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Executive Summary

This Technical Report is provided to satisfy a request from the State of North Dakota directed to the Department of Homeland Security (DHS) Office of Emergency Communications (OEC) Interoperable Communications Technical Assistance Program (ICTAP). Specifically, the State required a detailed road map for the process of migrating to a statewide Next Generation 9-1-1 (NG9-1-1) system. The response in this report includes high-level and detailed work flow diagrams giving a step-by-step plan along with an overview of the process and detailed definitions of each of the tasks identified in the flow diagrams.

In addition, a description of the Enhanced 9-1-1(E9-1-1) system existing in the State is presented. We wish to acknowledge the considerable support from the North Dakota ESC3, without which the detail in the current system description would not have been possible.

To assist in understanding the work plan, a general overview of NG9-1-1 has been included as well as an example showing the steps involved in one particular approach to the migration implementation.

Both the current system description and the overview of NG9-1-1 are provided for completeness and for the benefit of newcomers to this information.

This report provides a generic methodology that is not specific to a particular state or region. The preferred approach for a given state or region depends on a number of factors, many of which are not fully defined until the planning process is underway and a transition plan is under development. As seen in the work flow diagrams, there are numerous inputs and branch (or decision) points. The outcomes resulting from the resolution of all these considerations will unfold when the methodology is applied.

This report also includes an overview of the paths being followed by selected states and regions. This provides illustrations of some of the possible alternative approaches. Most of these projects are in their early stages and it is very early to assess progress. Future lessons-learned from these projects should be very helpful in North Dakota's planning and merit monitoring.

Following are the recommendations that we view are most significant:

- The development of a detailed Transition Plan is essential. A project of this magnitude and complexity requires careful coordination among numerous organizations. A smooth implementation requires an in-depth planning of all activities including cooperation among various parties. Implementation of such a plan is key a positive outcome.

- Consideration should be given to utilization of a well-qualified consulting firm to assist the State. An experienced consultant can bring a wealth of experience to the project that is difficult to provide with internal staff. Such a

firm can also assist in understanding the complex and dynamic technology involved. The State has acquired a very knowledgeable program manager and the ESC3 is certainly informed, but the magnitude of the effort may be beyond what the State can support without help.

- Early and continuing involvement of the stakeholders is vital to their acceptance and realization of the full benefit of their knowledge and to make best use of their current and planned systems.
- A decision with far-reaching consequences is the selection of an acquisition process. System implementation and operation can be performed by public safety, contractors, or a combination of the two. Options for contractor provided systems and services include the use of a prime contractor or integrator, leased or provisioned facilities, or managed services. The pros and cons of each of the alternatives should be carefully weighed.

Additional recommendations are provided in the Summary and Recommendations Section.

At least as important as technical considerations are funding and budget, legislative and regulatory issues, and stakeholder outreach. These topics are addressed in Section 6.1 and in the flow diagram presentation and discussion of Appendices C and D.

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1 Introduction

This report is provided in response to a request from the State of North Dakota to provide technical assistance under the Next Generation 9-1-1 service offering of the Department of Homeland Security (DHS) Office of Emergency Communications, Interoperable Communications Technical Assistance Program (ICTAP). Specifically, the request was to support the development of a detailed step-by-step roadmap for the migration of the State's 9-1-1 systems to the capabilities defined as Next Generation 9-1-1. Both near-term and longer-term implementation plans are desired.

The report is organized into this introduction, a description of North Dakota's current E9-1-1 implementation (prepared in collaboration with the State), a general overview of NG9-1-1, the process for transition from a legacy system to NG9-1-1, and presentation of both top-level and detailed work flow block diagrams. The latter includes supporting text to explain the content and use of the flow diagrams. In addition, an overview of the organizations that have supported the development of NG9-1-1, the relevant standards bodies, and representative state and regional efforts toward implementing NG9-1-1 are addressed. Finally, a summary with leading recommendations is provided.

2 Current System Description

2.1 General Overview

Currently, 23 public safety answering point (PSAP) sites serve the State, one of them being in South Dakota. Figure 2-1 shows a State map with the locations of the PSAPs.

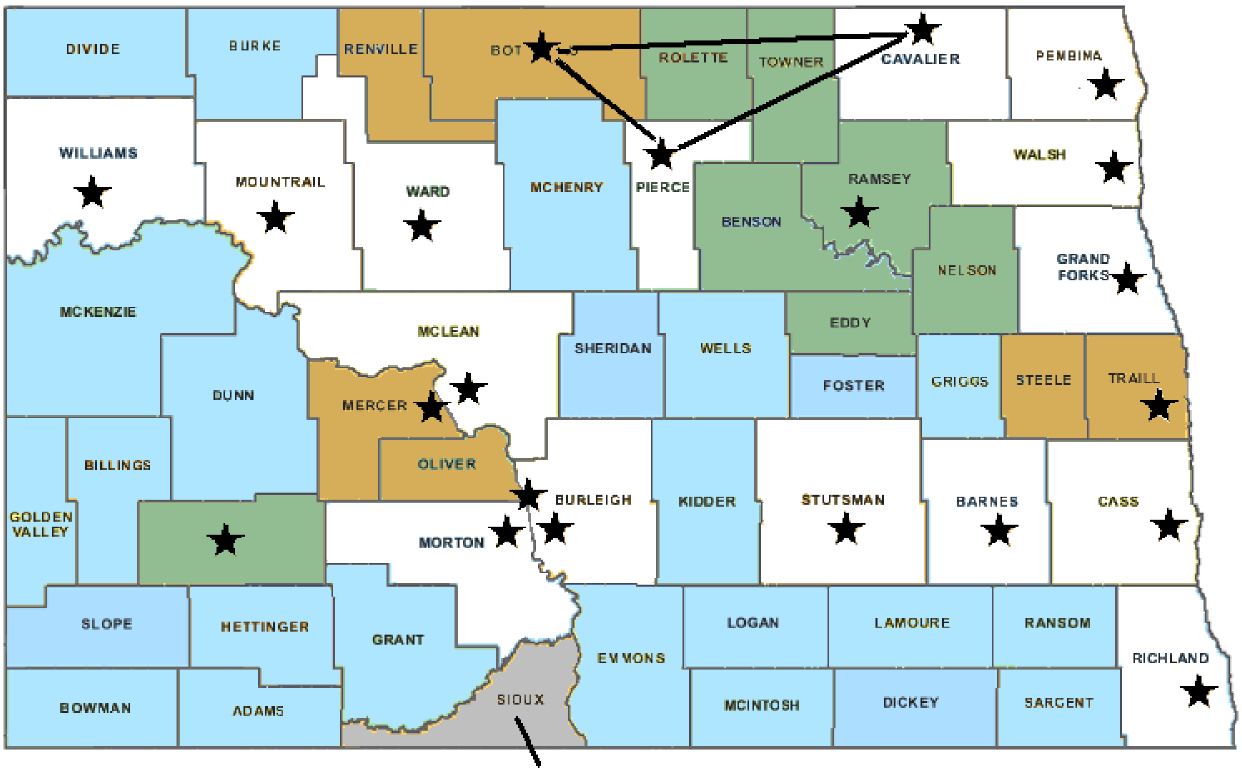


Figure 2-1 Locations of PSAPs in North Dakota

As indicated on the map, Sioux County is dispatched from South Dakota. In addition to North Dakota jurisdictions, the Red River Regional Dispatch Center in Fargo also has obligations in Minnesota, as discussed below.

Also, indicated on the map, a joint need to replace equipment has motivated the counties of Bottineau, Cavalier, Pierce, and Renville to consolidate Consumer Premises Equipment (CPE). This CPE, housed in Langdon, serves three separate dispatch locations, but is technologically one PSAP. In addition to providing these counties a significant cost savings, it permits very simple switching of the call-answering function among the locations – allowing each site to provide immediate back-up to the others.

While this four-county collaboration is the most recent, it is obvious with 55 governing bodies imposing fees, but only 21 PSAPs in North Dakota, there is considerable sharing of services across the State. Notably, 24 of the counties are served by the PSAP operated by State Radio, six are jointly dispatched by the Lake Region Law

Enforcement Center, and three other two-unit PSAPs exist. North Dakota also has possibly the only true multi-state PSAP – the Red River Regional Dispatch Center in Fargo serving the separate jurisdictions of Fargo, West Fargo, and Cass County, as well as Moorhead and Clay County, Minnesota. A complete listing of PSAPs appears in Table 2-3. Section 2.6 gives a mapping between the site names in the 2012 Operations Survey and the site locations used in the 2008 NG9-1-1 Master Plan.

The reduction to 23 PSAPs over the last ten years has been largely through the expansion of the State Radio and Lake Region PSAPs and through the development of the multi-state Red River Regional Dispatch Center.

Additionally, as noted above, the counties of Bottineau, Cavalier, Pierce and Renville have essentially created a "virtual PSAP" by consolidating their Customer Premise Equipment and running remote dispatch terminals in three locations. From a network standpoint, North Dakota now has only 19 PSAPs in operation. As we move into implementation of "Next Generation 911", there will be additional opportunities to consolidate equipment – reducing jurisdictional costs in this area. The number of PSAPs in North Dakota compares favorably with the neighboring states of Minnesota, South Dakota, and Montana with 97, 34, and 58 PSAPs, respectively.

Table 2-1, below, provides a picture of what PSAP Surveys have indicated. It is significant to realize that in a single year the public safety answering points of North Dakota manage 244,000 emergency calls, (a 19% increase over 2009) – well over two-thirds of which are now coming from cellular phones. This indicates a dramatic shift from landline to wireless calls in the last few years.

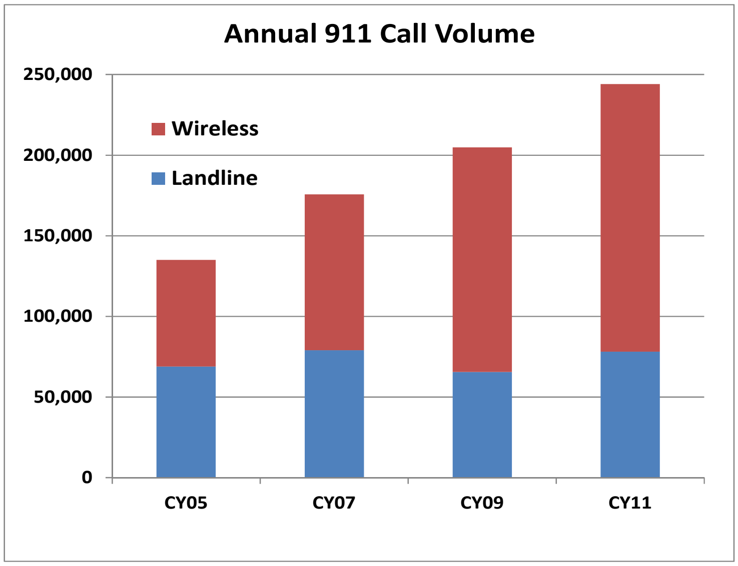
Table 2-1 Overview of North Dakota PSAP Capabilities and Loading

	Statewide Total	Largest PSAP	Smallest PSAP
Dedicated 911 Trunks	62	10	2
Administrative Phone Lines	153	10	3
911 Calls per Month	20,333	5,041	65
Admin. Call per Month	80,881	21,541	894
Total of all Calls per Month	101,214	26,582	959
Total 911 Calls per Year	244,000	60,582	782
Wireless as a % of 911 Calls	68%	74%	29%
Active Dispatch Stations	79	8	2
Dispatchers – Full-Time	257	26	4
Dispatchers – Part-Time	23	0	1
LE Agencies Dispatched	115	9	1
Ambulances Dispatched	136	6	3
Quick Response EMS Units	83	14	1
Fire Agencies Dispatched	374	31	12
Total Agencies Dispatched	708	60	17

The data reported in Table 2-1 is from the 2012 Operational Survey and correspond to the full year of 2011. ND State Radio was used as the largest PSAP and Pembina County 911 PSAP as the smallest.

Table 2-2 provides a graphic representation of the growth in annual call volume since 2005. Much of last year's increase can be attributed to the booming oil counties.

Table 2-2 Growth in Call Volume



As of May 2005, every North Dakota PSAP had deployed the necessary hardware and/or software upgrades in order to receive the wireless location (latitude/longitude) information, and every cellular company had implemented "wireless 911 services" statewide. North Dakota became the sixth state in the nation to achieve 100% statewide implementation.

2.2 PSAP CPE

Table 2-3 provides a summary of the equipment currently deployed in the North Dakota PSAPs. The data presented is from the ESC3 2012 Operational Survey with responses as of August 3rd. Please note that the PSAPs are listed by name and this is not necessarily the same as the location (see Table 2-5). Given the "virtual PSAPs formed by the consolidation of the counties of Bottineau, Cavalier, Pierce and Renville, there are effectively 19 PSAPs in the State. All 19 PSAPs responded to the survey and are included in Table 2-3.

There are three PSAP answering position CPE equipment manufacturers represented in North Dakota, with Zetron having eleven sites, Positron (Intrado) five sites, and PlantCML (Cassidian) four PSAP sites each. Of the five Positron sites, two are VIPER installations. The two VIPER units are the basis for the Near-Term NG9-1-1 Proof of Concept. It is interesting to speculate how the newly enhanced version of the VIPER might be employed in an NG9-1-1 configuration. However, this section of the Technical Report addresses the current implementation.

Included in Table 2-3 is both the date of installation for equipment (when the data is available) and the estimated end-of-life for that equipment. For the later, the operable term is “estimate.” The end-of-life estimate provides a basis for planning the potential phased statewide migration to NG9-1-1. This may be necessitated by budget constraints.

Stutsman and Richland Counties have decided to move jointly toward sharing i3 compatible CPE. As indicated by the ESC3, the 9-1-1 system at the Richland County PSAP is on the verge of failure and needs to be replaced. The 9-1-1 system at the Stutsman County PSAP is not far behind. Even though they are more than 100 miles apart, the two counties plan to share PSAP resources. A Joint Powers Agreement has been approved by the two entities which will allow for the parties to jointly acquire, operate, and/or maintain Emergency Services Communications Services (ESCS) equipment and services. This will include providing backup communications equipment and or dispatching services for each other. It’s anticipated that equipment installation will occur in December of 2012.

Other sites shown in Table 2-3 as at or near end-of-life are Barnes County/Valley City 911 and ND State Radio. Others may be in this condition, but did not provide an end-of-life estimate in the survey.

Even consolidation of PSAPs closely located can be challenging. The most recent consolidation of the West Fargo PSAP into the Red River Center in Fargo involved almost a year of frequency planning and testing, policy unification, and training. Such a change cannot be undertaken without a detailed migration plan implemented with adequate time – or public safety will suffer.

A constraint on consolidation is that the limited number of “statewide frequencies” (managed by State Radio) does not provide the capacity to safely dispatch the vast number of agencies involved in emergency response.

While some of the PSAP CPE may be upgradable to make it IP capable, most is too old to justify upgrade. The costs associated with upgrading and the age of the equipment should be evaluated in relationship to the State’s final NG9-1-1 solution to assure that the right financial and technological decision is being made on a case-by-case basis. Table 2-3 shows manufactures and the date of installation. Normally, the workstations for any PC-type workstation system should be considered for replacement.

Table 2-3 PSAP Equipment

	Manufacturer/Model			Install Year/Estimated End-of-Life			
PSAP	**ANI/ALI Controller**	**Mapping**	**PBX**	**ANI/ALI Controller**	**Answering Position Equip.**	**Mapping**	**PBX**
Barnes County/Valley City 911	Positron Lifeline	Bullberry		NA/NA	2005/2012	2003/NA	
Bismarck/Burleigh Combined Communications Ctr	Cassidian, Vesta Pallas	Geographic Technologies Group, GeoBlade Viewer	Cassidian, Pallas/Nortel	2009/NA	2001/NA	2012/NA	2009/NA
Bottineau/Renville 911	CASSIDIAN ESC1000	BULLBERRY INSIGHT		2007/NA	2007/NA	2009/NA	NA/NA
Grand Forks PSAP	Positron VIPER	AccuGlobe	Integra	2011/2021	2011/2021	2003/NA	2009/2019
Lake Region 911	Zetron	Seatol	Zetron	2005/NA	2005/NA	1997/NA	2005/NA
Mandan/Morton County Communications	Zetron	Bullberry	Siemens	2009/NA	2009/NA	2005/NA	2011/NA
McLean County	Zetron			NA/NA	NA/NA		
Mercer-Oliver E911	Zetron	SEATOL		2010/2020	2010/2020	1995/2020	
Minot Central Dispatch	Cassidian Sentinel	Bullberry	Nortel	2008/2018	2008/2018	2007/NA	2008/NA
Mountrail County 911	Zetron	Bullberry		2002/NA	2002/NA	2002/NA	
Pembina County 911 PSAP	Zetron	Bullberry	Avaya	2004/2019	2004/2019	2011/NA	2007/2020
Red River Regional Dispatch Center	Positron VIPER	New World Systems	Harris	2012/2027	2012/2027	2011/2026	1989/2012
Richland County Communications/911	Cassidian Rescue Star	Bullberry	Rescue Star	1999/2016	2007/2016	2007/NA	1999/NA
Stark 911	Zetron	Bullberry	Comdial	1999/NA	1999/NA	1999/NA	2003/NA
Stutsman County Communications	Zetron Series 3200	Bullberry	Mitel SX-200 ICP	1999/2012	1999/2012	2005/NA	2008/NA
Walsh County Communications/9-1-1	Positron	Bullberry	Avayo	2004/2010	2004/2010	2008/NA	2008/2015
Williston Police Department	Positron	Bullberry		2002/Any Yr		2006/NA	
ND State Radio	Zetron/3200	Bullberry/Insight	Nortel/ITD	2003/2013	2003/2013	2005/2013	NA/2012
Hillsboro/Trail County	Zetron/3200	Seatol					
Notes:							
NA - Not available or unknown							

2.3 Infrastructure – OSP and SSP Interfaces

This section addresses the interfaces with the originating service providers (OSPs) and system service providers (SSPs). The former includes wireline and wireless service providers as well as VoIP service providers. The latter provides the services necessary to route legacy landline 9-1-1 calls to the appropriate PSAP in a specific geographic area.

Two CenturyLink-owned selective routers, one in Fargo (5E) and the other in Bismarck (DMS-100), serve all of the PSAPs. The CenturyLink selective routers deliver most wireline and all wireless calls. There are several PSAPs that are served by direct trunks from the wireline central offices and do not have the benefits of selective routing.

All of the PSAP trunk lines are Centralized Automatic Message Accounting (CAMA)-type trunks delivering analog voice and Automatic Number Identification (ANI). Some PSAPs receive both wireline and wireless calls on the same trunks while others have separate trunks for each. CenturyLink has installed router-to-router trunks between their selective routers, enabling PSAPs to transfer fully-enhanced 9-1-1 calls across the network where necessary. NDACo has indicated that all end office trunks that terminate on CenturyLink's selective routers use Signaling System 7 (SS7) signaling and the end offices that are direct trunked to an on-site ANI/ALI controller use CAMA type trunks.

For each of the PSAPs, Table 2-4 identifies the serving wireline and wireless tandems, the local service provider, and the landline ALI database provider.

The end office trunks that terminate on CenturyLink's selective routers are currently SS7 signaling. Today, SS7 is the most efficient and fastest method for delivering E9-1-1 traffic to a traditional TDM-type selective router and is supported by most, if not all, end offices, whether it is a landline, wireless or VoIP carrier. Having all SS7 trunks from the end offices to the selective routers is today's best choice that most carriers can support.

Table 2-4 Local ILECs and Data Service Providers

PSAP		Dedicated 911 Trunks [a]			Local Telephone Service Provider (ILEC)	Landline ALI Database Provider [d]
		Bismarck CenturyLink 911 Tandem	Fargo CenturyLink 911 Tandem	Direct Local Trunks		
Barnes County/Valley City E911			2		Century Link	Intrado
Bismarck/Burleigh Combined Comm. Center		5			Centurylink	Intrado
Grand Forks PSAP			3		Century Link	Intrado
Lake Region 911 (6 County)			2	3	North Dakota Telephone	Seatol
Mandan/Morton Co. Communications		3			Century Link	Intrado
McLean County E911		2			West River Telecom.	Seatol
Mercer/Oliver County E911		2			West River Telecom.	Seatol
Minot (Ward Co.) Central Dispatch		2		4	Souris River Telecom.	SRT
Mountrail County E911		2		6	Midstate Telephone	Intrado
North Central 4-County	Cavalier Dispatch	2	2		United Telephone	United Telephone
	Pierce Dispatch			2	North Dakota Telephone	United Telephone
	Bottineau/ Renville Dispatch			2	United Telephone	Intrado
North Dakota State Radio (24 Counties)		5[b]	5[b]		Century Link	Intrado/Bullberry
Pembina County E911			2[b]		Polar Communications	Intrado
Red River Regional Dispatch Center			5[c]		CenturyLink	Intrado
Richland County Communications			2		Century Link	Intrado
Stark County E911		3			Century Link	Intrado
Stutsman County Communications			3		Century Link	Intrado
Traill/Steele County E911			2		Century Link	Seatol
Walsh County Communications			3		Century Link	Intrado
Williams Co./Williston Communications		3			Nemont Telephone	Intrado
		31	31	17		

a. All PSAPs also have two dedicated data links to Intrado for requesting/receiving location information
b. Individual trunks are designated for landline and wireless calls - trunks in other PSAPs serve both
c. RRRD Center has an additional 5 trunks serving Clay County Minnesota not included in this table
d. All wireless location information is provided through Intrado

Those PSAPs that are supported by direct end office trunks with no connection to a selective router utilizing CAMA trunks should consider connecting to one of the legacy selective routers. These PSAPs also have standalone ALI systems which means they only have access to landline ALI records that reside solely in their jurisdictions.

Without a connection to a selective router and a shared ALI database, these PSAPs lack the ability to transfer wireline enhanced 9-1-1 calls to a neighboring PSAP. All wireless calls are routed through a selective router for the PSAPs and data can be transferred to another PSAP. This arrangement allows for ALI data to also be shared between any PSAPs for calls that are routed to them through one of the CenturyLink selective routers or transferred to another PSAP that is served by one of the CenturyLink selective routers. Another major deficiency in direct trunking is the inability to automatically reroute 9-1-1 calls to a designated alternate PSAP in the event of a network or PSAP outage.

2.4 Infrastructure - Data Services

CenturyLink/Intrado provides the centralized wireless and VoIP ALI database for all of the PSAPs, and the wireline ALI database for many of the PSAPs. Some of the PSAPs have standalone on-site databases. These standalone databases are updated by the local jurisdictions utilizing telephone company data provided by the participating telephone companies. Selective routers are updated utilizing data from the Intrado ALI database.

All of the CenturyLink/Intrado ALI database links to the PSAPs are redundant.

As seen in Table 2-4, there are eight PSAPs that have standalone ALI systems. A standalone ALI system normally has a major limitation - only the PSAP that houses the system can view the ALI information. The ALI information cannot be shared with another PSAP in the event of a transferred 9-1-1 call or a misrouted call to another PSAP.

Statewide common databases are not in use, although many PSAPs are using an Intrado database.

A critical data source in the NG9-1-1 environment is GIS. These databases hold the key for the advanced routing of the calls to the correct PSAPs and response agencies. Currently each PSAP develops map data for themselves.

The State of North Dakota is presently developing a seamless statewide digital mapping of all road centerlines and addressed structures in the State. This work is due for completion in May of 2015. These two layers will serve as core datasets for landline call routing in an NG9-1-1 environment. Other datasets that will be required include state, county, municipal, law, fire, EMS and PSAP boundaries. Ultimately, a source should be identified for the consolidation and maintenance of this information as well to support future core NG9-1-1 services.

All PSAPs that answer Phase II wireless calls have a mapping system in place while only seven have a CAD system. The count of CAD systems is from the 2012 Operational Survey.

2.5 Infrastructure - STAGEnet

All PSAPs within the state do have STAGEnet points of presence. The PSAP's are all connected by either carrier grade Ethernet transport service that is delivered via a fiber connect or by direct fiber connections. Three PSAPs currently have direct fiber while the remaining gain access to STAGEnet via carrier Ethernet service. The fiber endpoints are connected via 1G interfaces while the carrier Ethernet services are presently configured for 5Mb of bandwidth. The Ethernet transport service is capable of being provisioned at various increments ranging from 5Mb to 1G service. The PSAP end point circuits are all connected to a redundant 10G backbone that serves both government and education statewide.

Only one PSAP is presently connected to STAGEnet via a fully redundant and physically diverse manner. The state is currently performing a study to determine the options that exist to provide physical diversity and redundancy to the remaining PSAPs in the State. Individual PSAP's will have the option to procure those redundant connections if they desire.

The STAGEnet backbone is a 10G service spanning across the State with points of presence in four major cities with the ability to provide points of presence in the eight largest cities. The backbone is architected in a fully redundant and physically diverse manner providing support for both IPv4 as well as IPv6. Internet access is provided in a manner that provides physical diversity, failover and redundancy, having points of presence in both Bismarck and Fargo. The State is currently executing a study with a third party consulting firm to review the architecture and design of the backbone to verify NENA standards compliance and to identify if any upgrades or changes may be required to support the public safety and PSAP community.

The STAGEnet mission states that the State of North Dakota Information Technology Department along with the STAGEnet partners will develop and enhance a statewide network to service its primary consumers. STAGEnet will exist to provide a secure, reliable and cost-effective network that has the scale and flexibility to support the convergence of data, voice and video to meet and surpass the business objectives of government and education.

2.6 Mapping of PSAP Names to Locations

The following table gives a mapping of the PSAP names used in the 2012 Operational Survey to the PSAP locations used in the 2008 Kimball NG9-1-1 Master Plan.

Table 2-5 Mapping of PSAP Names to Locations.

PSAP Names as Used in the 2012 Operational Survey	PSAP Locations as Used in the 2009 NG9-1-1 Master Plan
Barnes County/Valley City 911	Valley City
Bismarck/Burleigh Combined Communications Ctr	Bismarck
Bottineau/Renville 911	Bottinueau, Langdon, and Rugby
Grand Forks PSAP	Grand Forks
Lake Region 911	Devils Lake
Mandan/Morton County Communications	Mandan
McLean County	Washburn
Mercer-Oliver E911	Stanton
Minot Central Dispatch	Minot
Mountrail County 911	Stanley
Pembina County 911 PSAP	Cavalier
Red River Regional Dispatch Center	Fargo
Richland County Communications/911	Wahpeton
Stark 911	Dickinson
Stutsman County Communications	Jamestown
Walsh County Communications/9-1-1	Grafton
Williston Police Department	Williston
ND State Radio	Bismarck State Radio SE and SW
Hillsboro/Traill County	Hillsboro

3 Overview of NG9-1-1

The benefits of migration to NG9-1-1 are many and are widely recognized. Among the leading advantages is the ability accept and deliver a variety of information media such as text, images, video, telematics, sensors, and more. NG9-1-1's use of IP technology provides the foundation to readily accommodate the constant march of information sources, including the social media. Another major benefit is the improvement of reliability and survivability through the resilience of IP-based networks. It also provides the flexibility to allow workload and expertise sharing among PSAPs, not to mention backup in the event of failure or disaster. Another major improvement over legacy systems is a much improved capability for information sharing between PSAPs, as well as related public safety and service entities.

Aside from the migration to native IP, the major distinction of NG9-1-1 from legacy systems is the inclusion of location information with each call for service. In fact, NG9-1-1 is highly location-centric and routing is location-based. This is facilitated by the application of Internet Engineering Task Force (IETF) standards for delivery of location data through the use of the geolocation header in the Session Initiation Protocol (SIP). The specific location entries are the Presence Information Data Format – Location Object (PIDF-LO) and Uniform Resource Indicator (URI) defined in the IETF SIP standards.

When full NG9-1-1 implementation is realized, it will be incumbent on the originating service providers (or their database contractors) to provide location data at call initiation. The call ultimately is delivered to the proper PSAP with location information. This is in contrast to legacy wireline E9-1-1 systems where a Selective Router uses Automatic Number Identification (ANI) to determine the appropriate PSAP for delivery. The PSAP then queries the Automatic Location Identification (ALI) database for location.

Figure 3-1 shows a conceptual high level architecture for NG9-1-1. The figure depicts a final-state IP-based system, except for the legacy network and the Legacy Gateway Interface (LNG).This has also been referred to as the NENA futuristic model (Reference 1). Indeed, the realization of NG9-1-1 is anticipated to be a long-term evolutionary process involving technical, economic, and institutional change (Reference 2).

During the phased migration of North Dakota to NG9-1-1, the State will be a mix of legacy and NG9-1-1 capability. The special needs during this transition state are discussed below in Section 4. This section provides a description of the IP end-state configuration and components. No claim is made for complete detail and this is left to NENA documents referenced here and in Sections 5.1 and 5.2.

We first address the ESInet, shown in the center of the diagram. As a matter of fact, the NENA i3 standard addresses only the Emergency Services IP Network

(ESInet) and its interfaces. The Detailed Functional and Interface Specification for the NENA i3 Solution (Reference 3) makes the following statements: "Critically, the i3 standard is not, by itself, the same thing as an NG9-1-1 system. The i3 standard describes only the network, components, and interfaces required to establish Next Generation 9-1-1 service. In order to deploy a fully-operational NG9-1-1 system, 9-1-1 authorities, equipment and software vendors, originating service providers, and access network providers will require detailed specifications for technical, operational, and human elements that are not described in the i3 standard." The reference goes on to point out that NENA has developed some of these extra-i3 standards, but much remains to be done.

NENA defines the ESInet (Reference 4) as "a managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core functional processes can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 services. ESInets may be constructed from a mix of dedicated and shared facilities. ESInets may be interconnected at local, regional, state, federal, national and international levels to form an IP-based inter-network (network of networks)."

The core elements of the ESInet are seen in Figure 1 and serve the following functions:

- Border Control Function (BCF) –sits between the ESInet and external networks providing firewall security and Session Initiation Protocol (SIP) border control.
- Emergency Services Routing Proxy (ESRP) – routes calls to the next hop. ESRP's may be termed as originating, intermediate, or terminating, depending on where it stands in the sequence of routing hops among ESInets and IP PSAPs. A terminating ESRP is normally located at an IP PSAP.
- Emergency Call Routing Function (ECRF) – responsible for providing routing information based on the location (civic addresses or geographic coordinates) of the caller to a querying ESRP or any entity within the ESInet.
- Location Validation Function (LVF) – generally used to confirm the validity of civic locations (addresses) associated with IP packet emergency calls. For validation, the LVF will draw upon a Geospatial or GIS Database (see below) that includes the information necessary to validate a civic location (Reference 5). In some cases, the LVF may be outside of an ESInet, but must be accessible by internet.

In addition, two important functions are associated with the ECRF as follows:

- Geospatial Database (or Spatial Information Function)–contains all of the GIS data corresponding to the jurisdictions served. This data is used by the ECRF and LVF to determine if a location is valid for 9-1-1 routing and to perform the routing. It also supports PSAP mapping displays under certain circumstances. Reference 3 states that this database "is a specialized form of a Geospatial Information System and may be implemented on a conventional GIS with the appropriate interfaces." A NENA working group is preparing instructions for uploading geospatial information to this database. In the interim, the NENA Information Document for Synchronizing Geographic Information System Databases with MSAG and ALI (Reference 6) is available.
- Policy Store –provides the business rules and policies for the handling of calls for a given jurisdiction. Examples of these policies include hours of operation, alternate routing, default routing, and routing to a specific telecommunicator or emergency responder (Reference 4).

The LVF and the ECRF use the same Location-to-Service Translation (LoST) query/response protocol. LoST is an IETF Emergency Context Resolution with Internet Technologies (ECRIT) developed protocol to support routing of NG9-1-1 calls. The ECRF, supported by its GIS Database, is frequently termed as a LoST server. There can be a "forest" hierarchy of interconnected LoST server databases that can reach statewide or beyond. The GIS Database requires frequent maintenance to remain current and even more actively updated in high growth areas.

On the left-hand side of Figure 3-1 the end user devices (both IP and legacy) and originating service and access networks are shown. For simplicity, the distinction between the originating service networks and access networks is not addressed. In the NG9-1-1 end state, the originating service providers will have made the transition to IP meeting the interface requirements of Reference 3.

The Location Information Servers (LIS) are databases of subscriber locations created when a carrier implements NG9-1-1.An exception is wireless carriers that have location information in their Call Information Database (CIDB).The familiar selective router and its database are a necessary part of the legacy network, although they are not shown.

On the right-hand side of Figure 3-1, the supported IP PSAPs are shown along with other ESInets (that comprise a network of ESInets). (The IP PSAPs in essence are hosted by an ESInet.) An elaborate discussion of the interfaces to the IP PSAPs is presented in Section 5.6 of Reference 3. One of the extra-i3 documents that serve as a companion to the i3 standard is the NENA NG9-1-1 System and PSAP Operational Features and Capabilities Requirements (Reference 7). This document, as the name implies, addresses the operational capabilities and features that are expected to be supported by a PSAP in an NG9-1-1 system.

The above discussion is highly simplified; for full details see Reference 3 and the other documents referenced above as well as in Sections 5.1 and 5.2.

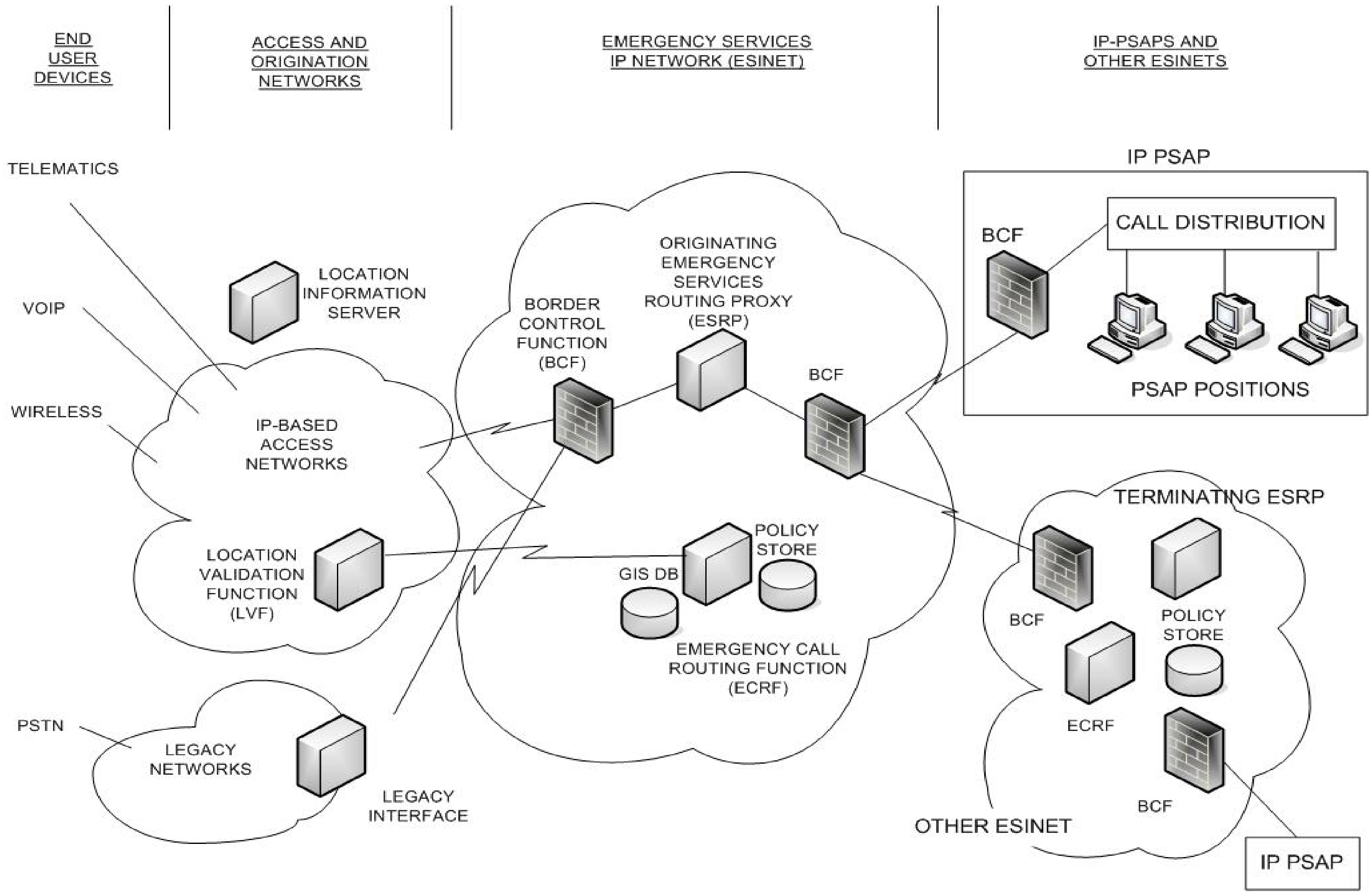


Figure 3-1 High-Level NG9-1-1 Functional Architecture

4 Transition from Legacy System to NG9-1-1

As previously discussed, the last section presents the system fully transitioned to the NG9-1-1 vision. In this section we examine the transition process. First, the tools to support the transition are considered and, second, the process for non-disruptive step-wise migration is investigated. The latter essentially provides snapshots of system configurations during the step-wise process from start-to-finish (often over a considerable period of time).

We note the distinction between originating service providers (OSPs) and system service providers (SSPs). The former includes wireline and wireless service providers as well as VoIP service providers. The latter provides the services necessary to route legacy landline 9-1-1 calls to the appropriate PSAP in a specific geographic area. Both have a role to play in the NG9-1-1 migration process. Coordination of the ability of the OSPs to provide calls in native IP-based infrastructure with the ability to receive them with NG9-1-1 capability requires attention.

With so many players involved, there clearly is a need for close coordination among all parties (i.e., OSPs, SSPs, PSAPs and the NG9-1-1 administrator) during the transition process.

Legacy E9-1-1 systems include the following four databases (Reference 4): MSAG (Master Street Address Guide), TN (Telephone Number) Database, ALI (Automatic Location Identification), and the SRDB (Selective Router Database). These databases support routing to the proper PSAP and provide location information when requested by a PSAP. As discussed in Section 3, NG9-1-1 systems have databases affiliated with the Location Validation Function and the Emergency Call Routing Function. The LVF validates location information (using MSAG data incorporated into the GIS Database) and the ECRF directs PSAP routing. During the migration from legacy to NG9-1-1 implementation, the legacy databases must continue to be maintained until the transition is complete. This will likely mean daily updates. The exact process for the migration from the legacy to the NG9-1-1 is beyond the scope of this report, but is addressed in Reference 4.

The data uploaded to the LVF and ECRF databases replaces the legacy MSAG and SRDB functionality (Reference 4). The TN and ALI databases are essentially subsumed into the Location Information Servers provided by the originating service providers when they advance to IP-compliant delivery.

4.1 Tools for Call Handling in a Transition System

There are two fundamental approaches for the support of calls for service during the migration process. In the first, geographic pockets of both IP-compliant

(ESInet) and legacy systems simultaneously interoperate (a mixed system). Here the interaction is supported by various classes of interim gateways. In the second, a hybrid IP and legacy system is temporarily installed. This is exemplified by the use of so-called IP Selective Routers (IPSR). Each of these is considered, in turn, in the following subsections.

4.1.1 Gateway-Based Transition

Given the phased build-out of the migration to NG9-1-1, there may exist enclaves of NG9-1-1 and legacy capability, depending on the transition strategy. Problems can arise when a call destined to a legacy PSAP is delivered by an IP-compliant network to an ESInet or when a call intended for an IP-PSAP traverses a legacy network to a selective router. Another situation of interest is the need to transfer calls between the two networks. This is where gateways come into play.

Section 8 of NENA "NG9-1-1 Transition Plan Considerations" (Reference 4) gives a general overview of the utilization of gateways. Figure 4-1 is adapted from Figure 8-1 in Reference 4 to illustrate three classes of gateways – the Legacy Selective Router Gateway (LSRG), the Legacy Network Gateway (LNG), and the Legacy PSAP Gateway (LPG).

The LSRG interfaces an ESInet to a legacy network via a selective router:

- The selective router directs incoming calls toward the LSRG, rather than CAMA trunks of the legacy PSAPs.
- In the reverse direction, the ESInet directs the call to the selective router.
- The LSRG performs conversion from CAMA to IP in one direction and the reverse in the other.
- The LSRG collects location information to provide in response to queries from either the SR or an IP PSAP (on the ESInet).

The LNG interfaces a legacy network directly to an ESInet:

- The LNG supports conversion of the legacy SS7 (or ISUP) TDM to SIP for use by the ESInet.
- The LNG uses the telephone number to query for location information and, also, directs the call to the correct ESRP on the ESInet.
- The LNG supports only traffic inbound to the ESInet, in contrast to the LSRG that performs conversion in both directions. This is shown by the arrows in Figure 4-1.

The LPG allows an ESInet to interface directly to an individual legacy PSAP:

- The LPG converts from SIP to CAMA TDM.
- The LPG does not perform TDM to SIP conversion, but can issue queries back to the ESRP.

Of course, for the interface between the i3 ESInet and an IP PSAP, no conversion is required.

Where this gets complicated is with the location and non-location signaling needed. This signaling will vary with different media, such as landline, wireless, and VoIP. Those details are beyond the scope of this report and may be found in References 3 and 4.

Another consideration is that during the transition period, legacy and NG9-1-1 data bases must coexist, as discussed above. The details of how the databases interact are also left to References 3 and 4.

If the entire State migrated to ESInet compatible networks, but enclaves of legacy PSAPs remain, these legacy enclaves can connect to the NG9-1-1 networks via LSRGs. This does not negate the need for selective routers in the legacy enclaves. If only isolated legacy PSAPs remain, LPGs (without SRs) are an option.

Whether the State or the localities are to be responsible for providing the gateways, it is clear that the originating service providers and system service providers must participate, as appropriate. This is because the gateways are basically a part of the process of migrating capability from legacy TDM to IP. One of the functions of the gateways is to support the transition of emergency call routing from one world to the other. A couple of examples are modification of the SR routing table when it is to point to a LSRG and location servers associated with LNGs. For the latter, the carrier must provide subscriber ANI data for retention in the location server.

Ultimately the gateways are discarded when the migration to IP is complete. However, in the interim they support an orderly, step-by-step transition process.

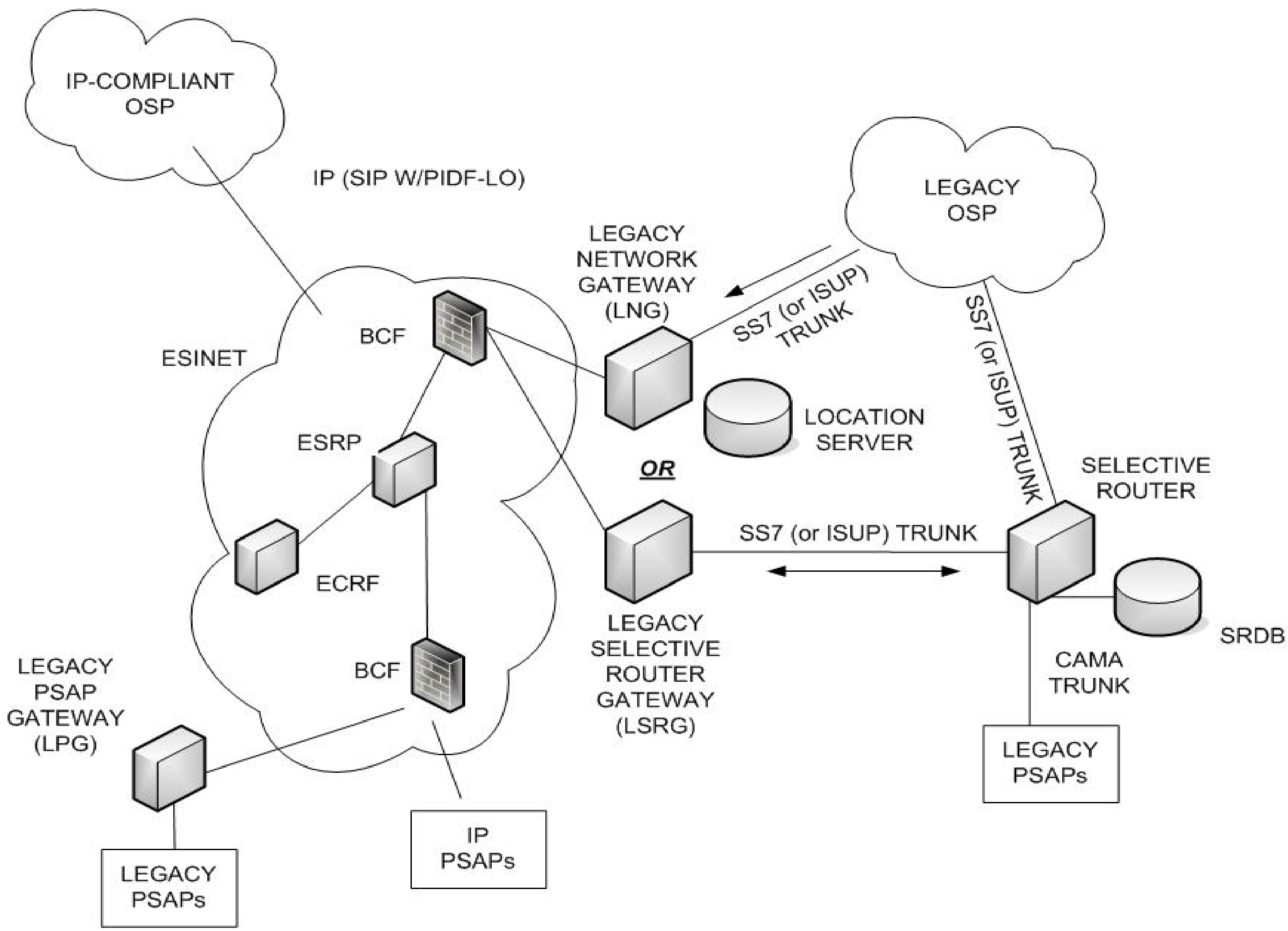


Figure 4-1 Illustration of Gateway Alternatives

4.1.2 IP Selective Router Application

The Internet Protocol Selective Router (IPSR) preserves the functionality of a Selective Router while providing interfaces to IP and legacy originating networks and to IP and legacy PSAPs. It retains the legacy routing techniques of a Selective Router and includes TDM to SIP (and vice versa) interfaces. Figure 4-2, adapted from Reference 4, Section 10.4, shows a typical IPSR configuration.

In Figure 4-2, the IP-based PSAP is labeled as the "RFAI PSAP." RFAI stands for Request for Assistance Interface provided by the Alliance for Telecommunications Industry Solutions (ATIS). RFAI is regarded as an interim interface pending an i3 sanctioned interface. However, if and when the i3 approved standard for this interface will be issued is unknown. The primary difference is that RFAI uses ANI/ALI for location determination versus the Presence Information Data Format – Location Object (PIDF-LO) that carries location embedded in the IP call for service. As a result, the RFAI PSAP must query ALI for location information, just as the legacy PSAP does.

Other IPSR configurations can be implemented, but are not examined here. For example, an IPSR can be interfaced with an ESInet via Session Border Control.

Ultimately the IPSR is removed when the migration to a fully-IP system is completed. However, with careful planning, it is possible for IPSR to be implemented on the same host as ESInet capability, allowing the investment not to be lost.

For additional particulars on both the gateway-based transition and IP selective router use, the reader is referred to the aforementioned Section 8 of Reference 4. This is a complex topic and the surface has barely been scratched here.

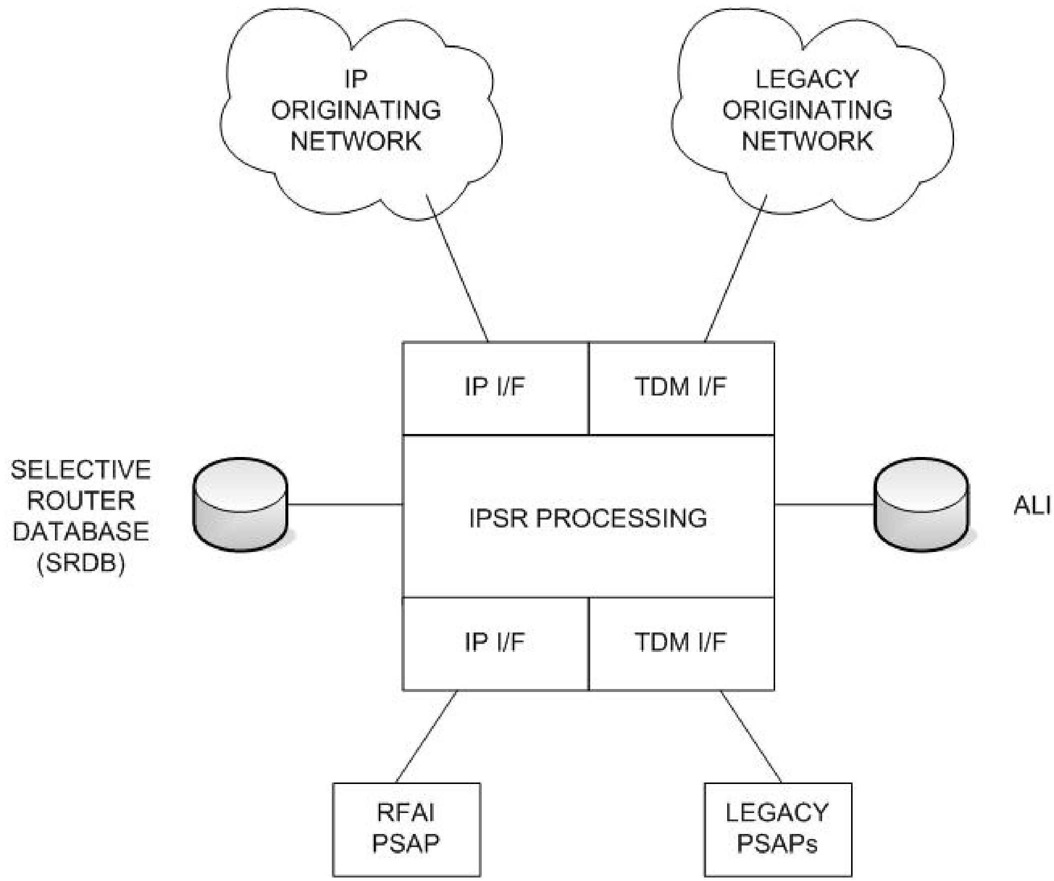


Figure 4-2 IP Selective Router Configuration

4.2 Illustration of the Transition Process

This section addresses the changing configuration of a system during the step-by-step migration toward NG9-1-1. The discussion focuses primarily on the physical implementation or the technology. Planning and policy issues (e.g., management, funding, legislative, etc.) are addressed in References 8, 9, and 2 as well as in the discussion of the task flow diagrams of this report.

The transition process depends on the caller media (wireline, wireless Phase I. Wireless Phase II, data-only, and 2nd or 3rd party), the originating service network (legacy PSTN or native IP), and the PSAP capability (no 9-1-1, Basic 9-1-1, and E9-1-1). We believe that all PSAPs in North Dakota are E9-1-1 capable or will be made so prior to the migration to NG9-1-1. To keep the discussion tractable, we are limiting ourselves to two cases: wireline/legacy PSTN/E9-1-1 and wireless Phase II/legacy PSTN/E9-1-1.

Reference 2 expresses the belief that NG9-1-1 system implementation will follow one of the two following broad frameworks:

- A **Coordinated, Intergovernmental Approach** managed under the auspices of state or local authorities or
- An **Independent, Unilateral Approach** with decentralized deployment of NG9-1-1 by local jurisdictions.

Although the former requires considerable coordination among numerous government agencies, it has numerous advantages including the potential for equipment consolidation across PSAPs, resulting in cost sharing and saving, convenient support for cross jurisdictional events, improved information exchange, and improved chances for Federal funding. Fortunately, the intergovernmental approach is being followed by almost all entities, including North Dakota.

Figures 4-3 through 4-8 provide one representative migration path. There are many alternative paths and the most appropriate one for a given project can only be determined through the process leading to a detailed transition plan. These figures are loosely based on Reference 10.

Annotation on the figures describes the actions associated with each step in the transition. During the transition process all legacy capabilities must remain functional to preserve service until the replacements are thoroughly checked-out and proven. As an example, in Figures 4-4 and 4-5, legacy and IP service are both available to the PSAPs until the latter is proven.

Figure 4-8 is not really the final end-state desired in a fully i3-compliant system. In that case, the OSPs will have migrated to IP delivery to the ESInet and the

PSAPs will have all transitioned to IP-compliant CPE. However, that may not be realized for a significant period of time.

Although not shown in the figures, all circuits and processing must be redundant to achieve the reliability essential to public safety emergency services.

Not presented in this example is the case where PSAPs have migrated to IP compatibility before the realization of the i3 ESInet is initiated. In this case, the starting configuration may include IP Selective Routers (IPSRs). The Positron VIPER is belongs to the family of devices in this category. In this case, it would be the IPSR, rather than the LSR, that is replaced in a step-wise process. If desired (but not recommended), the IPSRs can be retained if a gateway is placed between them and the ESInet.

We emphasize again, that this is only one of a large number of possible migration paths and the most suitable approach depends on many factors including the existing system configuration at the start, the specific media being supported, and design decisions. In addition, it is important to understand that this simplified presentation of the migration possibilities does not address the database issues. This includes the retention of legacy databases for an interim period and the implementation of the location databases on which NG9-1-1 is critically dependent.

Sections 9.2 through 9.5 of Reference 4 give a great deal of detail on transition activities.

To review, Section 4 has provided an introduction to the tools needed to support the migration process and an illustration of one of the possible applications of these tools in the process.

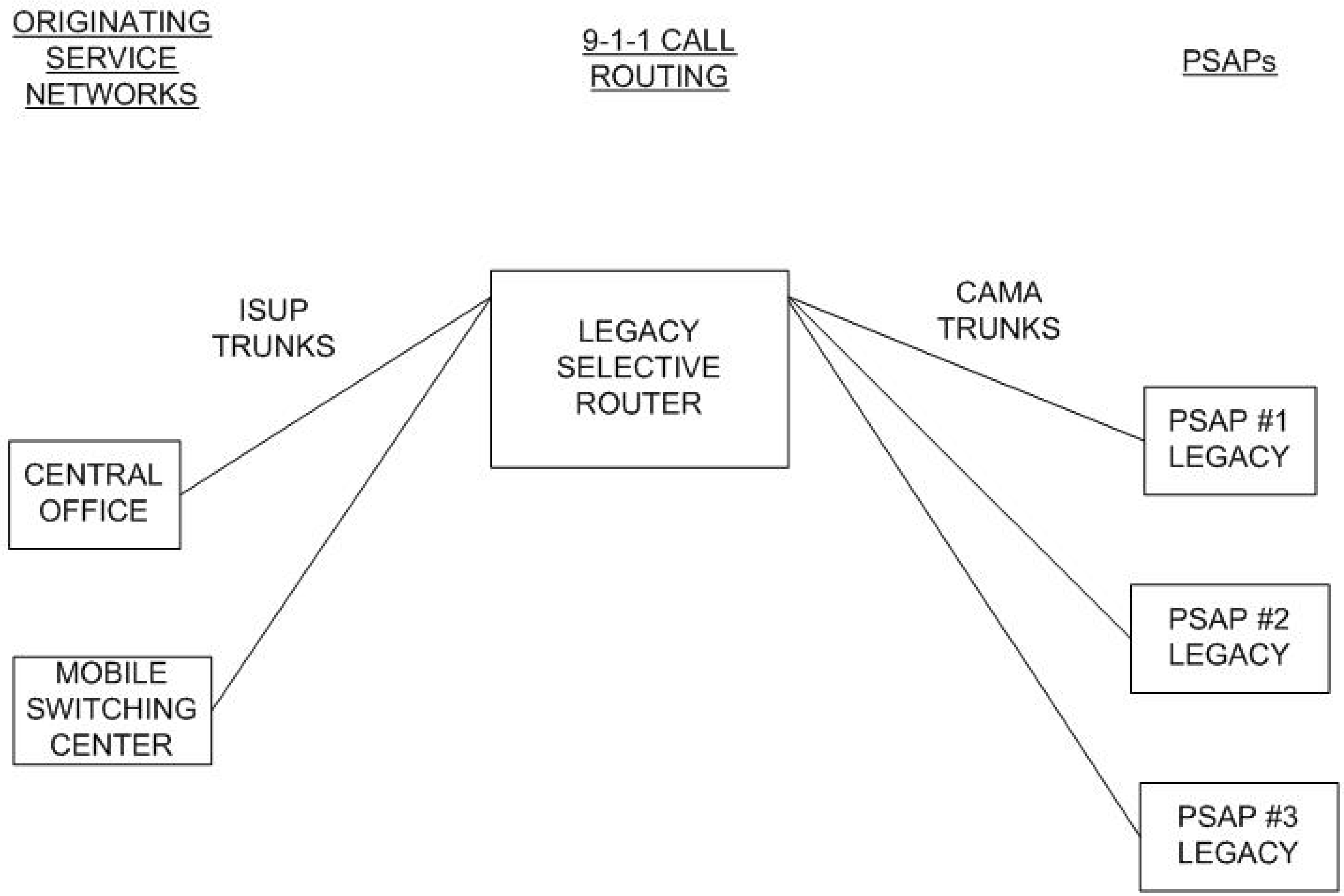
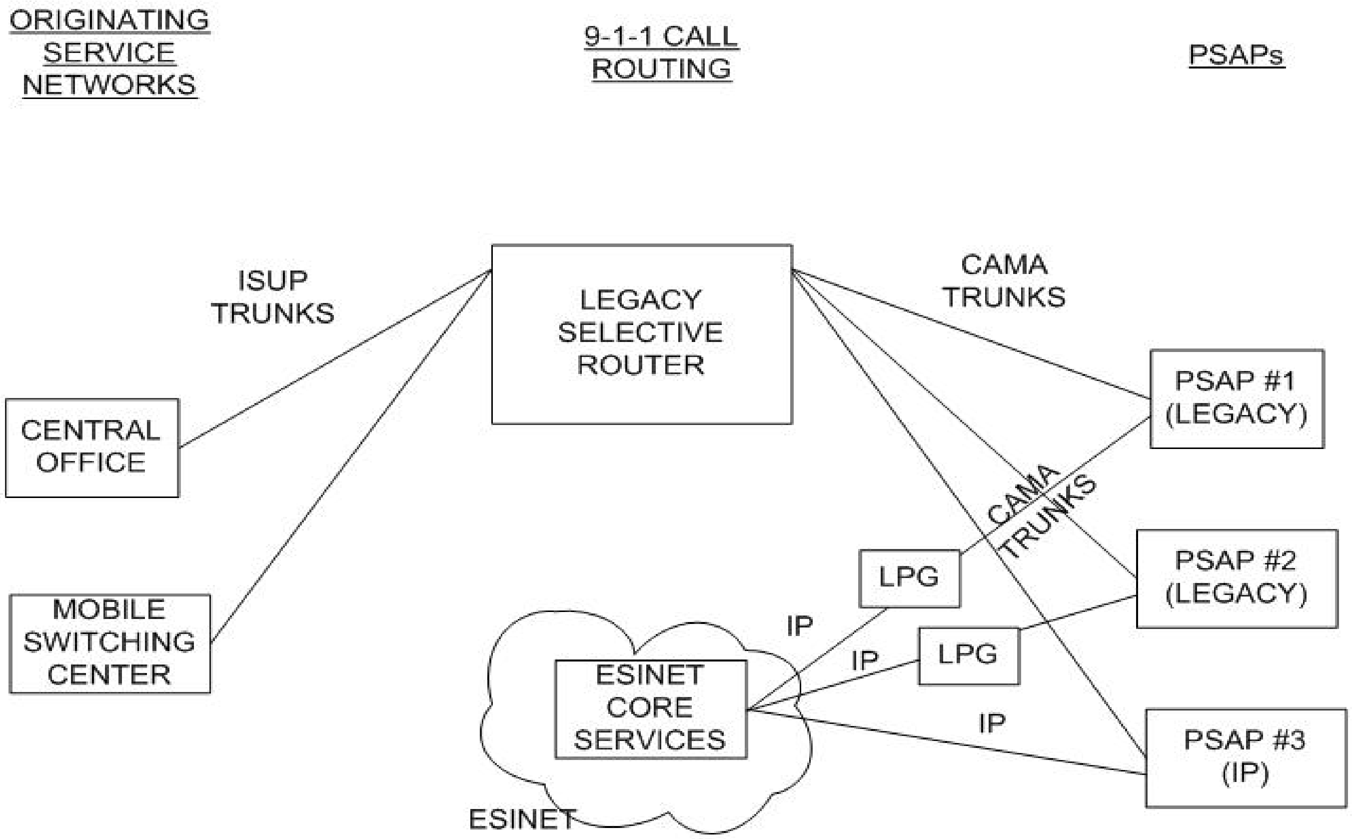
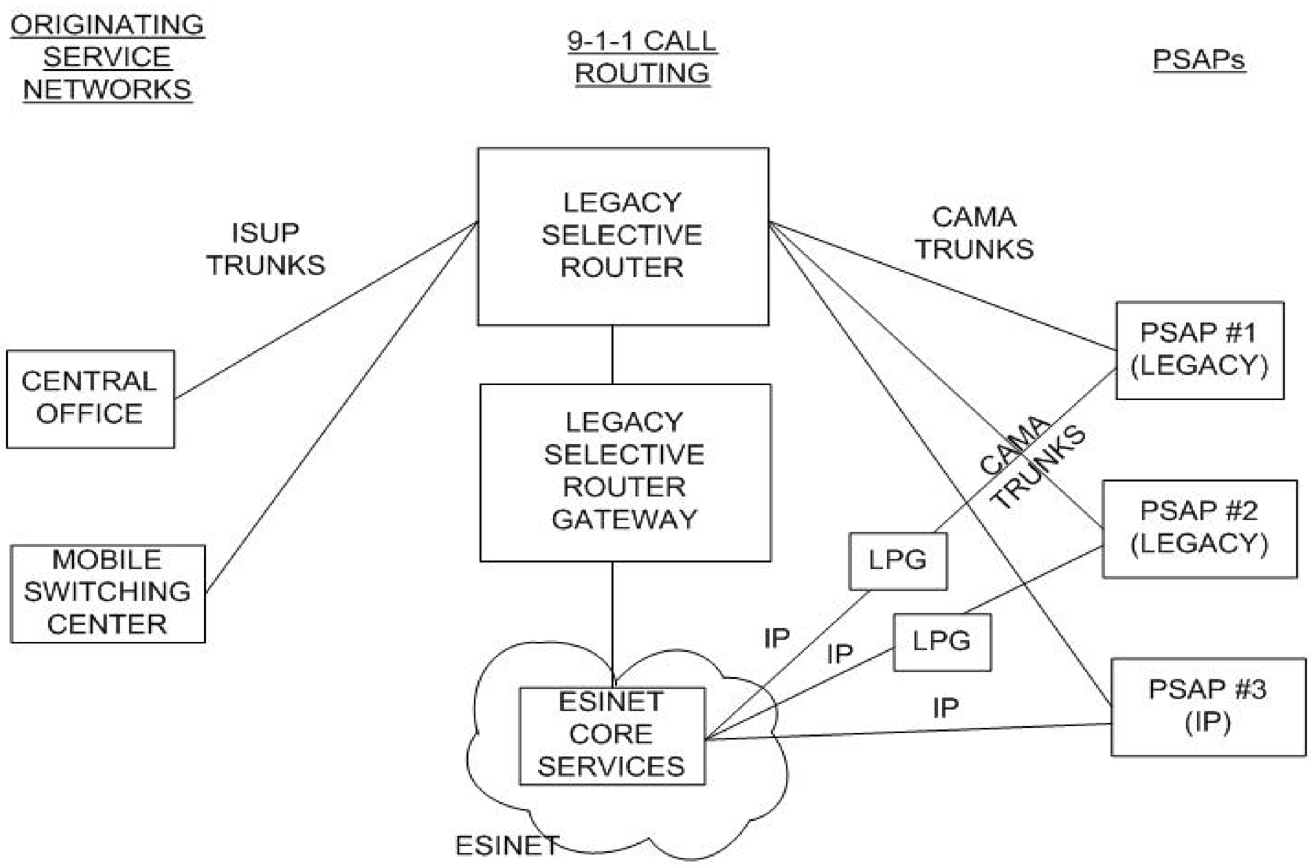


Figure 4-3 Existing (Starting) Configuration



- INSTALL (OR ACTIVATE) ESINET WITH CORE SERVICES
- INSTALL LEGACY PSAP GATEWAYS (LPGs) FOR LEGACY PSAPs #1 AND #2
- CONVERT LEGACY PSAP #3 TO IP-COMPATIBLE

Figure 4-4 First Transition Step



- INSTALL LEGACY SELECTIVE ROUTER GATEWAY (LSRG) AND INTERFACE TO ESINET CORE SERVICES
- PROGRAM THE SELECTIVE ROUTER TO ROUTE TRAFFIC TO LSRG
- RETAIN CAMA TRUNKS TO PSAPs AS CONTINGENCY
- DELIVER CALLS VIA ESINET TO PSAPs AND THOROUGHLY CHECK OUT

Figure 4-5 Second Transition Step

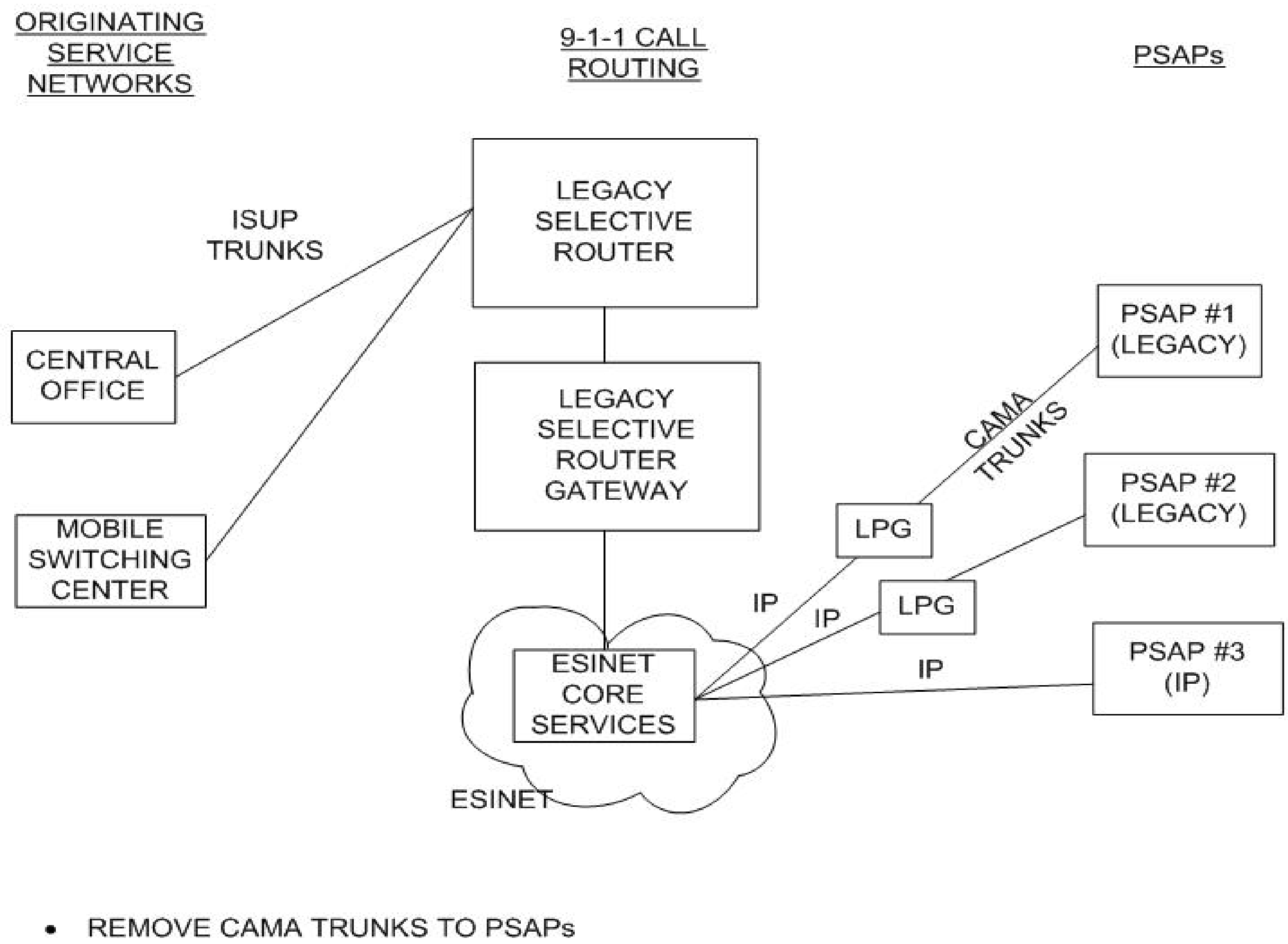
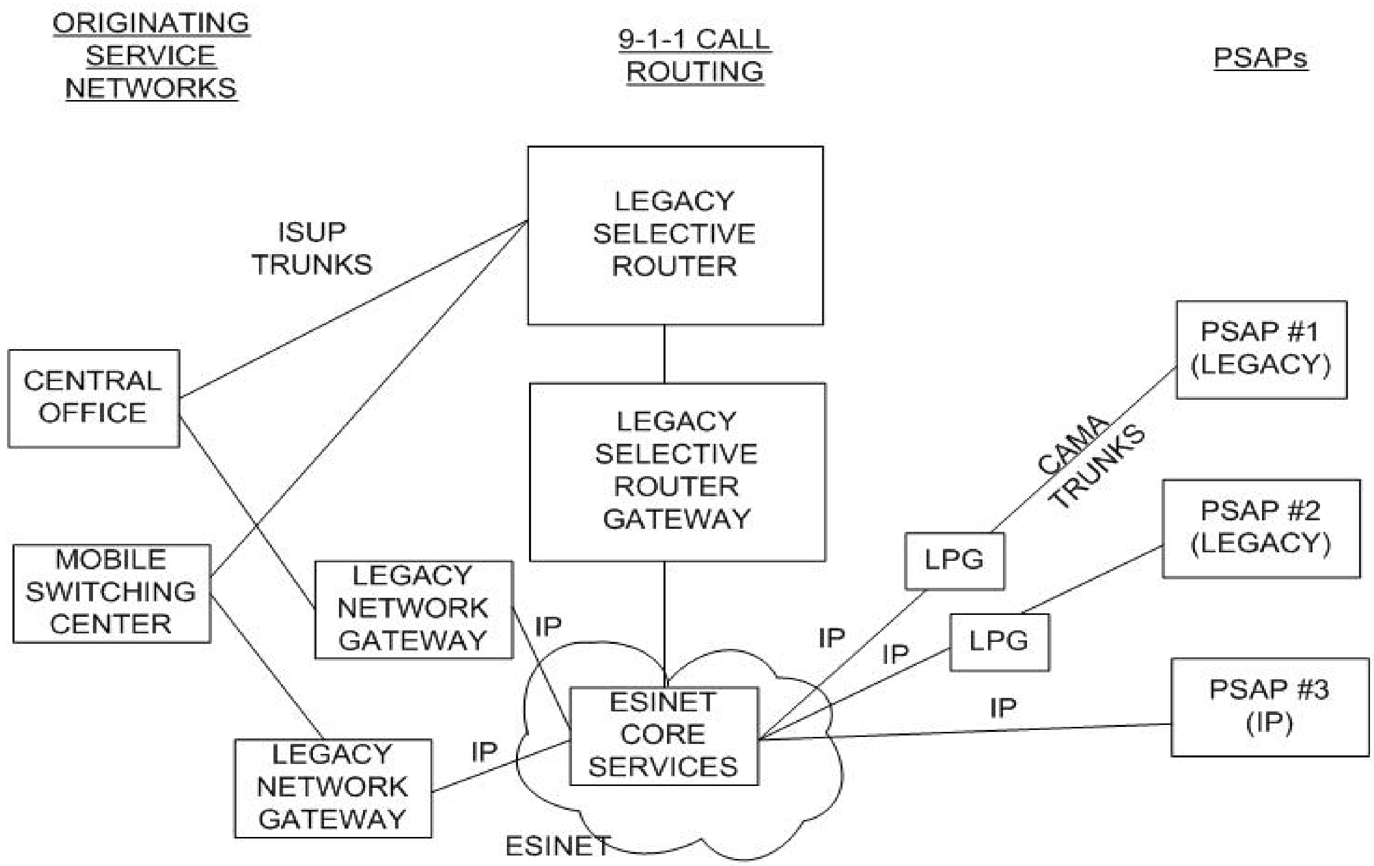
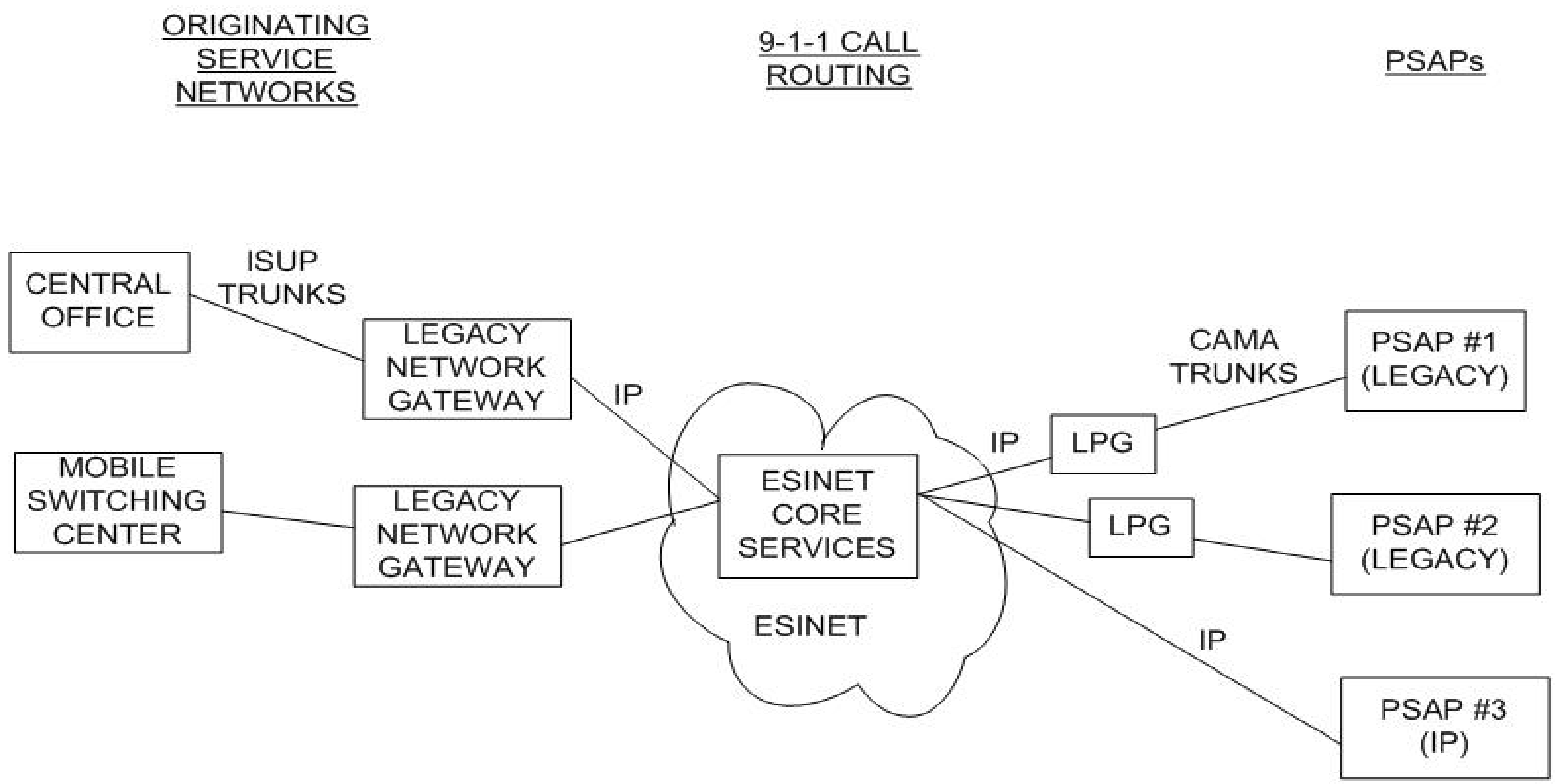


Figure 4-6 Third Transition Step



- INSTALL LEGACY NETWORK GATEWAYS (LNGs) BETWEEN OSP & ESINET
- OSP DIRECT CALLS TO LSR AND LNGs
- CHECK OUT CONFIGURATION WITH DIRECT PATHS FROM OSP TO ESINET
- LSR REPROGRAMMED TO ELIMINATE ROUTING TO LSRG

Figure 4-7 Fourth Transition Step



- LEGACY SELECTIVE ROUTER AND LEGACY SELECTIVE ROUTER GATEWAY REMOVED. ALSO ISUP TRUNKS TO LSR REMOVED
- OPERATION IS NOW FULLY CONVERTED TO ESINET

Figure 4-8 Fifth Transition Step

5 Related Activities

This section provides information useful in the NG9-1-1 planning and development process. Specifically, this section addresses some of the NG9-1-1 history and identifies instructive documentation as well as applicable standards. In addition, representative examples of NG9-1-1 planning and implementation activities are described.

5.1 Planning and Development Support Organizations

The two organizations most prominent in planning and promoting NG9-1-1 development are the National Emergency Number Association (NENA) and the U.S. Department of Transportation (DOT).

Among the best resources for NG9-1-1 planning are the references used in the preparation of this document and found in Appendix B. Especially recommended are References 3 and 4.

The need for NG9-1-1 was first identified in the year 2000 in NENA discussions about future 9-1-1 needs and concepts. In 2003, NENA formed the Technical Development and Operations Committees for future system IP design. In 2006, NENA established a NG9-1-1 Transition Planning Committee. In the same year, DOT kicked-off their initiative for NG9-1-1architecture. In 2008, DOT Intelligent Transportation Systems (ITS) Project developed a concept for an NG9-1-1 proof of concept (POC) demonstration and conducted successful tests. The POC demonstration included three primary instrumentation sites and five PSAPs across the Northern tier of the U.S. This was the first major deployment of software and network components to evaluate the NG9-1-1 and the implementation capability at that time. In late 2008, the DOT effort was transferred to the National 9-1-1 Office, a joint DOT/Department of Commerce program conducted under the DOT National Highway Traffic Safety Administration (NHTSA).

Links to the NENA, the DOT ITS, and the National 9-1-1 Office sites, respectively, are: http://www.nena.org/?NG911_Project, http://www.its.dot.gov/ng911/index.htm, and http://www.911.gov/index.htm.

Many other organizations contribute to the NG9-1-1 development and implementation process including:

- The NG911 Institute (see: http://www.e911institute.org/)
- The National Association of State 9-1-1 Administrators (see: http://www.nasna911.org/index.php)

- The Association of Public Safety Communications Officials (see: http://www.apco911.org/)
- The Emergency Services Interconnection Forum (see: http://www.atis.org/esif/index.asp)

In addition to the above, the U.S. Department of Homeland Security (DHS), Office of Emergency Communications (OEC), Interoperable Communications Technical Assistance Program (ICTAP) sponsored the preparation of this technical report. OEC is also conducting one-day NG9-1-1 Workshops that describe NG9-1-1 and address approaches to successful implementation. In the future OEC is likely to also offer NG9-1-1 training courses.

5.2 Standards Bodies

The following quote from Reference 8, Page 1-4, gives a high-level summary of the organizations central to standards development for NG9-1-1.

> "The consensus on an NG9-1-1 technical architecture is documented in the interlocking standards principally from the Internet Engineering Task Force (IETF), Alliance for Telecommunications Industry Solutions (ATIS), Third Generation Partnership Program (3GPP), and the National Emergency Number Association (NENA)."

Sections 4.2, 4.3, and 4.4 of Reference 14 give specifics on the relationships among these organizations.

The basic foundation for NG9-1-1 standards is the IETF Emergency Calling Protocol Standards. As explained in Ref 14 these emergency calling protocol standards are the product of consensus "requirements from a wide variety of nations, carriers, industry associations and vendors."

The NENA i3 Standard was addressed in Section 3, above, and corresponds to the ESInet. NENA is the controlling body for the i3 Standard. In addition, NENA provides a variety of requirements and information documents, as well as, handbooks and white papers addressing NG9-1-1 beyond the borders of the ESInet. A listing of NENA publications can be found at: http://www.nena.org/?page=Standards.

5.3 State and Locality Activity

After many years of planning (as described above) NG9-1-1 has achieved substantial momentum toward realization. Approximately thirty states have produced NG9-1-1 Master Plans or Strategic Plans. On the order of twenty-five states and regions are proceeding with pilots or system implementation. Many states are or have implemented statewide IP networks as a first step and are moving step-wise forward. A number of regions have spearheaded implementation efforts in their states. There is so much activity underway that it is virtually impossible to track all of it.

Tables 5-1 through 5-5 provide an overview of the work underway in five representative states and regions. Specifically, these tables address the States of Alabama, Tennessee, Washington, and Maryland as well as a region comprised of fifteen counties in Illinois. Each of the tables addresses the acquisition process and the phased implementation. The former includes the division of responsibility between the public safety agencies and the contractors, especially for the IP network and the core ESInet services.

Table 5-1 State of Alabama NG9-1-1 Implementation Approach

- In June, the State of Alabama awarded a contract to iNETWORK for a three year migration to NG9-1-1
- The project has four phases, as follows:
  - Phase I – wireless only through existing Selective Routers (SRs) in months 1 through 6
  - Phase 2 – wireless only through both SRs and ESInet in months 6 to 18
  - Phase 3 – all media through ESInet using transitional components in months 18 through 30
  - Phase 4 – all media through full ESInet in months 30 to 36
- The State is providing the IP network and iNETWORK is installing core call routing equipment and software in two existing State facilities
- Each of the phases provides an incremental technology advance to the entire State (about 100 PSAPs) culminating with full NG9-1-1 implementation in Phase 4
- In Phase 1 the core sites are implemented serving as aggregators to interconnect with the originating service providers. In successive phases the IP network assumes additional call delivery responsibility

Table 5-2 State of Tennessee NG9-1-1 Implementation Approach

- Working with AT&T, the State of Tennessee is currently implementing a private Multiprotocol Label Switching (MPLS) network termed "NetTN"
- The State intends to implement an NG9-1-1 system building on the NetTN IP network
- Early this year TeleCommunication Systems (TCS) was contracted to provide NG9-1-1 management services integration
    - To include network operation and data management
- Two stage implementation of 9-1-1 delivery over NetTN is planned
- Stage 1: Implements the core network, two NetTN Control Centers (NCCs) and four Aggregation Points. The latter will accept 9-1-1 calls from wireless and VoIP service providers
- Stage 2: Connection of NetTN to PSAPs and delivery of 9-1-1 calls from the NCCs to the PSAPs
- 9-1-1 delivery over NetTN is scheduled for 2012 and management services integration is planned for completion in 2013

Table 5-3 State of Washington NG9-1-1 Implementation Approach

- Working with CenturyLink and Intrado, a Statewide ESInet has been implemented
    - Installed in parallel with the legacy system to allow a migratory transition
- Next, an pilot group of nine counties were interfaced with the ESInet in sequence
    - Legacy PSAP Gateways were employed
- Following success of the pilot, all remaining counties were migrated to the ESINet with completion in March 2012
- Attention has shifted to the PSAP CPE
    - Proofs of Concept are being conducted for remote hosting of PSAP CPE using Intrado and Cassidian platforms
    - For each platform, two geographically diverse and mirrored hubs are established using PSAP equipment on a regional basis
- The outcomes of the CPE Proof of Concept studies are not yet known, although both vendor models appear viable
- A coming step is the telco conversion to digital of their transport to the ESInet

Table 5-4 State of Maryland NG9-1-1 Implementation Approach

- The Maryland State Police (MSP) is pursuing a project to transition their call handling system to NG9-1-1
  - Driven by the need to better support the transfer of calls from the county primary PSAPs to the secondary PSAPs at the MSP barracks
- The Maryland Bureau of Public Works has approved funding for a pilot in the Eastern Shore region of the State
  - The pilot is scheduled for completion late in 2013
- The pilot will build on the existing Network Maryland IP network and includes:
  - CPE set-up in a host remote environment permitting backup by alternative hosts
  - Capability to receive the ANI/ALI information from primary PSAPs
  - Call delivery regardless of the media used (landline, wireless, VoIP, etc.)
- The network and CPE must meet applicable NENA i3 standards when made available

Table 5-5 Counties of Southern Illinois NG9-1-1 Implementation Approach

- 15 counties with 21 PSAPs have joined to establish the Counties of Southern Illinois (CSI) NG9-1-1 system
- NG9-1-1, Inc. was selected as the system integrator and Solacom Technologies chosen to provide the core ESInet and PSAP systems. The ESInet was designed by Assure911.
- The ESInet will reside on a broadband fiber-based network being deployed across Southern Illinois by Clearwire Communications
- Detailed design has been completed and the CSI petition for authority to operate is now before the Illinois Commerce Commission
- The first phase includes the core ESInet system including a Legacy Network Gateway (LNG) and Emergency Services Routing Proxy (ESRP)
- Identical data centers have been implemented in Harrisburg and Murphysboro
- The system is expected to be installed, tested, and operational next year

The Illinois Commerce Commission (ICC) required detailed design information before granting the Counties of Southern Illinois authorization to operate. This design detail can be found on the ICC web site.

Many other examples can be cited including Pittsylvania County VA, Denton County TX, and the North Central North Carolina NG9-1-1 Compact.

Following are a couple of observations from examination of the work being done be various states and regions.

First, there appear to be two distinct approaches to step-wise implementation of NG9-1-1:

- Each successive phase corresponds to the transition of a geographic area of the state to NG9-1-1 implementation.
- Successive phases correspond to incremental advances in technology leading to full NG9-1-1 realization in the final phase.

Figure 5-1 provides an illustration of each approach where Maryland is using the former and Alabama is using the latter.

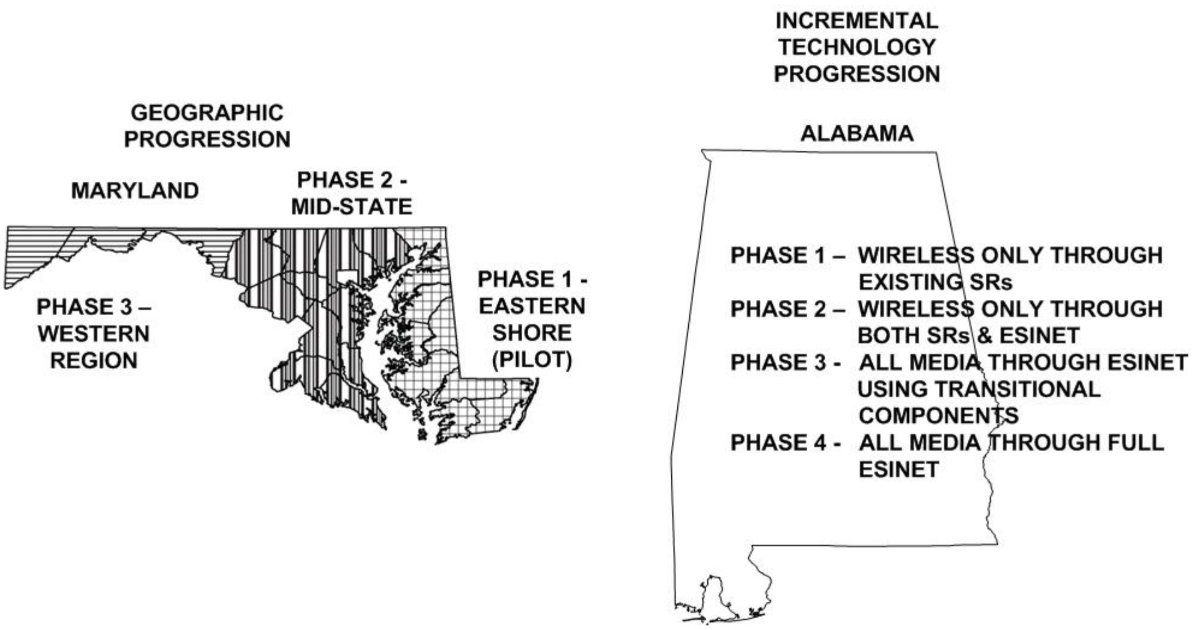


Figure 5-1 Phased Implementation Alternatives

Of course there can be hybrids of the two concepts. Each alternative has advantages. For example, in the geographic approach, the first phase can be a pilot and in the incremental technology implementation all of the PSAPs are provided with the same level of service simultaneously.

The second observation is that there are many diverse alternatives for system acquisition and operation including:

- Public safety implemented and operated,

- Contractor provided systems and services, or
- A hybrid combination of the above approaches.

Contractor provided systems and services can take many forms including:

- Prime contractor or integrator solution,
- Leased or provisioned facilities, or
- Managed (or hosted) services.

Tradeoffs include up-front vs. recurring costs, level of control, and responsibility for on-call maintenance. A common approach is:

- Public safety builds the IP network or leases/provisions it from major carriers and
- A prime or integrator delivers core i3 capabilities or provides them as managed services.

There is considerable interest in hosted services for the ESInet core. A number of vendors offer the option of installing capability at the customer sites or remotely hosted from vendor sites including Cassidian Communications, InterAct Public Safety, and Intrado. For example, the Plaquemines Parish in Louisiana has announced plans to proceed with a cloud solution of fully managed NG9-1-1 solutions from Intrado. The State of Delaware is planning a bundled package from Intrado that include premises equipment and software as well as cloud hosted management.

6 Discussion of Work Flow Diagrams

A top-level flow diagram is provided as Figure 6-1. It gives a high-level view of activities/tasks that support the migration to a NG9-1-1 implementation of emergency call services. The detailed version of the task flow diagram is provided in Appendix C. Text describing each of the more than 50 task blocks in the detailed work flow diagram appears in Appendix D. The numbers assigned to each of the blocks in the diagram correspond to the numbering in Appendix D.

It is not the intention to examine each of the individual tasks in detail. Rather, the focus is on significant groupings of activities and threads through the flow.

The content that appears in the diagrams and accompanying task descriptions is based on a combination of sound system engineering practice and the technology associated with migration to NG9-1-1. Although the Appendix D diagram is complex, we make no claim that it is complete in every regard. For example, activity associated with the block titled “Conduct Design Reviews and Acceptance” would normally include preliminary and critical design reviews as well as acceptance for design freeze. The technology is addressed in other sections of this report and system engineering practice is covered in References 11, 12, and 13.

The work flow diagrams are segmented by time frame into near-term, intermediate-term, and long-term. Following is the logic for the grouping of activities into the three time frames:

- The near-term corresponds to the program initiation activities including program planning and stakeholder outreach.
- The intermediate-term covers the period during which the system design crystallizes and concludes with the performance of a Proof of Concept Demonstration.
- The long-term completes the program through the statewide build-out by geographic phases.

The completion of the implementation of NG9-1-1 involves substantial time-consuming effort and three biennium’s corresponding the legislative sessions may be a target for completion. Other than that, the development of a schedule for each of the major project segments and the final completion is not attempted here. Many issues drive the preparation of a schedule such as availability of funding, securing agreements with the stakeholders, the outcome of the POC Demonstration, and the composition of the transition plan for the incremental rollout.

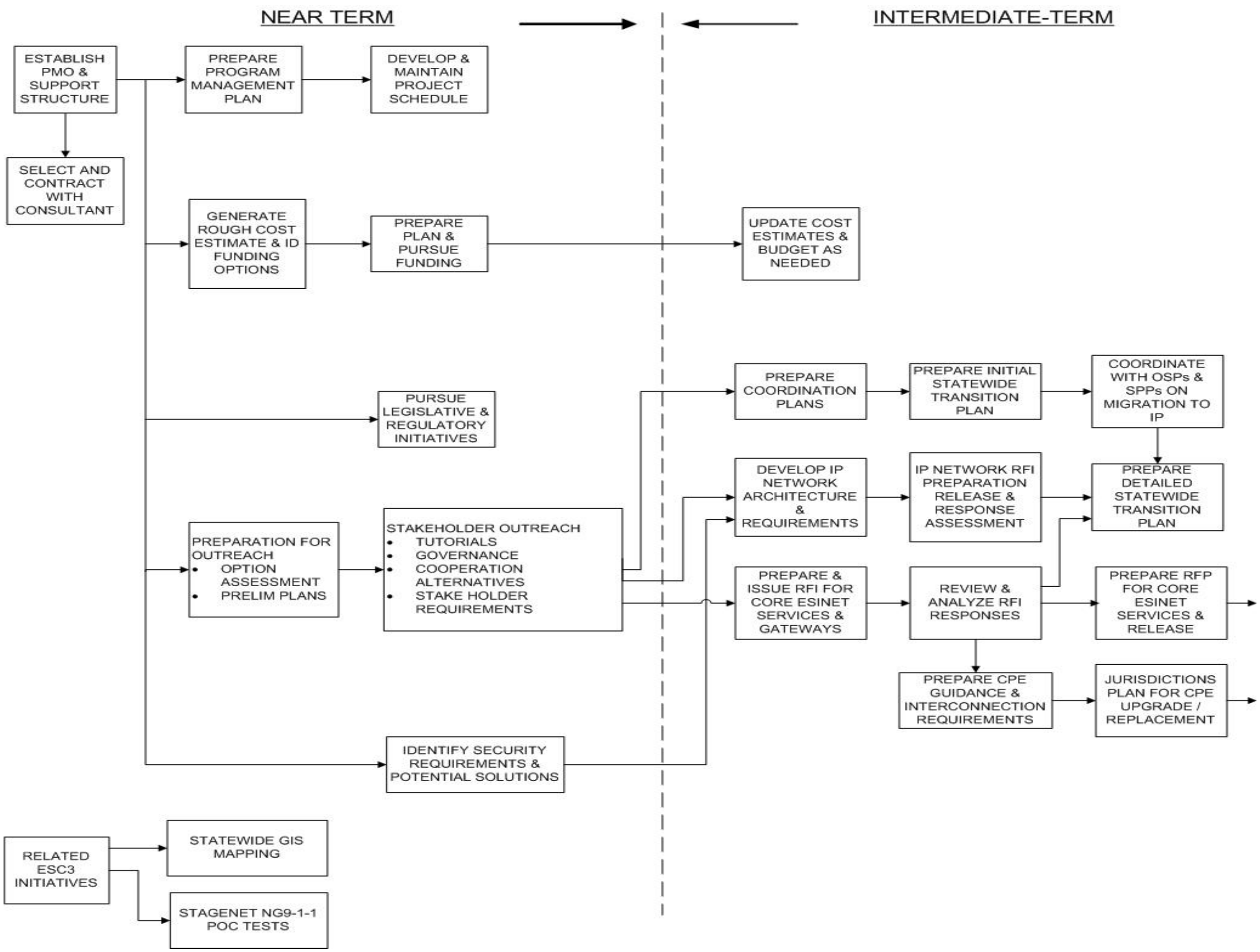


Figure 6-1 High Level Work Flow

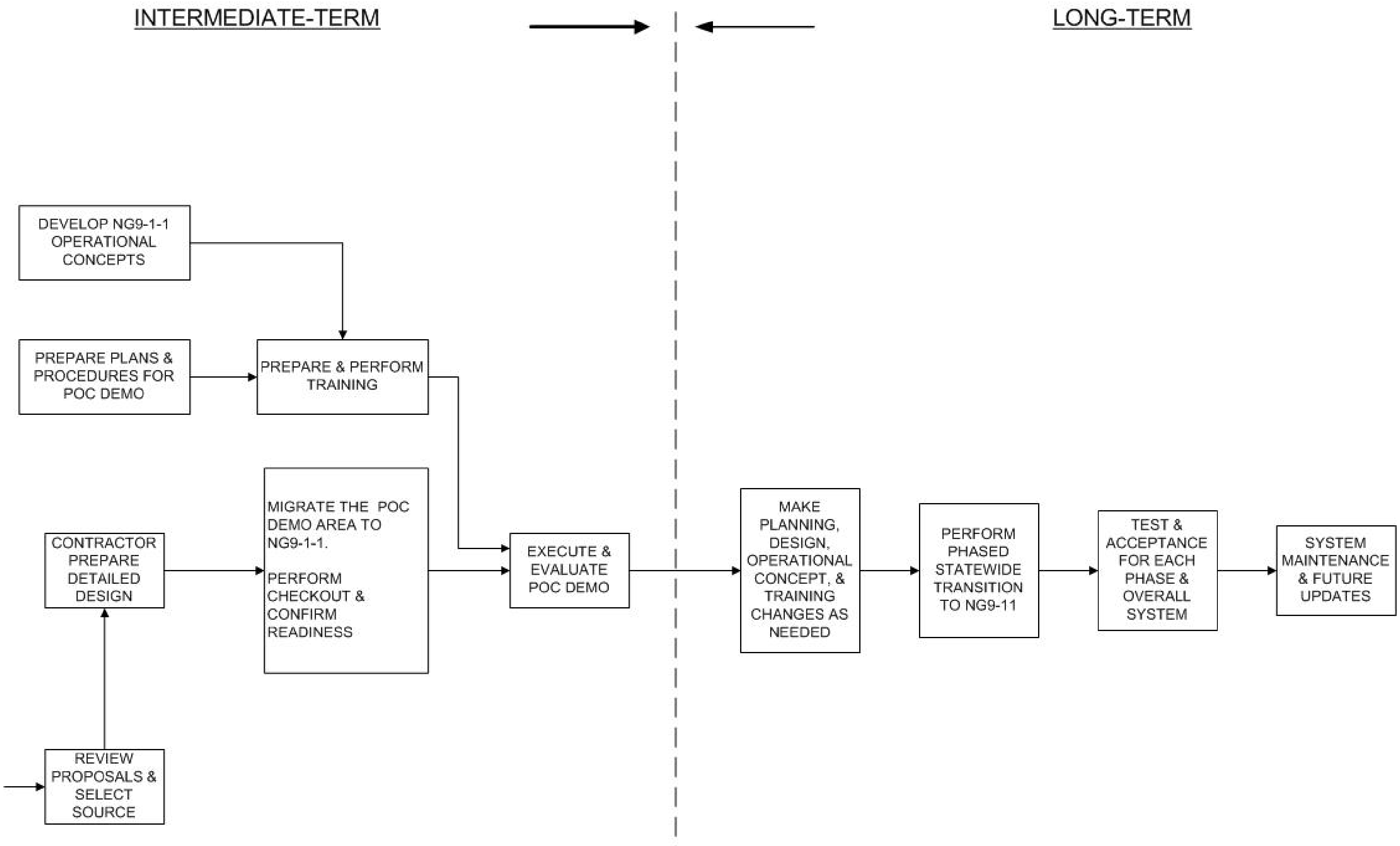


Figure 6-1 High Level Work Flow (con't)

6.1 Near-Term

We understand that the State has acquired a qualified program manager for the project, and that individual will be responsible for organizing and staffing the program management office. One of the first issues faced by the program manager is whether to hire a consulting firm. Given the complex and dynamic nature of NG9-1-1, well qualified consultants provide valuable assistance to help avoid pitfalls that they have learned about through experience. The consulting firm can act as a virtual extension of the program office if sufficient qualified full-time staff is not available.

The ESC3 is clearly aware of much of the necessary up-front effort, as evidenced by First Tier Work ESCCC High Level Work Plan that is part of Reference 14. Among the initial activities of a large project should be the Program Management Plan (PMP). Topics for possible inclusion are project organization, management processes, technical processes, work packages, schedules, budget, success criteria, test strategy, and deployment plan. Some of the material in the plan (e.g., schedules and budget) will be preliminary or top-level in nature and further developed in separate tasks. If the program manager and/or the supporting consultant are PMI certified, they will be familiar with what should be included in the PMP.

A consultant can be extremely useful in preparing cost estimates, based on their knowledge of the technology and experience on similar projects. Funding possibilities and their pursuit are clearly topics that ESC3 has been concerned with for some time. Like schedule, cost estimates and budgets are something that need to be updated as more exact information becomes available, such as from selection of procurement alternatives and review of responses to RFIs and RFPs.

Another near-term activity is the review and identification of rules and regulations that may impact the implementation of NG9-1-1. This could include existing regulations specific to legacy technology, limits on the sharing of data among public safety agencies, liability, and eligible use of 9-1-1 funds. Legislative and regulatory changes must be pursued, as needed. Liability limitations need to be extended to non-voice services or technologies. The realization of regulatory initiatives could easily be one of the most challenging and delayed efforts of the project.

Development and maintenance of the program schedule are obviously critical to program planning and control. Schedule maintenance will make adjustments as more knowledge is acquired through activities such as review of vendor RFIs and development of the phased statewide transition plan.

Something else to consider early in the process is the selection of acquisition or procurement alternatives. Choices include State-owned and operated, vendor owned and operated with the option for State purchase, managed (or hosted) services, and leased facilities. Tradeoffs include up-front vs. recurring costs, level of control, and responsibility for on-call maintenance services.

Much of the rest of the near-term is related to the preparation for and the conduct of the stakeholder outreach. Preparation is obviously critical so that the PMO and consultant are familiar with the possibilities for stakeholder participation before discussions begin. This would include knowledge of options for stakeholder organization cooperation (or coordination) and governance plan talking points.

A major incentive for cooperation among jurisdictions in the long-run is all the new media delivered to the PSAP with NG9-1-1 technology. Most PSAPs already have heavily loaded call-takers and the need to process the new classes of services will seriously exacerbate the situation. Coordination among the PSAPs will allow the work load to be shared among them and even offers the possibility that call-takers can specialize in specific media such as text and video. A given specialist can support a collection of cooperating PSAPs.

As pointed out by Reference 9, "the roles and responsibilities and intergovernmental arrangements for the IP-enabled 9-1-1 system will need to be defined across jurisdictional boundaries and within new partnerships."

6.2 Intermediate-Term

In this time frame the serious work leading to the detailed transition planning and system design is performed. The Intermediate-Term culminates with the execution of the Proof of Concept Demonstration.

Transition planning kicks-off with the preparation of a Coordination Plan that documents the results of stakeholder commitments. This provides the basis for preparation of first-cut and detailed Transition Plans that document the steps that will be followed in the phased statewide migration to NG-1-1.

The first steps leading to the eventually detailed design are the preparation of detailed requirements for the IP Network (to become the ESInet) and for the core ESInet services (defined in Section 3). The ESInet is normally thought of as the combination of the IP transport network and the NG9-1-1 core services. However, to promote system implementation flexibility, we have separated the two in the work flow diagrams. This creates the potential for the State to work with the DCN for the expansion of the STAGEnet for the IP transport and contract separately for the NG9-1-1 core services. However, if the State wishes, the NG9-1-1 contractor can assume the responsibility to work with carriers to provision the IP transport.

The core ESInet services include the databases associated with the Emergency Services Call Routing Function (the Geospatial Database and the Policy Store).

RFI's for both the IP transport network and the ESInet core services allow the gathering of up-to-date data for informed transition planning and development. This, in turn, supports the preparation of requirements to be incorporated into the RFP for core ESInet services. The evolution of i3 standards and the dynamic nature of the vendor offerings make ongoing interaction with vendors, including through the RFI process, very useful. Samples of RFIs can be provided, on request.

If the RFI for the IP network produces adequate information on availability of required connectivity and bandwidth, quality of service (QoS), and cost data, then a provisioning can proceed without an RFP. Given the State's long-standing relationship with the carriers that comprise the DCN, this seems reasonable. But, the RFP is still an option.

Clearly the gathering of data through the RFI process is highly interactive with the development of detailed transition plans.

In parallel with the above, another significant activity is to ensure that the CPE acquired by the jurisdictions for their PSAPs is compatible with NG9-1-1. Also, requirements for interconnection to the State-supplied NG9-1-1 network should be addressed. The review of PSAP CPE plans can be conducted as part of the ongoing cooperation and coordination among the PSAPs and with the State. One of the inputs to transition planning is the need for the jurisdictions to replace CPE that is nearing end-of-life or no longer supports their needs. However, there is no need for the jurisdictions to wait until the State NG9-1-1 rollout arrives in their area. They have only to preserve the ability to interface with the legacy selective routers and related databases.

A major consideration in CPE planning is the extent to which the State will support local PSAPs through hosted services provided by the State. A number of states, including Washington and Virginia, are planning centralized processing support for the localities that may include hosted solutions for local 9-1-1 Call Center equipment, software, and related services. This topic must be addressed early in planning and included in the original and ongoing stakeholder interaction.

Coordination is needed with the originating service providers and system service providers on scheduling of their migration to support IP interfaces to the ESInet and to maintain their continuing support to legacy routing and databases. Ongoing legacy capability is necessary because (1) some of it will be part of the interim system configurations during the transition to full i3 and (2) parallel legacy operation is needed to ensure uninterrupted service until the new installations are fully shaken-down and have proven their ability to meet public safety standards for reliability and availability.

Following the bidding and negotiation process for the provider of ESInet core services, the selected vendor will enter into detailed design followed by review of the design by the ESC3 and others they designate.

Development of NG9-1-1 operational concepts, among other things, provides a basis for the preparation of the training courses and their presentation to anticipated participants in the POC Demonstration. Of course the operational concepts and training courses will be refined based on lessons learned in the POC Demo. Hopefully, preceding work of other states and localities can be used as a pattern to simplify the preparation of operational concepts and training materials by North Dakota.

In Section 4, above, some of the possible paths for the migration to NG9-1-1 were addressed. As discussed, the realization of the ultimate vision for NG9-1-1 will be a step-wise process. Therefore, planning must consider the specific stage of the migration to demonstrate in the POC. It may well be some combination of legacy and core ESInet components.

The POC Demo provides the opportunity to shake-out and remedy the problems that every implementation of new products and technology experiences. This provides confidence that, when accepted for operational use, the new configuration will meet the aforementioned high standard of performance required of public safety systems and, especially, those supporting emergency response.

6.3 Long-Term

The focus of the long-term time frame is the completion of the statewide phased rollout of NG9-1-1. Each of the phases will be thoroughly tested for performance and compatibility with remaining legacy components and with the PSAP CPE. Eventually, testing will be performed for the acceptance of the entire statewide system.

The responsibility for routine and problem maintenance will depend on acquisition alternative decisions make early in the program. Also, future updates to the systems are to be expected as the technology supports additional public media and applications.

7 Summary and Recommendations

The primary purpose of this technical report is to provide the requested detailed work plan for the implementation of statewide Next Generation 9-1-1. Sections 4 and 6, and Appendices C and D, describe a step-by-step process including detailed flow diagrams for the implementation process. In addition, supporting information is included in Section 2 (Current North Dakota E9-1-1 System Description), Section 3 (an Overview of NG9-1-1), and Section 5 (Related Activities).

Following are some of the more significant findings and considerations addressed in this report:

- Based on our interaction with the ESC3 via conference calls, the State appears to have a good understanding of the fundamental early steps toward successful migration to a Statewide NG9-1-1 system.
- The State has secured a program manager to oversee the planning and phased implementation of the migration to NG9-1-1. Based on our discussions with the State, it is apparent that the program manager fully appreciates the value of a carefully prepared Program Management Plan (PMP). Section 6 and Appendix D address the content that should be included in the plan, including organization, work packages, budget, as well as risk identification and mitigation.
- An early and important decision is whether to procure a well-qualified consulting firm to support the program. Such a consultant can provide first-hand experience in the development and execution of a large-scale NG9-1-1 project. Programs of this magnitude are only encountered once in multiple decades and existing staff typically face a stiff learning curve. Even if the State has a very informed and capable core staff, it may be that there are not enough hours in the day for them to accomplish all that needs to be done to manage and control a program of this size. One of the benefits offered by a competent consultant is assessing the reality to claims made by vendors.
- Early and continuing involvement of the stakeholders is vital to their acceptance and realization of the full benefit of their knowledge and to make best use of their current and planned systems. Above all, this provides an opportunity to encourage and promote the sort of cooperation among the localities that will allow the sharing of resources and attendant cost savings.
- The need for stakeholder engagement has been stressed in the work flow diagrams and the accompanying text of this report. This can be seen in Block 15 (Stakeholder Outreach, Participation & Buy-In) of the detailed work flow diagram and in Block 20 (Preparation of a Cooperation and Coordination Plan). Stakeholder involvement is a key to the development of a Statewide Transition Plan.

- As addressed in Section 6.1 and Appendix D, non-technical topics often have more impact on progress and planning that technical and require extensive attention, especially during the early or near-term work. As one example, data provided by the stakeholders on the age and condition of their PSAP CPE is one input to the phasing of the NG9-1-1 rollout.
- The architecture of the ESInet is an issue to be addressed early. The alternatives are a single statewide network or multiple regional networks to be tied together by a top-level network. Our impression is that the State has at least a strong leaning to the single statewide network. This is highly related to the selection of a fundamental approach to the system implementation. The possibilities here are a coordinated approach with the State managing the implementation, or independent, unilateral development by local or regional entities. Again, we believe that the State has a strong preference and it is a matter of bringing all the localities into the fold.
- As discussed in Section 4, there are a number of alternative implementation paths toward NG9-1-1 that can be followed. The preferred alternative may not be apparent at the outset and can best be selected during the effort leading to the preparation of a detailed transition plan. This report has repeatedly stressed the importance of such a plan. There are far too many moving parts to be smoothly brought together otherwise. These include the originating service providers, the provisioning of necessary assets, the interaction with the PSAPs, and simultaneous operation of legacy and next generation capability during the migration.
- One of the alternatives to consider is step-wise implementation by geographic area versus incremental technology. The former is simply the implementation through a sequence of geographic areas. As described in Section 5, the latter involves the installation of increasing levels of NG9-1-1 technology statewide in each phase. Among the advantages of the first alternative is the possible use of the initial geographic area as a pilot. In fact, each successive geographic region provides increased experience for the following phases. The incremental technology approach has the advantage of providing the same level of capability statewide at each step.
- Another very significant branch point is the selection of approaches for system acquisition and operation. Alternatives are addressed in Sections 5.3 and 6.1. As discussed in those sections, implementation and operation can be performed by public safety, contractor, or a combination of the two. Contractor provided systems and services can take a variety of forms including use of a prime contractor or integrator, leased or provisioned facilities, or managed services. Each concept has its pros and cons that must be carefully considered. The acquisition approach can have an impact on the choice between the geographic versus incremental technology phase implementation discussed in the last paragraph.

- There is growing interest in contractor hosted services. Leading advantages are the possibility of rapid implementation of operational capability and minimal upfront cost. Disadvantages include loss of full control, significant recurring costs, and long-term commitment to the provider.
- Some states/regions have found that an ongoing dialogue with leading vendors during early planning activities can provide valuable ideas regarding implementation options. It seems likely that the State has already been following this path. Of course, it becomes more formal when RFIs are issued.

From the above, it is evident that there are a substantial number of important decisions that must be made as the detailed work flow is followed. Many are most effectively made early in the process.

It is widely recognized that states and localities can get a head start toward NG9-1-1 by taking the following steps:

- Begin the provisioning of a secure IP network that can eventually interconnect PSAPS,
- Provide a GIS system with the detail and layers necessary for NG9-1-1,
- Begin the installation of IP-based CPE for the PSAPS, and
- Conduct Proof of Concept Demonstrations.

Interestingly, North Dakota is making progress on all four, as discussed in Section 2.

Appendix A Acronym List

Acronym	Definition
3GPP	Third Generation Partnership Program
ALI	Automatic Location Identification
ANI	Automatic Number Identification
ATIS	Alliance for Telecommunications Industry Solutions
BCF	Border Control Function
CAMA	Centralized Automatic Message Accounting [Trunk]
CIDB	Charging Indication Database or Call Information Database
CLC	Call Logic Center
CPE	Customer Premises Equipment
CSI	Counties of Southern Illinois
DHS	Department of Homeland Security
DCN	Dakota Carrier Network
DOT	U.S. Department of Transportation
ECRF	Emergency Call Routing Function
ECRIT	IETF Emergency Context Resolution with Internet Technologies
ESC3	Emergency Services Communications Coordinating Committee
ESInet	Emergency Services IP Network
ESQK	Emergency Services Query
ESRK	Emergency Services Routing Key
ESRP	Emergency Services Routing Proxy
ESN	Emergency Services Number
GIS	Geographic Information System
GMLC	Gateway Mobile Location Center
ICTAP	Interoperable Communications Technical Assistance Program
IETF	Internet Engineering Task Force
ICC	Illinois Commerce Commission
ILEC	Incumbent Local Exchange Carrier
IP	Internet Protocol

IPSR	Internet Protocol Selective Router
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part [SS7 Trunk]
ITS	U.S. Department of Transportation Intelligent Transportation Systems
LIS	Location Information Server
LNG	Legacy Network Gateway
LoST	Location to Service Translation [Protocol]
LPG	Legacy PSAP Gateway
LSRG	Legacy Selective Router Gateway
LVF	Location Validation Function
MPC	Mobile Positioning Center
MPLS	Multiprotocol Label Switching
MSAG	Master Street Address Guide
NDACo	North Dakota Association of Counties
NENA	National Emergency Number Association
NHTSA	U.S. Department of Transportation National Highway Traffic Safety Administration
OEC	Department of Homeland Security Office of Emergency Communications
OSP	Originating Service Provider
pANI	Pseudo Automatic Number Identification
pALI	Pseudo Automatic Location Identification
PIDF LO	Presence Information Data Format Location Object
PMI	Program Management Institute
PMO	Program Management Office
PMP	Program Management Plan
POC	Proof of Concept
QoS	Quality of Service
RFAI	Request for Assistance Interface [Standard]
RFI	Request for Information
RFP	Request for Proposal

SBC	Session Border Control
SIP	Session Initiation Protocol
SRDB	Selective Router Database
SSP	E911 System Service Provider
STAGEnet	Statewide Technology Access for Government and Education Network
TDM	Time Division Multiplexing
TN	Telephone Number
URI	Uniform Resource Indicator
URL	Uniform Resource Locator (location sensitive)
URN	Uniform Resource Name (location insensitive)
VIPER	Intrado Positron Voice over IP for Emergency Response [Product Trademark]
VoIP	Voice over Internet Protocol
VSP	VoIP Service Provider

Please note that not all of the acronyms found below are used in this document. Some are included because they appear prominently in referenced material.

Appendix B References

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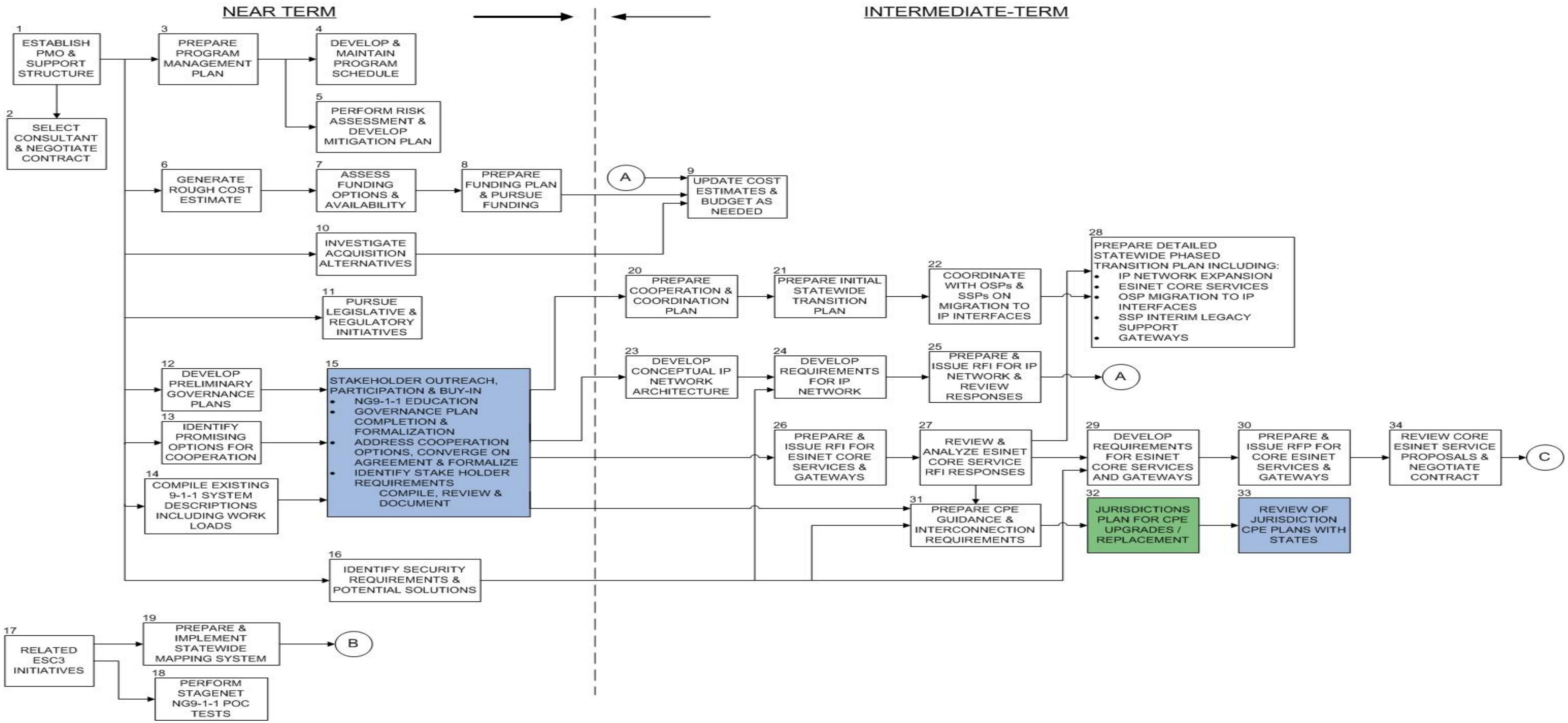
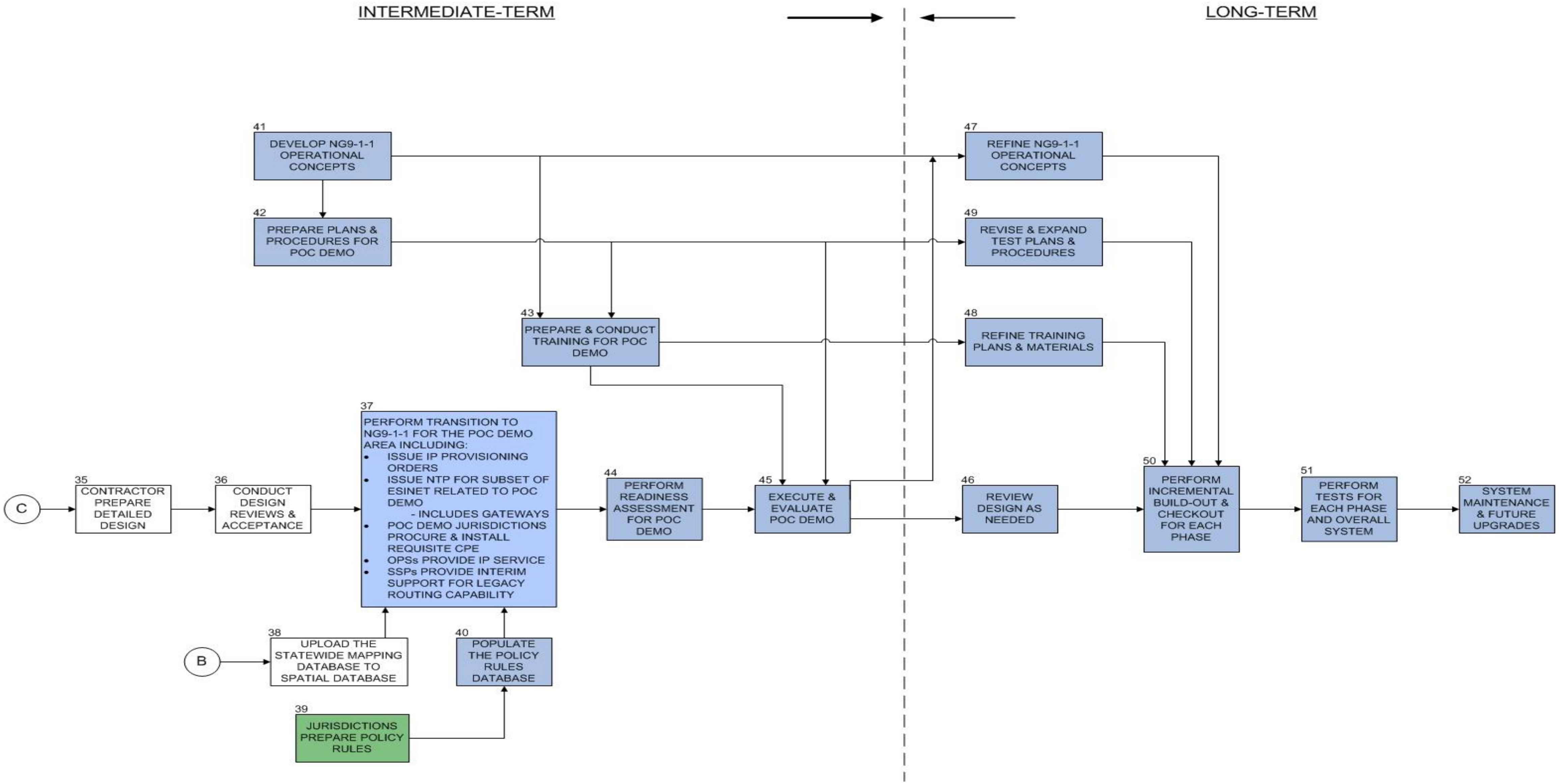
Appendix C Detailed Work Flow Diagrams




INTERMEDIATE-TERM
LONG-TERM
41
DEVELOP NG9-1-1 OPERATIONAL CONCEPTS
42
PREPARE PLANS & PROCEDURES FOR POC DEMO
43
PREPARE & CONDUCT TRAINING FOR POC DEMO
47
REFINE NG9-1-1 OPERATIONAL CONCEPTS
49
REVISE & EXPAND TEST PLANS & PROCEDURES
48
REFINE TRAINING PLANS & MATERIALS
37
PERFORM TRANSITION TO NG9-1-1 FOR THE POC DEMO AREA INCLUDING:
• ISSUE IP PROVISIONING ORDERS
• ISSUE NTP FOR SUBSET OF ESINET RELATED TO POC DEMO
- INCLUDES GATEWAYS
• POC DEMO JURISDICTIONS PROCURE & INSTALL REQUISITE CPE
• OPSs PROVIDE IP SERVICE
• SSPs PROVIDE INTERIM SUPPORT FOR LEGACY ROUTING CAPABILITY
C
35
CONTRACTOR PREPARE DETAILED DESIGN
36
CONDUCT DESIGN REVIEWS & ACCEPTANCE
44
PERFORM READINESS ASSESSMENT FOR POC DEMO
45
EXECUTE & EVALUATE POC DEMO
46
REVIEW DESIGN AS NEEDED
50
PERFORM INCREMENTAL BUILD-OUT & CHECKOUT FOR EACH PHASE
51
PERFORM TESTS FOR EACH PHASE AND OVERALL SYSTEM
52
SYSTEM MAINTENANCE & FUTURE UPGRADES
B
38
UPLOAD THE STATEWIDE MAPPING DATABASE TO SPATIAL DATABASE
40
POPULATE THE POLICY RULES DATABASE
39
JURISDICTIONS PREPARE POLICY RULES

Appendix D Technical Text for Detailed Flow Diagram Tasks

This appendix provides an explanation of the activities corresponding to each of the blocks in the Detailed Flow Diagrams found in the Appendix C pocket. There is a one-to-one mapping between the numbers here and in the flow diagram.

The blocks in the Detailed Flow Diagrams are color coded as follows:

- Primarily State responsibility – no color background,
- State and local joint responsibility – light blue background, and
- Primarily local responsibility – light green background.

Please note that not all of the activities listed here are found in the Top-Level Diagram because of task consolidation and omission in that simplified presentation.

Following are descriptions of the tasks in the Detailed Flow Diagrams:

1. **Establish PMO and Support Organization**
   Select and appoint a well-qualified individual willing to commit to a long-term association with the project as program manager. Strong familiarity with 9-1-1 systems and capabilities in North Dakota is critical to the success of the project. The selected program manager will work with specified appropriate organizations (e.g., ESC3, ITD, and NDACo) to define the necessary support organization and recruit members. The organization structure and membership may be refined during preparation of the Program Management Plan.
2. **Select Consultant and Negotiate Contract**
   Select a consultant with strong NG9-1-1 qualifications and negotiate a contract to cover the duration of the project. At this time, the number of well qualified consultants is limited. The consultant's team should include one or more individuals with Program Management Institute (PMI) certification.
3. **Prepare Program Management Plan**
   Produce a document patterned after the PMI Project Management Body of Knowledge (PMBOK). Topics for possible inclusion are project organization, management processes, technical processes, work packages, schedules, budget, success criteria, test strategy, and deployment plan. Some of the material in the plan (e.g., schedules, budget, and risk mitigation) will be preliminary or top-level in nature and further developed in separate tasks. Revise and expand the Program

Management Plan as driven by further analyses and as additional relevant information is acquired or developed.

4. **Develop and Maintain Program Schedule**
   Prepare the schedule for various project tasks and activities, taking into account the interaction and sequencing of functions. Update as additional information becomes available such as from preparation of the detailed transition plan and interaction with the service providers and vendors.
5. **Perform Risk Assessment and Develop Mitigation Plan**
   This consists of risk identification, analysis, monitoring, and control. Common program risks are schedule, funding, cost control, and performance. Mitigation includes identification of preventative measures, backstops, and alternatives.
6. **Generate Rough Cost Estimates**
   This can be based on an update of the cost estimates that appear in the Next Generation 9-1-1 Planning Report prepared for North Dakota in 2008 (Reference 16). Data provided by the update for 2013 of the Status Report on Emergency Services Communications for the legislature in 2010 (Reference 17) and the STAGEnet POC Tests are among possible resources.
7. **Assess Funding Options and Availability**
   Continue the identification and consideration of potential funding sources. The obvious possibilities include federal grants, fees on wired and wireless telephone access, and appropriations by the State legislature. The June 2011 NENA Next Generation 9-1-1 Transition Policy Implementation Handbook Application of the Implementation Checklist (Reference 8) provides a number of funding recommendations in Issue Number Two.
8. **Prepare Funding Plan and Pursue Funding**
   Based on realistic assessment of the availability of funding from the options identified in the previous step, construct a funding plan and build a campaign to secure the needed resources.
9. **Update Cost Estimates and Budget as Needed**
   Revise cost estimates as better data becomes available, such as through cooperation plans, detailed transition plans and responses to RFIs and RFPs.
10. **Investigate Acquisition Alternatives**
    Alternatives include State-owned, managed (or hosted) services, and leased facilities. Different choices are possible (or even likely) for major

subsystems. Tradeoffs include up-front vs. recurring costs, level of control, and responsibility for on-call maintenance services.

11. **Pursue Legislative and Regulatory Initiatives**
    Review rules and regulations that may impact the implementation of NG9-1-1 including regulations specific to legacy technology, limits on the sharing of data among public safety agencies, liability, and eligible use of 9-1-1 funds. Pursue legislative and regulatory changes, as needed.
12. **Develop Preliminary Governance Plans**
    In preparation for shareholder discussions, identify key topics related to governance as talking points. The governance model will designate those responsible for comprehensive statewide coordination. Likely candidates are the ESC3 and the State's NG9-1-1 Program Manager. Widespread stakeholder participation in planning will foster the development of further working relationships among 9-1-1 community members. Support and incentives for planning and implementation of shared resources is vital.
13. **Identify Promising Options for Cooperation**
    In preparation for shareholder discussions, identify promising options for cooperation and/or resource sharing among PSAPs/jurisdictions. Some movement is already seen in North Dakota with examples such as the Lake Region PSAPs and the State Radio. The possibilities may already be known to the State's NG9-1-1 planners.
14. **Compile Existing 9-1-1 System Descriptions Including Workloads**
    Gather information on existing 9-1-1 systems as a basis for planning the transition to NG9-1-1. Should include call for service loading and identification of shared resources. Much or all of this is being acquired via the update to the "911 PSAP Operation Survey" being updated to support preparation of the Emergency Services Communications Status Report for the 2013 legislature session.
15. **Stakeholder Outreach, Participation, and Buy-In**
    Nothing is more crucial to the success of the project than full participation and buy-in by the stakeholders. Profitable outreach sessions are supported by the development of talking materials for governance plans and options for cooperation. The major objective is agreement and acceptance of these governance and cooperation concepts. Collection and review of stakeholder requirements is also an objective. The useful starting point for the outreach is tutorial material on NG9-1-1.
    Effective policy and procedures are essential to successful governance. Examples of topics to be included include shared resources, data management, interface definition and control, and interconnection

requirements. Ultimately, governance agreements (e.g., MOUs, contracts) must be accepted and implemented by the stakeholders.

16. **Identify Security Requirements and Solutions**
    The migration to IP-based networks for NG9-1-1 introduces new security vulnerabilities. Standard IP-network security policies, such as virus protection, firewalls, and encryption must be implemented. And, of course, physical security remains a necessity.
17. **Related Ongoing ESC3 Initiatives**
    These are the related activities that ESC3 has underway at the present time.
18. **Perform STAGEnet NG9-1-1 POC Tests**
    This is the current program to demonstrate the use of and IP-network to remote call-taking capability to alternative PSAPs.
19. **Prepare and Implement Statewide Common Mapping System**
    This is the effort underway to generate seamless statewide digital mapping. Accuracy and database layers are to be consistent with the requirements of NG9-1-1. It is currently scheduled for completion in June, 2015. The database is to be maintained current after that date.
20. **Prepare Cooperation and Coordination Plan**
    Based on stakeholder cooperation agreements develop a plan for the sharing of resources.
21. **Prepare Initial Statewide Transition Plan**
    Perform first cut at the phasing for the statewide incremental transition to NG9-1-1. Major inputs to this process are the cooperation agreements with the stakeholders and knowledge of existing 9-1-1 systems including need for equipment replacement.
22. **Coordinate with OSPs and SSPs**
    Plan and negotiate with originating service providers and system service providers on their schedule to support migration to i3 compatibility. Similarly, work with the SSPs on their interim support to legacy routing and databases.
23. **Develop Conceptual IP Network Architecture**
    Define the architecture for the IP network. The key issue here is whether a single statewide ESInet will support all public safety services or a hierarchical concept with regional ESInets tied to the primary network will be used. Major inputs to this process will be the coordination plans developed with the stakeholders and the pros and cons for a flat or hierarchical structure.
24. **Develop Requirements for IP Network**

Given the network conceptual architecture, requirements suitable for an RFI will be developed. Requirements are driven by the connectivity to be provided, the projected loading, and the needs of the ESInet core services.

25. Prepare and Issue RFI for IP Network and Assess Responses

Prepare a request for planning information from the Dakota Carrier Network (DCN) regarding availability of required connectivity, quality of service (QoS), and bandwidth for expansion of the STAGEnet. Provisioning cost data is also needed. Assess responses and incorporate salient information into planning.

26. Prepare and Issue RFI for ESInet Core Services

Prepare a Request for Information that allows the State to expand their ESInet Core Services (including supporting databases) knowledge base with corporate qualifications, solutions, implementation strategies, support, and pricing structure. Recommendations for alternative procurement strategies, if any, should be requested. Also needed is information on capabilities to support interim coexistence of NG9-1-1 and legacy systems during the phased deployment of NG9-1-1 capability. In addition to Core Services, the responder should provide information on the NG9-1-1 CPE that they offer or plan to offer.

27. Review and Analyze ESInet Core Service RFI Responses

Evaluate alternative solutions, implementation strategies, on-going support capabilities, corporate stability, and pricing structures. Determine what vendors should receive the RFP, when issued.

28. Prepare Detailed Statewide Phased Transition Plan

Build on the stakeholder outreach and RFI responses to generate a detailed plan for the phased transition from legacy to fully NG9-1-1 capability. Key components include IP network (STAGEnet) expansion, ESInet core services, OSP migration to ESInet interface compatibility, SSP interim support for legacy routing and database, and gateways. The proof of concept demonstration should be conducted in the first phase of the migration.

29. Develop Requirements for ESInet Core Services

Based on NENA specifications develop the requirements ESInet Core Services, including supporting databases.

30. Prepare RFP for Core ESInet Services and Gateways

Prepare and issue RFP for Core ESInet Services.

31. Prepare CPE Guidance and Interconnection Requirements

Document guidance for the procurement of NG9-1-1 compatible CPE by the jurisdictions. Considerable latitude should be afforded. Also, define the requirements for interconnection to the NG9-1-1 network.

32. Jurisdictions Plan for CPE Upgrade/Replacement

In accordance with NG9-1-1 specifications and guidance, the jurisdictions perform design and selection of vendor products for CPE upgrade or replacement.

33. Review of Jurisdiction Plans with State

State and jurisdictions jointly review plans for CPE upgrade and replacement for compatibility with the core ESInet design and interconnection requirements.

34. Review Core ESInet Service Proposals and Negotiate Contract

Review the proposal for technical merit and cost. Select the apparent winner and conduct negotiations.

35. Contractor Prepare Detailed Design

Building on the proposal, prepared a detailed design ESInet Core Services, Gateways, and related items.

36. Conduct Design Reviews and Acceptance

Present the detailed design to the State for their review and acceptance.

37. Perform Transition for the POC Demo

Perform the transition to NG9-1-1 for the area where the POC Demo will be included. This process includes IP network (STAGEnet) expansion, implementation of ESInet core services and gateways, OSP migration to ESInet interface compatibility, SSP interim support for legacy routing and database, and jurisdiction CPE installation.

38. Upload the Mapping Database into the Geospatial Database

Upload the statewide GIS mapping database to the Geospatial Database for use by the Location Validation Function (LVF) and Emergency Call Routing Function (ERCF). NENA is preparing step-by-step instructions for the uploading of geospatial layers/files to the Geospatial Database. Part of the process is synchronization of the legacy GIS data with the Master Street Address Guide (MSAG) and ALI databases (Reference NENA 77-501).

39. Jurisdictions Prepare Policy Routing

Jurisdictions specify how their call routing is to be done. The policy routing provides for the migration of legacy policies for alternate routing to NG9-1-1.

40. Populate the Policy Routing Database

Load the jurisdiction policy routing to the ESInet Core.

41. Develop NG9-1-1 Operational Concepts

Develop the operational concepts for use in the NG9-1-1 POC demo.

42. Prepare Plans and Procedures for the POC Demo

Develop detailed plans and test procedures for the NG9-1-1 demo.

43. Prepare and Conduct Training for the POC Demo

Develop the training plan, training materials, and conduct training for the personnel participating in the NG9-1-1 POC demo.

44. Perform Readiness Assessment for POC Demo

Perform checkout and preliminary testing to verify readiness for the POC demo.

45. Execute and Evaluate the POC Demo

In accordance with the test plans and procedures execute the POC demo. Evaluate results and identify changes/improvements to the NG9-1-1 implementation as needed.

46. Refine Design as Needed

Based on analysis of the POC Demo results, design changes should be implemented as needed.

47. Refine NG9-1-1 Operational Concepts

Based on the lessons learned from the POC demo, change/refine the NG9-1-1 operational concepts as necessary.

48. Refine Training Plans and Materials

Based on the lessons learned from the POC demo, change/refine the NG9-1-1 training plans and materials as appropriate.

49. Revise and Expand Test Plans and Procedures

Based on the lessons learned from the POC demo, revise the NG9-1-1 training plans and materials as appropriate for use in the implementation of the following phases.

50. Perform Incremental Build-out and Checkout for Each Phase

In accordance with the program schedule, perform implementation of the NG9-1-1 transitions for each succeeding phase. Perform preliminary checkout and operator training for each deployment phase.

51. Perform Test and Acceptance for Each Phase and Overall System

In accordance with the test plans and procedures execute the testing and evaluation for each successive phase. Resolve issues uncovered by the testing. The testing for each phase should include confirmation of interoperability with the rest of the State. The testing for the last phase provides the basis for overall system acceptance.

52. System Maintenance and Future Evolution

Responsible parties perform routine and on-call problem maintenance activities. Monitor NG9-1-1 evolution and plan future upgrades as appropriate.