Performance of the Metricom Ricochet Wireless Network

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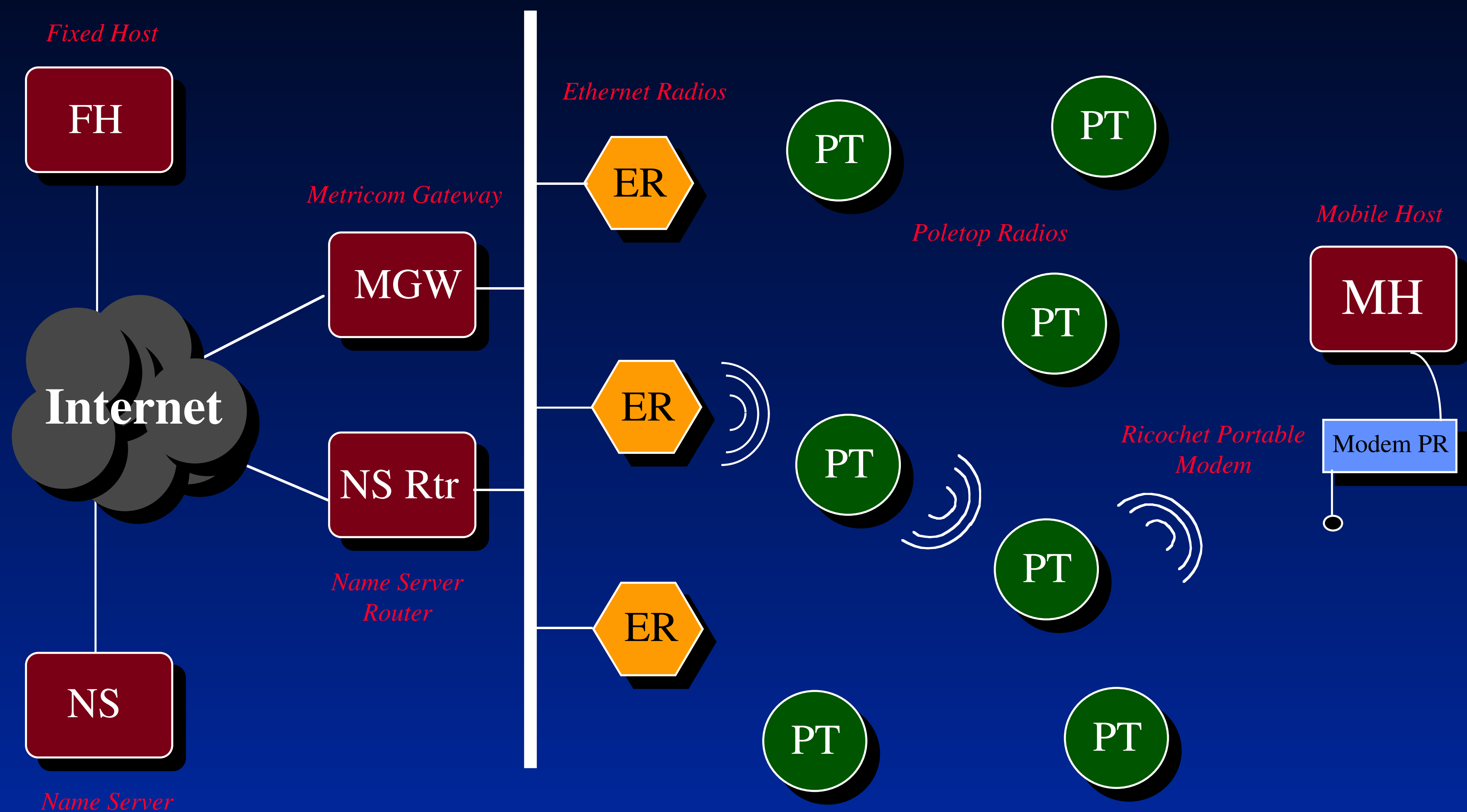
Motivation

- Metricom’s Ricochet system deployed in San Francisco Bay Area, offering low cost, “anytime”, “anywhere” Internet access.
- Establish performance results under real traffic loads.
- Determine interaction between packet radio flow control and link-layer mechanisms and end-to-end TCP mechanisms.
- Explore viability of multimedia traffic.
- Determine performance effects in presence of other ISM-band devices.

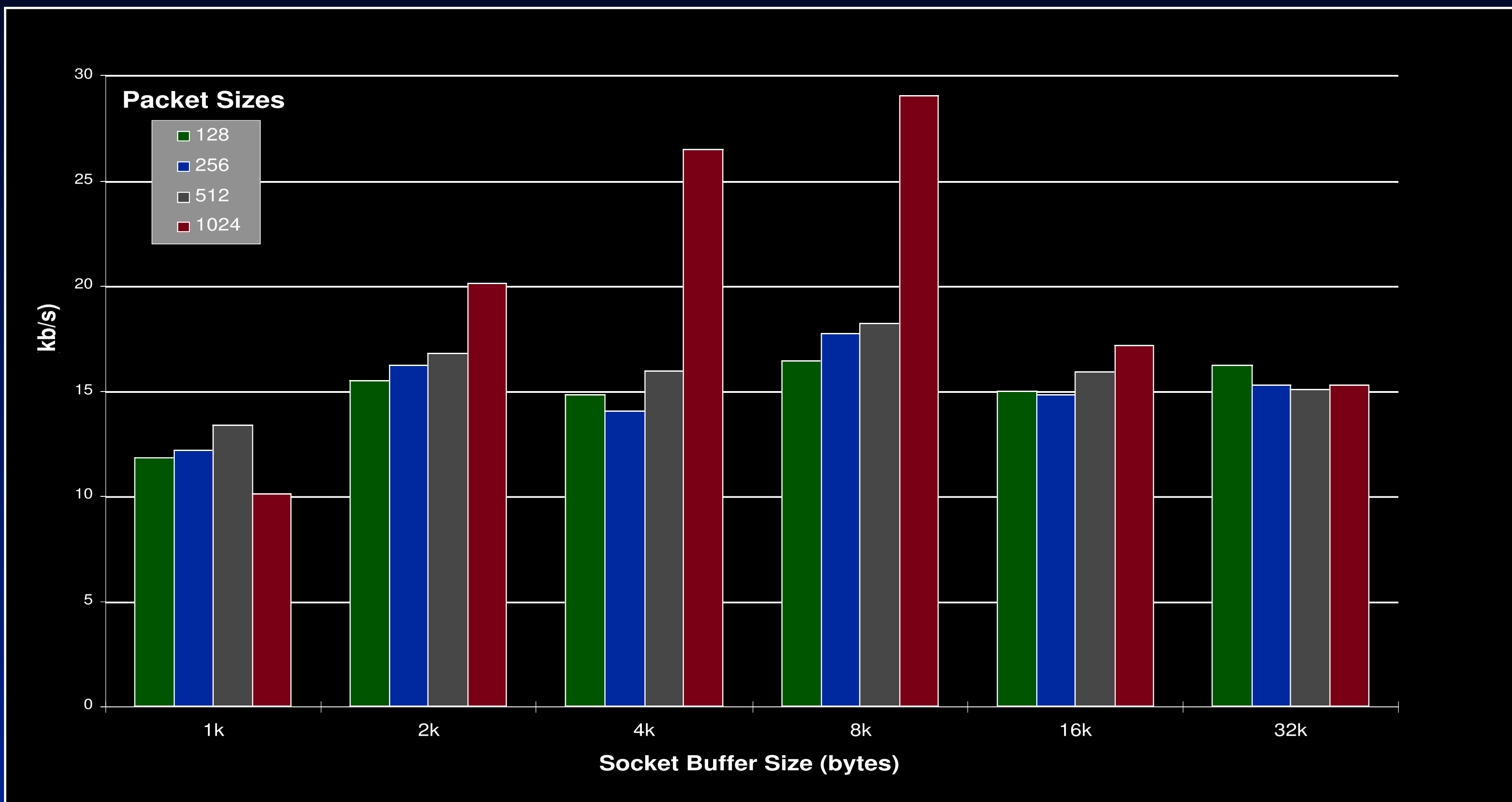
System Overview

- 915 MHz ISM band wide-area packet radio network.
- Frequency-hopping spread spectrum (160 hopping channels) half-duplex radios.
- Geographic routing based on latitude and longitude.
- Alternate routing between packet radios.
- Maximum data forwarding rate of 100 kb/s.
- 2-3 wireless hops between portable modem and wired access point (WAP).

Network Topology

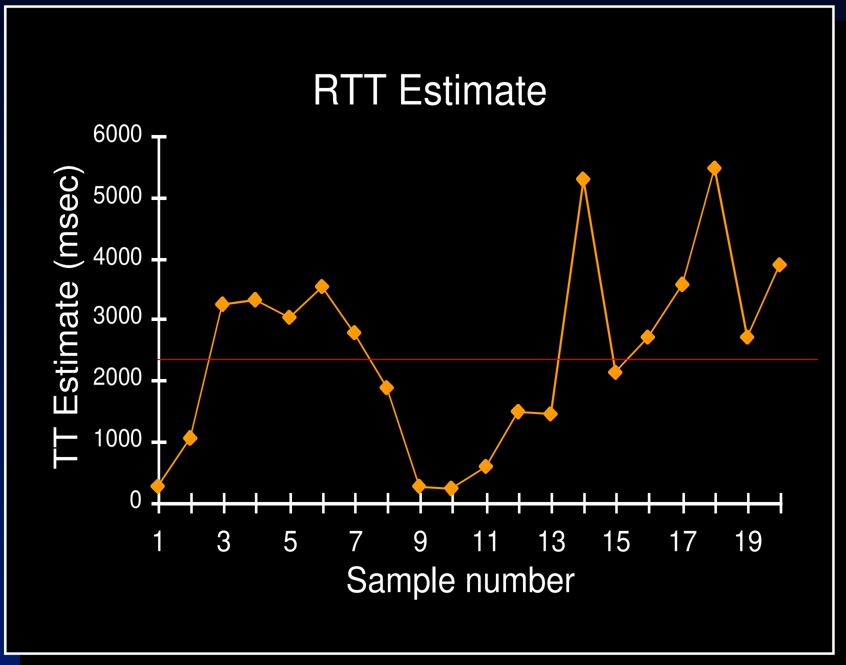


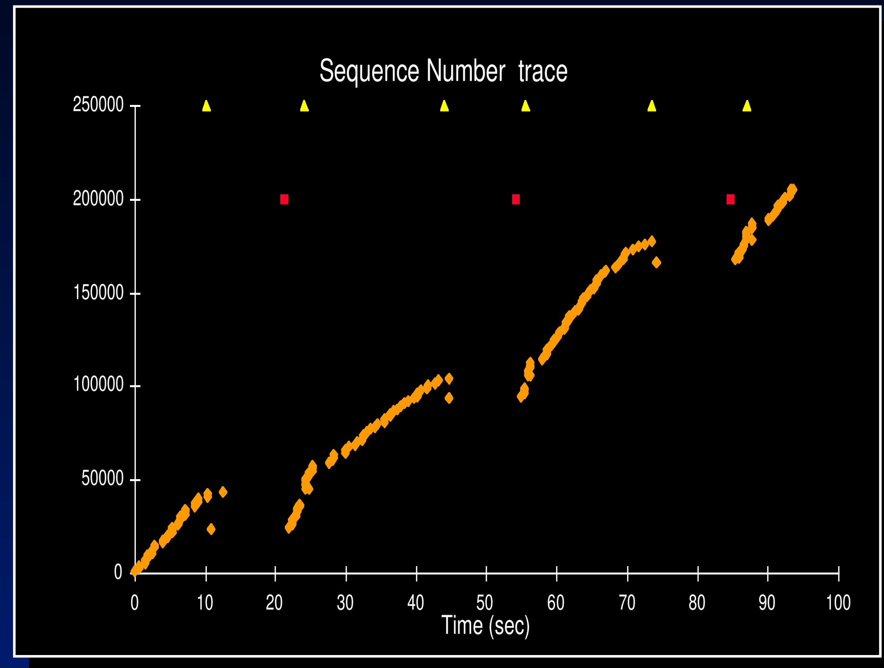
TCP Throughput



Performance best at 4-8KB buffer size and 1KB packet size.

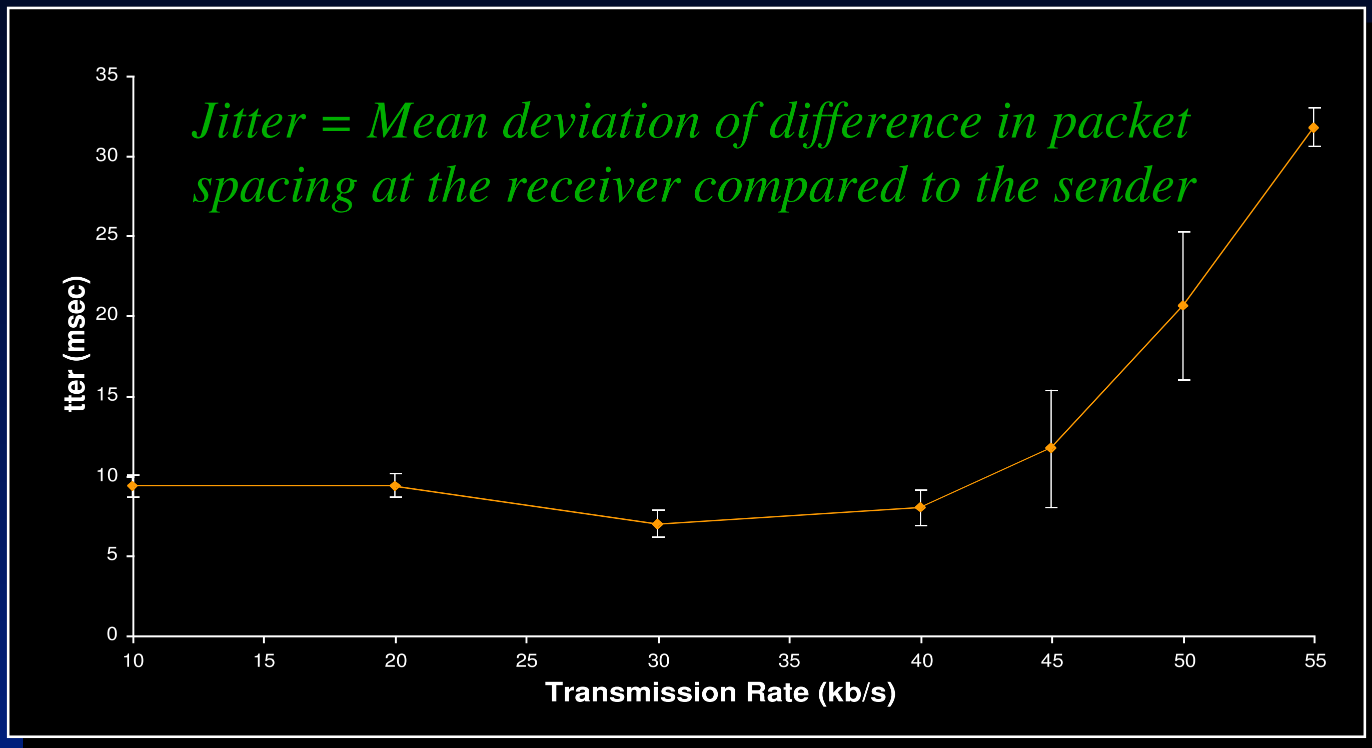
TCP Connection Analysis





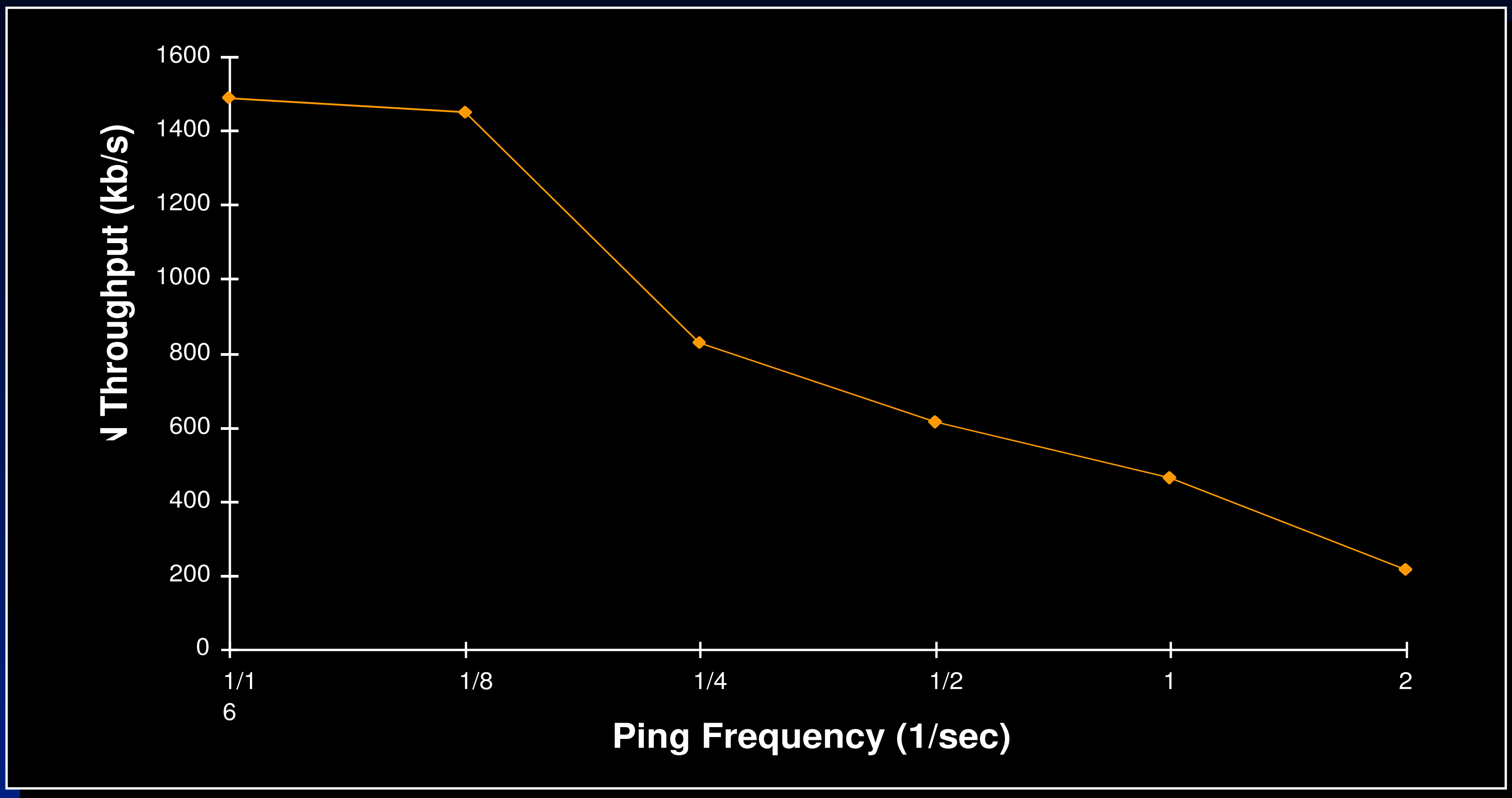
- 20 samples of round-trip time estimate during TCP transfer.
- Mean = 2450 ms, standard deviation = 1500 ms (approx.).
- Since one-way (rate-controlled UDP) jitter is not large, contention with acknowledgments across half-duplex radios probably main reason for variation.
- Leads to long idle periods after multiple losses.

UDP Performance



- Peak UDP throughput: 50-58 kb/s.
- In best-case situations, jitter is tolerable for video.

Ricochet-WaveLAN Interaction



- Both operate in the 915 MHz ISM band → interference.
- Significant WaveLAN throughput degradation even with infrequent traffic on Ricochet network.

Main Results

- TCP throughput between 15 and 30 Kbits/s.
- TCP performance suffers from long idle periods caused by reverse channel contention; large variations in round-trip estimates.
- Maximum UDP throughput 50-58 Kbits/s.
- UDP jitter acceptable for multimedia applications.
- 10-15% degradation for Ricochet when WaveLAN is active (simultaneous TCP transfers)
- 50% TCP degradation over Ricochet in presence of flooding WaveLAN traffic.