Public Safety Digital Communications Advancement in Mobile Ad Hoc Networking

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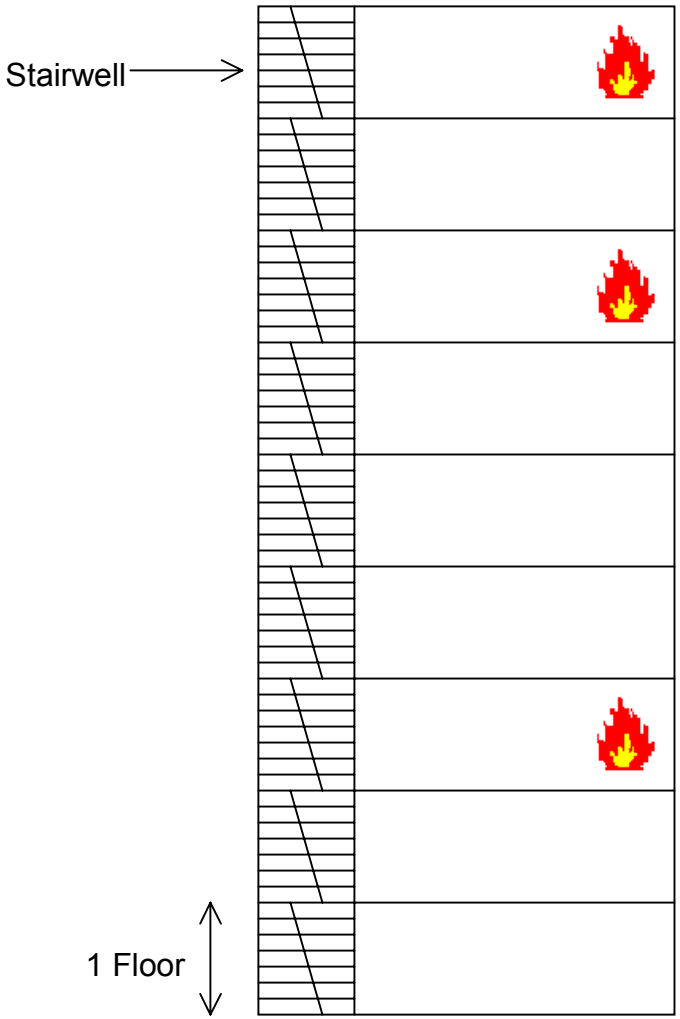
The Problem

Columbine High School Shootings

World Trade Center Attacks

Massive communications failure at both events…

Firefighter Scenario 1



Firefighters In Contact

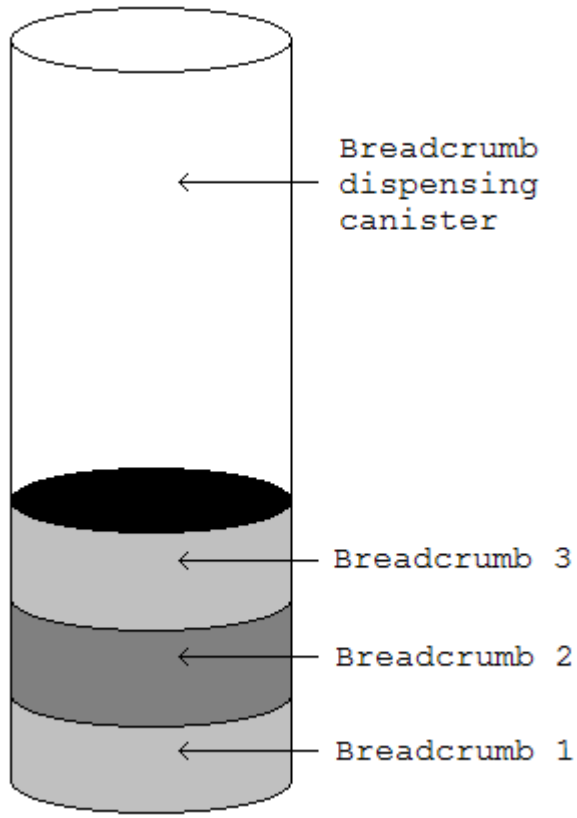
Firefighters Out of contact

Using current MANET Routing Protocols and hardware infrastructure

Hardware

- Wireless Mobile Device

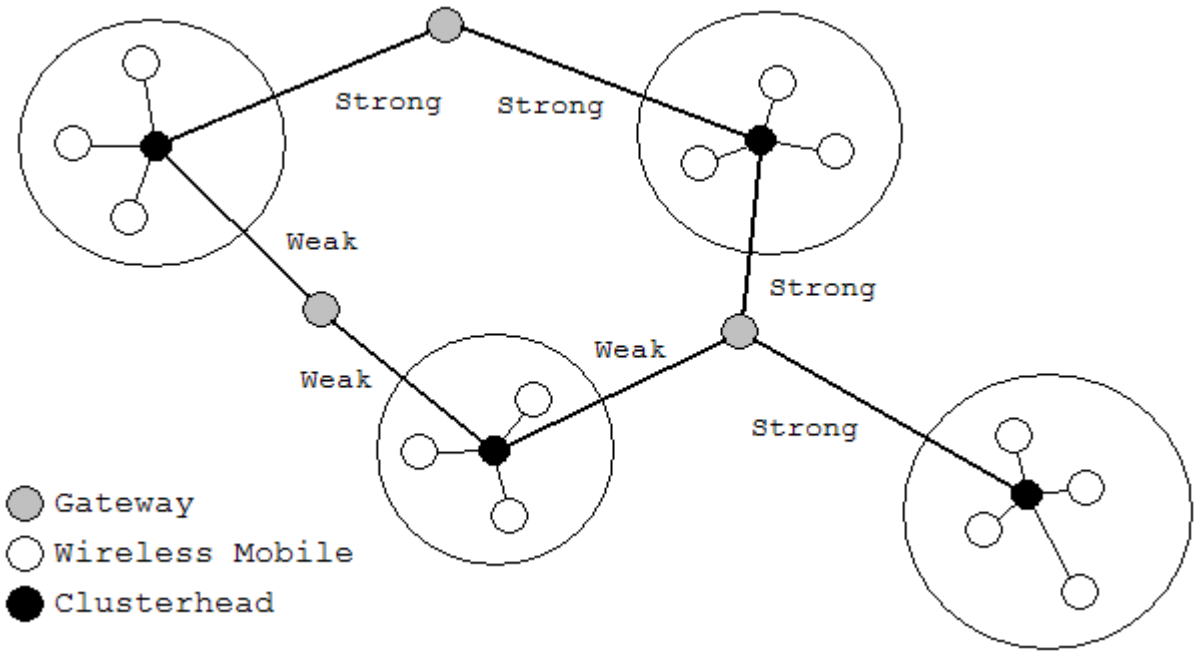
- Breadcrumb



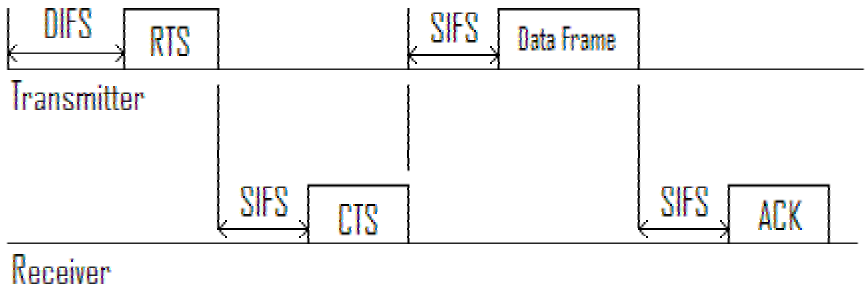
MANET Routing Protocols

- Clusterhead Gateway Switch Routing
- Signal Stability Routing
- Near Term Digital Radio

Public Safety Network Architecture



802.11 Basic Equations



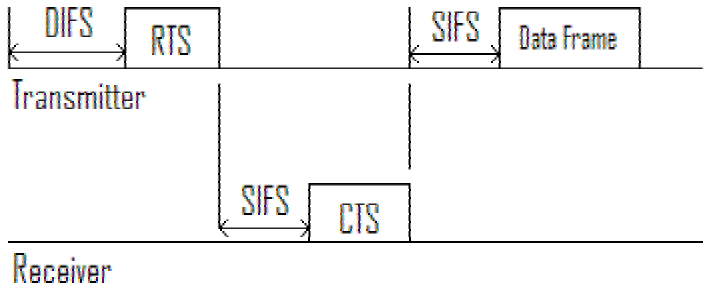
DIFS(50µs) + back off time(51.4µs) + RTS(111µs) + SIFS(10µs) + CTS(106µs) + SIFS(10µs) + voice frame(250µs) + SIFS(10µs) + ACK(106µs) = 704.4µs for Short PLCP Format virtual access method

DIFS(50µs) + back off time(51.4µs) + RTS(207µs) + SIFS(10µs) + CTS(202µs) + SIFS(10µs) + voice frame(346µs) + SIFS(10µs) + ACK(202µs) = 1088.4µs for Long PLCP Format virtual access method

10ms/704.4µs = 14 users with the Short PLCP Format

10ms/1088.4µs = 9 users with the Long PLCP Format

Public Safety Basic Equations



DIFS (50µs) + back off time (51.4µs) + RTS Frame @ 11Mbps (25µs) + SIFS (10µs) + CTS Frame @ 11Mbps (21µs) + SIFS (10µs) + PLCP overhead @ 11Mbps (10.9µs) + MAC overhead @ 11Mbps (24.7µs) + Voice Payload @ 11Mbps (129µs) = 332µs with the Short PLCP Format virtual access method

DIFS (50µs) + back off time (51.4µs) + RTS Frame @ 11Mbps (32µs) + SIFS (10µs) + CTS Frame @ 11Mbps (27.6µs) + SIFS (10µs) + PLCP overhead @ 11Mbps (17.5µs) + MAC overhead @ 11Mbps (24.7µs) + Voice Payload @ 11Mbps (129µs) = 352.2µs with the Long PLCP Format virtual access method

10ms/332µs = 30 users per channel with the Short PLCP Format

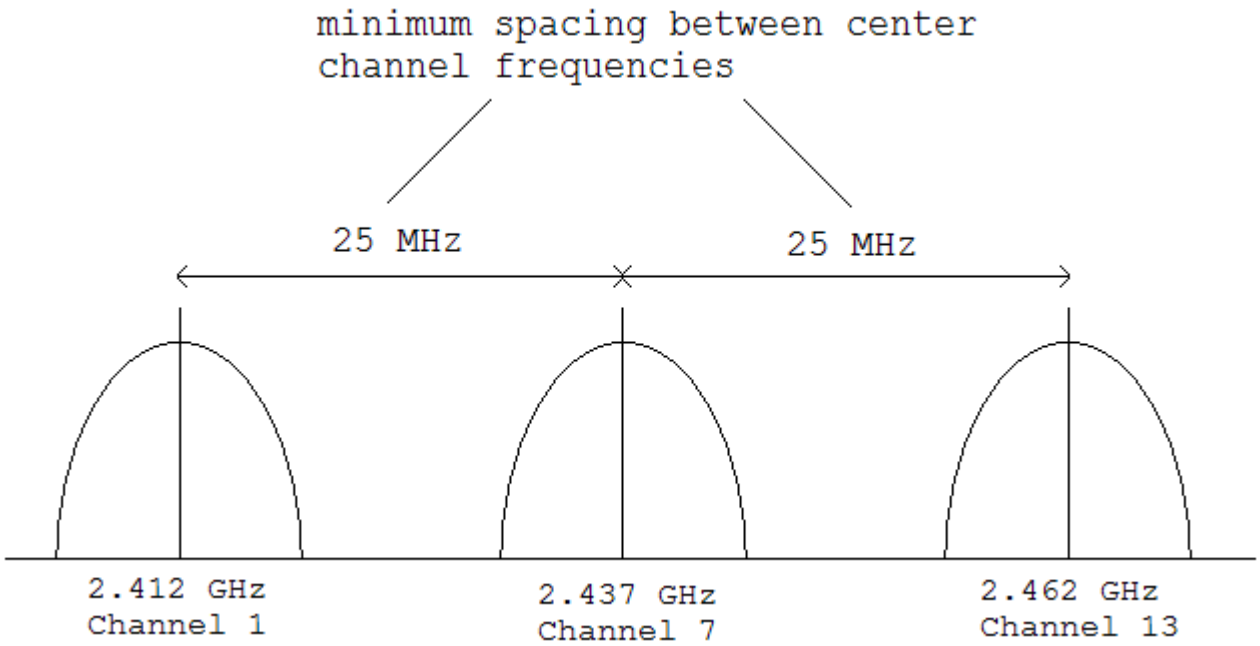
10ms/352.2µs = 28 users per channel with the Long PLCP Format

Basic Results

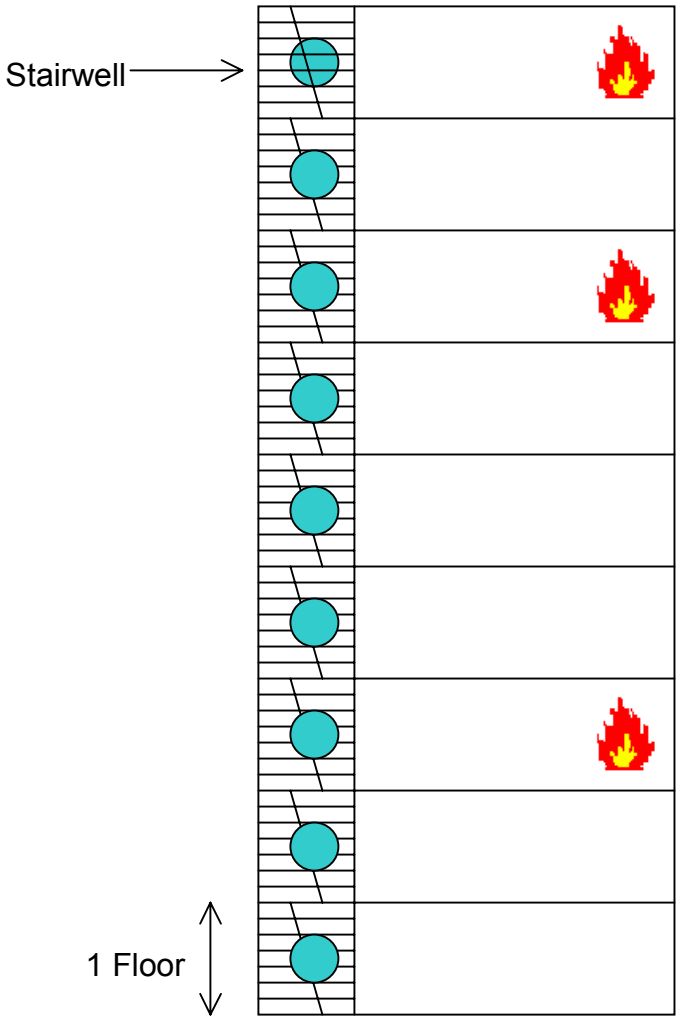
	Current 802.11b standard	Proposed change
Short PLCP Format	14	30
Long PLCP Format	9	28

Simultaneous number of users with the virtual access method

802.11 Spectrum Usage



Firefighter Scenario 2



Firefighters
In Contact

Firefighters
Out of contact

Breadcrumb

Using new proposed MANET Routing Protocols and hardware infrastructure

Solution Problem Points

- Denial of Service Attacks
- Power Consumption and Battery Weight
- Single Point of Failure
- Route Stability w/Fading Channels and Interference

Future Work

- OPNET
- Breadcrumb development
- Practical Implementation of MANET protocol