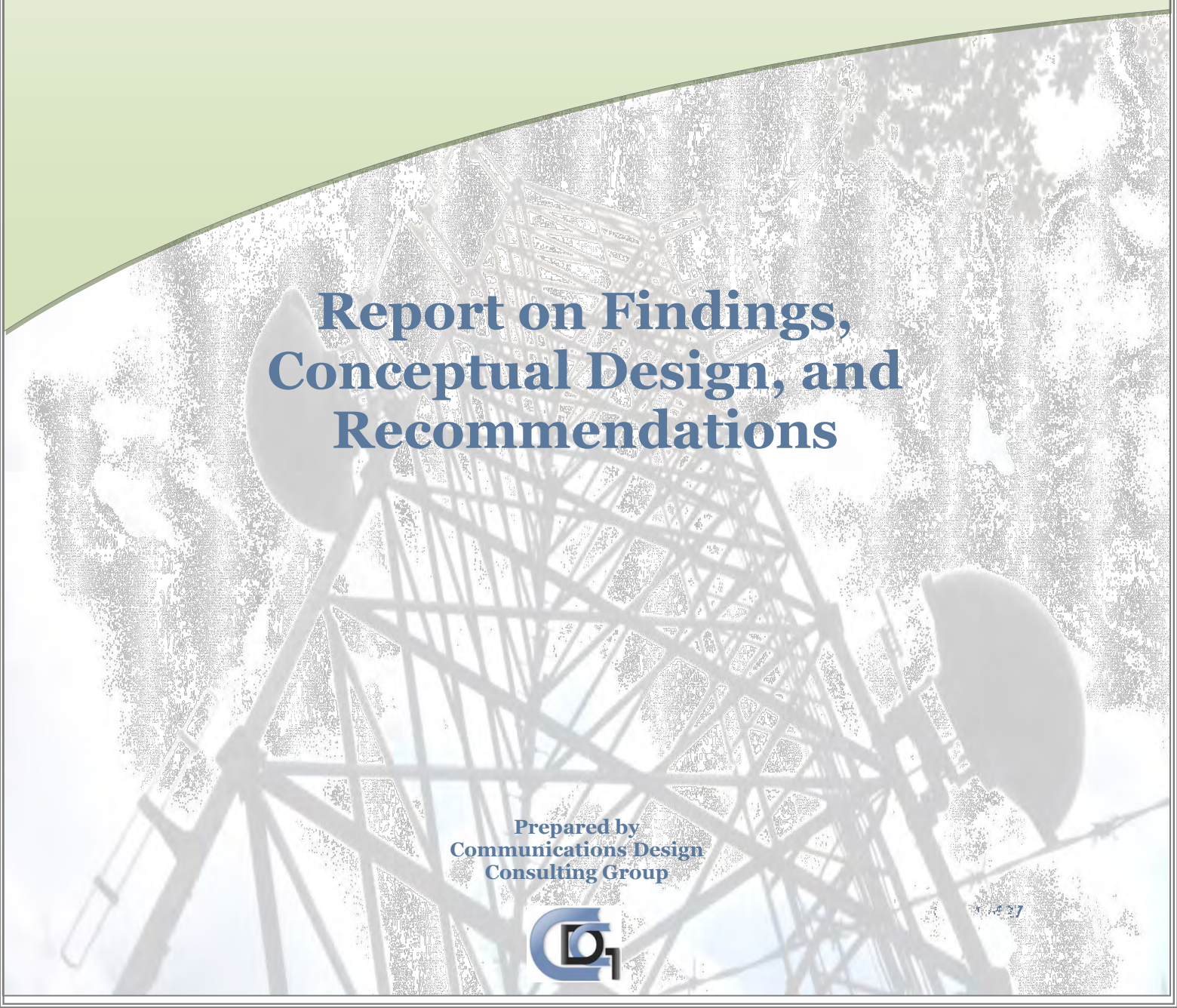
Town of Norwich, VT
Radio Communications Study

October 22, 2010



Report on Findings, Conceptual Design, and Recommendations

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1.0 Project Background

Rapidly changing radio communications technology, evolving industry standards, and marketplace driven Federal regulations affecting Public Safety present challenges and risks to local government radio planners that are faced with replacement or upgrades of existing radio networks.

With this background, the Town of Norwich, Vermont has recognized the need to evaluate their existing radio communications systems and to look into the future. This study was undertaken by Norwich to provide guidance in its short and long range plans for improving communications for the fire, police and public works departments..

CDCG was retained by the Town to conduct an evaluation of the public safety communications systems and to develop a strategic communications plan for the improvement of these systems working under the direction of the Town, CDCG was charged to:

- Met with Norwich project team to conduct a project kickoff meeting.
- Conduct on-site interviews with participating departments in Norwich
- Conduct on-site visit and interview of the Town's dispatch service provider at Hartford Police Department
- Conduct on-site visits and interviews with Hanover Dispatch to identify capabilities
- Visit major transmitter sites
- Develop an understanding of the existing two-way land mobile radio and alert systems currently used by the Town
- Document communications requirements based on the user interview process, evaluated alternative technologies available to upgrade land mobile radio systems
- Develop a strategic plan to upgrade the public safety and public services land mobile radio systems
- Prepare budgetary cost estimates to implement the recommended improvements

This project is an important undertaking, and the information contained in this report represents a series of steps that will be required to develop and implement communication system improvements capable of meeting the needs of public safety agencies for at least the next ten years. The material contained in this document is not intended to represent a final system design. The information is presented at a conceptual level, and is intended to be used for planning purposes including discussion and refinement as the project evolves. The final system design will be developed in subsequent project phases in which specifications for systems procurement would be developed.

1.2 Report Objectives

The primary objectives of this report include the following:

- Identify and understand the use of the Town's existing two-way voice communications systems.
- Identify future needs by department including:
    1. Initial and Long-Term Capacity
    2. Interdepartmental Communications
    3. Redundancy Requirements
    4. Networking Requirements
    5. Radio Coverage Needs
    6. Feature Capabilities
    7. Backup and Recovery Operations
- Identify requirements regarding the FCC mandate to narrowband existing radio systems before January 1, 2013
- Determine the technologies required to meet current and long-term needs

- Develop conceptual system designs based upon the approved technologies
- Prepare budgetary cost estimates for equipment/systems
- Provide the results of our findings in this report

1.3 Mission

Making public safety communications more effective, efficient, and cost effective is the overall driving force behind this initiative. Meeting the FCC Narrowbanding mandate of January 1, 2013, enhancing signal coverage capabilities for all public safety organizations shall receive the highest level of commitment to guarantee a reliable, state-of-the art communication system is in place to ensure the effectiveness of public safety personnel. Furthermore, the Town of Norwich seeks to review call-taking and dispatching services currently provided by Hartford Dispatch Center, as well as those offered by Hanover Dispatch Center.

1.4 Shared Vision

In the effort to save lives and protect property, Norwich public safety officers share a vision of improving communications to achieve better signal coverage and improved first responder services to the community they serve. Crime, fires, and natural disasters will dictate that public safety agencies cannot effectively protect life and property without effective communications. The shared vision is one wherein no individual in Norwich shall be at risk due to the lack of an effective public safety communication system.

1.5 Business Case

The development of the Public Safety Communications plan will propose alternatives to enhance the issues of reliability, coverage, capacity and interoperability. Realizing that some existing equipment will be replaced as it wears out, and that parts are no longer available for some of the equipment, a stance of do nothing is not a viable option. The Federal Communications Commission [FCC] mandated compliance with frequency band changes [i.e. narrowbanding], thereby forcing older equipment out of operation and re-aligning newer equipment to be spectrum efficient.
Of critical importance within the Town of Norwich, there is an immediate need to improve radio coverage for all departmental systems.

Although the existing land mobile radio systems have continued to evolve over the years and has generally served the Town departments well, CDCG and the Town have identified areas where public safety communications could be improved and made more capable. The most frequently reported user problems or areas requiring improvement are identified as follows:

1. **Inadequate Radio Coverage**

   Inadequate radio coverage was the largest concern of all users interviewed. There are significant areas in Norwich in which users are frequently unable to communicate successfully with handheld radios and many times with mobile radios. The problem is most pronounced when personnel are operating in some of the more remote areas of the Town.

   Rating on a scale from 1 to 10, with 1 being the worst and 10 the best, the departments expressed the following coverage performance:

Radio Type	Mobile	Hand-Held Portable
Police	6	1
Fire	9	1
Public Works	2	1

2. **Old and Outdated Radio Equipment Due For Replacement**

   There is a small number of subscriber equipment that has to be replaced to be narrowband compliant. These are typically Public Works radios.

3. **Dispatch Communication Center**

   Norwich desires to improve 9-1-1 and dispatch services and has requested CDCG to evaluate technical requirements of Hartford and Hanover Dispatch Centers.

4. **Frequency Assignments**

   Identify potential frequencies in order for Norwich to be spectrum independent; that is, not rely on frequencies used by other agencies.

5. **Communications Tower Sites**

   Identify potential tower sites in Norwich to increase overall radio coverage for Police, Fire and Public Works.

6. **Narrowbanding**

   The FCC narrowbanding mandate requires radios to be narrowband compliant prior to January 1, 2013. It appears that Norwich Police and Norwich Fire have narrowband capable equipment with the exception of fixed equipment, and will require re-programming of radios to complete narrowband. Public Works is not fully compliant.

1.6 Communications Plan and Approach

It is recommended that the Town of Norwich upgrade its public safety communication networks to improve overall service to the public, and especially improve signal coverage reliability by expanding the exiting systems.

The adoption of this plan will require that the Town acquire a new communications infrastructure. Existing spectrum and radio equipment can be re-used, and existing radio systems will continue to operate during procurement and implementation of the sub-systems and equipment providing an uninterrupted cutover to the new system. The detailed communications plan is found in Section-3

2.0 Current System Environment

2.1 Radio Communications Systems

Nationwide, public safety professionals rely upon radio communication systems to support mission critical operations. In Norwich, there is increasing pressure on the current two-way voice communication systems. This section will provide a description of the existing system infrastructure of each department participating in this study, along with a description of their current system, a summary analysis of each agencies' problems and concerns, and a description of the needs and wants of each agency

2.2 Overview of Current Systems

Today, there are three independent public safety radio systems operated by the Town of Norwich.

Norwich public safety two-way voice systems are analog systems that operate in VHF-Highband [150 MHz] or in the UHF [450 MHz] frequency bands.

In Vermont, all local and state Law Enforcement agencies operate in the UHF band. Fire and EMS agencies operate in VHF-Highband to promote interoperability among mutual aid departments and hospitals.

However, Norwich is adjacent to several towns in New Hampshire. New Hampshire Law Enforcement statewide operates in on VHF-Highband using digital modulation, while the fire services continue to operate in the analog mode, however Hanover police uses analog modulation and Lebanon fire and police use digital modulation. The digital operation for inter-state interop communications is difficult as analog and digital radio systems are not compatible.

2.3 Remaining Life of Existing System

In Norwich, the majority of existing public safety two-way voice radio equipment is fairly new and has a useful lifecycle of at least five years. With proper use and maintenance, equipment reliability can be extended.

2.3.1 Fixed Infrastructure

Fixed radio system infrastructure consists of base stations or repeaters (transmitters & receivers) and antennas. Fixed infrastructure equipment used in Norwich is provided by Motorola.

Infrastructure equipment is generally comprised of mobile radio equipment configured for fixed base operations.

2.3.2 Subscriber Units

Subscriber units consist of mobile and portable radios used by various departments. The Town has been purchasing new subscriber units over a period of years to support user needs. At the present time there are approximately 114 subscriber units in operation, including alert paging receivers. The age of these radios varies but most are narrowband compliant that indicates that they were manufactured after February 1997. All of the subscriber base is of current production and is supported by the manufacturer.

All radios were reviewed for FCC narrowbanding capabilities. All but seven [7] radios are capable of being reprogrammed to the narrowband emission. The Spectra base station radios at the police station and the Motorola base station at the fire station will have to be replaced as they are not capable of being narrowbanded. The four Midland and one [1] Uniden radio are not capable of narrowband emissions.

2.3.2 Fire Alert Paging

A two-tone sequential paging system transmitting on the main fire dispatch frequency is used to alert and dispatch fire personnel. Receipt of the dispatch is provided by a positive voice acknowledgment from the fire apparatus or mobile or portable radio.

Traditional fire or EMS alerting paging systems are one-way alerting systems providing an important function to first responders in rapid response to emergency calls.

These tone and voice paging systems have been the mainstay of paid-on-call and volunteer fire and rescue services since the 1960s. Tone and voice paging systems are used to dispatch fire and EMS squads in Norwich. Fire alert paging systems transmit unique tones that alert a single pager, or a group of pagers, that emits a tone alert and then followed by voice message. Members can also monitor their respective dispatch channels over the pager to remain current to the unfolding of the event.

According to inventory records provided by the Town, there are approximately 43 pagers in Norwich. All of the units are Minitor-V receivers that can be re-programmed for narrowband.

2.3.3 Equipment Inventory

Norwich Radio Inventory						
Manufacturer	**Type**	**Band**	**Model**	**Police**	**Fire**	**DPW**
Motorola	Portable	UHF	HT1250	1		
Motorola	Portable	UHF	MT2000	3		
Motorola	Base	UHF	Spectra	1		
Motorola	Base	VHF	Spectra	1		
Motorola	Mobile	UHF	PM1500	3		
Motorola	Mobile	UHF	CDM1250	1		
Motorola	Mobile	VHF	CDM1250	4		
Motorola	Mobile	VHF	PM1500		3	5
Motorola	Mobile	VHF	Radius			1
Motorola	Mobile	VHF	M120			3
Midland	Mobile	VHF				4
Uniden	Mobile	VHF				1
Motorola	Mobile	VHF	GM300			2
Motorola	Mobile	VHF	CM200			1
Motorola	Base	VHF	CM300			1
Motorola	Portable	VHF	SP50			5
Motorola	Base	VHF	Radius		1	
Kenwood	Mobile	VHF/UHF	TK790		3	
Kenwood	Mobile	VHF	TK790		1	
Kenwood	Mobile	UHF	TK790		1	
Pyramid	Vehicle Repeater	VHF	SVR200		2	
Motorola	Mobile	VHF	CDM1250		1	
Motorola	Portable	VHF	HT750		27	
Motorola	Portable	VHF	HT1250		9	
Motorola	Pager	VHF	Minitor-V		43	
				14	91	23
			Totals	Police Mobiles:		8
				Police Portables:		4
				Fire Mobiles:		9
				Fire Portables:		36
				Fire Pagers:		43
				DPW Mobiles:		17
				DPW Portables:		5
						122

2.4 Departmental Operating Environment and Concerns

This section is intended to provide the reader with an overview of how Norwich departments use communications systems available to them. Information used in this section was obtained from personal interviews, and from materials provided by the Town as part of this project.

2.4.1 Norwich Police Department

Operational Overview - How System Is Used
The Norwich Police Department operates on one half-duplex UHF frequency pair. The frequency and system is owned and maintained by the Town of Hartford, and is comprised of a main transmitter site located on Hurricane Hill.

A local base station is installed at the Norwich Police Department that is used for local dispatch, as an informational channel and for local departmental communications. This unit is a desktop mobile radio unit.

Patrol operations are carried out on frequency 460.250 MHz. The frequency 465.250 MHz is used as a service channel and tactical channel when necessary. The frequency pair 453.900/458.900 MHz licensed to Norwich is currently not used by the department.

Presently, the Police Department is dispatched by the Hartford Police department emergency communications center, which operates twenty-four hours per day.

Norwich PD has PTT-ID programmed on all radios. However, Hartford dispatch is not set up to receive unit IDs. Hanover Dispatch can receive radio IDs.

The Police Department radios are equipped with an emergency alert button [radio pushbutton when depressed, sends alert and unit unique ID to dispatch indicating officer in trouble]. However, this function is not programmed because Hartford does not use unit IDs.

The Department does not utilize encryption on its system and has no plans to do so.

Mobile data function is performed using Verizon aircards providing access to NCIC and VLETS databases.

The police department also utilizes a vehicular repeater system [VRS] in marked vehicles to increase overall handheld portable coverage. This is accomplished by interfacing the vehicle mobile radio to the VRS unit thus repeating the portable transmission through the mobile radio. The VRS unit is in-band UHF.

According to information provided by the Police Department, it maintains an inventory of 9 mobile radios, and 4 portable radios and tow base stations.

Cellphone communications is not highly reliable in Norwich and coverage is spotty. Although the commercial network is a communications tools, it is not a mission critical system. As a result, NPD uses this system a small percentage of the time.

Major Problems Experienced
The Police Department listed the following as the largest problems encountered with existing radio systems:

- Poor mobile radio coverage
- Extremely poor portable radio coverage

The Police department desires to see improvements in the following areas:

- Improved Portable Coverage (In-building)

2.4.2 Norwich Fire Department

Operational Overview - How System Is Used
The Norwich Fire Department presently employs a VHF-High Band radio system for communications. The dispatch system is owned and maintained by the Town of Hartford, and is comprised of a main transmitter site located on Hurricane Hill.

A local transmitter is installed at the Norwich Fire Department that is used for local departmental communications. This unit is a desktop mobile radio unit and has paging capability.

Fire dispatch operations are carried out on frequency 154.325 MHz. The frequency 156.165 MHz is used for fireground communications.

One mobile only frequencie is licensed by the Town for fireground and tactical communications. One UHF frequency pair is licensed for monitoring SCBA use and one unlicensed VHF frequency is used the mobile repeaters. The use of portable radios has become popular over the years and each department maintains several portable radios to enhance fire ground communications.

Presently, the Fire Department is dispatched by the Hartford Police department emergency communications center, which operates twenty-four hours per day.

The fire department also utilizes a vehicular repeater system [VRS] in Engine 1 and Engine 2 to increase overall handheld portable coverage. This is accomplished by interfacing the vehicle mobile radio to the VRS unit thus repeating the portable transmission through the mobile radio. The VRS unit is in-band VHF.

The fire department also uses single head mobile radios on VHF and UHF in Engine 1, Engine 2 and Ladder 1.

Norwich Fire also has a UHF frequency [453/458.9375] for SCBA monitoring.

According to inventory records, the fire department maintains and operates 9 mobile radios in department equipment, 36 portable radios, 43 alert paging receivers, and one base station.

Cellphone communications is not highly reliable in Norwich and coverage is spotty. Although the commercial network is a communications tool, it is not a mission critical system. As a result, the Fire department only utilizes this network for sensitive calls.

Major Problems Experienced
The following problems were identified during the interview process:

- Poor mobile and portable coverage in critical areas of Town
- Poor In-Building Coverage
- Poor alert paging function; many times pagers are alerted but the message cannot be heard.

The Fire Department desires to see improvements in the following areas:

- Improved Portable Coverage (In-building)
- Improved Paging and Alerting Systems

2.4.3 Norwich Public Works

Operational Overview - How System Is Used
The Norwich Public Works Department presently employs a VHF-High Band radio system for communications within the department. The system's primary transmitter is located at the DPW garage and consists and operates of a simplex frequency 155.940 Mhz. This unit is a desktop mobile radio unit.

According to inventory records, the Public Works Department maintains and operates 17 mobile radios and 5 portable radios on the system.

DPW radios are older than radios used by the police and Fire Departments.

Cellphone communications is not highly reliable in Norwich and coverage is spotty. Although the commercial network is a communications tools, it is not a mission critical system. DPW reported that it uses the system to supplement its radio system and uses this service 60% to 70% of the time.

Major Problems Experienced
The following problems were identified during the interview process:

- Very poor coverage performance
- Some interference

2.5 Existing FCC Authorizations

The Town of Norwich is authorized by the FCC to operate on several frequencies within its borders. The table below summarizes these authorizations.

Call Sign	Expires	Licensee	FRN	Frequency	Class	Emission	Location	Ant Ht [ft]	ERP [w]
KSI330	2013	Fire Dept	3636552	154.3250	FB & MO	20K0F3E	10 N. Main	70	150 / 45
				156.1650	MO	20K0F3E	40 km radius		40
WNPC346	2014	Public Works	3636552	155.9400	FB	20K0F3E	DPW	45	70
					MO	20K0F3E	10 km radius		35
WQHL501	2017	Police Dept	9661299	453.9000	FB2 & MO	20K0F3E	10 Hazen St	28	75 / 50
				458.9000	MO & FX	20K0F3E	16 km radius		50
WPZR396	2014	Fire Dept	9661299	453.9875	MO	11K2F3E	10 km radius		2
				458.9875	MO	11K2F3E	10 km radius		2
WQMZ941	2020	Fire Dept	3636552	155.8275	FB2	11K3F3E	DPW		100
				158.8575	MO	11K3F3E	18 km radius		45
		Fire Dept Police Dept		173.2250 453.0625	Unlicensed Mobile Repeater Frequencies.				

Norwich Fire utilizes the 154.325 MHz frequency that is licensed to both Norwich and Hartford. The channel is being shared by both departments. Although Norwich held the original licensee, there appears to be no MOU allowing Hartford use of this channel. The Hartford transmitter site has the more predominant coverage due to the higher elevations on Hurricane Hill. The Fire Department site is lower and only provides local coverage.

For Law Enforcement, the Police Department is using 460/5.250 MHz. This frequency is licensed to the Town of Hartford only but is dispatching Norwich PD on it. The Town of Norwich has 453/8.900 MHz licensed at the Police Department location and is not currently using this frequency. This frequency could be used for police operations should Norwich desire to have its own police channel. The existing license would have to be modified to other sites(s) to enhance coverage. Preliminary review shows that this frequency can be expanded to other locations within the Town. Analogous to the Fire Department's situation, coverage from the Norwich transmitter site is not adequate in providing reliable communications.

The Public Works 155.940 MHz frequency is licensed at the DPW garage and is not licensed to any other entity in the region like the police and fire channels.

2.6 Current Communications Sites

This section discusses the current transmitter sites utilized by Norwich.

2.6.1 Current Communications Sites

2.6.1.1 Hurricane Hill

Hurricane Hill is the primary transmitter site serving the Town of Norwich fire and police departments. The site is located approximately 5-miles south of the downtown Norwich. The site consists of a 120-ft guyed tower and an 8' x 8' communications equipment shelter that is of concrete construction.

The existing tower belongs to the Town of Hartford and appears to be in very good condition providing basic levels of coverage currently experienced by Norwich.

The existing electronic equipment building is air-conditioned and has an emergency backup generator installed. At the time of CDCG's site visit, no access was made into the shelter. A chain link fence secures the site and there is an intrusion alarm on the door of the shelter.

Hurricane Hill
Town of Hartford Tower

2.6.1.2 Town of Norwich Police Department

The Police Department communications utilizes a local transmitter and antenna located on the Police department building roof. The site is located at 10 Hazen Street, Norwich.

2.6.1.3 Town of Norwich Fire Department

The Fire Department communications utilizes an antenna that is roof mounted on the Fire Station site located at 11 Firehouse Road, Norwich.

Norm – The picture of the mobile radio on top of a rectifier is not from the NFD. I will send you a picture.

2.5.1.4 Norwich Department of Public Works

This site is owned by the Town and is located on 24 New Boston Road, Norwich. The antenna is roof mounted on the Town Garage.

It is determined that this location is suitable for constructing a new tower for Norwich public safety communications. There is space at the site to accommodate a new tower and electronic equipment shelter.

2.5.1.5 Tracy Hall - Town of Norwich EOC

This site is used by Norwich as the Town's Emergency Operations Center and is located at 300 Main Street, Norwich. There is currently no radio equipment at this location.

3.0 Design Alternatives and Recommendations

3.1 Operational Requirements

How quickly and effectively public safety agencies respond to citizen's needs is dependent, to a large degree, on their communications systems. Increasing demand for public safety services, growing requirements for multi-agency responses and increasing specialized services establish the need for enhanced public safety radio capabilities. In personal interviews conducted within the Town, public safety and public service agencies prioritized their requirements for two-way voice communications. The following sub-sections discuss overall common requirements, public safety requirements on the local and regional level. Additional Norwich requirements are also discussed in detail in this section.

3.1.1 Common Requirements

Reliability – The mission critical nature of law enforcement, fire service, and EMS require reliable two-way voice communications, which are engineered and maintained to ensure uninterrupted service. These communications systems provide the only lifeline to back-up assistance during emergencies.

Interoperability – Complexity, size and frequency of emergency events are raising the requirements for coordinated multi-agency responses. The ability to communicate among responding agencies is critical to the successful completion of the response. Interoperability is, therefore, fundamental to a coordinate efficient response to complex emergency situations.

Improved Coverage – The hilly terrain in Norwich creates significant challenges to providing reliable radio coverage in the Town. Many coverage problem areas or "dead spots" were reported by users and have been identified in this report. Upgraded communications systems must provide improved and more consistent radio coverage throughout the Town to support public safety and public service agencies.

Improved Channel Capacity – The Norwich fire department utilizes their own tactical channel to support routine and simultaneous incident responses, has the capability to use the tactical channels of mutual-aid departments and the National interoperability channels known as VCALL/VTAC. . The Norwich police department does not have its own tactical channel but does have the capability to use the National interoperability channels known as UCALL/UTAC. Norwich fire also has the need for their own dispatch/operating frequency.

3.1.2 Public Safety Requirements

In-Building Coverage – The mission critical nature of public safety operations requires more personal levels of communications. Much of the work of public safety agencies occurs inside buildings and in places that are away from their vehicles. Additional radio system coverage is necessary to support this type of operation. Both fire and police have not only poor in-street coverage, but very poor in-building communications as well.

Improved Redundancy In Communication Systems – Existing communication systems lack back-up capabilities required for public safety operations. A catastrophic failure of one communication system would severely limit the effected agency's ability to effectively communicate. New communication systems should be designed to provide an appropriate level of redundancy to assure continued effective communication linkages for all users.

Improved Paging and Alerting – The Town relies on a large contingent of paid-on-call members to provide fire suppression and EMS related services. Their rapid mobilization and coordinated response require the ability to reliably and effectively alert them via paging and alerting systems, which can reach responders wherever they may be. The alert paging function in Norwich requires improved coverage performance.

3.2.1 Spectrum and Regulatory Issues

The requirements outlined in the FCC DA-09-2589 report and the rules set forth therein has mandated a process to require a channel efficiency of 1-voice channel per 12.5 kHz of spectrum for all users operating between 150-174 and 421-512 MHz. In Norwich and in most of public safety, licensees use 25 kHz (wideband) channels. Narrowbanding requires users to migrate to 12.5 kHz (narrowband) channels. The mandate also requires data efficiency of 4800 bps for a 6.25 kHz channel, or 9600 bps for a 12.5 kHz narrowband channel. At the end of 2012 [officially January 1, 2013], all users operating between 150-174 and 421-512 MHz must be operating on no greater than 12.5 kHz voice channel spectrum efficiency, 9600 bps (or equivalent) data rate.

Users who are not narrowband compliant by this deadline risk cancellation of their FCC licenses. From assessment of the Town of Norwich current licenses, the VHF and UHF frequencies are currently licensed for wideband use. Therefore, the Town must narrowband by the end of 2012. The requirements placed on the Town in order to be narrowband compliant include determining if both infrastructure and subscriber units are narrowband compliant. If they are not, the equipment must be replaced. Any equipment that was manufactured after February 14, 1997 is already narrowband capable.

However, the Norwich inventory shows that most equipment can be re-programmed for narrowband use. The inventory can be found in Section 2.3.3.

Transition from wideband to narrowband on an analog system will result in a reduction in coverage of about 3 dB. Loss of coverage is primarily due to reduced deviation of the transmitter in a faded environment, partially mitigated by a slight improvement in sensitivity of narrowband receivers.

Norwich has requested from CDCG coverage maps showing the difference between wideband and narrowband operations. These were provided to Norwich under separate cover in mapbook format.

During narrowbanding, all licensed frequencies will remain the same. No frequency exchange is required. FCC licenses must be updated to reflect a narrowband emission designator. Narrowband emission designators include 11k0F3E (voice), 11k0F1D (data), and 11k0F2D (data). Updating the emission designator requires frequency coordination. The coordinators simply add new emissions designators and remove old ones. Channels will be narrowbanded on a one-for-one basis. One method through which the FCC will verify narrowbanding compliance is through the emission designator on the FCC licenses. The first four digits of the emission designator describe the bandwidth of the channel. Wideband emission designators starting with 20K0 or 16K0 must be removed, and narrowband emissions less than or equal to 11K3 must be added.

3.2.1 Availability of Sufficient Channels for Present and Future Use

Implementation of an improved radio communications system for Norwich will require additional frequencies to make Norwich "frequency independent" and able to develop an effective and efficient communications system. That is, dedicated Norwich frequencies for Norwich public safety communications.

Law Enforcement

Norwich PD currently utilizes Hartford PD frequencies for communications. It is also licensed for 453/458.900 MHz, which is not being used in Norwich. Therefore, this frequency pair is ideal for implementing a Norwich PD channel, licensed solely to Norwich and implemented in Norwich. Furthermore, implementing this channel in Norwich will result in better coverage as discussed in the next section.

Please note that signal coverage from the Hartford transmitter site on Hurricane Hill in Norwich town boundaries is considered very poor. Implementing a new frequency in Norwich will improve overall coverage. This is discussed in the radio coverage section of this report.

Fire Services

As previously discussed, Norwich Fire uses the Hartford FD frequency of 154.325 MHz. Norwich is seeking alternate frequencies for their own operations under this project.

Please note that signal coverage from the Hartford transmitter site on Hurricane Hill in Norwich town boundaries is considered very poor. Implementing a new frequency in Norwich will improve overall coverage. This is discussed in the radio coverage section of this report.

CDCG conducted research on the usage of the 155-174 MHz band in 75-mile radius of the center of Norwich. A search was conducted of the FCC database. Frequencies in the 155-174 MHz band are allocated in accordance with radio services defined by the FCC in Part 90 of the Commission's Rules and Regulations. Local Governments are eligible for frequencies in several radio services in which specific uses are allowed. Norwich is eligible in the Local Government, Highway Maintenance, Forestry Conversation, Police, Fire, Power and Emergency Medical Radio Services.

The results of the frequency searches resulted in identifying two potential frequencies: 155.8275 MHz and 158.8575 MHz as viable frequencies, and should be licensed as soon as possible. These new allocations will be sufficient to meet the short-term needs of the Town.

3.2 Design Goals and Objectives

The fundamental component of any radio system design begins with design goals and objectives. These goals and objectives are determined through input from interviews of radio system users, application of accepted engineering standards and from experience in designing and implementing radio communications systems. The features desired by users are also an important factor to consider in establishing design goals and objectives.

The basis of these system designs is the understanding that the new radio system must support the needs of all radio users now and in the future. The system must, therefore, be flexible enough to accept the addition of radio users and features to accommodate changing user needs over the life of the system. The major goals of the new radio system are as follows:

- Provide wide-area radio coverage
- Provide improved interoperability among local and adjoining jurisdictions
- Provide quality voice capability for all radio users
- The system should be expandable to meet future needs
- The system should be designed with back-up capabilities
- The system should be affordable

These goals will be better defined in this section of the report to allow a better understanding of the conceptual system design and the chosen system parameters.

3.3.2 Radio Coverage Requirements

Adequate radio system coverage was the leading priority of all users interviewed. All public safety and public service departments in Norwich were vocal in requiring a high level of radio coverage due to the emergent nature of their work. These users requested that the level of radio coverage provided by an upgraded system be based on a hand-held portable in-building coverage design.

Radio propagation predictions were prepared for both the 450 MHz and 150 MHz frequency bands designs using industry approved propagation software. The coverage predictions were prepared for mobile operations and portable on street and in-building coverage in order to show portable use in the type of environments required by the system users and fire pager coverage.

Several sites were evaluated and submitted to the town in Coverage Mapbook format provided under separate cover.

3.3.3 Radio Sites and Facilities

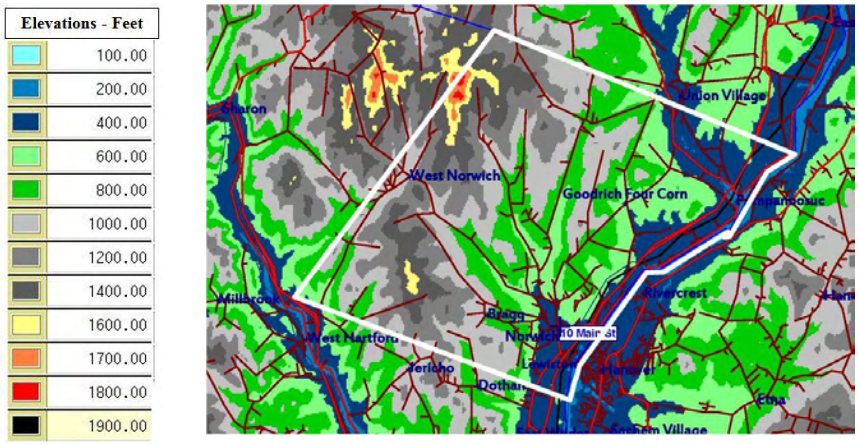
There are myriad of issues that must be considered when planning a communications system design. The potential site's ability to provide the needed radio coverage is of paramount concern. Beyond that each site must be evaluated based on how easy or difficult it will be to acquire the site for use in the system. Each site must be closely examined to determine the characteristics of the area in which it is located. Issues such as zoning and future use must be considered. What, if any impediments exist that will make construction of the site difficult. All of these issues and many more must be carefully examined to determine the suitability of each site.

During the evaluation of the Town's existing radio systems and in consideration of alternative system designs, CDCG considered the use of all existing radio sites as well as several other existing communications sites owned by cellular companies or other communications companies. Priority was given to using existing communications facilities, followed by using land which is owned by Norwich, and finally to commercially available sites.

The propagation analysis was used as the basis to determine which of the sites provided the radio coverage required meeting the goals and objectives of the system. As mentioned earlier, priority was given to existing Town owned land or radio sites. Each site was evaluated individually to determine the level of coverage that could be expected from that site. Some 15 sites were evaluated to determine the combination of sites that would provide ubiquitous coverage of the Town. The following sites were determined to be the best available sites: Norwich DPW Garage and Hayes Hill in Etna, NH.

3.3.4 Propagation Analysais Results

The map below depicts the terrain variations within the borders of Norwich. The landscape is generally described as hilly and wooded; terrain varies from low elevations at the Connecticut River to greater than 1,700-ft at Gile and Griggs mountains. Roads typically follow valleys or in between ridges that are critically destructive to radio communication signals. Note that beginning at the south corner of the town boundaries, terrain generally slopes upward north. Blue and green represents the lowest elevations while yellow and red represent the highest elevations.



Propagation results were provided under separate cover in Mapbook format. Only key coverage maps are provided in this document to present the reader with sufficient general overview of coverage issues and results. Mapbooks that were provided to Norwich were as follows:

Radio Coverage Issues

3.3.6 Site Connectivity

Each system design offered is comprised of remote base station sites and a primary control point at the emergency communications center. Each of these is separated by several miles and must be tied together, or interconnected, to facilitate the passage of audio and data signals between sites, communications system, and dispatch centers. This is a critical element of the radio system.

Interconnection of the system can be accomplished in a number of ways. One popular method of controlling remote base stations is the use of telephone tie lines. Dedicated leased telephone lines connect the radio console and the remote base station. Control of the base station or repeater is accomplished through signaling tones generated by the radio system to control the various functions. This is how the Town of Hartford is controlling radio equipment located on Hurricane Hill.

The costs of dedicated telephone tie lines vary but an average cost of $50 per month per line and up depending on distance and location would be a typical cost. Telephone tie lines are not without problems. Users have experienced interruption of service through cable cuts or through failure of telephone equipment in switching offices. While the telephone companies are generally very responsive to repairing outages of emergency radio systems, users have reported that outages occurred at a frequency greater than required in a public safety system.

In recent times, the most popular means of connecting these types of remote base stations is the use of unlicensed microwave radio system. Unlicensed radio links has proven reliable and effective at providing the level of connectivity required of a public safety system. These systems offer a high degree of flexibility in their configuration.

3.3 Proposed Network Configuration and Recommendations

3.3.1 Narrowbanding Existing Systems

The Town of Norwich appears to be ready to convert to narrowband operation. There are approximately seven [7] subscribers in questions with two requiring replacement; however, the current inventory is capable of being narrowbanded.

Narrowbanding should be coordinated with Hartford Dispatch Center and local municipalities that Norwich frequently communicates with on their frequencies. Both the fire and police radios have frequencies programmed in their radios belonging to other town and close coordination is required as to when reprogramming should be begin to minimize mixed mode [wideband and narrowband] operation where audio and coverage may be degraded.

Coverage performance in narrowband may differ from wideband because when converting to narrowband operation, the receiver's ability to overcome the reduced transmitter deviation influences the effective receiver sensitivity. While the noise floor sees some improvements, the ratio between the carrier and noise is reduced. Loss of coverage is typically 3-dB

In layman's terms, when converting to narrowband operations there is a reduction in coverage in areas where wideband operation experienced low signals [fringe area]. If a radio system performance in wideband never had fringe area communications problems, then coverage due to narrowband conversion will show no coverage reduction. Conversely, systems with noticeable fringe areas [very noisy signal] in the wideband mode should expect very poor or no coverage in these areas when narrowbanded.

Maps showing wideband and narrowband performance comparison was provided under separate cover – Mapbook-1.

Budgetary cost for converted the existing inventory to narrowband is provided in the cost section of this report.

3.3.2 Improve Existing Police, Fire, and DPW Radio Systems

CDCG's recommendation to improve radio communications in Norwich is to relocate police and fire communications currently located on Hurricane Hill. While the Hurricane Hill location has considerable ground elevation, it does not provide reliable coverage in Norwich. The site is approximately 5-miles south of downtown Norwich.

In collaboration with Norwich public safety officials and signal propagation analysis, a site located in Norwich is highly desirable and advantageous and will provide a higher degree of coverage reliability greater than the existing site at Hurricane Hill. The selected site is located in proximity to the Norwich Town Garage. Furthermore, a second site is recommended to fill in coverage gaps, especially in the northeast part of Norwich. Coverage analysis shows that the Hayes Hill site located in Etna, NH will provide coverage in this area.

Additional remote transmitter sites may be required to improve coverage in other areas of Town experiencing deficient coverage, such as the southwest portion of Norwich. Our recommendation is the system should be evaluated for realtime coverage supported by the two proposed sites prior to implement supplemental solutions.

3.3.2 Operating Spectrum

As discussed elsewhere's, both the police and fire departments are utilizing frequencies licensed to the Town Hartford. Although both Towns have worked cooperatively and closely with each other regarding the use of the spectrum, we recommend that Norwich have their own frequency authorizations to institute flexibility regarding public safety communications.

There is already an unused UHF frequency pair licensed to Norwich for police operations. The frequency is licensed as a base station at the Police Department; however, preliminary examination of this frequency shows that it can be licensed at alternate locations within the Town.

For the fire services, CDCG has performed frequency research and has found two VHF frequencies that can be licensed in Norwich. The two frequencies can be configured for repeater operation.

DPW currently utilizes a simplex VHF channel currently operating from the DPW garage. DPW should be converted to repeater operation. A mobile only channel is required for this functionality.

Additional research is needed to identify to what extent the frequencies can be expanded to other locations without violating FCC co-channel assignment rules.

3.3.3 Communications Sites

It is recommended that the Town utilize two [2] transmitters sites for public safety communications. These are:

1. New proposed tower at DPW garage
2. Hayes Hill, Etna, NH

Hayes Hill is the Town of Hanover's primary radio site and may be available to Norwich to install the appropriate base station equipment. The site has an antenna mounting structure, shelter, and emergency generator.

For the DPW site, a new tower structure and communications shelter is recommended at the DPW garage location. This site is selected as it on Town property with electrical power available.

The infrastructure equipment consists of the equipment necessary to provide the critical communications link between transmitter sites, and from the 911 center to the mobile and portable radios including alert pagers.

- Site compound - approximate 50' x 50' land area minimum required for a new site with access road
- Fence for security
- 180-foot self-support tower to meet the radio coverage requirements
- Equipment shelter [8'x8' or 8'x12'] fully equipped with electrical, HVAC, etc.
- Emergency power generator
- Foundations for shelter, tower and generator
- Antenna systems for voice radio and alert paging
- Site ground and surge protection systems
- Diesel/propane generator with automatic start, automatic transfer switch and fuel tank
- Alarm system for equipment status and site security
- Alert paging and dispatch monitor analog conventional simulcast equipment

3.4.5 Conceptual Infrastructure Design

Radio Equipment

Equipping the communications site with RF equipment [base stations and repeaters] to provide reliable coverage should utilize equipment specifically designed to provide public safety grade level of service. The benefits typically include interference mitigation, continuous duty operation, and other technical parameters designed for 24/7 operations. The lifecycle of this equipment is typically a decade or more. Converted mobile radio with accessories configuration is not recommended.

A new repeater programmed on the current police license for 453.900 MHz will be installed at the proposed new location.

The new VHF frequency pair for the fire department will be configured for repeater operation as well. The DPW VHF channel that is now simplex, can also be configured for repeater operation. A new mobile only frequency will be needed to do this.

Currently, the simplex channel that fire and DPW are using is optimum for base station [9-1-1] to mobile communications. This is due to base station typically on higher elevation terrain compared with the surrounding terrain. Mobile-to-mobile [or portable-to-portable] communication is difficult since both units have low antennas [car rooftop]. Coverage between vehicles is difficult as terrain is a predominant factor signal blockage. Typical ranges are about 1-mile. In simplex operation, some mobiles may not hear both sides of a base-to-mobile conversation depending where they are in Norwich.

Repeater Systems

A repeater system [also known as mobile-relay] operates as half-duplex. This arrangement allows the base station to receive and transmit simultaneously. A received signal from a mobile or portable unit is automatically retransmitted by the repeater transmitter. The retransmitted signal is then received by all radios on the frequency. This configuration is normally used to increase coverage of the mobile or portable units. In similar fashion, it makes it possible for all mobile or portable radios to hear each other regardless where they are in Town.

The use of repeaters also allows fixed locations, such as 9-1-1, police and fire departments, to control the repeater using RF control stations thus not requiring leased line of microwave links between these locations.

Transmitter Simulcast

CDCG recommends that transmitter simulcasting of the two communications sites be deployed. Transmitter simulcasting is used to obtain wide area coverage. Simulcasting is two or more transmitters transmitting the same voice communications on the same frequency simultaneously. By maintaining very accurate control of frequency and other signal parameters of multiple transmitters, the reliability of reception in the coverage overlap area is improved through this technique. This is due to the subscriber unit potentially "see" more than one transmitter signal at its receiver [in the overlap area only].

The major benefit of simulcasting is achieving high quality wide area coverage while maintaining simplicity of operation from a users perspective. The use of simulcast transmission simplifies the user interface because it eliminates the need to change radio channels as the user moves through one coverage area to another. As discussed, simulcasting requires more accurate control of certain parameters than normally in conventional systems. Simulcasting requires a highly stable transmitter frequency, as well as control over the modulated voice signal. Therefore, the cost of simulcasting is more than non-simulcast systems.

Multisite, Non-Simulcast

For non-simulcast system, one technique for providing wide area coverage is referred to as transmitter steering. This configuration employs multiple transmitter sites along with a receiver voting network. This technique requires that certain receivers within the network be weighted as to their primary coverage of certain geographical areas. Then the transmitter that would best cover that area is selected automatically. In other words, the system automatically selects the appropriate transmitter based on received signal from the field. In a single frequency simplex system, the selected transmitter would be used to send the dispatcher's audio. In the case of a two-frequency half-duplex system such as a repeater configuration, the selected transmitter rebroadcasts the received signal.

Unfortunately, due to propagation anomalies, transmitter steering may cause an incorrect transmitter to be selected. In addition, transmitter steering will not afford area-wide mobile-to-mobile and portable-to-portable coverage due to the fact that in certain areas the selected transmitter might not be heard by the other users. Also, there is a problem in determining which transmitter should be used to make the initial dispatch call. Although the dispatcher may have the capability to select the transmitter used, the dispatcher must make a guess as to the location of the unit being called. After the unit responds, then the voting system selects the transmitter, and the dispatcher automatically uses the proper transmitter. But that initial call can be problematic. This technique however, is more appropriate and is commonly used in data system applications for wide area coverage.

Receiver Voting

Whether simulcast or multicast is utilized; a receiver voting system will be required.

Voting receivers are used to route the appropriate audio to the respective base station repeater. In this scenario, the signal transmitted by the mobiles or portables can be received by one of the two proposed receivers. A voting system comparator is used to choose the best signal received from the two receivers. The voted signal is then routed to the transmitters for rebroadcast of the signal in a repeater system, or to select the appropriate transmitter site in a transmitter steering network.

Site Connectivity

Furthermore, the two proposed transmitter sites will require a link to exchange and control audio at each location. As discussed, leased telephone lines are an option but not if simulcast is used. Generally, a leased line [4-wire audio] is needed for each repeater/base station for control. This cost can average $50/month per base station. For simulcast, a T1 is recommended. A T1 is a high-speed [1.54 MBPS] data link that is needed to maintain the appropriate simulcast parameters. It can also accommodate several transmitters. Leased T1 circuits cost range from $400 to $1,000 per month depending on location, service provider, and distance. Therefore, public safety will generally deploy their own wireless link for this function. CDCG recommends that the Town implement an unlicensed microwave link for connectivity. To implement this solution, line-of-sight [LOS] is required between transmitter locations. Preliminary analysis shows that there is LOS between the proposed DPW location and Hayes Hill.

Dispatch Center and Department Location Requirements

The requirements for the Dispatch Center require minor modification to interface Norwich systems with the communications console. The modification is transparent to the communications center; that is, it would be the same

modification regardless if it were Hartford or Hanover. The console is modified to accommodate police and fire RF control stations needed to access the radio system. The control stations would be remoted from the console position.

In lieu of RF control stations and of greater preference is to employ an unlicensed microwave hop to the communications center, connecting it directly to both proposed radio sites. This connectivity would provide the dispatcher "console priority". Console priority is a console feature that will pre-empt a call-in-progress to ensure that the dispatcher has priority to transmit emergency calls at any moment. In this direct interface mode, the RF control stations are not required but could serve as a backup should the console fail.

Radio control at the Norwich Police, Fire, DPW departments and EOC would be by RF control stations, similar to the existing police department configuration in use today.

4.0 9-1-1 and Dispatch Center Considerations

This section is intended to compare and contrast technology options that may be available to Norwich to improve its outsourced 9-1-1 call-taking and dispatching operations. The Town currently utilizes Hartford Dispatch Center for these services; however, it is open to transfer these operations to Hanover Dispatch. The Town has historical information regarding Hartford to assist them in identifying which center to chose. Cost projections have not provided; however, this report does provide technology capability and interface requirements for both Hartford and Hanover Dispatch Centers.

Our research has identified that a partnership with either dispatch facility would not pose significant technical, operational, logistical, political, and economic challenges. Both Centers have modern facilities with concurrent technologies. Staffing capabilities are similar. Our recommendation is that both can provide a high level of call-taking and dispatch services to Norwich. Norwich should negotiate services and fees directly with each center to provide the best solution for the Town. Our general belief is that dollars over service should not rule public safety decisions. Dispatching efforts may include lower or higher cost, but the final effort should be focused on improving service and response time rather than saving money.

However, there is one key element that differs between both Communications Centers - radio communications for both Law Enforcement and the Fire Services.

Hartford Dispatch: Norwich Fire utilizes the 154.325 MHz frequency that is licensed to both Norwich and Hartford. The channel is being shared by both departments. Although Norwich claims to be the original licensee, there appears to be no MOU allowing Hartford use of this channel. As a result, neither can expand this frequency to other sites without the other providing a Letter of Concurrence to the FCC. Norwich is seeking alternate frequencies for their own operations under this project. Please note that signal coverage from the Hartford transmitter site in Norwich town boundaries is considered very poor, as discussed in the radio coverage section of this report.

For Law Enforcement, the Police Department is using 460/5.250 MHz. This frequency is licensed to the Town of Hartford only but is dispatching Norwich PD on it. The Town of Norwich has 453/8.900 MHz licensed at the Police Department and is not currently using this frequency. The license would have to be modified to other sites(s) to enhance coverage. It appears that this frequency can be expanded to other locations within the Town. Analogous to the Fire Department's situation, coverage from the Norwich transmitter site is not adequate in providing reliable communications.

Hartford has the capability to accommodate the new frequencies on their communications console equipment.

Hanover Dispatch: Should Norwich transfer call-taking and dispatching services to Hanover, Hanover will allow Norwich to be dispatch on their current primary dispatch frequency. Although coverage from Hayes Hill appears to be somewhat reliable, it is recommended that Norwich continue to seek alternative frequency for the fire services and locate the transmitter within Town boundaries.

For Law Enforcement, the Town of Norwich would have to build out the 453/8.900 MHz channel to provide the required coverage.

Hanover has the capability to accommodate the new frequencies on their communications console equipment.

Considerations for Communication Center Selection

In seeking services for Call-Taking and Dispatch services, it is important that the Communications Center is capable to receive, process, and distribute information rapidly. If the goal of the communications center is to transmit messages efficiently, then it must be designed and operated with the fewest impediments to information flow. Inbound information must be received promptly.

There must be an adequate number of call-takers and call-taking positions, caller ID, and enhanced 911 used to facilitate caller identification, features such as voice mail boxes to avoid the necessity of taking messages, enhanced radio systems; computer aided dispatch [CAD], and a wide area network [WAN] for distribution of information and messages to participating agencies.

Besides the effective use of technology, the staff must be well trained, and routine and emergency procedures must be practiced and reviewed constantly. In addition, common policy and procedures will be necessary.

Policy and procedure development guidelines are available from commercial printers and the Association of Public Safety Officers Association [APCO]. The policy and procedure document must rationalize differences in past practices into standardized operating procedures such as: what call information is given initially, how E 9-1-1 hang ups are handled, multi-unit/agency/services responses, canceling a response, pre-arrival information, and special channel assignments for unique incidents. Participating agencies and the public at large will be best served if the communications staff does not have a multitude of different procedures to follow.

Once the call information has arrived in the communications center, the information needs to be prioritized. Incidents identified as, or suspected to be emergencies must receive immediate processing, while non-emergencies should be processed when units are available. The staff must be trained to identify emergency incidents, even when they are not reported as an emergency. Staff must know the correct response according to adopted Policy and Procedures. The staff also needs the tools that will allow them to alert, contact, and communicate with the response units.

The telephone system must perform at an optimum level and achieve the highest reliability. It must allow Enhanced 911 calls to be answered first. Seven-digit emergency numbers are typically used less as the use of Enhanced 911 increases.

Ideally, only seven-digit calls that require a unit to be dispatched should be answered at the communications center. However, this will not always occur. A telephone system at the communications center should include the following features:

- Ability to accept all existing seven-digit published numbers.
- Ability to transfer a non-emergency, or non-call-for-service caller, to a specific department.
- Ability to transfer a non-emergency, or non-call-for-service caller, to a voice mailbox.

Individual departments, particularly police, must capitalize upon the use of Direct Inward Dialing (DID). DID will assist in keeping messages out of the Communications center. Administrative calls for specific departmental functions, such as records, traffic, investigations, and general information, should not be routed through the Communications Center.

Finally, the Dispatch Center should follow industry best practices, standards and related requirements from [1] the **Association of Public-Safety Communication Officials (APCO).** APCO Best Practices are accredited by the American National Standard Institute. Currently APCO has best practices and standards for staff training, management, and technical applications; [2], **National Emergency Number Association (NENA).** NENA has developed standards for E-911 related data protocols, transferred and switching standards, along with operational standards; and [3], **National Fire Protection Association (NFPA).** NFPA codes have been adopted by reference by some code enforcement agencies. Other NFPA codes such as NFPA 1221, recommends communication center standards should be considered guidelines but are not mandated. NFPA 1221 is recognized as containing pertinent communication center design issues and is used by the Insurance Services Office in developing Public Protection Classifications for fire departments that is used by some insurance companies for determining fire insurance rates

The following matrix is a high-level survey comparing capabilities and function of Hartford and Hanover Communications Centers.

	HARTFORD, VT	HANOVER, NH

	HARTFORD, VT	HANOVER, NH
Sponsoring Organization	Hartford Police Department	Hanover Police Department
Governance	Advisory Panel	None, Bylaws
Director	Mr. Scott Smith	Mr. Doug Hackett
User Input	Advisory Panel meets twice yearly	Bi-annual Chief meetings; open door policy
Backup Center	PSAP Backup: VSP Rockingham & Derby Radio: Hanover	Lebanon Dispatch; fiber link between facilities; building up interop in region
Plans to replace, remodel or enlarge facility	Just completed upgrade; new Harris communications dispatch consoles when state contract executed	Equipment refresh program; logging recorder replaced; planning for 2016 major upgrade
Capacity for additional call responsibility under current	Currently dispatching Norwich on Hartford radio channels for Police and Fire Currently providing dispatch services to Norwich; currently no service issues; no staffing issues	Staffing currently not at maximum staffing; will require additional FTE to accommodate Norwich
Law enforcement agencies	Currently dispatching Hartford, Windsor, and Norwich Police departments	Currently dispatching Plainfield, Cannon, Enfield, Hannover, Lyne, Orford and Peirmont Police Departments
Fire service agencies	Currently dispatching Hartford, Sharon, South Royalton, Norwich, Hartland, Windsor, West Windsor, Reading, West Weathersfield and Ascutney Fire Departments	New Hampshire: Currently dispatching Cornish, Plainfield, Meriden, Oxford, Cannon, Grafton, Grantham, Springfield, Hanover, Lyme, Orford, Peirmont and Bradford Fire Departments Vermont: Fairlee, Thetford, Strafford, West Fairlee and Vershire Fire Departments
EMS agencies	Hartford, Norwich, Sharon, South Royalton, Hartland, Windsor, West Windsor, Reading, West Weathersfield and Ascutney.	Hanover, Corinth, Carmen, Enfield, Grafton, Orford, Peirmont, Bradford, Fairlee, Thetford, Strafford, Vershe, West Fairlee, Lyme, Cornish, Springfield
E-911 wire line and wireless operations	Wireline: Wireless: 9-1-1 wireless calls routed directly to Hartford	Wireline: Wireless:

	HARTFORD, VT	HANOVER, NH
Seven digit law enforcement operations	Norwich Police has a line with recorder referring to Hartford Dispatch for after hour calls There is an emergency line between Hartford and Norwich to transfer dispatch calls (News to me)	Hanover has existing 469 seven digit number to transfer calls to Hanover. Can transfer calls to voicemail, cell phone, etc. Hanover will provide required 7-digit line services as required by Norwich
Municipal, residential, and commercial alarms	Hartford has new alarm system and is looking to expand services	Hanover is open to provide alarm monitoring services
Police/Fire/EMS dispatches	Call volume approximately 2500 per year	No statistics since PSAP operated by the state
PSAP	Utilizing Intrado [Positron] PSAP	No PSAP in Hanover; New Hampshire has single statewide PSAP
EMD	Hartford currently providing EMD services	Hanover transfers EMD calls to 9-1-1 in New Hampshire or Vermont for EMD
Communications Console	There are two dispatch positions. The current console is a Motorola Centracom Console that will be replaced by a new Harris console in the near future	There is two dispatch positions plus one supervisor position. The Motorola Centracom Dispatch Console was upgraded to Gold Elite in 2009
Computer Aid Dispatch & Records	Utilizing Spillman CAD	IMC CAD is currently utilized by Hanover
Mapping/AVL		Currently no mapping capability; software in place need to develop files. Should be operational within 2-years.
Telephone systems	In house PBX, Fairpoint provides service	Utilizing Avaya PBX with redundant T1s to telephone exchange. Has POTS lines for backup
Call taking staff	Currently the Dispatch Center has eight [8] full time and three [3] part time staff. Typically two plus the supervisor on duty days; two on evening shifts and one 12am-6am	Currently the Dispatch Center has eight [8] full time and three [3] part time staff. There are two for the 1am-6am shift; and three on Friday evenings. Staffing based on volume and event
Recording **IRR /Logging**	Currently using Acorn for recording	Currently using ??? for recording; will have sufficient capacity for Norwich
Emergency power	Emergency generator	Emergency generator; planning for UPS in the future
Special monitoring	Monitoring local security cameras	Monitoring video for booking in Enfield; utilizing IP cameras
Technical Support	Have in-house IT person; using Burlington Communication for radio and recording; Fairpoint for telephone	Utilizes town IT staff with in-house technical capability; Service contracts for video, records, phone and radio
Training	In-house training; supplementing with APCO	In-house training; supplementing with APCO

	HARTFORD, VT	HANOVER, NH
Radio systems and sites	Currently utilizing one site for communications – Hurricane Hill This is a 150-ft triangular tower	Currently have multiple sites with Hayes Hill being primary. Other sites include South Main St tower, Police Department and Lyme Rd site

5.0 Preliminary Design and Budgetary Estimates

5.1 Introduction

This section will present a set of budgetary estimates for the proposed conceptual system design along with software upgrades to meet FCC Narrowbanding requirements.

5.2 Assumptions

A set of design assumptions has been employed to properly estimate the budgetary costs of the proposed system. These assumptions are based on the conceptual system design alternatives discussed in Section 3.3. The cost of a communication system is largely dependent upon two components: the system infrastructure, which includes repeater sites, and the number of subscriber units to be re-programmed or replaced.

5.2.1 Infrastructure

The pricing shown below identify capital costs for the proposed project. Estimated pricing is not based on any vendor; however, ***it assumes high tier equipment and on industry best available average estimates. Actual cost resulting from the final design, competitive bidding process, and selection of equipment tier may be less.***

5.2.2 Estimated Budgetary Costs (NEEDS UPDATING)

Estimated Capital Cost – Includes Installation

Item		Estimated Expenditures
Narrowbanding		
1-Reprogram mobile and portable radios [Qty 109 @ $75 ea]		$ 8,175
	Sub-Total:	**$ 8,175**
Radio Equipment		
2-Base station[1] [Qty 2 @ $22,000 ea]		$ 44,000
3-Unlicensed microwave[2] [Qty 4@ $25,000 ea]		$100,000
4-Multiplex equipment [Qty 3@ $5,000 ea]		$ 5,000
5-Receiver voting system		$ 7,500
6-Simulcast equipment[3]		$ 75,000
7- RF control station[4]		$ 29,000
8-Console equipment interface		$ 6,000
	Sub-Total:	**$266,500**
Tower Site [proposed DPW location]		
9- Tower[5]		$135,000
10- Communications Shelter[6]		$ 45,000
11- Generator[7]		$ 15,000
	Sub-Total:	**$195,000**
Other		
11-Physical path surveys, per end [Qty 4 @750 ea]		$ 3,000
12-Tower structural analysis [Qty 1@$2,500]		$ 2,500

[1] Base station/repeater includes duplexer, antenna, transmission line, lightning & surge protection, grounding
[2] 5.8 or 4.0 GHz unlicensed microwave includes antenna, transmission line, lightning & surge protection, grounding
[3] GPS and audio synchronization equipment for transmitter simulcast
[4] Control stations for Dispatch Center [2], Norwich PD, FD, and DPW
[5] 180-foot self-support tower, foundation, grounding, lightning protection
[6] 8'x12' prefabricated shelter, foundation, electrical, HVAC, conduits, and delivery
[7] 10 kw generator, fuel tank, etc.

13-Contingency [@10% project]		$ 47,517
	Sub-Total:	**$ 53,017**
GRAND TOTAL		**$522,692**

6.0 Next Steps

Given that the number of subscriber units being reprogrammed or replaced to meet the narrowband mandate, the level of coverage identified and the proposed infrastructure to support it, the Town of Norwich needs to select the best approach to finalize and approve the final system configuration and conceptual design.

Once this is completed, attention will be turned to completing the following:

- Apply for FCC frequency coordination and licensing
- Develop detailed system specifications and a Request for Proposals (RFP) and issue to the vendor community
- Proposal solicitation
- Develop proposal evaluation criteria
- Review and evaluation vendor proposals
- Select successful vendor
- Negotiate and execute a purchase contract with the selected vendor, having completed the technical, contractual and pricing issue review and acceptance