ENSC 833: NETWORK PROTOCOLS AND PERFORMANCE

FINAL PROJECT PRESENTATION
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SIMULATION AND PERFORMANCE ANALYSIS OF WIMAX & WI-FI WHILE STREAMING AUDIO AND VIDEO CONTENT

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Roadmap

- **Introduction**
- Scope of Project
- Simulation Scenarios Setup
- Results and Discussions
- Conclusion
- Future Work
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Introduction

- Over 165 million mobile professionals, organizations and institutions using wireless technologies.
- Main characteristics are Mobility, Reachability, simplicity and Maintainability.
- Two main WLAN technologies under consideration:
  - WiMAX
  - Wi-Fi

  Both of these are designed for Internet Protocol Applications.
- Performance Comparison of these two technologies while Streaming Audio and Video Content.
- Simulation and analysis using Riverbed Modeler 18.0, a tool to simulate the behavior of the oriented network.

Overview: WiMAX

- World Interoperability for Microwave Access (WiMAX) is an IEEE 802.16 standard for wireless broadband access to large areas.
- Optimized for high speed Wireless Wide Area Networks (WWAN) and Packet Data Service.
- Operating range: up to 50 Kilometers.
- Stable and high transmission Speed: 72 Mbps.
- Provide fixed and mobile wireless access.
- Lower delay in long distance transmission.
- More signal coverage, better frequency utilization and bandwidth efficiency.

WiMAX Network Architecture

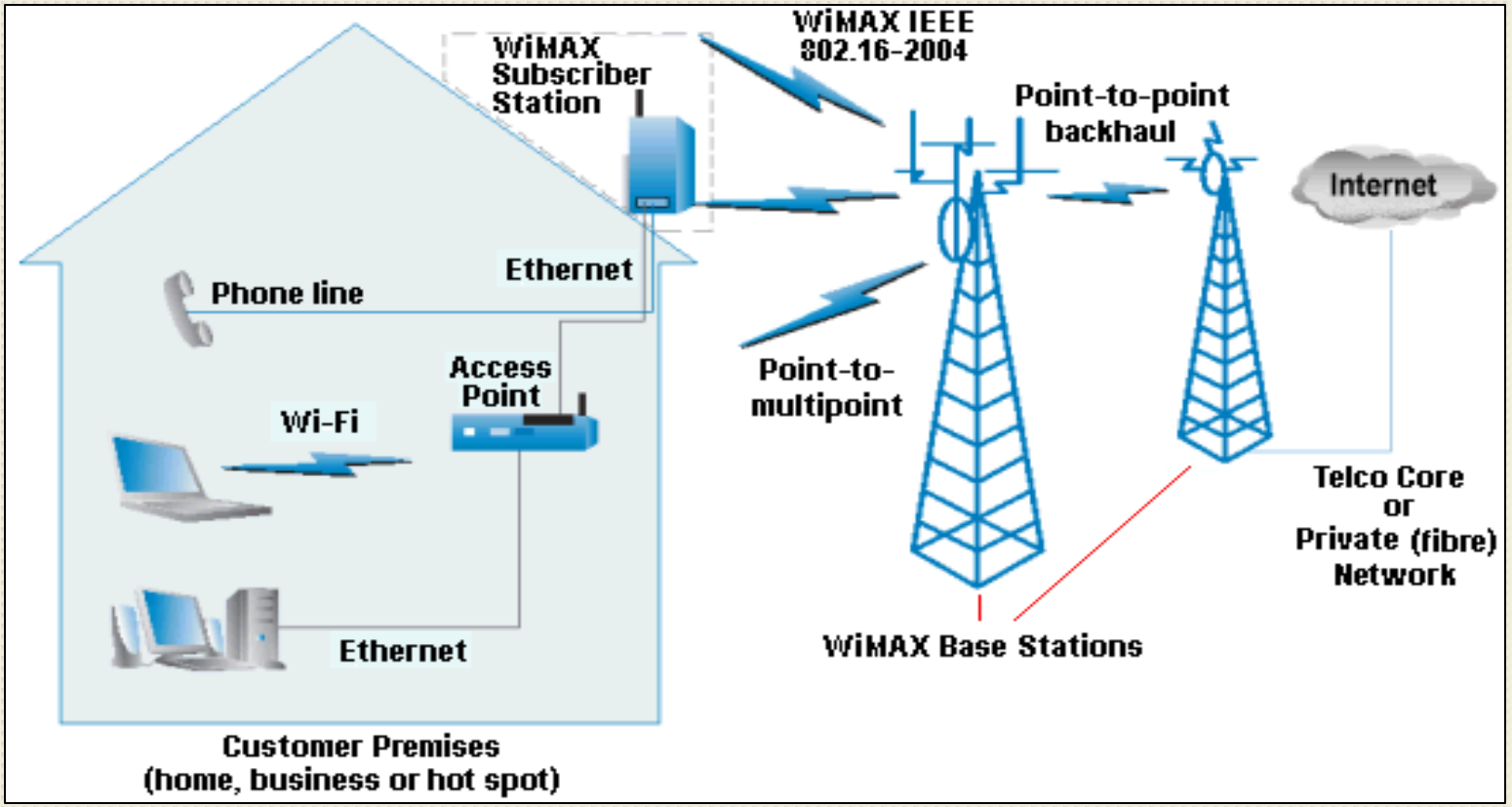

Figure 1: WiMAX Network Configuration [3]

Overview: Wi-Fi

- Wireless Fidelity (Wi-Fi) is based on IEEE 802.11 standard.
- Optimized for very high speed WLAN.
- Operating range: few hundred feet (30-100 meters).
- Speed: 54 Mbps.
- Relatively low cost to users.
- Uses an unlicensed band for operation.
- Today millions of offices, homes, airports, cafes, etc. have Wi-Fi connectivity.

Wi-Fi Network Architecture

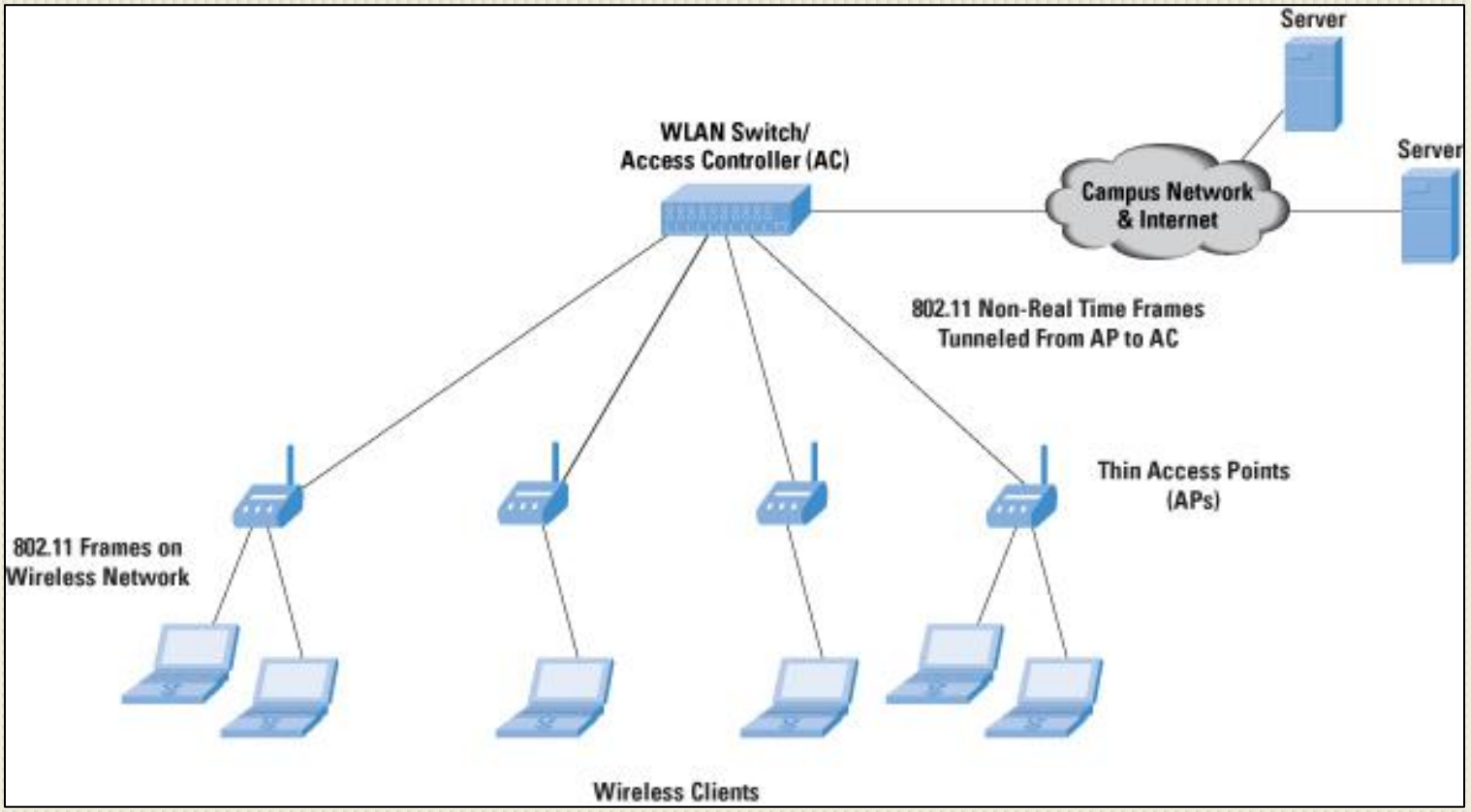

Figure 2: Wi-Fi Network Configuration [5]

Comparison of WiMAX and Wi-Fi

Feature	WiMAX (802.16a)	Wi-Fi (802.11b)
Primary Application	Broadband Wireless Access	Wireless LAN
Frequency Band	Licensed/Unlicensed 2 G to 11 GHz	2.4 GHz ISM
Channel Bandwidth	Adjustable 1.25 M to 20 MHz	25 MHz
Half/Full Duplex	Full	Half
Radio Technology	OFDM (256-channels)	Direct Sequence Spread Spectrum
Bandwidth Efficiency	<=5 bps/Hz	<=0.44 bps/Hz
Modulation	BPSK, QPSK, 16-, 64-, 256-QAM	QPSK
FEC	Convolutional Code Reed-Solomon	None
Encryption	Mandatory- 3DES Optional- AES	Optional- RC4 (AES in 802.11i)
Mobility	Mobile WiMAX (802.16e)	In development
Mesh	Yes	Vendor Proprietary
Access Protocol	Request/Grant	CSMA/CA

Figure 3: Comparison between WiMAX and Wi-Fi [3]

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Scope of Project

- Applications such as Skype, Google Talk, FaceTime & many more promising technologies today are providing face to face real time communication at very low cost to its customers.
- Voice calls are also even more frequent in our daily lives.
- Used Riverbed Modeler 18.0 to create network topologies in a 1Km x 1Km campus network for WiMAX and Wi-Fi networks.
- Simulation and performance evaluation of both networks using video conferencing application (audio and video content).

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Simulation Scenario Setup

- **First scenario** consists of WiMAX and Wi-Fi networks with fixed mobile workstation.
- **Second scenario** consists of both the networks with moving mobile workstation.
- Compared performance based on various QoS parameters such as Throughput, Jitter, Delay and Load.

Simulation Scenario 1

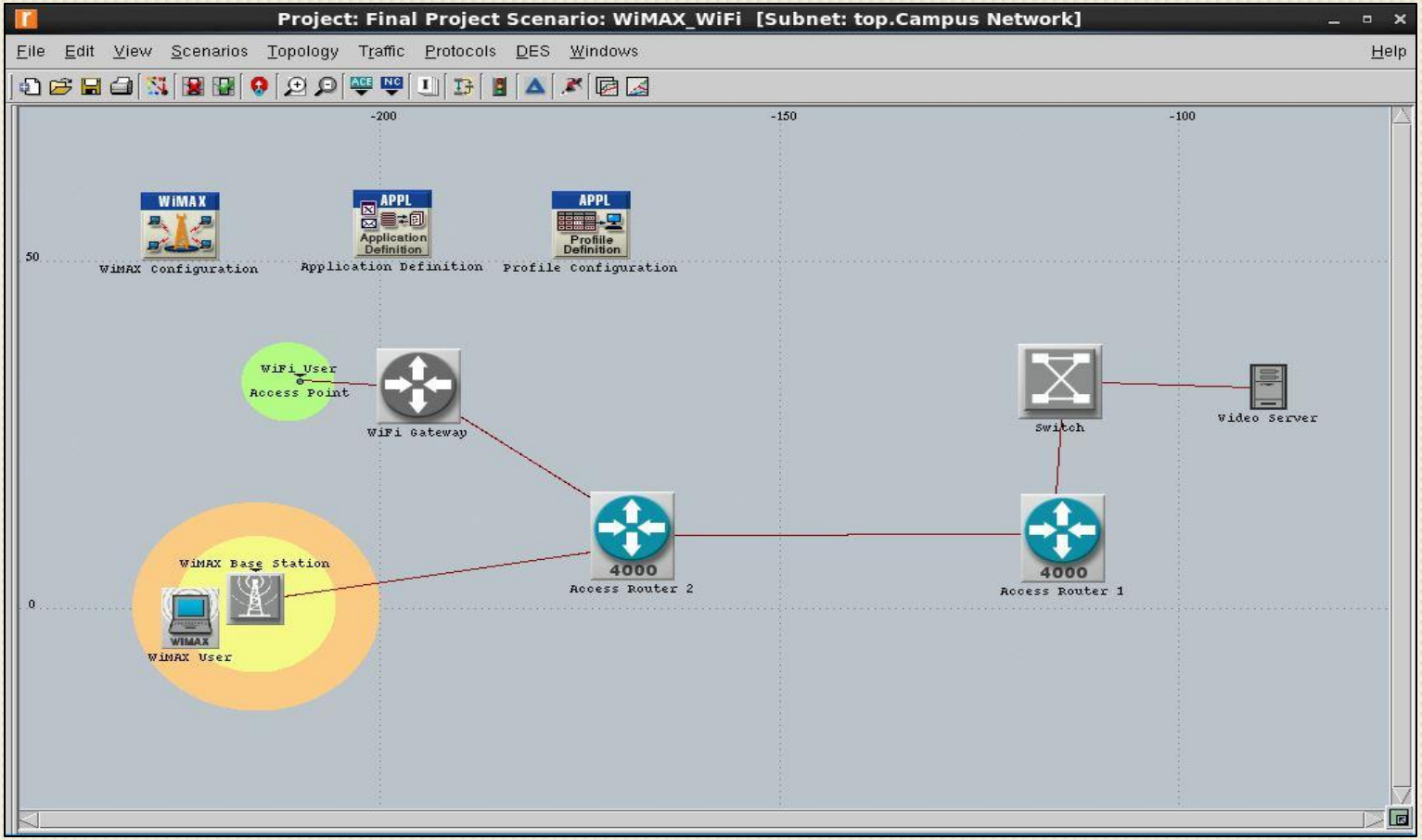

Figure 4: WiMAX and Wi-Fi Network Scenario with Fixed Nodes

Simulation Scenario 2

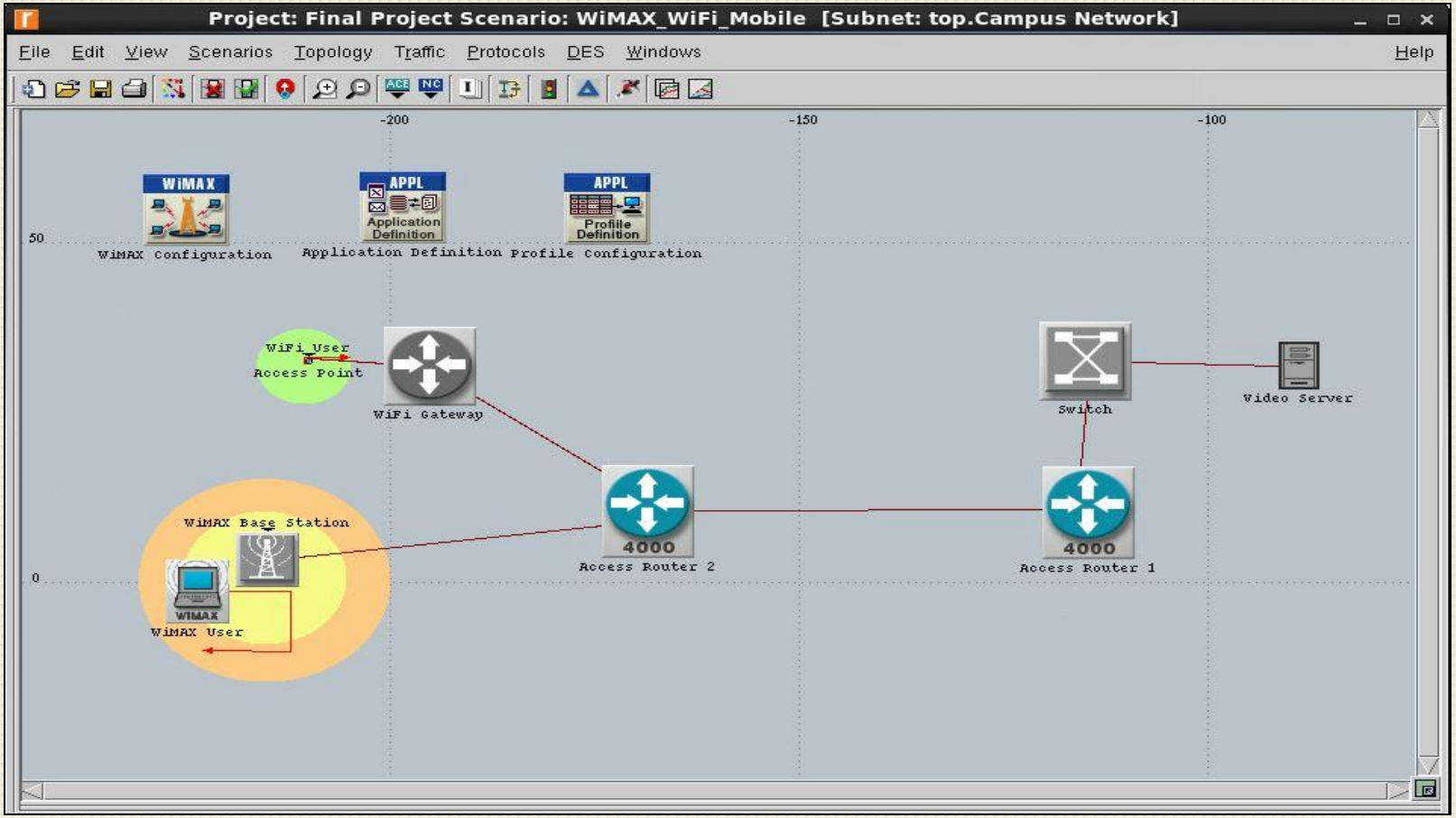

Figure 5: WiMAX and Wi-Fi Network Scenario with Moving Nodes

Simulation Scenario 2 Extended Zoom

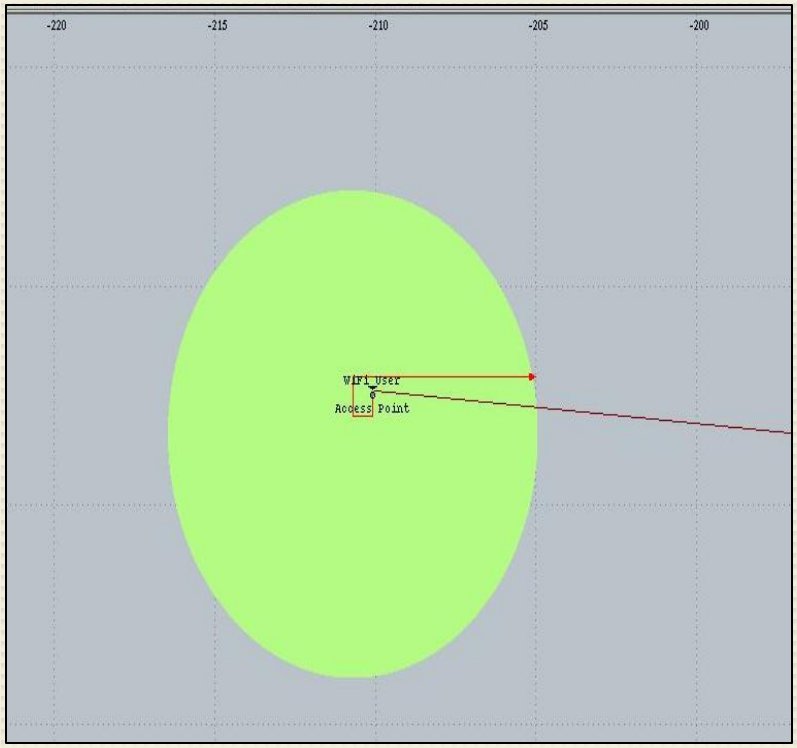

Figure 6: Trajectory of Wi-Fi User in Network Scenario with Moving Nodes

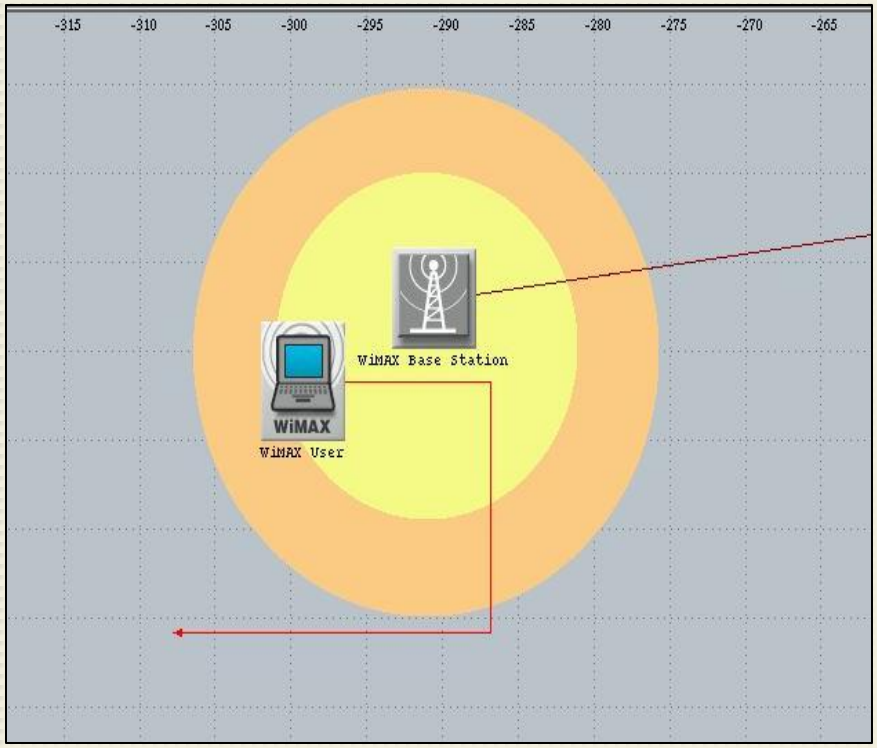

Figure 7: Trajectory of WiMAX User in Network Scenario with Moving Nodes

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Simulation Results: Traffic Received

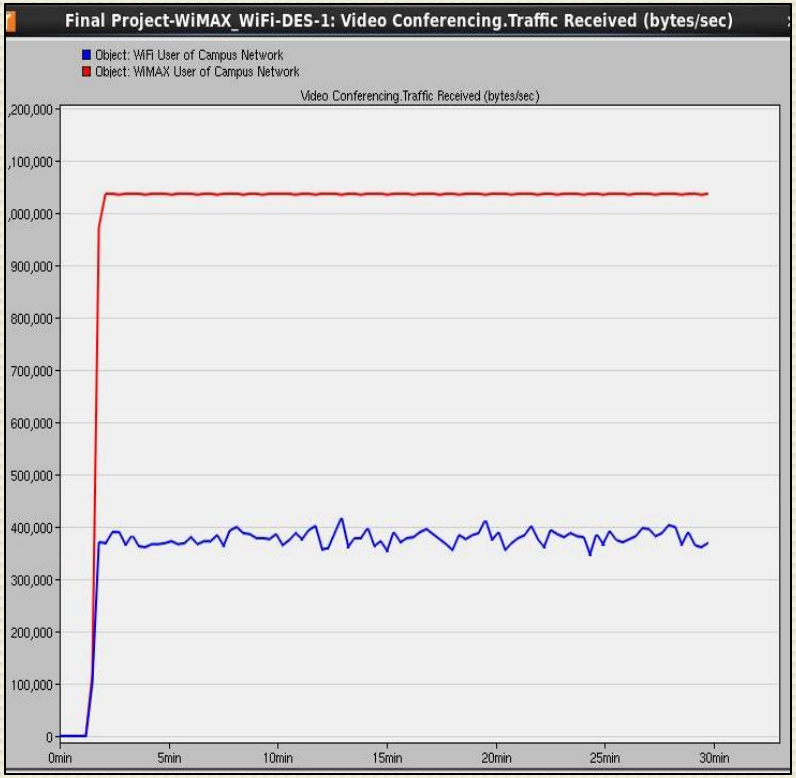

Figure 8: Traffic Received of Network Scenario with Fixed Nodes

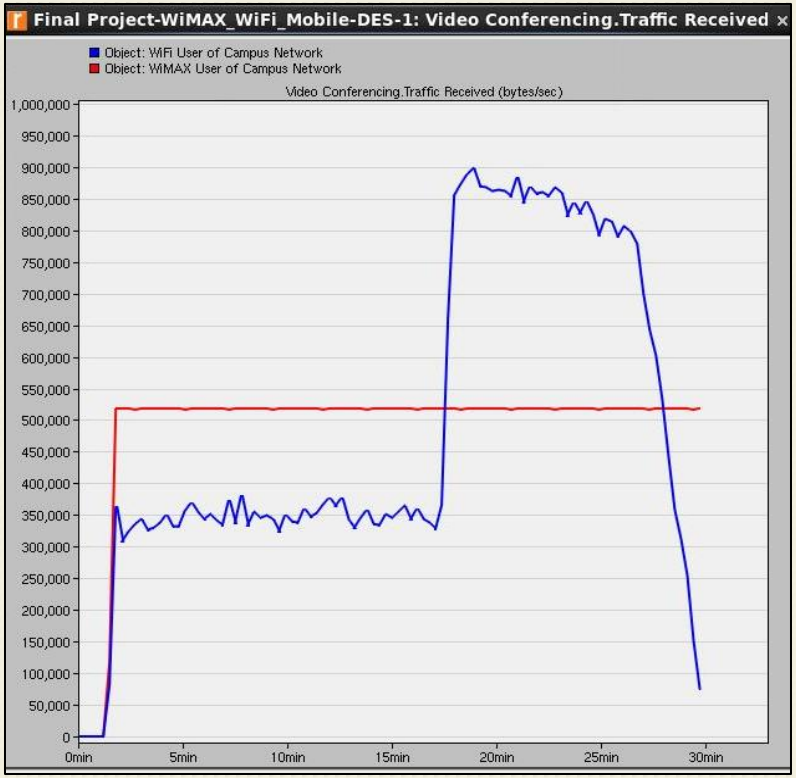

Figure 9: Traffic Received of Network Scenario with Mobile Nodes

- **Traffic received by WiMAX is higher and more stable than Wi-Fi .**

Simulation Results: Traffic Sent

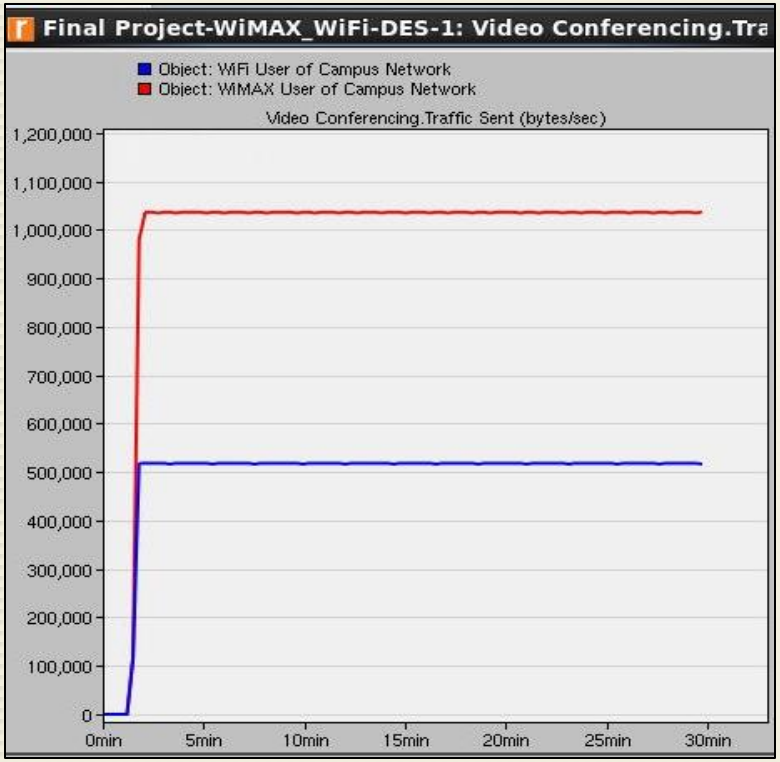

Figure 10: Traffic Sent of Network Scenario with Fixed Nodes

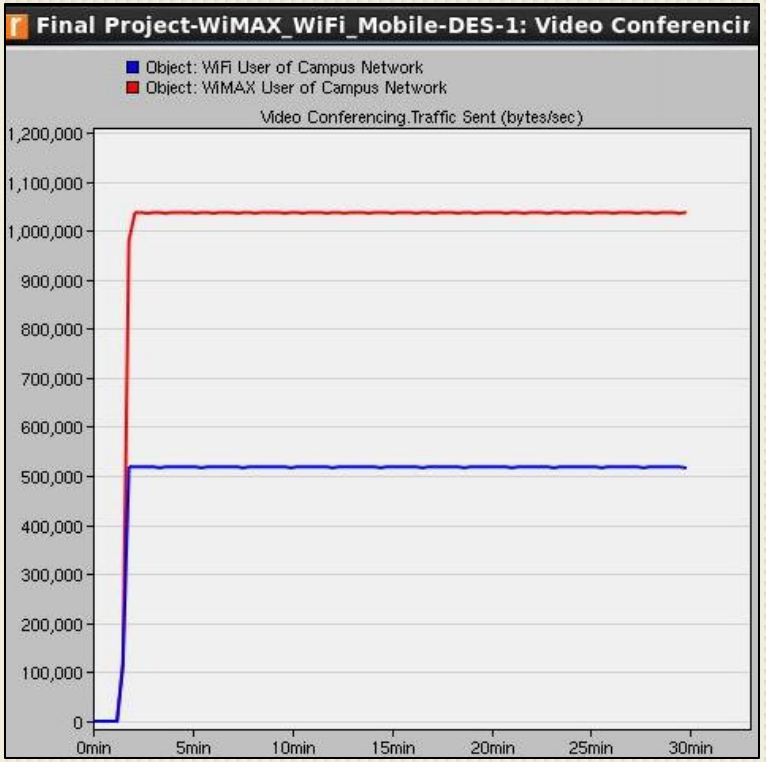

Figure 11: Traffic Sent of Network Scenario with Mobile Nodes

- **Traffic sent by WiMAX is almost twice than Wi-Fi under same conditions.**

Simulation Results: Throughput

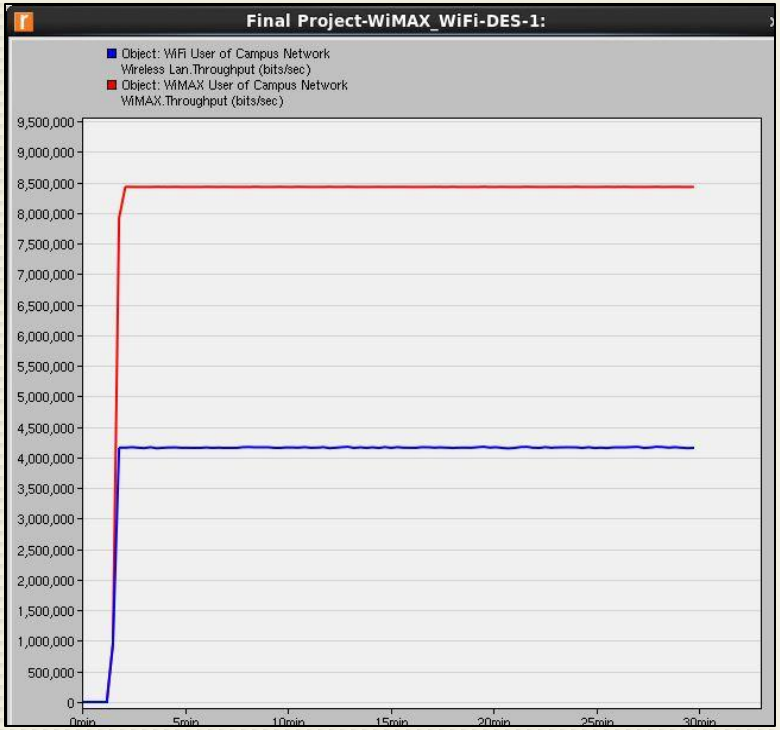

Figure 12: Throughput of WiMAX and Wi-Fi Network with Fixed Node

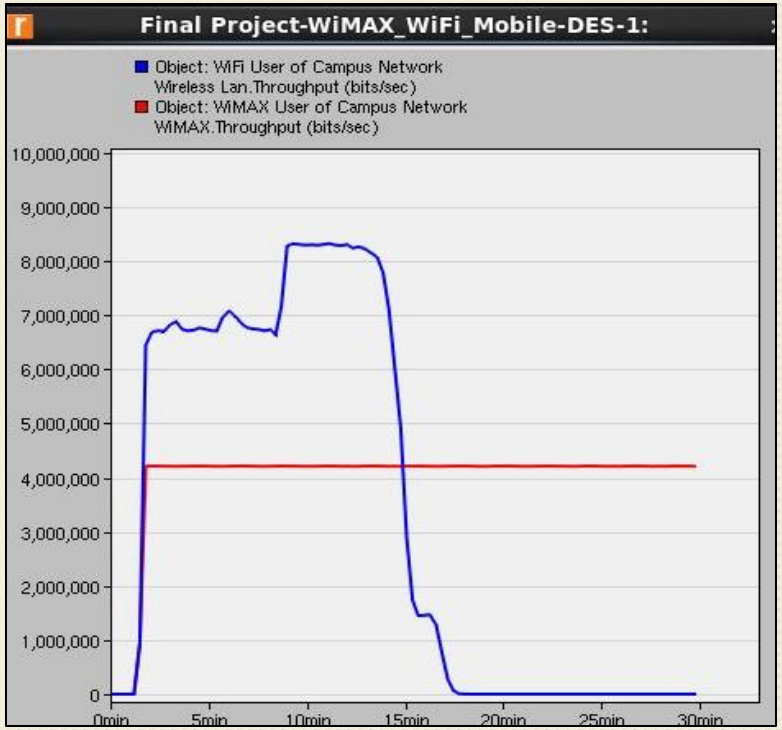

Figure 13: Throughput of WiMAX and Wi-Fi Network with Mobile Node

- **WiMAX has overall better and stable throughout than Wi-Fi.**
- **As Wi-Fi user is within 10m range of access point, it gives better throughput than WiMAX.**

Simulation Results: Jitter

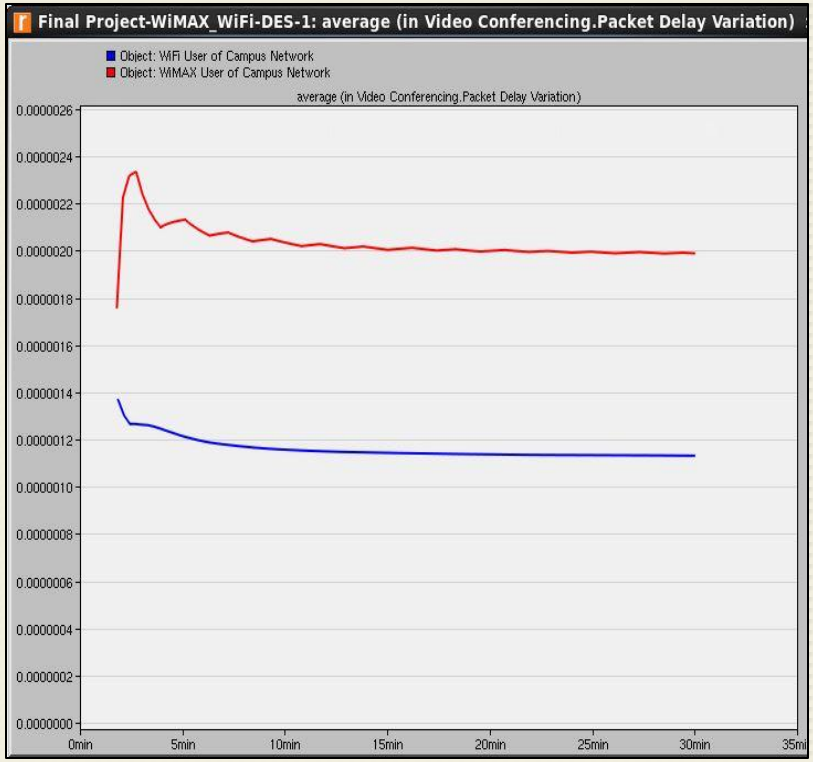

Figure 14: Jitter of WiMAX and Wi-Fi Network with Fixed Node

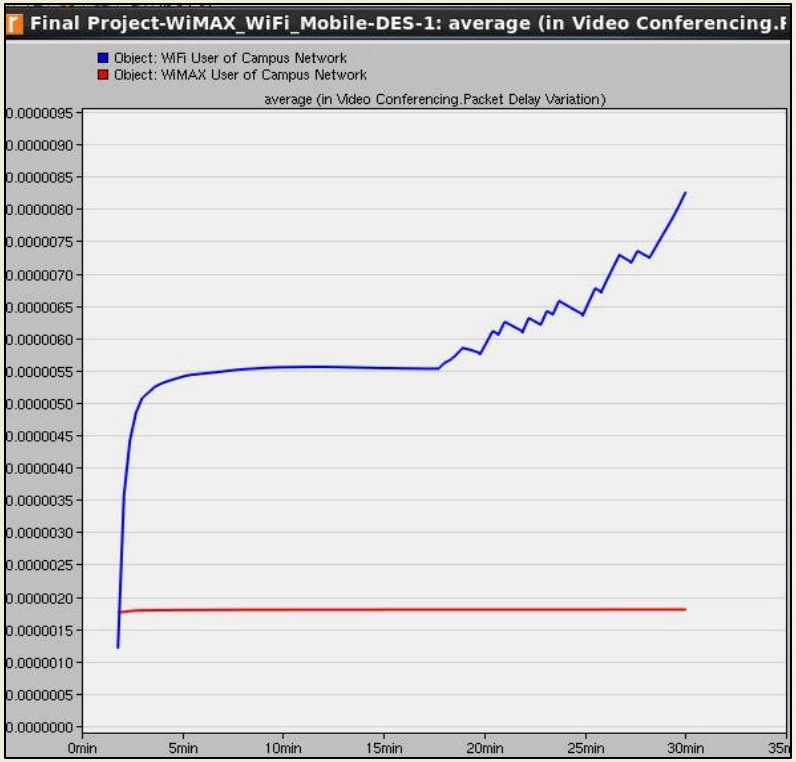

Figure 15: Jitter of WiMAX and Wi-Fi Network with Mobile Node

- **For long distance transmission, WiMAX is superior network for video conferencing applications which has lower delay variation.**

Simulation Results: Delay

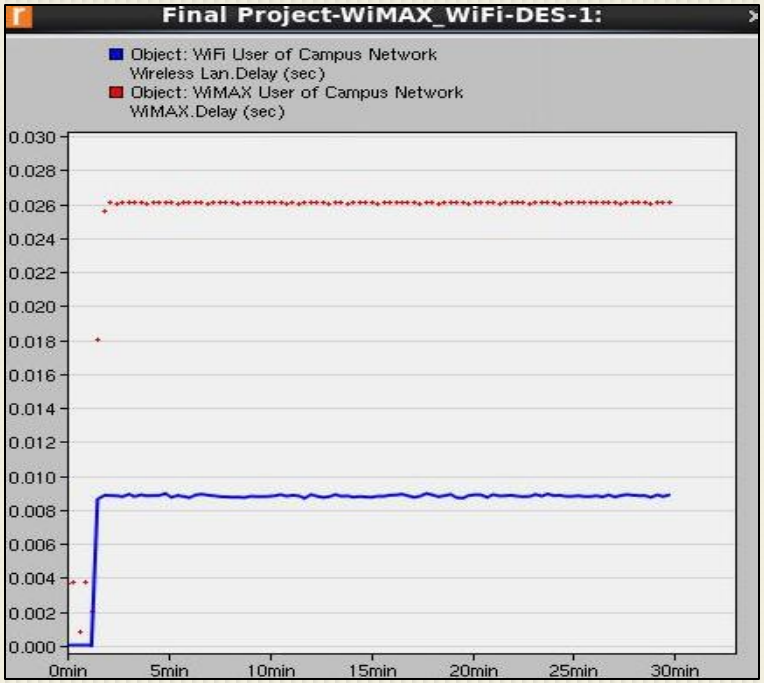

Figure 16: Delay of WiMAX and Wi-Fi Network with Fixed Node

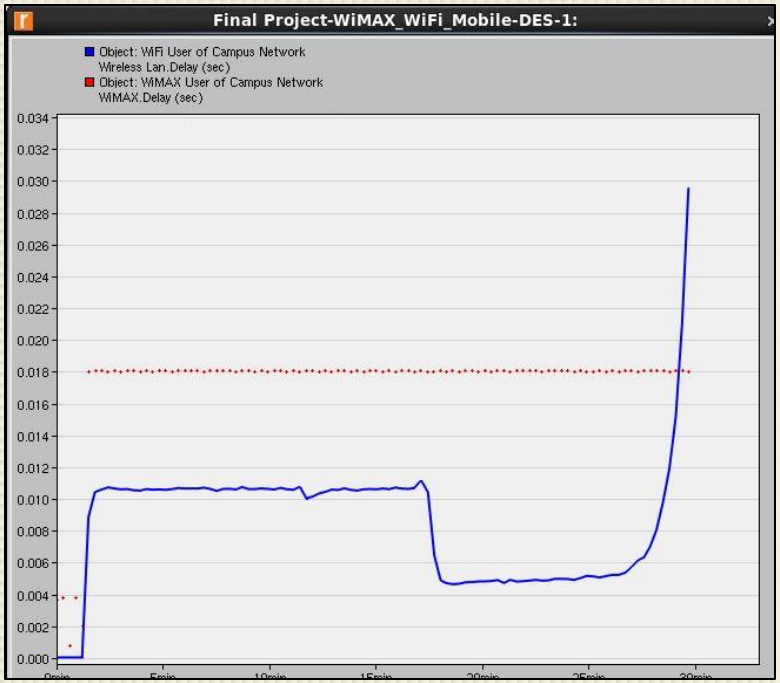

Figure 17: Delay of WiMAX and Wi-Fi Network with Fixed Node

- **Delay of Wi-Fi is almost one-third of the delay of WiMAX.**
- **Wi-Fi is faster and smoother in a small area network as compared to WiMAX.**
- **WiMAX is better for large areas where Wi-Fi is insensitive to large ranges.**

Results: Load

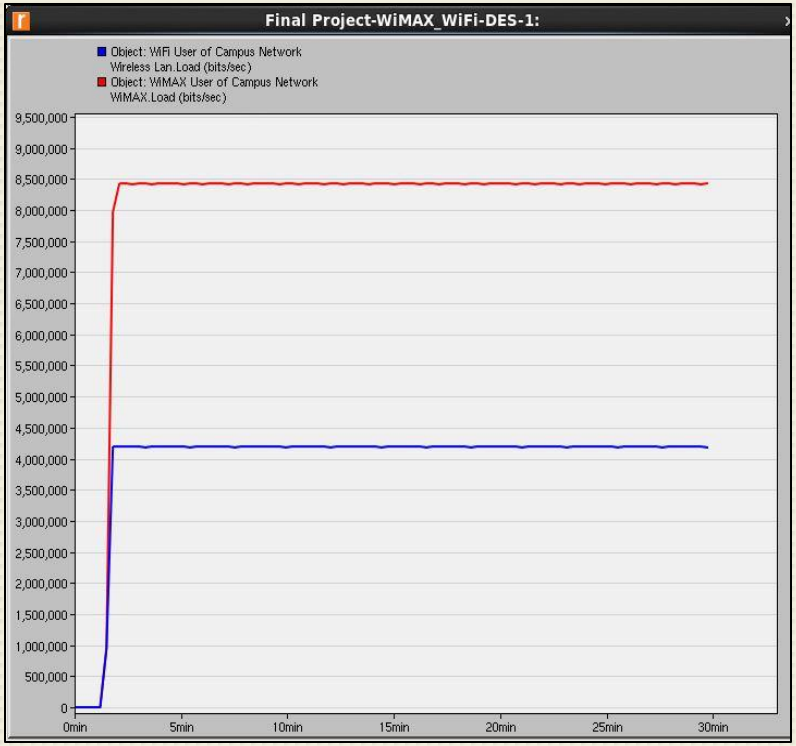

Figure 18: Load of WiMAX and Wi-Fi Network with Fixed Node

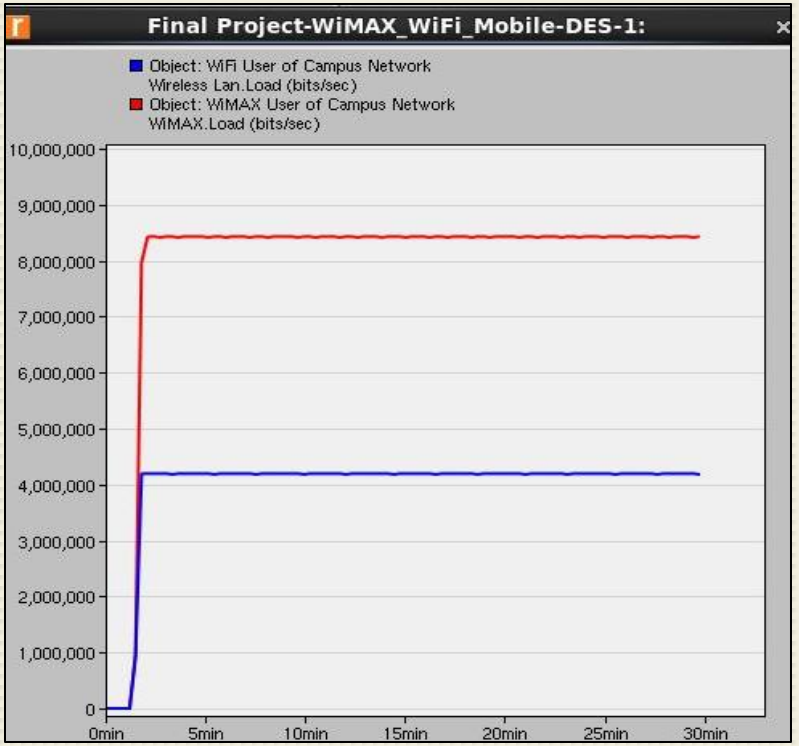

Figure 19: Load of WiMAX and Wi-Fi Network with Fixed Node

- **WiMAX networks can sustain higher load than Wi-Fi networks because WiMAX provides broadband services to carry heavier traffic over the network.**

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Conclusions

- WiMAX outperforms Wi-Fi in long distance wireless transmission.
- WiMAX have better and stable throughput compared to Wi-Fi networks.
- Wi-Fi has better performance with higher band width efficiency and lower delay in small area networks.
- More Delay in Wi-Fi network as the distance between workstations and access point increases.
- WiMAX is able to carry more load than Wi-Fi because WiMAX provides broadband service to carry heavier traffic over the network.

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Future Work

- Integration of Wi-Fi and WiMAX to achieve better performance by connecting a WiMAX WLAN router to a WiMAX base station.
- Simulations when a large number of users are using network at a same time to see the data transmission performance of WiMAX and Wi-Fi.
- Simulation by streaming Youtube video located on a far away server.
- Simulations by taking mobility and handover algorithms under consideration.

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References

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Questions ??