2nd international OMNeT++ Workshop
VirtualMesh: An Emulation Framework for Wireless Mesh Networks in OMNeT++

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Overview

- Introduction and Motivation
- VirtualMesh
  - Architecture
  - Traffic Interception and Redirection
  - Packet Flow
  - Information Exchange with Simulation Model
- Performance Evaluation
  - Latency between Hosts
  - Simulation Overhead
  - TCP Throughput
- Conclusions
# Experiments

## Simulations
- Quick validation of protocols
- Large scale evaluations
- Mobility
- Reproducability
  - Different code as real system software
  - Limited level of implementation details
  - Approximation of real environment

## Test Beds
- Real system software
- Real environment
- Reproducability
- Effort to test with different topologies
- Limited size
- Mobility
- Undesired interferences
Network Emulation

> Reproducability
> Larger scenarios
> Mobility
> Controlled interferences
> Real system software
VirtualMesh

> Combines simulation and real test-beds
> Scalability by virtualization
> Simulation of MAC and physical layer
> Traffic redirection to a simulation model by virtual interface
VirtualMesh Architecture
Traffic Interception and Redirection

> Replacement of wireless network device by virtual device *PacketModeller*

> TUN/TAP redirects MAC frames to user space process

> Identical configuration interface
Packet Flow in Simulation Model

Traffic to/from nodes

1. Packet to/from nodes

2. Packet Proxy

3. Node Manager

4. Packet

5. Proxy Host

6. WlanNIC

7. Simulated host

8. Simulated host

9. Proxy Host

10. WlanNIC

11. Packet

12. Packet

Channel Control

ID | hostname | IP   | port | virtual MAC  
---|----------|------|------|--------------
node01 | 10.1.0.2 | 2040 | AABBCDDEEEFF  
node02 | 10.1.0.9 | 4050 | AABBCDDEEEFF  
node03 | 10.1.0.8 | 4050 | AABBCDDEEEFF  

March 6, 2009
Information Exchange between PacketModeller and Simulation Model

> Simulation model must know static and dynamic parameters describing external nodes

— Registration of static parameters by REGISTER message

— Dynamic parameters are included in DATA packets
Performance Evaluation: Latency between Hosts

- a) physical host to physical host
- b) physical host to para-virtualized host
- c) physical host to fully virtualized host
Performance Evaluation: Packet Modeller Overhead

- RTTs between two virtualized hosts without/with PacketModeller

![Graph showing RTTs between two virtualized hosts without/with PacketModeller]
Performance Evaluation: Simulation Model Overhead

> Simulation model processing
  a) 2 context switches
  b) 1 hop
  c) 2 hops
  d) 3 hops
TCP Throughput for 1/2/3-Hop Chains

![Graph showing throughput for different scenarios](image)
Conclusions

> Emulation provides a valuable extension of test and performance measurement facilities for communication software

> VirtualMesh
   — Host virtualization
   — Traffic interception
   — Integration of OMNeT++