

Reliable Communications for First Responders

Jon M. Peha

Carnegie Mellon University

**Associate Director, Center for Wireless & Broadband Networks
Professor of Engineering & Public Policy**

peha@cmu.edu

www.ece.cmu.edu/~peha

www.epp.cmu.edu/httpdocs/people/bios/peha.html

Early Communications Infrastructure

- In 1860, Pony Express carried mail 2000 miles from Missouri to California in just 10 days.
- Ride horses in relay.
 - Each rider for 7-10 hours.
 - Each horse for 1-1.5 hours.
- Pony Express was replaced by the telegraph.

- Can we manage communications infrastructure for first responders as effectively?

Lives in the Balance

- “Without functioning communications systems, first responders and government officials cannot establish meaningful command and control, nor can they develop the situational awareness necessary to know how and where to direct their response and recovery.”
 - House Select Bipartisan Committee to Investigate Hurricane Katrina, Feb. 2006
- Lives are lost in big and small emergencies, regularly, *throughout the US.*
- 9/11 should be a wake-up call: the US public safety communications infrastructure is no longer adequate.
 - Not designed for today’s technology, or today’s needs.

The Interoperability Myth

- Many believe that the principal problem is interoperability.
 - the ability of responders from different agencies to communicate and share information.
- Thus, if we merely “fix” the interoperability problem, the infrastructure will be adequate.
 - So why is this not working?
 - “Despite hundreds of millions in federal funding for technology and communications, the absence of true communication interoperability within and between affected jurisdictions severely hindered rescue and response efforts at all levels of government.” – House Committee on Katrina
- We do see many dangerous interoperability failures.
 - But it is just one symptom of more fundamental problems.

The Problems Become Tangled

- 9/11 Commission reported interoperability problems.
 - Finding: “The inability to communicate was a critical element at the World Trade Center, Pentagon, and Somerset PA crash sites, where multiple agencies and multiple jurisdictions responded.”
 - Recommendation: “Congress should support legislation which provides for the expedited and increased assignment of radio spectrum.”
- However
 - More spectrum could be useful, but it alone will not solve interoperability problems.
 - Potential spectrum shortage is a different problem.
 - More spectrum could even add interoperability problems

Problems Beyond Interoperability

- Shortage of public safety spectrum may be looming.
 - Capacity would then be inadequate for large emergencies.
- Dependability
 - Many systems not designed to be dependable during large disasters, e.g. hurricanes.
- Security
 - Many systems not designed with strong protection against hostile parties, e.g. criminals or terrorists.
- Outdated technologies, lack of capabilities
 - Systems do not make use of valuable new capabilities, e.g. high-speed data services, location detection, video, etc.

The Mother of All Problems: Fragmented Policy

- By tradition, public safety is a *local* issue.
- 50 thousand public safety agencies in the US.
- Many run their own communications systems.
 - Different systems for adjacent towns.
 - Different systems for police, fire, EMS.
 - Then add limited interoperability features - maybe.
- Thousands of independent decision-makers, with little coordination
 - Designing and running highly complex system to support life-and-death decisions.

Because of Fragmented Policy

- Interoperability problems become possible.
 - No inherent technical reason for such problems to exist.
- Much of public safety spectrum is wasted.
 - One reason for unnecessary spectrum shortages.
- When large disasters hit, the impact may be greater.
- Communications between agencies is often not secure.
- Billions of tax-payer dollars are wasted.

The High Cost

- The amount of public safety infrastructure in a region is highly correlated with the number of municipal governments involved.
 - More so than the size (area) of the region.
 - More so than the population of the region.
- Spectrum is a major hidden cost of public safety infrastructure.
 - Spectrum allocated to public safety as part of DTV transition worth \$4-10 billion in commercial auction.
 - If existing public safety spectrum were used efficiently, additional spectrum probably would not be needed.
 - Inefficiencies result of fragmentation, not simple error.
- **The argument that we cannot afford a better system is absurd. A better system could cost less.**

No Simple Silver Bullet

- Additional spectrum
 - Useful as home for new and better systems.
 - Useful to prevent spectrum shortage.
 - But spectrum alone will have limited impact.
- Interoperability “fixes”
 - Improvement is needed. Grants can help.
 - But some “fixes” exacerbate other problems, e.g. spectrum shortage.
- New technologies
 - e.g. mesh networks, UWB, satellites, frequency reuse, wifi
 - CMU is experimenting with new technologies.
 - Some are highly beneficial, but there is no single solution.
 - We need new policies to make proper use of new technologies.

Solution: A National Strategy

- We need a *comprehensive national* strategy
 - that addresses all needs of public safety
 - including spectrum, interoperability, dependability, more
 - that is developed with leadership from *federal* government
 - that produces a national architecture based on open standards
- Many options to consider, including
 - National infrastructure run by federal entity.
 - National architecture, but many regional networks, each run by local agencies.
- More spectrum + federal funding to *enable* a transition
 - Not to avoid a transition.
 - New strategy would save money & spectrum in the long run.

Actions

- A complex new strategy requires significant investigation
 - Empower programs within federal government
 - Begin supporting researchers outside government to advance the strategy.
 - e.g. 2005 Lieberman-Collins bill
- Provide federal funding for communications systems, but only to those advancing the national strategy.
- Make sure use of TV spectrum is consistent with national strategy
- Strengthen mechanisms for inter-agency cooperation.
 - FCC, DHS, DoJ, etc.

Policy Reform for Commercial Systems Too?

- Public safety agencies rarely systematically consider whether commercial services or unlicensed technology can be useful to emergency responders.
 - Lost opportunities
- Commercial carriers also important for general public during disasters.
 - e.g. using cell phones to call for help.
 - Today's environment rewards cutting costs, but not improving dependability after large-scale disaster.
 - Provide market-based incentives for dependability and security by providing better information to consumers

Carnegie Mellon University



**More information on this topic
is available at
www.ece.cmu.edu/~peha/safety.html**

Jon M. Peha

**Associate Director, Center for Wireless & Broadband Networks
Professor of Electrical Engineering & Public Policy**

Carnegie Mellon University

peha@cmu.edu