Comparison of QoS between WiFi, WiMAX, and Ethernet LAN for Online Gaming Traffic
Roadmap

- Introduction
- Background Information
- Motivation & Scope
- OPNET Implementation
- Simulation Results
- Conclusions
- Future Work
- References
Gaming is all around us
Available through many different media
  o PCs
  o Phones
  o Portable handhelds
Online gaming through PC represents of >4% of entire internet traffic[1]
Mobile traffic represent ~10% of entire internet traffic[2]
  o 61% of people use mobile phones for gaming
Introduction

Hardcore Gamers
Introduction

Casual Gamers
Introduction

Professional Gamers
Ethernet LAN (Local Area Network)

- IEEE standard protocol for wired network communication introduced in the 1980’s
  - IEEE 802.3 family

- Allows for fastest transmission
  - Up to 100 Gbps

- Wired communication reduces transmission errors
  - Becoming the one of the most reliable protocol for network communication
Ethernet cables
WiFi (Wireless Fidelity)

- Wireless LAN (WLAN) technology to allow devices to connect to the internet without any wires
  - IEEE 802.11 family

- Using an access point or hotspot, wireless devices connect to these access points through radio waves

- Limited range
  - Between 35 to 250m

- Transmits up to speeds of 72.2 Mbps over a 20MHz channel or 150 Mbps over a 40 MHz
Illustration of how WiFi works
WiMAX (Worldwide Interoperability for Microwave Access)

- WLAN technology that uses base stations to transmit coverage for wireless devices
  - IEEE 802.16 family

- Uses a WiMAX tower, similar to a cell tower, to transmit frequencies

- Provides either high speed or far places but not both
  - Up to 365 Mbps downstream or 376 Mbps upstream through a 40MHz FDD channel
  - Up to 50 km in range through line of sight service
How WiMAX works
Motivation & Scope

Motivation

- To have a better idea of how different network topologies affect our gaming world
- To see how much better are certain technologies compared to others

Our scope for this project is to measure the performance between Ethernet LAN, WiFi, and WiMAX

- Ethernet LAN acts as a baseline for the most optimal results
  - Compare network topologies together to see the difference in performance
- Use QoS factors to analyse the performance
<table>
<thead>
<tr>
<th></th>
<th>Ethernet LAN</th>
<th>WiFi</th>
<th>WiMAX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model specification</strong></td>
<td>IEEE 802.3u 100BASE-T</td>
<td>IEEE 802.11g</td>
<td>IEEE 802.16d</td>
</tr>
<tr>
<td><strong>Data rate</strong></td>
<td>100 Mbps</td>
<td>54 Mbps</td>
<td>75 Mbps</td>
</tr>
<tr>
<td><strong>Simulation Time</strong></td>
<td>15 minutes</td>
<td>15 minutes</td>
<td>15 minutes</td>
</tr>
<tr>
<td><strong>Random Seed</strong></td>
<td>128</td>
<td>128</td>
<td>128</td>
</tr>
</tbody>
</table>
Ethernet LAN Topology

- Campus network 100 x 100m
- 1 Ethernet server
- 1 router
- 3 gaming workstations
- Application, Profile, and Task Definitions
WiFi Topology

- Campus network 100 x 100m
- 1 WiFi server
- 1 router
- 3 gaming workstations
- Application, Profile, and Task Definitions
**WiMAX Topology**
- Campus network 100 x 100m
- 1 WiMAX server
- 1 base station
- 3 gaming workstations
- Application, Profile, and WiMAX Config Definitions
Customized Gaming Traffic
  - According to Johannes Farber, approximation of a typical gaming server to client traffic

<table>
<thead>
<tr>
<th>Outgoing Packet Inter-arrival Time</th>
<th>Outgoing Packet Size</th>
<th>Incoming Packet Inter-arrival Time</th>
<th>Incoming Packet Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme (0.055, 0.006)</td>
<td>Extreme (120, 36)</td>
<td>Constant (0.04)</td>
<td>Extreme (80, 5.7)</td>
</tr>
</tbody>
</table>

Gaming Workstations
  - Distances from the router/access point/base station
    - Gamer 1 = 30m
    - Gamer 2 = 42m
    - Gamer 3 = 98m
Ethernet Topology Results – Ethernet Delay (sec)

- Fairly constant steady-states
- Longer distances from the router means higher delay
- Between 11-12μsec
Ethernet Topology Results – Ethernet Load (packets/sec)

- Converges for steady-states
- Almost even distribution of packets for all 3 gaming workstations
- Approximately 17.2 packets/sec
WiFi Topology Results – *Wireless Lan Delay (sec)*

- Fairly constant steady-states
- Longer distances result in shorter delay
- Between 50-127μsec of delay
WiFi Topology Results – Wireless Lan Load (bits/sec)

- Roughly similar steady-state values
- Packet distribution are nearly the same through all 3 clients
- Approximately 23,200 bits/sec
Simulation Results

WiMAX Topology Results – WiMAX Delay (sec)

- Similar steady-state values
- Almost even delay for all 3 gaming workstations
- Approximately 53μsecs of delay
Comparisons of 3 topologies – Gamer1

- WiFi has the highest delay for Gamer1
- Ethernet has lowest delay for Gamer1
- Constant delays
Comparisons of 3 topologies – Gamer2

- WiFi has highest delay for Gamer2
- Ethernet has lowest delay for Gamer2
- Constant delays
Comparisons of 3 topologies – Gamer3

- WiMAX has highest delay for Gamer 3
- Ethernet has the lowest delay for Gamer3
- Constant delays
### Summary of Simulation Results

<table>
<thead>
<tr>
<th></th>
<th>Ethernet Delay</th>
<th>WiFi Delay</th>
<th>WiMAX Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamer1</td>
<td>11.3μsec</td>
<td>126μsec</td>
<td>53.4μsec</td>
</tr>
<tr>
<td>Gamer2</td>
<td>11.4μsec</td>
<td>105μsec</td>
<td>53.2μsec</td>
</tr>
<tr>
<td>Gamer3</td>
<td>12.0μsec</td>
<td>50μsec</td>
<td>53.3μsec</td>
</tr>
</tbody>
</table>
Using Ethernet LAN as a baseline

- WiMAX has a better performance than WiFi overall
  - Lower end-to-end delay
- For longer distances, WiMAX has a higher delay compared to WiFi
  - Gaming station 3 almost 100m away from the base station begins experiencing higher delay than WiFi
  - Sacrifices higher speeds for longer distances

WiMAX’s delay for all simulated gaming workstations remain fair constant

- The coverage of WiMAX spreads throughout a large area so a small scenario of 100x100m does not vary the delays between the gaming workstations
WiFi results did not behave as expected

- Decrease in delay time as distance away from server increases
  - Contribute this factor to the limited range of WiFi
  - As distance increases, WiFi connection begins to deteriorate
Future Work

- Should implement newer standards of 802.3 (Ethernet LAN), 802.11 (WiFi), and 802.16 (WiMAX) for newer comparisons.

- Should use real, exact traces of online games instead of approximation.

- Should simulate more QoS factors for better analysis.

- Simulate with more nodes in a larger scenario.
References


Thank you
For
Your time 😊