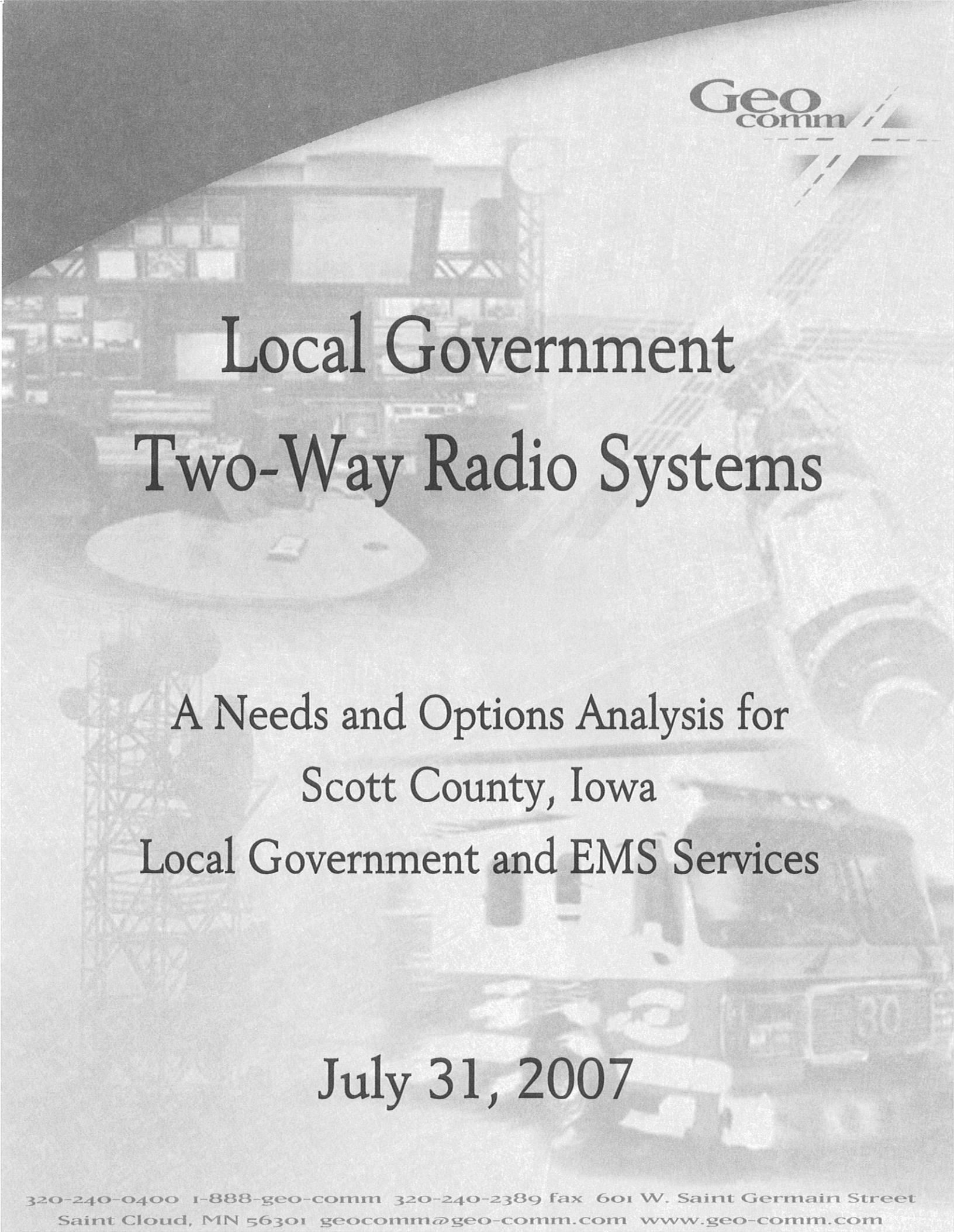


Local Government Two-Way Radio Systems

A Needs and Options Analysis for Scott County, Iowa Local Government and EMS Services

July 31, 2007

320-240-0400 1-888-geo-comm 320-240-2389 fax 601 W. Saint Germain Street
Saint Cloud, MN 56301 geocomm@geo-comm.com www.geo-comm.com

Executive Summary

This report studies the current and potential future two-way voice and data radio system options for not only our direct clients (cities of Davenport and Bettendorf, MEDIC EMS, and Scott County) but for all of public safety and local governments in Scott County, to include school operations. And, while for this analysis GeoComm uses the FCC's definition of "public safety" radio users to include emergency services, public works, transit, and school operations, there is no intent to imply that funding for the independent school district's radio systems is the responsibility of the clients for this study.

The report examines the choices of technology and acquisition models available to implement the system improvements that are recommended.

Basically, there are two technology choices:

- Standards ("P25") compliant radio systems or non-standards compliant.
  - P25 provides a gateway to compatibility with most other governmental radio systems of today and the future for purposes of all-important **interoperability**.
- Systems that are not standards compliant, such as the Racom EDACS radio system currently being used by many of the entities in the county, although this report addresses how to work around this issue and leverage some recent technology advancements by Tyco Electronics, the manufacturer of the Racom system.

GeoComm recommends a migration path that would involve moving all Davenport radio operations over to the Racom EDACS system, but with a number of stringent caveats that would ensure compatibility with future P25 systems in Iowa and elsewhere as well as provide contractual assurances that the Racom EDACS system would provide enough capacity and coverage to meet the stringent needs of the Davenport Police and Fire Departments.

There are also two basic acquisition choices:

- Purchase, own, and maintain your own radio system(s).
- Purchase, own, and maintain your own end-user radios, but "subscribe" them to a 'trunked' radio system infrastructure built, owned, and maintained by others, public, private, or public-private partnerships. This is kind of like the cell phone service model all are aware of.

Due to the significant existing (and relatively recent) investment by Bettendorf, the county, MEDIC (and others) in subscriber radios that are subscribed to the Racom EDACS system, and the fact that these radios will not work on any other vendor's 800 MHz trunked radio system in the area, GeoComm is recommending a continuation of this subscription relationship with Racom, and adding as many as 600 or 700 Davenport radios to the Racom system.

GeoComm recommends that an intensive and stringent "standard of service" negotiation begin with Racom to see if they can and are willing to meet said standards, in return for which they could gain a large number of new, recurring paying customers and many dollars in equipment sales.

The final client one-time expenses and/or recurring monthly costs cannot and should not yet be calculated or written, as they should be left to the rigors of the negotiation process set forth in this document. Suffice it to say, that for the implementation of the end capabilities that GeoComm has set forth in the report, the cost would be far less over the next 15 years than the outright purchase and expensive maintenance by the clients of a system with similar capabilities.

Section 1
Introduction

Purpose

The entities of Scott County government, city of Davenport, city of Bettendorf, and the Medic EMS service (the clients) retained GeoComm Corporation to undertake a public safety communications study. This study investigates the need for and feasibility of implementing any new, state of the art, public safety voice and data radio system(s) to serve the communication needs of local governmental agencies in Scott County and their public safety partner, Medic EMS services. The concept of such a radio system(s) incorporates several different ideas:

- The possibilities inherent in an integrated countywide communications system that enables people in different jurisdictions and departments to communicate directly.
- The possibility that radios on such a system could also directly intercommunicate with like radios in and from other areas of Iowa, as well as radios from Illinois and other areas throughout the United States using standardized channels and/or protocols.
- The possibility that economies of scale and/or acquisition models would allow systems and technologies to be implemented, would be either inaccessible to smaller agencies acting on their own, or less costly than if they were implemented by individual jurisdictions on a gradual basis.
- The potential of capitalizing on the tradition of cooperative ventures by the governmental entities of the county and the state of Iowa.
- The potential of either capitalizing on or extending value received from previous public investments in similar systems.

The specific Scope of Services covering this engagement was as follows:

Scope of Work

To complete the study, the selected consultant must perform these tasks:

1) Perform a Needs Assessment Study and develop a Requirements Definition to meet the radio needs of the Clients and MEDIC EMS's public safety and public service agencies for the next 15 years. The plan shall address specific needs of the police, fire, public utilities, and general government agencies, plus other departments as required.

2) Address the FCC re-farming and narrowbanding issues and make recommendations. Analyze a Clients and MEDIC EMS-wide trunked radio system alternative for the Clients and MEDIC EMS's consideration.

3) Include a plan for adding a mobile data computer capability either initially or at a later date.

4) Identify the specific functional requirements for a state-of-the-art radio communications system for alerting, dispatch, and coordination of both public safety and non-public safety units within the Clients and MEDIC EMS.

5) Assess the layout of, and space available in, the communications center(s) and recommend renovations to accommodate new consoles, recording equipment, and ancillary equipment.

6) Define the present and future radio channel usage and recommend a channel plan. Include all present and potential users in the Clients and MEDIC EMS, plus adjacent jurisdictions. Emphasize requirements for inter-operability and operational coordination with participating agencies and describe how the proposed system will be P-25 compliant. Also, describe how the proposed system would interface with the existing statewide plans for interoperability and addresses the five elements of improved interoperability as outlined in the Office of Homeland Security SAFECOM program.

7) Identify the impacts of Wi-Max on the proposed system.

8) Evaluate existing radio equipment to determine its reliability, and parts availability, and assess the feasibility of utilizing that equipment to supplement the proposed system. Consider and make use of existing equipment, property, and facilities to the greatest extent possible.

9) Analyze alternatives based on Clients and MEDIC EMS-approved criteria.

10) Develop and recommend a course of action that will address the Clients and MEDIC EMS's long-term communications requirements.

11) Prepare preliminary system designs, consisting of major elements of the system, and schematic block diagrams. Include general types of antennas systems, radio stations required, trunking capacity (if applicable), computer and processors required, and the type and quantity of interconnection circuits. Include requirements for floor space, towers, power, HVAC, and other parameters needed to define the site facilities.

12) Define site facilities sufficient to provide budgetary estimates of construction costs.

13) Provide cost estimates for implementation of the recommended system change(s).

14) Perform propagation analysis and preliminary site selection. Produce maps showing predicted radio system coverage. Map scales will be specified by the Clients and MEDIC EMS's Communications Committee using an approved base map.

15) Provide a written report outlining the needs of the Clients and MEDIC EMS agencies as determined from the above tasks. The report shall include budgetary estimates for a preliminary design and a proposed implementation schedule.

16) Present the report to the Clients and MEDIC EMS's Communications Committee. Additionally, the Consultant may be called upon to make a presentation to the Board of Clients and MEDIC EMS Commissioners.

As will become evident as the report progresses, some of the above tasks became more relevant and others less relevant as the range of options became better defined and refined. The basic organization of this report will be to follow the tasks outlined above, and provide commentary under each. However, as a preamble to that discussion, now would be a good point in the report to establish some basic understanding of how two-way radio systems such as are being described actually work. First, a word on GeoComm's process for this project.

Methodology

The study began with an "educational briefing" for local government decision makers from public safety, general government, schools, and utilities on the general state of affairs in which is commonly referred to as "public safety" radio. *(The term "public safety" is used very broadly herein to reflect a wide array of activities far wider than traditional police, fire, and EMS activities).* This briefing was held on January 31, 2007 in Davenport, and was very well attended.

The study proceeded with the collection of information about existing radio systems and their usage and effectiveness in the county. Site visits were conducted, and comprehensive surveys were collected from 38 units of local government or operational entities (a county department, for example) as a part of the effort. The survey is intended to identify the strengths and limitations of the current systems, as well as the current and future communication needs of the user agencies. A questionnaire was given to almost all governmental agencies in the county. This questionnaire along with site visits has provided the basic data for the study. This was supplemented by interviews with area officials and a review of pertinent documents and FCC licensing files and lengthy meetings with local radio service providers (vendors). The questionnaire itself is included as Appendix 2 to this report, and it contains summarized results as well.

GeoComm arranged for a day long "technology and business models briefing" to be conducted for key operational staff and policy makers by the two leading full service communications system vendors, Racom and Motorola. This event was held on May 22, and was well attended.

The GeoComm project staff has developed alternative functional designs for several system alternatives, as well as rough "order of magnitude" cost estimates for these alternatives.

This report represents the results of these efforts and presents the findings and recommendations of the study.

Section 2
Summary of Data Collections and Observations

Introduction

In order to provide the proper context for the technical discussions that follow, it may be best to begin by answering this fundamental question: How do these two-way radio systems work?

Simply put, a two-way radio system exists for three reasons. First, it permits the agency HEADQUARTERS (a dispatch center such as Scott County Dispatch) to reach out to and talk to one, many, or all of its subordinate FIELD UNITS. It also permits the FIELD UNITS to talk into the HEADQUARTERS one or more at a time. Lastly, it permits FIELD UNITS to talk to other FIELD UNITS to coordinate their activities.

For these capabilities to exist, the radio system must have two essential elements:

- Adequate communications pathways (usually called channels) over which the above communications can be conducted in a somewhat organized manner. These pathways are channel licenses and assigned by the Federal Communications Commission (FCC). The FCC has a whole category of radio frequencies at various places on the radio spectrum set aside for free licensing which can be used by state units and local government. The units of government in Scott County hold several dozen of these licenses in the VHF (150 Megahertz or MHz)) band, UHF (450 MHz), 800 MHz and now 4.9 Gigahertz (GHz) bands. Appendix 3, at the end of the report, contains information on all of these licenses, with the caveat that each call sign license; such as WPPF854, held by Scott County, may cover many discrete radio channels, as this one does with 20 radio channels in the 800 MHz band.

- Adequate strength of radio signal from the system's main antenna or tower out to the field units. The signal needs to be strong enough so that in the remotest part of the jurisdiction it can get there in a fashion that is hearable and understandable without too much static or interference. The field units also need to be able to get their somewhat weaker radio signals back into the system. This issue is also related to the FCC radio license issue. Ideally, if one had lots of FCC licenses, one would have lots of PATHWAYS or CAPACITY TO TALK. However, if these licenses were limited to 5 watts of power and 25 feet of elevation on a tower, one could not talk very far. The trick is to get licensing for as much power and as much elevation as needed to yield the Talk Out and Talk In signal strength desired or needed in your system.

  Above is termed "TALK OUT" coverage, meaning talking OUT from the headquarters; and "TALK IN" coverage, meaning ability of field units to have their signal get back to headquarters.

For there to be solid Talk Out coverage, there essentially needs to be a blanket of radio signal power being transmitted from the transmission tower(s) from which the headquarters signal is emanating. Similarly, for there to be effective Talk In, a similar blanket needs to exist that covers the entire area listening to inbound radio signals from field units. Once these blankets exist, they exist for all radios that are tuned to this system, regardless of their number.

Assume it would cost an imaginary $3,000,000 to build such a Talk Out blanket for all of Scott County's land mass, with adequate power to provide a readable radio signal to 97 percent of the 458 square mile county area for portable (hand-held) radios inside standard construction buildings at the first floor level. Now assume (*not a likely scenario*) there was only *one* such portable radio in the county that was a part of this network. That radio would be able to hear HQ at 97 percent of the spots in the county from inside buildings of that type. $3 million would be a lot of money to spend to provide such coverage to one radio, but the point is, it could be done. Now assume there are 500 such portable radios participating on this radio system. It would take the same $3,000,000 to build "the blanket" to make said radio signal available to 500 portable radios as it does to make it available to one portable radio. The only area where more radios drive up the cost, is if the radios require adding more channels to the network, but even in that case, the added cost of an additional channel is small in comparison to the rest of the infrastructure.

There is a lot written about such "blankets" in this report. Questions such *as "To which agencies do we want to provide radio service under this blanket?"* will be critical. And, *"Should the clients build, own, and operate their own 'blanket' or are there providers out there who might be willing to let the clients 'get under a blanket' they are already building or have built for other agencies or customers?*

Also, *"How thick do we want and can we afford to make our blanket?"* The thinner the blanket, the less **penetration** of a radio signal into cars, buildings, through the bodies on which portable radios are belt-carried, etc. For example, agencies such as highway departments (where workers, by design, spend very little work time inside buildings) often build radio systems intended to serve only their agency to provide coverage in 97 percent of the area to mobile radios only, having high receiving antennas mounted high on the roof of a truck. It is far cheaper to build a system to this level of coverage, knowing it provides relatively little penetration into buildings (and to portable radios with far less effective antennas) than it is to provide a level of coverage that reaches most all portable radios, when worn on the belt (the mass of the abdomen actually blocks lots of radio signal) in most all buildings of most all types of construction at the basement level.

It also needs to be remembered that it is a virtual impossibility to build a radio system that will provide 100 percent signal coverage to 100 percent of the area in 100 percent of the above and below ground possible environments in 100 percent of the construction environments. CAN'T BE DONE. PERIOD. And if it could be done, no local agency could afford to do it. There will always be that "missile silo" type of location underground beneath some plant someplace in the county where it is just about impossible to get radio signal in to and out of, unless one knows about it in advance and can build special aids at that site for this purpose. These "special aids" are usually called bi-directional amplifiers (BDA's). A BDA is a passive antenna and amplifier device which takes a decent strength radio signal present on the outside of a building, allowing a pathway to get inside the building and be re-radiated inside. Similarly, a BDA takes the moderate to low strength radio signal generated by a walkie-talkie inside a building, allowing it a pathway to get outside and perform as if that walkie-talkie were on the outside of that building. BDAs are "frequency generalists", meaning if a BDA is placed in a building to assist transmissions in the 806 and 851 MHz, range the radio system used by the city or county will also provide a similar assist to any other radio users on any other radio system operating at that same frequency range inside that building. BDAs have been successfully used to permit communications to and from public safety radios in some very hard to cover areas, such as from subway tunnels up to fire trucks at the street level.

Many of our Scott County questionnaire/survey respondents are already participants on a relatively high-tech, relatively new style of shared access radio system called "trunked[1] radio". This system's infrastructure is owned and maintained by a Marshalltown, Iowa company called **Racom**. Their network covers most of Iowa and parts of neighboring states as well. Governmental entities, and some commercial users as well, who choose to subscribe to this system obtain the benefits of statewide (in Iowa) radio coverage from mobile and portable radios on the street. Trunked radio will be discussed in more detail later on. Other survey respondents find their current conventional (meaning not-trunked) radio systems generally meet their needs, but even then some reported their systems as being inadequate. They suffer from channel congestion, interference, and poor signal coverage. Most users are desirous of obtaining advanced features available from newer systems, such as: mobile data terminals, encryption, automatic operator identification, telephone interconnect, "private call" from radio to radio, and related features available in today's trunked radio systems. Most respondents want better portable coverage, including in-building coverage. Most already conduct significant amounts of inter-agency communication and see this as an important communication requirement.

[1] The reader is referred to Appendix 1 of this report for a "Primer" on trunked radio.

COMMENT: When survey respondents report they want better IN-BUILDING COVERAGE, one should not necessarily assume this means 100 percent coverage inside all buildings, as discussed above. Rather, it can often mean a radio system designed to facilitate communications between people inside the building and people outside the building. For example, if a system were built to provide signal only to portables "on the street" (no in-building coverage), that would mean in some (but certainly not all) cases portable users inside a building could not expect to talk to HQ or hear from HQ. But, if the portable radio user inside the building wants and needs to talk to their District Fire Chief at the fire truck outside the building, then it is not necessary that the radio system "blanket" penetrate the building, but it is necessary that an ability be provided to permit a portable radio inside the building to talk direct, radio to radio, to the chief's radio several hundred feet away outside the building.

The general picture of two-way radio users in Scott County is as follows:

- City of Bettendorf:
  - All radio users are subscribers to the Racom operated M/A-COM manufactured 800 MHz EDACS™ trunked radio system.
- Scott County government agencies:
  - All radio users subscribe to the Racom 800 MHz EDACS trunked system.
- MEDIC EMS:
  - Except for paging, all radios are on the Racom 800 EDACS MHz trunked system.
- City of Davenport:
  - All radio users in all departments are on city owned, conventional, (non-trunked) UHF (450 MHz) "wideband"[2] radio channels.
- Fire departments outside of Davenport and Bettendorf:
  - All the "rural" fire departments operate on VHF (150 MHz) wideband conventional (non-trunked) radio channels for tone and voice paging and voice communications to and from their dispatch agency (sheriff's dispatch).
- Police departments outside Davenport and Bettendorf:
  - Are all dispatched by the sheriff's department and operate on the Racom 800 MHz "EDACS" trunked system like the sheriff's department.
- School districts:
  - The Bettendorf school district operates a wideband UHF (453 MHz) radio channel with 22 field radios for their school busses, and uses 110 Nextel cell phone/walkie-talkie units for in-school communications, at an annual cost of nearly $34,000
  - The North Scott School District subscribes its 48 bus radios and two walkie-talkies to an 800 MHz Motorola SmartNet™ trunked radio system offered by Comelec out of Dubuque for which it pays about $9,000 per year in subscription costs. They also have several Nextel devices for use at each school.

[2] The term "wideband" refers to how many kilohertz (KHz) wide a channel is. Historically, radio channels below 512 MHz (UHF and VHF channels) were licensed as 25 KHz wide channels. However, the FCC has mandated that all wideband channels below 512 MHz must be re-licensed *no later than 2013* on channels that are 12.5 KHz wide. In most cases this means replacing the base radio station and the field radios so that they can operate on these "narrowband" channels.

- Davenport schools are subscribers to 800 MHz E.F. Johnson LTR™ trunked radio systems (actually two separate systems) operated by River City Communications. They have about 200 radios, 107 of which are installed in school buses operated under contract by First Student Transportation Services, and the remaining 90 or so are used in various roles throughout the school district. They own these radios and pay $5.00 per month to subscribe each of them to the River City trunked system, or a total of $12,000 per year.

In the preceding descriptions, pains were taken to mention the manufacturers of the 800 MHz trunked radio systems (Motorola, E.F. Johnson, and M/A-COM – **now Tyco Electronics**), as well as their trade names for their 800 MHz trunked radio systems (SmartNet, LTR, and EDACS, respectively). **This is critical,** because all of these systems date back to "pre-standardization" of protocols for trunked radio systems, and, as such, no trunked radio subscribed to any one of these three systems can directly intercommunicate in a trunked mode to any radio subscribed to either of the other two systems.

Furthermore, as these three systems are all operated in the 800 MHz band, they are also incompatible with radios in the UHF band at 450-460 MHz and the VHF band at 150 MHz, meaning there are at least two levels of incompatibility and lack of "interoperability" between many of these radios, as follows:

- Inability to for a trunked radio to talk on or to another brand trunked system or radio due to incompatible trunking protocols.
- Inability for one radio in one frequency band to talk to another radio in another frequency band.

This entire issue of "communications interoperability" (or lack thereof) between and amongst radios used in public safety and broader local and state government functions has become a huge driver in decision making, technology, public policy, and public and grant funding activities relating to communications systems. While local government communications professionals have been aware of these problems for decades, the failures of communications systems and/or their effective usage in such incidents as September 11, 2001 in New York; Hurricane Katrina in New Orleans; the Columbine school shooting in Colorado; the Virginia Tech school shooting; the Beltway Sniper incident in the Nation's Capital; and numerous other cases have raised the awareness of governmental leaders and major interest and impetus (not to mention money) has now been focused on solving these issues. How often has one heard some aspiring politician state in the past few years, "Our first responders still can't talk to each other"?

Communications Interoperability Snapshot

The current state of communications interoperability in and among the tax supported entities in Scott County is as follows:

- All subscribers to the Racom EDACS system can intercommunicate fully with each other, within that system, and with many (perhaps all) other subscribers to the Racom EDACS system elsewhere throughout Iowa and into southern Minnesota and Illinois.

- Where local "interoperability gateways" have been implemented and are effectively operated and/or managed, Racom subscribed radios can talk outside the Racom network (***provided they are still within the coverage area of the Racom network***) through such a "gateway" (also known as "linkers" or sometimes "ACU1000's") over to an otherwise incompatible trunked radio system, or one or more conventional (non-trunked) radio systems, all regardless of frequency band, and presuming the radios on both sides of said gateway are within the coverage areas of their home radio systems.
  - For example, there are two such "linkers" in place that can be used to connect a "talk group" on the Racom EDACS 800 MHz trunked system used by the Sheriff and Bettendorf Police and Fire with police or fire UHF conventional radio channels used by Davenport Police Department or Fire Department, and vice-versa.

- All of the UHF radio channels used in the various Davenport departments *could* be programmed into all of the UHF radios used by those departments, and in some cases may have been. On the other hand, one can imagine there might be situations where agencies like the police department might not want all their radio channels to be available to other than police personnel. Nevertheless, there is complete radio band and protocol compatibility with the city of Davenport, which may or may not have been fully implemented.

- All of the users of VHF radio in the fire service (all the rural fire departments) can communicate directly with each other over several VHF radio channels and to most all other fire services in the Midwest over a set of compatible "mutual aid" radio channels. And, where an "all-service" (meaning not exclusively police or fire) VHF radio channel has been adopted (as it has been in Illinois under IREACH at 155.055 MHz) , these VHF radios could certainly participate in that system.

- The MEDIC EMS Racom radios can fully intercommunicate <u>within the Racom system</u> with all other Racom subscribed radios and via any "linkers" that are installed to inter-connect certain Racom talk groups with certain outside talk groups. Also, to the extent that MEDIC EMS rigs or personnel portables have access to the legacy UHF "Med Channels", they can/could also be used for intercommunication with Davenport UHF radios on these channels, or with the Bettendorf PSAP on those same channels.

- The UHF radios used by Bettendorf school busses can't talk to anybody else in Bettendorf, although they could be accessed by properly programmed Davenport radios, but there's not much need for that.

- The 800 MHz Motorola trunked radios used by North Scott Schools can't talk to any of the other 800 MHz users in Scott County due to either trunking protocol or frequency incompatibility issues.

- The 800 MHz E.F. Johnson trunked radios used by Davenport Schools and First Student Busses can't talk to anybody else's 800 MHz radios due to trunking protocol issues or band incompatibility.

- None of the analog 800 MHz radios in use in Scott County are (today) directly compatible with the new 800 MHz digital trunked radio system being implemented and operated by Motorola for the State Police in Illinois (called Starcom 21), due to trunking protocol differences and analog versus digital incompatibilities.

- Any Racom subscriber in Scott County has full intra-system interoperability with any other Racom user over in Illinois (East Moline, for example).

- Any VHF analog conventional radio in Scott County could have full interoperability with any similar VHF analog conventional radio in Illinois provided they share common radio frequencies such as 155.475 MHz for law enforcement.

- Any UHF analog conventional radio user in Scott County could have full interoperability with any similar UHF conventional radio user in Illinois, provided they shared access to common radio channels, and were both within range a repeater serving said radio channel or they shared a simplex or talk-around UHF channel.

- There is an excellent opportunity for significant radio interoperability between any and all users of 800 MHz (as well as 700 MHz when that arrives), regardless of what trunking system they may be normally operating on.
  - Specifically, the FCC has set aside five discrete 800 MHz radio channels called the "NPSPAC Interoperability Channels". They consist of one "Calling Channel" and four tactical channels that can be deployed as desired in a given area. If some unit of government (or Racom) were to install five repeaters on these channels at either one very high/hot tower spot or geographically throughout the quad city area, and then the owners of any local government 800 MHz radios in the area were to have these five channels programmed into their radios, any or all of these radios could talk directly to each other on these channels. This would not be trunked radio, so incompatible trunking protocols would not matter. This is not digital radio, so non-standard digital protocols would not matter. This is just plain-old conventional analog repeated radio at 800 MHz. GeoComm has seen some very effective and creative implementations of these five repeater channels in several two-state metro areas (St. Louis metro and Kansas City metro) very much like the Quad Cities area.
  - If this were to be done, network cost would be minimal (assuming no more than $15,000 per repeater channel x 5 and subscriber radio programming costs not more than $25 per radio) When finished, this would mean all the North Scott School radios, all the Davenport School radios, (and that would include a total of 155 school busses which could be useful in some mass evacuation movement) all the Racom radios in use throughout Scott County today or in the future, and any and all Illinois side 800 MHz radios either independent or subscribed to Starcom 21 could intercommunicate seamlessly.

- There is no radio to radio interoperability between persons using Nextel devices and persons using standard public safety portable or mobile radios.

- It is also relevant to note the Nextel system is widely available and used by a large cross section of users in any market, and unfortunate experience shows when major incidents (weather disasters, man-made disasters, etc.) occur, shared commercial systems such as Nextel are often overloaded by non-public safety users, rendering them less available or unavailable when needed.
- Theoretically, the same could be said for systems such as Racom's EDACS system, but it would need to be dramatically tempered by an analysis of their subscriber profile (largely public safety), as well as an understanding of the capability within such a system to establish service based access priority as well as partitioning.
  - "Partitioning" means that if at a given tower site on the Racom system there are (for example) ten channels, and six of those ten channels are on frequencies licensed to the county government, then access to those ten channels can be restricted to radios owned or otherwise authorized by the county government. This would mean any potential channel access contention at that site would be "internal to county radios", and not be in competition with any non-county radios attempting to access the other channels at that site. Consequently, if there is contention among county users at a given site, and if partitioning is in play at that site, then that issue is resolvable by adding more partitioned county channels at that site.

In summary, while the current radio systems and their configurations provide a number of opportunities to create interoperability where it may not exist today, too few of them have been fully exploited.

Other Issues and Processes that Need Consideration

In addition to the issue of interoperability, there are several other related and relevant issues to be considered in any such analysis and reflected in any plan that flows from that analysis. Specifically, these are:

- Radio System "Standards Compliance"
  - Its relationship to the availability of federal and/or state funding assistance
- "Narrowbanding" of two-way radio channels below 512 MHz
  - Any cost issues associated with equipment replacement
  - Any system performance degradation flowing from a more narrow channel
  - Any licensing issues associated with obtaining new, narrowband channels
- Digital versus analog communications systems
- "Nextel re-banding" at 800 MHz
  - Any cost issues related to this
  - Any service interruption issues related
- Availability and accessibility of any channels at 700 MHz
- Applicability of 4.9 GHz channels and their impact on high speed data

- Activities planned and under way by the state of Iowa for the Iowa Statewide Interoperable Radio System (ISIRS) and compliance with or consideration of them

Taking these issues in the above order:

Radio System "Standards Compliance":

Early versions (late 1970's to mid 1990's) of trunked radio systems (almost all of which were at 800 MHz) all operated with different trunking protocols and were inherently incompatible with each other. There were three major vendors of such systems (E.F. Johnson, Motorola, and General Electric, which later became Ericsson, which later became M/A-COM which is now becoming Tyco Electronics). All three of these vendor systems are present in significant numbers in Scott County today, with the county and Bettendorf on the Racom Tyco EDACS system, North Scott Schools on the Comelec Motorola SmartNet system, and Davenport Schools on the River City Electronics E.F. Johnson LTR system.

Not only were these systems incompatible with each other, this incompatibility meant the users of said systems had to pay premium dollar for their end user radios, since there could be no competition on end user radios for these "closed architecture" systems. This was very much like older, non-trunked systems like the systems in place in Davenport and with the rural fire departments today. This means you can buy a non-trunked UHF radio to operate on the Davenport Police or Fire channels for as little as $400 each, while one might have to pay upwards of $4,000 to purchase an EDACS 800 MHz trunked radio to operate on the Racom system.

Since the largest group of purchasers for such radios are governmental entities in the United States, these users decided to band together to try and get the manufacturers to stop these practices. This effort was called **APCO Project 25**, (now called just P25) since it was started by APCO, the nation's largest and oldest interest group represent public safety and local government two-way radio users, and since it was their 25th in a series of "special projects" APCO had undertaken. It followed an earlier APCO Project 16, which set forth the minimum user functionality required for a public safety grade trunked radio system.

The concept of P25 was to address two issues:

1. Create standards for trunking system protocols so radios from one vendor could operate on a trunking system infrastructure from another vendor.
2. Create standards for how digital two-way radio in public safety would work. (There is a later discussion on digital in general.)

Now, many years later, the P25 standards have been promulgated and accepted by the electronics industry standards setting body, and P25 systems are seeing significant implementation throughout the United States. Clearly, one of the major reasons for this wide spread and rapid P25 implementation is that many to all federal grant dollars (and there have been billions in grants awarded) has been conditioned on systems that were P25 compliant. The entire federal government is required to always require P25 compliance in everything they buy, when they implement trunking and/or digital systems.

For many years, there was one major vendor who disagreed with the technical outcome of the P25 process. They thought it came up with a less sophisticated and capable technology than they were offering, and in a strictly technical sense, they were probably right. That vendor was today's M/A-COM or Tyco Electronics (the provider of all of the equipment for the Racom EDACS system in widespread use in Iowa), and they refused to manufacture P25 compliant equipment and created havoc for local decision makers trying to sort their way through all the competing claims of the two sides of the argument.

However, in 2006, Tyco decided to jump on the P25 bandwagon and is now delivering radios that will operate in a P25 digital mode on a P25 trunked radio system *and/or* a non-P25 compliant mode on either their proprietary EDACS analog system or their proprietary OpenSky™ digital trunked systems.

Today's environment is that if one chooses to build or operate on a P25 compliant trunked radio system infrastructure at VHF, UHF, 700 or 800 MHz, one can now get competitive procurement bids from four vendors for end user equipment (Motorola, E.F. Johnson, Kenwood, and Tyco.) This means one can now purchase a lower-end (public works standard) P25 compliant, 700/800 MHz digital trunked radio for less than $1,500. And these radios will operate on any P25 compliant 700/800 MHz system for which they are authorized to be programmed, as well as any conventional, non-trunked 700/800 MHz radio channels in either an analog or digital mode. But, importantly, they will *not* operate on the Racom EDACS system, or the E.F. Johnson LTR system, or the Motorola SmartNet legacy systems.

Narrowbanding of Channels Below 512 MHz:

The FCC is under tremendous pressure to come up with more radio frequency "bandwidth" or channels, with the demands for wireless access and wireless broadband access (which requires much "fatter" channels). The problem is the radio spectrum is a finite physical commodity. It only has so many "hertz" to go around. But the FCC knows that new technology is far more precise in radio transmission and receipt than it was in the 1930's when the FCC started allocating and divvying up the spectrum. The FCC now believes it can issue licenses for more narrow channels in the voice radio service up to 512 MHz. In fact, they have a plan to force all licensees under 512 MHz to use channels that are only half as wide (from 25 KHz down to 12.5 KHz) by 2013, and they even have a goal of reducing this channel width by 50 percent again (down to 6.25 KHz wide) as soon as vendors can make radios that will do it.

But this does mean that anyone operating a base station or field radio on one of today's wideband VHF or UHF radio channels will have to get it re-licensed to a narrowband channel not later than 2013, and ensure their radio equipment is "narrowband capable". For example, Davenport has recently purchased some replacement UHF repeaters, which are narrowband capable, but not yet licensed for or operating on narrowband. The same can be said for the Bettendorf Community Schools UHF radio channel. It is unknown, however, how many of the field radios in either environment are also narrowband capable, and they will fall under the same 2013 deadline.

Any UHF or VHF radio equipment purchased today is required by the FCC to be narrowband capable, and backwards compatible with wideband channels, so any natural replacements over then next six years will only tend to increase the overall narrowband compliance of these systems and not likely be a significant burden, as this hardware requirement has been in place for several years now.

There is one other potential issue related to narrowbanding. Radio channels carry electrical energy, and the amount of that energy (signal strength) is somewhat driven by the width of that channel. The narrower the channel the less radiated energy can be fit into that channel. In theory, (and sometimes in practice) if one is operating a radio system on a wideband channel from the top of a given tower site, and just barely covering their jurisdiction with that signal, if one was to change that to a narrowband channel at the same output power from the same tower site, the coverage performance of that channel would be reduced. It is not being said that this would definitely be an issue with any of the VHF or UHF channels in use in Scott County today, as for it to be an issue, the performance of the legacy system would have had to be borderline in some areas where it matters.

Digital versus Analog Communications Systems:

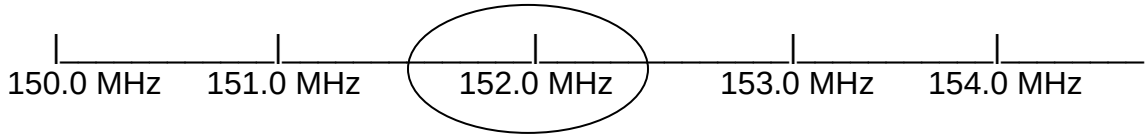
In two-way radio systems today, there are two basic technology directions. They are Digital and Analog. This section of the report will explore the pros and cons of these two technologies.

First, one has to dispel the "way too high tech" aura that often surrounds any discussion of digital. Almost everyone deals with digital every day in many ways. When one says digital, one is *not* referring to digital as in "digital clocks", where the digits display prominently (10:54, for example) as opposed to the hands of a clock pointing at hours and minutes. What one is referring to is the act of a micro chip computer processor in the transmitting radio (Called a VOCODER, which stands for VOICE ENCODER/DECODER) that takes the sounds that are spoken by the person transmitting, analyzes them, and puts them into packets of data (encoding) wherein the sounds are turned into sets of 1's and 0's (digits), and it is then these series of DIGITS that are transmitted through the airwaves. Hence the term DIGITAL. On the receiving end, there is a like computer processor in the receiver radio that hears these packets of DIGITS and is programmed with the same logic in its "de-coder" as in the transmitting radio's encoder. Hence, the encoded digital packet that was sent can be decoded and returned to normal sounds that can be interpreted by the human ear.

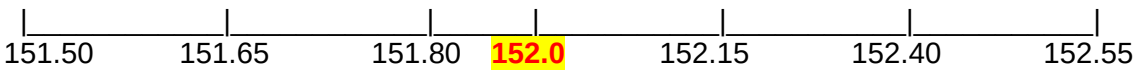
Probably the most common way people deal with digitized speech everyday is in voicemail systems. When you call and receive a voicemail greeting, that greeting is not likely stored as an analog stream of sounds on a piece of audio tape in some cassette. Rather, the owner of that voicemail box has stored their greeting as a digitized packet of data that is stored on a computer chip someplace until you retrieve it by accessing that voice mailbox. Similarly, when you leave a message in that person's voicemail box, your message is digitized and stored in a place in the system's memory where it can be later retrieved by the owner of that voicemail box. As everyone has heard, the quality and clarity of voice reproductions in digitized voicemail systems can be excellent.

But the reason that two-way radio (and just beginning now broadcast radio and TV) have begun to migrate to digital systems are somewhat different than those for voicemail systems. It has primarily to do with what is called “bandwidth”. This over-used term refers to both the frequency response of any given communications pathway or transmission medium, and the “carrying capacity” of said pathway or medium. In two-way radio, the MEDIUM of the transmission is the airwaves or the electromagnetic spectrum. The communications pathways within that medium are the CHANNELS, or the specifically assigned radio frequency licensed by the FCC. The “bandwidth” of these channels is a function of how “wide” a channel is. In other words, if one was to look at the spectrum of electromagnetic radiation as a continuous line, it might look like the line below:

Along that line there would be tic marks indicating specific frequency points:



Now if one zooms in on, blows up, and examines just what is in the circle above, one can see:



At each of the above tic marks is an assignable FREQUENCY. In the case of a “simplex” or non-repeated radio channel, this one frequency makes up this CHANNEL or communications pathway. In the case of a repeated or “half duplex” radio channel (such as one always uses and encounters in the 800 MHz world) a CHANNEL consists of two frequencies, or what is called a “frequency pair.” One channel carries mobile to base communications and the other channel carries base back to mobile communications. *(Note: In 800 MHz systems the two frequencies of a channel are 45 MHz apart, with the low side being at ABOUT 810 MHz in and the high side being at 855 MHz.)*

Referring back to the continuum above, one can see that each channel is 0.15 Megahertz (MHz) away from its adjacent channel. This is called “channel spacing”. 0.15 MHz is also referred to as 150 Kilohertz (KHz). Therefore, it can be said that the above are “150 KHz wide channels”. That is their bandwidth.

The continuum representing the spectrum of usable electromagnetic radiation is much longer than what is depicted above, but it is finite. There is a beginning point at which there is no usable radiation (the soles of your shoes, for example), and an end point where there is too much radiation (an x-ray machine, for example) to be usable in a two-way radio system. Since this is a finite continuum, the width of each assignable frequency within that continuum is what determines how many frequencies one can have to assign or license to users. If every assignable frequency were 1 MHz wide, and the usable spectrum was 1,000 MHz from end to end, then one would have only 1,000 frequencies available for licensing in any one area of the world.

The width of a channel is a function of two different issues. The first is historical and technological. Channel widths were set at their historical size because the manufacturers of radio transmitters and receivers could not achieve perfection early on. In other words, if a transmitter was supposed to transmit on 1000 KC in 1930 (that would be 1000 KHz today, right in the middle of the AM radio dial in your car) wavered between 995 KHz and 1005 KHz, the receiver that was trying to pick up that transmitter's signal had to listen over the range from 995 to 1005 to make sure it picked it up. Hence, the 1000 KHz channel was actually from 995 KHz to 1005 KHz but was "centered on 1000 KHz". This "historical technological slop over" meant that lots of space on the spectrum was lost due to having to compensate for this slop. Having to separate channels by the above 10 KHz (the next ones would be at 990 MHz and 1010 KHz) meant that fewer channels could be licensed, driving up the value of any one license and limiting access to licenses.

The second issue has to do with sound reproduction. A channel that is "wider" (more KHz wide) offers a better FREQUENCY RESPONSE than one that is narrower. This means that a wide channel can carry low and high frequency sounds better. It is for this reason that when FM radio first came out in the 1950's it was home to "classical music" that sounded so much better when transmitted over the wider channels in that band. In the FM band, channels are spaced 0.20 MHz or 200 KHz a part (91.1 to 91.3, for example) as opposed to 0.10 or 100 KHz apart in the AM band. That means they had twice as much bandwidth at FM than at AM. Wider channels meant "bigger bandwidth" which meant better sound reproduction.

All of the above was true when what were being transmitted were analog sound wave forms, where high sounds go higher on the wave form and low sounds go lower on the form.

Enter digital. In digital, there is very little variation between the wave form representing a "1" and the wave form representing a "0", and it is only 1's and 0's that get transmitted. Hence, if one is taking a complex voice transmission consisting of a very high soprano going to a very low basso profundo sound and digitizing it, you are still only ending up with 1's and 0's representing the highest highs and the lowest lows and they can be sent over a relatively narrower channel without significant degradation.

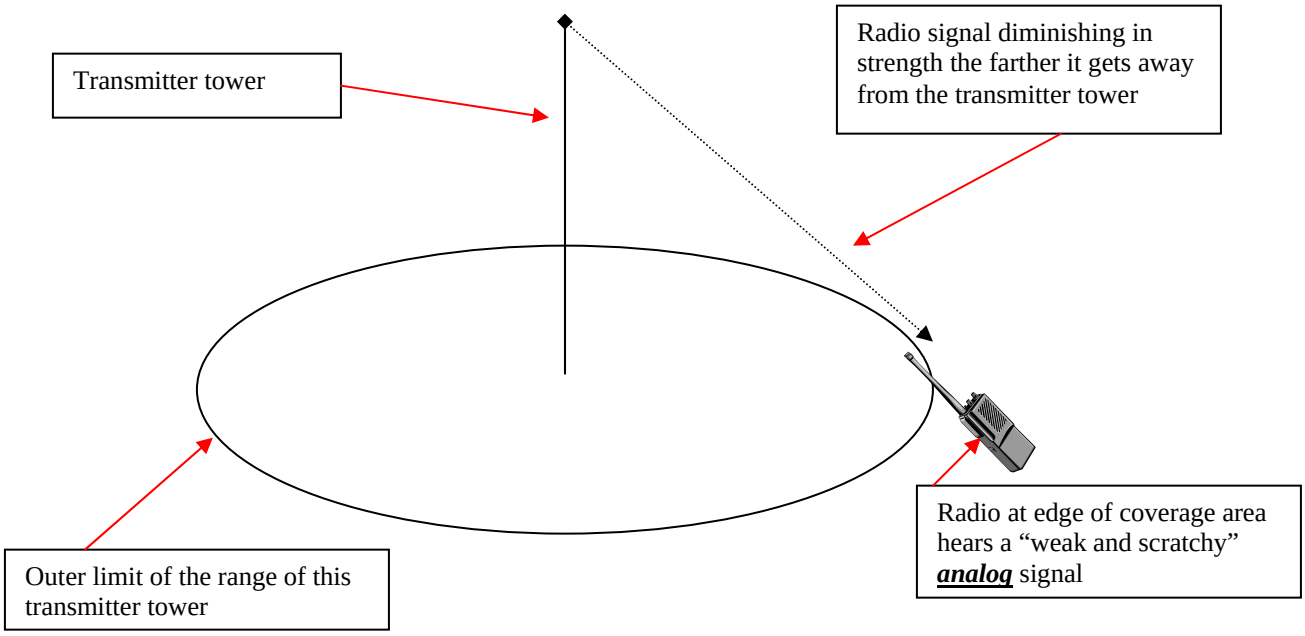
The reason and answer number 1, to the question of "WHY GO DIGITAL?"

Answer #1: Because digital transmissions will permit the employment of frequencies that are narrower; hence, permitting the issuance of more licenses for more (but narrower) channels to accommodate the vastly increased demand.

NOTE: The current (and very slow) migration of broadcast TV stations from their current 6 MHz wide **analog** frequency assignments (at VHF Channels 2-13) to new **digital** frequency assignments is being done primarily to free up the literally thousands of radio frequencies within the current VHF TV spectrum for re-use (the FCC calls it "re-farming") by new and digital users. This means that even more users will be able to be accommodated within the old TV band.

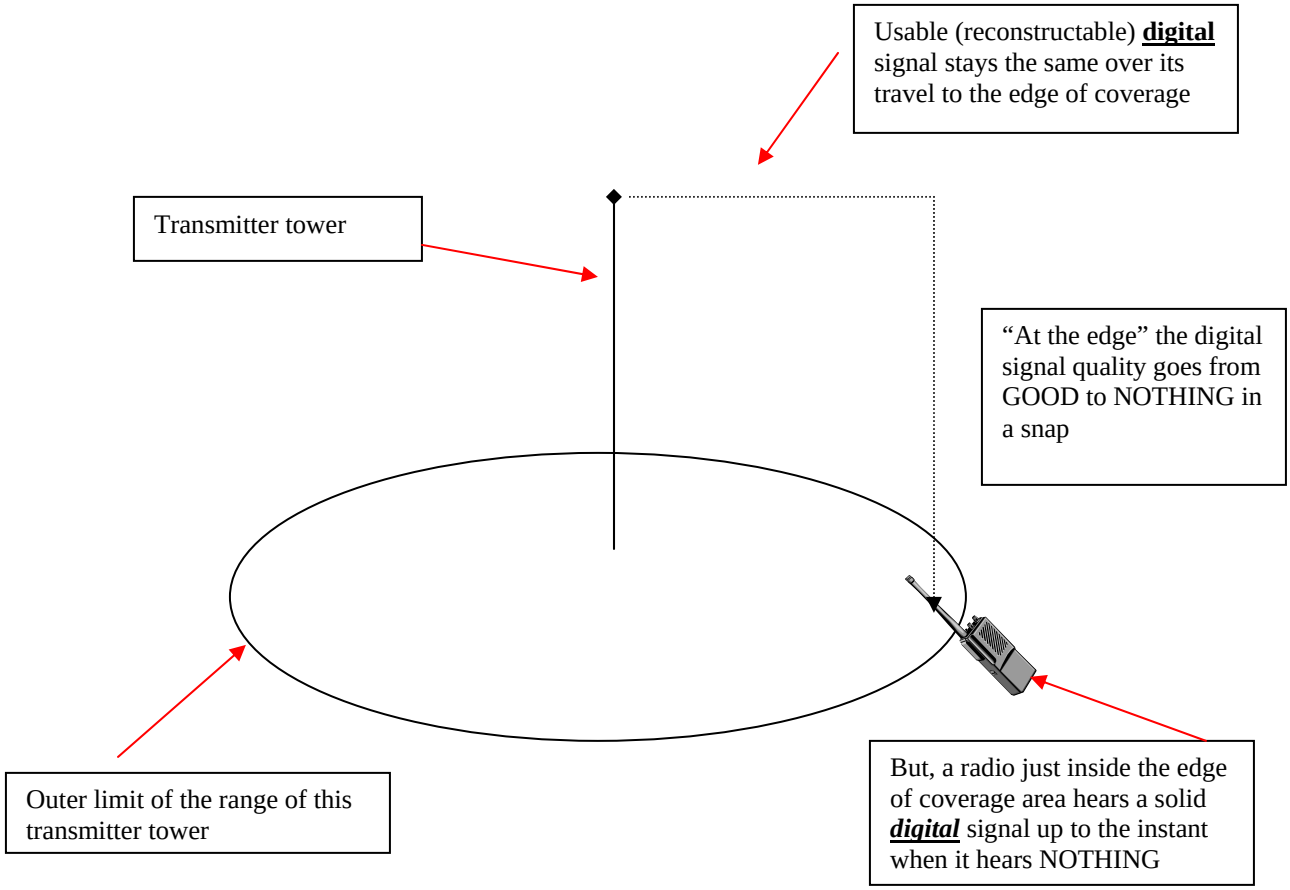
The second main reason for digital is signal quality. Because the signal going through the air is carrying only 1's and 0's in digital systems, if all or a large majority of the 1's and 0's that were transmitted can make it to the receiver, once they are reconstituted into their original analog form for the loudspeaker output, it can sound just like the original input sound at the transmitter end. In fact, digital receivers now employ sophisticated computer driven logic logarithms that can actually compensate for 1's and 0's that might have been lost or garbled en route to the receiver. This is called "error correction logic".

Digital provides better signal quality <u>within the range</u> of a given radio system. This is *not* to say that a digital system provides better or greater range. It *is* to say, however, that over the effective range of a given transmitter, a digital signal will sound better at more places at the extreme outer edge of that range than would an analog signal. Perhaps the following <u>analog</u> diagram will help picture this:



The diagram on the next page depicts how a digital transmission performs. The key here is to understand that the signal stays at its relatively high and usable level throughout its entire trip out to the edge of coverage, but when it gets to that edge, it "falls off a cliff" and cannot carry enough "reconstructable" 1's and 0's to be usable.

This phenomenon (and the condition that immediately precedes "falling off the cliff") have become to be called "going digital" by frequent users of digital cell phones. Many of us have heard the caller's voice become badly garbled, meaning that either not quite enough digits were making it through to be reconstituted into intelligible speech, or the error correction logic was not quite up to the task of "guessing" what sounds the talker was making. On the other hand, it is impressive how good the sound is up until just before the caller "drops off the cliff", so to speak.



Answer #2 to "WHY DIGITAL?" Better signal quality throughout the coverage area of the system than with analog.

The third area of advantage for digital is what is referred to as "embedded signaling". This means the inclusion of pieces of information within the voice transmission that carry intelligence apart from or over and above the words being spoken. For example, with embedded signaling, it is possible for digital voice and data to be occupying the same radio frequency at the same time. It is also possible for a radio serial number to be transmitted at the same time the speaker's voice is being transmitted, or an alarm signal or status signal, etc. This is signaling that is embedded. Such signaling is not only useful for carrying information such as a unit ID; it can also be used for control signaling between the given radio and the system's "head end".

Answer #3 to "WHY DIGITAL?" Opportunity for efficiencies gained via embedded signaling.

A final advantage for digital is its inherent "encryption". Encryption means "coding" as in the sense of "secret coding", so to speak. Spies "encrypt" their secret messages. Simply put, a simple radio receiver listens to the sounds going through the airwaves. If those sounds are analog wave forms, that receiver will pick up and reproduce those analog wave forms and the listener will hear the voice, music, or whatever was being carried by those analog wave forms. Public safety has been vexed for decades by "scanner" users. In some cases, leading citizens scan police frequencies on their radio scanners (radios that sample lots of channels in a short time, not unlike how the "seek" or "scan" button functions on your car's broadcast radio) and have been of assistance to the police as they were "on the lookout for" some suspect for which a description was just broadcast on the police radio. Similarly, the news media depend heavily on police and fire scanners to stay abreast of what is happening in the community.

Unfortunately, the criminal element has also discovered scanners. There are many documented cases of miscreants who run the gamut from the hosts of loud parties to burglars and robbers using what they hear about police patrols or call assignments to interfere with, avoid, or thwart police activity.

An inherent advantage of a digital radio system is that what are transmitted through the air are not analog wave forms that can be picked up by a simple radio receiver or scanner. Rather, what is being transmitted is all those 1's and 0's and the typical analog receiver or scanner that tries to listen in will only hear the "white noise" of those digits going over the air. But, more current (and expensive) scanners are also coming with digital receivers, and providing they know the digital coding scheme being employed by the radio system (many do) they can also (or will soon be able to) listen in as well.

Having said that, it is true that on the day one switches their radio system to a digital system, some people who have been monitoring via scanner will no longer be able to, unless they spend money on a new and higher tech scanner, which some will not do. It is also important to note that some of those who will instantly be "cut off" once you go to digital are folks whom you may want to monitor you. For example, if an Iowa Trooper working the Davenport area has a scanner in his patrol car listening to the Davenport Police Department channel, once the DPD goes digital, until or unless that trooper gets a new digital capable scanner, he'll no longer be monitoring what's happening (local police-wise) in the area through which he is traveling.

Finally, just like it has been possible to add encryption to analog radio systems (often making them digital while encrypted, as in the DES standard) ranging from "voice inversion" *(which made the speaker sound like Donald Duck on a bad day!)* to full digitization, it is also possible to impose additional or higher level encryption to digital radios on a case-by-case and as-needed basis. The principle here is to encode the digital transmission such that the person doing the eavesdropping cannot (without huge supercomputers and bankrolls) possibly crack the code to decode the transmissions.

IMPORTANT NOTE ON COMMUNICATIONS SECURITY: Cell phones and Nextel phones were originally thought to provide improved communications security for law enforcement, simply because they were up at 800 MHz (which many scanners did not cover) and because cell conversations tend to change channels as the callers move from place to place during the communication. Hard learned lessons have shown that analog cell phones are not too secure at all. Further, digital cell phones are only slightly more secure. Yes, the signal is digitized (as in the above discussion) but it is digitized according to an open industry standard. Hence, scanner makers can (and have) made scanners which use this standard to decrypt digital cell phone talk. Newer cell phones like PCS services (Sprint PCS, for example) do not operate at 800 MHz; they operate at 1,900 MHz and are totally digital. This may provide some increased security if the scanners of the "bad guys" don't cover 1,900 MHz (but some do). In the final analysis the only true form of communications encryption is the above referenced Digital Encryption System (DES) overlaid on an already digital system. Not only does this take inherently encrypted (but using an open standard) digital radio signals, but it encrypts them again, using a coding scheme selected at random by the user agency, which no other person monitoring the frequency could know or discern.

Answer #4 to "WHY DIGITAL?" It provides for some inherent encryption and communications security.

There are a number of issues that need to be considered when one implements any level of encryption. Certainly keeping the "bad guys" from listening in on sensitive operations is a valid reason to encrypt. Encrypting the transmission of data that is confidential (patient information on a medical emergency or the ID of a juvenile detainee) is appropriate. But one needs to remember that there are also "good guys" or at least "neutral guys" out there who might want to listen on your radio communications and whom you might want to have that ability.

Examples of the "good guys" would be local police officers and fire personnel at home on their scanners; officers from neighboring and state jurisdictions who listen on scanners to keep abreast of what is happening in Scott County that might impact them or their communities, the news media when reliance on them facilitates rapid public dissemination of warning information, etc. And even the general public, who has been known to hear a BOLO (**B**e **O**n the **L**ook **O**ut) broadcast and within a few minutes they call 9-1-1 and report, *"The party you are looking for is hiding behind a car at the corner of 1st and Main"*.

"Nextel Re-banding at 800 MHz"

For about the past decade, there has been a major problem potentially affecting public safety radio users operating on 800 MHZ channels assigned under the FCC's National Public Safety Planning Commission (NPSPAC) process. These channels tended to be in the 821 and 866 MHz range (none of the channels in any of the Scott County area 800 MHz trunked systems were "NPSPAC channels").

Without going into too much detail, the problem related to Nextel phones/radios and their unique form of operation on the Nextel network on radio channels close or adjacent to the above referenced NPSPAC channels. After much debate, it was agreed and ordered by the FCC that Nextel Corp. would pay 100 percent of the cost (up to $2 billion) to relocate all NPSPAC licensees to other locations on the 800 MHz spectrum away from the harmful interference. This action also involved a general reorganization of the 800 MHz band causing for the relocation in the 800 MHz band of many licensees who were not in the 821 MHz range as well (such as some of the Scott County users).

Where local governments are the licensees (as is the case with Scott County government) on 800 MHz channels, *and* where that local government owns, operates, and maintains their 800 MHz radio system infrastructure, those local governments are required to enter into an often laborious and sometimes contentious negotiation process with Nextel to decide what needs to be done, how much it will all cost, and how much Nextel is willing to pay for said activity. This whole process is mediated by a supposedly neutral third party called "The Transition Administrator," or TA for short, whose say is final.

Fortunately, it is our understanding that since Racom is the operator of the overall system used by the Scott County public safety entities, they are managing and are deeply involved as this is written in these negotiations with Nextel, and assure us that "everything will be taken care of". Clearly millions of dollars worth of work and/or equipment modifications or change-outs will be on the discussion table for the very large Racom 800 MHz EDACS system, and while the Scott County users should definitely be interested in the outcome, if all goes according to the FCC's plan, they should not have to incur any out-of-pocket expenses or uncompensated aggravation as a result of this re-banding process.

Availability and Accessibility of Channels at 700 MHz:

As referenced earlier, the FCC is under almost constant pressure to "find" more radio spectrum, especially for use by "public safety". Congress has even gotten into the act to order them to do so.

This issue has a direct relationship to the television transition to digital TV (DTV). As broadcasters are moving to DTV (don't confuse DTV with HD TV) they are vacating a number of VHF and UHF television channels. Also, UHF TV never saw the demand that was expected of it once cable and satellite TV came along. So the FCC ordered that a number of UHF TV channels up at TV channel 60-69 be vacated and set aside for public safety use. This amounts to a massive amount of spectrum for public safety. It is about 24 MHz of spectrum, and each of today's radio channels is only 12.5 KHz wide, so 24 MHz is hundreds to thousands of discrete radio channels, depending in their ultimate width.

It is also convenient that this new spectrum at 700 MHz is at the high end of 700 MHz (beginning at 764 MHz), which puts it right next to the soon to be re-band public safety 800 MHz spectrum (which actually begins in the high 790 MHz area). This means that radio systems will be able to be built using a mixture of the new, re-banded 800 MHz channels as well as the newly available 700 MHz channels, generally seamlessly. Of course, any field radio that was to try and access a system using a mix of these 700 and 800 MHz channels would have to be both 700 and 800 MHz capable, and that capability has only been around for about two years from some vendors, and won't be around for a few weeks or months from some others. **This means that older 800 MHz trunked radios (like all of the current EDACS radios in use in Scott County) would not be able to access (mean transmit on or listen to) any 700 MHz channels that might be a part of any state of Iowa system or channel expansion to the Racom system to provide more capacity in Scott County.** The same could also be said for the old Motorola and E.F. Johnson radios in use in the Davenport and North Scott schools 800 MHz trunked systems.

GeoComm has had in-depth discussions with state of Iowa radio planners as well as with the CTA consulting firm who is assisting the state on planning for their ISIRS system. It can't be stated for certain at this time, but it seems as if it is a good possibility that any ISIRS system is likely to operate on a mix of 700 and 800 MHz radio channels.

Not unlike in the original NPSPAC planning process under which the NPSPAC 821 MHz channels were allocated on a county geography by county geography basis (not county government entity, per se); the 700 MHz channels will be similarly allocated. In Iowa there is a 700 MHz Regional Planning Commission (RPC) that has undertaken the task of developing for submission to the FCC for approval such a plan for the many, 700 MHz radio channels. This process is very arduous, and can be contentious, as the Iowa Region 15 plan will have to achieve the concurrence of Region 22 in Minnesota, Region 24 in Nebraska, Region 26 in Missouri, Regions 13 in Illinois, Region 45 in Wisconsin, and Region 38 in South Dakota. This RPC is all volunteers from affected and interested agencies. It appears as if they may be in a position to submit their draft plan for regional concurrence around the end of this year. Once that has been done, and ultimately approved by the FCC, then local entities (must be broadly defined public safety) will be able to submit license applications for these channels.

Issues and Opportunities with 700 MHz:

- All must be digital (except for some very low power on-scene interoperability channels).
- All must be P25 compliant digital.
- Some channels *may be set aside* for "channel aggregation" which could allow for some very "fat" channels that would enhance and permit very wideband data and video communications.

Applicability of 4.9 GHz Channels and Their Impact on High Speed Data:

One of the most recent major developments in public safety radio is the FCC's decision to allocate a huge amount of spectrum up at 4.9 Gigahertz (GHz), very high in the spectrum. As a result of being this high a frequency, the applicability of 4.9 GHz to land mobile voice communications is limited. However, one of the attractive attributes of this spectrum is the ability to package and create very broadband channels, through which one can pump high volumes of dense data, ideal for such activities as real time video.

Both Bettendorf and Davenport have applied for and received FCC licensing at 4.9 GHz. The APCO website contains the following statement:

> *"The FCC has allocated a significant amount of spectrum (50 megahertz) at 4.9 MHz for just this type of implementation. There are public safety groups working closely with the manufacturing community, federal interests, and standards bodies to create a "tweaked" 802.11 series standard that includes all of the functionality of Wi-Fi, but operating at a frequency that is exclusive to public safety.*
>
> *The potentials are enormous. Public safety technology usually takes a back seat to the exploding commercial market in the wireless world. This translates to significant cost to public safety because public safety can not provide a market nearly as large as the commercial market. In this case, public safety can take advantage of the development in the commercial market and with very little alteration, make it work in our own field.*
>
> *For those of us in the public safety environment, all of those high tech applications you have heard of and perhaps wished for and have actually seen in the commercial world, may now be within grasp, not only technically, but also financially."*

Public safety agencies can apply for licenses to use the spectrum within their areas of jurisdiction. The rules permit broadband mobile operations, fixed hotspot use, and temporary fixed links. Fixed point-to-point operations are also permitted but this use requires a separate license for each station. Aeronautical uses are generally not allowed. However, public safety agencies that want to use the band with aircraft can request a waiver from the FCC.

The rules prohibit use for services that are made commercially available to the public. Therefore, municipalities cannot use the 4.9 GHz band in mixed-use networks that offer public access.

According to the U.S. government's Public Safety Wireless Network Program (PSWN), the newly allocated spectrum allows public safety agencies "to implement on-scene wireless networks for streaming video, rapid Internet, and database access, and transfers of large files such as maps, building layouts, medical files, and missing person images" and "establish temporary fixed links to support surveillance operations." In short, this spectrum allocation is intended to support exactly the same applications that public safety agencies are running today over metro-scale Wi-Fi mesh networks.

The Potential of the 4.9 GHz Band versus Issues with "Wi-Fi"

Public safety agencies have high hopes for data communications systems in the 4.9 GHz band. The broadband wireless data communications capabilities of Wi-Fi have great attraction to public safety. As APCO notes, "Several agencies around the country are already implementing [Wi-Fi] 'hotspots' to create mobile environment networks to service MDT (Mobile Data Terminal) operations providing the work force with connectivity that previously was limited to the office. Such things as mug shots and video to and from the vehicle become possible." These applications are similar to those being implemented in the Raytheon Quad Cities demonstration project system, which is operating on the 4.9 GHz spectrum licensed to Davenport.

Some public safety agencies are leery of using standard Wi-Fi because of perceived shortcomings. APCO says, *"Agencies need to be very cautious. Wi-Fi as it now exists works in a very, very open environment. There are security concerns (which do have solutions), but worse, Wi-Fi (802.11a, b, and g) work in a frequency band that is unlicensed. That means it is being shared with many other private and commercial Wi-Fi providers as well as garage door openers, cordless phones, and other totally unregulated devices. These devices can provide a significant amount of radio noise in the same RF environment and can be detrimental to a critical resource for a public safety agency."*

The FCC's allocation of spectrum in the 4.9 GHz band to public safety was a direct response to these concerns. While the FCC did not mandate the use of Wi-Fi protocols in the spectrum (and, in fact, they pointedly declined to mandate any access standards), it is widely believed that the equipment used in the 4.9 GHz band will use a slightly modified version of 802.11a. APCO states, "*There are public safety groups working closely with the manufacturing community, federal interests, and standards bodies to create a 'tweaked' 802.11 series standard that includes all of the functionality of Wi-Fi, but operating at a frequency that is exclusive to public safety."*

Public safety agencies believe that running Wi-Fi in the 4.9 GHz band holds great promise for improving the communications capabilities.

Activities Planned and Under way by the State of Iowa for the Iowa Statewide Interoperable Radio System (ISIRS)

While researching issues for this report GeoComm has had consultations with Rich Hester and Les Fish, communications engineers with the Iowa DPS, as well as with consultants from CTA Consulting, who are preparing an ISIRS feasibility study for the state. Several of the main issues with this effort deal with the choices of technology and frequency band. Clearly, the initial design objective of the ISIRS system will be to meet the day to day and extraordinary event radio requirements of state agencies such as the state patrol and DOT. These requirements are somewhat different than those of local public safety agencies, particularly as it relates to radio system coverage and system capacity. In the case of coverage, few state employees require the level of in-building coverage that a local fire fighter, paramedic, or deputy would require handling an event in a building. Similarly, it is rare that there is as heavy a concentration of state radio equipped units in a small area as one might find at a major urban fire or crime situation, all of which impacts on the capacity required of a system designed primarily to support state agency activities.

The state planners and consultants are also aware of the inherent possibilities and benefits of local involvement in the ISIRS system. Going back to our much earlier "blanket" analogies, if the state is going to implement a trunked system blanket covering the entire state, then it would be very wise to consider allowing local entities to either "crawl under that blanket" and enjoy whatever coverage and/or capacity it provides in its initial configuration, or, perhaps, to install added capacity and/or coverage components (more towers and/or more channels) to the already present state infrastructure, making a better system for everyone at a fraction of the cost of acting independently.

For these and other reasons, the Iowa Legislature has had the foresight to create and empower the ISIRS Board, with 15 members (six from state agencies, eight from local public safety agencies and PSAPs, and one from the public at large). This Board will ensure that plans and usage of any forthcoming IRIRS system will reflect local interests and thoroughly explore any potential for local involvement.

As for technology choices, every indication tells us that the state and its consultant study will require that any ISIRS system is "standards compliant", which pretty much means it will be P25 compliant. An open question is whether it would be best to build it in the VHF band (150 MHz) or use currently or newly available 700 and 800 MHz channels. Our sense is that for reasons of technology (too much interference potential on VHF) as well as difficulty in finding enough interference free, compatible for pairing VHF radio channels in a state which is largely VHF from border to border now, the ISIRS system will likely be built at 700/800 MHz.

Such “statewide” 800 MHz trunked systems are no longer new or novel. Nor are many of them truly “statewide” in the sense that “everyone in the state” uses them. Yes, many of them cover the state, and serve most to all agencies of state government, but most of them also have had a hard time encouraging cities and counties to migrate over to their systems in great numbers. It has been our observation that much of this is due to a planning and implementation model that had the state government build the system itself, and then go out to the locals and see if they wanted to join up. This inevitably resulted in the locals feeling that they were not “at the table” from the start. Fortunately, the political and organizational approach being followed in Iowa appears to be avoiding this problem.

It appears premature to predict what sort of construction timetable, funding, and cost sharing models might flow from the ISIRS process, but it would seem as if some logical elements might include:

- State pays for basic infrastructure to support the requirements of state agencies
- Locals could subscribe their radios to said infrastructure if it meets their needs
- Locals could enhance the state infrastructure at their own (locally shared) expense, or in “trade” for bringing something of value to the table that the state might want, such as a good tower site

As it relates to Scott County’s near-term radio future and its relationship with any ISIRS system, it would seem prudent to (ideally) look for P25 compliance in the Scott County radios so as to permit direct interoperability with ISIRS network components, and perhaps ISIRS subscriber radios, should they end up at 700/800 MHz.

Longer term, provided that subscriber radios in use in Scott County public safety agencies were P25 compliant, or were on a path for migration to P25 compliance, the county agencies would then have left open the opportunity to move their radio fleet over to the eventual ISIRS infrastructure, should it offer a better performance, value, functional, or interoperability environment at whatever time it becomes available.

Section 3
Summary of Findings

Introduction

At the outset of this study, GeoComm determined that the main question was:

> *"Is it necessary for the clients to plan to improve the current, or implement new local government radio communications capabilities over the next fifteen years, and if so, which way makes the most sense?"*

By way of background, the Scott County clients are considerably more advanced in both their communications capabilities and interoperability than many counties and urban areas of the United States. In the 1990's there was a plan (which was never fully implemented) that would have had all of the public safety and city/county government radio users in Scott, Bettendorf, and Davenport be on one integrated trunked radio system, and that was to have been the Racom EDACS system.

As GeoComm understands it, the need to spend a lot of money to purchase several hundred 800 MHz trunked subscriber radios (at maybe $4,500 each), as well as some concerns about the wisdom of participating on a trunked radio infrastructure that was shared with non-public safety users and was owned by a private, for profit company caused the city of Davenport to decide to not carry out their initial intention to participate in this plan.

Now, nearly a decade later, actual experience on the Racom system by Bettendorf and the county has reportedly been quite positive.

Therefore, the obvious first alternative to examine was *"Why not just migrate the city of Davenport over to the current Racom system, as configured?"*

But there were many other issues that complicated this examination:

- The current Racom system configuration may not have adequate channel capacity at tower sites that serve Davenport's 65 square miles to meet the capacity needs of Davenport's nearly 600 user radios.
- The current number of Racom tower sites and/or their location configuration may not provide the necessary signal coverage strength to penetrate large buildings in downtown Davenport nor to all corners and areas of Davenport.
- The Racom EDACS system is not P25 compliant, nor are any of the currently used Ericsson or M/A-COM subscriber radios P25 compliant, which would mean that they could not directly participate in or directly access any planned P25 compliant ISIRS system, or the Illinois Starcom 21 system.
- The EDACS subscriber radios in use today are not capable of accessing 700 MHz channels, should they become a part of any ISIRS system.

- The current Davenport UHF radio systems are not yet licensed for narrowband compliance, although it is reasonable to expect that normal equipment replacement by 2013 would ensure their technical equipment compliance.
- The current County Fire VHF radio system is not yet narrowband compliant or licensed, but they too have six years of normal equipment replacement to achieve that objective, and it is reasonable to assume that a significant portion of all of today's fire radios are already narrowband capable.
- There already exists a brand new P25 compliant, digital 700/800 MHz trunked radio system within reach of much of Scott County today (the Motorola owned/Illinois State Police subscribed Starcom 21 system), to which some or all radio users in Scott County could subscribe. This system could even be set up for a Scott County partition on the system, and additional tower sites and channels could be implemented in Scott County to improve its coverage and/or capacity.
- Why not just do more to provide interoperability connectivity between systems and/or radios in Scott County that should be able to interoperate but can't today?
- The state of Iowa is moving fairly quickly down a planning road that appears headed towards some form of "open access" statewide P25 compliant, probably 700/800 MHz trunked radio system, which would serve all state agencies, and could be accessible and/or upgradeable to also serve local entities.

With all of these variables in play, GeoComm approached this project with the bias of favoring one closely integrated two-way radio system to which all local government service providers (including schools, transit, public works, and public utilities) in the county could participate. Our additional biases were that said system should be as fully interoperable with external systems as was possible, and that as many opportunities for future-looking migration to "better options" be kept open as possible.

Another significant area of concentration would need to be the "ownership/usage model" that GeoComm would recommend. There are two very general options, with several sub-options to each. They are:

- **Government owns the system**
  - Historically it was one local government owning its own radio system(s), as is the case in Davenport today.
  - In many places in the United States today, higher level governments (counties, regional councils, or consortiums of counties) have banded together to build and operate a regional trunked radio system to which all units of local government beneath them can subscribe.
    - Hopefully, such systems include a representative Regional Governing Board for said system.
  - In some places, state government has built statewide systems in which units of local or county government are invited to participate.
    - Hopefully, such systems include a representative Statewide Radio Governing Board for said system.

- **A private entity owns the system**
  - As is the case with the Racom system, the commercial entity is free to market participation on the system to a fairly wide range of potential clients, and the system owner ultimately determines the system robustness, redundancy, capabilities, capacities, and technologies, presumably being mindful of what their customer community wants and needs. The system owner (Racom) then negotiates its monthly subscription rate per radio with its customers, and sells said customer as many EDACS radios as they need (no EDACS competitive radio is available) and the relationship begins, subject to cancellation down the road by the customer. The general rate for Racom subscriptions is in the vicinity of $28 per radio per month.
  - As is the case with the Motorola owned and managed Starcom 21 system in Illinois, the system was built to the specifications of the lead customer **(Illinois State Police)** who demanded certain grades of service for capacity, coverage, interconnectivity with legacy systems, and redundancy, in return for which the lead customer (State Police) committed to purchase not fewer than 10,000 subscriber radios from Motorola (giving up the right or opportunity to purchase these radios from P25 compliant competitors) and to subscribe each of these not less than 10,000 radios for not less than seven years. In their business model, Motorola then decided that they needed to charge $53.00 per radio per month to recover their costs incurred in building Starcom 21 to the technical requirements of the State Police. Motorola is also free to market participation in Starcom 21 to other units of government in Illinois (state or local), with the caveat that no added customers on Starcom 21 can cause for the state contract mandated “Grade of Service” to be compromised. For example, if Motorola wanted to sign up the city of Chicago to be Starcom 21 users, they (Motorola or Chicago) would have to add major channel resources to today’s relatively “thin” Starcom 21 infrastructure in Chicago so as to not take away from the State Police’s required Grade of Service. In this example, if Motorola paid to add this infrastructure, it would presumably be reflected in what they would charge Chicago per month. Or, if Chicago paid the one time cost for said infrastructure upgrades, then they would either get the “state monthly rate” or, depending on the value of the upgrades the city provided, they may even get a reduced monthly subscription rate.

With all of the preceding as background, the report will now return to the original 16 points under this effort’s Scope of Services and discuss each of them.

Response to Scope of Service Specifics

1) Perform a Needs Assessment Study and develop a Requirements Definition to meet the radio needs of the Clients and MEDIC EMS's public safety and public service agencies for the next 15 years. The plan shall address specific needs of the police, fire, public utilities, and general government agencies, plus other departments as required.

   GENERAL RESPONSE: In general GeoComm has determined that the best course of action for the clients would be to suggest:

   All radio users in Davenport should migrate over to the Racom network, **pending satisfaction of several stringent caveats**.

   a. That Racom be advised the potential addition of all of the above Davenport subscribers to their system is to be conditioned by Racom agreeing to be contractually bound by all of the terms and conditions set forth below.

   b. That it is mutually understood between Racom and any of the subscriber entities, the monthly subscription fee for a given radio is negotiable based on contributions the subscriber may or may not make to the overall Racom system, including (but not limited to) such elements as space on government owned towers, governmental purchase of any required additional repeaters, towers, or antennas.

   c. That Racom contractually agree to provide not less than P.01 grade of system access to all subscribers in Scott County at all times.
      i. That performance on Grade of Service standard be captured by the EDACS MIS system each month and be provided to the client(s) with each month's bill, and said bill be reduced by a pre-negotiated percentage for each graduated failure below P.01 access levels. (Not more than one busy per 100 "push to talk" channel requests on the busy hour of the busy day of that month.)

   d. That Racom contractually agree to provide a signal strength that meets a technical (not subjective) measurable standard to be negotiated with the city of Davenport that would apply as follows:
      i. In 95 percent of the outdoor land mass within the city limits.
      ii. In 95 percent of all Class 2 construction buildings (standard commercial construction offering a radio signal resistance of -12 dB) at the ground level, inside one wall.
      iii. In 100 percent of all ground level spaces of a selected group of not more than 50 "high value" or "high target" buildings of a level of construction more dense than Class 2, with said list being developed by the Davenport Police and Fire Departments.
         1. Said compliance could be via either native signal strength in the area or via implementation of BDAs, where required.

   e. That specific coverage requirements, not unlike those in point (d.) above be developed for the parts of the county and specific buildings outside Davenport and Bettendorf, and that Racom's contractual agreement be required.

f. That Racom provide to all police, fire, and EMS subscribers to their system in Scott County, at a cost not more than 15 percent higher than their current sales cost for current EDACS subscriber radios, new portable and mobile radios which are:
   i. 700 and 800 MHz capable
   ii. EDACS and P25 capable and enabled for both

g. That Racom contractually agrees to install five NPSPAC interoperability conventional repeater base stations at locations to be negotiated with the county at no cost to the county.

h. That the current Racom users in the county who are police, fire, and EMS would "donate" their old EDACS radios to a "to be distributed" pool and said radios (which would not be 700 MHz capable or P25 compliant) would be distributed to non police, fire, or EMS migratees in the county to the Racom system, and migratee would then presume to pay the monthly Racom subscription fee for said "donated" radio.

i. That Racom contractually agree to a per radio fee for re-programming the existing EDACS radios to add the five NPSPAC interoperability repeater access channels as well as their "talk-around offsets" to all such radios.

j. That Racom propose an optional fee for Racom to reprogram the existing approximately 260 Motorola and E.F. Johnson 800 MHz trunked radios in use by North Scott and Davenport schools to include the five NPSPAC interoperability repeater access channels (at a minimum), as well as their talk-around offsets, if technically possible.

k. That explorations be undertaken to migrate the Bettendorf 22 UHF school bus radios over to either the very economical River City 800 trunked system or the Comelec trunked system used by the North Scott schools, and whatever system they were to migrate to, their subscriber radios would have been re-programmed as in point (j.) above.

l. That Racom agree to mutually developed redundancy and survivability standards for all infrastructure components that affect the clients continued access to and use of the system.

RATIONALE: By implementing the above steps (assuming agreement on conditions and costs can be reached with Racom), the client group would embark on a migration pathway that would result in the following outcomes:

- All radios used in police, fire, and EMS activity in the urban part of the county would operate on the fully integrated Racom system for the maximum in interoperability and capability within that user group across much of the state of Iowa.
- Required standards of coverage and capacity would be implemented and contractually enforceable.
- Interoperability resources would have been implemented to facilitate inclusion of non-integrated radios into the direct 800 MHz interoperability plan for the Quad City area.

- A migration pathway for participation by police, fire, and EMS radios (today) to participate in the current Illinois Starcom 21 systems and any planned P25 ISIRS system would be established.
- A potential migration pathway for the non police, fire, or EMS 800 MHz radios to P25 system participation would be open, pending eventual retirement/replacement of older EDACS-only radios with newer dual mode (EDACS/P25) radios.
- With said P25 subscriber radio compatibility, should the clients ever choose to leave the Racom network to migrate to another participatory network such as ISIRS or Starcom 21, or to build their own P25 local system, they would already have compliant subscriber radios.
    i. *At this point, unless there were to be enough money from sources like federal grant funds to purchase all new EDACS/P25 dual mode radios for the rural fire departments, GeoComm is not recommending the migration of rural fire to the Racom system*. Rather, we recommend keeping rural fire on VHF and implementing the required narrowband migration gradually over the next five years at a relatively minor cost. For each fire department we would also recommend implementation of a multi-site simulcast transmit system for the main fire paging channel so as to dramatically increase the coverage and penetration capability of said system. We anticipate such a system would cost approximately $300,000.

2) Address the FCC re-farming and narrowbanding issues and make recommendations. Analyze a Clients and MEDIC EMS-wide trunked radio system alternative for the Clients and MEDIC EMS's consideration.

GENERAL RESPONSE: We believe these elements have been well covered in the body of the report as well as in the above recommendations.

3) Include a plan for adding a mobile data computer capability either initially or at a later date.

GENERAL RESPONSE: The current state of affairs as it relates to mobile data, in general, is very much in flux. There are two major issues with mobile data for a client group that includes two agencies that serve wide open geographic areas such as rural Scott County. They are:

a. Bandwidth: This is what determines the number of bits of data that can be downloaded or uploaded to any device at a specific place. A perfect analogy for this is the example we have all had with respect to our home computers. In the beginning we didn't have much need for lots of bandwidth, since all we were doing was sending and receiving pure text e-mails. Over dial-up phone lines (due to their bandwidth capacity being designed to carry the human voice only) we got as much as we needed, occasionally up to 48,000 bits per second. Then we started wanting to do web searches and exchange pictures back and forth in or attached to our e-mails.

Dial-up phone lines were no longer enough bandwidth, so we moved to cable or the phone company's Digital Subscriber Line (DSL) service (who continue to battle out bandwidth in millions of dollars worth of ads). Then some of the more aggressive internet users decided that neither of these were enough so they went to dedicated "T1" telephone circuitry, and continued in search for greater bandwidth.

Much of the same situation exists as it relates to wireless access to bandwidth for mobile data, except instead of comparing various wired alternatives for bandwidth, one needs to look at radio frequency and channel alternatives. Years ago, when public safety mobile data was introduced, if one got 1,200 bits of data per second (1.2 kbs) net throughput over a 25 KHz wide UHF radio channel, one was satisfied, and with simple text police data like motor vehicle registrations, was enough. Then people wanted to start sending rudimentary floor plans and longer data items such as long driver's license records out to MDTs and the industry responded with RF modems and compression techniques that could handle up to 9.6 kbs, with a net throughput of around 6 kbs. But that was nowhere fast enough for things like mug shots, mobile web searches, etc. At that point, the availability of public safety dedicated spectrum that contained wide enough channels at a place on the band that would work in a mobile environment became problematic. There just wasn't much or any available. At that time, many public safety agencies migrated over to commercial broadband networks offered as an integrated part of some of the national wireless service carriers such as Sprint, AT&T, or Verizon. For example, the Davenport Police Department recently migrated from a single 800 MHz radio channel using the Racom data network at 9.6 kbs over to AT&T Wireless "air cards" for their in-car laptops, where they are experiencing far higher data rates than their previous system, but are also having to pay a monthly fee to AT&T for said access.

Another technical innovation and migration pathway involved entities trying new and (some would say) more exotic solutions such as "unlicensed, spread spectrum" systems such as the system implemented in Bettendorf (by Racom) using 900 MHz unlicensed channels from a number of "hot spots" around town.

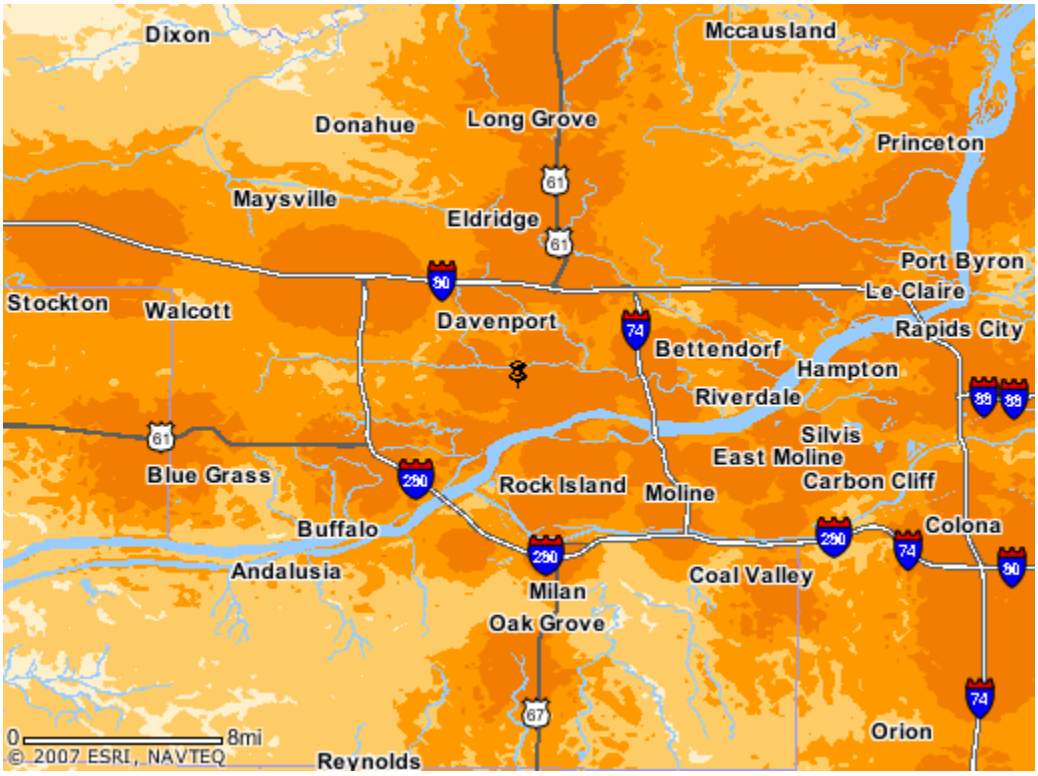
b. Coverage: An issue closely related to bandwidth is one of coverage. Until and unless one has adequate money and adequate control to install as many transmitters/receivers on whatever broadband channel you plan on using in all the places you need to put them to provide the adequate signal strength, not all of the receiving devices will get the bandwidth access and throughout your system may need. With proprietary systems, this can sometimes be done on a city basis (like Bettendorf), provided it is not a huge city. Few counties, especially those like Scott County with lots of sparsely populated rural areas could afford to do what Bettendorf did, as it would cost way too much in infrastructure. On the other hand, if one chose to use the commercial services like Davenport's AT&T Wireless air cards, they also have not spent the requisite money to have solid, wall-to-wall coverage in rural areas either. Yes, they might offer decent coverage along interstate highways, as they use the same towers they use for voice cell service, but if it is a sparsely populated rural area with no freeway, there is probably not much signal strength available for your laptop's air cord, your Blackberry, or even a voice cell call.

It is our opinion *(and industry experts we discussed this mobile data issue with agree with us)* that the technology, political, regulatory, and licensing climate is a little too uncertain right now to commit to a long term plan for integrated, shared, countywide mobile data technology. GeoComm thinks there is some future, possibly, in a 4.9Gz backbone, but we're not sure that will be practical for a countywide environment due to range issues at that place on the spectrum, and the consequent need for more infrastructure to get signals everywhere one would need them. Further, there is some hope in the way 700 MHz will be rolled out, and how the ISIRS system might deploy it that there could be a statewide, 700 MHz, "fat channel" data network sharing tower sites with the ISIRS system, to which agencies could subscribe.

With all of this in mind, GeoComm would suggest that Davenport and Bettendorf continue to do what they are doing, while also paying particular attention to the results of the Raytheon demo system using the 4.9 GHz spectrum licensed to Davenport.

As for the other entities desiring mobile data, GeoComm would suggest some planned experiments using wireless air cards from some of the several providers offering service in the county and try that out until the above matters are settled. By way of examples, below are captured the wireless air card coverage prediction maps from four of the major vendors and are displaying them on the next two pages**. A great deal of caution should be used in accepting these predictions as facts,** and one should definitely try out the service before committing to equipment or subscription, but several of them do look promising. The great advantage is that one does not have to invest in infrastructure, and one's laptop mobile data computer doesn't really care whose air card it is using, as long as it has been registered and set up properly.

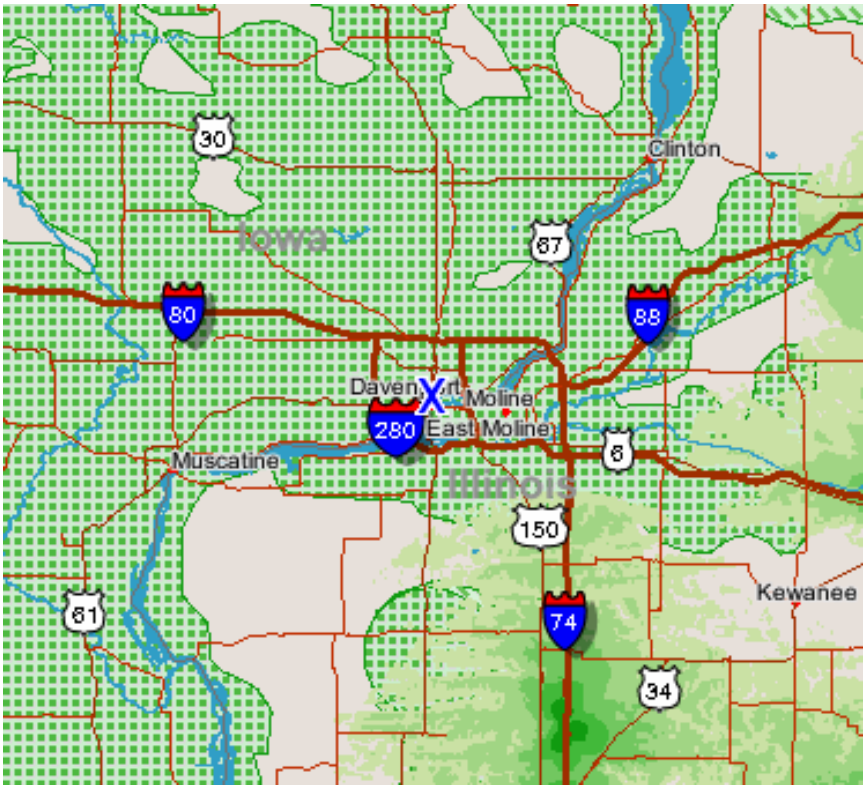
AT&T Wireless Coverage. *Darker is better.*



Sprint Voice and Data Coverage (but *not* their high-speed broadband). *Green is good.*

Verizon Wireless Coverage at the "VCAST and Broadband Level". *Purple is good.*

T-Mobile Coverage – Sometimes Iowa Wireless Roaming. *Hashed green is good.*



4) Identify the specific functional requirements for a state-of-the-art radio communications system for alerting, dispatch, and coordination of both public safety and non-public safety units within the Clients and MEDIC EMS.

GENERAL RESPONSE: GeoComm feels this topic has been well covered in other sections of the report, and we think the feature set of today's EDACS system, with the added functionality of available digital encryption, along with the dual bode (EDACS and P25) and dual band (700 and 800 MHz capabilities) that we called for in the public safety radios meet the requirements.

5) Assess the layout of, and space available in, the communications center(s) and recommend renovations to accommodate new consoles, recording equipment, and ancillary equipment.

GENERAL RESPONSE: As this project and study has unfolded, it has been our sense that the relevance of this issue has diminished. We are aware that Davenport and the county are going to be occupying a new consolidated PSAP, with the possibility that Bettendorf might join at some point in the future. Since we are recommending that the EDACS radio system be retained, and gain even broader use, and since control of the EDACS system and recording things from it will already be necessary elements in the new city-county PSAP, nothing should be required that would not otherwise have been required.

6) Define the present and future radio channel usage and recommend a channel plan. Include all present and potential users in the Clients and MEDIC EMS, plus adjacent jurisdictions. Emphasize requirements for inter-operability and operational coordination with participating agencies and describe how the proposed system will be P-25 compliant. Also, describe how the proposed system would interface with the existing statewide plans for interoperability and addresses the five elements of improved interoperability as outlined in the Office of Homeland Security SAFECOM program.

GENERAL RESPONSE: Since GeoComm has recommended that Davenport migrate to the Racom system, and since it is a trunked radio system, no "channel plan" is necessary or possible, since all channels are used by the trunked system on an automatically allocated basis. However, GeoComm **strongly recommends** serious thought be given to re-thinking the whole "fleet map" that is employed within the Racom EDACS system in use in the county. Simply put, the design of the system's fleet map and what talk groups can do what and which radios they are installed in are the heart of how a trunked radio system works, as well as being the driver behind how that system will be used and how busy it is or can become. For example, if in a ten-channel trunked system there were only four talk groups implemented, that system could handle literally thousands of subscriber radios without ever delivering a busy signal. The reason for this is that with four talkgroups, there are only four theoretical pathways for the thousands of users to talk through, and if all four of those pathways are in use, the SYSTEM ITSELF (the ten channels) are not busy, but the "party lines" (the talk groups) are all in use.

Therefore, since nobody would try and "talk-over" another user on one of the four talk groups, everybody would wait patiently until the chatter stopped on the talk group they were seeking to access, and then they'd try to be the "first in" and talk. On the other hand, if, in that ten-channel trunked system, you had 20 talk groups, then as few as 20 radios could tie up all ten channels (two radios on each of ten talk groups) by talking to each other at the same time.

This points out how important talkgroup configuration can be to how a system is used and, sometimes, overused, and with the addition of Davenport units to the Racom system, and the implementation of the merged PSAP, we would strongly recommend that the current fleet map be re-visited, especially with nearly a decade of trunked radio experience under some of the user's belts. *(Note: MEDIC has recently run into some issues on their radios flowing from – perhaps – too many talk groups too inefficiently deployed and using up the radio's capacity to "remember" talk groups.)*

7) Identify the impacts of Wi-Max on the proposed system.

GENERAL RESPONSE: GeoComm believes this topic was well covered in our extensive discussion of mobile data earlier.

8) Evaluate existing radio equipment to determine its reliability, parts availability, and assess the feasibility of utilizing that equipment to supplement the proposed system. Consider and make use of existing equipment, property, and facilities to the greatest extent possible.

GENERAL RESPONSE: Where possible (such as the North Scott and Davenport school systems) GeoComm has recommended retaining old equipment and modifying it so as to create interoperability capabilities that don't exist today. We advocate a plan whereby the "less capable" current EDACS Racom radios be reallocated to the other than front line police/fire/EMS units and replaced in the front line by the newer dual mode EDACS/P25 radios. We recommend that the existing VHF fire radios be retained, unless money could be found to buy these fire departments new dual mode EDACS radios, but they'd still want and need to retain their VHF radios for mutual aid with neighboring county fire departments. The bulk of the Davenport UHF equipment, to the extent that it is serviceable, narrowband capable, and relatively new, would have some residual value at auction. And, if it meets those criteria, the city could keep one or more UHF repeaters on the air and keep the portable UHF radios available in a cache for emergency situations, with the awareness that they will not intercommunicate with the Racom radios unless through an existing "linker".

9) Analyze alternatives based on Clients and MEDIC EMS-approved criteria.

GENERAL RESPONSE: GeoComm feels that the bulk of the report has done just this.

10) Develop and recommend a course of action that will address the Clients and MEDIC EMS's long-term communications requirements.

GENERAL RESPONSE: GeoComm feels that the bulk of the report has done just this.

11) Prepare preliminary system designs, consisting of major elements of the system, and schematic block diagrams. Include general types of antennas systems, radio stations required, trunking capacity (if applicable), computer and processors required, and the type and quantity of interconnection circuits. Include requirements for floor space, towers, power, HVAC, and other parameters needed to define the site facilities.

GENERAL RESPONSE: Because GeoComm has not chosen to recommend an alternative that would have any of the entities building and owning their own all new radio system(s), nor do we think that is prudent given the significant expense already committed to the Racom system (as well as the user's high level of satisfaction), this is one of those elements of this study that has become less if relevant and is not needed.

12) Define site facilities sufficient to provide budgetary estimates of construction costs.

GENERAL RESPONSE: Same general response as above.

13) Provide cost estimates for implementation of the recommended system change(s).

GENERAL RESPONSE: To begin with, this is somewhat tricky. First of all, many of our recommendations involve serious negotiations with Racom. Simply put, it is our view that it would be *extremely attractive* to Racom and their equipment partner Tyco Electronics to:

A. Retain the current Scott County subscribers in a world where everyone seems to be rushing to P25 systems.

B. Provide for them a demonstration pathway to existing (Starcom 21) and future (ISIRS) P25 systems.

   i. A feature in great need in other places with large legacy non-P25 EDACS systems which are surrounded by newer P25 Motorola trunked systems. Places like Denver, Kansas City, and much of Florida.

C. Add several hundred new subscribers from Davenport (and sell them new dual mode – dual band radios, as well as gain their monthly subscriber fees).

D. Be a showcase in Iowa for how to handle the many legacy Racom EDACS users throughout Iowa while the state is implementing their P25 ISIRS system; and thereby protect their currently large EDACS customer base in Iowa, as well as improving their standing with the ISIRS system planners.

For all of these reasons, GeoComm thinks Racom and Tyco have a great incentive to be aggressive in working with the clients to move this plan forward. For that reason, any mention of pricing in this public document could serve to harm the clients negotiating position with Racom and Tyco. GeoComm will provide verbal comment as to approximate system element costs; but, at this point we think the negotiations should be undertaken with the table wide open. It is our suggestion that a sort of RFP be prepared for Racom to provide an initial response, and then for the serious negotiations flow from that proposal.

14) Perform propagation analysis and preliminary site selection. Produce maps showing predicted radio system coverage. Map scales will be specified by the Clients and MEDIC EMS's Communications Committee using an approved base map.

GENERAL RESPONSE: Given the above discussion and the alternative GeoComm has recommended, this has become unnecessary. Since we are advocating a position that has the clients negotiating a "standards of service and performance" agreement with Racom in order for them to acquire the additional subscriber sales and monthly revenue represented by the addition of the Davenport radios *(perhaps 600 – 700 radios, amounting to as much as a quarter million dollars per year in subscriber fees, not to mention as much as $5 million dollars in new radio sales for the implementation of this whole plan)*, we think it is important to grant Racom the latitude to draft their proposed system enhancements and then scientifically and objectively defend them to the client's satisfaction and based on the client's criteria, as a part of the negotiation process.

15) Provide a written report outlining the needs of the Clients and MEDIC EMS agencies as determined from the above tasks. The report shall include budgetary estimates for a preliminary design and a proposed implementation schedule.

GENERAL RESPONSE: See the above responses. As far as implementation timelines are concerned, with the possible exception of delays brought on by the Nextel re-banding process that Racom is currently negotiating with Nextel, there is no reason that the above referenced RFP and negotiation process could not begin immediately. If said negotiations were successful, and if necessary one time monies were available to the clients, implementation could occur in well under one year.

Further, the GeoComm team (led by Mr. Linnee) would be eager to provide the service of facilitation to these interesting negotiations, and act as the client's agent in developing and articulating the client's desires and demands in this negotiation process. This could be a groundbreaking opportunity to bring true cohesiveness and interoperability to a radio world that has all too long seen two "warring factions".

As an add on to these thoughts, GeoComm also urges the clients to actively consider pursuing some of the up to $1 billion on federal grant funds to be made available yet in 2007 (much of it to local governments) from the NTIA and DHS for projects moving towards implementation of 700 MHz. We see the project as set forth via our recommendations as a good "demonstration project" of how to bridge the heretofore troublesome gap between "islands of EDACS surrounded by seas of P25" that occur in several important places in the United States and GeoComm would be happy to assist in preparation of any grant applications towards that objective. GeoComm has been directly involved in the preparation and award of well over $15 million in DHS and DOJ radio communications grants for interoperability projects and systems in the past three years.

16) Present the report to the Clients and MEDIC EMS's Communications Committee. Additionally, the Consultant may be called upon to make a presentation to the Board of Clients and MEDIC EMS Commissioners.

GENERAL RESPONSE: GeoComm eagerly anticipates this opportunity.

Appendix 1
Trunked Radio Systems

Reprinted from **"Ick! I Hate Technical Stuff"**, © Professional Pride, 1998, By Paul D. Linnee, ENP

One of the latest developments in the two-way radio world is something called TRUNKED RADIO or TRUNKING. For some reason, trunked radio has been a difficult concept for lots of folks to get their hands around. We'll try here to explain the basic concepts of trunked radio in a fashion that (we hope) will make you able to be conversant about a topic that is almost certain to impact your system in the next 10-20 years, if it hasn't already.

First of all, ***trunking in itself, does not necessarily mean 800 MHz.*** The fact is that trunking is a method of efficiently using and re-using several radio channels that could be done (at least in theory) in any of the frequency bands available for land-mobile communications such as VHF, UHF, etc. Yes, you could even use trunking on the 40 good old CB radio channels! However, the reality is that for a trunked system to work properly, it needs at least a handful (usually 5 or more) of relatively adjacent **pairs of radio frequencies**. We say "pairs of radio frequencies" because a trunked system is always "repeated". Repeated means that the talk path goes to and through a device called a REPEATER (much more on this later) and it needs one frequency for the transmissions headed to the repeater and another frequency for the transmissions coming out of the repeater. Therefore, each CHANNEL consists of two FREQUENCIES, one inbound and one outbound from the repeater. So, to repeat (no pun intended), a trunked system needs several pairs of frequencies (channels) and about the only place in the usable spectrum left where you can find relatively clean (free of interference) pairs of frequencies is in the 800 MHz. band, to include the NPSPAC channels, which are located at 821 and 866 MHz respectively. That's why almost all of the trunked systems you'll hear about for the foreseeable future will be at 800 MHz. *(Yes, Virginia, it is true that there are UHF (400 MHz.) trunked systems in use. One place is by the Navy for shipboard trunked radio systems on aircraft carriers).*

Now that we've established that "trunked" doesn't *necessarily* mean 800 MHz, but that almost all trunked systems are 800 MHz trunked systems (have we got you confused, yet?), lets try and get a handle on how trunking works. The best way I've found to understand this is to make a comparison between simple two-way radio (non-trunked) and simple telephone systems. On day one, when Alexander Graham Bell invented telephone, he ran one pair of copper wires from Place A to Place B. Over these two wires he sent voltage which turned into voice at the other end. This is a "talk path". On day two, he ran another pair of wires from Place C to Place D. This is another talk path. If the telephone world would have followed this basic concept, each of us today would have as many pairs of wires running from the phone at our house to as many other different places as we could imagine we would ever want to talk to. This would definitely be lots of wires and a real mess.

Every time we wanted to talk to somebody, we'd have to go into that pile of wire "spaghetti" and find the pair of wires that went to the place we wanted to call and connect them to our phone. Then we'd have to hope that the party we were calling had also found the pair of wires that came from our house and connected them to their phone. If they had, we could send a ring down those wires, they'd pick up and we could talk.

Needless to say, old Alex figured this problem out real fast. What he did was invent "telephone exchanges". That meant that from every house there was just one pair of wires running to a central place. At that central place (you've all seen pictures of old telephone company switchboards and operators), then we'd ring the operator, who would plug into our pair of wires and ask us who we wanted to talk to. We'd tell her (they were always "hers" back then) and then she'd run a "patch cord" from the plug representing our pair of wires to the plug representing the pair of wires that went to the place we were calling. Then she'd put a ring on those wires and the phone would ring at the desired place. If somebody answered, we'd talk. When we were done, we'd hang up and the operator would get an indication of that and remove that patch cord and free up that temporary connection between the two of us.

OK, here's how the analogy works: The first example of a pair of wires running to every place we might want to call is exactly like simple non-trunked two way radio. The only difference is that instead of dealing with wires we are dealing with specific radio frequencies or pairs of frequencies that make up radio channels. Imagine CB radio. If you want to talk to me on CB Channel 14, both you and I have to have CB radios. They must both be turned on. They must both be switched to the same "pair of wires" (channel). Then when you call me, you are the only person who can be talking on Channel 14 at that instant and if I hear you, I answer you. Nobody else in our geographic area (say 10 miles in diameter) can be using that channel at the same time. If they do, we end up in a party line sort of situation, which is what CB is. Now jump to public safety radio. Let's say your agency has a 4 channel radio system with 4 channel radios in all the cars and trucks. If the dispatcher wants to talk to Car 54, the dispatcher must know which channel (pair of wires) Car 54 is tuned to, wait until nobody else is talking on that channel and then call for Car 54. (Old enough to remember ***"Car 54 Where are you?"*** If so, its time to retire!)

You all know what radio scanners are. Imagine you are in TV station's "assignment desk" room in a major metro area. They might have 10 of these scanners mounted on the wall, all humming away. Let's say each scanner has one channel turned on. That means they are monitoring 10 channels continuously (one of each of 10 scanners). Not all the channels are all talking at the same time (usually). Each channel in each scanner is assigned to a different agency in the same unit of government (1 police, one fire, one street dep't. etc.). All of a sudden, there is a big deal going down in Agency #1 and their channel gets real busy. At the same time, however, none of the other 9 channels are busy at all. The folks at Agency 1 are dying. Their channel is all tied up and they are having a hard time getting any air time for all the important things they need to say, while the other nine are dead silent. If only some of the folks from Agency 1 knew that channel 5 (the sanitation department) was dead silent, they could switch to it, if they even had that channel in their radios.

This is what trunked radio is all about.

Let's take the same unit of government and give them a 10 channel trunked radio system. What we do is take all 10 channels and control them by a computer. Then we put all 10 channels in all of the mobile and portable radios of that unit of government. Now, we no longer think in terms of ***"channels"***. Instead, we think of terms of ***"talk paths"***, or in trunked radio language, ***"talk groups"***. A typical assignment of talk groups to a unit of government (a city, for example) might look like this:

Talk Group Designation	***Assigned to***
Police North Patrol	Police
Police South Patrol	Police
Police Tactical	Police
Police Investigative	Police
Police Traffic/Radar	Police
Police surveillance	Police
Police Car to Car	Police
Police Administration	Police
Police Common	Police
Fire Dispatch	Fire
Fire Command	Fire
Fire truck to truck	Fire
Fire Ground Tactical 1	Fire
Fire Ground Tactical 2	Fire
Fire administrative	Fire
Fire Common	Fire
Sanitation 1	Sanitation
Sanitation 2	Sanitation
Park Maintenance	Park
Park Operations	Park
Sewer Mtce. 1	Sewer
Sewer Mtce. 2	Sewer
Street Mtce. 1	Streets
Street Mtce. 2	Streets
Public Works Common	Public Works
City administration 1	City Manager
City administration 2	City Manager
Inspections 1	Building Inspections
Inspections 2	Building Inspections
City Wide Common 1	City wide
City Wide Common 2	City Wide
Statewide VHF Emergency (155.475)	Hard patch to 155.475 (always up)

Each of the radios owned by the separate agencies are programmed to be able to access only the talk groups for their agency, plus some or all of the "common" talk groups (Like city common). That way, you don't have sewer workers listening in on police surveillance activities, etc. So, for a city that used to have only radio 10 channels, we now have 32 separate talk groups.

In reality, in a trunked system, all of the radios are actually remote computers first and radios second. Lets take a look at one simple transmission and see how this all works:

- Police Car 1 wants to talk to Police Car #2. He knows 2 is monitoring the North Patrol Talk Group.
- Police 1 selects (via a knob like a channel selector) North Patrol and calls for #2.
- Police 1's radio (computer) sends a split second command to the central system computer saying:

    - I am Police 1
    - I am authorized to access the North Patrol talk group
    - I want to talk on the North Patrol talk group
    - Please take a channel (pair of frequencies) from your set of 10 stored channels and set it up to support the following communication between me and everyone else on North Patrol.

- The central computer hears all of this and picks one of the 10 channels in its bank (6) and then:
    - Sends a command out to all radios monitoring the North Patrol Talk Group
    - Tells all those radios to tune to channel # 6 from the 10 channels the system has.
    - Sends a signal back to Car 1 which tells car one it is OK to talk. (*)
- Car 1 talks and everyone monitoring the North Patrol Talk Group hears Car 1, especially Car 2.
- Car 2 goes to answer, and the whole process is repeated.

(*) Car 1 isn't actually told that it is OK to talk. In reality, Car 1 always assumes that it is OK to talk unless the computer tells her radio that no channels are available on which to set up a talk path for that talk group at that instant. In that case, Car 1's radio would beep when she pressed the talk button, with the beep indicating that no talk path is available. This is great, because it means that several users will no longer be permitted to talk at the exact same instant (A dispatcher will never again have to say, "Two cars calling, try again!"). Further, no user will think they got through when they didn't actually get through. Another neat side benefit of trunked systems is that (in order to work and be able to identify each user's radio) each radio is assigned its own ID number. This is really just like ANI (Automatic Number Identification) in an E9-1-1 system. It means that every time a radio talks, its ID number can be displayed for the dispatcher and the other receiving radios. That ID number can be listed in a database and can automatically cause for a plain English display to be shown saying not "RADIO 123344", but "CHIEF SMITH" when the Chief talks. This could be the end to those occasionally gross and inappropriate (but unidentified) comments (or other noises) that some of our fine and professional field personnel find it necessary to make now and then. Further, it also creates the ability to establish a "private call" whereby a properly equipped radio (one with a touch tone pad on it like a phone) can "dial up" the radio number of the party she wants to talk to and then establish a private talk path between her and the other party for the duration of that chat. This would seem to be ideal for Supervisors to use to communicate with an errant subordinate or one needing guidance, without risking everyone else hearing the counseling or other advise being given.

A final benefit of trunked systems is that they are, by definition, much harden to listen to from scanners. In a conventional radio system, if two detectives on a surveillance are saying some really juicy stuff, all on one channel all the time, the scanner buff (or bad guy or "newsie") need only lock in that one channel and (provided they are within range) listen to their heart's content. In a plain (non digital) trunked system, that same buff would have to listen to all 10 channels of our 10 channel trunked system all of the time in hopes of picking up snatches of what the two detectives are saying, because every time they are talking, the computer is assigning them a different one of the 10 channels for their talk path. So, in order to hope to hear them, they'd have to monitor all 10. But, in so doing, they'd have to listen to and wade through all of the other talk going on in the system and, by doing this to pick out our detectives, they'd certainly miss much of what the detectives are saying.

In trunked system design, the key is to have enough channels (pairs of frequencies) serving the trunked system users (regardless how many talk groups there may be) so that there are very few, if any, occasions where the user's radio beeps to indicate inability to provide a talk path to that user. It is often the case that the number of channels necessary to support a given agency's communications on a trunked system can be as few as 25% or less than they would need for the same level of communications in a conventional, non-trunked environment. The author is aware of a planned large metro wide trunked system which will support 25,000 end user radios which are now using over 300 conventional VHF, UHF and 800 MHz. channels and it will do it with 96 NPSPAC 821 MHz. channels. Further, through this system, every single user will have coverage throughout the entire 2,500 square mile metro region and have the ability to inter-communicate with any other user from any other agency or type of agency. ***Now that's INTER-OPERABILITY, folks!***

To sum up trunked radio, the technology came into being as a mechanism for getting better efficiency and utilization out of a very limited number of available radio channels in urban areas. In fact, the FCC now requires that any agency that has more than 5 806 MHz. channels must implement a trunked radio system, and all NPSPAC channels will likely be used in trunked systems.

🗁 *SPECIAL NOTE AND CAUTION:*

There are several vendors of trunked radio systems. In the past, these systems were not inclined to be able to talk to each other in a trunked mode. Each vendor used proprietary computer protocols (just like an IBM PC trying to work with an Apple MAC PC) so that (for example) a Motorola trunked radio could not be used in a trunked mode on a (formerly called) Ericsson GE EDACS trunked radio system (then called ComNet Ericsson and now called MA/COM), and vice versa. The same could have been said about the E.F. Johnson “LTR” trunking systems.

Perhaps you have heard of something called ***APCO PROJECT 25*** *(Often shortened to just "P25").* This is a user based standard setting effort which was intended to force the radio manufacturers to make radios that will all work to the same minimum standard of trunking protocols so that a radio from one vendor will, in fact, work on a trunked system from another vendor, in a trunked mode. This is being done for the obvious reason of ensuring greater inter-system inter-operability, but also for the important reason of ensuring that a unit of government that buys Vendor A's trunked system on day one, can gain the advantage of competitive bidding for the end user radios by getting bids from more than one vendor as time goes on.

PROJECT 25 was very controversial and a slow process. Its Phase 1 is virtually complete and several vendors have agreed to and have implemented the protocol standards in it, among them Motorola, M/A-COM and E.F. Johnson. Now, soon to come will be "Phase 2" of P25, with the standards that will accompany it hopefully being committed to "backwards compatibility", so that everyone who bought P25 compliant gear up to now will not have to replace it to be compliant with "P25 Phase 2".

1.2 ANALOG vs. DIGITAL RADIO

This won't be nearly as confusing as you might think. (Now that's good news!). That's not to say that it isn't confusing, but it is to say that we who use radios really need to know only a small portion of this gobbledygook.

Here goes: Radio systems can send out radio waves that are either the noise (usually a speaker's voice) transmitted is the form of ***analog*** waves which look like squiggly but flowing lines on a radar screen, or they can send out ***digital*** series of 1's and 0's (that's zero, not the letter O). Digital stuff is very common in our every day lives. All computer data is digital. All those wonderful voice mail messages we hear are digital. If they weren't, can you imagine all the audio tape those systems would use?

In digital, there's a microprocessor at the transmitting and at the receiving end. The transmitter microprocessor "looks at" all the words sent to it from the talker's microphone. As it looks at those words, it breaks each word down into a series of 1's and 0's (based on what the word sounds like) so that a simple single word might end up looking like this: 10011000111100011011011100 1.

Now the transmitter's microprocessor and the receiver's microprocessor share the same "digital dictionary" so that when the transmitter microprocessor hears the word "STOP" and turns it into "1010101010101", when the receiver microprocessor gets "1010101010101" it can "translate" that into the word "STOP". There are three distinct advantages to digital transmissions:

❶ It takes up less space in the frequency bandwidth to send 1's and 0's (even long series of them) than it takes to send words converted into analog waves. Hence, more digital transmissions can be compressed into a narrow bandwidth space than can analog transmissions. This will eventually permit the FCC (when everyone has gone digital) to slice the usable spectrum into narrower channels than we have today. This means we can get more channels from the same bandwidth than we have today, without them interfering with each other. *(NOTE: Recently, the FCC has resorted to auctioning off frequency bandwidth to commercial users of that bandwidth such as cellular providers, paging companies, etc. These auctions are netting literally billions of dollars for the U.S. Treasury, all of which is earmarked for deficit reduction. So you can see why the FCC and the Feds, in general, would like to get more channels within the finite usable spectrum.... so they can get more money from these auctions. Currently, and likely into the future, public agencies such as public safety are exempt from competing for frequencies at such auctions. Thank goodness for little favors!)*

❷ Digital transmissions are generally of a higher quality throughout all of a given transmitter's range. With analog, the closer the receiver is to the transmitter, the better the radio signal quality. As the receiver gradually gets farther away, the signal gradually deteriorates. You have all heard, ***"Your signal is getting weak and scratchy"*** as the receiver of your signal gets farther away. That's analog. At some distance away the signal gets so weak and scratchy that it can no longer be understood. With digital, the receiver will likely be able to hear 100% of the message at 100% quality within 100% of the coverage area of the transmitter. ***This does <u>not</u> mean that digital signals go farther! It does mean that a digital signal will be of a generally higher quality within the same coverage area than an analog signal.*** It also means that when one begins to get near the outer fringe of a digital transmitter's range, the receiver will "drop off the end of the world" and not be able to hear anything at all any more. All of this is due to the little old 1's and 0's. If the receiver can hear and understand all of the 1's and 0's, it can fully reconstitute them and reproduce the voice from the transmitter, just like the transmitter was next door. To help this, these smart guys have also come up with some called *Error Correction Logarithms* which are capable of taking a set of 1's and 0's which have a few 1's and 0's missing and (using some very heavy duty logic programs) figure out what the missing 1's and 0's *should have been* and insert them.

❸ The last of our advantages for digital is security. Remembering our discussion about how it was harder for a scanner buff to monitor a trunked radio transmission? Well, it was harder but the words (maybe not the words they wanted to hear, but still words) could still be heard clearly over the scanner. With digital, what goes through the air to be picked up by a scanner is no longer words. All the scanner would hear are 1's and 0's, and they simply sound like "white noise" or pure static. The only radio receiver which can takes those 1's and 0's and make any sense out them is one with the same exact logic within it as the transmitters and receivers of the digital system, and the permutations of how many different coding schemes can be used here are mind boggling. *(I remember when digital first came out for two way radio in the late 1970's, Motorola had a commercial that described the total number of digital coding schemes available to be a number as great as the number of grains of sand that would be present if you covered all of Chicago with 10 feet of sand! Now that's a rather large number in anyone's book.)*

So, not only has trunking made it harder for scanner buffs to hear, by "going digital" we've made it darn near impossible. This may sound neat, but it does have its downside too. For example, assume your agency has installed a digital system, and the cops in your neighboring jurisdictions have scanners in their cars over which they have always monitored you folks. It has worked out well many times when they heard that chase coming their way and so forth. Well, forget that plan! Their scanners are no smarter than the average scanner buff's so all they will hear is your pretty white noise. Further, it's a good guess that your local major "newsies" will not be at all thrilled when they discover they can't listen to the local cops or fire fighters any more. We've heard of several cases where both trunked and/or digital systems have been installed and the installing agency had to make an arrangement with the local news organizations to let the newsies have a receiver only radio that was a part of that trunked and/or digital system so they could listen to, at least, the main operational and dispatch channels or talk groups.

The final issue on digital is that it is not unique to trunked radio. True, we're beginning to see more and more digital trunked systems, but one can use digital transmission on any type of system at any frequency band. Cops have been doing digital UHF and VHF for years, especially in their "scrambled" narcotics and other special channels.

So, now you know all about "trunked radio". At least all you need to know at this point. Sometimes it is in the trunk. Sometimes it isn't, but even when it isn't, it is trunked.

Appendix 2
Data Collection Instrument

Scott County Local Government and MEDIC EMS Voice and Data Communications
2007 Needs Analysis and Requirements Definition Project

Communications Infrastructure and Usage Survey _____

Introduction: The purpose of this survey document is to gather as much information as possible regarding the degree to which voice, data, and remote control communications is conducted today by units of local government[1] in Scott County and the MEDIC EMS service, and the circuits or pathways over which that activity is conducted. For example, if a community has a sewage lift station, and that lift station has the ability to be remotely turned on and off, if that remote turning on and off is done via a leased telephone line to that lift station, then that is "data or control communications" between two points and should be counted in this survey. Similarly, if that sewage lift station is remotely activated via a radio link (called a SCADA system) instead of a leased phone line, then it should also be counted.

In general, the aim of this survey is to quantify the number of such communications pathways in existence and the money that is being spent on this type of communications today, and the type of activities that are being performed via these communications links and systems, so as to determine whether or not performing these functions as a part of a new countywide voice/data/control radio system is a cost effective alternative.

It is also a purpose of this survey to try to develop a picture of what potential new usage a new radio based communications network might get if it were readily available and affordable. In other words, are there things that are either not being done today, or are being done inefficiently, that could be done better if there were an affordable and reliable communications system and pathway?

As you work on this survey, if questions arise as to whether or not a given activity or type of communications pathway should be included, don't hesitate to contact the county's consultant on this project, **Paul Linnee, at 612-483-5778** or via e-mail at **paull911@aol.com.**

Thank you for your cooperation on this project and we'd appreciate having the completed surveys returned to the name and address listed below by **no later than March 15, 2007.** Return surveys to:

Paul D. Linnee
GeoComm Corp.
5800 Park Avenue
Minneapolis, MN 55417
Or fax to 612-235-6770

[1] By the term "LOCAL GOVERNMENT" we mean cities, the county, special purpose districts (school, water, fire, transit, etc.), and all other "tax supported entities" that provide public safety or other public services at the local level.

Appendix 3
Scott County Voice and Data Radio Upgrade Survey

Items in Red with Yellow Highlight are Response Totals Where Numerical

1. Name of unit of government/organization responding:

2. Department of that unit of government/organization:

3. Person completing the survey

4. Telephone/e-mail for this person:

5. General functions performed this department:

6. Does the agency/unit you are responding for have:

   A. Any cellular or Nextel telephones? _____Yes _____No

   If **yes**, how many: **TOTAL REPORTED: 378**

   If **yes**, average total monthly bill for these phones: **$10,773 or $129,726 per year.**

   If **yes**, is it your opinion that the business matters handled via cell phone could be handled as well or better using a "walkie-talkie" type radio or a vehicle mounted two-way radio which provided moderate communications security?

   _____Yes _____No

   Comments: **THE VAST MAJORITY OF RESPONDENTS TO THIS QUESTION SAID NO.**

B. Any two way radios that you lease from a commercial provider (*we're just asking about the equipment here, not the service or any subscription fees*)? If so, how many, of what type, from whom, and for how much money? (Please explain on an attached sheet)

_____ Yes (See attachment) _____ No **ALL SAID NO**

C. Any two-way radios that are subscribed to a commercial service (and you either OWN or LEASE the radios themselves) such as Racom? If so, how many (portables versus mobiles), from whom, and how much to you pay? (Please attached an explanatory sheet.)

_____ Yes (See attachment) _____ No

RESPONSES: Over 300 mobiles and 500 portables

7. Does the agency you are responding for have any systems, equipment, devices, or similar electronic or mechanical equipment at remote locations **which you are either monitoring or controlling today** via microwave, leased telephone line, conventional two-way radio, or dial-up phone lines?
_____ Yes _____No

If **YES**, please describe and provide the quantity of such systems, how they are being controlled or monitored and an average of the monthly charges (if any) for the communications media you are using below and on the next page. **ALSO, please provide any diagrams (rough hand drawn ones are OK) you may have which depict general circuit paths, etc.** If **NO**, please indicate whether there are any such needs that you think could be met via radio control and specify what those needs might be.

_____

_____

_____

_____

_____

8. **Does your agency have an FCC licensed two-way radio system in place today that your agency is the licensee on?** *(Do not include systems such as the sheriff's radio system if you are dispatched by the sheriff, as that system will be counted in the sheriff's survey. Only include those your agency holds the FCC license for.)*

_____Yes _____No

If **YES**, please tell us as much as you can about said system like the FCC licensed "Call sign" for the system, what frequencies, how many hand-held portable and vehicle mounted mobile radios you have, their approximate ages, etc. in the space below. ***If YES, please attach copies of the relevant FCC license forms to your response.***

9. If **NO** to item 8 (meaning you don't have a two way radio system today) please tell us if you feel that the operations of your unit/agency could be more efficient and/or effective if the employees had access to a two-way radio system via which they could conduct relatively private conversations among their own work group (and with other dissimilar work groups inside or outside your unit of government) and/or send and receive data. *(Which would generally be text at this time, but could eventually be photos, forms, etc.)*

_____ YES, we could be more efficient/effective.

_____ NO

If **YES to item 9**, please indicate about how many such radio devices you would like to see your unit have in order to achieve the efficiency and effectiveness you envisioned:

___**1,137**____ Number of hand-held portable radios

___**659**_____ Number of vehicle mount mobile radios

___**39**_____ Number of hand held "mobile data" units

___**147**_____ Number of vehicle mount "mobile data" units.

10. **Now we would like to get your views on what is generally called "Inter-operability".** When applied to voice communications, in its simplest form, this means the ability to talk from one radio to another radio. *For the purposes of this project, we are taking it as a "given" that you would want one radio within your organization to be able to talk to another radio within your organization*. Beyond that, what we are trying to assess is the degree to which it would be important for one radio within your organization to talk to another radio from outside your organization. For the purposes of this question, please assume that by ORGANIZATION we mean DEPARTMENT or DIVISION of your unit of government. For example, what we are asking is ***"How valuable would it be for a radio in one of your sewer department trucks or crews to be able to talk to a radio in your police department?"*** Or, ***"How important would it be for a radio in one of your street department trucks to be able to talk to (for example only) a radio in an Iowa DOT truck?***"

    Also, as a part of responding to this question, if your agency has any documents, SOPs or processes for how "inter-agency" type communications should be conducted, please tell us and provide copies, if possible. Similarly, if you have any written agreements regarding the shared use of any radio channels between two or more agencies (inside or outside of Scott County), we would also like to see copies of them. With the above examples in mind, and thinking of usually "other than routine day to day operations" and more of "special events" or disaster or emergency situations, please answer the following questions using the scale of "1" is not important to "4" being very important:

    A: Interoperability with other departments in my unit of government could be:
    AVG: 3.08

    1 2 3 4

    B. Interoperability with other departments in <u>other units of government</u> could be:
    AVG:2.68

    1 2 3 4

11. **Now we need to understand your communications coverage requirements**. By "communications coverage" we mean over how wide an area, and inside of what sort of structures do you or would you need reliable two-way radio coverage.

    Using the same 1-4 scale as was used above (1 being not important to 4 being very important), please reply to the following:

    A: We need to have solid radio signal <u>outdoors</u> throughout our entire service area known as _____(name of area) **MOST SAID BI-STATE WIDE/AVG: 3.75**

    1 2 3 4

B: We need to have solid radio coverage outdoors **AND** inside a vehicle **without** an antenna outside (such as a hand-held walkie-talkie being used by somebody riding on a school bus) throughout our entire service area. **AVERAGE: 3.27**

1 2 3 4

C: We regularly need to have solid radio coverage outdoors from areas outside our service area but within Scott County. Example: A Street department truck going to another community to get a load of blacktop. **AVERAGE: 3.0**

1 2 3 4

D. We regularly need to have solid radio coverage from our base to field radio units which are outdoors, when they are in places **outside of Scott County** to as far away as: **MOST SAID BI-STATE AREA WIDE/ AVERAGE: 2.67.**

1 2 3 4

E. We regularly need to have solid radio coverage **INSIDE** standard construction buildings (within our service area) at the ground level and above. **AVERAGE: 3.44**

1 2 3 4

F: We regularly need to have solid radio coverage **INSIDE** standard construction buildings, but from down in the basement of such buildings. **AVERAGE: 2.97**

1 2 3 4

G: We have a specific need for solid radio coverage **INSIDE** a special (heavy) construction building(s) at the ground level or below: *(Please indicate which specific structure(s) you are referring to)*: **AVERAGE: 3.10**

1 2 3 4

SPECIFIC STRUCTURE(S): **many specific buildings Listed)**

H: We have a need for two or more of our vehicles or personnel to be able to talk to each other over the radio when both (or more) of these vehicles are significant distances away from Scott County. (Example: Two vehicles with our staff in them drive to Waterloo, and once in Waterloo, they need to talk to each other). **AVERAGE: 1.81**

1 2 3 4

12. **Now we'd like to assess your views on "communications security".** By this we mean the ability to conduct your radio voice or data communications with a strong certainty that nobody else can **practically** intercept and eavesdrop on your communications. For example, CB radio would be totally un-secure. If you are talking on CB channel 18, anybody within two miles who tunes into channel 18 can hear you. Or, if you are talking on the main Davenport Police dispatch channel today, anybody located anywhere in the Quad Cities area with a $49 scanner can usually hear you.

    Using the previous 1-4 scale, with 1 being unimportant and 4 being very important, please respond to the following statements:

    A: We require a voice communications system which is totally secure and not practically capable of being monitored by anyone. **AVERAGE: 2.45**

    1 2 3 4

    B. We require a voice communications system which is moderately secure from casual eavesdropping, but we have no additional security requirements. **AVERAGE: 2.29**

    1 2 3 4

    C: We require a voice communications system which is moderately secure, but we also require access to a special higher level of security at certain times under certain conditions. **AVERAGE: 2.55**

    1 2 3 4

    D: We require a voice communications system which permits our citizens and the news media to monitor our daily activity, except for specialized highly sensitive activities which we would conduct via some other media. **AVERAGE: 1.64**

    1 2 3 4

13. **Finally, we'd like to better understand your data communications needs.** Please respond as indicated to the following items:

    A: If an appropriate radio system were in place which would support mobile data communications (laptop PC in a vehicle accessing files or networks back at some fixed facility), we would likely take advantage of if.

    _____ True _____False _____Not sure yet

    If TRUE, how many such mobile data devices would you think you would <u>eventually</u> want to deploy? **266**

B. If YES, please describe what sorts of data communications you would envision performing via such devices?

C. Do you envision a current or eventual need (as opposed to a "want") do have your data communications include pictures, diagrams, etc. (anything other than straight text)?

_____Yes _____No _____Not sure yet

D. If YES, please tell us (in general) what these needs for other than straight text data communications would be (police and fire can skip this as we are well aware of those needs):

14. **Paging System Issues:**

A: Does your agency use radio based pagers? ___Yes ___ No

B: Do these pagers (check all that apply):

_____ Display a text/numeric message for the recipient

_____ Only make a noise to indicate I should do something.

_____ Make noise and report a voice message to me.

_____ Permit me to respond by typing a response on a keyboard.

C: What radio channel are these pagers activated over (if you know)?

_____

D: Who activates the pager and/or puts in the text message?

_____

E: Please describe the outer limits of the geographical area in which your public position requires that your pager be activated indoors. (Example: My fire pager must go off inside all buildings in the entire county – except for the _____)

_____

F: Please specifically describe any and all issues you have regarding the performance of your pager.

_____

_____

G: How many pagers (either owned or rented) do your agency currently use?

Owned **291** Rented **0**

15. **Ownership and control of systems**

A. Do you think that your specific local government or EMS agency would or should require that any radio system you would use be owned, managed and controlled by your unit of government, (as opposed to shared governmental control or participation in a commercial service)?

4 Yes (Opinion below please) **11** No **23** No Opinion

B. If you answered NO to the above *(meaning NO, you don't think your local government should REQUIRE that IT own a system)* do you think your unit of government should consider participating in a multi-agency, shared control radio system?

11 Yes (Opinion below please) **0** No

C. If you answered No to 15A above, do you think your unit of government should consider participating in a shared access, commercial system not owned by local government?

4 Yes (Opinion below please) **5** No **2** No Opinion

Conclusion: In the space below, and on as many additional sheets as you would like, please add any comments or views you may have on the concept and process of upgrading the local governmental voice, data, and remote control radio communications systems in place in and serving local government in Scott County.

THANK YOU FOR YOUR ASSISTANCE!

FCC Universal Licensing System Search

FRN like **2567428** **City of Bettendorf, Iowa as licensee**

Matches **1**- **14**

Call Sign	Name	Radio Service	Status	Expiration Date	Frequencies licensed	Purpose for which this frequency is used
KAP250	BETTENDORF, CITY OF	PW	Active	08/16/2014	155.805 base and mobile wide band VHF	Fire dispatch paging
KD39565	BETTENDORF, CITY OF	PW	Active	02/10/2014	453.4375 low power (2 watt) UHF mobile	Storm siren activation
KFK692	BETTENDORF, CITY OF	PW	Active	03/03/2014	154.220 wide band VHF base and mobile	County fire VHF channel
KJ7860	BETTENDORF, CITY OF	RS	Active	04/05/2014	10525.00 MHz purpose unknown	Police radar units
WNKB402	BETTENDORF, CITY OF	PW	Active	10/22/2012	460.450 wide band UHF repeater channel	Police operations Ch 1 (legacy)
WNKB418	BETTENDORF, CITY OF	PW	Active	10/14/2012	453.100 wide band UHF repeater channel	Storm sirens
WNMX668	BETTENDORF, CITY OF	PW	Active	10/27/2013	154.40 wide band VHF	County fire repeater input
WPBC824	BETTENDORF, CITY OF	PW	Active	11/17/2012	154.220; 154.280, 154.40 wide band VHF	County fire and mutual aid
WPLR920	BETTENDORF, CITY OF	PW	Active	12/30/2012	Ten wide band UHF **mobile only** repeater channels @ 462.95; 462.975; 463.0; 463.025; 463.05; 463.075; 463.1; 463.125; 463.150; 463.175 MHz *(add 5 MHz for "high side" of each channel)*	Med Channels for access to/from ambulances
WQAB412	BETTENDORF, CITY OF	PA	Active	04/28/2014	4.9 Gigahertz new license for wideband data application	Not yet in operation

FCC Universal Licensing System Search

FRN like **4765608** **Licensee = City of Davenport**

Matches **1**- **9** (of **9**)

Call Sign	Name	FRN	Radio Service	Status	Expiration Date	Frequencies licensed	Purpose for which this frequency is used
KB48616	DAVENPORT, CITY OF	0004765608	PW	Active	01/05/2014	Wide band 154.94 mobile only, low power	Art museum
KB80669	DAVENPORT (RIVER CENTER)	0004765608	IG	Active	02/25/2011	UHF 463.6625 (splinter) low power only	Event mgmt/shows @ River Center
KK2763	DAVENPORT, CITY OF	0004765608	PW	Active	06/28/2015	UHF 460.325 (wide band) mobile only	Low power short range police talk-around
KNR2	DAVENPORT, CITY OF	0004765608	AF	Active	08/17/2009	Aircraft band 123 MHz A.M.	Davenport Airport UNICOM channel
KRZ749	DAVENPORT, CITY OF	0004765608	PW	Active	01/04/2014	UHF (wide-band) repeater @ 453.225 MHz	City Transit (“Citibus”)
WNJU503	DAVENPORT, CITY OF	0004765608	GP	Active	09/01/2012	809.9625 MHz repeater channel	Old police mobile data channel, being retired
WNYJ396	DAVENPORT, CITY OF	0004765608	PW	Active	04/26/2013	Two UHF wide band channels @ 453.150 and 453.525 MHz (add 5 MHz for high side)	Public works, various units
WPFI966	DAVENPORT (RIVER CENTER)	0004765608	PW	Active	07/22/2014	Two mobile only UHF splinter channels @ 453.1125 and 458.1125 MHz.	River Center event management
WQEA345	City of Davenport, Iowa	0004765608	PA	Active	12/13/2015	**4.9 Gigahertz new application**	Raytheon is current user for wideband data testing
WPLM301	DAVENPORT, CITY OF	0002285336	PW	Active	09/01/2013	Ten wide band UHF **mobile only** repeater channels @ 462.95; 462.975; 463.0; 463.025; 463.05; 463.075; 463.1; 463.125; 463.150; 463.175 MHz *(add 5 MHz for “high side” of each channel)*	Medical control (hospital and ambulance) channels
KAH280	DAVENPORT, CITY OF	0004765582	PW	Active	09/19/2015	One wide band UHF repeater @ 460.575 MHz	Fire: #1 Repeater
KNAB417,	DAVENPORT, CITY OF	0004765582	PW	Active	09/19/2015	One wide band UHF repeater @ 460.600 MHz	Fire: #2 Repeater
KNAB418 , 19, 20, 21, and 23, + KV9731	DAVENPORT, CITY OF	0004765582	PW	Active	09/19/2015	More 460.575 and 460.600 licenses	Fire: 6.1 meter low power RF control stations
KTA976	DAVENPORT, CITY OF	0004765590	PW	Active	08/03/2013	155.370 (Pt to Pt); 460.125 & 460.275	Police: Point to Point + 2 Police channels
WPPX998	DAVENPORT, CITY OF	00012434213	PW	Active	03/08/2015	170.250 MHz wide band VHF	Engineering: Survey equipment
WPPY315	DAVENPORT, CITY OF	00012434213	PW	Active	03/10/2015	17-/250 MHz wide band VHF	Engineering: Survey equipment

FCC Universal Licensing System Search

FRN like **2582450** **Davenport Hospital Ambulance Corp. (Medic EMS)**

Matches **1**- **2** (of **2**)

Call Sign	Name	FRN	Radio Service	Status	Expiration Date	Frequencies licensed	Purpose for which this frequency is used
PPWNLB522	DAVENPORT HOSPITAL AMBULANCE CORPORATION	0002582450	PW	Active	03/15/2013	One UHF wide band base station @ 453.175 MHz.	Business channel
WPBQ696	DAVENPORT HOSPITAL AMBULANCE CORP	0002582450	PW	Active	02/10/2013	Nine wide band UHF base repeater and mobile licenses @ 462.95; 463.0; 463.025; 463.05; 463.075; 463.1; 463.125; 463.150; and 463.175 MHz *(add 5 MHz for "high side")*	Medic control channels

FCC Universal Licensing System Search

FRN like **2566263** **(Scott County, Iowa as licensee)**

Call Sign	Name	Radio Service	Status	Expiration Date	Frequencies licensed	Purpose for which this frequency is used
KNGG526	SCOTT, COUNTY OF	PW	Active	09/03/2013	154.22, 154.28, 159.27 (All wide band VHF)	Fire dispatch channels
KUO255	SCOTT, COUNTY OF	PW	Active	10/31/2014	155.70, 155.475, 155.58, 156.21 (all wide band VHF)	
WNEJ965	SCOTT, COUNTY OF	MW	Active	10/30/2011	Microwave hop	
WNEJ966	SCOTT, COUNTY OF	MW	Active	10/30/2011	Microwave hop	
WNEJ967	SCOTT, COUNTY OF	MW	Active	11/08/2010	Microwave hop	
WNEJ968	SCOTT, COUNTY OF	MW	Active	11/08/2010	Microwave hop	
WNEJ969	SCOTT, COUNTY OF	MW	Active	11/08/2010	Microwave hop	
WPPF854	SCOTT, COUNTY OF	YP	Active	12/02/2014	Twenty 800 MHz frequency pairs making up 20 channels @ 809.9875; 810.2375; 810.4625; 811.9625; 812.2625 812.9625; 813.2625; 813.4875; 813.7375; 813.9375 813.9625; 813.9875;l814.9625; 815.7375; 815.9675, 814.2625; 814.4625; 814.4875; 814.7375; 815.4875	Used on the Racom system

...

Various other FCC license holders in the County

Call sign	Licensee name	FRN	Radio Service	Status	Expires	Frequencies licensed	**Purpose for which this frequency is used**
KBA283	LE CLAIRE, CITY OF	0005671102	PW	Active	12/03/2011	453/458.05 wide band UHF repeater Ch	Public Works (I believe telemetry from lift station).
KDN536	ELDRIDGE, CITY OF	0005671938	PW	Active	08/27/2011	155.04 wide band VHF simplex channel	
KNAX250	BLUE GRASS, TOWN OF	0002560282	PW	Active	09/02/2013	153.77 & 154.22 VHF wide band simplex	Probably local fire house
KNFW498	RIVERDALE, TOWN OF	0002582534	PW	Active	02/03/2013	154.22 & 154.28 VHF wide band simplex	Probably local fire house
KNIN982	WALCOTT, CITY OF	0005671219	PW	Active	02/16/2014	153.86 wide band simplex	Public works
KTI703	BUFFALO, CITY OF	0002567220	PW	Active	07/10/2012	154.025 wide band simplex	Public works
WNLL455	LECLAIRE, CITY OF	0005671102	PW	Active	04/27/2013	453.250/458.250 wide band UHF repeater	Public Works (I believe telemetry from lift station).
WNZA783	LE CLAIRE, CITY OF	0005671102	PW	Active	04/15/2012	159.210 wide band VHF simplex	Police
WPTE442	Genesis Health System d/b/a Genesis Medical Center, Davenport	0002572782	PW	Active	09/10/2011	155.340 wide band VHF	Statewide hospital
WPVC336	ELDRIDGE, CITY OF	0002565687	PW	Active	06/17/2012	453.975 wide band UHF	Looks like SCADA
WQAP387	TRINITY MEDICAL CENTER	0010433456	PW	Active	07/14/2014	155.340; 463.0; 463.075; 463.1; 463.125	All medical channels
WQFG407	BETTENDORF COMMUNITY SCHOOL DISTRICT	0014294698	PW	Active	07/08/2016	453.775/458/775 wide band UHF repeater	Used in 22 school busses
WPUZ850	NORTH SCOTT COMMUNITY SCHOOLS	0005076088	YB	Active	06/04/2012	Six 800 MHz channels which are shared with a number of other commercial users on the **COMELEC** trunked subscriber system. **Even though licensed in the District's name, they are also licensed to other entities and are not eligible to be taken by the District to some other radio system**	Used in 48 school bus and 2 portable radios.