Project Presentation for ENSC 835

# Performance Analysis of Voice Communication in a Private 802.11 Network

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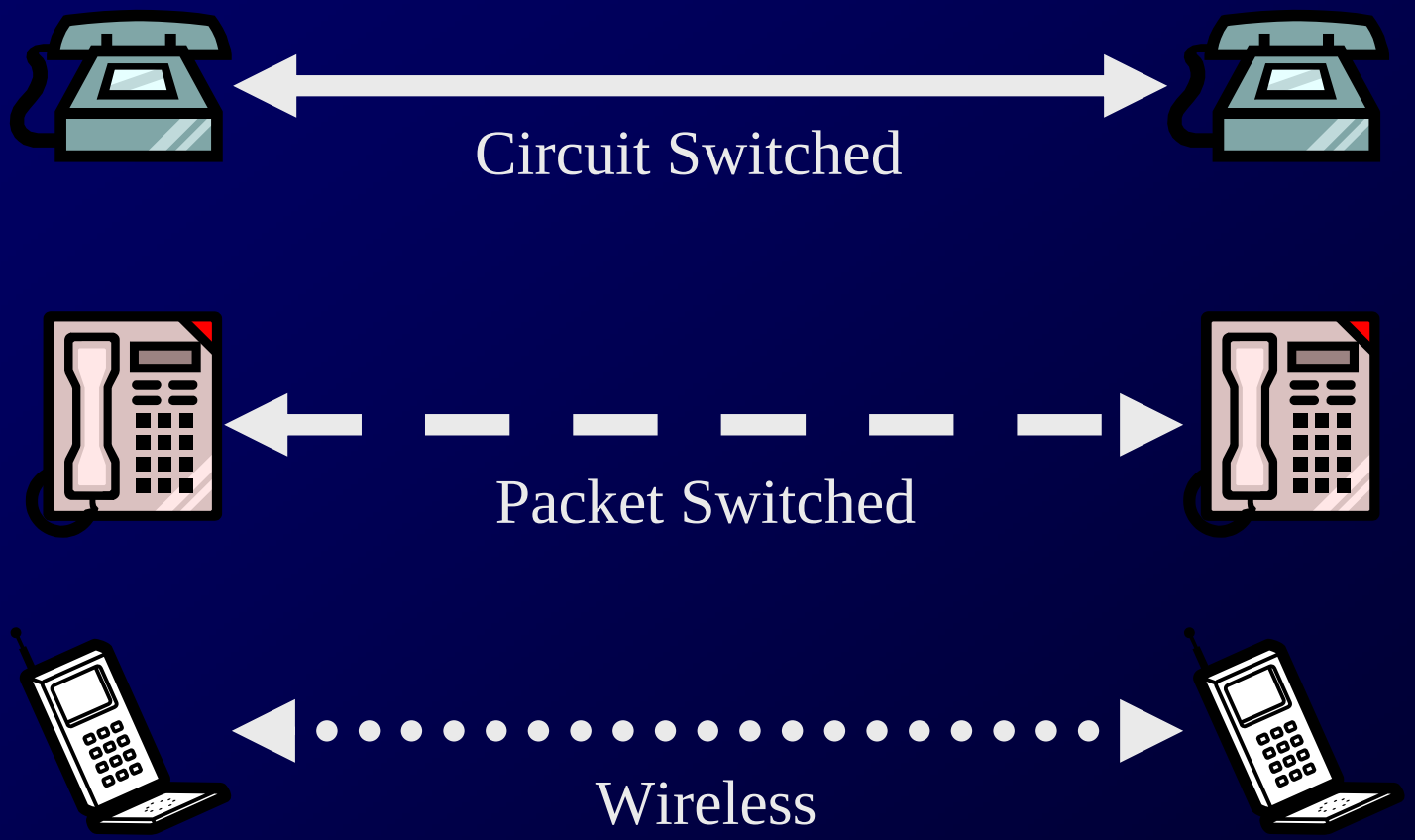
# Outline

- **Introduction:**
  - What is Voice over 802.11?
- Problem Definition:
  - Quality Quantified
  - Network Settings
- Implementation:
  - ns-2 Implementation
  - Measurement from Traces
- Future Work

# What is Voice over 802.11?



# Plain Old Telephone System


Good:

- Sounds good
- Low delay

Bad:

- Unused bandwidth

# Voice over Internet Protocol


Good:

- Efficient use of medium
- Single network infrastructure

Bad:

- Delay and Jitter
- Packet loss

# Voice over 802.11


- VoIP (Voice over IP) with mobility
- Suffers same quality issues as wired VoIP
- Additional concerns:
  - Less reliable medium
  - Security

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# Quality Quantified

- Guidelines to measure quality objectively
- Measurable factors are:
  - Loss – Biggest problem
  - Jitter – Translated into end-to-end delay
  - Delay – Annoyance to user

# How to Measure?

- Loss – Percentage of packets dropped:

  100% – (# of received packets) / (# of expected packets)

- Jitter – Variation in packet arrival time:

  actual reception time – expected reception time

- Delay – Average time of transit:

  packetization delay + propagation delay + queuing delay

# What is Good?

- Loss:

  Average: < 5%  Ideal: < 1%

- Jitter:

  Average: < 60 ms  Ideal: < 20 ms

- Delay:

  Average: < 150 ms  Ideal: < 50 ms

# Network Topology

- Technology of interest: 802.11b
- One Access Point (AP)

  Access Point serves as Private Branch Exchange (PBX) allowing access to external Central Office (CO) lines.

- Multiple Mobile Stations (STA)

  Mobile Stations may connect to each other or connect to a CO line through the PBX.

# Network Parameters

- Voice encoding algorithm

  Affects packet size, packetization delay, and packet rate. (G.711, G.723, and G.729)

- Data rate

  Affects propagation delay and chance of collision (1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps)

# More Network Parameters

- Short preamble vs. Long preamble

  Affects propagation delay
  (96 µs vs. 192 µs)

- Point Coordination Function (PCF) vs. Distributed Coordination Function (DCF)

  Allows better coordination within network to minimize collision.

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# ns-2

- ns-2 version 2.26 used on Cygwin / XFree86 (validated)
  - Use the ns-2 2.26 all-in-one package
  - Get the latest cygwin setup.exe, and carefully choose required components (gcc 3, perl, awk, diff, etc…)
  - ./install ← That's it.
  - Validated (with minor adjustment)

Instructions are found here (by Nicolas Christin):
http://www.sims.berkeley.edu/~christin/ns-cygwin.shtml

# Point Coordination Function

- Point Coordination Function support is not part of the ns-2 package.
  - Patch for ns-2 version 2.1b8 contributed by Anders Lindgren: http://www.sm.luth.se/~dugdale/index/software.shtml/
  - Ported changes to version 2.26

# 802.11b High Rate PHY

- 802.11b specifies High Rate Physical Layer (PHY)
  - New modulation scheme allowing data rates of 5.5Mbps and 11Mbps.

    8-chip complementary code keying (CCK)

    Same channel bandwidth as 802.11
  - Short preamble

# Application Layer

- Real-time Transport Protocol (RTP) and

  Real-time Transport Control Protocol (RTCP)

  - Both already implemented in ns-2
  - Group based sessions
  - Use simple Constant Bit Rate (CBR) agents to simulate traffic
  - Different payload sizes according to encoding algorithm

# Measurement from Traces

- ns trace files need to be analyzed by separate script
- Perl scripts are used to calculate
  - Loss
  - Jitter
  - Delay
- Output can be visualized through xgraph

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# Future Work

- Dependent on the public release of the new specifications: 802.11g and 802.11e
- 802.11g specifies extended rates of up to 54Mbps using the same 2.4GHz band as 802.11b.
- 802.11e specifies Quality of Service extensions.

# References


1. IEEE Std 802.11-1999, IEEE Standard for Local and Metropolitan Area Networks: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: http://standards.ieee.org/getieee802/download/802.11-1999.pdf.
2. IEEE Std 802.11b-1999, Supplement to IEEE Standard 802.11, 1999 Edition: Higher-Speed Physical Layer Extension in the 2.4 GHz Band: http://standards.ieee.org/getieee802/download/802.11b-1999.pdf.
3. H. Schulzrinne et al., "RTP: A Transport Protocol for Real-Time Applications," RFC 3550, IETF, July 2003: http://www.ietf.org/rfc/rfc3550.txt.
4. H. Schulzrinne et al., "RTP Profile for Audio and Video Conferences with Minimal Control," RFC 3551, IETF, July 2003: http://www.ietf.org/rfc/rfc3551.txt.
5. "IP Telephony Design Guide - An Alcatel White Paper," Alcatel, 2003.

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