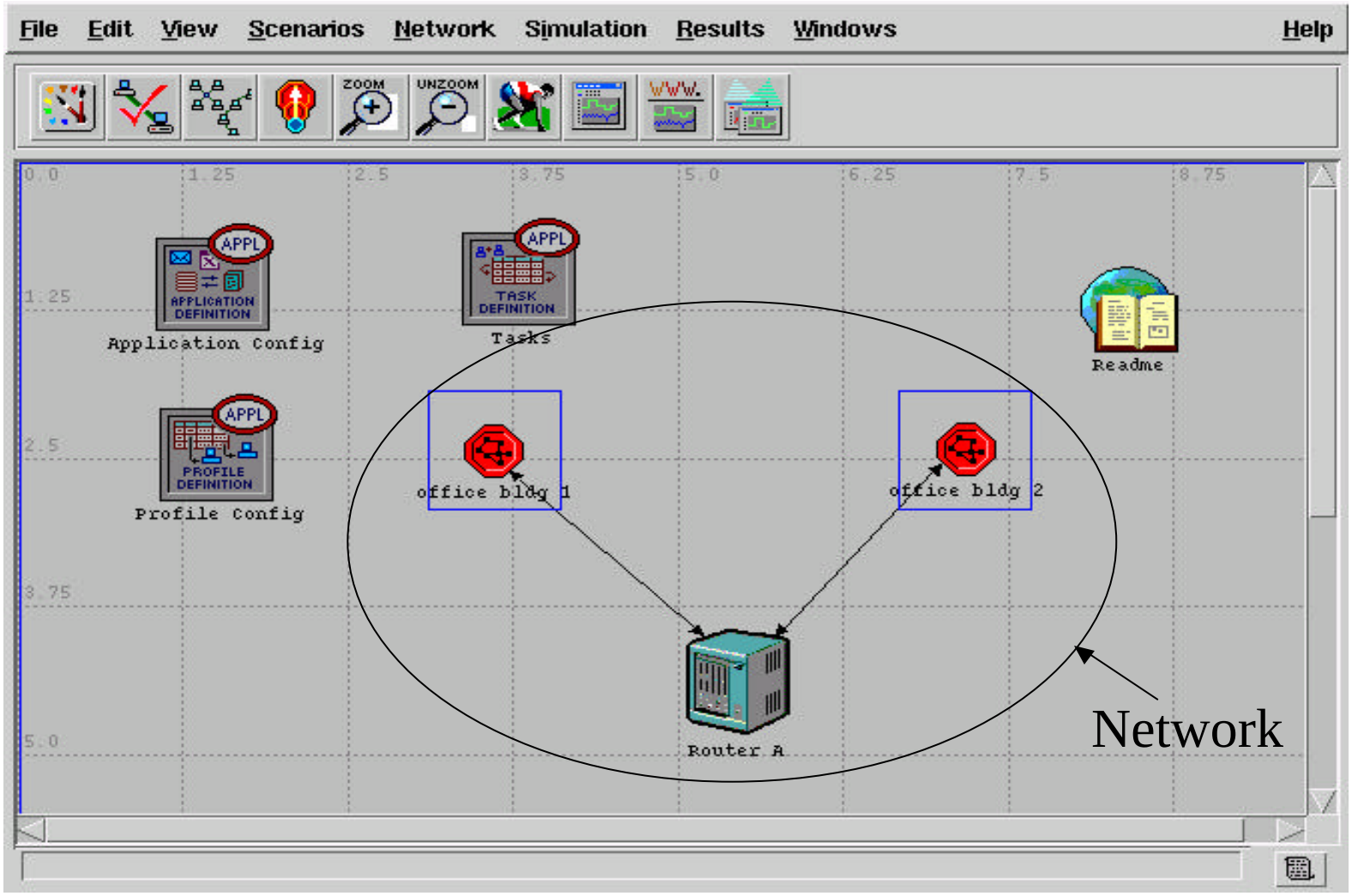


- Trace used: Starwars
- Simulation Results: Successful communication between two workstations are observed

WLAN 2: Complex Network

- Trace-driven traffic through network (movies from course website)
- Activity configuration of each node is done through “Task Definition” object
- The ordering of the task is defined through “Application Definition” object
- The start and stop time for each application is configured by “Profile Definition” object

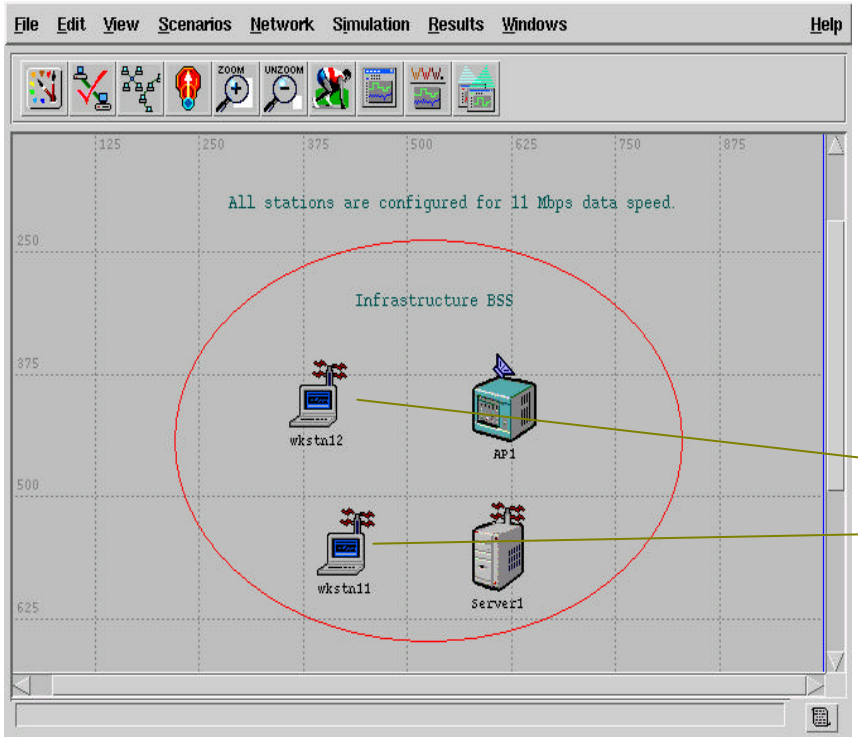
WLAN 2: Complex Network (cont'd)



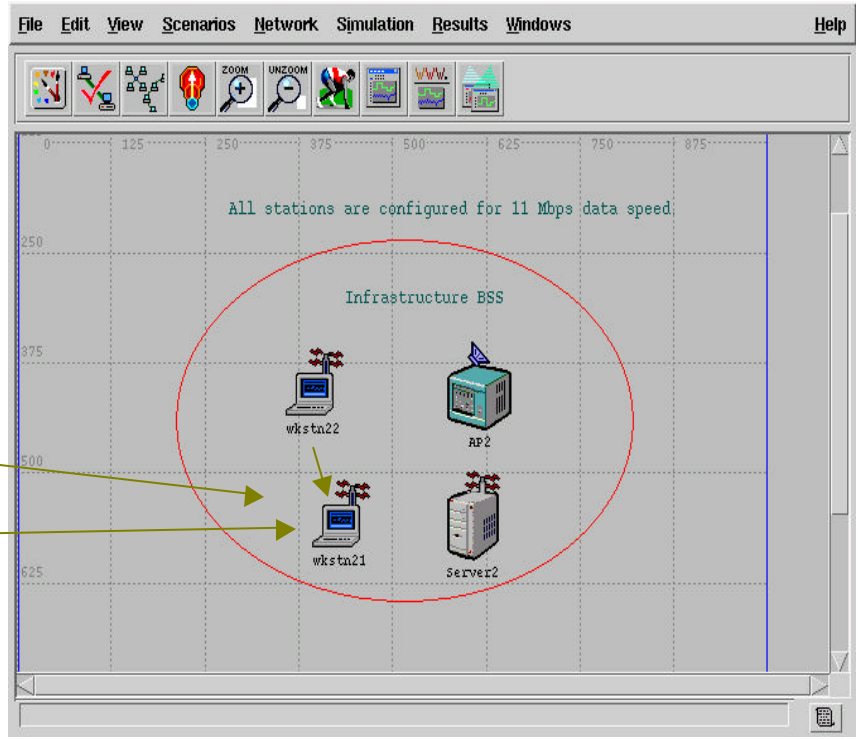
WLAN 2: Complex Network (cont'd)

- 2 subnets, each has 1 access point, are connected by an Ethernet Router

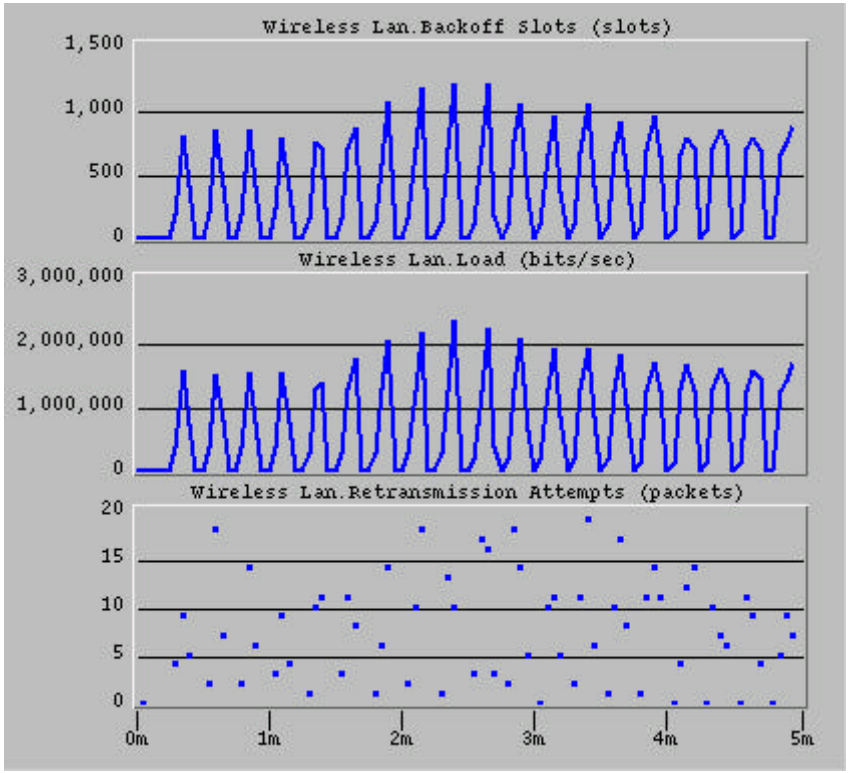
Subnet 1:



Subnet 2:



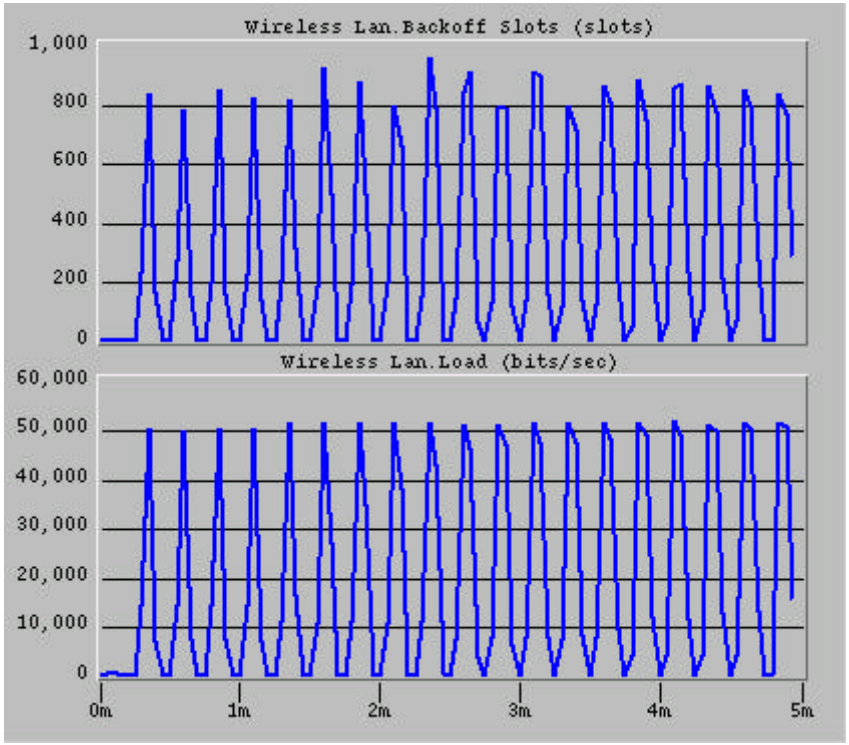
WLAN 2: Complex Network (cont'd)



- Simulation results at wkstn22

  (the most congested source)
- Analysis: Up to 20 retransmission attempts are observed.

WLAN 2: Complex Network (cont'd)

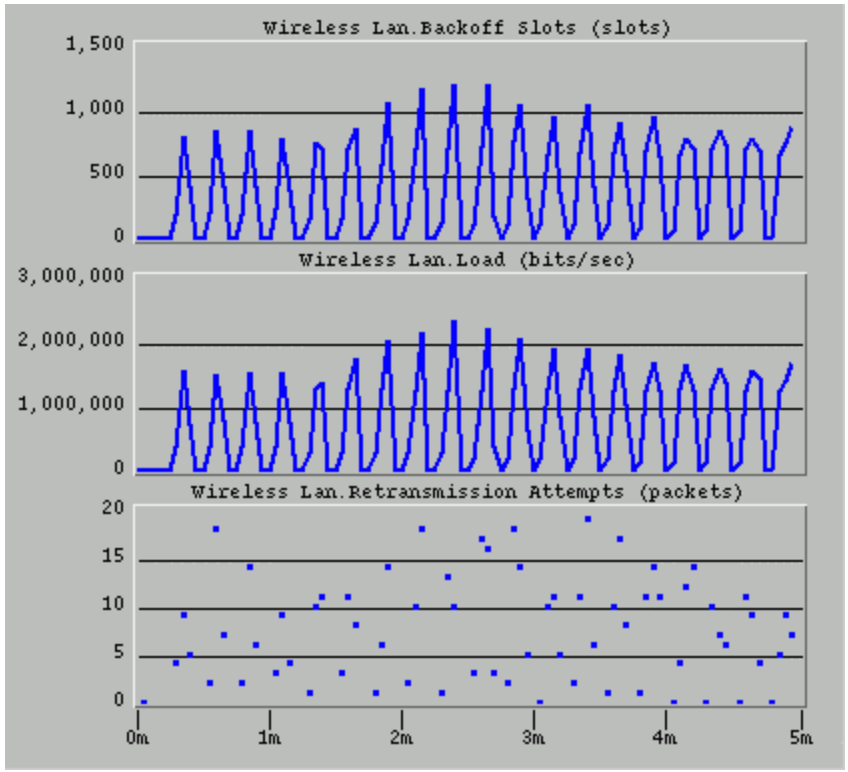


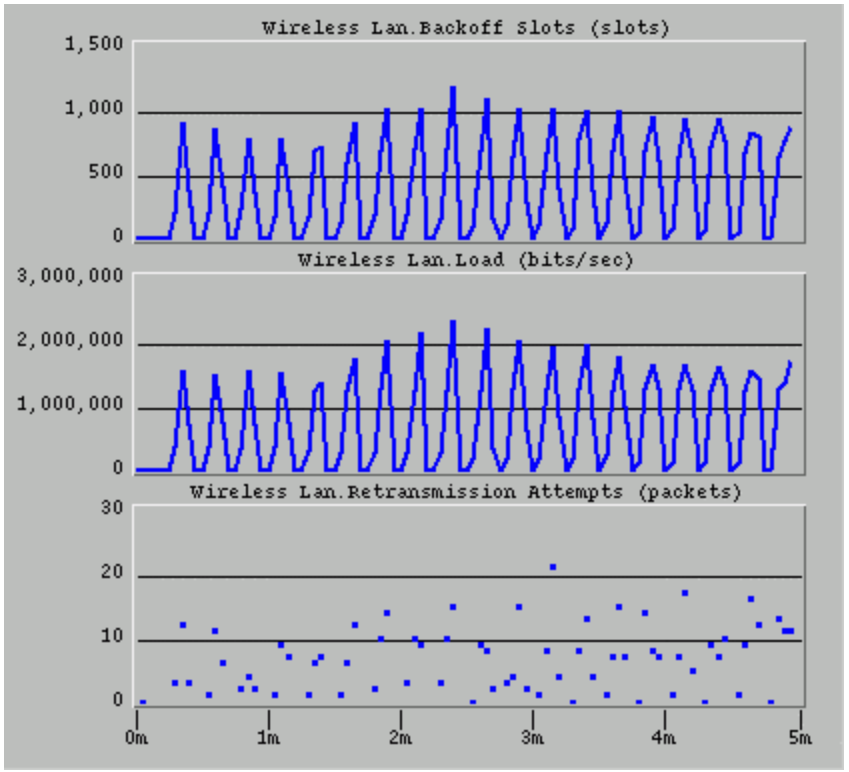
- Simulation results at wkstn21 (destination)
- Analysis:
  - sending acks due to higher layers (TCP)
  - large backoff slots as it's competing with wsktn22 & local AP

WLAN 3: MAC Variations

- Want to change the backoff mechanisms and see performance difference
- OPNET WLAN MAC does binary exponential backoff (double backoff window every time)
- Changed MAC to:
  1. Linear backoff (backoff window grows by 16)
  2. Exponential distribution for backoff time selection
  3. Change to a p-persistent variant

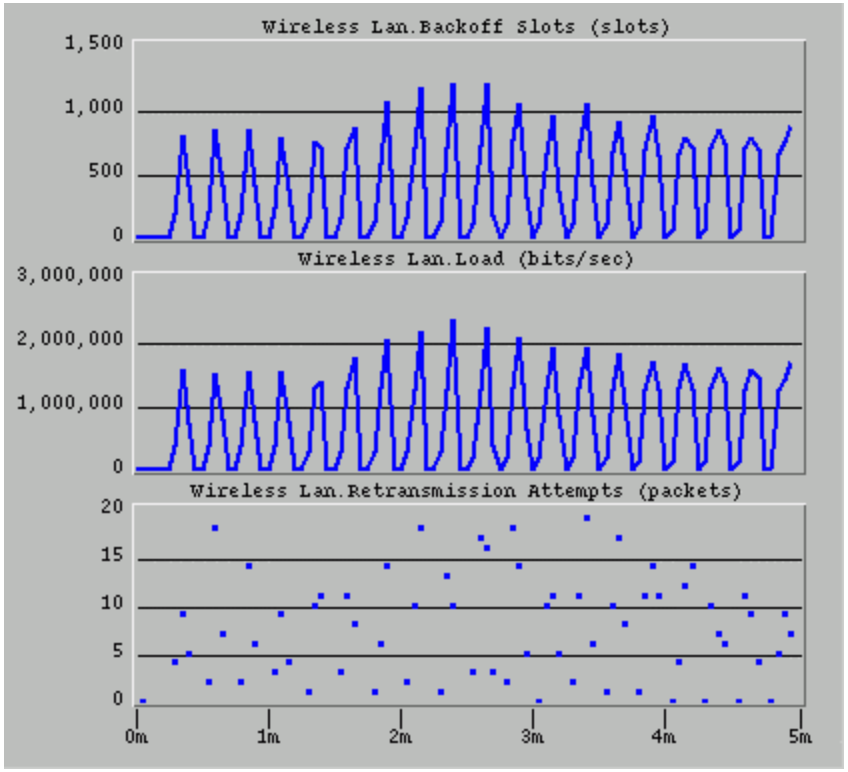
WLAN 3: MAC Variations (cont'd)

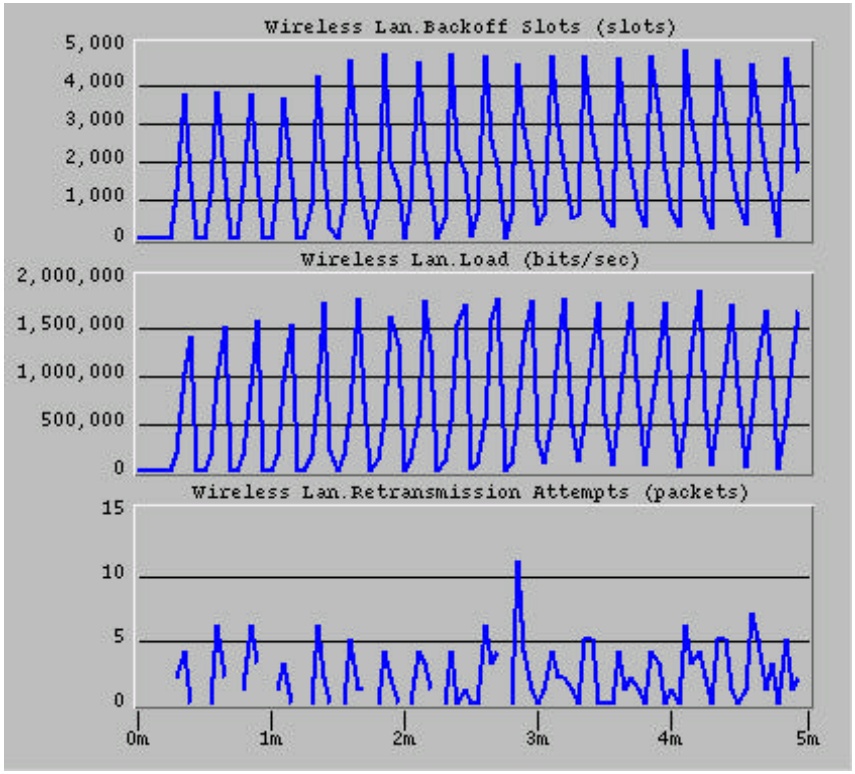




- Linear backoff (backoff window grows by 16)
- No significant change seen

WLAN 3: MAC Variations (cont'd)





- Exponential distribution; mean = 10*backoff_win_size
- Less retransmissions seen with higher exp. distrib. mean

WLAN 3: MAC Variations (cont'd)

- p-persistent MAC? What is it?
  - Station still defer while medium is busy
  - When medium is free station transmits with probability p and defers with probability (1-p)
  - Repeated in next backoff slot
- To Do

Project Difficulties

- Unstable development environment, caused by OPNET, models, or hardware issues. Encountered a lot of tool crashes.
- Insufficient documentation. A lot of time spent learning about & working around the models, only to find easy solution much later.

Conclusions & Future Works

- WLAN models in OPNET work but does not allow for analysis of PHY
- Models TCP/IP layers are preventing the excessive congestion we want in the network
- Can tune the backoff selection algorithm based on network conditions

- More comprehensive simulations
- Investigate effect of roaming
- Investigate effect of different data traffic

Contribution Breakdown

- Project Planning: ALL
- Technical Simulation: Marion
- MAC Variants, Presentation: Jim
- Analysis & Documentation: Tim

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