Modeling Infrared LANs in GloMoSim

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Talk Outline

- Motivation and Applications for Infrared Wireless LANs
- Overview of UCLA's GloMoSim
- How GloMoSim models Radio Channels
- Modifications to GloMoSim for Infrared Channel Models
- Using IRSim to create Infrared Models for GloMoSim

An Introduction to GloMoSim

Aim:

Provide a scalable simulation environment for wireless network systems using the parallel discrete-event simulator Parsec

Features:

- Layered approach similar to seven layer OSI model
- Simultaneous Node and Layer Aggregation
- Scalable to thousands of nodes
- Extensive Library with today's most popular protocols
- Easy to make user modifications to code

Glomosim Layers

- Application: Telnet, FTP, CBR and HTTP
- Transport: TCP, UDP
- Network: IP
- Routing: Bellman-Ford, Fisheye, AODV, DSR, LAR1, WRP
- MAC: CSMA, FAMA, MACA, IEEE 802.11
- Radio: Radio with various noise parameters
- Propagation: Free space, Two-Ray, Generic
- Node Placement: Uniform, Grid, Random, Group Random, File
- Mobility: None, Random Waypoint, File

Main Radio Parameters

- Radio Type: Acc Noise, No Noise, Sircim
- Model: Analytical, Sircim
- Pathloss: Free-Space, Two-ray, Generic
- Propagation Limit (dBm): determines packet delivery
- Packet Reception Model: SNR (maximum acceptable), BER Table
- Bandwidth (bits/sec)
- Transmission Power (dBm)

How Radio Works

- radio.pc is called when there is a message from Channel or MAC
- radio.pc calls the appropriate Radio Type file (Acc Noise, No Noise or Sircim)
- Radio Type file calls appropriate Propagation Model file (Analytical or Sircim) which determines if the receiver can be reached
- Propagation Model file calls appropriate Pathloss file which returns the power lost during transmission
- Radio Type file keeps track of collisions, battery expendeture, packets from MAC and packets from Channel

Infrared Additions

- Model: Infrared, Infrared Rooms
- Propagation Type: Free-Space, Nakagami, Shadow
- Noise Models: Incandecent, Sun, Flourescent Light Sources

Infrared Free-Space Propagation Model

Computing Received Power:

$P_{rx} = \frac{A}{4\pi d^4} P_{tx}$

where

P_{rx} is the received power (default $= 1\mu$W)

A is the surface area of transmitter (default $= 1cm^2$)

d is the distance between nodes

P_{tx} is the transmitted power

Assumptions:

- All transmissions take one bounce and follow a Lambertian reflection pattern
- Field of View (FOV) is 90^o for the transmitter and receiver

Infrared Shadow Propagation Model

Computing Received Power:

(1) Received Power is free-space

(2) PDF determines probability of arrival of packet

- $f(r) = e^{-\lambda r}$
- r is the distance between the transmitter and receiver
- λ is a constant such that at 5 meters the probability of successful transmission is 0.5

(3) Scale Power based on distance

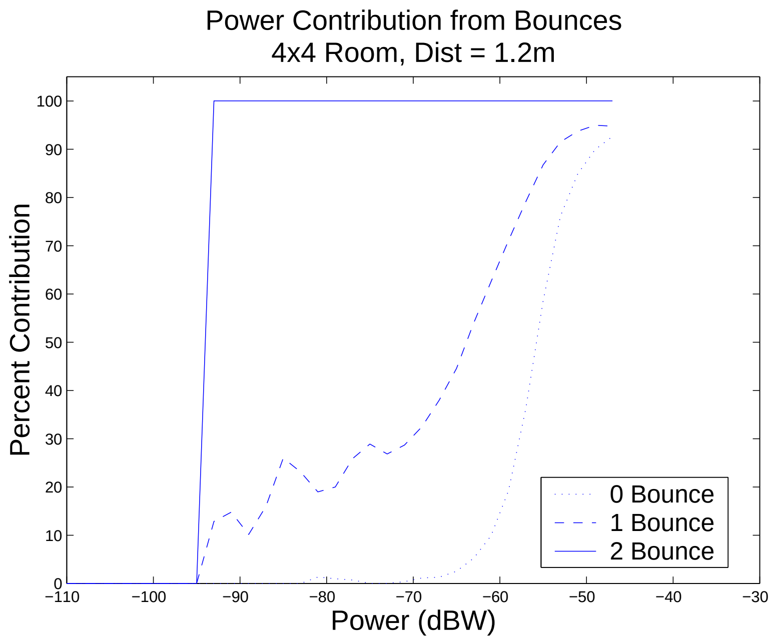
- Multiply free-space pathloss by shadow probability

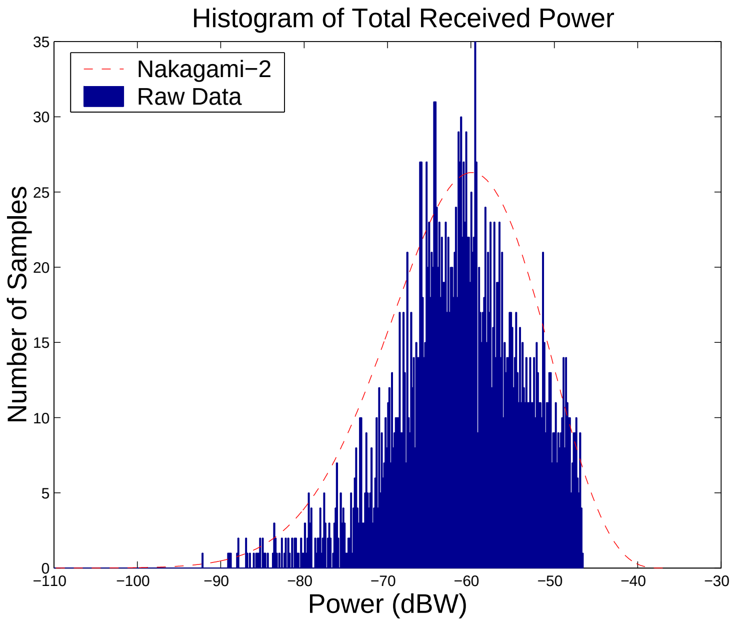
$$P_{rx} * f(r)$$

IRSim Data Analysis

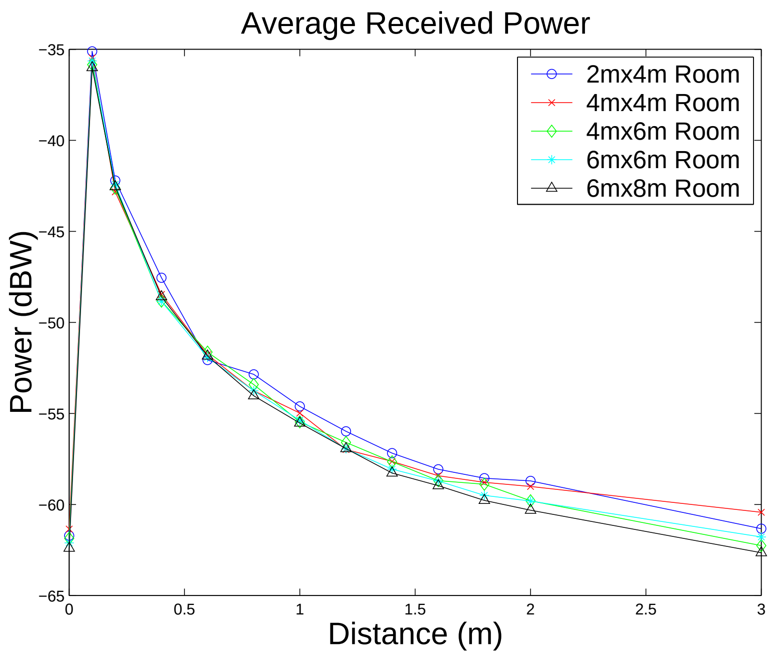
Method:

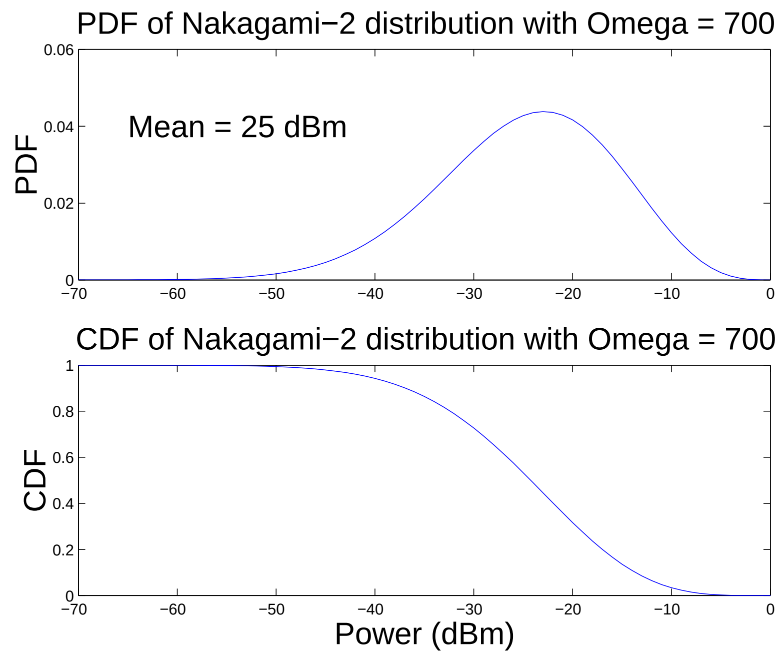
- Place a transmitter randomly in a room
- Place ten receivers at a distance d from the transmitter
- Record the power received at the receiver





Infrared Nakagami Propagation Model





(1) Mean power is determined by distance between transmitter and receiver

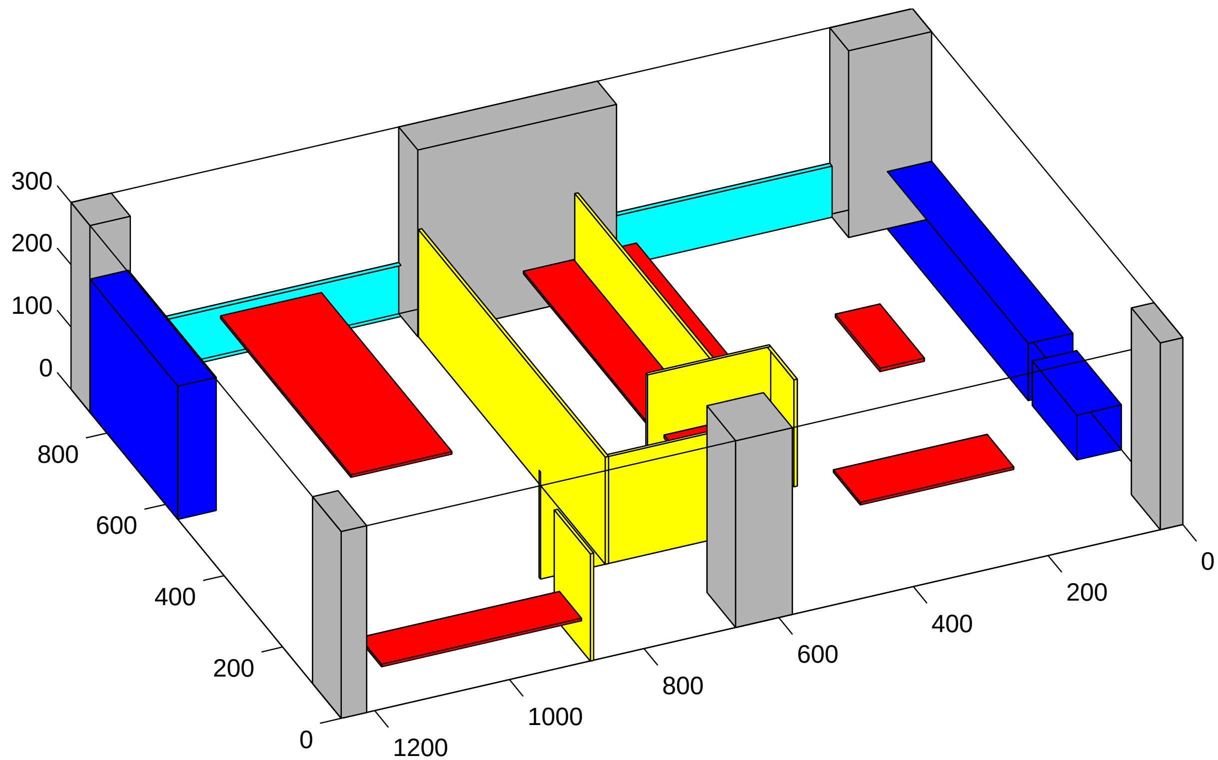
Infrared Nakagami Propagation Model Cont...

(2) Power is scaled according to the CDF and random seed

- Use the midpoint method to determine CDF value corresponding to the uniformly distributed random seed.
- $F(p \geq P) = 1 - \frac{2p^2}{\Omega} e^{\frac{2p^2}{\Omega}} - e^{\frac{2p^2}{\Omega}}$
- p is the received power
- Ω is the Nakagami factor = 700 (determined from IRSim results)

(3) Return mean power scaled by the pdf value of the random seed

Final Product



- MATLAB GUI interface
- Enter a building's blueprints to simulate network