VOIP under: WLAN 802.11g and Ethernet connection

VS

Telephone Landline

ENSC 427 Team 1
Luke Dang tld@sfu.ca
Jason Tsai kta2@sfu.ca
Jeffrey Tam jta6@sfu.ca

Project Website: www.sfu.ca/~kta2

Introduction

- **Motivation:**

  Using jitter, MOS value, packet delay variation, end to end delay as parameters, we evaluate whether VOIP under WLAN and Ethernet has potential to replace the traditional telephone system especially in a company.

- **Preview:**

  Public Switched Telephone Network

  Voice over Internet Protocol

Traditional Telephone System

- Known as Plain Old Telephone System (POTS)
- Utilizes Circuit Switching
- Digital Sound quality @ 10kHz with 8-bit Resolution at best (ie: quality of AM radio station)
- 0.1% dropped calls → Reliable
- MOS: 4.0 – 4.5

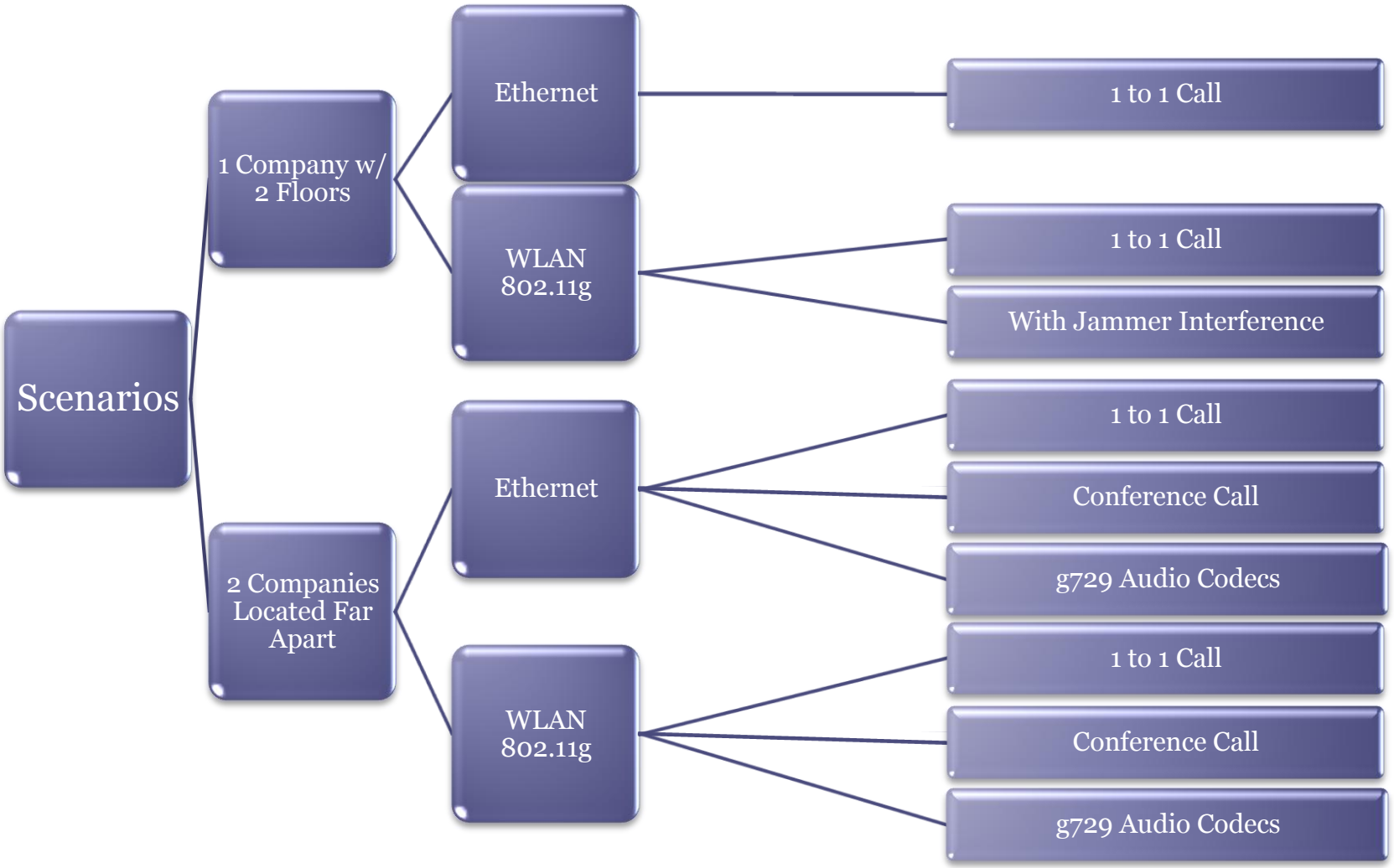
Voice over Internet Protocol

- Utilizes Packet Switching
- Digital quality from 22.1kHz 44.1kHz at 16-bit resolution (ie: FM Radio quality)
- Free of charge for VoIP-to-VoIP connections
- 5 % calls are dropped
- 911 service not available

Circuit Switching vs. Packet Switching

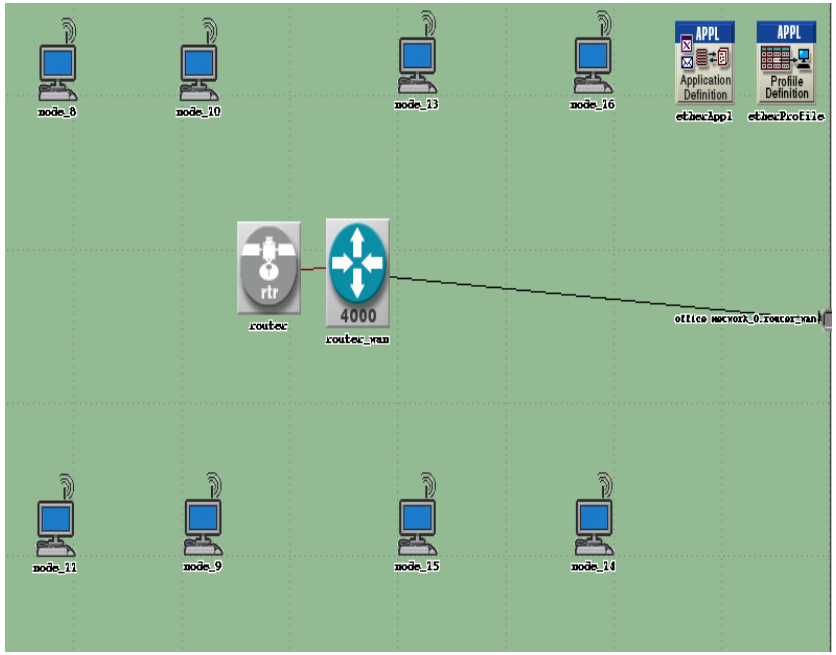
Circuit Switching	Packet Switching
• Continuous transmission of data • Dedicated transmission path • Message are not stored • Infrastructure is Expensive • Fixed bandwidth transmission	• Transmission of packets • No dedicated path • Packets may be stored until delivery • Less expensive • Dynamic use of bandwidth

Scenario Specifications

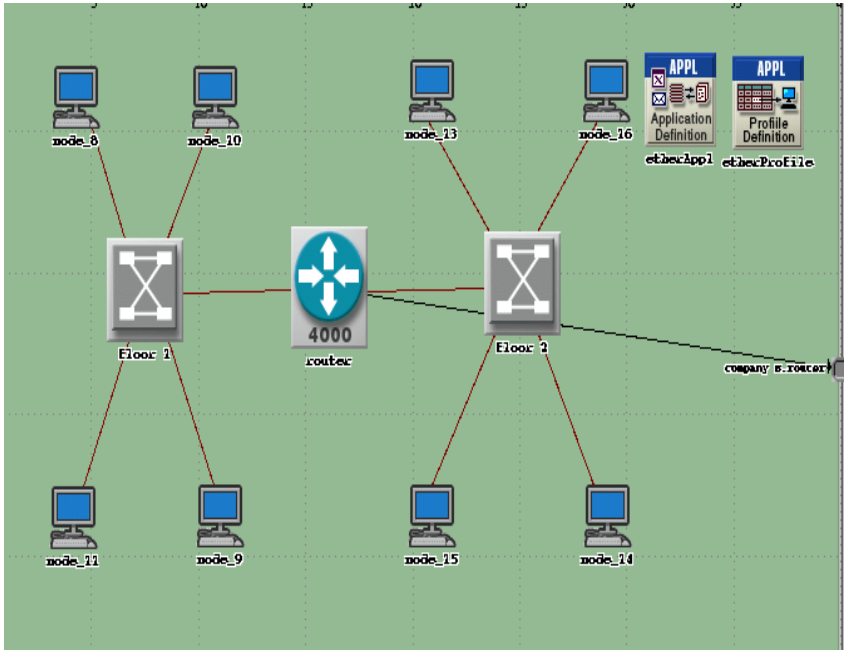


Physical Setup – Within 1 Company

- 2 Floors, 4 meters apart in altitude



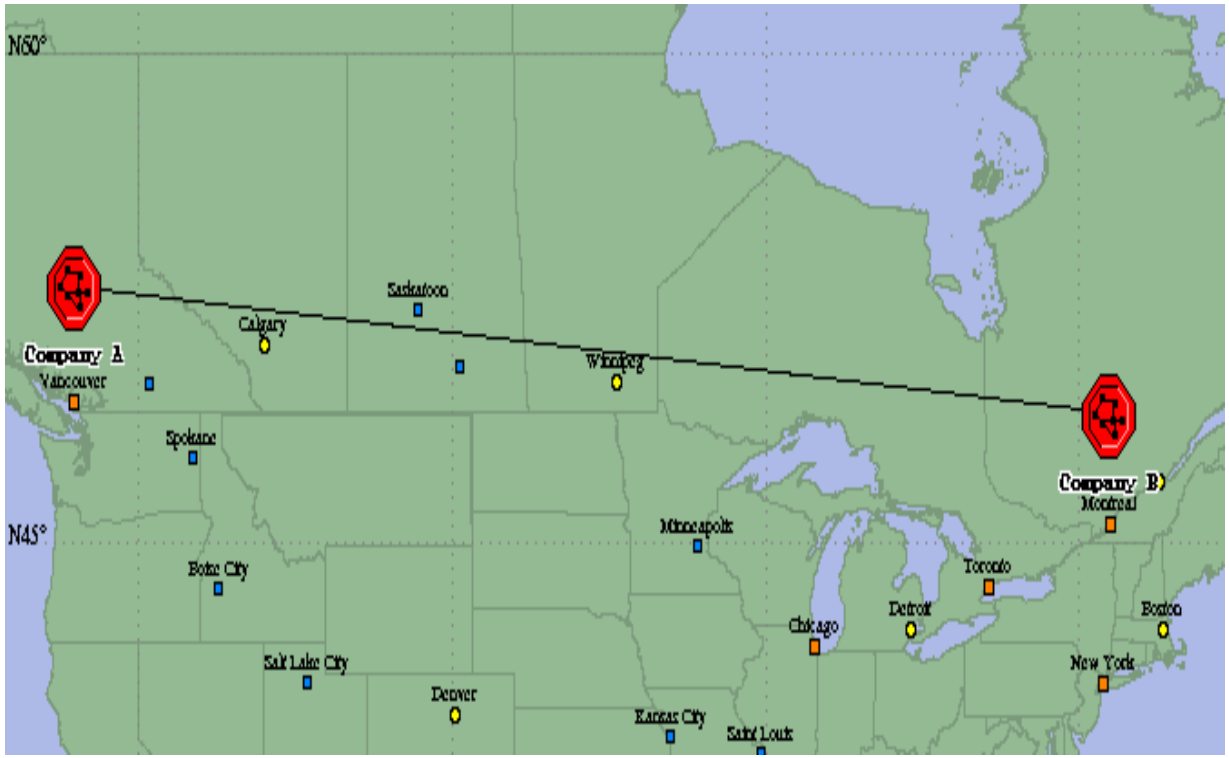
WLAN 802.11b



Ethernet

Physical Setup – Between 2 Companies

- Company A locate in Vancouver
- Company B locate in Montreal



Setup Specifications

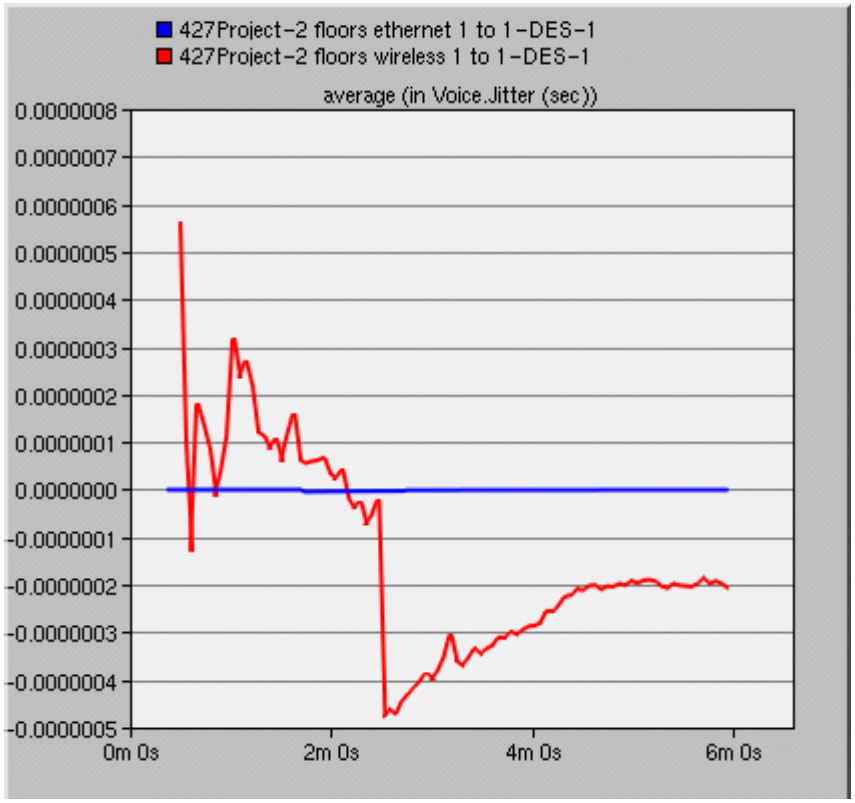
- Under 56 Mbps WLAN 802.11g connection
- G.711 audio codec employed
- 1 voice frame per packet
- 1st packet sent after 10 seconds

- Traffic flow:
  60 seconds call duration for 5 minutes

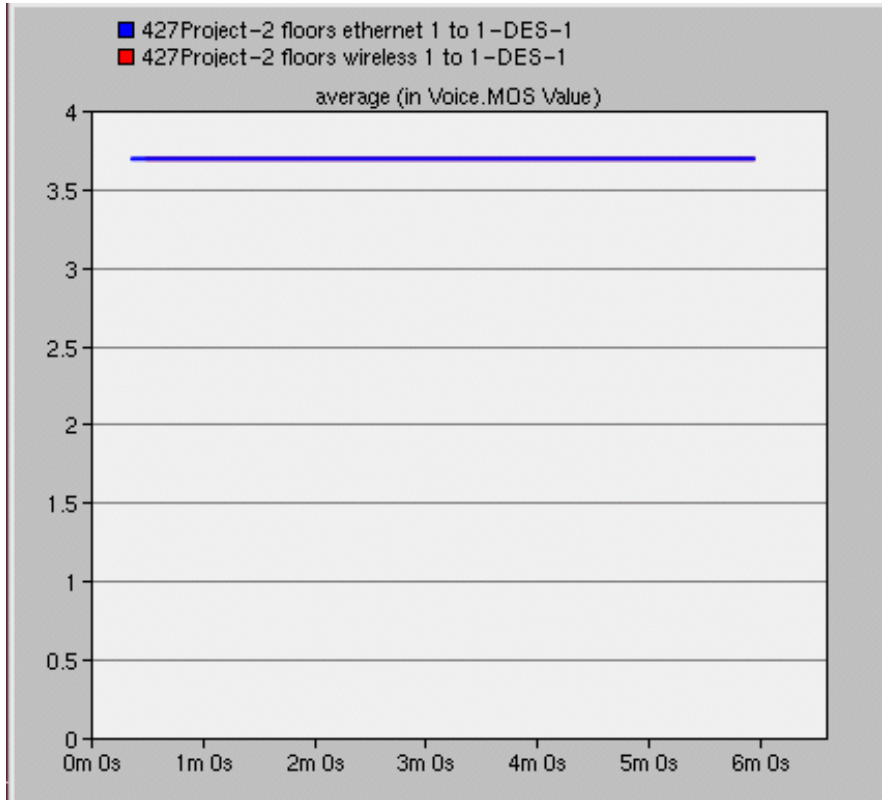
Analysis Parameters

- **Jitter**:
  The delay in packet transmission that leads to pulse displacement. Jitter can be thought as “shaky pulse”
- **Mean Opinion Score Value (MOS Value)**:
  The numerical measurement of voice quality. MOS is expressed in a scale from 1 (worst) to 5 (best)
- **Delay Variation**:
  The difference measurement in end to end delay between packets
- **End to End Delay (ETE Delay)**:
  The time required for a packet to travel from source through network to destination.

WiFi vs. Ethernet: 1 to 1 local call

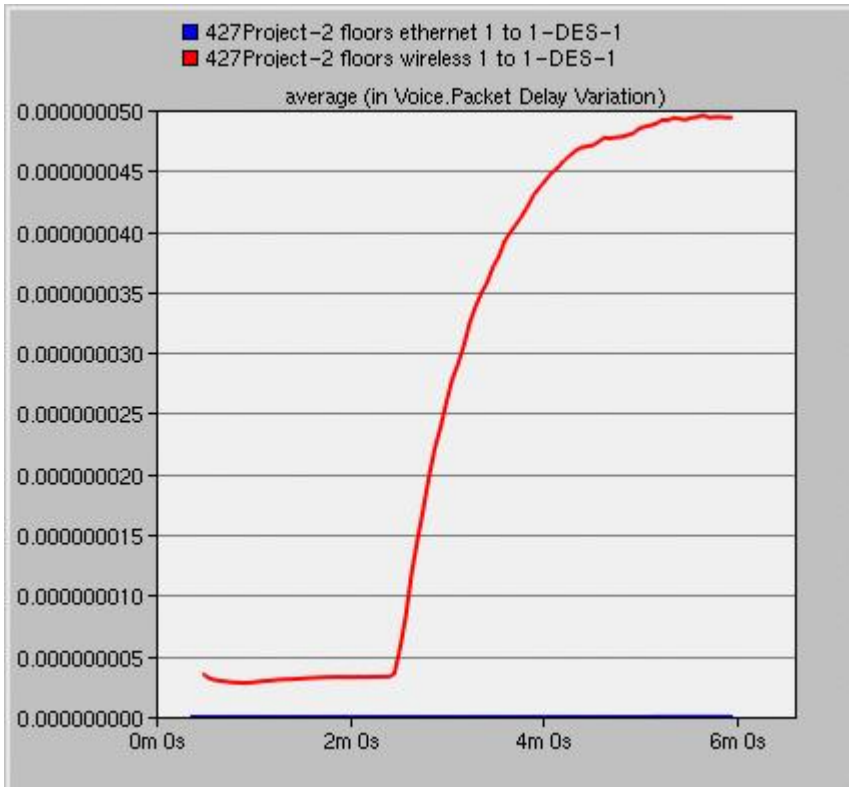


Voice Jitter

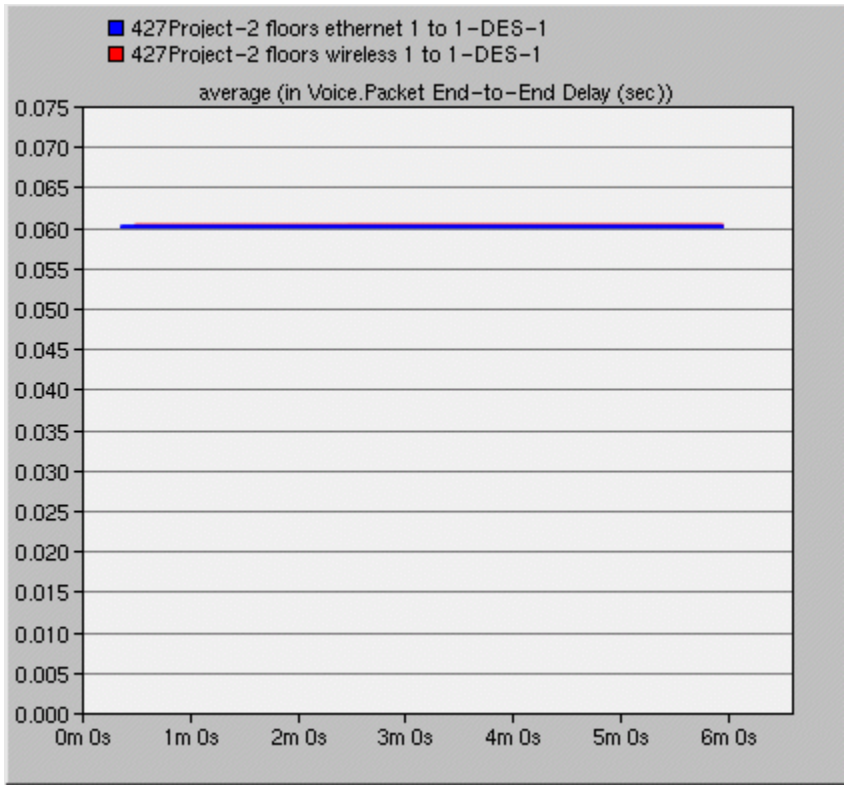


Average MOS Value

WiFi vs. Ethernet: 1 to 1 local call

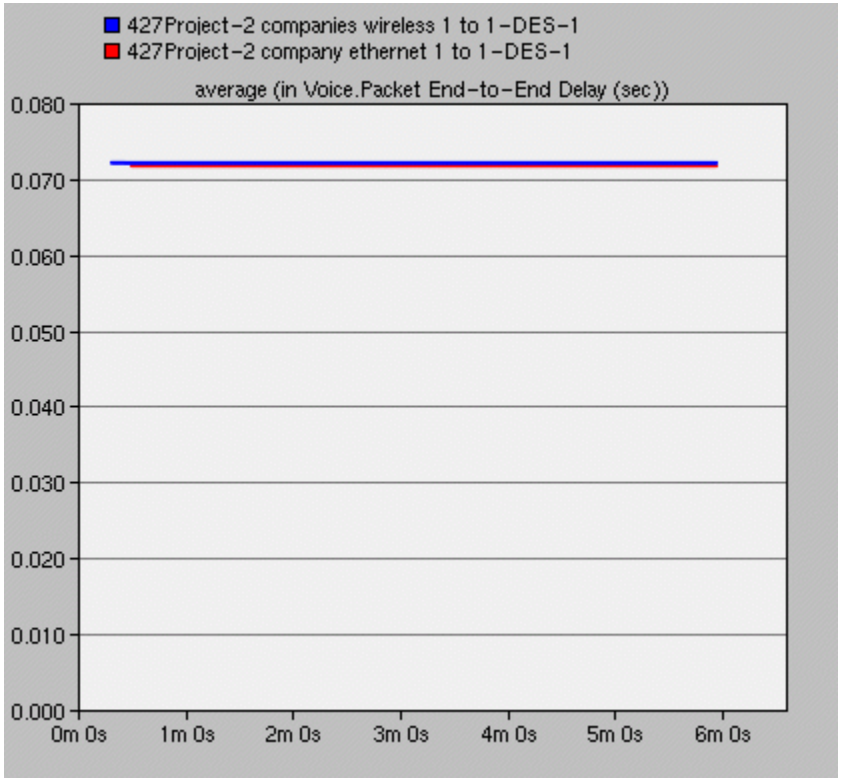


Average Voice Packet Delay Variation

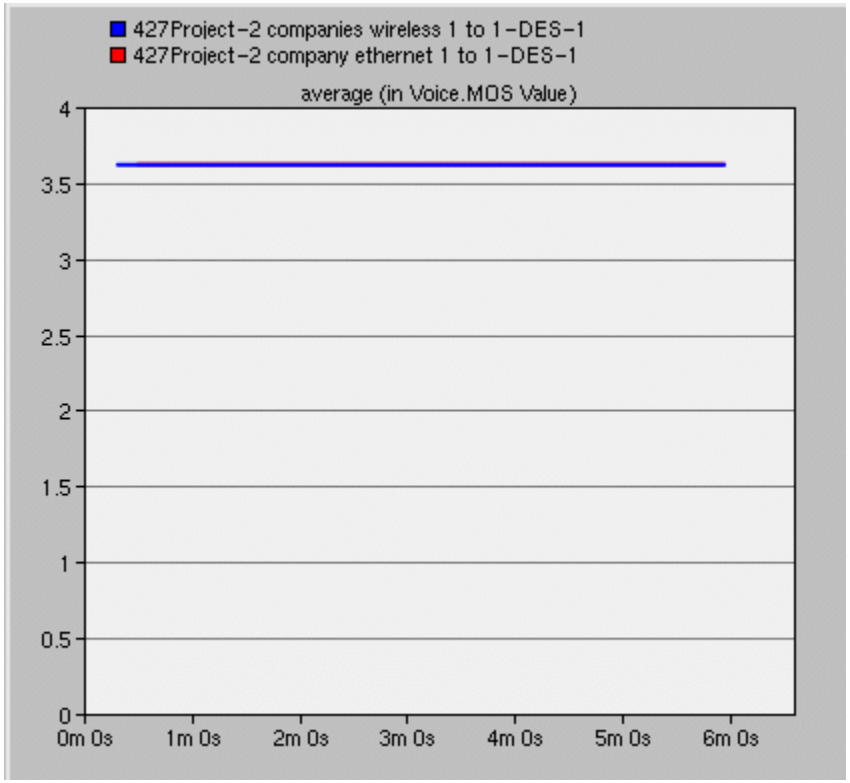


Average Voice Packet End-to-End Delay

Wifi vs. Ethernet: 1 to 1 Long Distance Call

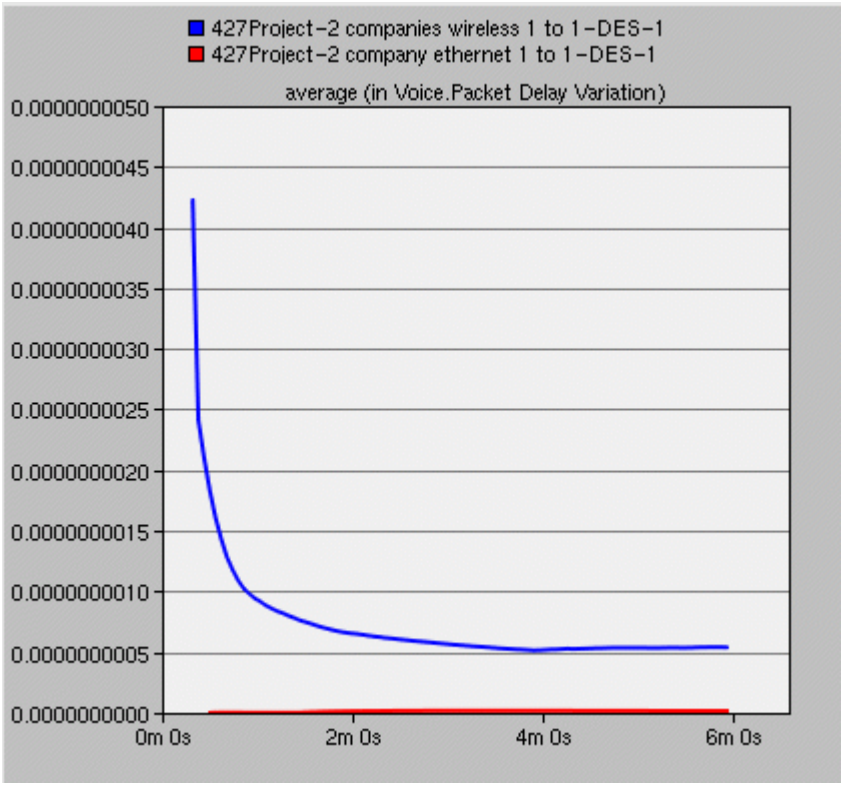


Average End to End Delay

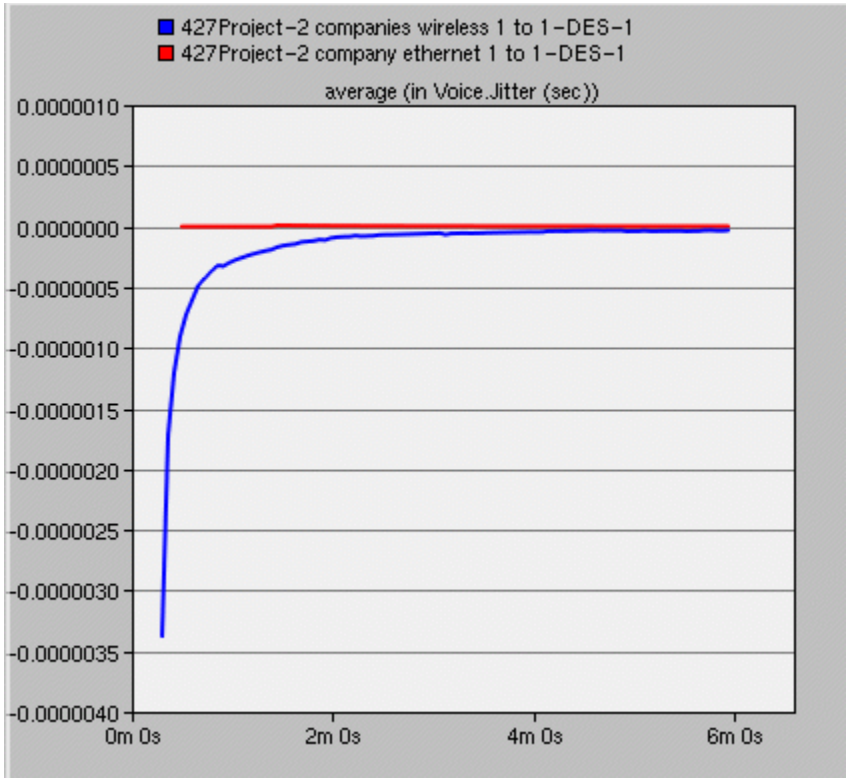


Average MOS Value

Wifi vs. Ethernet: 1 to 1 Long Distance Call

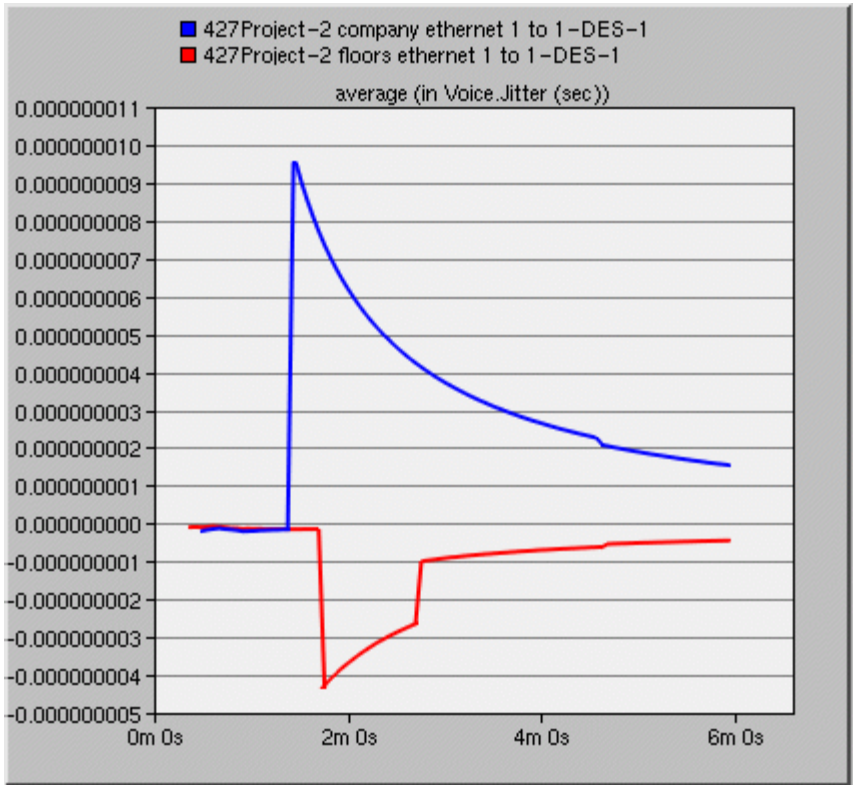


Average Voice Packet Delay Variation

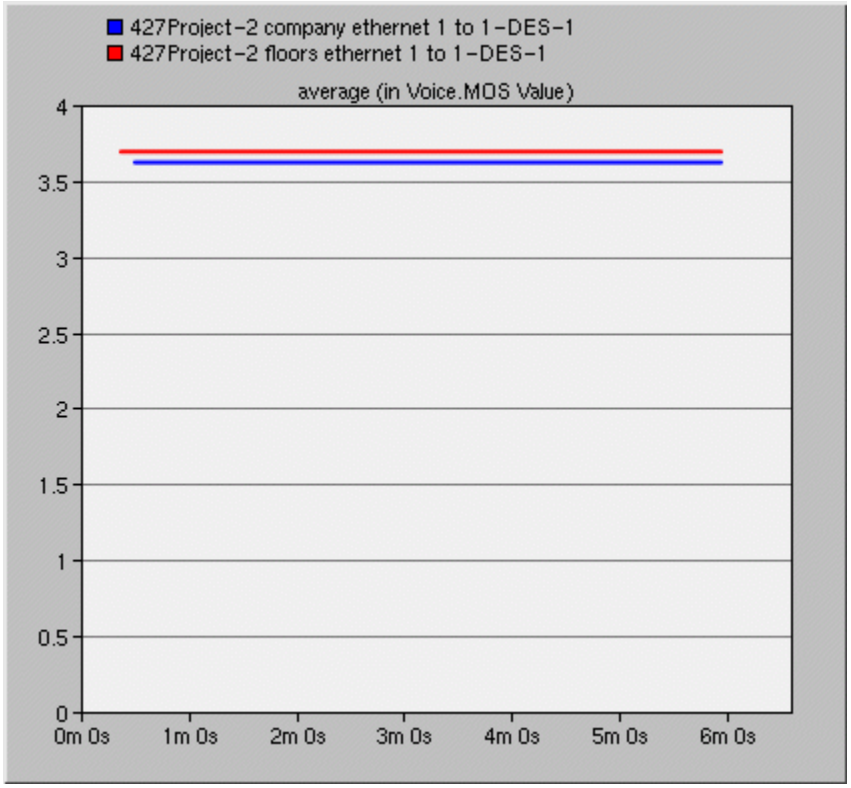


Average Jitter

VoIP Call Distance Comparison

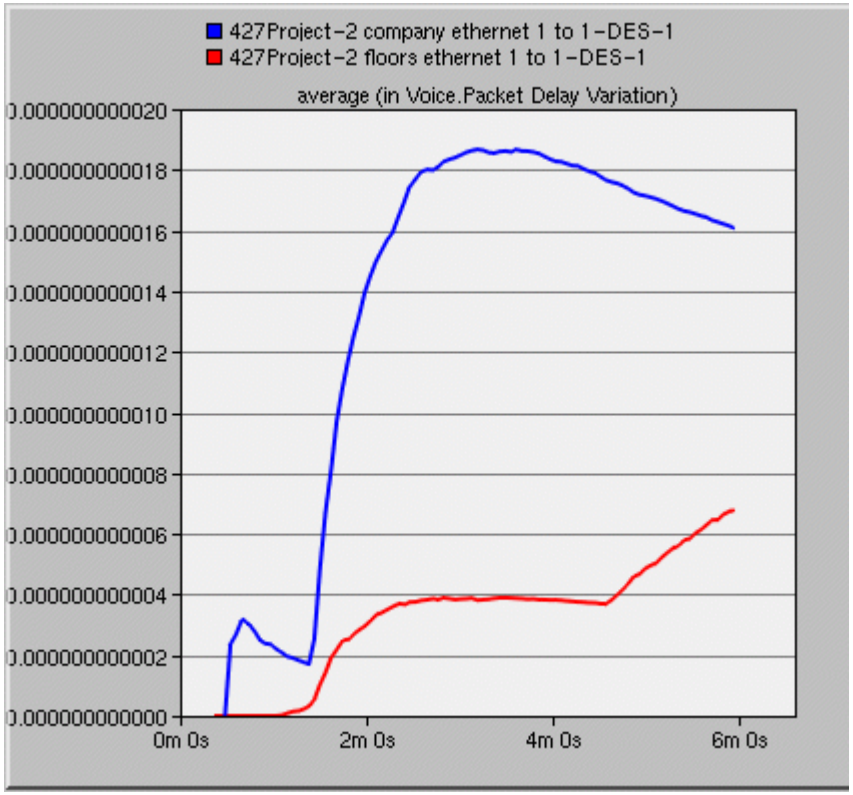


Average Voice Jitter

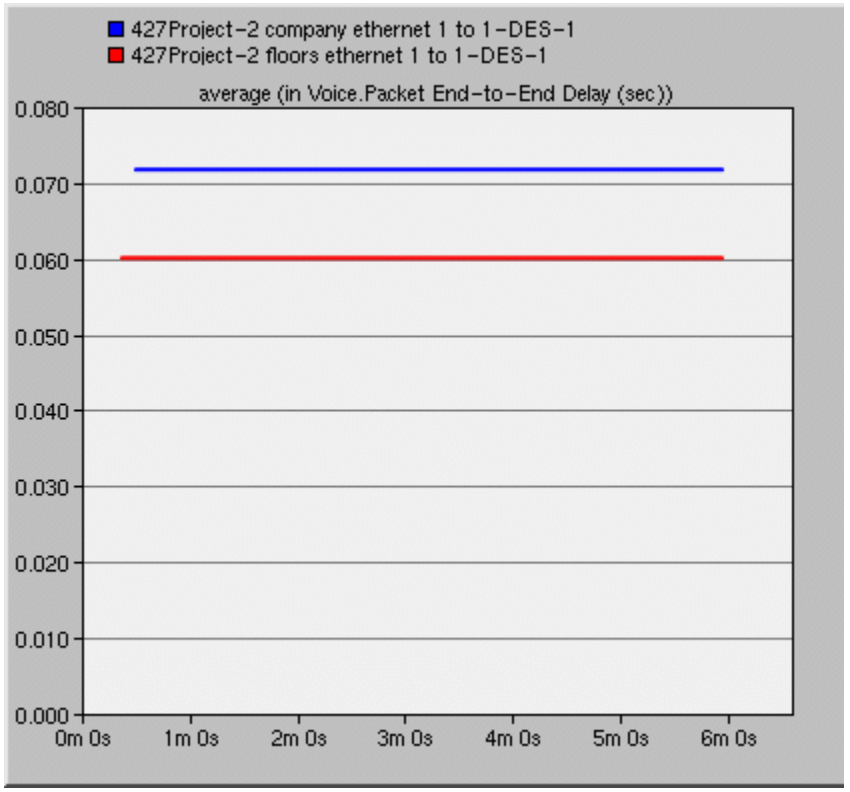


Average MOS Value

VoIP Call Distance Comparison



Average Voice Packet Delay Variation



Average Voice Packet End-to-End Delay

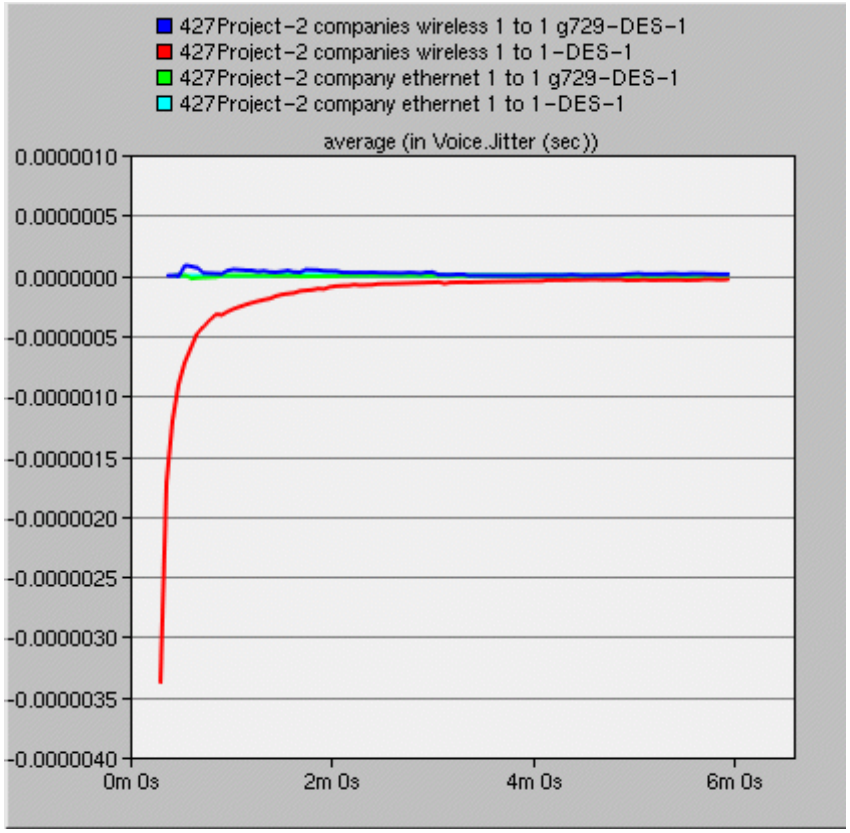
Audio Codec: G.711 vs. G.729

	G.711	G.729
Quality	64 Kbps	24 Kbps
Audio	Uncompressed	Compressed
Jitter	Higher	Minimal
Tradeoff	High Quality	Use Less Bandwidth
Others	Perform better when high bandwidth is available	Perform better under heavy traffic congestion; Require license; Popular

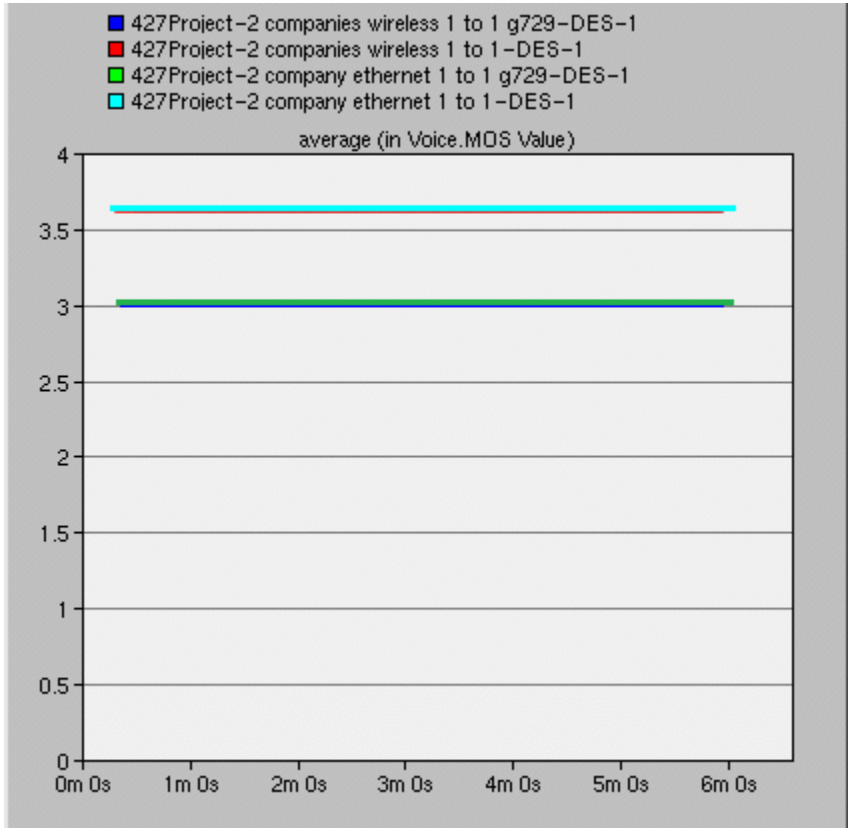
In general:

Difference is unnoticeable in normal conversation unless music is played in the call as it is difficult to predict the next tone during data compression.

G.711 vs. G.729 Codec Comparison

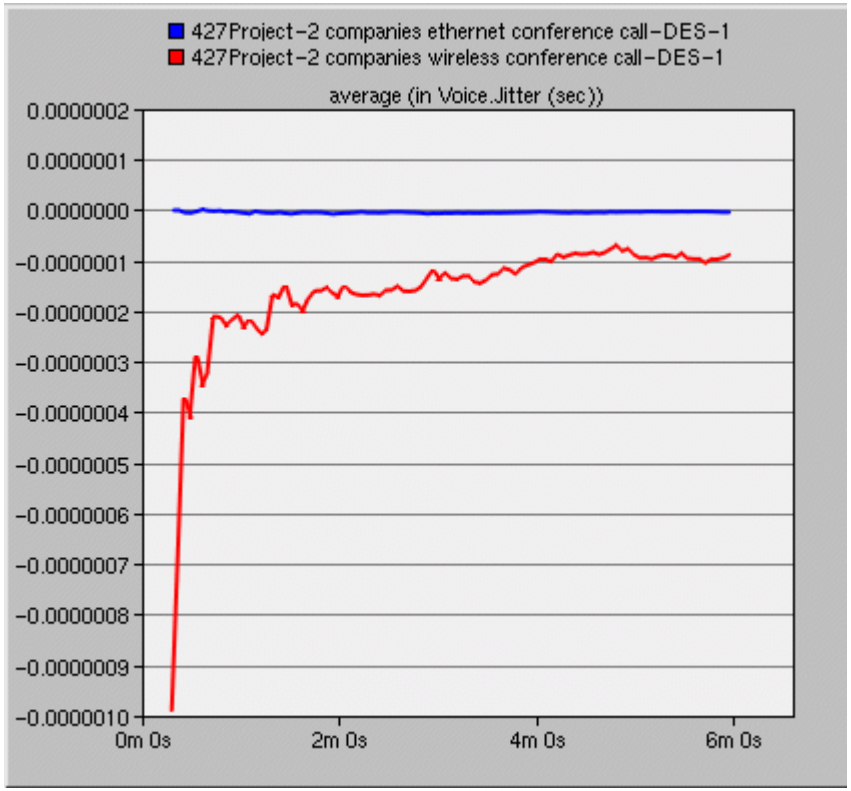


Average Voice Jitter

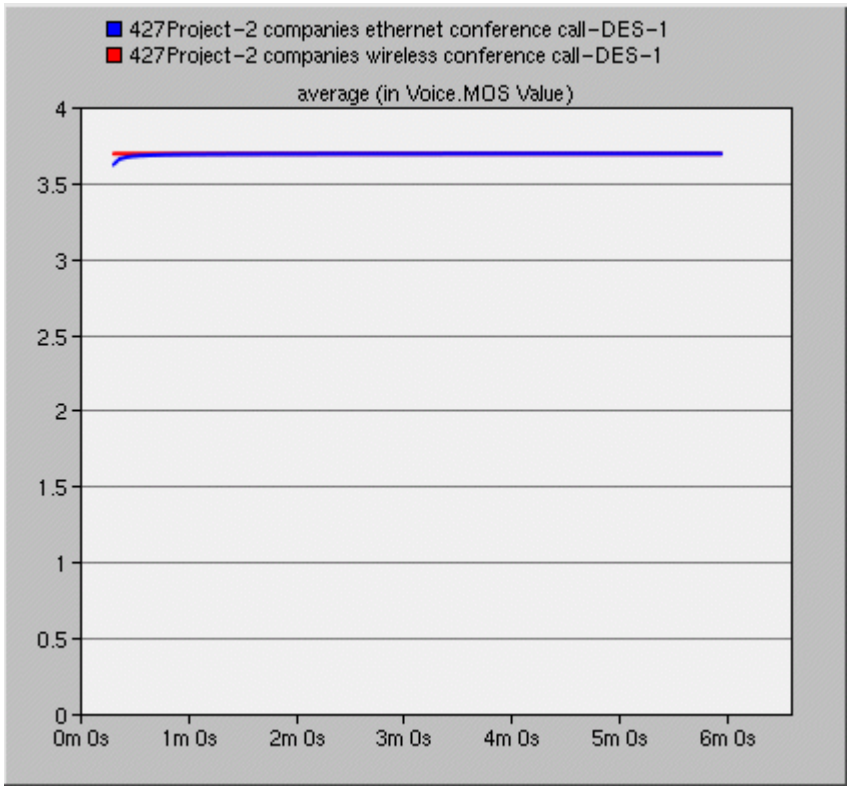


Average MOS Value

Wifi vs. Ethernet: Long Distance Conference Call

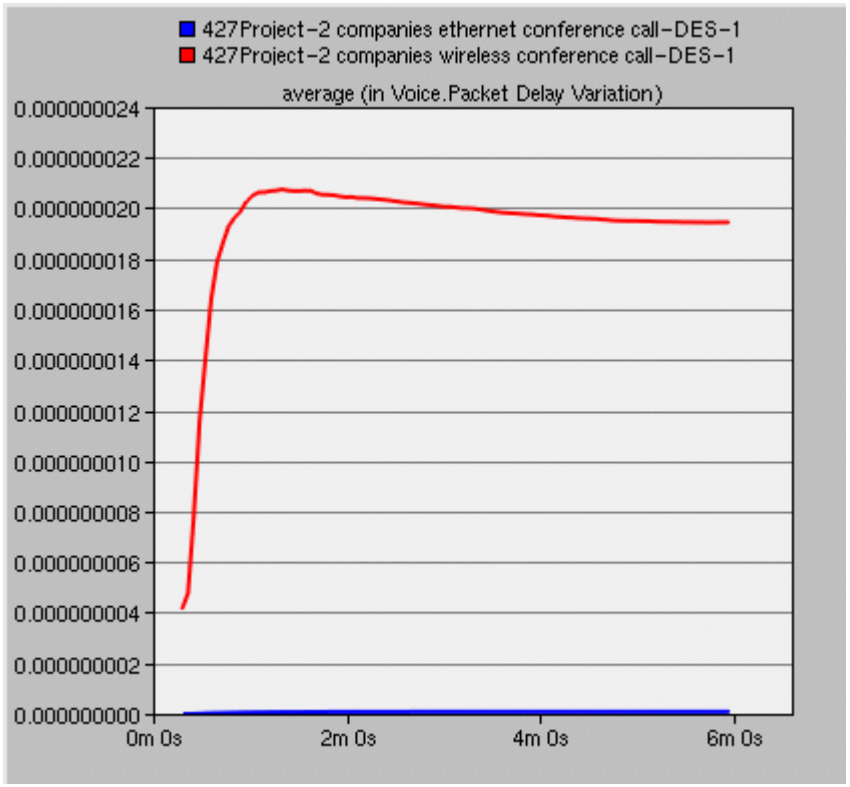


Average Voice Jitter

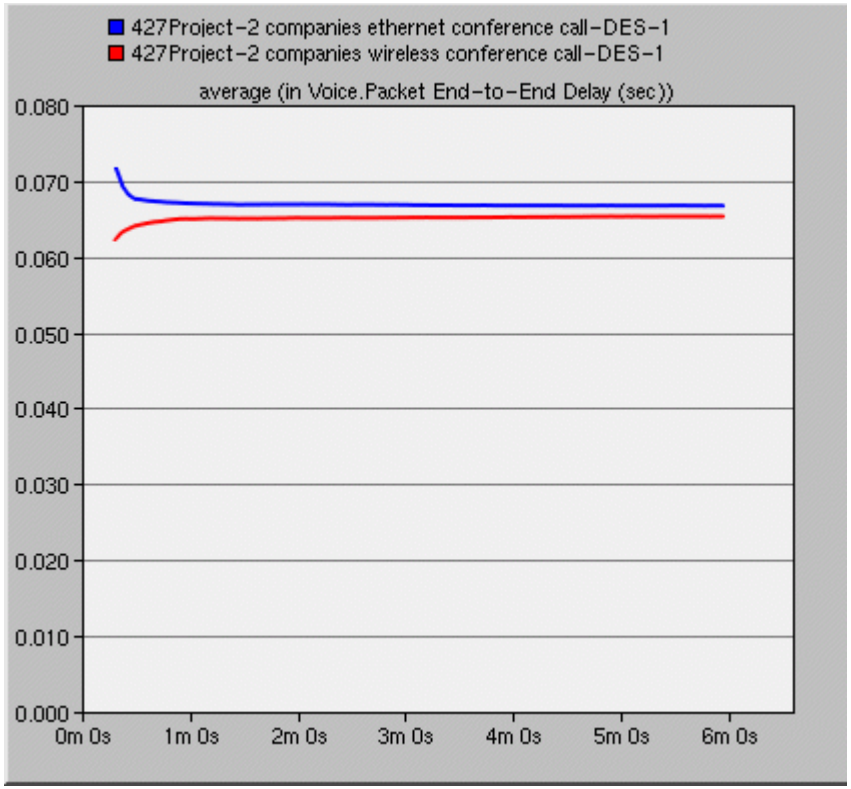


Average MOS Value

Wifi vs. Ethernet: Long Distance Conference Call



Average Voice Packet Delay Variation

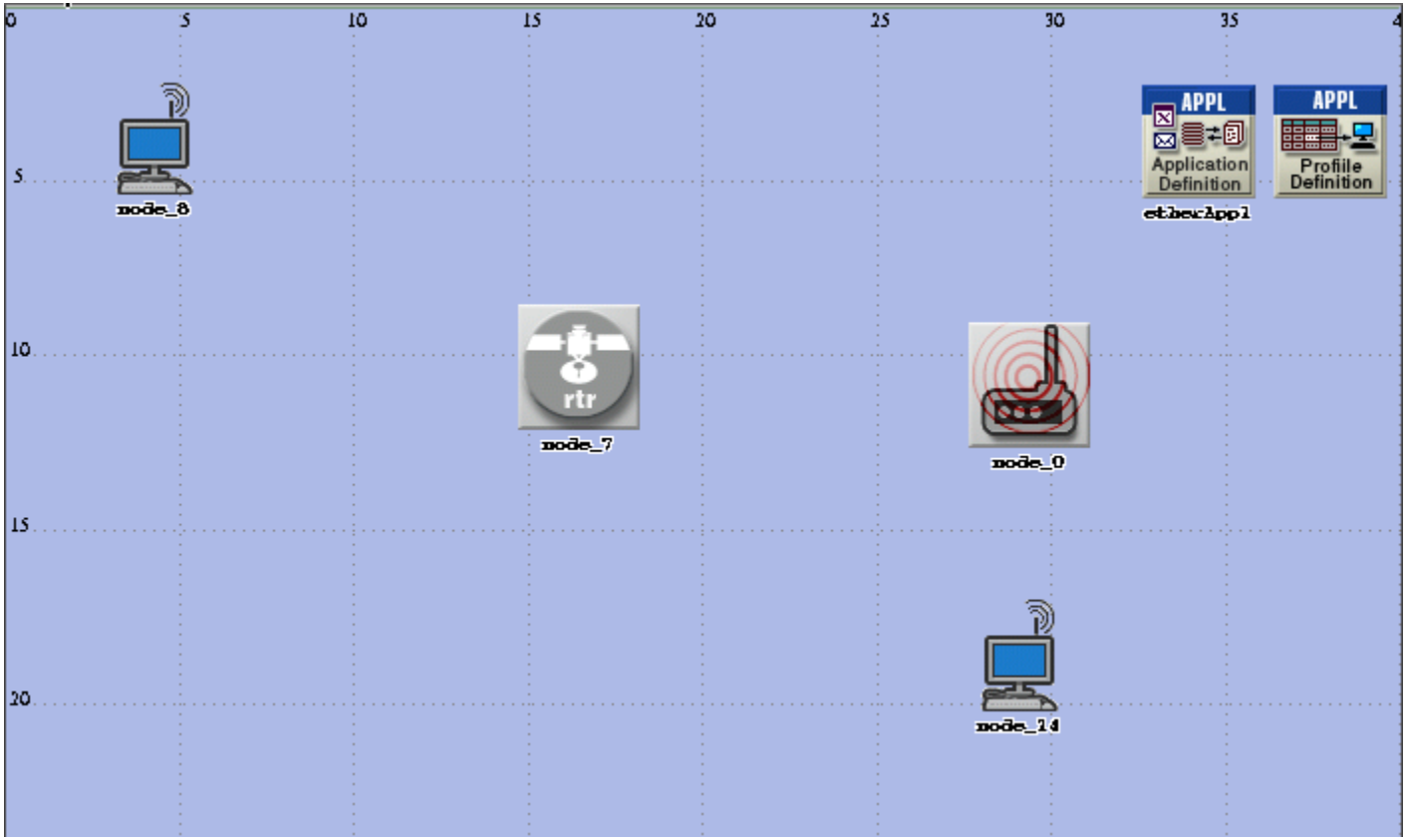


Average Voice Packet End-to-End Delay

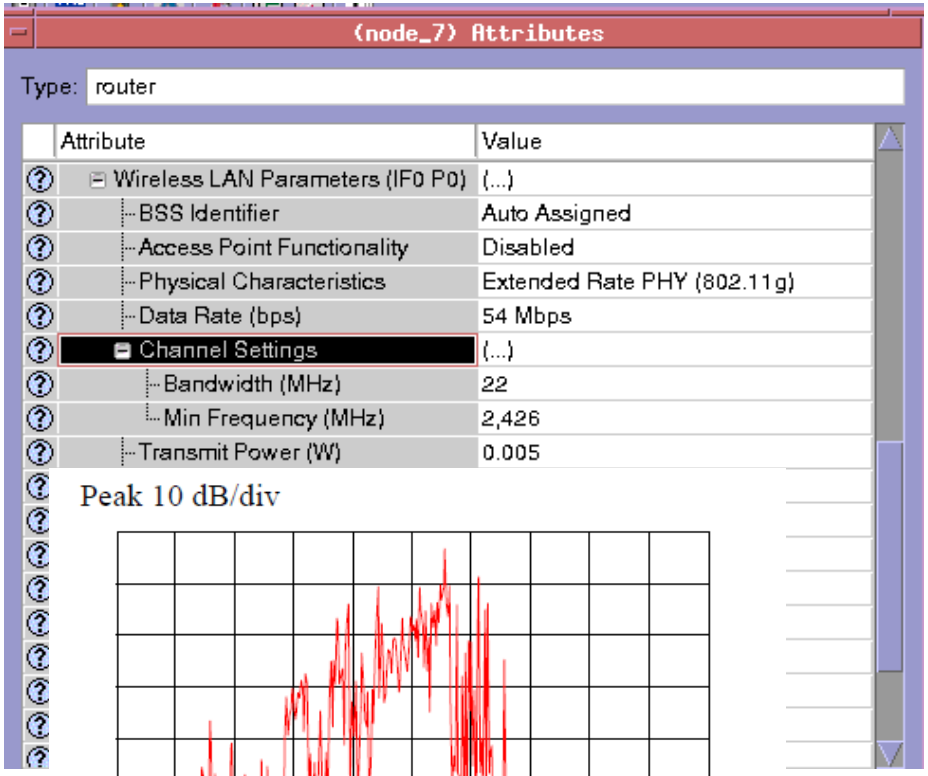
Consequences of Interference to WiFi Connection

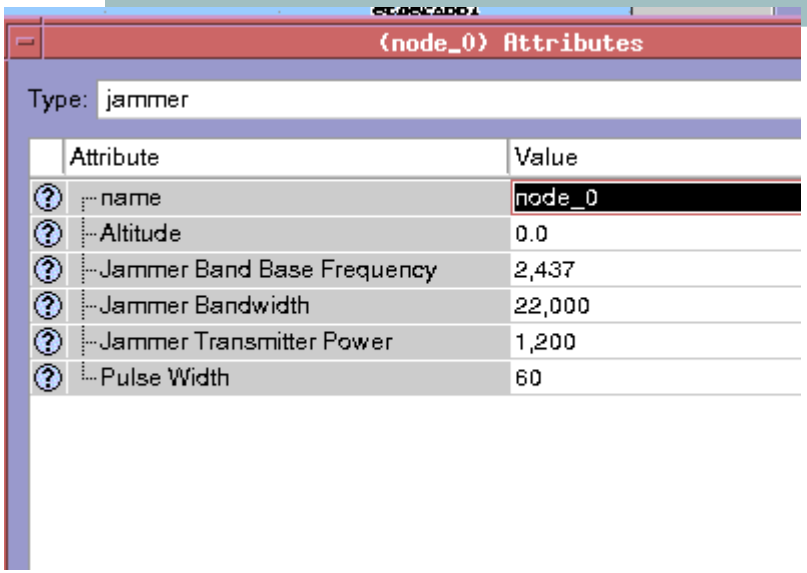
- WLAN 802.11g operates in 2.4GHz
- Other device includes: Cordless phones, microwave, bluetooth
- Solution:
  Switch Channel
  Frequency Hopping

Physical Setup – Interference to WiFi Connection



Configuration





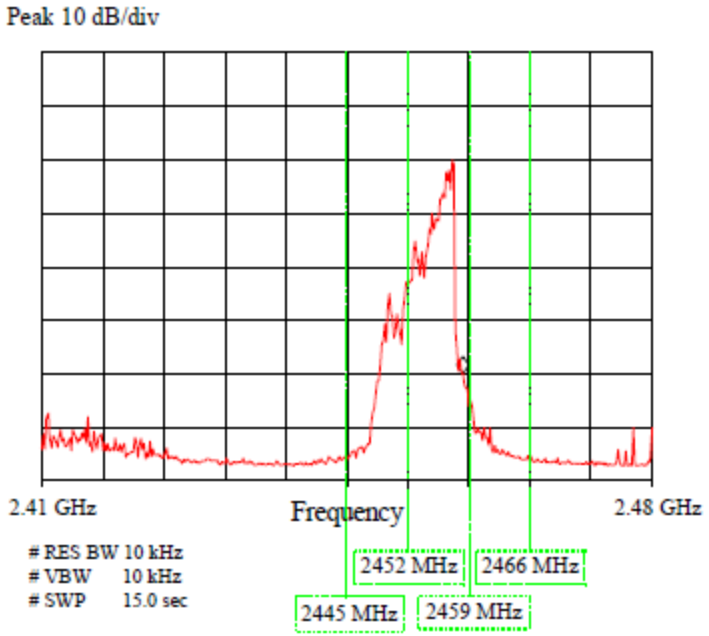
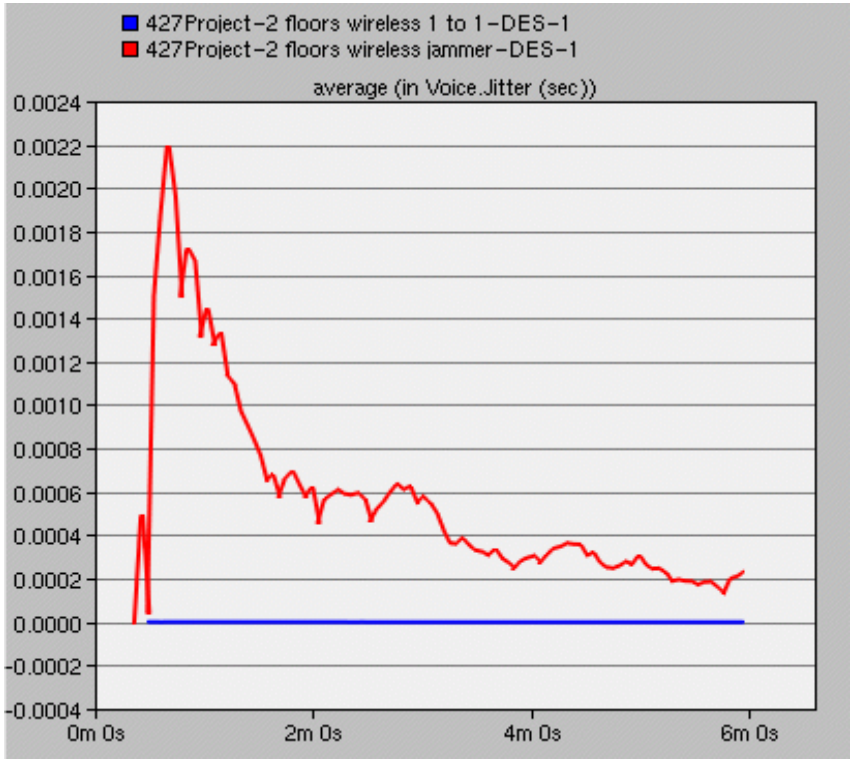


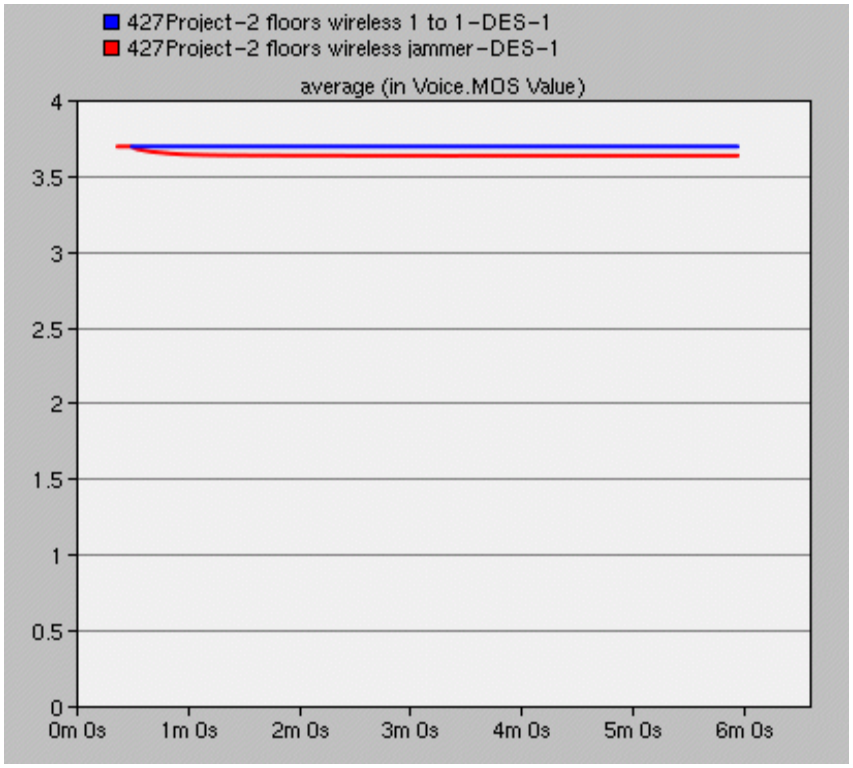
Fig. 1. Max-hold spectrum for residential microwave oven.

Reference: [6]

WLAN 802.11g with Interference



Average Voice Jitter



Average MOS Value

Analysis:

Below listed the factors and their affect on parameters (jitter, MOS value, Delay Variation, End-to-End Delay) based on an Ethernet network scenario.

Factors	Jitter	MOS Value	Delay Variation	End-to-End Delay
WLAN 802.11g	Increase	No Change	Increase	No Change
Increase Distance between Callers	Increase	Decrease	Increase	Increase
Added Wireless Interference	Increase	No Change	Increase	No Change
Increase Workstations	Increase	No Change	Increase	Increase
Under G.729 Audio Codec	Decrease	Decrease	Decrease	No Change

Conclusion

- Circuit Switching vs Packet Switching
- G711 codec give better voice quality (MOS) but consume more bandwidth than G729
- Ethernet shows more reliability and less delay than wireless
- POTS has less drop rate than VOIP but more costly
- VOIP is a good substitution for POTS

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THANK YOU !

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