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This series of articles is intended to provide a general conceptual understanding of Interoperable Communications as they pertain to Public Safety Communications and Emergency Management/Incident Response support.

## **Present Initiatives**

*Presently the FCC is looking at several methods of maximizing utilization of existing radio spectrum. These include the “Narrow-Banding Initiative and the 800MHz re-farming initiative.*

- *Narrow Banding – An initiative before the FCC that will provide for a “2-for-1 for each presently assigned channel.*
- *800 MHz Re-Banding – An initiative before the FCC to attempt to separate Cellular telephone from Public Safety frequencies within the 800MHz band.*

*Radio Frequency Versus Coverage - The concept behind frequency versus coverage states that the lower the frequency (VHF) the larger the coverage area; Conversely, the higher the frequency (900MHz) the smaller the coverage area. It is obvious that frequency must remain the concern of individual agencies based upon their needs and integrity, and should not be the major determining factor in interoperability communications decisions. By example, an agency that has chosen an 800 MHz radio environment chose it to support a definitive need for a large number of users and data transfer requirements. The agency that chooses to stay with VHF did so in order to support a lower number of users over a larger geographic area. Both of these decisions are correctly derived from the specific needs of each agency.*

Satellite / Wireless Communications - Satellite communications can provide voice, data, and video through one medium simultaneously over far greater distances than any terrestrial wireless communication system.

- The Narrow-Banding Initiative is a rather technical aspect of radio technology. The concept is that when the FCC authorized particular frequencies to be used by public safety and other entities, the frequency allocated was a “center” frequency with a “Bandwidth” of 25Khz, or the center frequency with a 12.5Khz area on either side of center. This was to allow for the frequencies that make up the human voice. In the days of analog radios and non-solid state devices, this was necessary to keep adjacent channels from interfering with each other. With the improvement of “discreet” components, it is possible to maintain voice quality and reduce interference with a bandwidth of 12.5Khz. This “Narrow-Banding” uses half as much spectrum per assigned frequency. Unfortunately our newfound extra channels cannot be used by the same agency that owned the original frequency

because if the 2 new frequencies are used from the same sight, they will interfere with each other. This means that someone must now manage the movement of the newfound frequencies to other geographic areas that will not interfere with each other.

- The 800MHz “Re-Banding initiative is an attempt to separate public safety frequencies from cellular telephone frequencies. Presently, this phenomenon is a very real problem for most 800MHz users. The initiative involves an offer from Nextel to provide nearly 1 Billion Dollars to assist in re-tuning base and ancillary radios and the associated coupling systems for all public safety users of the 800MHz band.
- National Incident Management System (NIMS) – The Department of Homeland Security’s initiative for migration to both physical and communications Interoperability.

**Formats and Architecture** - Formats and architectures in communications are like formats within computer systems. Microsoft’s format is not compatible with Sun Systems format, or any other format. Within the communications industry, formats such as Trunking are not compatible with older conventional environments. An example of this is that Motorola’s architecture is not compatible with E. F. Johnson’s architecture.

- Analog Simplex – Single channel radio systems using one frequency for both send and receive.
- P16 – APCO Approved Analog Trunking Format
- Digital – Converts analog voice to a digital format, then transmits the data and converts it back to analog voice. This format can move data and has expanded housekeeping capabilities, i.e. dynamic regrouping, call ID, etc.
- P25 – APCO approved Digital Trunking Format.
- Passport – Commercial Analog Trunking Format
- Tetra – European Digital Trunking Format
- VoIP – Format used to convert voice to data packets and manage those packets like any other network data.
- Nextel – Cellular telephones are basically 800-900MHz radios on a proprietary format.

- VHF (1/h) vs. UHF vs. 700MHz, 800MHz, & 900MHz – The concept behind frequency versus coverage is that if power output is equal on all frequencies, the lower the frequency, the larger the coverage area.
- Coverage as to Frequency Band – Low-Band VHF up to UHF has the ability to follow the contour of the earth, the lower the frequency the more ability to follow terrain. UHF specifically works well for building penetration. Frequencies above UHF (700 to 900 MHz) neither follow terrain nor penetrate well
- FCC Imposed Limitations to the Solution
  - Local Interoperability support of towers, repeaters, transmitters, etc. (800 MHz)
  - Frequency Use by Geography (More than you get your channel)
  - Loading Requirements
  - Support of USA Channel
  - Power Output
  - Antenna Size and Height
- Now and Tomorrow – The Landscape – Presently, only the military is utilizing the full capacity of Satellite-based communications. Public Safety utilizes hand-held satellite telephones as a back-up means of communications. The ability to send voice, data and video is available today. The ability to regularly use satellite systems at capacity much higher than present landline and cable Internet speeds is only a few months away.
- Satellite Capabilities – Systems are available that can transmit and receive data at speeds approaching Cable modem. This capability can support voice, data and video transmission. With all three types used simultaneously, present systems may slow down to the point of losing reliability. In the near future, 6 months to a year, the capacities will be ten-fold of the present.
- Satellite Limitations - As has always been the case with any satellite communications system, it is possible to lose connectivity when blocked by some natural or man-made element. The only method of defeating this phenomenon is to create satellite to radio networks that compensate for the blockage.
- Wireless Capabilities - Present 80211X systems can provide wireless connectivity at extremely limited ranges. PCS digital systems can provide wireless support wherever there is Cellular telephone coverage. The dovetailing of Satellite systems to PCS systems can provide reasonable coverage in almost any environment

- Wireless Limitations - PCS and 80211X systems only have a limited coverage area. Though PCS is cellular based, only about 25% of the nation is actually covered by cellular systems.
- Communications Interoperability is the combining of multiple agencies with multiple communications infrastructures into an Incident Defined communications environment to achieve a practical and successful Response that is transparent to the First Responder.
- “Practical” is defined as fiscally responsible, while being able to implement the solution in a timely manner.
- “Successful” is defined as a practical solution that does not adversely affect the First Responder.
- This means that to experience effective Communications Interoperability, the Second Responder must utilize technology that will support the direct communications between agencies that need to respond to a particular event.

This can be achieved with varying levels of success by utilization of the different methods discussed by SAFECOM’s Interoperability roadmap called the Seven Levels of Interoperability.

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