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November 5, 2013

David Tucker
Enhanced 911 Board
100 State Street
Fourth Floor
Montpelier, VT 05620

Subject: Final Report for Alternative Structure for Taking Emergency 911 Calls in Vermont

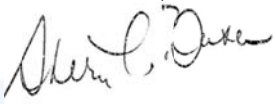
Dear Mr. Tucker:

L.R. Kimball is pleased to submit our report on Alternative Structure for Taking Emergency 911 Calls in Vermont. We look forward to providing future professional Public Safety consulting support to future 911 Board initiatives.

If you have any questions regarding the information submitted, please contact me by telephone at 804-512-2471 or via email at Sherri.Bush@LRKimball.com. I look forward to hearing from you.

Sincerely,

Sherri A. Bush,



Consultant

/maj

Enclosure

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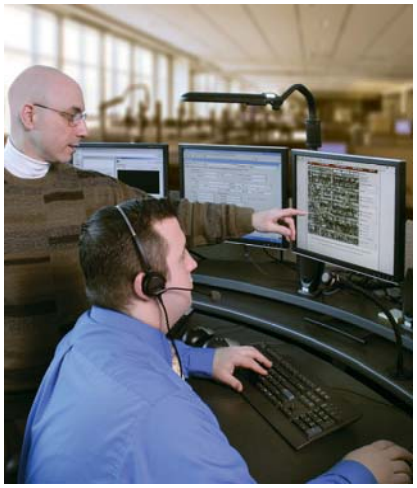

Final Report for

Alternative Structure for Taking Emergency 911 Calls in Vermont

Prepared for

State of Vermont 911 Board

November 5, 2013

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EXECUTIVE SUMMARY

L.R. Kimball is pleased to provide the following report and recommendations to the State of Vermont 911 Board regarding the optimum number of 911 call centers statewide, number of full time employees (FTEs) needed to handle the call volume in the recommended number of call centers, and the facility costs exclusive of 911 equipment for the call centers. This report provides background, findings, standards and effective practices supporting a recommendation to not separate 911 call taking from dispatch. If the State of Vermont (State) elects to pursue repairing the current separations of 911 call taking and dispatching, an extensive distinct study will be needed that includes all impacted services and entities. However, if the State of Vermont 911 Board decides to pursue reducing the number of Public Safety Answering Points (PSAPs), L.R. Kimball recommends two geographically diverse 911 call centers splitting equitably the call load. A staff of 48 FTEs will be necessary to effectively operate the two centers. This report also provides a budgetary estimate for new facilities, recommended equipment and technology and operational costs for both centers to be $20,189,300.

L.R. Kimball recommendations are based on direct knowledge and experience in conducting numerous similar studies and the vast PSAP and vendor community experience of our consulting staff. These recommendations are supported by industry best practices and standards as noted in this summary and at appropriate points throughout this report.

The industry standards that are cited within this report and detailed in Section 5 specifically are derived from the following entities:

- National Fire Protection Association (NFPA) Section 1221 Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems
- Commission on Accreditation for Law Enforcement Agencies, Inc. (CALEA) *Standards for Public Safety Communications Agencies*
- National Emergency Number Association (NENA)
- Association of Public Safety Communications Officials (APCO)
- International Academies of Emergency Dispatch (IAED)

These standards-setting entities provide standards and guidance in the operations and technical aspects of the modern emergency communications center. L.R. Kimball experience, effective and best practices, and lessons learned from previous emergency communications center studies, planning and implementation activities, and programming and design efforts, provides application perspective on the impact of each of these standards. Other standards of great impact on facility design components for electrical and cable infrastructure are Standards and Guidelines for Communications Sites (Motorola R56 standards, 2005) and the Institute of Electrical and Electronic Engineers (IEEE) standards for electrical, grounding and communications systems design.

Background

The State of Vermont Statute Title 30 Chapter 87[1] is similar to many other state statutes in that it establishes the authority and responsibilities of an executive body to oversee the development, implementation and supervise the operation of the 911 network and telephone systems and related equipment and services statewide. The authority in Vermont is called the Enhanced 911 Board (Board). The Board's authority and responsibilities include oversight of the funding requirements as detailed in Title 30 Chapter 87 Sub-Section 7054[2] that specifies what may and may not be funded by disbursement of the enhanced 911 fund.

As in many states, the Board under the authority established in Title 30 Chapter 87 manages the funding of the 911 equipment and network while costs associated with dispatch functions are considered the responsibility of the local municipalities. The method in which these costs are managed varies from state to state. However, across the country this split in control and/or funding has created an environment where the states have become focused on only the portion for which they are financially responsible rather than the whole emergency communications picture.

There is no statewide level authority over the provision of dispatch services in Vermont, with the exception of statewide Public Safety agencies such as the Vermont State Police. The current methods of processing 911 calls in Vermont are 1) call taking and dispatching from the same PSAP, and 2) 911 call taking only, and transferring calls once the dispatching agency is identified early in the call taking process.

Cost Estimates

In order to provide an estimate for the cost of a 911 call answering center; L.R. Kimball had to make several assumptions so some functionality, such as inclusion of a CAD system, has been included that is not currently being planned by the Vermont E911 Board. Ongoing/recurring costs must be included in the decision making process as costs associated with facility maintenance and upkeep, replacement and/or upgrade costs of facilities, equipment and networks will require funding and thorough planning.

It is unlikely that the state would realize a cost savings associated with 911 call technology due to the expanded financial responsibility that the State would incur and the initial capital costs associated with establishing two geographically diverse centers. Two facilities are needed to ensure redundancy and continuity of operations. Table 1 on the following page summarizes the costs associated with establishing these call centers.

1 Title 30: Public Service, Chapter 87: Enhanced 911; Emergency Services
http://www.leg.state.vt.us/statutes/sections.cfm?Title=30&Chapter=087

2 http://www.leg.state.vt.us/statutes/fullsection.cfm?Title=30&Chapter=087&Section=07054

Total 911 Call Center Estimated Costs				
Type of Cost	Description	Quantity	Individual Cost	Total Estimated Cost
Non-recurring	One-time charges for additional furniture and equipment	1	$709,600	$709,600
	One-time charges for facility construction - 2 facilities	2	$4,880,000	$9,760,000
	CAD	78	$75,000	$5,850,000
Recurring (monthly)	ESI network connectivity^	27	$1,100	$29,700
Recurring Personnel Costs	Proposed personnel for both centers (annual)	1	$3,840,000	$3,840,000
			Total Estimated Costs	$20,189,300

Table 1—Total 911 Call Center Estimated Costs

Recommendations

The hybrid 911 model currently in operation in Vermont has features that work very well and features that could be improved upon. L.R. Kimball applauds those PSAPs that provide both dispatch and 911 call taking as this is the industry best practice. Vermont is ahead of much of the rest of the country in implementing a statewide Emergency Services Internet Protocol Network (ESInet) for 911 service. In addition, L.R. Kimball believes the amount of money spent to provide 911 service statewide is well within the range spent in other states that do not provide an ESInet. However, those PSAPs that must transfer the 911 call to a separate dispatch location are not providing the same level of service to the citizens of Vermont.

L.R. Kimball does not recommend the state separate call taking from dispatch. If the state chooses to pursue separation of call taking and dispatch, L.R. Kimball recommends establishing two 911 call centers for the State of Vermont. Condensing the technology from eight separate telephony systems to two, and streamlining the network from eight to two will realize economy of scale for these specific components. However, by elevating the call center service to the state level, the state then takes on the complete costs of facilities, and personnel, the additional costs of expanding the state ESInet and implementing statewide computer aided dispatch (CAD) and CAD-to-CAD connectivity via an expanded ESInet, in addition to the network and equipment costs already being supported. Overall, this will increase costs for the state. Also, a transition from eight PSAPs to two call centers will further separate call taking and dispatching which will undermine any service efficiencies that may be gained through reducing the number of sites that answer 911 calls.

L.R. Kimball strongly encourages the state to study the feasibility of consolidation of call taking and dispatch services statewide to work toward a goal of reducing the separation of call taking and dispatch instead.

1. PROJECT OVERVIEW

1.1 Scope of Work

From time to time certain policy makers have suggested that the Vermont 911 system is providing an undue subsidization of the eight PSAPs in which 911 calls are currently taken, and that it would be more cost effective to adopt the practice found in a handful of states that have made a policy choice to completely separate 911 call taking from emergency dispatch services. Like most policy changes, there may be new or increased costs associated with such a change, and the Board wants to better understand what those costs might be in order to make an informed decision. L.R. Kimball was contracted by the State of Vermont E911 Board to examine the Enhanced 911 (E911) system statewide and determine how many 911 call centers would be needed to handle the state's 911 call volume and transfer each of those calls to a separate agency that would provide the dispatch services. In addition to determining the number of call centers, L.R. Kimball estimated staffing needs, the initial capital expenditures, as well as annual operating costs for each call center. The scope of work does not include a cost-benefit analysis of current costs versus projected costs under a 911 call center model.

The scope of work also included a discussion on 911 best practices and the ways a call center model does or does not meet these practices.

Vermont currently operates a system that is a hybrid between 911 call-taking only, and call-taking and dispatch services provided from the same location that takes the 911 call. This hybrid model is the result of choices made at the local level, where some towns continue to operate their own dispatch functions. Evaluation of dispatch functions was not part of the scope of work since in many cases these services are provided at the local level. However, where dispatching and call taking impact each other from a quality of service perspective, Kimball has included discussion for consideration.

1.2 Methodology

For the task of determining the number of 911 call centers needed statewide, L.R. Kimball considered several factors including:

- The total 911 call volume
- The geographic distribution of the 911 call volume
- The need for redundancy within the 911 statewide system to ensure continuity of operations
- State geography as it relates to the suggested location of 911 call centers

Once the number of call centers was determined, L.R. Kimball estimated the costs associated with establishing each facility based on new construction.

1.2.1 Project Parameters/Constraints/Assumptions

- The scope of this study is limited to a single component of emergency communications: 911 call handling. The reality is that emergency communications includes two intertwined components. These components are 911 call taking and dispatching of field police, fire and EMS response. Identifying costs, service issues and potential

configurations based only on 911 call handling was difficult and, at times, not possible. Therefore, recommendations are general in nature and represent Kimball's best estimate at the time of this report.

- The identification of any dispatch related ramifications that would result from a change to a 911 call center model is not within the scope of this study. To fully understand the impact of a change to a 911 call center model at the local level, it is necessary to examine the impact on emergency communications as a whole including both call taking and dispatch functions at each location.
- Dispatch functions are assumed to still be provided at the local level and/or through Vermont State Police dispatch centers.
- Comparative analysis of existing costs versus new model projected costs is not part of the scope of work.
- 911 call center costs are based on construction of new facilities. Should an existing facility be selected for renovation to house a larger/merged 911 call center, an engineering study would be required to provide a cost estimate.

1.3 Key Definitions

911 Call Center – A facility whose purpose is to receive 911 calls from a defined area, determine what type of service, law enforcement, fire and/or medical, are needed and transfer the call to the local dispatch-only site. The local dispatch-only site will then send the appropriate field personnel to each call for service.

Public Safety Answering Point (PSAP) – An emergency communications facility with enhanced 911 capabilities, operated on a 24-hour basis, assigned the responsibility of receiving 911 calls and dispatching, transferring, or relaying emergency 911 calls to other public safety agencies or private safety agencies.

Dispatch-Only Site - A dispatch-only site is an agency that only provides dispatch functions. These sites do not receive 911 calls directly. All 911 calls are transferred from other PSAPs. The majority of the calls are transferred by a 911 call center or PSAP designated to receive that municipality's calls.

Dispatch Functions - Dispatch functions include all functions and tasks associated with actually sending a law enforcement, fire, or emergency medical services (EMS) response to a 911 call and any field personnel support. Dispatching is done via radio or mobile data device. These functions may begin once the call taking process is complete or simultaneously with the call taking process, depending on the PSAP/dispatch configuration.

2. CURRENT ENVIRONMENT

2.1 Overview

The Vermont E911 Board was created by legislation in 1994, with the mission to provide and oversee the operation of a statewide emergency telecommunication system, accessible to everyone. The State of Vermont Statute Title 30 Chapter 87[3] establishes the authority and responsibilities of the Vermont E911 Board. Vermont currently has eight PSAPs. For purposes of this report, a PSAP is an agency that receives 911 calls and may also provide dispatch services to some or all of the response agencies in the PSAP's service area. The eight PSAPs include:

- Derby – Vermont State Police (VSP)
- Rockingham – VSP
- Rutland – VSP
- Williston - VSP
- Hartford Police Department
- Lamoille Sheriff's Office
- Saint Albans Police Department
- Shelburne Police Department

A map that displays the general location of the PSAPs within the state is located in Appendix A.

These PSAPs have a combined total of 26 call taking positions, also known as workstations. Public Safety answering points operated by the VSP account for 18 of the 26 positions with the remaining 8 divided among the remaining non-VSP PSAPs. In addition to the 8 PSAPs, there are an additional 27 law enforcement dispatch-only sites and an unknown number of fire and EMS dispatch-only sites, which are operated by local agencies and are not part of the state 911 system. These sites do not receive E911 calls directly, but instead receive calls that have been answered in one of the eight PSAPs and transferred.

2.2 Funding

The State of Vermont E911 Board provides $45,000 per call taking position per year for the 26 call taking positions. The money can be used by the PSAP to fund whatever costs are deemed necessary. The cost of 911 in Vermont today is $4.5 million which includes the payments made per call taking position, the Internet Protocol (IP) network, 911 call taking equipment and administrative costs.

2.3 Technology Overview

Vermont provides 911 customer premise equipment (CPE) to the 8 PSAPs for all 26 call taking positions. Each of the eight PSAPs is connected to a statewide IP network that allows the State of Vermont E911 Board to control the call flow (and keep accurate statistics regarding calls). For example, if one of the eight PSAPs is experiencing high call volume; the calls will be

[3] Title 30: Public Service, Chapter 87: Enhanced 911; Emergency Services
http://www.leg.state.vt.us/statutes/sections.cfm?Title=30&Chapter=087

automatically re-routed via the IP network to another PSAP in the system. However, the 27 dispatch centers are not connected to the IP network.

The eight PSAPs take the 911 call and screen the call for address verification, type of emergency assistance needed and then conference in the appropriate dispatch center via the traditional phone lines. The 911 call taker will remain on the line with the caller and provide emergency pre-arrival instructions[4] as needed. In a limited number of cases, automatic number identification information (ANI) and automatic location information (ALI) spill (data feed) is provided to the dispatch center for population in a CAD system.

2.4 2012 Call Volume

The following table provides a summary of the volume and types of calls received by each PSAP.

2012 Combined PSAP Call Volume				
PSAP	911 Wireline Call Volume	911 Non Wireline Call Volume	10-digit & Admin Calls*	Totals
Derby – VSP	7,364	13,581	461	21,406
Rockingham – VSP	7,642	15,005	721	23,368
Rutland – VSP	9,402	25,768	398	35,568
Williston – VSP	14,730	49,722	2,561	67,013
Hartford - Police Department	2,403	6,815	319	9,537
Lamoille Sheriff's Office	3,130	6,884	305	10,319
St. Albans Police Department	4,577	10,235	670	15,482
Shelburne Police Department	3,232	8,041	614	11,887
Totals	52,480	136,051	6,049	194,580

*It is likely that the number of administrative calls is much higher for each PSAP when taking into account the administrative calls received that pertain only to dispatch functions. The call counts were provided to Kimball by the E911 Office.

Table 2—2012 Combined PSAP Call Volume

[4] Pre-arrival instructions include medical, fire and law enforcement call query protocols that provide guidance to the type of response and what assistance can be provided prior to responders' arrival on scene. For example, verbally guiding a caller through the steps to perform CPR; or advising a caller to leave or clear a location where a fire or chemical threat exists; or guiding a crime victim through steps that may preserve evidence.

3. 911 CALL CENTER MODEL OVERVIEW

Over the last several years states have increasingly looked for cost efficiencies as budget dollars have become tighter. States that directly support the 911 portion of emergency communications have naturally looked at ways to reduce the costs associated with this support. One way to reduce state level costs is to reduce the number of 911 answering positions and other network costs through consolidation and thereby reduce the costs to the states. However, this approach has unintended consequences as it addresses only one component of the emergency communications system.

Emergency communications is split into two components; 911 call taking and emergency service dispatching functions. Each of these components may be housed in a PSAP that performs both functions; or 911 call taking can be done as a standalone service leaving emergency dispatch to some other set of agencies. Vermont, like many other states, has a mixed approach, where the Vermont PSAPs sometimes provide both services to designated communities while in other cases the PSAP only takes 911 calls and the dispatch role is left to local police, fire and ambulance agencies. The Vermont 911 Board has no jurisdiction over whether a town should or must have its emergency services dispatched from one of 8 PSAPs, which helps to explain why there are an additional 44 dispatch only centers in Vermont. Completely separating these components may or may not impact costs at the local level, but costs at the state level will increase. It is also important to note that separating these components will reduce the effectiveness of the emergency communications system because of the additional time required to contact a dispatch agency or agencies to respond to a specific emergency.

The current Vermont funding model provides call taking equipment across the state. Radio dispatch console systems (RDCS) and CAD systems are generally procured at the state level and provided to local communities based on some cost sharing model, but without the benefit of 911 funds. This separated funding model has an impact on how end-to-end call processing is delivered across the state. In areas where call taking and dispatching are provided from the same location (PSAP) the one-stop shopping service model is in place. Other areas have call taking performed at one location and the resulting dispatch of response agencies are provided at a different location (dispatch only centers). In the transfer of calls there is another fissure created by the need of the dispatching entity to re-query transferred callers – creating a duplication of effort and adding more time to the call handling process. The remedy for this would have all call taking and dispatching provided from one PSAP. Effective practice in L.R. Kimball's experience is to strive to limit the transfer of calls. Providing call taking and dispatching of all response agencies within a defined geographical area will eliminate routine transfers and provide the optimum level of service to that area.

If Vermont were to pursue improving service levels statewide by bringing all call taking and dispatching together in a combined communication center, it would require consolidation of state and local resources so that both 911 call taking and emergency dispatch could be handled from two or more regional emergency communication centers. Call taking and dispatching would be handled by separate employees within the combined facility. This would require a change in governance over emergency communications as a whole (call taking and dispatching) in order to bring control under a single entity. Consideration of such an approach is outside the scope of this study and the work to consolidate emergency communication functions would require further study, as well as legislative changes and the cooperation of the local communities that currently provide their own dispatch services. As in most cases, the key to making such a change starts with how it is to be funded. L.R. Kimball's experience and observations reveal that if a consolidation initiative (study, planning) does not require funding from a local level, then those specific stakeholders are more willing to participate in the process.

From L.R. Kimball's observation in hundreds of PSAPs of all sizes and service levels over the past 10 years, it is clear that industry effective and best practices ascribed to by PSAP managers is to limit the transfers of emergency calls to avoid points of failure that include human error, equipment failure and/or network glitches. Current areas of the state that require a transfer of callers to reach the dispatch agency(ies) now have a lesser, or slower, level of service, than those areas that have call taking and dispatching provided from the same location. Creating a situation where all 911 calls require a transfer to a dispatch center(s) could actually degrade the level of service currently provided in many cases by requiring every 911 call to be dispatched by a separate agency. This approach is contrary to best practices. Should the state of Vermont elect to pursue reducing the number of PSAPs and creating a model where all 911 calls are transferred to a dispatch only center, then the call processing time would be lengthened for all callers.

As observed in the sample state models in the following section, there are methods that strive to mitigate the negative impact of the transferred call model. A viable method for Vermont would be to automate the call query/collection and dissemination process by expanding the eligible disbursements to include funding a statewide CAD system or systems with CAD-to-CAD capabilities and connecting all the dispatch centers to the ESInet. However, providing a common CAD system and connecting all of the various dispatch centers to the ESInet would carry significant costs.

Nonetheless, if the State were to choose to separate call taking and dispatching as described in this report, the two 911 call centers should have the same networked CAD system and the dispatch sites should have CAD-to-CAD capabilities between themselves and the two state call centers. This will allow sharing of consistent data and reduction in processing time by providing the data components of each call along with the transfer. While call takers and dispatchers must validate the caller's location and details of the incident, they will have the benefit of having that data automatically populated in a CAD system thus reducing the data entry time frame. The time stamped entries will serve as an audit trail for the state call centers and dispatch centers that can be used in investigations, quality assurance reviews and tracking historical data and employee productivity.

3.1 911 Call Center Model Examples

L.R. Kimball is aware of other states that have utilized the 911 call center model and has provided high level information on those programs below.

3.1.1 State Example One

One state[5] separated 911 call taking from dispatch when 911 was initially implemented statewide. All authority for 911 within the state resides at the state level and the two 911 answering centers are owned and operated by the state. The 911 call takers are considered state employees. All 911 operations are completely paid for through state level resources.

The two centers provide redundancy for each other and calls are dispersed between the centers based on availability. All 911 calls are received by one of two centers, triaged and then transferred to the appropriate dispatch-only site(s). There are 88 dispatch agencies throughout the state.

[5] The state requested not to be identified within the report, but was happy to provide information to assist.

The state purchased and provided a CAD system to allow for information transfer from the 911 call answering center to the 88 dispatch agencies. The state handled the competitive procurement of the CAD system and offered to provide the CAD license and maintenance for any of the dispatch agencies that wished to participate. The only complaints the state has received are from those dispatch agencies that quit utilizing the system because of interface issues that arose and the resolution had to be funded locally.

All 88 of the dispatch-only agencies are on the statewide IP network. When calls are transferred from the 911 answering center, it is done via the IP network. The call transfer time for a medical call can take up to 90 seconds as the 911 call taker provides the emergency medical dispatch (EMD) instructions. Call transfers for law enforcement or fire services generally take 30 seconds.

3.1.2 State Example Two

Another example of a state[6] implementing 911 call taking separately from dispatch is still operating with a single 911 call answering center. The state does have another fully redundant and diverse site utilized as an unmanned alternate call taking center. The equipment at the unmanned center is monitored and tested on a regular basis. All authority for 911 within the state resides at the state level and the 911 answering center is owned and operated by the state. The 911 call takers are considered state employees. All 911 operations are funded at the state level through an allocation from the general fund.

Both 911 facilities are equipped with 14 call taking positions. The active center is typically staffed with five to eight call takers and they have never needed to exceed the fourteen positions. However, in the event of a large scale emergency, they could staff both centers and have a total of 28 positions. The call taking center is equipped with both 911 and CAD equipment.

The 911 call taking center accepts the initial 911 call, verifies the type of help needed, call back number and location and then transfers the call to one of approximately 60 dispatch locations. The State provides each of the dispatch locations with a phone dedicated to the 911 transfer calls. The state is investigating the ability to transfer CAD data, ANI/ALI and mapping location information to the dispatch locations with the call transfer. It is possible that the state owned CAD system is capable of interfacing with other CAD vendors. The State is currently testing the interface ability with one dispatch location. If the testing is successful, the State will offer the interface functionality to the remaining dispatch locations.

3.1.3 State Example Three

In another state where a state 911 office provided CPE, network, EMD and training to the PSAPs statewide, consolidation of the 911 call processing portion of emergency communications was mandated. Consolidation of dispatch functions was encouraged as well, but could not be mandated since the state only had authority over the 911 portion. In keeping with what is commonly seen, control of the dispatch portion was retained by local municipalities. This unanticipated result caused the emergency communications system statewide to become fractured as it then required more 911 call transfers. These call transfers add a built in delay in the dispatch of emergency personnel.

6 IBID

The state is now evaluating the best way to proceed to ensure the best possible emergency communications system is in place statewide.

3.2 Summary

The division of emergency communications into its two separate components; call taking and dispatch functions, is a model that exists, but is not wide spread. Where it does exist, the state has established 911 call centers to receive 911 calls statewide and then transfer them to the appropriate dispatch-only site(s) while dispatching functions continue to be provided at the local level. A complete separation of call taking and dispatching in Vermont will allow for the continuation of a consistent statewide 911 call processing methodology. This lower but nonetheless consistent service level can be achieved, and somewhat mitigated, through automation via a networked CAD system, CAD-to-CAD data sharing capabilities and expansion of the ESInet. The use of a statewide CAD system or the ability for a statewide CAD to interface with the CAD system(s) used by each local dispatch agency can mitigate, though not eliminate, the inherent delay built into the emergency communications system by 911 call transfers.

If the state decides to pursue a 911 call taking only approach, L.R. Kimball recommends the State procure and utilize a networked CAD system for the planned two 911 call centers, establish interfaces with CAD systems at the local level and connect each of those dispatch centers to the state ESInet. The costs associated with this level of automation are included in the costs estimates provided in Section 4.

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4. VERMONT CALL CENTER MODEL

Apart from the service impacts of separating call taking from dispatching in areas where it is currently provided together, the following focuses only on projecting the number of 911 call centers based on the following criteria:

- The total 911 call volume
- The geographic distribution of the 911 call volume
- The need for redundancy within the 911 statewide system to ensure continuity of operations
- State geography as it relates to the suggested location of 911 call centers

L.R. Kimball assumed that the existing IP network would be utilized.

4.1 Number of Call Centers

The statewide 911 call count is just under 195,000 calls which is a relatively low number. Typically, a call volume of this size could be handled in a single 911 center. However, in L.R. Kimball's opinion, a single statewide 911 call center would present redundancy issues and potential problems with continuity of operations should a single center become incapacitated, evacuated and/or need to be relocated for a long period of time.

Given the need for redundancy, L.R. Kimball recommends that the State establish two call centers. Each center should be physically, organizationally and technologically sized to be able to absorb the other center in the event of a catastrophic systems failure or long-term facility evacuation.

Given the existing call distribution, L.R. Kimball believes the best configuration is one call center in the northern portion of the state and one in the southern portion. The table on the following page depicts such a configuration with the existing eight PSAPs assigned to either the north or the south call center. The call volume numbers reflect 2012 statistics and were supplied to L.R. Kimball by the E911 Office.

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Estimated Call Volumes - North and South Call Center Configuration				
Existing PSAP	911 Wireline Call Volume	911 Non Wireline Call Volume	10-digit and Admin Calls	Totals
North Call Center				
St. Albans	4,577	10,235	670	15,482
Lamoille	3,130	6,884	305	10,319
Williston	14,730	49,722	2,561	67,013
Derby	7,364	13,581	461	21,406
North Call Center Totals	29,801	80,422	3,997	114,220
South Call Center				
Rutland	9,402	25,768	398	35,568
Rockingham	7,642	15,005	721	23,368
Hartford	2,403	6,815	319	9,537
Shelburne	3,232	8,041	614	11,887
South Call Center Totals	22,679	55,629	2,052	80,360
Combined Totals	52,480	136,051	6,049	194,580

Table 3—Estimated Call Volumes – North and South Call Center Configuration

Ideally, the 911 call volume would be split between the two call centers. However, based on current PSAP locations, state geography and existing call distribution, the division depicted in the above table represents the most logical configuration for a call center model.

4.2 Call Processing

The current industry standard for 911 call taking[7] has the 911 call taker receive the incoming call, obtain vital information for responders, determine the jurisdiction(s) and type of service, law enforcement, fire and/or EMS and provide pre-arrival instructions when appropriate, while the dispatcher dispatches the appropriate response agency(ies). All 911 callers are queried to determine the incident type (nature), the incident location and the calling party name and call back phone number. The call information is then sent via CAD to the appropriate dispatcher(s) for radio dispatch of field units. For example, CAD will generate two incidents, one law enforcement incident and one fire incident for a call that requires both law enforcement and fire response ensuring that both response agencies are notified at the same time of the same information. When the call taker remains on line with the caller (e.g. medical call, crime in progress), further information important to response and mitigation of the incident can be gathered, entered into CAD, viewed by the dispatcher(s) and relayed to the field units. This model provides the best possible service to callers by potentially reducing the overall response time through a faster call processing and dispatch time. This methodology also allows the call taker/dispatcher to both focus on obtaining necessary information and dispatching units without having to manage an upset caller, field response personnel and potentially answer additional incoming calls. The key to achieving maximum efficiency in call taking and dispatch is standardized call taking

7 NENA Call taking Operational Standard/Model Recommendation NENA 56-005 June 10, 2006

protocols, which are already in place, and effective use of the CAD system so that communications between call taker and dispatcher are seamless. Proximity of call taker and dispatcher (in the same room) raises the quality of service through increased situational awareness, coordinating capabilities and speed of process.

In a two call center model under the parameters provided to L.R. Kimball, the incoming 911 calls would be routed to one of two call centers. The call takers would continue to answer calls and interview callers according to NENA standards which dictate:

- NENA 56-005, *911 Call Answering Standard*, states, "Ninety percent (90%) of all 911 calls arriving at the Public Safety Answering Point (PSAP) shall be answered within ten seconds during the busy hour (the hour each day with the greatest call volume, as defined in the NENA Master Glossary 00-001). Ninety-five (95) percent of all 911 calls should be answered within twenty (20) seconds."
- The 2013 version of NFPA 1221, Section 7 states, "Ninety-five percent of alarms[8] received on emergency lines shall be answered within 15 seconds, and 99 percent of alarms shall be answered within 40 seconds" and, "Ninety percent of emergency alarm processing shall be completed within 60 seconds, and 99 percent of alarm processing shall be completed within 90 seconds."

Once the location of the incident and call back number is obtained, the type of incident and the appropriate response agency is determined. The call would then be transferred to the appropriate dispatch-only site for the response agency to be notified and dispatched to the incident. The 911 call taker may remain on the line to continue providing any pre-arrival instructions such as EMD. The dispatch-only site would then conduct its own interview, dispatch field personnel and/or apparatus. There may be incidents that will require coordinating the response of other agencies dispatched by other dispatch only sites. In these cases, the additional levels of response may be coordinated by radio contact or telephone.

The use of a CAD system(s) and CAD-to-CAD data sharing interface will automate the data sharing portion of this process, create consistency in the data being passed between the call centers and dispatch sites, and among response agencies; and will document the incident for agency use, audit trails, quality reviews and training.

4.3 Staffing

Staffing projections are routinely provided in operations based studies by L.R. Kimball staff. As such, L.R. Kimball was commissioned by NENA to perform a staffing study in conjunction with a peer consulting firm called 9-1-1 SME Consulting with the objectives of developing staffing and budget models. The resulting PSAP Staffing Guidelines and Staffing Worksheet[9] are used nationally to assist in projecting staffing needs for PSAPs. L.R. Kimball uses this projection tool along with customized techniques to also assist in projecting supporting staff and dispatch staff as appropriate. The combination of the Erlang-C[10] call center staffing calculator with the APCO Project RETAINS[11] staffing tool calculator are the foundation of the NENA staffing tool. The staffing tool baseline maintains no less than two staffed call taking positions (workstations) are necessary even in the smallest of PSAPs with the lowest call volume. This supports the EMD protocol provision by one party

8 NFPA 1221 defines an alarm as "a signal or message from a person or device indicating the existence of an emergency or other situation that requires action by an emergency response agency."

9 http://www.nena.org/general/custom.asp?page=PSAP_StaffingGuide

10 http://searchcrm.techtarget.com/definition/Erlang-C

11 http://apcointl.org/resources/retains/retains-toolkit-20.html

while other calls or tasks are performed by the second party. Expanded into larger call centers the tool accommodates both a combined duty operations plan, as well as assigned call takers. Since PSAPs operate 24/7 there is a need to have a minimum number of staffed workstations (positions) around the clock therefore a minimum of four to five FTEs are required to staff a single workstation 24/7. This projection will vary with the number of shifts to be covered; e.g. 8 hour shifts require 3 or more groups of FTEs over 24 hours while 12 hour shifts require 2 or more for the same period.

L.R. Kimball conducted a high level staffing needs assessment based on the reported call volume statistics using the tools as described.

The first step in estimating staffing levels is to estimate the total call volume each call center will handle, including both 911 and related ten digit emergency, administrative and non-emergency calls.

The 2012 combined 911 call volume for all Vermont agencies is just under 195,000. To account for emergency calls received on 10-digit lines, administrative calls and non-emergency calls, along with future call growth, the total call volume for the purposes of estimating staffing is 250,000. For purposes of this report, call volume is assumed to be roughly evenly split between two centers.

The next step is to calculate the number of workstations needed to manage the call volume. The number of workstations was arrived at using an Erlang-C calculator and the NENA call performance standards described above.

When looking at scheduling at a more granular level, determining the busiest and slowest days of the week and hour of those days allows the call center manager to staff workstations on shifts more efficiently based on actual workload. However, for the purposes of this preliminary staffing estimate, the average number of workstations that need to be covered is used. In this case, the average number of workstations that need to be covered to manage the incoming call volume is three workstations. Since call volume is not evenly distributed around the 24-hour clock, some hours of the day will require more than three workstations to be covered and others will require less than three workstations to be covered. Management will have to make the specific placement of staff and number of workstations based on call volume trends. For example, the total number of calls received in a 24 hour period will most likely come during specific time periods such as rush hour or school start and finish times.

Using the Erlang-C/APCO/NENA base projection of five FTEs needed to staff one workstation 24/7, the staffing and associated cost table on the following page illustrates the coverage needs for a two call center model for Vermont.

911 Call Center Staffing and Personnel Cost Summary			
Position Title	Number of Employees	Estimated Base Pay Per Position	Estimated Total Base Pay
Call Center Director/Manager	2	$80,000	$160,000
Shift Supervisors	12	$80,000	$960,000
Telecommunicators (Call Takers)	34	$80,000	$2,720,000
Total Call Center Staff Needed	48		$3,840,000

Table 4—911 Call Center Staffing and Personnel Cost Summary

Staff position needs and payroll costs are based on the following:

- Supervision – The call centers will need a shift supervisor on duty at all times. Public Safety best practices require 24/7 supervision. National Fire Protection Association has developed codes, standards, and recommended practices through a process approved by the American National Standards Institute (ANSI)[12]. To cover this, five to six supervisors per call center will be needed to ensure one supervisor on duty on a 24/7 basis. This group can be supplemented by senior telecommunicators functioning in an acting supervisory capacity.
  L.R. Kimball also assumes that training and quality assurance and control functions, which are essential, will be spread across this group initially. The creation of a separate staff position(s) to cover these support functions may be necessary once the call center is operational and the true work load assessed. The salary estimate is based on a 10 percent increase of the telecommunicator pay scale.
- All call center staff are assumed to be full time state employees.
- The salary for all employees is based on the average cost used within Vermont to estimate a new state employee and is inclusive of benefits. The actual pay per position would be higher for managers and lower for the call takers, but would fall within the total budget estimate. A civilian director is assumed to be required at each call center.

4.4 Facility Size

The operation of the statewide call centers will require the construction of new facilities or the renovation of an existing building. For new construction, a site of at least three to five acres should be identified and assessed for suitability prior to acquisition. With either option, consideration should be given to industry best practices for 911 centers listed below.

The industry standards cited and used to guide the design input and technology best practices recommended include NFPA Section 1221, CALEA, NENA and APCO. These standards-setting bodies provide standards and guidance in the operations and technical aspects of a modern PSAP. The NESC; the latest edition of NFPA 70, National Electrical Code (NEC); American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance (ANSI/TIA/EIA) standards; the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Method Manual; and Motorola R56 Standards and Guidelines for Communication Sites impact the electrical and cable infrastructure. The

12 NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* (Edition 2010). Chapter 7 sets forth the standards for PSAP operations; Section 1 of Chapter 7 addresses management.

Institute of Electrical and Electronic Engineers' (IEEE) standards impact electrical, grounding and communications systems design.

Additional consideration must be given to codes adopted by the local jurisdictional authority. For example, if the most recent version of the International Building Code (IBC) is used, specific criteria must be followed to ensure the stability and integrity of buildings identified as critical facilities.

The design of a space intended to support 24/7operations must meet the needs of a modern call center or PSAP. Of great importance is the comfort and safety of the staff and the capacity of the space to address current needs, as well as needs for the next ten to twenty years. A hardened design is desired and intended to allow this operation to continue when the surrounding community is affected by power outages, severe weather events or man-made and/or natural disasters. There are compromises and decisions required to accommodate limitations in funding, vision and, at times, politics. The effort and attention given to the design of a new facility, and specifically to the allocation of the communications space and support areas by the facility occupants, will determine the capacity and life span of the structure, service and, ultimately, the organization.

4.4.1 Spatial Requirements

In emergency communications operations, the number of workstations drives the floor space and adjacency needs. Effective architectural 911 design practices employed by L.R. Kimball and other experienced 911 facility architects[13] provide direction in determining the amount of space required to properly support emergency communications within a range of square feet (SF) based on the organizational and operational model. The number of required workstations is developed by first reviewing the future operations of the center and determining the number of personnel required for the workload. The quantity of positions is then determined to support the required staff. Support, administrative, training needs and future expansion must also be taken into consideration.

Programming based on the concept of a consolidated organization provides a range of available SF on a per console basis. To adequately support the anticipated workload, 12 workstations are needed in each of the call centers. An additional space allotment on the main floor should be given to accommodate future consoles as well. Twelve workstations will provide adequate room for each center to take over call taking operations for the entire state, allow for expansion, training and supervisory positions.

The number of workstations projected for an operation is used in combination with the amount of SF per position to project the total work area of the call center floor.

Consideration must be given to providing space for areas such as administrative and support offices, a training room, a kitchen, locker space, storage, hallways and bathroom facilities, and bunk rooms.

[13] Two recent L.R. Kimball partner architectural firms experienced in 911 center design are JacobsWyper Architects, LLP (Tim Lisle, AIA) and Becker Morgan Group (Ernie Olds, AIA)

4.4.2 Call Center Workstations

Within the allotted space, each position can require up to 175 SF of floor space per workstation and work area on the operations floor. The 175 SF represents the individual footprint of a position as normally fitting within a 10-foot by 10-foot area (100 SF) with the remaining 75 SF representing the necessary areas surrounding the furniture footprint, such as pathways, open areas, doorway access and clearance allowance in compliance with the Americans with Disabilities Act (ADA). This preliminary spatial allocation number is generally used for planning and can fluctuate with various room configurations and/or system furniture solutions.

4.4.3 Equipment Rooms

To project the space needs for an equipment room or rooms, planners must know the number and type of systems and equipment needed to support the call center. This space estimate should include utility considerations and demarcation points for all services. Other uses for this space may include network servers and routers, secure data storage for served agencies' records servers or repositories.

To accommodate hardware (e.g. servers, routers), circuitry (e.g. trunks, cabling) and backroom power needs for a call center sized to process approximately half of the statewide call volume, an equipment room would require a minimum range of 250 to 375 SF. This allows for 10-15 equipment racks/cabinets, adequate accessibility around the racks/cabinets, adequate floor and wall space for circuitry and cabling, floor space for other equipment that may be stored/accessed in an equipment room such as an uninterruptible power source (UPS) that provides battery backup until an emergency generator is activated, and demarcation for telephone circuits, power and grounding.

4.4.4 Training Room

The two call centers will need to construct an area to provide training for new employees. Call takers must master a wide range of interpersonal and technical skills and must perform their functions in a high-stress mission critical mode. There is an on-going need for call takers to maintain their existing proficiency and skills. A well-equipped systems training room or area will provide the required environment and equipment to carry out this critical training away from the operations floor and from the distractions found inside a 'live' call center.

L.R. Kimball recommends a dedicated systems training room or area with positions that are identical to the consoles on the operations floor, equipped with equipment and phone, to support training and live calls.

The training area can be used for new employee and continuing education training, incident overflow during high periods of call activity (severe weather) and can be staffed with additional call takers for special operations, emergency operations center (EOC) emergency management activations and other activities, and to monitor employee activity and perform quality assurance.

4.4.5 Facility Costs

One of the largest one time capital costs is usually the construction or renovation of an appropriate facility. It is rare that an existing structure is found to be suitable to house an emergency call taking operation. While it may be possible to locate a

facility of adequate size, typically the costs to renovate the floor space to current Public Safety industry standards[14] for a hardened facility with adequate cable infrastructure become as costly as new construction. Costs associated with both renovation and new construction options include site selection, evaluation and acquisition, and facility design, programming[15] and construction.

Industry standards[16] provide direction in determining the amount of space required to properly support emergency communications within a range of SF based on the organizational and operational model.

Site acquisition costs are difficult to project as they are based on land values for a specific place and time. Other factors that will impact costs involve assessing threats and vulnerabilities of potential site(s). Site assessment(s) and engineering study(ies) will reveal the suitability factors that define the pros and cons associated with each site. If stakeholders identify municipal-owned land that may be viable for locating a consolidated communications center and if a site evaluation shows the site to be a good location, then site acquisition costs could be minimal. L.R. Kimball recommends acquiring the services of an architectural firm with significant experience in 911 center design to conduct these site assessment(s).

Projecting accurate costs for a new facility requires a much higher level of detail and planning than is within the scope of this project. However, broad budgetary numbers are provided for use as a planning starting point. The projections provided are offered for planning purposes as cost estimates and cannot be considered accurate without site acquisition, assessment, programming processes and in many cases design completed.

To determine a budgetary estimate, L.R. Kimball combined industry best practices, average hardened facility construction costs per square foot, and some basic assumptions about the programming of the facility. Combining these criteria with 20-year growth projections and 12 recommended console workstations, an overall estimate for building size and cost can be calculated.

Table 5 on the following page details size and cost options for each of the call centers. These estimates include the general base building and minimal site development. It does not include site acquisition and improvement costs, if needed. As with any planning estimate, costs will need to be adjusted once a complete and in-depth space programming study is completed and other decisions regarding amenities, service area, staffing and number of workstations are made. Potential partnerships creating collocation opportunities will affect space needs, costs and funding.

The initial high level estimate for needed square footage indicated a facility size of between 9,600 and 14,400 SF to accommodate the workstations and administrative office space, equipment room(s), and other adjacencies. For comparison, several options below and above this estimated size are provided. Based on an estimated cost of $350 to $450 per square foot for construction/renovation, L.R. Kimball projects facility costs to range from $3.3 million and $5 million dollars. It is L.R. Kimball's opinion that the size of the facility would be closer to 9,600 SF since workstation space does not need to accommodate equipment associated with dispatch functions. It is important to note that these cost ranges are an average of

14 NFPA 1221

15 The process of defining space needs for a facility through identifying use of facility and individual office/floor square footage and costs.

16 NFPA 110 and 1221; IEEE; Motorola R56; NENA; APCO

what is found nationally. Square footage construction costs may vary greatly in specific areas so it is important to check the local market to verify estimated square footage construction costs.

The Square Footage/Workstations column of the table below reflects the facility square footage inclusive of office, conference, kitchen and other space in addition to the actual workstation square footage. These per square foot estimates are based on L.R. Kimball's experience in providing design input to both Kimball architects and partnering architectural firms such as JacobsWyper[17] and Becker Morgan Group[18].

911 Call Center New Construction Cost Estimates				
# of Workstations	Square Footage/ Workstations	Building Square Footage	Cost/Per Square Foot	Total Estimate
12	800	9,600	$350	$3,360,000
12	900	10,800	$350	$3,780,000
12	1,000	12,000	$350	$4,200,000
12	1,100	13,200	$350	$4,620,000
12	1,200	14,400	$350	$5,040,000
# of Workstations	Square Footage/ Workstations	Building Square Footage	Cost/Per Square Foot	Total Estimate
12	800	9,600	$400	$3,840,000
12	900	10,800	$400	$4,320,000
12	1,000	12,000	$400	$4,800,000
12	1,100	13,200	$400	$5,280,000
12	1,200	14,400	$400	$5,760,000
# of Workstations	Square Footage / Workstations	Building Square Footage	Cost / Per Square Foot	Total Estimate
12	800	9,600	$450	$4,320,000
12	900	10,800	$450	$4,860,000
12	1,000	12,000	$450	$5,400,000
12	1,100	13,200	$450	$5,940,000
12	1,200	14,400	$450	$6,480,000

Table 5—Call Center New Construction Cost Estimates

17 http://www.jacobswyper.com/ Timothy W. Lisle, AIA Principal Partner; sample projects include Charleston Co SC, Greenville Co SC and Lenoir and Jones Counties NC

18 http://www.beckermorgan.com/ Ernest W. Olds, AIA Principal Architect; sample projects include Arlington VA and Scotland Co NC

4.5 Cost Estimates

In order to provide an estimate for the cost of a 911 call answering center; L.R. Kimball had to make several assumptions. We preferred to err on the side of too much capacity, so some functionality, such as the addition of a CAD system, has been included that is not currently being planned by the Vermont E911 Board. Ongoing/recurring costs must be included in the decision making process as costs associated with facility maintenance and upkeep, replacement and/or upgrade costs of facilities, equipment and networks will require methodical planning and funding. These recurring costs would require negotiation with suppliers/vendors and therefore not possible to forecast.

For purposes of estimating UPS generator power, it was assumed that it would need to support 14 positions each using a computer-based 911 telephony application and a computer aided dispatching application. Each position was assumed to have a computer and three 19-inch liquid crystal display (LCD) monitors. The number of positions was rounded up in order to assure appropriate UPS generator power.

Each of the positions was assumed to be configured with "ergonomic" dispatch furniture with motorized moving surfaces, as well as task lighting. However, the furniture was not considered into the size of the UPS as it is not typically connected to a UPS.

The operating assumption is that the 911 backroom equipment will be comprised of servers operating in a redundant/failover mode attached to some type of a redundant array of independent disks[19] (RAID) or other storage device.

If implemented, CAD will also be supported through the use of redundant servers in the equipment room attached to a RAID or other storage device.

All backroom equipment will be supported using network routers and switches.

4.5.1 Equipment Costs

Vermont intends to transfer the current 911 CPE into the two 911 call centers. As this is a known cost and is already being funded; the cost of 911 CPE has not been included in this report.

4.5.1.1 Uninterruptible Power Supply

Uninterruptible power supply (UPS) systems provide two distinct "services". When operating on commercial power the UPS serves as a filter, smoothing out spikes in the power (surge suppression) that is delivered to the devices attached to UPS protected circuits. When commercial power fails, the UPS continues to deliver power to the attached devices while the generator comes online and reaches a point where it is able to deliver stable power. Once the generator has started and stabilized, UPS again acts as a pass-through device smoothing out the "spikes" in the power provided by the generator.

[19] Formerly "redundant array of inexpensive disks"

It is not common practice to attach devices that use electrical motors or other devices that have large initial loads. For example, ergonomic furniture is usually not connected to UPS protected circuits, because the actuator motors have very large short-term power draws. In the same way devices like laser printers and portable heaters are also not connected to UPS protected circuits.

UPS size was estimated by summing the calculated power loads for the estimated equipment. Once that value was calculated, an additional 20 percent growth factor was added resulting in a UPS requirement of 17.93 kVA. Given this value, Kimball suggests a 20 kVA UPS be installed. If there are additional computers or circuits or other equipment that will need to be connected to UPS protected circuits, their power draw will have to be calculated, and a larger UPS will be required.

4.5.1.2 Emergency Generator

Emergency generators typically provide power support to all or most circuits in a facility whether or not the circuits are UPS protected. For example an emergency generator will need to power room lights, heating, ventilation and air conditioning (HVAC), and other equipment not attached to a UPS system.

Given the information provided, L.R. Kimball estimates that there is an additional need of approximately 15 kVA above and beyond the 20 kVA provided in the UPS, generating a need for at least 35 kVA of generator power. Generators operate most efficiently when running at 50 to 70 percent capacity. Based on the estimated generator power of 35 kVA, L.R. Kimball recommends that a 50 kVA generator be installed.

4.5.1.3 Call Center Cost Estimates

The table on the following page depicts the estimated cost of the equipment needed for the 911 call centers. Items such as fire suppression, security, overhead or subfloor trays for the equipment room, etc. are included within the facility cost calculations in 4.3.5 above.

New Equipment Cost Estimates			
Facility/Overall Equipment	# Needed	Cost	Total Estimate
UPS - 20 kVA	2	$12,000	$24,000
UPS installation	2	$2,400	$4,800
Generator - 50kW	2	$30,000	$60,000
Generator installation including foundation	2	$5,400	$10,800
LP Gas Fuel Tank (1000 gal) foundation & piping	2	$10,000	$20,000
Subtotal			$119,600
Operations Area Equipment	# Needed	Cost	Total Estimate
24/7 rated chairs, 1 per seat, including supervision, plus two spares	28	$1,200	$33,600
Consoles with adjustable height work surface, personal storage areas per planned position plus two or more for overflow	28	$18,000	$504,000
Master clock[20]	2	$20,000	$40,000
Administrative Area - desk, credenza, file cabinet, chair, phone	2	$3,000	$6,000
Other support equipment, e.g. printers/fax/copiers, hard copies of manuals and reference material to include EMD or other protocol card sets	2	$5,000	$10,000
Subtotal			$583,600
Equipment Room	# Needed	Cost	Total Estimate
19" racks	2	$350	$700
Cabinet*	2	$1,000	$2,000
Telephone, simple desk & chair	2	$900	$1,800
Bookcase	2	$250	$500
Tables	2	$700	$1,400
Subtotal			$6,400
Total			$709,600

Table 6—New Equipment Cost Estimates

4.6 Call Center Cost Summary

The costs associated with physically reducing the eight call centers down to two have been enumerated in previous sections and include the facility cost ranges for new construction; equipment, technology and networking projections; and an estimate

[20] An accurate timing device that generates synchronization signals to control other clocks or equipment. (Ref. NENA 04-002) NENA Master Glossary of 9-1-1 Terminology, NENA ADM-000, December 4, 2012. This device is normally used to synchronize time between CAD, 911 equipment, logging recorders and radio console systems.

of personnel costs. With the shift of call taking entirely to the state 911 call centers it is likely that the cost associated with 911 call taking will shift from a predominantly local responsibility to a state responsibility. Table 7 below summarizes the costs the state will incur to establish these call centers.

Total 911 Call Center Estimated Costs				
Type of Cost	Description	Quantity	Individual Cost	Total Estimated Cost
Non-recurring	One-time charges for additional furniture and equipment	1	$709,600	$709,600
	One-time charges for facility construction - 2 facilities	2	$4,880,000	$9,760,000
	CAD*	78	$75,000	$5,850,000
Recurring (monthly)	ESI network connectivity^	27	$1,100	$29,700
Recurring Personnel Costs	Proposed personnel for both centers (annual)	1	$3,840,000	$3,840,000
			Total Estimated Costs	$20,189,300

*The number of CAD workstations was calculated assuming 1 CAD workstation per each of the 12 positions within the two call centers and at least 2 positions within each of the 27 dispatch centers for a total of 78 workstations. CAD licensing is estimated between $60,000 and $90,000 per position. The mid-range was used for estimating purposes.

^ESI network connectivity was estimated based on an average cost for an IP connection. The IP connectivity average cost is based on Kimball's experience implementing IP networks throughout the US, and includes the cost of building out IP connectivity to those locations that do not currently have access.

Table 7—Total 911 Call Center Estimated Costs

5. BEST PRACTICES

A number of best practices and standards exist for emergency communications as a whole and call taking specifically. These best practices and standards have been created by organizations such as:

- National Emergency Number Association (NENA)
- Association of Public Safety Communications Officials (APCO)
- National Fire Protection Agency (NFPA)
- Department of Homeland Security (DHS)
- International City/County Management Association (ICMA)
- Commission on Accreditation for Law Enforcement Agencies (CALEA)

An effort that includes the creation of a new organization provides an ideal opportunity to establish a sound organizational foundation for the new call centers. This foundation should be based on key best practices and standards. This section provides an overview of these practices and standards.

5.1 National Fire Protection Association Section 1221 Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems

"This standard covers the installation, performance, operation, and maintenance of public emergency services communications systems and facilities." (NFPA Chapter 1, Section 1.1.1)

The purpose of this standard as stated in NFPA Chapter 1, Scope[21] is as follows:
(1) To specify operations, facilities, and communications systems that receives alarms from the public
(2) To provide requirements for the retransmission of such alarms to the appropriate emergency response agencies
(3) To provide requirements for dispatching of appropriate emergency response personnel
(4) To establish the required levels of performance and quality of installations of emergency services communications systems

5.2 Commission on Accreditation for Law Enforcement Agencies, Inc. Standards for Public Safety Communications Agencies

Commission on Accreditation for Law Enforcement Agencies [22] in conjunction with the APCO is a nationally recognized Public Safety communications center accreditation program that covers all aspects of communications center operations. There are 212 standards covered in the program for the following areas:

1. Organization
2. Direction and Supervision
3. Human Resources
4. Recruitment, Selection, and Promotion

21 http://www.nfpa.org/codes-and-standards
22 http://www.calea.org/content/public-safety-communications-accreditation-standards

5. Training
6. Operations
7. Critical Incidents, Special Operations, and Homeland Security

5.3 National Emergency Number Association

NENA has published standards and other documents such as white papers and articles for use by their membership and industry representatives to guide compliance with the NENA standards that cover the following areas:

1. Accessibility - www.nena.org/?page=Accessibility
2. Agency Systems - www.nena.org/?AgencySystems
3. Core Services - www.nena.org/?page=CoreServices
4. Interconnection & Security - www.nena.org/?page=InterconnectSecurity
5. NG9-1-1 Transition Planning - www.nena.org/?page=NG911_TransPlanning
6. PSAP Operations - www.nena.org/?page=PSAP_Operations

5.4 Association of Public Safety Communications Officials

Association of Public-Safety Communications Officials is an ANSI[23] accredited Standards Developer (ASD). The standards published by APCO include the following areas:

1. Training
2. Data sharing
3. Wireless 9-1-1 deployment
4. Operations
5. Management

Association of Public-Safety Communications Officials also provides informational documents and tools as resources for 9-1-1 centers to include staffing and retention information and effective practices guides.

5.5 International Academies of Emergency Dispatch

International Academies of Emergency Dispatch[24] is a non-profit standard-setting organization developing and promoting the use of standardized operational protocols for processing medical, fire and law enforcement calls for service.

These standards-setting entities provide standards and guidance in the operations and technical aspects of the modern emergency communications center. L.R. Kimball experience, effective and best practices, and lessons learned from previous emergency communications center studies, programming and design efforts, provides application perspective on the impact of each of these standards. Other standards of great impact on facility design components for electrical and cable infrastructure

23 http://www.ansi.org/
24 http://www.emergencydispatch.org/Organization

are Standards and Guidelines for Communications Sites (Motorola R56 standards, 2005) and IEEE standards for electrical, grounding and communications systems design.

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6. OPERATIONAL RECOMMENDATIONS

6.1 Separation of 911 Call Taking and Dispatch Functions

Any discussion about how to best provide 911 call-taking must include the impact on the overall emergency communication process that includes dispatching calls for service. The reactive nature of Public Safety response services require expeditious processing of emergency response requests – 911 calls. The public expectation is that all Public Safety agencies are close by and able to respond in time to save life or property. The reality is that until a crime, fire or medical emergency are reported, the response agencies are unaware of the in-progress, impending or past event. The public expectation is also that the authority answering their emergency calls is able to quickly process the information and facilitate the response – dispatch the appropriate agency(ies). The 911 call taking equipment and networks are designed to provide that dedicated link to emergency services. Failures in this link and processes create delays in emergency responses. Where these processes can be automated and consolidated, service providers at local, regional and state levels can minimize or reduce the risk factors of points of potential failure from human error, technology and operational/organizational processes such as the separation of call taking and dispatching.

While splitting the call taking process is not an effective practice, it is common within the Public Safety community. And, although there is no standard or best practice document stating that emergency calls should not be transferred, L.R. Kimball has observed effective industry practices in place across the country that strive to reduce the transfer of emergency calls by providing standardized call taking and dispatching service from the same PSAP. The separation of call processing and dispatching creates an inherent delay in the work flow process, as any transfer of calls and data requires time. In emergency communications, a loss of seconds or minutes can have a significant impact on the outcome of an emergency response request.

L.R. Kimball understands that the Board is limited to overseeing and influencing the call taking portion of the communications process while the dispatching portion of the communications process is regulated and provided at both the state (Vermont State Police) and the local/agency level. While it may not be possible to maintain or combine call processing and dispatching services into one operation, there are steps that can be taken to mitigate the negative impact of separation on the process. There are states that have implemented a single or two statewide 911 call centers. In one case, the call transfer delays are minimized by the use of a statewide CAD system. If the eight PSAPs are to be reduced to two 911 call centers based on the criteria described in Section 5, Kimball recommends the State procure and implement a networked CAD system and pursue provisioning the same CAD system and/or a CAD-to-CAD solution with and among the dispatch only sites. L.R. Kimball recommends that the State expand funding eligibility to include funding a percentage of the local agency CAD system costs based on the local procurement of the same CAD system as the state's CAD allowing ease of interfacing (e.g. 50 percent); or, fund a percentage of the costs of a CAD-to-CAD interface or solution for CAD systems that are not the same as the state's system (25 percent). The State can gain local buy-in by providing funding incentives for local use of the ESInet and new CAD system. Cost considerations must include network costs and costs associated with the geographically diverse placement of licenses.

Due to the roadblocks posed by real or imagined politics, funding and local versus state control issues, L.R. Kimball recommends an initial step of expanding the legislated eligible costs to include a 911 Board selected (vetted) CAD or CAD-to-CAD solution on a first-come first-served voluntary basis followed by a transition plan for the remaining PSAPs. In addition, L.R. Kimball recommends expanding the eligible costs to include connectivity to the Vermont ESInet for each of the

27 current dispatch locations for an estimated recurring monthly cost of $29,700. The ESInet connectivity was estimated based on an average cost for an IP connection. There may be additional costs assessed by the network provider, but at this time the connectivity is the only cost L.R. Kimball is able to estimate. The IP connectivity average cost is based on L.R. Kimball's experience implementing IP networks throughout the US, and includes the cost of building out IP connectivity to those locations that do not currently have access.

Reducing the number of PSAPs to two 911 call centers would require 12 CAD stations at each of the two 911 Call Centers, as well as two stations at each of the 27 dispatch locations. L.R. Kimball is assuming a total of 78 CAD stations would be needed. The cost of a basic to full feature CAD system will range from $60,000 to $95,000 per licensed position, with total cost projected range of $4,680,000 - $7,410,000. This cost estimate is based on vendor quotes provided to L.R. Kimball clients in the past 12 months. This does not include non-standard/custom interfaces; interface costs may be borne by the agency requesting the data, or as offered previously in this section the State could incentivize CAD use by funding all or a portion of the CAD system and networking costs. Interface costs will vary based on whether real-time data is needed (two-way interface) or if a repository can be established for agencies to retrieve data (one-way interface).

Note that consideration should be given to the cost impact of adding CAD and/or CAD-to-CAD across the state to the dispatch centers that have a very low call volume. There is no difference in the value of capabilities for handling a single 911 call or thousands of 911 calls; however the cost-per-call ratio for technology, networks, personnel and space increases as the call volume decreases. This will become increasingly an issue as next generation 911 services become available. Vermont should begin to discuss and consider the impact of the next generation 911 environment where texts to 911, videos, pictures and automatic crash notifications will be the type of media communicated to 911, on dispatch centers with very low call volume. It may become cost prohibitive to equip every dispatch center to full IP capabilities; however, not equipping all centers creates a disparity of service for the first responders and the citizens of Vermont. These discussions and considerations could help facilitate consolidation discussions between state and local authorities.

6.2 Call Transfers

When 911 call takers receive a call that must be transferred, the call taker must conduct a preliminary interview to determine the nature and location of the emergency. The call must then be transferred to the appropriate dispatch agency. The dispatcher then must re-interview the caller and dispatch field personnel. The average length of time added to a call during this process is 30 seconds. This is based on L.R. Kimball experience in measuring call processing times for similar studies across the country. Even when following the common sense format (best practice) of staying on the line when transferring calls, the accepting agency must still re-query some basic information from the caller then proceed to ask additional questions to best fit the response and have adequate data to share with the responders. Reducing transfers therefore can reduce call processing times and potentially reduce overall response times. For example, L.R. Kimball determined that in Charleston County South Carolina the call processing times averaged about six minutes for multi-agency and multi-jurisdictional responses due to transferring calls once, twice and in some cases three times. In a consolidated environment it was projected to reduce the call processing time down to under two minutes if all transfers were eliminated. Since this is a county model it was feasible to consolidate the ten local PSAPs and dispatch centers. At a state model level that involves separation of funding and oversight, and both state and local response, it could be far more difficult to accomplish a true consolidation. If a consolidation of call taking and dispatch centers is not pursued, then a reduction in the number of call centers based on the criteria in Section 5 and resulting in a further or complete separation of call taking and dispatching can be achieved if the State

determines that the delays in call processing are an acceptable risk that can be mitigated to the State's satisfaction by the automation of process through a statewide CAD and a CAD-to-CAD solution utilizing an expanded statewide ESInet.

In addition to the CAD-to-CAD interfaces or integration solutions as a mitigation option – another step to providing consistent accurate data to the dispatch centers is to ensure ANI/ALI information is transported and can be received by the dispatch centers – for locating callers and plotting and routing on maps. L.R. Kimball stands by the CAD solution as the better method of mitigating transfer issues because transferring data via CAD solves the overall data consistency issue (caller/incident location, incident descriptions, contact information, audit trail); while just providing the ANI/ALI data only solves the caller location issue.

For further consideration - the quality of technology available today has reduced issues such as calls lost during the transfer process, but the possibility still exists and increases with each transfer. In addition to inherent time delays, dispatch-only sites may not have equipment that is even capable to receive ALI and ANI. In a next generation 911 (NG911) environment the ability to receive all forms of data will be critical. This information is critical to locating callers when 911 calls are dropped from the network, when callers are in moving vehicles and when callers are unable to speak. The following points should be noted:

- While the call center that originally receives a 911 call can pass along location information verbally to the appropriate dispatch-only site(s), this verbal exchange adds another opportunity for human error.
- For wireless calls, the call center receiving a call from a moving vehicle would need to stay on the phone with the caller and the receiving dispatch-only site to update locations via the re-bid[25] process.
- Given the stakes involved to the emergency responders and the citizens served, national effective practices strive to reduce, limit or eliminate 911 transfers; however as indicated previously, the NENA call taking standard only specifies how to properly transfer a call and does not declare that transfers should not occur at all.
- L.R. Kimball recommends expanding the use and transport capability of the statewide IP network and adds the use of a CAD system and CAD-to-CAD data sharing to facilitate the passing of ANI/ALI, mapping information and, eventually, text, video and photos to dispatch-only sites.
- L.R. Kimball encourages the State to explore the potential for reducing call processing times through reducing the transfer of calls by studying the feasibility and practicality of developing a statewide consolidated operational model that funding and governance from a state and local level can support. A consolidated model can be achieved from an operational perspective with two centers serving the entire state – keeping in mind that state and local authorities must be provisioned an appropriate level of operational oversight within a governance agreement(s).

[25] A request for ALI record from the 911 center/PSAP to the ALI database.

7. SUMMARY

The hybrid 911 model currently in operation in Vermont has features that work very well and features that could be improved upon. L.R. Kimball applauds those PSAPs that provide both dispatch and 911 call taking as this is the industry best practice. Vermont is ahead of much of the rest of the country in implementing a statewide ESInet for 911 service. In addition, L.R. Kimball believes the amount of money spent to provide 911 service statewide is well within the range spent in other states that do not provide an ESInet. However, those PSAPs that must transfer the 911 call to a separate dispatch location are not providing the same level of service to the citizens of Vermont.

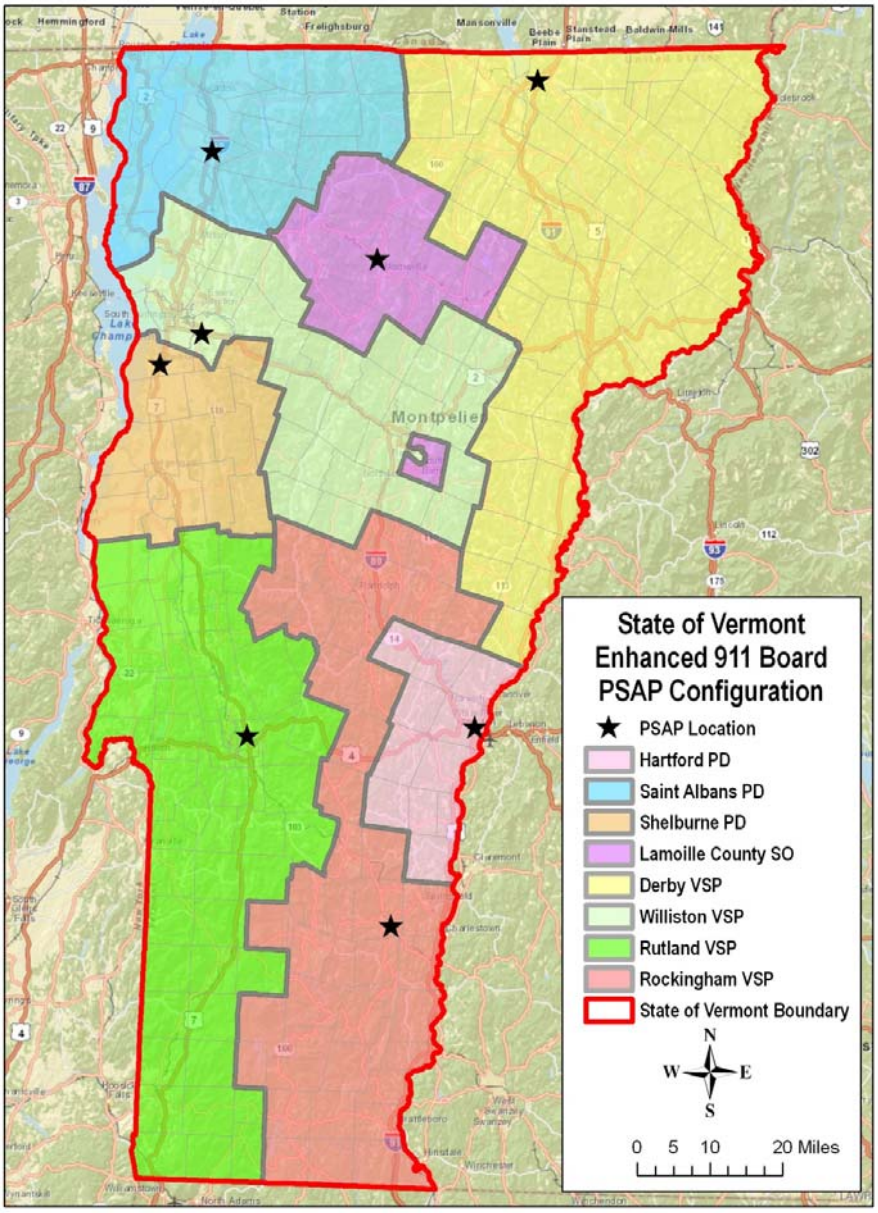
L.R. Kimball does not recommend further separation of 911 call taking and dispatching, and recommends that the State study the feasibility of consolidating call taking and dispatching statewide. However, if the State of Vermont wishes to reduce the number of PSAPs resulting in complete separation of 911 call taking from dispatch, L.R. Kimball recommends establishing a two call center model. It is important to note that this will increase the costs for the State.

While a reduction in the number of PSAPs is not a service improvement due to the potential of further fracturing the call taking process, there are ways to mitigate the risks involved. Standardizing the call taking protocols across all disciplines of law enforcement, fire and EMS will provide consistency and will create parity in service levels across the state. Introducing a networked CAD system for the two state call centers and incentivizing common CAD platform or CAD-to-CAD solution(s) through funding and technical support will reduce the time and improve the accuracy and consistency of data sharing across the call taking process steps between PSAPs, primary, secondary and dispatch only centers. Overall these steps toward automation and consistent operations will provide efficiency in the call taking process. Implementing data sharing with the CAD-to-CAD or integration solution with the dispatch sites will also have a positive impact on their service levels as it will create synergy and consistency in their processes and improve coordination between the levels of government response and recovery.

7.1 Back Up Planning

Regardless of whether the State reduces the number of PSAPs there should be a documented and practiced back up or fallback plan for continuity of operations for the resulting state PSAPs. Developing the two call center model will create a natural fallback plan should one of the call centers become inoperable. Recent catastrophic events in New York (September 11) and the post-Katrina flooding on the Gulf Coast has bolstered the concepts of creating and practicing for expanded levels of backup planning. To that end, the State should also identify or create an additional geographically diverse backup site should the two State PSAPs be compromised at the same time. Necessary components of back up planning include short and long term needs that include: space, equipment, network access for telephone, radio and data, training, access and sustainability. Costs associated with creating a physical back up site would be comparable to the projected costs of a new call center (See Section 4) if creating a full functioning, full equipped and networked, third site as a hot standby for the active sites. A lesser cold standby may only require the physical facility and limited equipment, which would significantly reduce costs. Other levels of backup should include data storage, off-site training and overflow capacity. Costs associated with these components are more difficulty to project as they may be provided within the operation of another state function. For example, data storage may be provided through technical services, off-site training could take place in any other state Public Safety training facility, and overflow capacity may be addressed through portable telephone/CPE licenses or equipment that can access a core server from the Web.

APPENDIX A – EXISTING VERMONT PUBLIC SAFETY ANSWERING POINTS



ACRONYMS AND TERMS

Term	Definition
911 Call Answering Equipment	This term may be used interchangeably with customer premise equipment (CPE). Refers to the hardware and software that is used to receive and answer a 911 call.
911 Call Center	Facility that receives 911 calls and transfers them to the appropriate dispatch center.
ADA	Americans with Disabilities Act - Federal Legislation passed into law July 26, 1990, that prohibits discrimination on the basis of disabilities.
ALI	Automatic Location Information - The automatic display of a caller's address/location of the telephone from which a call to 911 originates.
ANI	Automatic Number Information - The automatic display of the telephone number of the access line from which a call to 911 originates.
APCO	Association of Public Safety Communications Officials - APCO is the oldest and largest not-for-profit professional organization dedicated to the enhancement of public safety communications.
CAD	Computer Aided Dispatch - A computer based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities.
Call Transfer	The capability to redirect a call to another party.
CALEA	Commission on Accreditation of Law Enforcement Agencies
CPE	(Customer Premise Equipment) This term may be used interchangeably with 911 Call Answering Equipment. Refers to the hardware and software that is used to receive and answer a 911 call.
Emergency Medical Dispatch (EMD)	EMD is a strictly controlled program where the 911 call taker provides medical instructions to callers while field responders are enroute. These instructions can range from how to control simple bleeding to CPR instructions. The program is designed to improve patient outcome and match the level of field response to the severity of the medical issue.
Emergency Operations Center (EOC)	An EOC is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level in an emergency situation, and ensuring the continuity of operation of a company, political subdivision or other organization.
Full PSAP Consolidation	Full consolidation is defined as the consolidation of police, fire, and EMS call handling and police and fire dispatch functions for a defined region into a single facility.
Heating, Ventilation and Air Conditioning (HVAC)	HVAC is important in the design of medium to large industrial and office buildings, where safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.
International Building Code (IBC)	The International Building Code (IBC) is a model building code developed by the International Code Council (ICC) and first published in 1997. It has been adopted throughout most of the United States.

Term	Definition
Institute of Electrical and Electronic Engineers (IEEE)	The Institute of Electrical and Electronics Engineers is a professional association headquartered in New York City that is dedicated to advancing technological innovation and excellence.
Internet Protocol (IP)	The Internet Protocol (IP) is the principal communications protocol in the Internet protocol suite for relaying datagrams across network boundaries. Its routing function enables internetworking, and essentially establishes the Internet.
Kilo Volt-Ampere (KVA)	A KVA is used to measure the apparent power in a circuit. While both the volt-ampere and the watt has the dimension of power (time rate of energy), they do not have the same meaning. Some devices, including Uninterruptible Power Supplies (UPSs), have ratings both for maximum volt-amperes and maximum watts.
Kilowatt (KW)	The kilowatt is equal to one thousand (10^3) watts per second. This unit is typically used to express the output power of engines and the power of electric motors, tools, machines, and heaters. It is also a common unit used to express the electromagnetic power output of broadcast radio and television transmitters.
National Electrical Code (NEC)	The National Electrical Code (NEC), or NFPA 70, is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States.
Next Generation 9-1-1 (NG9-1-1)	NG9-1-1 is an Internet Protocol (IP) based system comprised of managed Emergency Services IP networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provide additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources, and provide multimedia data capabilities for Public Safety Answering Points (PSAPs) and other emergency service organizations.
National Emergency Number Association (NENA)	The National Emergency Number Association is a not-for-profit corporation established in 1982 to further the goal of "One Nation - One Number."
National Electrical Safety Code (NESC)	The NESC continues to be a stronghold in the U.S. electrical industry & communications utility field, & serves as the authority on safety requirements for power, telephone, cable TV, & railroad signal systems.
National Fire Protection Association (NFPA)	The world's leading advocate of fire prevention and an authoritative source on public safety, NFPA develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks.
Public Safety Answering Point (PSAP)	A facility that answers 911 calls and provides dispatch services.
Quality Assurance (Q/A)	System that facilitates review and evaluation of work product. Information is used to validate effectiveness of training and evaluate need for additional training or other corrective action.
Redundant Array of	RAID is a storage technology that combines multiple disk drive components

Term	Definition
Independent Disks (RAID)	into a logical unit. RAID is now used as an umbrella term for computer data storage schemes that can divide and replicate data among multiple physical drives
Shared Technology	May also be called virtual consolidation. Two or more PSAPs share key PSAP systems such as computer-aided dispatch (CAD), radio, 911 call answering equipment or logging recorders. Although technology is shared, each PSAP retains its existing organizational structure and remain in its own facility. This form of consolidation increases interoperability and allows for cost efficiencies through group purchases.
Square Foot	The square foot is an imperial unit of area defined as the area of a square with one foot sides.
Uninterruptible Power Supply (UPS)	A backup system designed to provide continuous power in the event of a commercial power failure or fluctuation.