



Section 4A. RF with Coverage Maps

4A.1 DuPage County System Description

Motorola is pleased to propose a solution to DuPage County, IL to join the STARCOM21 system already optimized and working in the County. This solution would expand the existing 4 site 8 channel Simulcast cell into an 8 site 18 FDMA channel (17 Talkpaths) system with 95% reliability to a portable with 12 dB building loss in the DuPage declared service area.

Motorola's STARCOM21 proposal meets the County's existing and future mission critical two-way radio communications needs and the requirement for a 2% Grade of Service (GoS) for 2700 Users. This requires the County provide a minimum of 10 additional frequencies for the channels STARCOM21 must add to provide this 2% GoS. This system is P25 APCO Phase 1 compliant and is capable of being upgraded to P25 APCO Phase 2 TDMA; however, this upgrade is not included in either the initial system or this proposal.

The 8 sites that will comprise the DuPage Simulcast cell are:

- ◆ Addison Tollway
- ◆ Westchester Tollway
- ◆ Lisle Tollway
- ◆ Aurora Tollway
- ◆ 127th street Tollway
- ◆ Argonne Tower
- ◆ Wheaton OEM Tower
- ◆ Streamwood Water Tower

The first 6 sites are already part of the system. They are managed and maintained by the STARCOM21, with Motorola being responsible for all implementation activities at these sites. The County is responsible for assisting Motorola with Wheaton and Streamwood during the Site Acquisition and Civil Works phases of the project.

Motorola will connect the Master Site in Downers Grove to Lisle, which will be the Prime site with a co-located Remote RF site. The Lisle Prime site is a few blocks away and is connected via fiber to the STARCOM21 Master site. This minimizes the

occurrence of link failure between the DuPage System's Prime site and STARCOM21 Master Site. All 8 sites will have a DC power backup that will provide 8 hours of backup in case of power failure.

STARCOM21 will be responsible for all T1 lines from the remote RF sites to the Prime Site.

The following Declared Service Area (Figure 4-1), Outbound Coverage Maps (Figure 4-2), and Inbound Coverage maps (Figure 4-3) show the coverage with APX7000 portables worn at hip, with half-wave antenna, in a swivel case, using RSM (Remote Speaker Microphone). For details regarding coverage testing, please refer to the document Coverage Acceptance Test Plan (CATP). CATP is tentatively scheduled for May 2011.



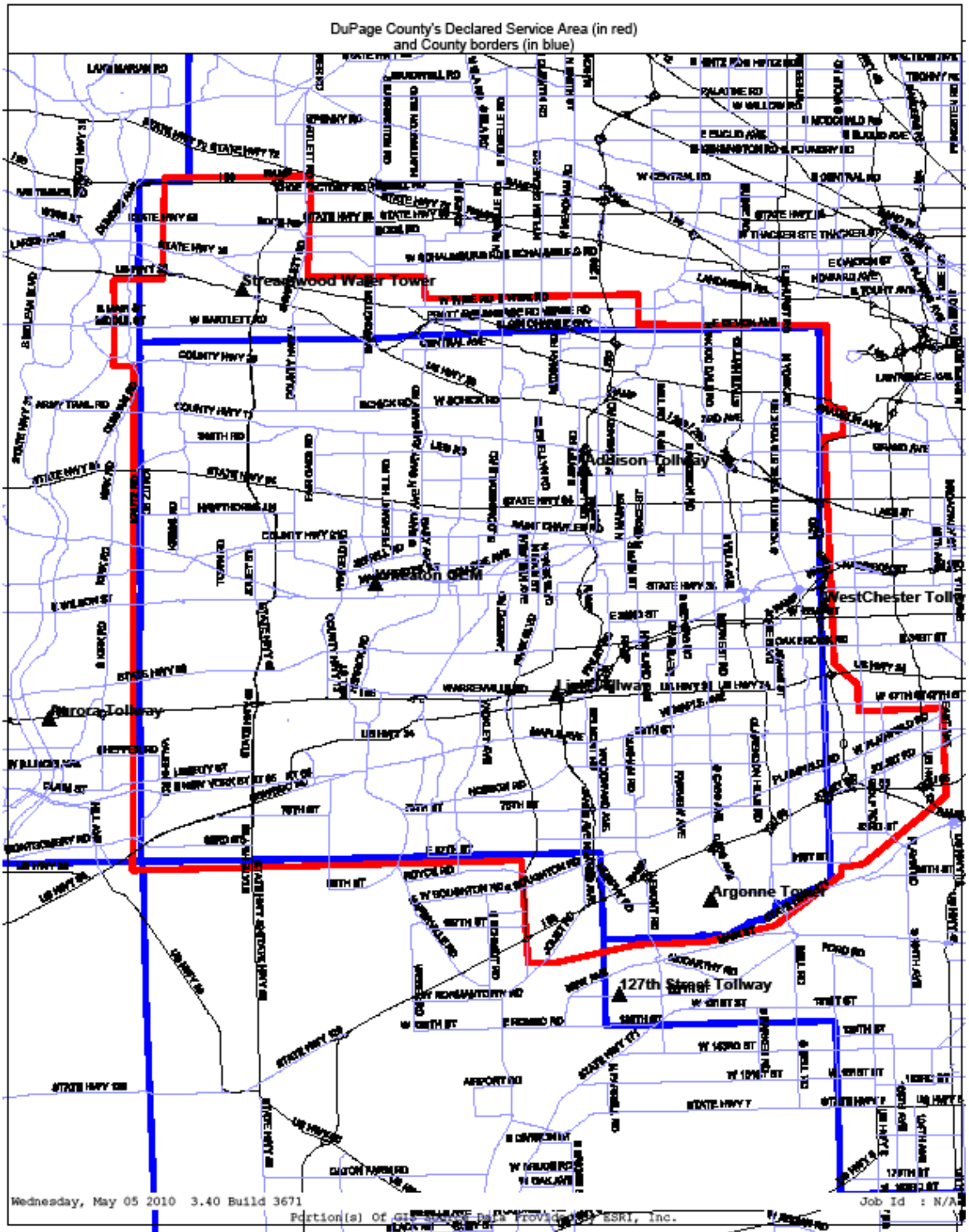


Figure 4-1: DuPage County's Declared Service Area (Red) and County Borders (Blue)



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Emergency Telephone System Board of DuPage County
DuPage Radio Interoperability Project
June 17, 2010

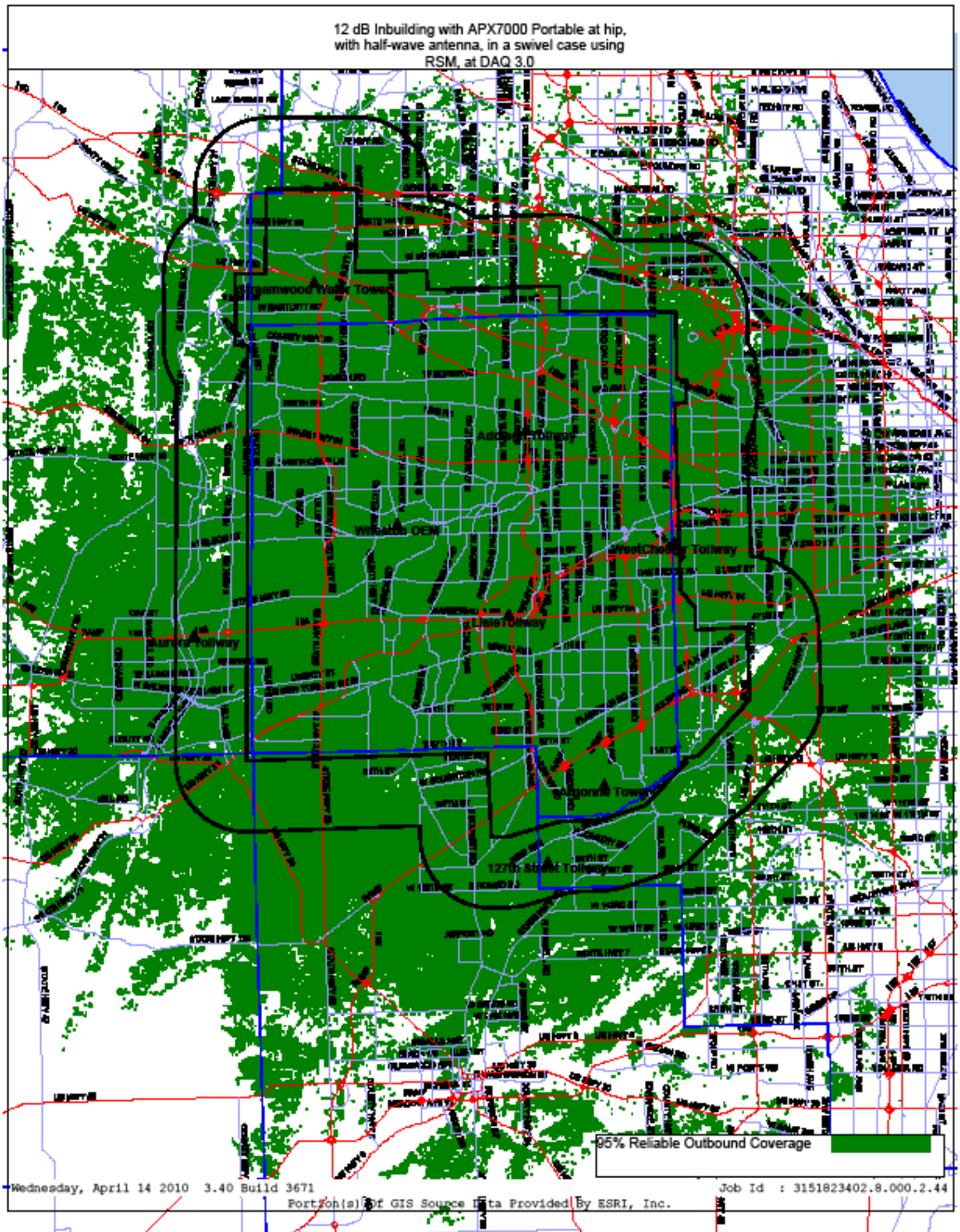


Figure 4-2: Predicted Outbound Coverage



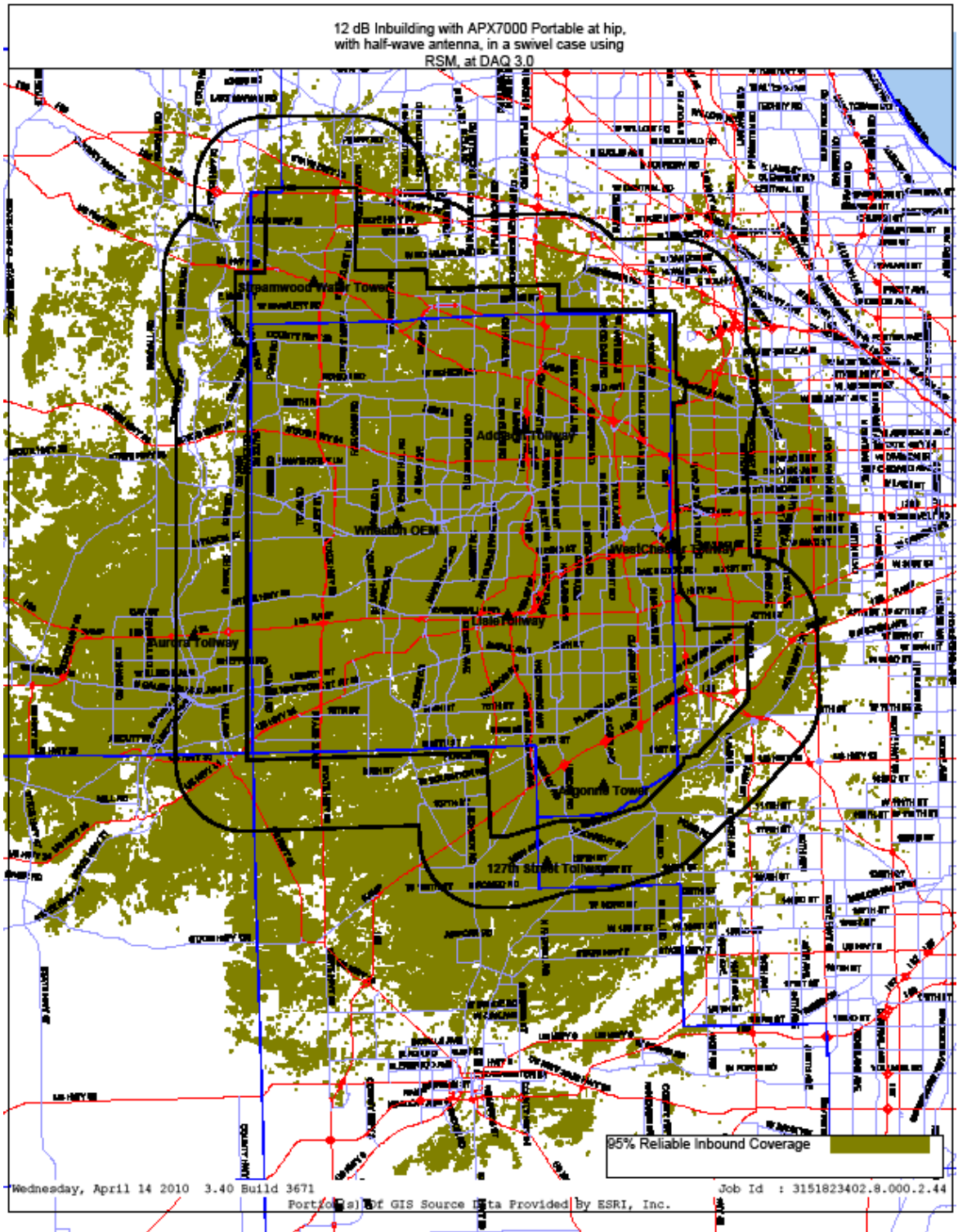


Figure 4-3: Predicted Inbound Coverage



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4A.2 ASTRO 25 Introduction and Overview

Motorola's ASTRO 25 Trunked Integrated Voice and Data system offers a comprehensive solution for the County. ASTRO 25 is Motorola's newest trunked narrowband digital wireless communications system. ASTRO 25 has been designed as a Mission Critical Network, meeting the requirements of Public Safety and Public Service Users. The following are capabilities of ASTRO 25:

- ◆ **Greater productivity** – System provides users with faster and more reliable access to more sources of information
- ◆ **Increased security** – Leading-edge encryption algorithms to keep voice and data transmissions confidential. The proposal for the County includes the capability to use the latest encryptions such as AES and DES-OFB as well as legacy encryptions such as DES-XL. Subscribers and Consoles need to be equipped with the desired encryption to make use of the encryption capabilities.
- ◆ **Interoperability with other Project 25 compliant solutions** – Allows the County to work seamlessly with other departments or agencies that have compliant P25 systems. An example of this would be Cook County.

4.2.1 Features and Benefits

Motorola's ASTRO[®] 25 solution is a state-of-the-art digital radio communications system specifically designed for mission-critical applications. Motorola has developed significant enhancements to the architecture of the Project 25 network. This new architecture utilizes industry standard Packet Switched IP network links for connectivity between system elements. This system will allow a mobile or portable user to make calls easily over a very wide geographical area. A user at any location within the coverage area can press the radio's PTT button to make a call to any valid talkgroup or individual located anywhere within the coverage area.

The advantages of this proposed configuration and the technology platforms used to implement it include:

- ◆ Digital technology compliant with Project 25 standards provide an open architecture network
- ◆ Common technology platform and protocols for both voice and data
- ◆ Robust architecture providing reliability consistent with Mission Critical applications
- ◆ Easy software upgrades with centralized downloading; service personnel only have to load the software once and it is automatically distributed throughout the network to support new features.
- ◆ Automatic voice and data call routing across entire network
- ◆ IP Simulcast Technology



Two-way radio voice communications are a critical part of daily activities of public safety personnel. ASTRO® 25 offers a wide range of advanced voice call services to meet the communications needs of these two-way radio users.

4.2.2 Project 25 Standards

Motorola supports the Project 25 standards process and has been implementing Project 25 trunked systems since 2001. Project 25 comprises a suite of voice and data standards as defined by TIA-102 standards documentation. Existing Project 25 systems operate using FDMA techniques, with a single voice channel occupying 12.5 kHz of bandwidth. Motorola has successfully implemented Project 25 integrated voice and data trunked radio systems including many city, county, and statewide systems. Motorola will continue to support the evolution of the Project 25 standards, including the still developing Phase 2 TDMA standards, and is committed to the migration of our ASTRO 25 network as the standards evolve.

4A.3 STARCOM21 Trunking System Overview

The system is made up of a combination of simulcast cells and site repeater RF locations. The STARCOM21 system supports operation in UHF, 700MHz and 800MHz bands.

Voice Over Packet

Motorola's ASTRO 25 Trunking System complies with a wide range of Project 25 standards. With public safety and industrial users moving toward countywide, statewide, and nationwide coverage, new systems are also expected to comply with rising industry expectations of increased communication capabilities. One of the benefits of voice over packet is improved performance. The use of leading edge transport network equipment provides for continued improvements in a system's ability to process the high volume of calls found on Wide Area Public Safety Systems.

Centralized System Management

The STARCOM21 systems features centralized management. This helps keep the system healthy with alerts, diagnostics, and faults reported at a centralized location. The accuracy of a system-wide clock helps ensure that key devices on the system record events at the same time to help improve fault diagnostics and call activity tracking. The network management system also provides functionality to remotely distribute software upgrades to products on the network. As a partner in the STARCOM21 system, Motorola will manage and maintain the network management subsystem. This includes the addition and configuration of new user radios on the network, the configuration of the radio tower sub-sites, and the configuration of



user's radio features on the system. Any applications that are present on Dupage County's local NM client are shared with other users of the system.

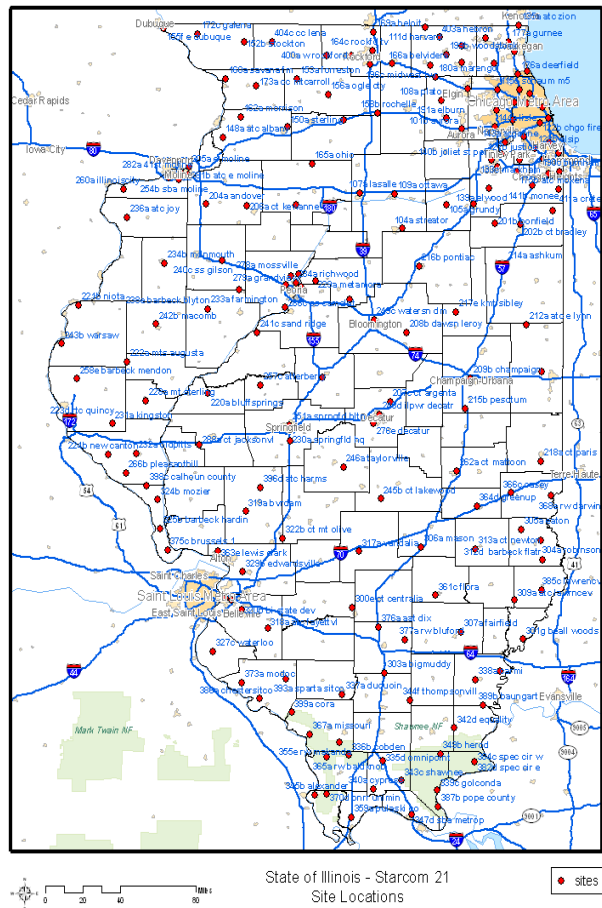
Flexible System Design

The modular design of the technology provides scalability in handling the needs of a small or large system. In addition to scalability, the flexible system design includes narrowband simulcast in the 12.5 kHz range. Large and heavily populated areas will benefit from the narrowband simulcast feature due to its improved frequency efficiency.

4.3.1 STARCOM21 Integration

STARCOM21 represents a unique opportunity to enhance interoperability among the Dupage County agencies, and other first responders in the State of Illinois.

STARCOM21 is a public/private partnership between Motorola and public safety/service agencies in Illinois. It was designed to provide shared system economies of scale while ensuring a public safety grade of service. STARCOM21 is chartered to enable interoperable communications among local, state and federal government users in Illinois. It was designed to enhance disaster response and support the Homeland Security Initiatives within the state. STARCOM21 is the designated interoperable solution for the Illinois Terrorism Task Force, all State Agencies and the Illinois Toll Authority. State users began operational use of the network in March of 2007. It is currently being utilized by a growing number of other municipal agencies.



The STARCOM21 Network is a digital trunked radio network built in Four (4) Zones. The sites are all hardened, secured, monitored and maintained on a 24 x 7 x 365 basis by Motorola. STARCOM21 offers users significant advantages including:

- ◆ Shared State-Wide Network allows for easy to use interoperability
- ◆ Quick implementation, already built, tested and being used
- ◆ Project 25 compliant standards based network
- ◆ Guaranteed network availability and grade of service
- ◆ Greater than 95% statewide mobile coverage

4.3.2 STARCOM21 Trunking Call Services

The STARCOM21 trunking system offers a wide range of advanced call services to meet the demanding communications needs of a diverse, mission-critical workforce. The available calling features and benefits are described below:

Talkgroup Call

The Talkgroup Call is the primary communication level in an ASTRO 25 trunked system as the majority of conversations take place within a talkgroup. Radios assigned to a given talkgroup are provided with Talkgroup Call capability and can communicate with other members of the same talkgroup. Talkgroup Call provides the effect of a “dedicated channel” for each talkgroup.

Multigroup Call

A Multigroup Call is a call involving multiple talkgroups at the same time and can be initiated by a properly authorized console dispatcher or radio unit. The talkgroups that are addressed in the call are pre-programmed within the radio units and system.

The advantage of Multigroup Call is the ability to simultaneously communicate important information to multiple talkgroups quickly and efficiently. A single Multigroup Call transmission utilizes fewer channel resources and airtime than multiple, separate talkgroup calls.

AllStart Talkgroup Call

AllStart is a talkgroup setting that operates in the same manner as the default call setup mode. This call setup approach requires that all sites with affiliated talkgroup members and other required resources be available before the call begins. Otherwise, the system returns a busy response to the user who initiated the talkgroup call. Once the required resources become available, the call request is granted.



FastStart Talkgroup Call

FastStart is a talkgroup setting that requests a group call setup whether or not all affiliated Talkgroup members are available. This “Automatic Busy Override by Talkgroup” call setup method still requires the participation of all affiliated consoles and critical resources before the call can begin.

As channels at the affiliated talkgroup members’ sites become available, they are added to the call in progress. FastStart will simplify the setup of automatic busy override functionality. FastStart applies regardless of the number of zones involved in the call. Caution: It should be noted that some talkgroup members may not be included in a FastStart talkgroup call if they happen to be affiliated at a busied site.

Emergency Alarm / Call

Emergency Alarm/Call provides users the ability to inform dispatch personnel of a life-threatening situation. By pressing the radio’s Emergency Alarm button, an alarm is sent to the dispatcher. Upon activation of the emergency radio’s Push-To-Talk, a channel is assigned for a predetermined amount of time. In the event that all voice channels are occupied, the system is capable of functioning in one of the following two modes:

- ◆ **Emergency Top-of-Queue** - If all voice channels are occupied when an emergency call is made, then the unit initiating the emergency shall be placed at the top of the busy queue list and allowed access to the next available voice channel. The emergency unit is given the highest level of priority regardless of how many units are already in queue. As soon as any user of any of the busy channels de-key, the emergency caller is granted the channel. This virtually eliminates channel contention and assures the first available channel will be assigned.
- ◆ **Emergency Ruthless Preemption** - If all voice channels are occupied when an emergency call is made, then the unit initiating the emergency is allowed access to the voice channel that has the lowest priority user currently assigned. It must be noted that until now the low priority current user de-keys, there could be RF contention between the emergency user and the low priority unit. Once the non-emergency user de-keys, the channel belongs to the emergency user.

Call Alert

Call Alert allows a user to initiate a signal that notifies another user to call back the alerting party. Call Alert capability helps ensure that important messages get through, even if the called party is away from the radio. In addition, Call Alert signaling takes place over the system control channel. This helps to preserve valuable voice channels for other communications.



4.3.3 STARCOM21 User Features (Voice Only)

The following features are designed to make the system easier to use.

Busy Queuing and Callback

Although trunking systems are considerably more frequency efficient than conventional radio systems, there may still be times on STARCOM21 when all of the voice channels are busy. If a radio user attempts to initiate a call while all the system channels are in use, the requesting user will be put into a Busy Queue and then automatically notified when a channel becomes available. This feature eliminates the need for the radio user to continually re-key in an effort to gain channel access.

Multiple Priority Levels

STARCOM21 provides multiple levels of priority allowing system access to the most critical users during busy periods. Individual users and talkgroups can be assigned specific priority level(s), with up to 10 levels available. This allows higher priority users to be placed higher in the busy queue for quicker system access.

Continuous Assignment Updating

This feature is designed to insure that a radio just coming into service during an active talkgroup conversation will be immediately assigned to the appropriate voice channel. A user is included in his or her active talkgroup call with no special action required. To achieve this, the system control channel continuously transmits the channel assignment for talkgroups involved in active calls.

4.3.4 STARCOM21 Voice Encryption

The STARCOM21 network offers the following secure features (these features can be quoted if Dupage County desires):

- ◆ Secure (encrypted) voice communications to the Console Operator.
- ◆ Supported algorithms include: ADP, DES-OFB, and AES (Optional per subscriber unit).
- ◆ Single or dual encryption.
- ◆ Multi-key encryption within same encryption algorithm.
- ◆ Distribution of key material to subscribers will be conducted manual rekeying using the KVL 3000 Plus key loader.

Secure (Encrypted) Voice Communications

Motorola systems have the capability to protect their Land Mobile Radio (LMR) voice communications with sophisticated, digital encryption. The encryption used in STARCOM21 offers a great improvement in terms of audio quality over earlier



encryption methods. Digital encryption does not impact audio quality. Encryption allows users the ability to send and receive sensitive information over the air with the confidence that only those for whom it was intended will receive it.

Supported Algorithms

ADP, DES-OFB and AES encryption algorithms are available on the STARCOM21 System.

Project 25 defines the DES-OFB encryption algorithm as the standard encryption algorithm that allows encrypted interoperability between Project 25 compliant radios from various manufacturers. OFB stands for Output Feedback, the encryption synchronization method adopted by Project 25.

The National Institute of Standard and Technology (NIST) defines AES encryption as the standard encryption algorithm defined under the Advanced Encryption Standard (AES) for use by U.S. Federal and Canadian National Government agencies and, on a voluntary basis, by organizations, institutions, and individuals domestically and internationally.

Single Algorithm

Single algorithm means that one encryption algorithm can be used in a two-way radio system. This allows users the ability to send and receive sensitive information over the air with the confidence that only those whom it was intended will receive it.

Multiple Algorithms

Multiple algorithm capability means that up to two or more different encryption algorithms can be used in a two-way radio system. Multiple algorithms provide additional flexibility for larger organizations requiring completely separate operations or for two or more completely autonomous groups, who only have to occasionally work and communicate together through an interoperable mode of operation. Multiple algorithms also provide backward compatibility to subscribers. Subscribers with multiple algorithms can be shared with different infrastructures that happen to use different encryption algorithms.

Distribution of Encryption Keys

Delivering and updating encryption keys to a secure device is done manually using the KVL 3000 Plus key loader. A key loader is a hand held portable device that connects via a cable to a secure device. The key loader supplies the “encryption keys” needed to perform encryption and decryption operations properly.



Key Loader – KVL 3000 Plus

The KVL 3000 Key Loader is used to create, store and transfer encryption keys used by Motorola's secure products. Once two or more devices have been given keys by the key loader, they can then communicate over a secure (encrypted) link.

4.3.5 STARCOM21 Wide Area Radio Roaming

Motorola's STARCOM21 wide area trunking system offers a sophisticated set of radio roaming features and capabilities simplifying user operation of the radio while ensuring that the radio is operating on the optimum site. Motorola's wide area roaming features and benefits are described below:

Automatic Site Registration

Automatic Site Registration is the automatic registration process that takes place whenever a radio is turned on or when the user roams from one trunking site to another. No operator intervention is required. This important feature enables continuous call processing for the user and effortless user roaming throughout the system.

De-Registration

There are three instances when a radio unit will de-register from a site. The first method is when a radio unit is turned off. The radio will perform a soft power down de-registering itself with the Zone Controller. The second way is when a user moves from one site to another. Automatic Site Registration occurs at the new site, and the Zone Controller automatically de-registers the radio at the old site. The third way a radio unit is de-registered is via a Time-Out Timer. De-registration occurs when a radio goes out of range for longer than a pre-selected amount of time. These de-registration processes help to ensure that precious frequency resources are not wasted.

Automatic Site Switching

One of the key features of a wide area trunking system is its ability to proactively select the optimum site as a radio user moves throughout the coverage area. Using Receive Signal Strength Indication (RSSI), the radio is able to monitor the signal strengths of control channel frequencies at adjacent sites and automatically make the necessary site changes when appropriate. The result is improved user communications by operating on the optimum RF site.

Preferred Site

Preferred Site operation allows a radio to search for an alternative, pre-programmed site that is operationally preferred over the current site. A radio will look for a



preferred site when it roams into another site in the system. If a unit is in an overlap area of multiple sites, it will favor its preferred site. This capability allows users to more intelligently manage and conserve repeater resources in coverage overlap areas.

Dynamic Site Assignment (Voice Only)

Dynamic Site Assignment ensures that STARCOM21 users have maximum system channel efficiency as the system utilizes channels only at sites where active talkgroup members are located.

Scan Operation on STARCOM21

A subscriber unit can only scan talkgroups when the user radio is affiliated at the same site as the desired scan talkgroups. In a wide area system, sites are only added to a call when a radio user at a particular site has that talkgroup selected. This is done to conserve frequency resources and maintain the Grade of Service (GOS).

4.3.6 700 MHz Voice Technology Overview

The proposed system includes the latest Motorola digital wireless solution specifically designed for mission-critical applications. Motorola has developed significant enhancements to the architecture of the Project 25 network. This new architecture utilizes industry standard Packet Switched IP network links for connectivity between system elements. The advantages of this proposed configuration and the technology platform used to implement it include:

- ◆ Provides seamless interoperability between local, regional and state agencies
- ◆ Cost effective solution utilizing available assets
- ◆ Common technology, platform, and protocols for both voice and data
- ◆ The Project 25 platform operates in a dual mode configuration, with both Project 25 Phase 1 Frequency Division Multiple Access (FDMA) and Phase 2 TDMA upgrade capability when available.
- ◆ Robust architecture providing reliability consistent with Mission Critical applications
- ◆ Easy software upgrades with centralized downloading; County personnel only have to load the software once and it is automatically distributed throughout the network to support new features
- ◆ IP Simulcast Technology, for better coverage and use of the County's frequency assets.

4A.4 700MHz Simulcast System

Motorola's approach to solving the unique challenges of Simulcast was to develop highly specialized equipment to eliminate the simulcast distortion problems inherent



in off-the-shelf equipment. Motorola's latest ASTRO 25 digital simulcast system as proposed for the County uses the newest simulcast technology. This newest ASTRO 25 digital simulcast technology uses GPS based time launch to insure that all sites transmit in synchronization, and eliminates the need for remote site call processing equipment. This technology also uses a new linear simulcast RF repeater station with a Linear Power Amplifier (PA). The use of a linear transmitter allows up to twice the signal delay spread tolerance of non-linear simulcast in narrowband 12.5 kHz channels. This means that audio quality is enhanced in the site 'overlap' areas. Users hear clearer, cleaner message, which correlates to better system acceptance.

Motorola's Project 25 solution is designed to provide consistent reliable coverage throughout the designated coverage area. Our proven simulcast technology will allow Dupage County to take true advantage of the key element in simulcast design—overlapping coverage. Motorola simulcast systems encourage the use of overlapping coverage by assuring the simultaneous reception of distortion free signals from multiple transmitter sites and the incorporation of enhanced composite signal receiver voting for the inbound signals. The capability to realize the significant benefits of composite outbound and inbound signals can only be achieved utilizing simulcast technology designed to standards that far exceed the systems offered by any other manufacturer.

The simulcast subsystems proposed for the voice system are based on IP technology. The IP technology has been extended for the Project 25 platform to include a cost effective IP Simulcast offering that eliminates the need for channel banks.

The 700 MHz, 800 MHz, UHF, and VHF frequency bands can be supported in Project 25 systems. The County proposed system has been designed to accommodate 700 MHz frequencies.

