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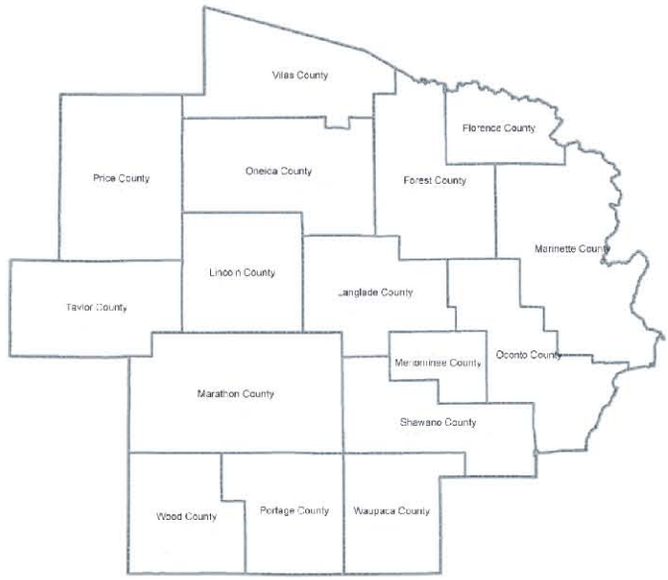
Regional Public Safety Radio Communications System Study

VOLUME 1



North East Wisconsin Public Safety Communications (NEWCOM)

May 31, 2005

Table of Contents

EXECUTIVE SUMMARY

Abstract

The sixteen counties that comprise NEWCOM, in response to various problems with their radio communications systems, have retained CTA Communications to review their communications environment. NEWCOM directed CTA to have special concern for their interoperability needs, and to recommend improvements that will not only respond to identified problems, but will also provide sufficient communications capacity to address the region's future needs.

CTA has analyzed each County's communications environment, and the environment of the region as a whole, and recommends a series of improvements phased to be implemented over a period of time.

Information Gathering

CTA Communications conducted over 94 interviews with various agencies and individuals. These interviews, along with written survey responses, provided us with an understanding of the current and desired operational environment. In addition, CTA conducted 145 site surveys and dispatch center surveys, which provided us with an understanding of the current communications equipment environment.

The agencies and communities within the Region have developed over the years a strong mutual aid and interoperability ethic. The agencies know they often depend on each. Your personnel have a strong interoperable mindset that is only limited by your technologies. Yet radios are generally in the same frequency band - VHF- allowing the counties to share frequencies. This sharing provides a large degree of interoperability among neighboring communities. Within each County, a good degree of agency interoperability and cooperation already exists. This is achieved primarily through use of the common VHF frequency band, and the sharing of channels. Your interoperability efforts are only limited by the technologies.

Problem Assessment Summary

Some of the Counties and agencies are in very good condition but many have room for improvement. CTA examined the counties' existing two-way radio and fire alerting/paging systems. Following is a summary statement of the problems, deficiencies, and concerns as either expressed to CTA in interviews and written surveys or observed by CTA during our site surveys.

Lack Of Coverage

Complaints about dead spots and poor voice coverage areas are common throughout the Region. Radio contact is often lost when operating with either portables or mobiles. Often these poor coverage areas are also areas where incidents frequently occur and that sometimes require a complex public safety response.

Inefficient Design

Many county systems consist of multiple repeaters distributed throughout the county, using the same frequencies but separated by different squelch tones and codes. Users must manually switch channels to access the repeater that provides coverage in their geographic area. This creates operational challenges for the field user, since they must proactively change channels as they move through the county. It also creates challenges for the dispatchers, who must also know where the field user is located at all times in order to select the proper repeater for communications. For a dispatcher who must monitor multiple channels, this process sometimes causes missed transmissions.

Transmitter Sites Inadequate

Many of the site facilities are inadequate. Poor site maintenance has led to loss of communications in a number of instances. Public safety communications systems must reliably function under all conditions. We observed problems with power, backup power, HVAC, site security, grounding, and lightning and surge protection. We also observed equipment buildings that were cramped, and would not support future expansion.

Aged Non-Fixed Equipment

A number of the agencies in the counties are using inexpensive radio equipment that generally would not be considered "public safety grade". When these radios are exposed to the kind of demands placed on them by public safety agencies, they often do not provide public safety service. They typically lack public safety radio features. Since they frequently transmit at lower power levels than typical public safety radios, their range is reduced, which further increases coverage problems. Some of the equipment was originally obtained used, and is no longer supported by the manufacturer. This means that repair parts are frequently no longer available. Much of the older equipment is not capable of meeting FCC mandated narrowband requirements.

Lack Of Back-Up Communications Between The Dispatch Centers

At present there exist only telephone line connections between dispatch centers. This prevents certain interoperability functions and makes little allowance for dispatch center back-up provisions. Lack of broadband interconnection keeps dispatch centers from being able to share data and files.

Fire Alerting/Pager System Limitations

As with the voice radio networks, most of the counties use multiple repeaters on the same frequencies for the fire alerting/paging operations. Dispatchers must manually switch between repeaters to obtain coverage in the geographic area of concern. Since the dispatcher must make an educated guess of the location of the individual being paged, some individuals fail to receive the call. The alerting systems have little or no redundancy. There are areas of the Counties where pager coverage is limited.

We note that there were substantial variations in the level of communications infrastructure and capabilities among the counties. While we found all of these conditions in some counties, we found in others that only one or two were evident. In the Study Report we described each county's specific situation. In this Executive Summary we describe the region collectively.

CTA also considered the future regulatory issues mandated by the FCC. Under their "Refarming" order, current radio systems in the 150 to 500 MHz bands will be required to be replaced with newer, more spectrally efficient equipment that uses less bandwidth.

While the older equipment is "grandfathered" until after 2011, the Counties will need to consider this mandate in their future operations. Much of the existing non-fixed radio equipments and some of the transmission infrastructure is not narrowband compliant at this time.

These major deficiencies plus a number of other operational and technical concerns inhibit the Counties' public safety agencies from interoperating at full capacity and efficiency. Mutual aid and assistance to and from neighboring jurisdictions routinely occur with limited ability to communicate by radio with the public safety personnel of those jurisdictions. This situation is inefficient at best.

Analysis

NEWCOM has determined that three conceptual phases will be used in the project: Near Term, Mid Term, and Long Term. Each phase has activities that address the areas of concern discussed above. CTA recommends that improvements are needed in several areas and technologies. The general goals of each of the three phases are:

Near Term

- Interoperability – Improve the ability of users in one agency to communicate with users in other agencies or counties by implementation of regional gateways. Improve the ability of dispatchers to communicate with dispatchers in other counties by implementation of a regional microwave network.

- Improved Coverage – Improve coverage in each county by adding sites and channels throughout the region, and simulcasting counties where necessary.

- Interconnectivity (Microwave) – Support new radio sites by adding microwave links. Improve interoperability, the ability of dispatch centers to back each other up, and also enable adjacent county radio sites to improve coverage by adding inter-county microwave links. Improve reliability by providing loop redundancy.

- Consoles – Improve dispatch capability in some counties by adding console position hardware where necessary.

- Non-Fixed Units – Improve reliability by replacing aged equipment. Enable modern features by updating older non-fixed equipment.

- Mobile Data – Increase mobile data access in counties currently equipped with data by adding units.

- Encryption – Improve law enforcement interoperability security by implementing a standard Regional encryption approach.

- Maintenance – Improve mutual aid response by standardizing regional radio programming and procedures. Improve maintenance response and overall reliability, as well as cost effectiveness by moving toward shared maintenance resources. Implement regional maintenance purchasing process.

Mid Term

- Interconnectivity (Microwave) – Prepare for Long Term interconnectivity improvements by incremental additional improvements in microwave.

- Consoles – Continue to add consoles if required.

- Non-Fixed Units – Begin considering the FCC narrowband mandate for portables and pagers. In general all non-fixed units not replaced in the Near Term will be replaced in this phase.

- Mobile Data – Improve interconnectivity and support the Long Term mobile data requirements by adding message switches.

Long Term

- Interoperability – Move toward seamless interoperability by implementing an IP connectivity network throughout the NEWCOM Region.

- Improved Coverage – Implement regional public safety grade coverage improvements by further simulcasting. Address the effects of digital P.25 conversion by adding sites.

- Interconnectivity (Microwave) - Upgrade to licensed links to provide a seamless and reliable interconnectivity between the regional entities.

- Non-Fixed Units – Implement replacement schedule based on a seven to ten year useful non-fixed equipment life span. Add units in response to known growth estimates.

- Mobile Data – Implement regional approach to Mobile Data by shifting to independent mobile data systems that are interoperable throughout the NEWCOM Region.

- Maintenance – Finalize a regional maintenance plan will be in effect and implemented.

Procurement

The equipment and services needed for these improvements fall into five major categories:

- Fixed
- Physical Facilities
- Microwave
- Non-Fixed
- Mobile Data

CTA recommends that NEWCOM pursue a regional purchase process. We envision a separate purchase process for each of these five categories of equipment. This process would produce a common pool of equipment and services, which would provide pricing that each county can select and use. We believe this will provide a number of benefits to the region:

- Competitive and larger scale procurement will provide effective pricing.

- Focusing on vendors that are expert in their area will provide higher feature and higher quality services and equipment.

We note that Oconto County has been successful in implementing projects in this separate purchasing manner in the past. They have several recent experiences of saving money in this way. This is consistent with CTA's recent experiences where separate purchases of categories of equipment resulted in better service and lower costs, even in complex projects.

We have included costs in the estimates that provide for the management and independent verification/validation services that will be necessary to integrate separate procurements. We recommend that the separate procurements be planned around the phased approach, with contractual controls in place to protect against long term cost escalation.

Estimated Cost

CTA has developed cost estimates for our recommendations. Our estimates reflect "average" expected pricing, which we recommend be used for planning and budgetary purposes.

We include four display tables:

- TABLE E-1 contains Near Term Estimates
- TABLE E-2 contains Mid Term Estimates
- TABLE E-3 contains Long Term Estimates
- TABLE E-4 contains a Total of the estimates for all three Phases

All tables show unescalated costs in 2005 dollars, since we do not include a specific timeline for the later phases.

In each table, we show for each county our estimates for the five equipment categories described above: Fixed infrastructure, Microwave, Consoles, Non-fixed, and Mobile Data. We also show the estimated Management (PM/IV&V) costs for design, procurement, and implementation oversight.

The "Interoperability" entry in each table shows the estimates for regional costs, that are not allocated to specific counties. We expect that this cost will be distributed among the counties in a pro-rated manner to be determined later.

Conclusions

The state of public safety communications in your counties will have a direct impact on the quality of life in your communities. Your citizens deserve the very best of service that you can provide. In this Study we have placed a great emphasis on realistic and conscientious spending. Our recommendations reflect not a "pie in the sky" system, but a good serviceable communications network that will serve you now and in the future.

The NEWCOM agencies and their personnel have expended a great deal of effort in assisting CTA in creating this Study. From our perspective it has been an enjoyable and satisfying experience. It is important that this effort be for good effect for the participants. We ask that all concerned parties carefully review the parts of the Study Report that pertains to them or their County, and also review the parts that describe the regional (NEWCOM) aspects of the project. From a position of knowledge you will then be able to take the next steps: decide on and initiate your course of action.

TABLE E-1
NEAR TERM COSTS ESTIMATE FOR NEWCOM REGION

NEAR		Fixed					
Total	Infrastructure	MW	Consoles	Non-Fixed	Mobile Data	PM / IV&V	
Florence	$ 2,065,989	$ 1,537,002	$ 158,133	$ 48,800	$ 174,200	$ 12,800	$ 135,053
Forest	$ 987,262	$ 679,149	$ 226,880	$ -	$ 31,700	$ -	$ 49,533
Langlade	$ 1,366,196	$ 811,953	$ 322,952	$ -	$ 135,000	$ 3,200	$ 93,092
Lincoln	$ 2,179,314	$ 1,363,324	$ 454,921	$ -	$ -	$ 214,200	$ 146,870
Marathon	$ 3,602,860	$ 2,542,358	$ 909,842	$ -	$ -	$ -	$ 150,660
Marinette	$ 101,008	$ -	$ -	$ -	$ 76,800	$ -	$ 24,208
Menominee	$ 1,446,379	$ 1,177,429	$ 108,280	$ -	$ 41,700	$ 37,800	$ 81,170
Oconto	$ 3,662,766	$ 2,089,622	$ 1,127,563	$ 195,200	$ -	$ 77,142	$ 173,238
Oneida	$ 3,851,897	$ 2,453,949	$ 553,467	$ 195,200	$ 286,600	$ 100,800	$ 261,881
Portage	$ 3,305,865	$ 2,188,648	$ 830,775	$ -	$ 105,000	$ 12,600	$ 168,842
Price	$ 1,822,728	$ 1,297,087	$ 237,200	$ -	$ 118,000	$ 50,400	$ 120,041
Shawano	$ 3,314,305	$ 1,287,144	$ 876,994	$ -	$ 676,700	$ 126,000	$ 347,468
Taylor	$ 1,973,680	$ 1,285,764	$ 158,133	$ -	$ 342,300	$ 12,600	$ 174,883
Vilas	$ 1,165,271	$ 43,344	$ -	$ -	$ 385,400	$ 466,200	$ 270,327
Waupaca	$ 5,679,310	$ 3,762,176	$ 1,002,278	$ -	$ 272,900	$ 264,600	$ 377,356
Wood	$ 3,687,438	$ 2,060,013	$ 876,994	$ 289,750	$ 79,400	$ 163,800	$ 217,481
Interoperability	$ 3,474,356	$ 772,452	$ 2,556,618	$ -	$ -	$ -	$ 145,286
NEWCOM	**$ 43,686,624**	**$ 25,351,414**	**$ 10,401,031**	**$ 728,950**	**$ 2,725,700**	**$ 1,542,142**	**$ 2,937,387**

TABLE E-2
MID TERM COSTS ESTIMATE FOR NEWCOM REGION

MID	Fixed						
Total	Infrastructure	MW	Consoles	Non-Fixed	Mobile Data	PM / IV&V
Florence	$ 569,216	$ 194,676	$ -	$ -	$ 304,200	$ 12,800	$ 57,539
Forest	$ 837,783	$ 192,396	$ -	$ -	$ 575,000	$ -	$ 70,387
Langlade	$ 1,423,194	$ 755,935	$ -	$ -	$ 479,300	$ 3,200	$ 184,758
Lincoln	$ 759,679	$ 235,657	$ -	$ -	$ 236,700	$ 214,200	$ 73,122
Marathon	$ 2,401,636	$ 890,377	$ 501,139	$ -	$ 218,400	$ 462,336	$ 329,383
Marinette	$ 1,455,038	$ 19,350	$ -	$ -	$ 679,500	$ 681,765	$ 74,423
Menominee	$ 760,479	$ 151,415	$ -	$ -	$ 510,900	$ 37,800	$ 60,364
Oconto	$ 445,660	$ -	$ -	$ -	$ -	$ 423,765	$ 21,895
Oneida	$ 2,123,753	$ 194,676	$ -	$ -	$ 1,270,600	$ 524,565	$ 133,911
Portage	$ 1,570,112	$ 324,461	$ -	$ -	$ 760,000	$ 359,223	$ 126,428
Price	$ 545,279	$ 92,880	$ -	$ -	$ 361,100	$ 50,400	$ 40,899
Shawano	$ 1,328,758	$ -	$ -	$ -	$ 598,000	$ 665,478	$ 65,280
Taylor	$ 121,081	$ 89,010	$ -	$ -	$ -	$ 12,600	$ 19,471
Vilas	$ 1,679,196	$ -	$ -	$ -	$ 1,130,500	$ 466,200	$ 82,496
Waupaca	$ 706,825	$ -	$ -	$ -	$ 407,500	$ 264,600	$ 34,725
Wood	$ 1,100,371	$ 35,521	$ -	$ -	$ 456,400	$ 548,994	$ 59,456
Interoperability	$ -	$ -	$ -	$ -	$ -	$ -	
NEWCOM	**$ 17,828,059**	**$ 3,176,356**	**$ 501,139**	**$ -**	**$ 7,988,100**	**$ 4,727,926**	**$ 1,434,538**

TABLE E-3
LONG TERM COSTS ESTIMATE FOR NEWCOM REGION

	LONG	Fixed					
	Total	**Infrastructure**	**MW**	**Consoles**	**Non-Fixed**	**Mobile Data**	**PM / IV&V**
Florence	$ 958,281	$ -	$ -	$ -	$ 478,400	$ 439,765	$ 40,116
Forest	$ 1,075,487	$ -	$ -	$ -	$ 606,700	$ 423,765	$ 45,022
Langlade	$ 2,009,064	$ 850,901	$ -	$ -	$ 614,300	$ 426,965	$ 116,897
Lincoln	$ 1,007,122	$ 86,946	$ -	$ -	$ 236,700	$ 637,965	$ 45,511
Marathon	$ 227,942	$ -	$ -	$ -	$ 218,400	$ -	$ 9,542
Marinette	$ 898,245	$ -	$ -	$ -	$ 756,300	$ 104,342	$ 37,603
Menominee	$ 1,110,790	$ 73,272	$ -	$ -	$ 552,600	$ 435,594	$ 49,324
Oconto	$ 257,925	$ 200,818	$ -	$ -	$ -	$ 38,571	$ 18,537
Oneida	$ 3,857,179	$ 103,200	$ 1,578,360	$ -	$ 1,557,200	$ 392,142	$ 226,276
Portage	$ 996,456	$ -	$ -	$ -	$ 865,000	$ 89,742	$ 41,714
Price	$ 954,658	$ -	$ -	$ -	$ 479,100	$ 435,594	$ 39,964
Shawano	$ 1,713,625	$ 123,047	$ -	$ -	$ 1,274,700	$ 239,400	$ 76,479
Taylor	$ 772,430	$ -	$ -	$ -	$ 342,300	$ 397,794	$ 32,336
Vilas	$ 4,739,523	$ 116,100	$ 1,393,955	$ -	$ 1,515,900	$ 1,456,965	$ 256,604
Waupaca	$ 1,494,321	$ -	$ -	$ -	$ 680,400	$ 751,365	$ 62,556
Wood	$ 769,618	$ -	$ -	$ -	$ 535,800	$ 201,600	$ 32,218
Interoperability	$ 6,571,772	$ 6,063,000	$ -	$ -	$ -	$ -	$ 508,772
NEWCOM	**$ 29,414,439**	**$ 7,617,284**	**$ 2,972,315**	**$ -**	**$ 10,713,800**	**$ 6,471,569**	**$ 1,639,472**

Table E-4
TOTAL COSTS ESTIMATE FOR NEWCOM REGION

Per County		Fixed				PM / IV&V
		Infrastructure	MW	Consoles	Non-Fixed	Mobile Data	
Florence	$	3,593,485	$ 1,731,679	$ 158,133	$ 48,800	$ 956,800	$ 465,365	$ 232,708
Forest	$	2,900,532	$ 871,545	$ 226,880	$ -	$ 1,213,400	$ 423,765	$ 164,942
Langlade	$	4,798,454	$ 2,418,790	$ 322,952	$ -	$ 1,228,600	$ 433,365	$ 394,747
Lincoln	$	3,946,116	$ 1,685,927	$ 454,921	$ -	$ 473,400	$ 1,066,365	$ 265,503
Marathon	$	6,232,437	$ 3,432,735	$ 1,410,981	$ -	$ 436,800	$ 462,336	$ 489,585
Marinette	$	2,454,291	$ 19,350	$ -	$ -	$ 1,512,600	$ 786,107	$ 136,234
Menominee	$	3,317,648	$ 1,402,116	$ 108,280	$ -	$ 1,105,200	$ 511,194	$ 190,858
Oconto	$	4,366,350	$ 2,290,440	$ 1,127,563	$ 195,200	$ -	$ 539,478	$ 213,670
Oneida	$	9,832,828	$ 2,751,826	$ 2,131,827	$ 195,200	$ 3,114,400	$ 1,017,507	$ 622,069
Portage	$	5,872,433	$ 2,513,108	$ 830,775	$ -	$ 1,730,000	$ 461,565	$ 336,984
Price	$	3,322,665	$ 1,389,967	$ 237,200	$ -	$ 958,200	$ 536,394	$ 200,904
Shawano	$	6,356,688	$ 1,410,191	$ 876,994	$ -	$ 2,549,400	$ 1,030,878	$ 489,226
Taylor	$	2,867,190	$ 1,374,774	$ 158,133	$ -	$ 684,600	$ 422,994	$ 226,689
Vilas	$	7,583,991	$ 159,444	$ 1,393,955	$ -	$ 3,031,800	$ 2,389,365	$ 609,427
Waupaca	$	7,880,456	$ 3,762,176	$ 1,002,278	$ -	$ 1,360,800	$ 1,280,565	$ 474,637
Wood	$	5,557,427	$ 2,095,535	$ 876,994	$ 289,750	$ 1,071,600	$ 914,394	$ 309,155
Interoperability	$	10,046,129	$ 6,835,452	$ 2,556,618	$ -	$ -	$ -	$ 654,059
NEWCOM	**$**	**90,929,122**	**$ 36,145,054**	**$ 13,874,485**	**$ 728,950**	**$ 21,427,600**	**$ 12,741,637**	**$ 6,011,396**

1.0 INTRODUCTION

The North East Wisconsin Public Safety Communications (NEWCOM) organization serves a diverse and changing region. This region is characterized by long-held traditional values coupled with dynamic growth and technological progress. The public safety agencies serving the NEWCOM region are faced with multiple technical and operational challenges, yet are united with a common goal - to better serve the public and increase agency efficiency and officer safety. The counties that comprise the NEWCOM region are:

- Florence County
- Forest County
- Langlade County
- Lincoln County
- Marathon County
- Marinette County
- Menominee County
- Oconto County
- Oneida County
- Portage County
- Price County
- Shawano County
- Taylor County
- Vilas County
- Waupaca County
- Wood County

The sixteen counties comprising NEWCOM have joined together to address the problems that must be overcome in order to have a reliable, effective communications system capable of providing interoperable wireless voice and data exchange as well as fire/EMS alerting for the entire region. The objective of their agreement is to assess the radio communications needs, the capabilities and vulnerabilities of the members (both collectively and individually), and then to develop a comprehensive communications plan. This plan is to be aimed at achieving a reliable, effective and fully interoperable communications system within the counties themselves and also between all local, state, and federal entities that may be involved in emergency management and response.

CTA Communications was commissioned to perform a comprehensive interoperability study for NEWCOM. This report describes the results of CTA Communications' having visited, interviewed, surveyed sites, and followed up with virtually all the Public Safety Agencies in the NEWCOM Region. CTA then studied the resulting data and has applied best communications practices in recommending, County by County, an interoperability and acquisition plan.

SECTION 2 of this report covers the general overall NEWCOM environment and recommendations. The section covers the following for NEWCOM:

- Regional Interoperability Environment
- Statewide Interoperability Environment
- Regional Interoperability Alternatives
- Regional Maintenance and Support
- Regional Interoperability Design and Implementation Plan
- Regional Interoperability Acquisition Strategy
- Regional Estimate of Probable Costs
- Regional Recommendations and Conclusions

SECTIONS 3 through 18 address each county separately and specifically, covering the same general aspects as listed above. Each county is fully described with the intent that their own sections will be essentially freestanding documents. SECTION 19 summarizes our final recommendations and conclusions for the NEWCOM group. We have also included an appendix that provides background information in the areas of:

- Frequency Bands
- Radio System Design Technologies
- Encryption
- Interconnectivity
- Mobile Data
- Regulatory Issues

CTA offers its sincere appreciation to all of the agencies which participated in this study for their cooperation and support. It was obvious from the knowledge and enthusiasm of the individuals with whom we met and interviewed that they are all cognizant of the importance of working together to solve their joint communications requirements. The agencies and departments provided us with open access to their personnel and to their facilities.

We especially express our thanks and appreciation to the NCWPRC representative for the professional manner in which they organized our meetings and interviews and the friendly and efficient response to our needs in preparing this report.

2.0 NEWCOM

2.1 Introduction

Although the sixteen counties and communities that make up NEWCOM have some operational commonality and many have similar communications issues, they are each unique and they vary widely in their radio system implementations. As some counties have updated their equipment, new interoperability challenges have occurred. For example, upgrading to narrowband or P25 digital voice systems provides the county certain advantages and features. But this may be at the cost of lack of direct interoperability with legacy wideband analog equipment. In addition to demographics and funding differences, there are other issues regarding inter-agency interoperability, adjacent Counties, and State interoperability concerns. The interoperability issues include frequencies, equipment, digital/analog mode, encryption type, as well as operational procedures for dispatchers and radio users.

The Counties in general are using radios in the VHF band. Transmitter tower sites have been installed over the years on an individual basis, generally in answer to an immediate requirement. Also sites were selected on an as availability basis, normally taking advantage of the most economical locations. There are coverage short-falls; in some counties there are significant areas without portable and often without reliable mobile radio coverage. There has been little use of potential shared sites that may be located in other jurisdictions.

Generally the sites were created as frequency channel specific – one certain channel set is used at a particular radio site, and a different channel set at the next radio site. This provides radio coverage in broad areas but it requires the users to change channels when they move from one area to another. Channel switching places complexities on operations and requires users to know which specific channel to use. It also requires dispatchers to know the users location to allow communication.

Many of the agencies' non-fixed radios are aging with limited capacity for compliance with FCC regulations, P.25 and narrow banding, and many have limited channel capacity. An added issue is that the law enforcement agencies have developed differing encryption procedures based on vendors' products and the time frames when they were obtained.

Maintenance of sites and radios has been performed to differing standards based on the individual maintenance provider and the agreements in place with the counties.

While interoperability is a main focus of this study, CTA was also commissioned to review coverage, PSAP (Public Safety Answering Point) centers, and mobile data needs throughout the NEWCOM Region.

2.2 Regional Interoperability Environment

The radio environment described above combined with the high motivation of the public safety employees produces an interoperability environment with the following characteristics.

- The agencies and communities have developed over the years a strong mutual aid interoperability ethic. The agencies often depend on each other for officer safety and to deliver services. The NEWCOM Region has an effective interoperable mindset that is only limited by affordable technologies.

- The radios are generally in the same frequency band - VHF- allowing counties to share frequencies. The sharing of frequencies takes place regularly throughout the NEWCOM Region. This sharing provides a large degree of interoperability within the NEWCOM Region and among neighboring communities.

- Within each County, a good degree of agency interoperability exists. This is achieved primarily through use of the common VHF frequency band, and the sharing of channels (programming other agencies' channels in the radios or dispatch positions).

- It is also common for Fire to share repeater and dispatch resources with County Sheriffs' dispatch operations. While this provides interoperability capability, it can also lead to overcrowded channel traffic, and confusion or missed calls.

- County to County, a standard approach to interoperability is lacking, although there are good practices in place regarding monitoring adjacent county traffic, the use of Mutual Aid (MARC) channels, and the use of WISTAC for event scene communications.

In a true interoperable environment, procedures must be in place for controlling and tracking the users as they move among the different systems. Both the visited county and the home county should be aware of the location of their officers.

- The aged non-fixed equipment in the NEWCOM Region presents interoperability challenges. The older units are not capable of operating in a P.25 and/or narrow band environment. Limited channel capacity restricts the sharing of channels. Also some the units will only accept certain encryption codes or are limited by the number of codes that can be programmed.

- Many individual agencies within the NEWCOM Region do not have sufficient radio equipment to meet their current public safety needs.

- Radio coverage throughout the region varies greatly. While generally there is moderate mobile coverage, there are some areas of the NEWCOM Region without mobile coverage. There are substantial areas in the NEWCOM Region without portable coverage.

- Adding to the coverage problem is the dependence on frequency specific sites for the agencies. This requires all users to be aware of the particular coverage areas, even when responding out of their normal service areas.

Based on the fact that there must be "operability" before there can be "interoperability", the lack of needed basic radio coverage is the most limiting factor for interoperability in the NEWCOM Region.

2.3 Statewide Interoperability Environment

The State of Wisconsin is facilitating interoperability among agencies within the State with the designation of several simplex and duplex radio channels to be used in multi-agency and multi-discipline communications as required. These channels are identified as follows:

MARC 1	-	All Public Safety
MARC 2	-	All Public Safety
WISTAC 1	-	All Public Safety
WISTAC 2	-	All Public Safety

WISTAC 3	-	All Public Safety
WISPERN	-	Law Enforcement
POINT to POINT	-	Law Enforcement
WEM CAR	-	Emergency Management
STATE EMS	-	EMS
FIRECOM	-	Fire Ground Blue

These channels are all in the VHF band and will work effectively in the NEWCOM Region.

Presently WISPERN and MARC1 and MARC2 Mutual Aid channels are used tactically for interoperability. Fire and EMS generally have been designated the WISTAC1 and WISTAC2 channels. The MARC 1 channel is duplex and can use repeaters, however currently only Waupaca, Oconto, and Shawano Counties within the region have repeaters for this channel. The WISTAC 1 channel is planned to be changed to IFERN as the MABAS fire system is developed in Wisconsin.

Additionally some Counties have MDCs (Mobile Data Computers) in their vehicles to access the Wisconsin TIME system. Coverage on this system is limited to State tower coverage areas.

The *Wisconsin Emergency Medical Services Communications Plan*, a Statewide EMS plan document, describes how the interoperability channels and frequencies are to be used for EMS, Hospital and Ambulance operations.

All Counties' law enforcement agencies can currently monitor State Patrol, and vice versa, although the State Patrol radio coverage is generally limited to the major highway system. The State Patrol have a long term goal of eventually moving to VHF - trunked technology. All plans should take this goal into account for the long term.

Overall it is expected that the radio environment in Wisconsin will remain in the VHF band. Operations will migrate to P.25 and narrow band formats, and there is the aforementioned long term possibility of VHF trunking in cooperation with the Wisconsin State Patrol.

2.4 Regional Interoperability Alternatives

The Department of Homeland Security, through its communications division - SAFECOM, has developed outlines for interoperability. This is divided into the following tiers in progressing order:

Level 1: Swapping Radios
Level 2: Shared Channels
Level 3: Gateways
Level 4: Proprietary Shared System
Level 5: Standards Based Shared System

In our interview and survey process we determined that the counties in the NEWCOM Region are fairly sophisticated in interoperability methods. Users have maintained a strong cooperative mind set and have worked out among themselves many viable interoperability workarounds.

The NEWCOM Region has moved past the Level 1 Interoperability (Swapped Radios), although there may always be some need for this in special events when non NEWCOM units are responding. The use of Level 2 Interoperability (Shared Channels) is on-going commonly throughout the region and should continue. In the Near Term we recommend the increased use of designated, shared interoperability channels. We also recommend that the thirteen counties that do not currently have transportable MARC1 repeaters obtain them for interoperability uses.

Level 3 interoperability is the use of Gateways. In the Near Term improvements CTA recommends the installation of two interoperability gateway devices, similar and/or equivalent to ACU-1000's. These will be supported by specific interconnectivity microwave or other broadband links between dispatch centers. This is an initial first step in creating NEWCOM Region wide interoperability and connectivity from county to county without regard to message type. These costs are displayed as non - county specific costs in SECTION 2.8.

CTA does not recommend that the NEWCOM Region consider Level 4 Interoperability (Proprietary Shared System). Although these systems are effective for small geographic areas, the NEWCOM Region would in fact lose interoperable capacity with any agency or group not using the same proprietary system.

Level 5 Interoperability (Standards Based System), is the eventual long-term recommendation for the NEWCOM Region. Essentially this would be a VHF, P.25/Narrowband system. As the only true standards based system available in the foreseeable future, this presents the most logical and cost effective solution for all NEWCOM participants. The project tasks and costs displayed in Near Term, Mid Term, and Long Term all are in line with this long term goal. Additionally, CTA recommends no steps in the phased path that might isolate any community. As part of the long term goal, we also recommend the establishment of regional encryption and radio programming standards to further enhance interoperability.

As mentioned previously, the Wisconsin State Patrol is exploring the possibility of a VHF, P.25 trunked radio system to be used statewide. The intent of CTA's recommendation is to provide a robust interoperability environment that could be gracefully migrated to the envisioned State system should this be the desire of the counties within the NEWCOM Region.

We note that interoperability *hardware* does not in itself provide interoperability. The concept of interoperability is between *people* and not simply between equipments. As such, the hardware recommendations we make here will only be as good as the training and exercises invoked by the people using the equipment, so that when interoperability is needed, both the equipment and the organization is prepared to be actively interoperable.

2.5 Regional Maintenance and Support

Currently the participants of NEWCOM Region are using differing methods and have different levels of maintenance for their radio infrastructure and field units. Some have individual employees generally tasked with overseeing the radio system. Most repair is done on an agency by agency basis. Maintenance agreements exist with at least three different radio shops, but most counties have their repair work performed on an hourly basis. Preventative maintenance has been a low priority. In order to improve the two way radio environment in the region there should be a restructuring of how maintenance and particularly preventative maintenance is approached by the participating counties.

A logical first step would be to combine the purchasing power of the sixteen counties.

The NEWCOM Region should develop a standardized pricing list of services from the maintenance providers. This would be negotiated with the maintenance providers perhaps on competitive basis.

CTA notes that economic advantages could only be realized if it is the commitment of all sixteen counties to remain within the framework of the standardized price and service list. This action could be done without a formal agreement among the counties and would not require the creation of a new extra-county legal entity.

In the long term, the NEWCOM Region should pursue a combined regional formal maintenance organization. This organization could take the form of a joint county-owned radio shop that serves all of the NEWCOM participants. It could also take the form of a joint-county team of employees that regulates a commercial operation dedicated to the sixteen participating counties. The commercial operation could be a division of an existing maintenance provider or a newly created radio shop. The commercial services should be created and established via a competitive bidding process. The use of commercial services in this manner would allow for an operation directed by the participants but would not necessitate the purchase of large amounts of radio repair and testing equipment. It would be beneficial to have a combination of NEWCOM region-owned facilities and commercial facilities.

The regional maintenance organization would require the adoption of formal agreements between the NEWCOM counties and perhaps the establishment of a new legal entity.

2.6 Regional Interoperability Design and Implementation Plan

A major transition and implementation plan recommended here for the NEWCOM Region is only feasible when performed in a logical, phased approach. NEWCOM has determined that three conceptual phases will be used: Near Term, Mid Term, and Long Term. Each phase has activities that address the areas of:

- Interoperability
- Improved Coverage
- Interconnectivity (Microwave)
- Consoles
- Non-Fixed Units
- Mobile Data

- Encryption
- Maintenance

Specific time frames are not being assigned to the phases as each county is in a different radio and financial situation. Some counties are at or close to mid-term or long-term levels in many areas. Mid-term and long-term activities would require coordination and planning on a regional basis. We describe next the general characteristics of each of the three phases; these are common goals for each NEWCOM County:

Near Term: Refer to Figure 2-1 for a graphical depiction

- Interoperability - In the Near Term there will be some NEWCOM region wide interoperability gateways implemented; interconnectivity will be added between dispatch centers

- Improved Coverage - The major goal of this phase is to improve coverage in each county; this will be accomplished by adding sites and channels throughout the region, and simulcasting counties where necessary.

- Interconnectivity (Microwave) - Add inter-county interconnectivity (microwave), which is necessary to support the site improvements and where applicable, future goals. In some cases, we recommend additional interconnectivity links with the dual purpose of using close-by radio sites to improve coverage, and also to provide loop redundancy.

- Consoles - Console position hardware is added where necessary.

- Non-Fixed Units - Update non-fixed equipment where there are shortfalls and replace aged equipment.

- Mobile Data – Add required units to existing MDC equipped agencies.

- Encryption - Begin to implement a standard encryption approach.

- Maintenance - Standardize radio programming and procedures, and move toward shared maintenance resources.

Everything accomplished in this phase will benefit future implementation phases.

Mid Term

- Interconnectivity (Microwave) - Additional improvements in interconnectivity in preparation for the Long Term improvements.
- Consoles - Units will be added if required.
- Non-Fixed Units - Address the narrowband mandate for portables and pagers. In general all non-fixed units not replaced in the Near Term will be replaced in this phase.
- Mobile Data - Message switches added to support the Long Term mobile data requirements and improve interconnectivity.

Long Term

- Interoperability – Implement an IP connectivity network throughout the NEWCOM Region.
- Improved Coverage - Coverage improvements in the areas of further simulcasting and addressing the effects of digital propagation.
- Interconnectivity (Microwave) - Upgrade to provide a seamless interconnectivity between the regional entities.
- Non-Fixed Units – Based on a seven to ten year useful non-fixed equipment life span, these units will be on a replacement schedule, and known growth estimates will be added.
- Mobile Data - Counties will move to independent mobile data systems that are interoperable throughout the NEWCOM Region.
- Maintenance - The agreed upon regional maintenance plan will be in effect and implemented.

Table 19-1 provides an overview of the Near Term, Mid Term, and Long Term recommendation for the NEWCOM Region.

In the following report sections these phases and plans are described as they apply to each individual NEWCOM county.

2.7 Regional Interoperability Acquisition Strategy

Upgrading communications in 16 counties is a significant undertaking. In order to achieve the improvements recommended for the various NEWCOM counties CTA anticipates the purchasing process will be quite involved. The equipment and services needed fall into five major categories:

Fixed - This includes transmitters, receivers, repeaters, antennas, multicouplers and combiners, voters, and simulcast equipment.

As a subset of Fixed is **Physical Facilities** - This category is perhaps the most difficult to identify. Contained here are towers, foundations, geotechnical surveys, tower analysis, site clearing, access road paving, security fencing, lighting, shelters, generators, UPS power supplies, HVAC, solar power, utilities connections, and grounding.

Microwave - This includes both *licensed* and *unlicensed - spread spectrum* microwave radios, microwave antennas, wave guide and other cabling, orderwire, Loop and Hot Standby switches, and DC power supplies.

Non-Fixed - This includes the mobile and portable radio equipment that will be used. Desk-top radios and pagers are in this category.

Consoles - Are a subset of the Infrastructure including central electronics and dispatcher terminals.

Mobile Data – This includes the field units with RF modems and laptops and/or terminals, the RF data portion also includes data transmitters and receivers with antennas and cabling, as well as data radio network control devices.

Purchasing two way radio systems is a complex and detailed process. Each County may be inclined to turn to single vendors to provide a "turn-key" solution.

While at first glance this may seem to be efficient, we note that the requirement of "turn key" service may not be the most efficient use of your capital. Since this is a *Radio system*, one would expect that *Radio equipment vendors* would normally be the ones you would approach for this service.

The inefficiency in the methodology is that radio equipment providers do not internally provide the ancillaries: microwave and particularly physical facilities as part of their product line. Radio vendors core business is to sell fixed and non-fixed radio equipment. Typically radio vendors have outsourced those efforts not part of their core business, and they do so mainly to assist their clients while selling their radio equipment.

As would be expected, in the outsourcing, the price for the service is escalated with pass through fees and administrative add-ons, as well as risk factors for unanticipated events. Potentially there is little financial incentive for the turn-key vendor to optimize these activities for a specific project. Non-radio expenses could as much as double when acquired from a turn-key vendor.

With respect to purchase of Mobile Data systems, the Radio System Vendors do frequently provide this product. There are a substantial number of equipment vendors that focus on Mobile Data as their primary product and the following issues should be considered:

- A vendor that is focused on Mobile Data may bring state-of-the-art innovation to this rapidly changing technology;
- Competition will drive the price down;
- The Mobile Radio vendors will not be excluded, they may take part in the process as well, and if there are any efficiencies involved in a common voice and data network, this will be to their favor.

To reduce costs, CTA recommends that the NEWCOM Region pursue a regional five part purchase process. This would involve five separate purchase/specification/bidding efforts:

1. Fixed Radio Equipment to include consoles.
2. Physical Facilities
3. Microwave
4. Non-Fixed Equipment

5. Mobile Data

This will produce a common pool of equipment and service pricing that each county can select from and will give the NEWCOM Region the most effective pricing. The selected vendor or vendors in each category should be vendors that are specialists in that category and well versed in providing the specific services and/or equipment. This five step procurement process will provide vendors that are more directed and expert in their particular area. This will give the NEWCOM Region the best possible financial and product results.

In the cost estimate, there is a category for PM/IV&V. This accounts for the services of experienced project managers and communications experts to conduct and oversee these added purchasing procedures with inspections and independent testing and verification after installations.

The separate procurements should be planned around a phased approach, with long term costs escalation controls. Typically the costs are only allowed to escalate in accordance with the Manufacturers' Cost Index which is published nationally.

2.8 Regional Interoperability Estimate of Probable Cost

Estimates were developed for the major categories of equipment as described in the interoperability design for the NEWCOM Region. The unit cost information is obtained from historical CTA cost files and vendor pricing for comparable projects. The various costs are compared and weighted in order to derive an average type of estimate.

Estimates reflect expected average pricing. The average prices are recommended for planning and budgetary purposes. Although CTA cannot guarantee bid price levels, successful competitive bidding typically results in savings on the price costs, especially in the area of radio equipment.

There are five display charts included here: Charts 2-1 through 2-3 display the Near Term, Mid Term, and Long Term consolidated costs for the entire recommended improvements for the entire NEWCOM Region. Each of the sixteen counties' estimates are further broken down and included in SECTIONS 3 through 18 that address each county separately.

CHARTS 2-4 and 2-5 display the recommended interoperability equipment for the Near Term and Long Term designs. This common regional equipment can not be assigned to any individual county; therefore, they are displayed below in two additional charts for the NEWCOM Region. The pro-rated amounts have also been included in the totals displayed in CHARTS 2-1 through 2-3.

CHART 2-1
NEWCOM NEAR TERM ESTIMATE

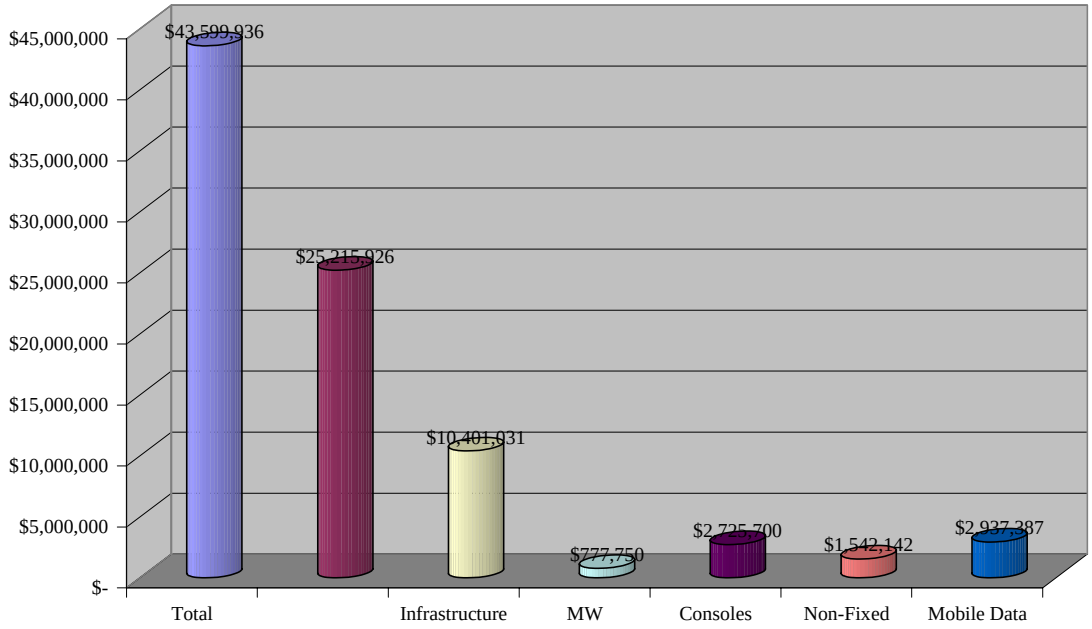


CHART 2-2
NEWCOM MID TERM ESTIMATE

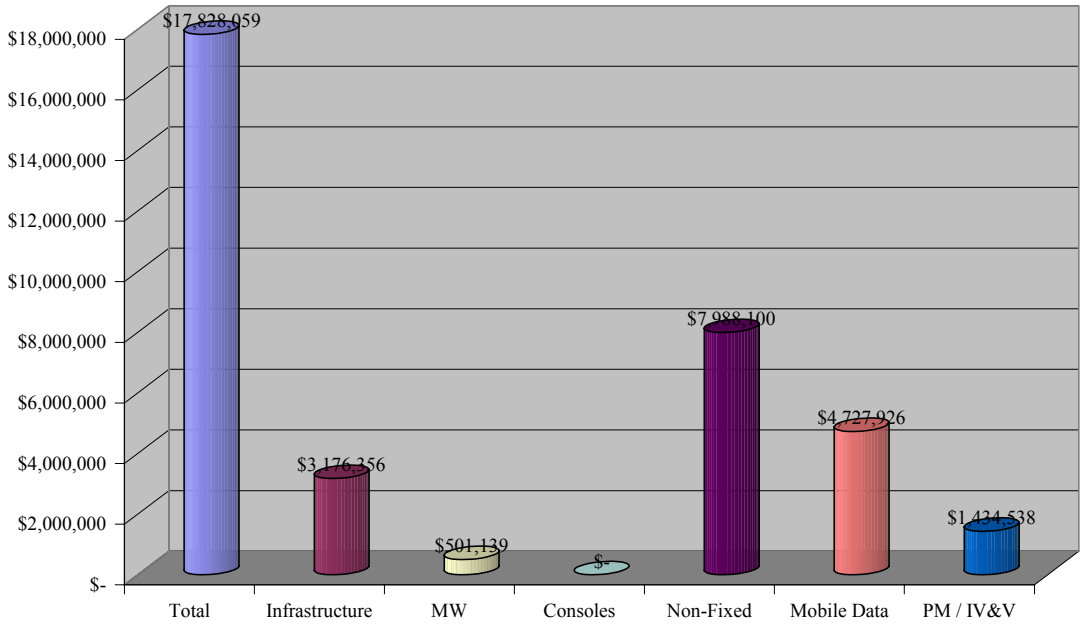


CHART 2-3
NEWCOM LONG TERM ESTIMATE

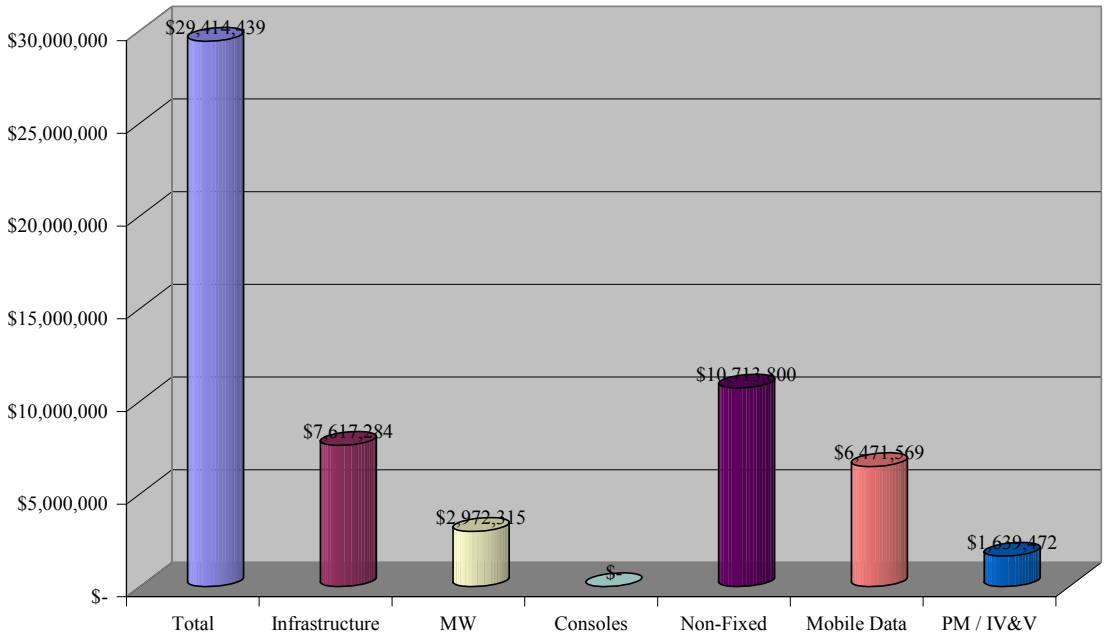


CHART 2-4
NEWCOM INTEROPERABILITY NEAR TERM ESTIMATE

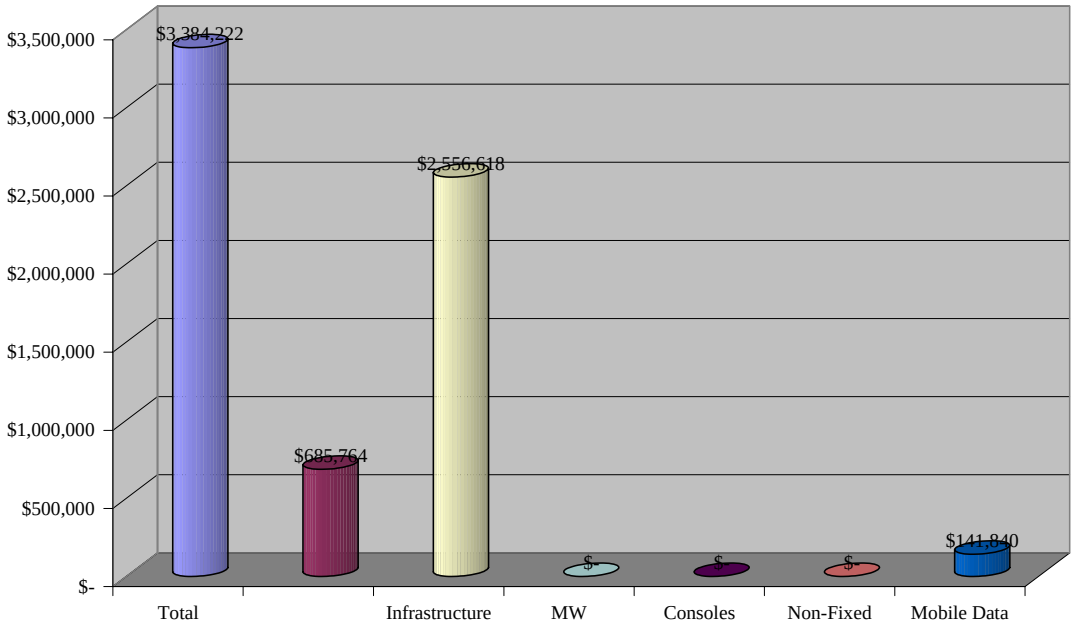
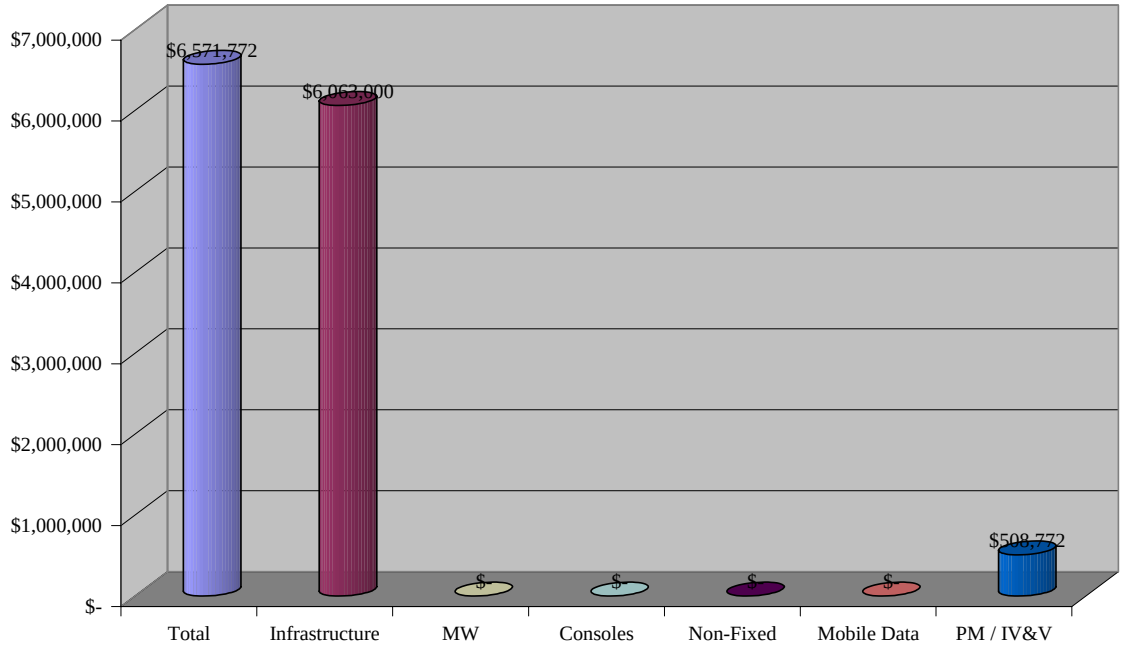


CHART 2-5
NEWCOM INTEROPERABILITY LONG TERM ESTIMATE



2.9 NEWCOM Recommendations and Conclusions

While there are few system design “standards” for mobile radio systems, the typical approach for radio system engineering is to apply generally accepted practices used throughout the industry. This provides a level of "acceptability" for both the owner and for the consultant or design engineer. The typical framework for designing public safety radio systems recently has come from the TSB-88 document, a set of guidelines developed in the 1990s by a TIA working group. This in general describes certain signal strengths and coverage levels as being "public safety grade". By adhering to the TSB-88 guidelines, the designer’s job is made easier as some of the design decisions are already established. No-one can fault the designer who uses TSB-88 as the baseline.

CTA considered the TSB-88 guidelines in our designs, and we do believe that the NEWCOM community should have a system that ascribes to TSB-88 grade as a long term goal, we also believe the costs of initially implementing this type system will be excessive, and the actual operational improvements realized may not be commensurate with the expense. As Voltaire stated "The Perfect should not be the enemy of the Good". The NEWCOM Region can achieve great improvements in coverage and reliability using reduced designs that are more cost effective, and not out of reach financially. The Near Term and Mid Term recommendations are not designed to TSB-88 levels, but they do offer dramatic advances over the coverage currently experienced. CTA recommends a series of improvements that while not fully "public safety grade" as defined by TSB - 88 in every category, will provide public safety affordable solutions for the NEWCOM Region. While there may be some risk to us in recommending a system that is “less than perfect”, there is the very real risk that if the only recommendation made is for a “perfect” system, it would be out of reach financially. It is the opinion of CTA that improvements that are “less than perfect” and are implemented with due diligence and consciously are far superior than a “perfect, but unimplemented” system.

The NEWCOM Region recommendations fall into the following categories:

- **Coverage improvements** – before achieving interoperability on agency, county-to-county, and state levels, it is important to first be able to communicate wherever needed.

- **Equipment upgrades** – many NEWCOM participants have outdated equipment, or radios with insufficient channel capacity to allow operation on all potentially used neighboring channels or emergency channels.

- **Frequency Band –** common frequency band improves near, mid, and long term interoperability - standardize on VHF for all two-way voice and data radio operations.

- **Common Standards** - standardize on P25 for Law Enforcement, and use DES OFB for encryption (later migration to P25 AES standard). This gives law enforcement compatible, standards-based, and secure radio equipment which complies with Federal standards.

- **Common Equipment Configurations** - standardize programming for the radios. This will assist interoperability and reduce on scene confusion of radio communications. A standardized radio channel programming approach will allow users to simply change over to the channel designated in an emergency situation.

Specific recommendations are made for each County in the following Sections of this Report.

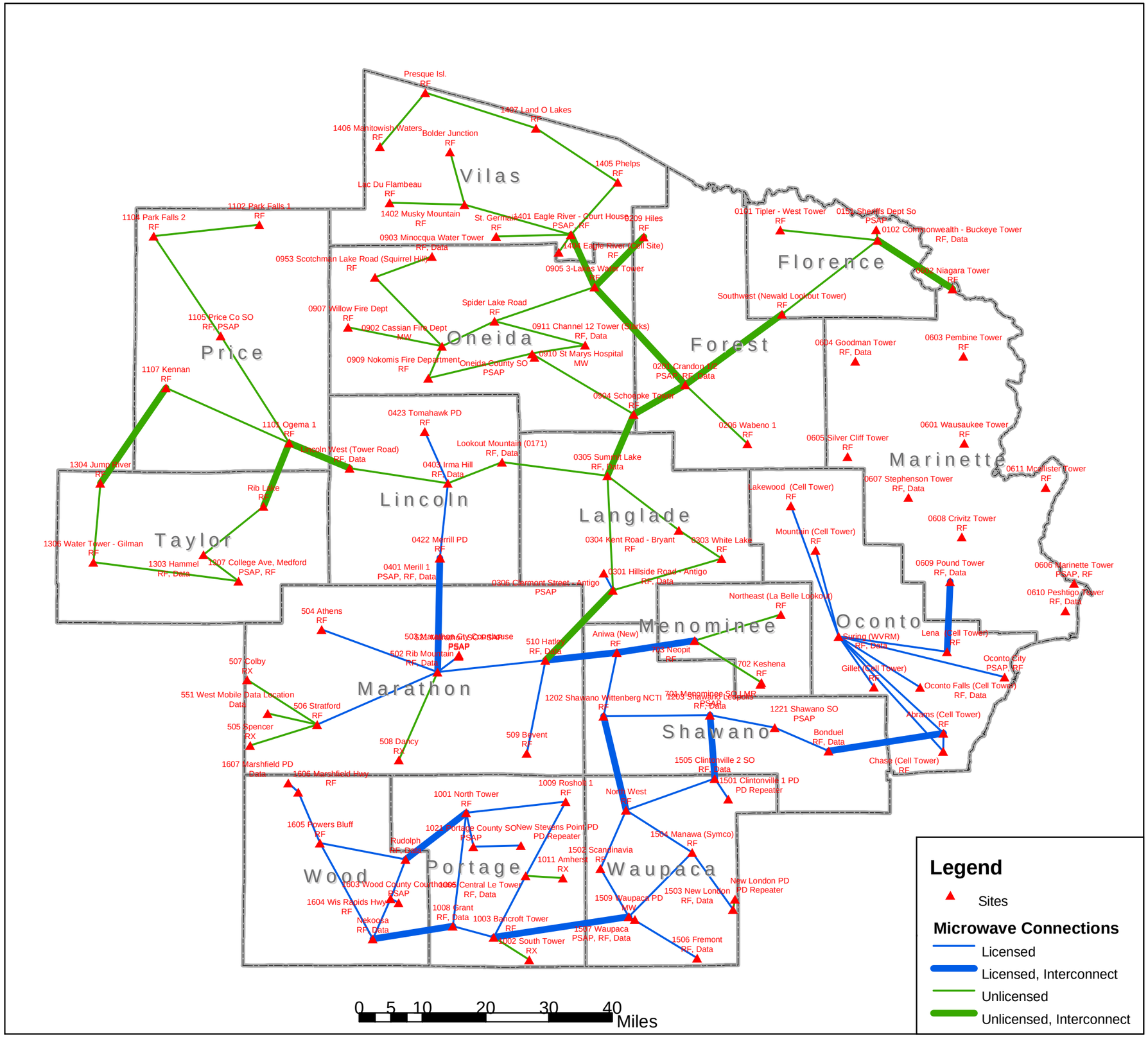


Figure 2-1
Interoperability Plan

Client
NEWCOM

Description
Sites and Microwave Interconnections for NEWCOM

Commission No.
20078

Scale 1 inch equals 15.4 miles

Data Sources and Notes:

Sites and locations from CTA Site Surveys and Interviews March through April 2005.

County Shapes from ESRI, Inc.

Township and City Shapes from the U.S, Census Bureau

Design:	HFR - 12 May 2005
Drawn:	MJL - 25 May 2005
Checked:	HFR - 23 May 2005
Approved:	HFR - 25 May 2005

File Name:
M:\FILES\20078 NEWCOM\cadd\Figure2-6_NEWCOM.pdf

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CTA Communications, Inc.
20715 Timberlake Road
Lynchburg, Virginia 24502-7217
an HSMM Company
www.CTACommunications.com
+1 (434) 239-9200