EXHIBIT 14

ASSURE911

Next Generation 9-1-1 Design Plan

Developed by

Assure911.net, LLC

For

Counties of Southern Illinois

Emergency Telephone Services Boards

NG911, Inc.

ILLINOIS INSTITUTE OF TECHNOLOGY

NG-911, Inc.
Next Generation 911
Systems, Consulting, Engineering
IT's more than a number, it's a life!

clearwave communications

January 31, 2012

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1.0 EXECUTIVE SUMMARY

Sixteen Emergency Telephone System Boards (ETSBs) in southern Illinois have banded together for the purpose of implementing a Regional Next Generation 9-1-1 (NG9-1-1) system. For planning purposes, the Counties of Southern Illinois (CSI) are operating through inter-governmental agreements and by-laws as a not-for-profit 501(c) 3 organization.

The CSI ETSBs have been selected by the National Emergency Number Association (NENA) as an NG9-1-1 Pilot Project for North America. This group of ETSBs has been successful in getting legislation passed in Illinois to authorize the Commission to approve a one-year Pilot Project for NG9-1-1. The fifteen counties and one municipality have partnered with a broadband company in southern Illinois, Clearwave Communications, for IP infrastructure and for transport of the ETSBs' 9-1-1 traffic. Basically, the fifteen counties are moving from the Public Switched Telephone Network (PSTN) to an IP emergency services network owned, managed and operated by the ETSBs of southern Illinois. See Attachment 1 for a list of the CSI Board Members.

The fifteen counties and one municipality cover about one-fourth of the state of Illinois in territory. There are approximately 395,000 people living in the area which is adjacent to parts of Missouri, Kentucky, Indiana and the other counties within Illinois. This is an economically depressed rural area.

This document includes an overview of the proposed network and the key factors driving the decision to move to a standards-based NG9-1-1 solution and the Design Plan to achieve that goal.

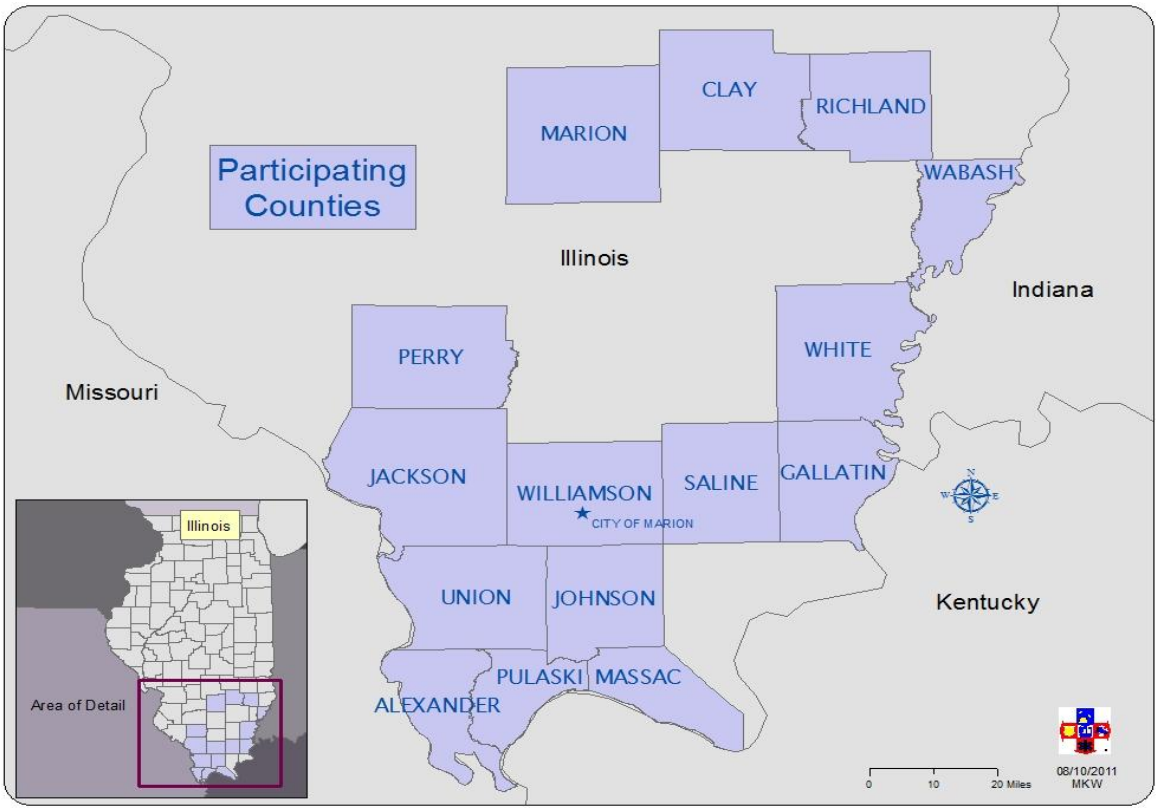
The CSI ETSBs look forward to gaining ICC approval to move forward with the Pilot Project immediately. A summary of the NG 9-1-1 Design Plan is as follows:

- The cooperation of the Access Carrier Service Providers is essential. Joint planning meetings have been held since June 8, 2011 to establish the relationships and to exchange data necessary to engineer the network. A separate Access Design Document has been developed; refer to Assure911.net-DG-CSI/NG911-002.
- The Plan will be implemented no earlier than 180 days from its filing with the ICC.
- Dual network access is required until after successful cutover of the ESInet.
- The CSI ETSBs plan to cut to live service after successful testing both at the Illinois Institute of Technology's Real Time Communications Laboratory (IIT RTCL) followed by full field testing in southern Illinois led by NG911, Inc.
- ICC approval triggers the migration of all services to the new, fully redundant architecture for service.
- The CSI ETSB Pilot Project will not exceed one (1) year in duration. The ICC will determine if the network remains operational after the Pilot Project is complete.

The design strategy assumes that the CSI ETSBs will finance, implement and maintain their NENA standards based NG9-1-1 Emergency Services Internet Protocol Network (ESInet.) Components of the ESInet will reside in two (2) diverse, fully redundant Data Centers over 50 miles apart in Harrisburg and Murphysboro, Illinois.

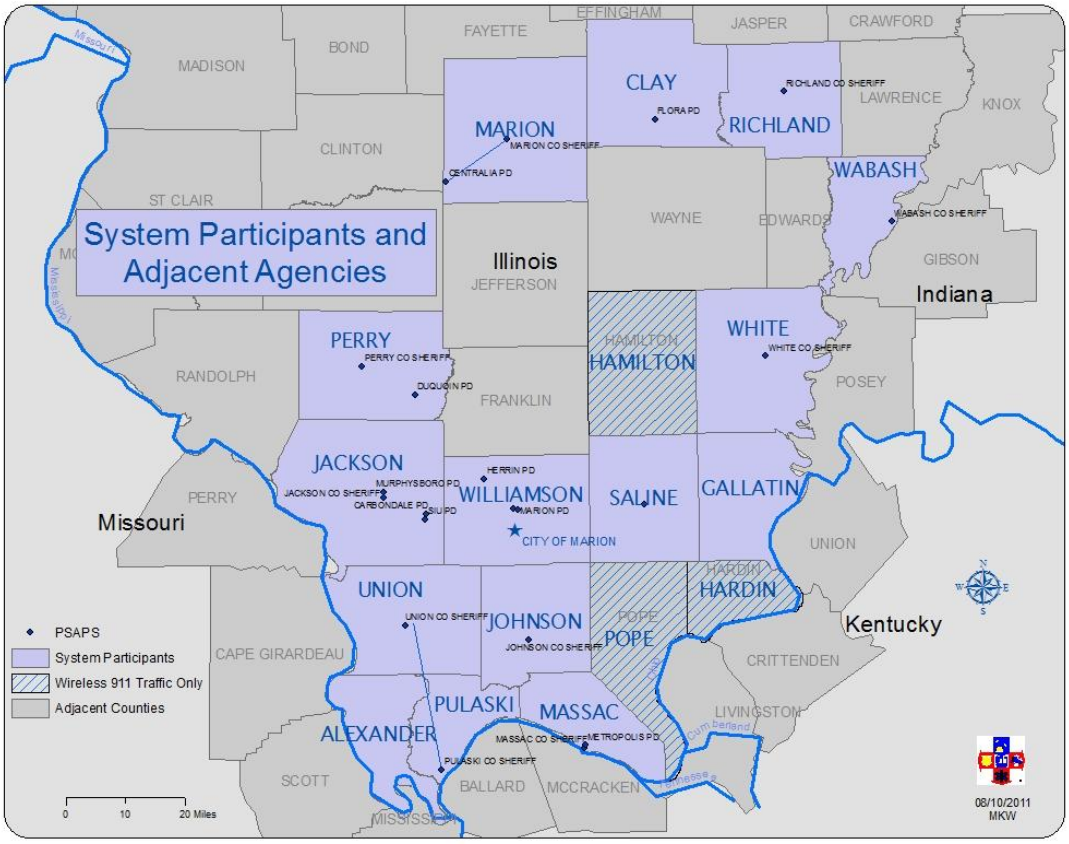
The network design is adaptable, scalable, will leverage the Clearwave Communications broadband fiber network solution, and utilize the NG911, Inc. provided Functional Elements (FEs) based on their contract awarded solution.

Figure 1.1 – Participating Counties of Southern Illinois Map



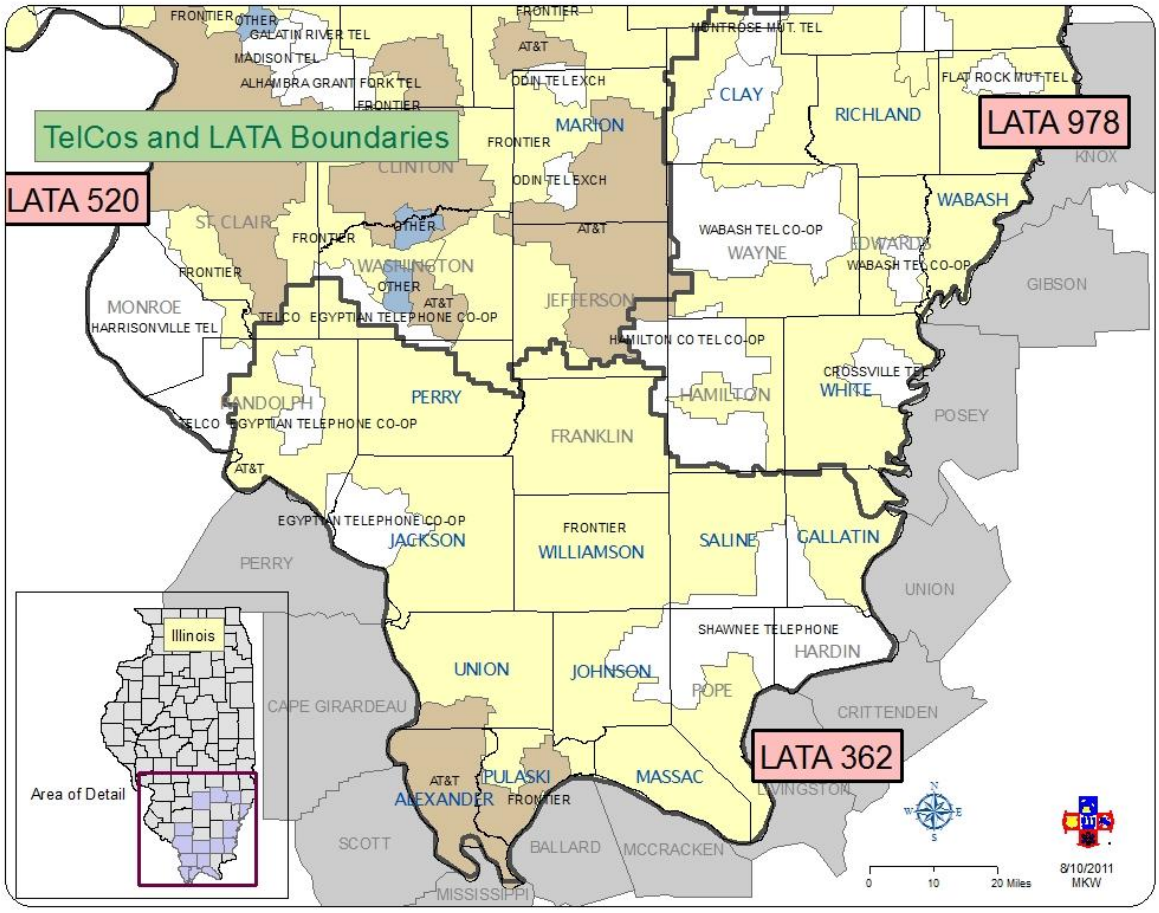
The Counties of Illinois (Plan Exhibit 1) include Alexander, Clay, Gallatin, Jackson, Johnson, Marion, Massac, Perry, Pulaski, Saline, Union, Richland, Wabash, White, and Williamson and the one municipality in the Plan, the City of Marion.

Figure 1.2 – Wireless Carriers



Wireless Carriers (Plan Exhibit 1) will be able to terminate their calls through the system into Hamilton, Hardin and Pope Counties. Where Access Carriers have cross boundary originating offices, the Design Plan allows for acceptance of the off-network boundary calls into the ESInet to be dynamically delivered to PSAPs in the surrounding counties by agreement and the use of Legacy PSAP Gateway (LPG) Extension Gateway EG modules of the ESInet. This will be transparent to the callers and the Public Safety agencies adjacent to the ESInet. The Design portion of the document shows how this will be accomplished through Routing and Database management.

Figure 1.3 - Map of Incumbent Exchange Carriers and the Regional Local Exchange Carriers



The Exchange Carriers who provide landline service in the CSI ETSB territory can be viewed on the Exchange Carrier map as shown in Figure 1.3. (Plan Exhibit 2) Key the map above: AT&T- tan; Frontier - yellow; Regional Local Exchange Carriers – white with labels; LATA – Local Access Transport Area – boundaries in bold black with LATA numbers in pink.

Meetings were held starting in June 2011 to inform the Carriers of the plan, and gain their cooperation and participation in the Planning, Engineering, Design, Provisioning, Implementation, Testing, Maintenance, Monitoring and Cutover processes. Meetings have included representatives from Wireline, Wireless, VoIP and CLEC Carriers. Data Exchange is but one step of the Carrier relationship. Data sharing facilitates:

1. Optimization of Physical and Logical Routes
2. Confirm Ordering Process
3. First Installation
4. Subsequent Orders Released, Circuits Installed, Tested, Accepted, Billed
5. Trial with IIT Lab Testing followed by CSI Field Testing resulting in Cutover Ready Transition
6. Documented results for the ICC

The major purpose of these meetings was to gather data necessary to complete the final network Design. This final Design uses traffic engineering information from the Access Carriers to size the trunks and facilities bringing call traffic to the ESInet based on engineering guidelines for Quality of Service parameters and P.01 Grade of Service. Refer to the Access Plan Assure911.net-DG-CSI/NG911-002 for details.

NENA released their ESInet Design for NG9-1-1 draft document *NENA 08-506 Version 1, August 16, 2011.* Where appropriate, references are made to the NENA text, diagrams and best practices. This CSI Project Design Plan was prepared ahead of the NENA Design document. The principles guiding the NENA work are included in this CSI Design Plan. All NENA References are listed in the reference section at the end of this document.

NENA: *"Future Path Plan Criteria for Technical Evolution"*

"In present and future applications of all technologies used for 9-1-1 call and data delivery, it is a requirement to maintain the same level or improve on the reliability and service characteristics inherent in present 9-1-1 system design.

New methods or solutions for current and future service needs and options should meet the criteria below. This inherently requires knowledge of current 9-1-1 system design factors and concepts, in order to evaluate new proposed methods or solutions against the Path Plan criteria.

Criteria to meet the Definition/Requirement:

1. *Reliability/dependability as governed by NENA's technical standards and other generally accepted base characteristics of E9-1-1 service.*
2. *Service parity for all potential 9-1-1 callers.*
3. *Least complicated system design that results in fewest components to achieve needs (simplicity, maintainable).*
4. *Maximum probabilities for call and data delivery with least cost approach.*
5. *Documented procedures, practices, and processes to ensure adequate implementation and ongoing maintenance for 9-1-1 systems.*

This basic technical policy is a guideline to focus technical development work on maintaining fundamental characteristics of E9-1-1 service by anyone providing equipment, software, or services."

The remaining sections of this Design Plan document provide the project overview, network design detail, assumptions and constraints, and the conclusion.

2.0 PROJECT OVERVIEW

2.1 Project Rationale

Over four years ago the CSI 16 ETSBs decided to undertake this project based on the following observations.

- Next Generation 9-1-1 was inevitable and was coming faster than people realized.
- Illinois does not have a State-wide 9-1-1 system; Regional solutions are the only option.
- There are deficiencies in the current system such as lack of redundancy, backup and the inability to deal with available and emerging technologies.
- None of the southern Illinois ETSBs could afford to do NG 9-1-1 individually and even with a Regional approach, the best chance for federal grant funding was to get ahead of the curve.
- Costs for the forty plus (40+) year old legacy PSTN technology have been mounting.
- Each ETSB must fully fund and manage their own solution and some counties in the Region have a low population so they cannot afford even the basic E9-1-1 solutions.
- The Counties of Southern Illinois decided that through a joint approach, the ETSBs could improve public safety.

2.2 Project Outline

Our project plan is to equip two (2) redundant Data Centers connected to 21 PSAPs with a combined 47 answering positions for fifteen (15) counties and one (1) major municipality. Details are included in the Design Plan section 3.0 of this document.

2.3 RFP Overview

Years of research and multiple Requests for Proposal (RFP) processes resulted in a contract with NG-911, Inc. Michael Ramsey, President and CTO assembled solutions from Solacom, Bullberry Mapping, Datamaster, Highergrround, Acme Packet and Assure911.net (Assure911).

Assure911 has been contracted to Design the Emergency Services Internet network (ESInet) and prepare the Test Plan. In addition to the comprehensive Test Plan delivered in a separate document, refer to the Test Plan Document, Assure911-NG911CSI-STP-001, Assure911 has partnered with the Illinois Institute of Technology Real Time Communications Laboratory (IIT RTCL) to conduct specific testing of the Pilot network. The IIT RTCL will conduct load, security, and failover lab tests. NG-911, Inc. will manage the full Test Plan, develop a Cutover Plan and manage deployment. Acme Packet is providing a robust redundant system of Session Border Controllers (SBCs) for security. Clearwave Communication is using $43 million in federal and state grant funds to install their diverse fiber network which is the backbone for the ESInet. SIU-Carbondale has been contracted to assist in preparation of the Geographic Information System (GIS) Data according to NENA standards. The RFP and contracts are being provided as additional exhibits to this filing. See the list of references at the end of this document to a list of additional exhibits. The RFP is Exhibit 13.

2.4 Standards

The NENA standards have been evolving. The Project and the Project Plan is based on NENA i3 standards, "*Detailed Functional and Interface Standards for the NENA i3 Solution Version 1.0," Standard number: 08-003 v1*". On June 16, 2011 NENA announced that its Executive Board formally approved an end-state architectural vision for Next Generation 9-1-1; along with a number of directives for additional Technical Development review. The document, commonly known as "i3," lays out a detailed architecture for key elements of NG9-1-1 systems, describing how networks and devices will eventually work together to enable voice, text, picture, and data exchange between citizens and first responders." For additional information and a glossary of standard terms see the NENA Glossary, which are listed in the References at the end of this document.

2.5 Access Carriers

CSI's ETSB has been actively hosting meetings to provide education through presentations and engage in interactive dialog with the Access Carriers, Wireline, Wireless, VoIP and CLEC. This Design Plan addresses traffic after terminating 9-1-1 traffic to the two (2) diverse Data Centers, and reflects regulatory, technical and operational requirements, and addresses 9-1-1 traffic from the originating service providers to the CSI ESInet Data Centers. Refer to the Access Plan, Assure911.net-DG-CSI/NG911-001.

2.6 Service Quality and Benefits

The Commission holds the CSI ETSBs responsible to ensure that the public will have at least the same quality of service as is now being provided by Frontier, AT&T and ICTC in their Selective Routers. It is the CSI ETSBs' intention to provide the citizens with a significantly higher level of service than they enjoy today. The goal is to respond more efficiently and more effectively with emergency services within CSI's communities. Lives will be saved and costs will be manageable under the new architecture. Future Benefits are covered in a separate document list as an additional exhibit in the references section at the end of this document.

2.7 Pilot Project Lessons

The CSI ETSBs realize there are many lessons to be learned. Lessons learned are being shared with NENA, Illinois NENA, the FCC staff, and the Illinois ETSB managers. Our plans are an exemplary solution which will be a part of an organic network of ESInets into the future, connecting the CSI ETSBs to other states and other ESInets within Illinois seamlessly and efficiently.

2.8 Design Plan

This Design Plan encompasses the work delivered by Assure911 to NG911, Inc. in support of an i3 NENA standards-based, IP-Based, Next Generation 9-1-1 Communication System for the ETSBs of the CSI. In addition, Assure911 will provide proactive patented monitoring software and services, utilizing years of expertise in the design and development of networks and network monitoring, and services capabilities in the provision of E9-1-1 services. Assure911 serves as a subcontractor to NG911, Inc. and all deliverables are provided through NG911, Inc.

2.9 RFP Highlights

This document defines the Network Design as described in the *"REQUEST FOR PROPOSAL FOR AN IP-BASED NEXT GENERATION 9-1-1 COMMUNICATION SYSTEM for Counties of Southern Illinois NG9-1-1 Association,"* submitted on September 21, 2010 by: Ken Smith – Chairman, 300 N. Park Ave., Herrin, Illinois 62948, 618-988-6911, document dated August 2, 2010. The CSI RFP is in Exhibit 13.

The Request for Proposal document specifies the following: *"We will be providing our own ESInet to connect the originating service providers, PSAPs and data centers. We are seeking bids on the hardware, software and services needed to run a next generation system on that network. We will provide our own CAD systems. We are seeking map display software but not requesting GIS data services."*

CSI stated Project Goals and Objectives include requirements that contributed to the Design and Test Plans:

- Counties of Southern Illinois NG9-1-1 Association (hereinafter referred to as CSI) is soliciting proposals from qualified and experienced organizations that can provide an IP-Based Next Generation 9-1-1, NENA i3 aligned Communication System.
- CSI desires to upgrade the aging analog 9-1-1 telephony system with an IP-based solution that meets NENA NG 9-1-1 standards, including the emerging NENA IP-Capable PSAP standards.
- The desired results will be increased functionality, redundancy, diversity, and scalability.
- The system must be capable of evolving with NG9-1-1 without requiring additional hardware upgrades and replacements.
- This system will be used to process, answer and direct all "calls" placed to 9-1-1.
- The system must support a minimum of two (2) geographically diverse, fully redundant data/system hosting centers. Our plan is to locate one at the Saline County Sheriff's Department in Harrisburg, IL and the second at the Jackson County Sheriff's Department in Murphysboro, IL.
- The system should not require a manual switchover and should have automatic failover capability.
- CSI prefers Common Off-the-Shelf (COTS) equipment rather than proprietary hardware to enable CSI to lower initial infrastructure cost as well as future hardware replacement costs, and to eliminate costly hardware maintenance contracts.
- Vendors must provide the option for CSI to purchase some, if not most of its own hardware per specifications supplied by the vendor.
- The solution should allow for Information Technology (IT) personnel from CSI to be trained to provide primary on-site Tier 1 support of the proposed system.
- The solution proposed must be capable of receiving 9-1-1 calls in a native Session Initiation Protocol (SIP) format upon installation. This would include gateways for legacy wireline, wireless and VOIP calls.
- Furthermore, the solution proposed must be capable of expansion to multiple additional counties/PSAPs by simply adding additional software and hardware.
- Systems requiring the replacement of components to expand will not be considered.

- As an option, we would also consider the additional cost of having administrative calls received in a native SIP format.

- The system must be able to integrate with a local ALI database management system as well as an integrated Mapped-ALI display.

- It is the desire of CSI to have a GIS-centric system that will be able to spatially route calls and the capability to use the GIS database in the future as the primary 9-1-1 validation database.

- CSI recognizes that a robust NG9-1-1 communications system capable of accepting all calls for emergency services in an efficient and accurate manner is the primary responsibility of CSI and its members. Reduced system cost, enhanced call taker capability, remote diagnostics and system architecture designed to accept future types of calls are some of the important objectives of this project.

- CSI will be purchasing GIS software both for the PSAPs and the data centers as part of this RFP; however, we have GIS staff that will be maintaining the data layers. We have contracted with SIU-Carbondale, our local university, to provide GIS students to scrub our existing data and put everything in NENA standard formats. Individual 9-1-1 Coordinators will provide updates to the road, structure, corporate boundary and jurisdictional layers.

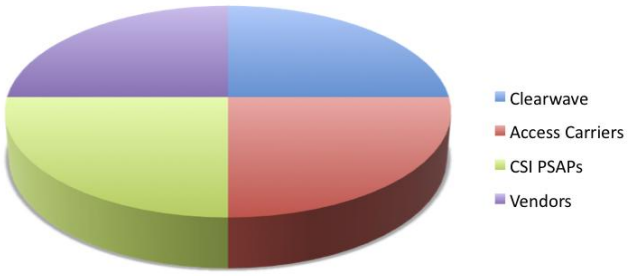
- We will synchronize the GIS data with the MSAG and ALI databases.

- All CSI PSAPs are currently taking phase II wireless calls or will be by the time this project commences.

2.10 Design Sources

The NENA i3 Standards provide an important resource for the NG9-1-1 Project for the Counties of Southern Illinois project, as does the CSI RFP. The Design further relies on access to data from four (4) resources: (1) Clearwave Communications who was awarded the grant to build the fiber network from the CSI Data Centers to the PSAPs, (2) CSI's Board of Directors who work for the sixteen (16) ETSBs who fund and manage the 21 PSAPs on the CSI network today, (3) the Access Carriers who bring all of the emergency services 9-1-1 calls to the 9-1-1 Emergency network today and will continue to do so into the future on the new architecture, and (4) the RFP contract-awarded vendors who are providing the Functional Elements (FEs) installed on the ESInet.

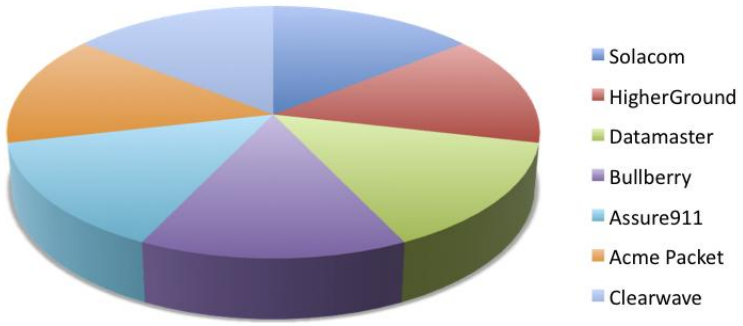
Figure 2.1 – Design Plan Sources, utilized by Assure911



2.11 CSI Vendors

Vendors who are providing Functional Elements of the NG 9-1-1 Architecture and other components of the ESInet and Next Generation 9-1-1 System are: Solacom, Higherground, Datamaster911, Bullberry, Assure911, Acme Packet and Clearwave. The System Integrator and prime contractor for the Project is NG911, Inc. NG911, Inc. will maintain an ongoing relationship with CSI under their contract for the 10 years at a minimum. Refer to the Contract Plan Exhibit 17.

Figure 2.2 – CSI Vendors, managed by NG911, Inc.



2.12 User Benefits

The primary benefits are location-based routing for increased accuracy, IP-based architecture for leverage of other public safety services the end-user may provide long term cost savings over PSTN 9-1-1 systems for better use of surcharge revenue, and dynamic back up and transfer capabilities which are more redundant, resilient and provide for better public safety.

User Benefits during Pilot include:

- Policy based alternate routing with new options.
- Callers can dial 9-1-1 in their own local jurisdiction or on behalf of someone in need of emergency services in other locations
- Capabilities for persons with disability as required by law.

Future User Benefits after the Pilot Plan are included in the CSI Narrative listed in the references at the end of this document.

2.13 Public Safety Agency Benefits

Public safety agencies will share the costs of the components of the next generation 9-1-1 network. The larger the pool of agencies in the network, the lower the unit cost for commonly shared equipment in the two (2) diverse Data Centers. The PSAPs will have less onsite equipment to own, operate and manage and to eventually become obsolete. Information technology resources will become part of a shared resource pool. Expertise will be shared for the good of the network in terms of deployment.

With a more reliable and diverse network, the agencies will be able to support each other in new and unique ways, leveraging the language skills in one center for example, and supporting each other during peak loads or in times of major trauma in a local area.

- Time-of-day and day-of-week options for call handling can be maximized across the network.
- Training and business processes can be standardized.
- Common measurements can be used to manage workload and quality of service.
- Reports can be developed once and used by each of the county agencies which will lighten the work load and create efficiencies. This includes day-to-day operational reports, engineering reports and reports required by Commissions.
- In the worst case scenario, if the whole CSI ESInet area was facing a devastating situation such as an earthquake or flood of a severe magnitude, calls could be routed and handled by other ESInet PSAPs.
- CSI has decided to leave their existing PSAPs in operation in their locations using the same personnel, seating and user interfaces. The Intergovernmental Agreements for back up PSAPs that exist today will be honored. New Agreements will be created as required. In the event of a challenge to a primary and back up PSAP, the routing of the ESInet could allow any other PSAP on the network to pick up the slack and all of the pertinent call origination information will flow to the new location.

3.0 NETWORK DESIGN DESCRIPTION

This Design Plan is submitted for approval by the ICC. The Design reflects the NG9-1-1 application leveraging the Clearwave network infrastructure. Data from all participants was essential to engineer the ESInet solution. The CSI ESInet network will be implemented in Phases. The NENA Standards are defined. Changes to the network external to the CSI ESInet and to the underlying network infrastructure will be occurring naturally. This Design reflects the current architecture and standards. Changes in the implementation will occur and be managed proactively by the CSI ETSBs on an ongoing basis.

The Network Design reflects the new IP-Based Next Generation 9-1-1 Communication System. This design documentation includes a detailed description, with technical specifications of network facilities applicable to the CSI network to provide 9-1-1 network and database services.

A separate Access Design Document has been developed; refer to Assure911.net-DG-CSI/NG911-002.

The following sections of this document describe how the Design of the NG9-1-1 Network will provide safe and continuously reliable service for the emergency services needs for the community and Public Safety agencies.

3.1 Network Design

The CSI Network Design will meet the State of Illinois requirements and is scalable and adaptable to the NG9-1-1 standards. The long term goal is to provide emergency services capabilities from anywhere, anytime, over any emergency services capable access device. The Network Design is geared to migrate 9-1-1 services from the traditional telephony standards and environment to an IP standards based environment which allows for expansion for access to emergency services to the public in a way that is not possible with today's 9-1-1 network architecture.

CSI's network partners in this venture are Clearwave Communications, the broadband network provider, and NG911, Inc., the integrator and provider of the array of functional elements that comprise the Next Generation system. NG911, Inc. has a suite of products from vendors who conform to the NENA NG9-1-1 i3 standards. Design, test planning, and monitoring support is provided from Assure911, along with further testing support from the Illinois Institute of Technology RTCL. A separate Test Plan Document has been developed; refer to Assure911-NG911CSI-STP-001.

3.2 Network Infrastructure

3.2.1 Counties of Southern Illinois and Clearwave

Clearwave, the broadband network provider has provided a portion of funding from their NTIA grant for the 16 ETSBs to begin work on the NG9-1-1 Project. The backbone network for the ESInet will ride on the Clearwave Fiber network. The phases of the Clearwave Project have a direct impact on the schedule for the NG9-1-1 project schedule.

Details of when the Data Centers and PSAPs will reside on the Clearwave network are included in this section of the Design Plan.

In August 2010, Clearwave Communications, as part of the Illinois Broadband Opportunity Partnership

(IBOP), received one of only a handful of grants awarded by the National Telecommunications and Information Administration's (NTIA's) Broadband Technology Opportunities Program (BTOP) to develop rural broadband. Headquartered in Harrisburg, Illinois, Clearwave has been providing Southern Illinois with voice and data services since 1996.

With the help of these federal and state grants, as well as private funding, Clearwave is building a much needed middle-mile infrastructure to make broadband accessible in the rural areas of southern Illinois, as well as directly connecting colleges, K-12 schools, libraries, health care providers and public safety entities. By August 2013, the Illinois Broadband Opportunity Partnership-Southern will have laid more than 740 miles of fiber optic cable through 23 counties, and connected 232 community anchor institutions to the next generation network

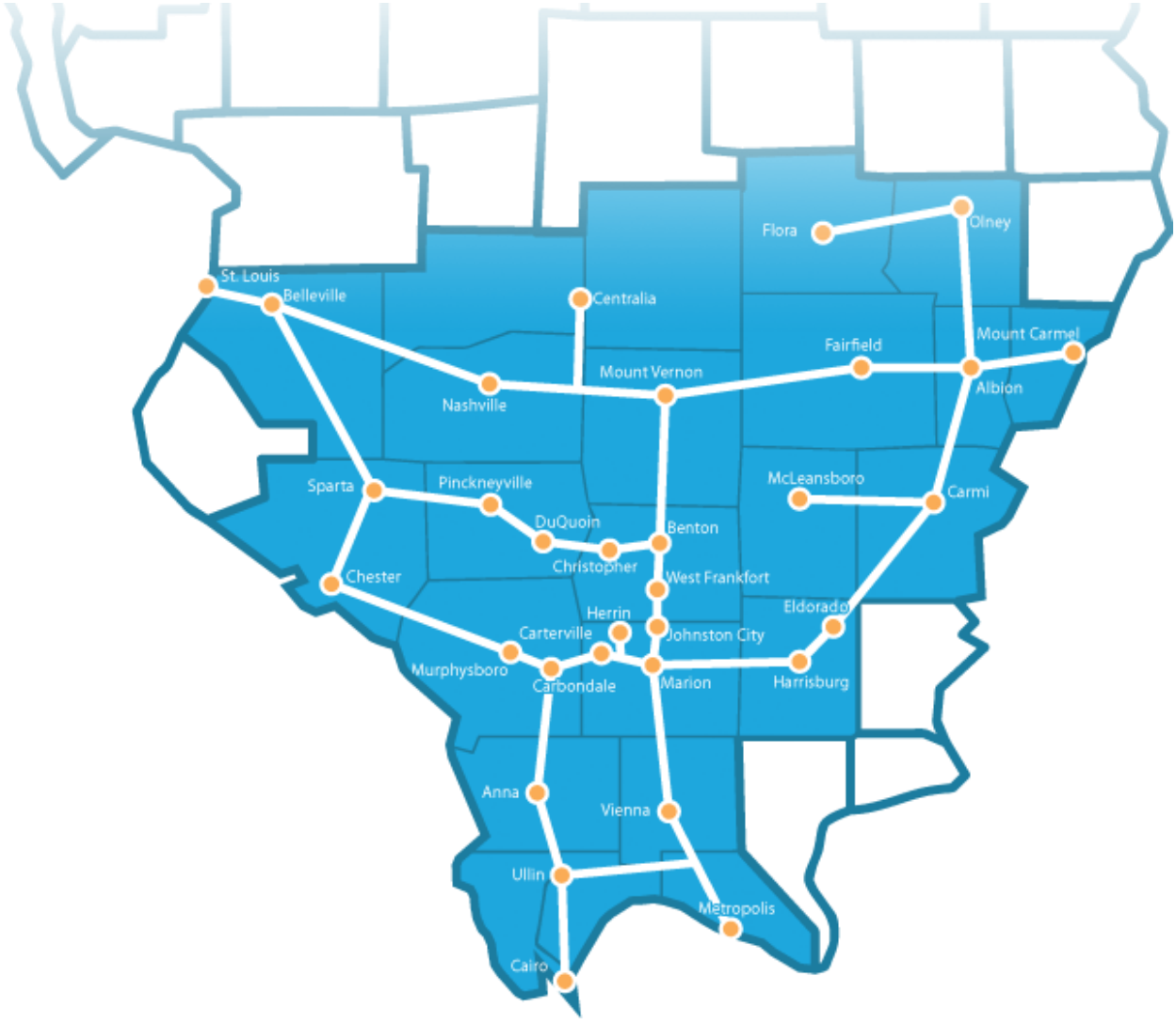


Figure 3.1 – Clearwave Fiber Map

Clearwave is a member of JULIE, Inc. (Joint Utility Locating Information for Excavators), a not-for-profit corporation that provides homeowners and professional excavators with one place to call for safe digging. The Clearwave network supports the CSI NG 9-1-1 ESInet.

3.3 CSI Design Strategy

This section describes the function of each of these major parts of the ESInet and their interworking. The CSI ETSBs will implement and manage the i3 NG9-1-1 ESInet and their functional elements in 2 CSI Data Centers over 50 miles apart – Harrisburg and Murphysboro. The Network Design is flexible and scalable; it utilizes the Clearwave Communications Broadband Fiber Network Solution, and utilizes the NG911, Inc. provided equipment which was designed and manufactured to meet the NENA i3 Standards.

The initially targeted 15 Counties include: Alexander, Clay, Gallatin, Jackson, Johnson, Marion, Massac, Perry, Pulaski, Saline, Union, Richland, Wabash, White, Williamson, and 1 City, Marion, in Williamson County. Refer to Figure 1.1.

The ESInet consists of 9-1-1 service from Access Providers to the CSI Data Centers, which is described in the Access Plan, Assure911.net-DG-CSI/NG911-002, as well as from the CSI Data Centers to the PSAPs.

This section describes the design strategy of the latter portion, from the Data Centers to the PSAPs, in two parts:

- The PSAPs and their associated Call Taker positions,
- The matched, duplicated Data Centers which are at the heart of the ESInet

3.3.1 ESInet – PSAPs

There are currently 21 PSAPs in the CSI project. Connectivity to the pilot project will take place in a phased approach. Figure 3.2 shows phases at which the initial PSAPs will be connected to the CSI ESInet.

The Clearwave network build out for fiber is dependent on Right of Way and Construction schedules. The maps below reflect the project roll out and PSAP connectivity anticipated at the time of the ICC Pilot application. Where Fiber is shown, the connection for Fiber will be to the telco hub Point of Presence (POP) where Clearwave is co-located. From the Clearwave POPs into the CSI PSAPs, the connections will be made via copper into the Data Centers and the PSAP Locations. In some cases copper facilities will be used to connect from the Clearwave Fiber to the PSAPs. The charts and diagrams reflect the difference between Fiber and Copper network connectivity. In all cases Clearwave will provision the ESInet infrastructure for CSI. CSI will directly contract with Clearwave on all matters related to planning and engineering and day to day management of the underlying network infrastructure. Clearwave will seek out and implement the most cost effective and reliable alternate Fiber and Copper underlying network options for CSI.

The charts below that show the nearest wire centers are used for illustrative purposes. Clearwave is going to co-locate with other telco carriers as their business model dictates and Public Safety is one client among many on their underlying network.

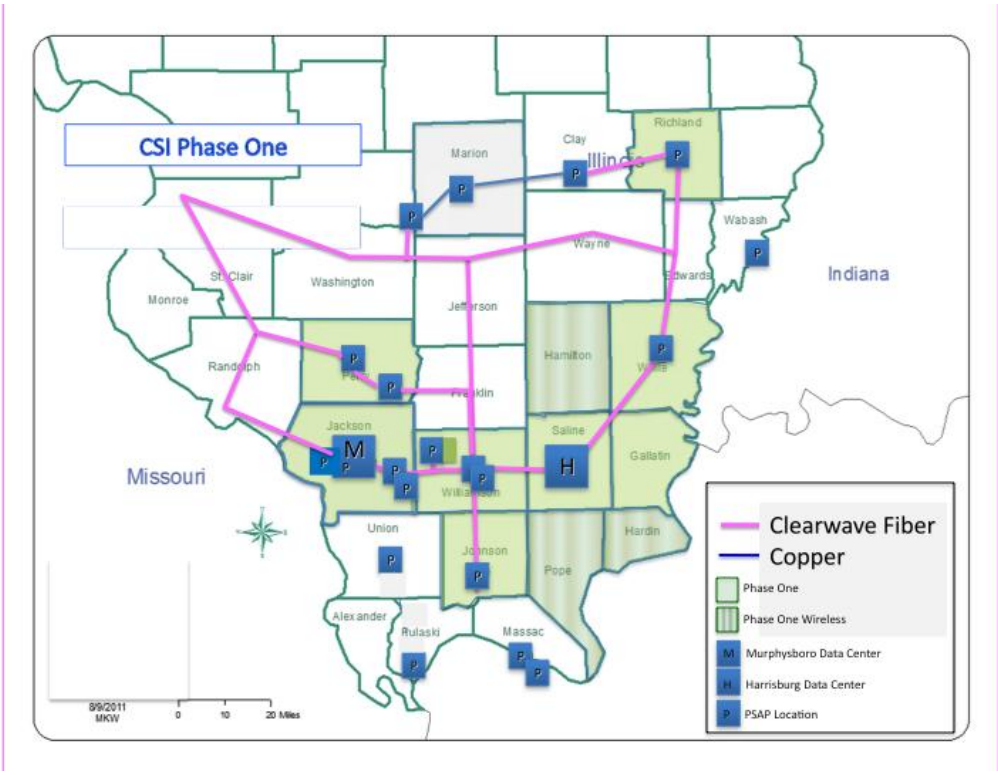


Figure 3.2 – Phase One Map

	PSAPs Phase One Connectivity at Pilot Cutover
1	Saline County Sheriff (Data Center Harrisburg Location)
2	Carbondale Police Department
3	Southern Illinois Police Department
4	Williamson County Sheriff
5	Marion Police Department
6	Herrin Police Department
7	Jackson County Sheriff (Data Center Murphysboro Location)
8	Murphysboro Police Department
9	White County Sheriff
10	Richland County Sheriff/Olney Police Department
11	Du Quoin Police Department
12	Perry County Sheriff
13	Johnson County Sheriff
14	Salem Police Department
15	Flora Police Department
16	Centralia Police Department

Figure 3.3 – Phase One PSAP Locations

	PSAP	Address	Nearest Wire Center CLLI	Nearest Wire Center Address	Fiber vs. T1
1	Saline County Sheriff (Data Center Harrisburg Location)	1 N Main St., Harrisburg	HRBGILXE	24 W CHURCH ST, HARRISBURG, IL 62946	Clearwave Fiber
2	Carbondale Police Department	501 S Washington St., Carbondale	CRDLILXE	208 W MONROE ST, CARBONDALE, IL 62901	Clearwave Fiber
3	Southern Illinois Police Department	701 S Washington St., Carbondale	CRDLILX	208 W MONROE ST, CARBONDALE, IL 62901	Clearwave Fiber
4	Williamson County Sheriff	300 W Jefferson St., Marion	MARNILXE	208 W UNION ST, MARION, IL 62959	Clearwave Fiber
5	Marion Police Department	100 S Madison St., Marion	MARNILXE	208 W UNION ST, MARION, IL 62959	Clearwave Fiber
6	Herrin Police Department	321 N 14th St., Herrin	HRRNILXE	401 N 14TH ST, HERRIN, IL 62948	Clearwave Fiber
7	Jackson County Sheriff (Data Center Murphysboro Location)	1001 Mulberry St., Murphysboro	MRBOILXE	1428 WALNUT ST, MURPHYSBORO, IL 62966	Clearwave Fiber
8	Murphysboro Police Department	211 N 11th St., Murphysboro	MRBOILXE	1428 WALNUT ST, MURPHYSBORO, IL 62966	Clearwave Fiber
9	White County Sheriff	108 N Main Cross, Carmi	CARMILXE	200 W CHERRY ST, CARMI, IL 62821	Clearwave Fiber
10	Richland County Sheriff/Olney Police Department	300 S. Whittle Ave., Olney	OLNYILXE	225 E CHESTNUT ST, OLNEY, IL 62450	Clearwave Fiber
11	Du Quoin Police Department	304 E Poplar St., Du Quoin	DUQNILXE	201 E PARK ST, DU QUOIN, IL 62832	Clearwave Fiber
12	Perry County Sheriff	12 E Water St., Pinckneyville	PYVLILXE	205 W RANDOLPH ST, PINCKNEYVILLE, IL 62274	Clearwave Fiber
13	Johnson County Sheriff	115 N 5th St., Vienna	VINNILXE	302 GREEN ST, VIENNA, IL 62995	Clearwave Fiber
14	Salem Police Department	201 S Rotan, Salem	CENLILCE	210 N LOCUST ST, CENTRALIA, IL 62801	Copper (T1)
15	Flora Police Department	123 N Locust St., Flora	FLORILXE	T321 N MAIN ST, FLORA, IL 62839	Clearwave Fiber
16	Centralia Police Department	222 S Poplar St., Centralia	CENLILCE	210 N LOCUST ST, CENTRALIA, IL 62801	Clearwave Fiber

Figure 3.4 – Phase One PSAP Location Detail

Figure 3.3 shows the Sixteen (16) of the 21 PSAPs that will be connected by Clearwave during phase one. Fifteen (15) of the 16 PSAPs will be rolled over to the Clearwave Fiber Network by August 2012, and one PSAP will connect via copper facilities. CSI will obtain copies of the circuit order layout records for the complete network architecture for provisioning, cutover and maintenance purposes.

The purpose of the nearest Wire Center information is to assist the Access Carriers in their planning.

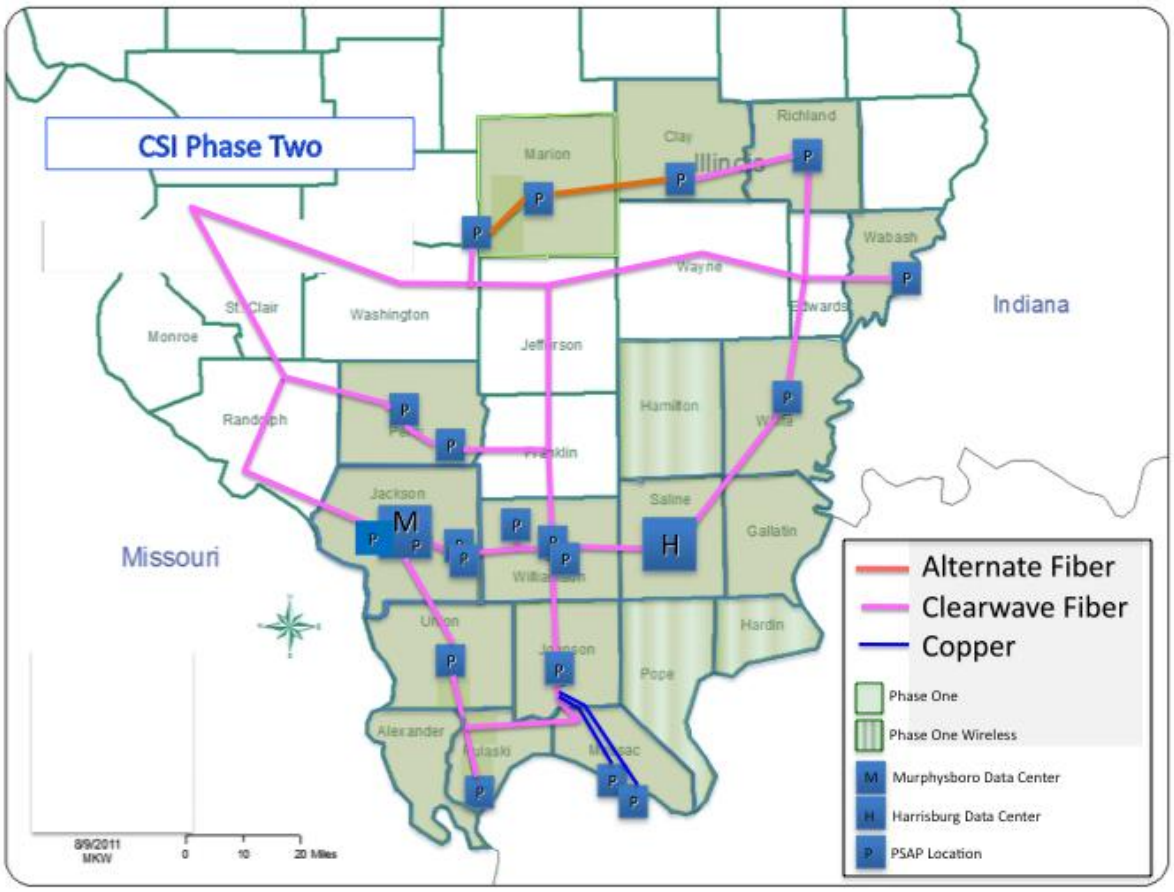


Figure 3.5 – Phase Two Map

	PSAPs Phase Two Connectivity at Pilot Cutover
1	Union County Sheriff
2	Wabash County Sheriff
3	Pulaski County Sheriff
4	Metropolis Police Department
5	Massac County Sheriff

Figure 3.6 – Phase Two PSAP Locations

	PSAP	Address	Nearest Wire Center CLLI	Nearest Wire Center Address	Fiber vs. T1
1	Union County Sheriff	307 W Market St., Jonesboro	ANNAILXE	306 MORGAN ST, ANNA, IL 62906	Clearwave Fiber
2	Wabash County Sheriff	120 E 4th St, Mt Carmel	MTCRILXE	600 OAK ST, MOUNT CARMEL, IL 62863	Clearwave Fiber
3	Pulaski County Sheriff	500 Illinois Ave, Mound City	ANNAILXE	306 MORGAN ST, ANNA, IL 62906	Clearwave Fiber
4	Metropolis Police Department	1020 Broadway St., Metropolis	MTRPILXE	614 FERRY ST, METROPOLIS, IL 62960	Copper (T1)
5	Massac County Sheriff	515 Market St., Metropolis	MTRPILXE	614 FERRY ST, METROPOLIS, IL 62960	Copper (T1)

Figure 3.7 – Phase Two PSAP Location Detail

The target for Phase 2 is August 2013. Figure 3.7 shows five (5) more of the 21 PSAPs will be connected by Clearwave directly or through Alternate Carrier provided Fiber and/or Clearwave provided copper facilities, (T1s) connected to the 2 Data Centers. Two (2) PSAPs remain on Copper T1s indefinitely. CSI will continue to obtain copies of the circuit order layout records for the complete network architecture for provisioning, cutover and maintenance purposes.

The purpose of the nearest Wire Center information is to assist the Access Carriers in their planning.

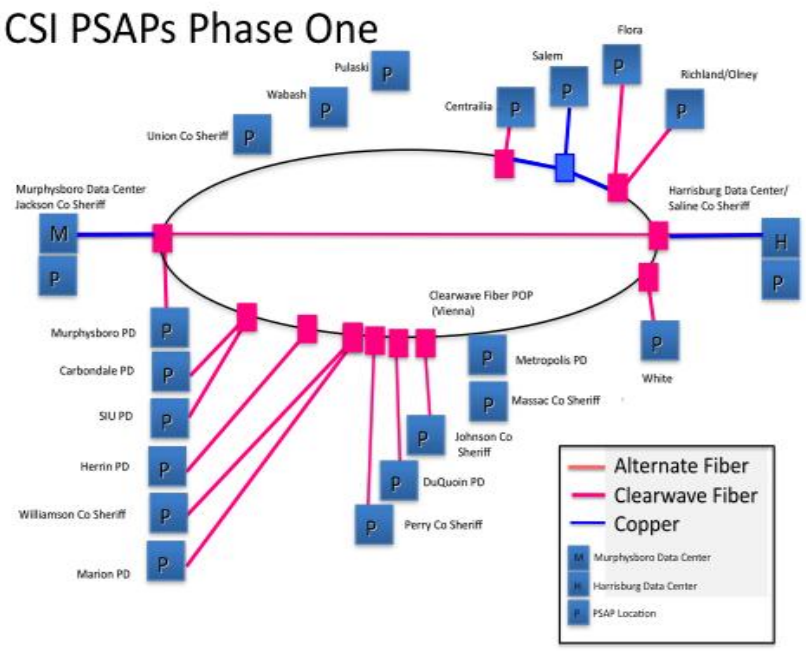


Figure 3.8 - PSAPs Phase One

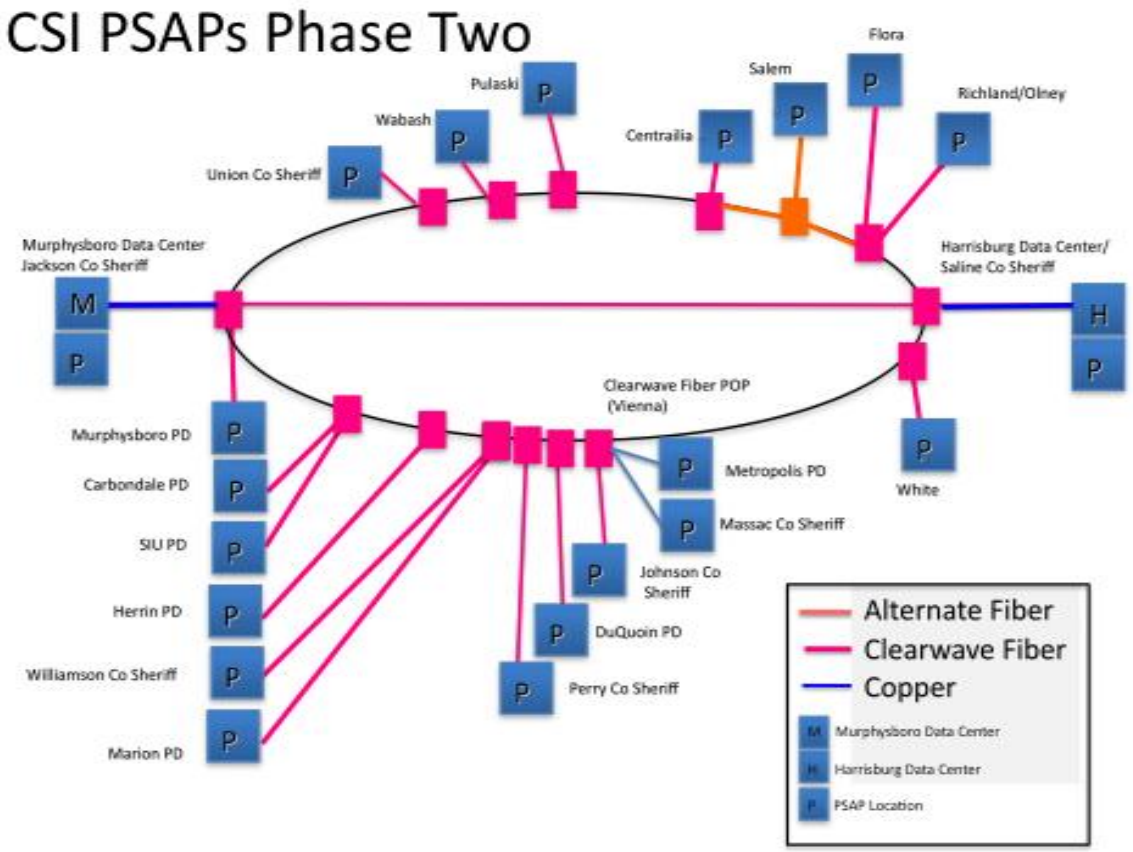


Figure 3.9 - PSAPs Phase Two

3.3.1.1 PSAP Homing Arrangements

Some PSAPs will be homed (connected) to the Data Center East via copper facilities connected to the Fiber Ring, and other PSAPs will be homed on Data Center West.

All PSAPs in the system exist today and will use existing Work Positions equipped with new NG9-1-1 call handler equipment.

Homing Arrangements:

Data Center East:

Richland County Sheriff Fiber 2012 until Fiber Ring 2013
White County Sheriff Fiber 2012 until Fiber Ring 2013
Massac County Sheriff – T1 no Fiber Planned 2013
Centralia PD Marion Co. - Fiber 2012 until Fiber Ring 2013

Data Center West:

Flora Police Department Fiber 2012 until Fiber Ring 2013
Wabash County Sheriff – Fiber no planned Ring 2013
Salem Police Department – T1 2012 on Fiber Ring 2013
Pulaski County – Fiber no planned Ring 2013
Metropolis Police Depart. – T1 no Fiber Planned 2013

3.3.2 ESInet – Data Centers

This section also describes CSI Data Centers, as well as the CLLI, codes SS7 Point Codes, and External IP addresses that identify the two Data Centers. It also includes a description of the call flow through the Data Centers to the PSAPs.

The ESInet has been designed to incorporate two fully duplicated Next Generation 9-1-1 Data Centers. A Session Border Controller (SBC) function has been designed into the network within each Data Center to provide a Firewall for protection from unwarranted Cyber Attacks and/or focused Network Overloads. The design is in accordance with the NENA i3 Standards; the Data Centers are the destination points for all inbound emergency 9-1-1 traffic in the areas served. The two Data Centers are also the exit points for all traffic outbound from the ESInet such as outbound calls from one of the PSAPs serving the areas to an adjacent PSAP, not yet on an ESInet, and outside of the areas. Access Carriers have been requested to terminate their own 9-1-1 facilities and trunking to the addresses of the Data Centers; the Data Centers will be connected to the Clearwave Fiber network at the beginning of 2012. Each Data Center is located in buildings that will also house an i3 Next Generation PSAP. Figure 3.10 provides the overview of the Data Center Architecture.

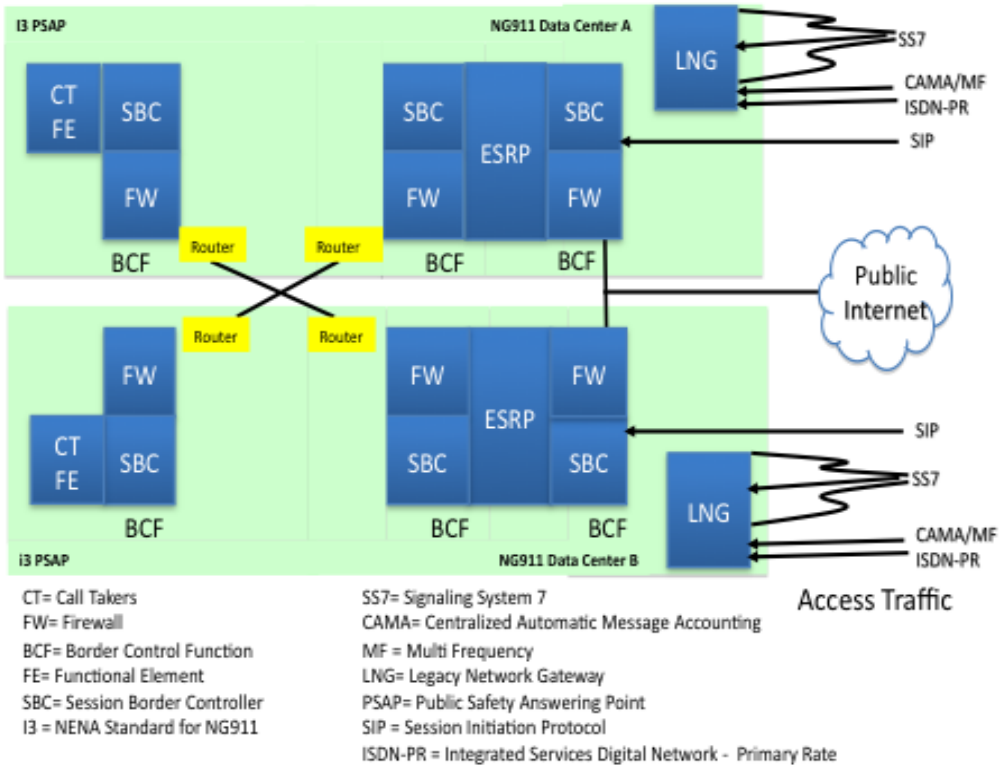


Figure 3.10 - Data Center Architecture – High Level

3.3.2.1 CLLI Assignments

The Counties of Illinois requested Common Language Location Identification (CLLI) for the 2 Data Centers, one in Harrisburg and one in Murphysboro. The following reflects the 11character identification for the terminating locations for Access Carriers to use for trunk group provisioning for their NG 9-1-1 trunk groups.

CSI CLLI Codes for ESRP Terminating Equipment (s)
MRBOILAF0ED
HRBGILDC0ED

CSI Data Center Addresses	CSI CLLI Codes for ESRP Terminating Equipment (s)
1001 Mulberry St., Murphysboro, IL	MRBOILAF0ED
1 N. Main Street, Harrisburg, IL	HRBGILDC0ED

3.3.2.2 IP Connectivity

The Internet Service Provider for the Counties of Southern Illinois is Clearwave Communications from which external IPv4 and IPv6 internet addresses will be procured.

Name Address ISP
Clearwave Communications
Corporate Offices 2 N. Vine St. Floor 3 Harrisburg, IL 618-294-8000

CSI IP Addresses for ESRP Terminating Equipment (s)	
Data Center	IPv4 IPV6 External Addresses
Murphysboro	TBD
Murphysboro	TBD
Murphysboro	TBD
Murphysboro	TBD
Harrisburg	TBD
Harrisburg	TBD
Harrisburg	TBD
Harrisburg	TBD

CSI Data Center Addresses	CSI IP Addresses for Solacom Terminating Equipment (s)
1001 Mulberry St., Murphysboro, IL	TBD
1 N. Main Street, Harrisburg, IL	TBD

CSI IP Addresses for ESRP Terminating Equipment (s)	
Data Center	IPv4 IPV6 External Addresses
Murphysboro	TBD
Murphysboro	TBD
Murphysboro	TBD
Murphysboro	TBD
Harrisburg	TBD
Harrisburg	TBD
Harrisburg	TBD
Harrisburg	TBD

Private internal IP addresses have been assigned internally to the Data Center components in the ESInet.

3.3.2.3 SS7 Connectivity

The SS7 provider for the Counties of Southern Illinois is currently under negotiations. CSI will connect to their SS7 network. F- Links are another option under consideration requiring no STP operator. Technical access options for SS7 signaling have been referred to NENA's CTO.

Syniverse Address SS7
401 N Broad Street, Philadelphia, PA 19108
56 Marietta Street NW, Atlanta, GA 30303

CSI SS7 Point Codes for ESRP Terminating Equipment (s)	
Murphysboro	005-119-012
Murphysboro Reserved	005-119-013 Reserved
Harrisburg	005-119-014
Harrisburg Reserved	005-119-015 Reserved

3.3.3 NG9-1-1 Call Flow

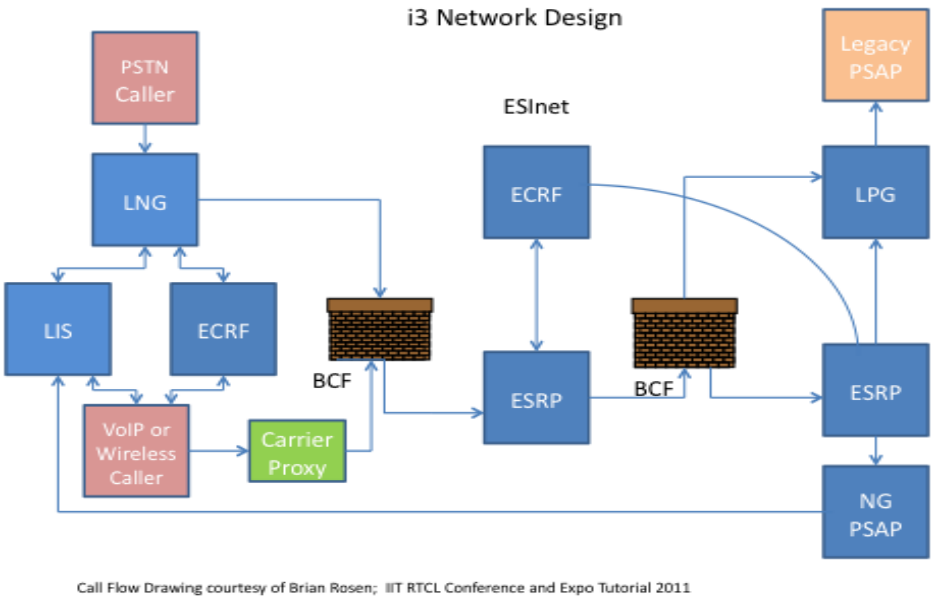


Figure 3.11 - Call Flow Diagram

The CSI Network has the same Functional Elements (FEs) in both Data Centers for redundancy. The acronyms are explained in the text that follows. The blue boxes represent additional FEs with the i3 NENA Standard architecture and design. The FEs are repeated for ease in following the diagram to show the flow. There is only a single ECRF (Emergency Call Routing Function) and a single BCF, and a single ESRP (Emergency Services Routing Proxy) for example in each of the Data Centers.

The following text describes the Call Flow for the NG 9-1-1 architecture. The ***Emergency Services IP Network*** **(ESInet)** is an IP (Internet Protocol) network. It is open to Public Safety, not just 9-1-1. The ESInet is a private, managed IP network, not on the open Internet. When NENA says ESInet they mean the network itself, routers and links, not the services that run on it. ESInets are built from the bottom up. Individual ESInets come together to form state ESInets and can connect to national and international ESInets. The key to network reliability is redundancy. CSI will use many types of bandwidth to support the ESInet. The FEs listed below are redundant in the CSI NG9-1-1 Design.

3.3.3.1 LIS – the *Location Information Server* stores information against some kind of key. Keys can be IP addresses, MAC addresses and telephone numbers, mostly for legacy wireline customers. The LIS uses DHCP (Dynamic Host Configuration Protocol,) the protocol that provides the IP address or HELD (a protocol identified by the IETF to deliver HTTP) an HTTP (Hypertext Translation Protocol) based location protocol. The calling device queries the LIS when it boots, periodically thereafter (especially when the user is moving) and before the user places a call. The LIS returns a PIDF (Presence Information Data Format,) the new form of location. A PIDF can contain a civic (street address,) or geo (X Y coordinates). You can get location by value or location by reference. Location by value means the actual location is sent in the signaling. Location by reference supplies a URI (Uniform Resource Identifier,) with a SIP or HELD protocol dereference.

3.3.3.2 ECRF – the *Emergency Call Routing Function* is the heart of the NG9-1-1 routing database used for ALL calls. It is queried using the LoST (Location to Server Translation) protocol (RFC5222). It sends location (PIDF) in, plus a service URN (Uniform Resource Name) and gets a URI, typically a SIP URI of where to send the call. Conceptually the ECRF geocodes a civic address to a geo, and uses a point-in-polygon algorithm against a set of service boundary polygons that represent the area served by a PSAP. ECRF replaces the MSAG (Master Street Address Guide) and ESN (Emergency Service Number) codes. The External ECRF (sometimes called the Public LoST server) routes to the correct ESInet and the originating ESRP (Emergency Services Routing Proxy) within it. Inside the ESInet, the Internal ECRF (sometimes called the Private LoST server) routes calls to the correct PSAP.

The ECRF is provisioned by the 9-1-1 Authority GIS system. In the case of the CSI, they have been working several years to create those boundaries; CSI contracted Southern Illinois University at Carbondale (SIUC) for assistance. GIS Polygons define the service boundaries and within minutes, new calls can be routed with new Polygons. This is useful in disaster situations. The GIS is enhanced with a "Web Feature Service" (WFS) interface that auto-provisions the ECRF and LVF. There are State ECRFs and a National Forest Guide to allow any ECRF to determine the route for any call regardless of location. If a local ECRF does not have route data for a location presented it, it can consult its State ECRF. If the location is in-state, the State ECRF will have the answer or will consult another local ECRF. If the location is out of state, the local State ECRF will consult the National Forest Guide, which has the URIs and state boundaries of all State ECRFs. The Forest Guide will consult the relevant State ECRF, which will either have the route, or will consult a local ECRF. In this way, queries for any location can be handled by any ECRF.

3.3.3.3 ESRP – the *Emergency Services Routing Proxy* is the closest thing to a Selective Router (SR) in the NG 9-1-1 architecture. The ESRP is the call routing engine. The ESRP uses the ECRF to choose a nominal next hop in routing. It then applies the route policy of the next nominal hop to determine the next actual hop. Route policy can take into account the state of the PSAPs, congestion, media server, source of the call and "suspicion level" provided by the border control function and more. Route decisions can include the next ESRP, a nominal PSAP, diversion PSAP, IMR (Interactive Media Response System) or Busy.

3.3.3.4 PRF – the *Policy Routing Function* evaluates the PSAP (Agency) controlled rules about how calls are routed in the ESRP. Inputs include the PSAP (System) state, congestion state, security posture, call suspicion, call state (SIP headers and added data) and more. The output is a routing decision. The ESRP queries the ECRF with location for the "nominal next hop. That entity's policy is obtained from a policy store and interpreted. Rules are in the form of IF "this is true", THEN do "that." "This" is the input conditions expressed with "and/or" statements. "That" is the route, the actual PSAP, diversion PSAP, IMR, or Busy. Policy is dynamic which means the capability to change it at any time to new calls route with new rules. Policy rules have a standardized format.

3.3.3.5 BCF – the *Border Control Function* provides the External security border for the ESInet and the internal isolation border for the PSAP. It has both firewall and Session Border Controller (SBC) (SIP specific) parts. It can mark calls with suspicion levels and has functions to block specific call sources. The ESInet BCF must withstand the largest feasible attack currently known to be in the range of 10 Gigabits. CSI has purchased SBC capabilities; the SBCs should be deployed at a State level in order to spread the cost of this large input bandwidth across many PSAPs. BCFs are recommended between ESInets and between an ESInet and an i3 PSAP.

3.3.3.6 NG PSAP - the *Next Generation PSAP* gets all calls from the ESInet via SIP (Session Initiation Protocol) protocols with Location routed by the ECRFs. The PSAP can use the ECRF/ESRP function to route to queues of call takers. All NG PSAPs are multimedia, meaning they can handle voice, video and text.

In the NG 9-1-1 architecture it is possible to have Virtual NG PSAPs. Calls are routed to the responding agencies with the ECRF. The Emergency Information Data Document (EIDD) is used between Functional Elements (FEs) inside and between PSAPs.

3.3.3.7 LNG and LPG – *Legacy Network Gateways* and *Legacy PSAP Gateways*
There are entry and exit points to and from the ESInet which will exist as long as there are non IP communications devices in the network. They are called Legacy Network Gateways and Legacy PSAP Gateways. Inside the ESInet the architecture uses IP protocol based communications.

3.3.3.8 LNG - the *Legacy Network Gateway* serves as the bridge between the existing originating networks and the ESInet. One means of interface to the LNG for transition purposes is the existing SR interface to the LNGs. This is an initial step to bring the CAMA/MF, SS7 and ISDN PRI (Legacy Signaling protocols) interfaces to the ESInet. The LNG is always outside the ESInet. It can and in the case of CSI will reside in each of the dual Data Centers housing the redundant ESInet FEs in Harrisburg and Murphysboro. Note: A pair of LNGs could serve the whole state. The LNG routes via the ECRF, always coming through the BCFs. The LNG always uses the ESRP to route the calls. The LNG interworks location protocols and formats between the legacy network and the ESInet. The E2 interface (wireless) or internal LIS (replaces ALI Data for wireline) faces toward the legacy network. The LNG either supplies location-by-value in the SIP signaling, or may supply a location reference that resolves to itself using SIP or HELD protocol towards the ESInet. This is a permanent part of the NG 9-1-1 solution as long as legacy networks are deployed. The LNG is on the Access side of the network architecture.

3.3.3.9 LPG – the *Legacy PSAP Gateway* allows existing non upgraded PSAPs to connect to the ESInet. In the case of CSI, there will not be any Legacy PSAPs inside the network, but there will be adjacent Legacy PSAPs off net until all PSAPs are converted to NG i3 PSAPs. The LPG has a full NG/SIP interface facing the ESInet and an SR/ALI interface facing the Legacy PSAP. No upgrades are needed at the neighboring Legacy PSAPs but the GIS must be compatible with Next Generation technology. In case of CSI there is an option under discussion to extend a piece of equipment called the EG, the Extended Gateway to the neighboring Legacy PSAP location to hand off/transfer calls as needed. This will be refined within the Cutover Plan, refer to . Assure911-NG911CSI-STP-002, Issue 1 The LPG is a temporary measure and is used for Egress until after the Selective Routers (SRs) have been decommissioned and the neighboring agencies are upgraded to NG 9-1-1.

3.3.3.10 Addressing - The form of address is changing from MSAG to “LVF Valid”. LVF is the Location Validation Function. This change introduces a few new address elements, for example, the prefix for a street type. Addresses inside the NG9-1-1 standard systems are conformant to the new FGDC (Federal Geographic Data Committee) standards. Note: The Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis. This nationwide data publishing effort is known as the National Spatial Data Infrastructure (NSDI). The NSDI is a physical, organizational, and virtual network designed to enable the development and sharing of this nation's digital geographic information resources. FGDC activities are administered through the FGDC Secretariat, hosted by the U.S. Geological Survey.

The biggest change: no allowances for local variations in addresses. All fields must be used as defined. That is why CSI has spent the last few years updating the addresses in their jurisdictions to conform to additional data fields. All addressing is based on GIS entries. If CSI changes the GIS, it changes everything and allows for flow through provisioning. The new form of address is the PIDF. PIDFs are XML (Extensible Mark-up Language) objects which can contain geographic or civic locations, which can be passed by value or reference. The PIDF is more or less the equivalent of an ALI record, but there is

ultimately no requirement for a centralized ALI database. PIDFs are stored in a LIS and sent with the call and passed around as XML objects. LISs are typically operated by access networks, or, in the case of the LNG, by the LNG operator. In the case of CSI, the LNG Operator is CSI.

3.3.3.11 LVF – the *Location Validation Function* is used by the LIS Operator to validate location before loading it into the LIS. Similar to MSAG validation, the LVF verifies that the location matches a known address within the 9-1-1 Authority's service area. It is like the ECRF, using the same protocols and same data. The LVF can validate to the street address not just address range. It can also validate to the building, floor, and unit (apartment, suite, etc.,) and room.

3.3.3.12 Multimedia – Multimedia means the PSAP, Bridge and Logger must handle multimedia, the i3 way using standardized interfaces. Video requirements drive ESInet sizing requirements. Brian Rosen's Rule of Thumb: 2Mb/PSAP + 2Mb per Position. For CSI, Clearwave has made a commitment to provide 10Mb to each PSAP. As the PSAPs add positions this is an engineering requirement to augment the bandwidth proportionately.

3.3.3.13 Additional Data

NG9-1-1 is by definition Multimedia capable: Voice, text and video. In the beginning you may have only audio operational but eventually all media will flow. If a Carrier does not support video they do not have to deliver it. It is not an option for the NG PSAP to accept less than all media types when the caller is ready. It is assumed Video Relay will send video as soon as the PSAPs can handle it. Text standards are evolving.

Call data is supplied by service providers in the path and possibly the device itself, signaled with the call, by value or by reference. Contains: Service Provider Contact data, Subscriber data, Service data (Class of Service equivalent), and a Hook for device-specific data such as sensors, telematics, etc.

Caller data is specific to the caller, (home, work or cell provide the same data). Can be signaled with the call or queried from a database. It contains: Contact Data, Emergency Contact Data, Medical Data, etc.

Location data is specific to the location of the call; two calls from the same location will have the same location data. An ECRF query with a special service URN yields a URI to the data. Contains: Building Owner/Tenant Contact information, Floor Plans, Alarm and Sensor data, Control Panel data and more.

Inside the PSAP Data - Further NENA development is underway to define standards between FEs inside a PSAP. These standards are built around a new data structure, the Emergency Incident Data Document (EIDD), which contains all of the information a PSAP knows about an incident. An incident is a real world event, like a car crash or a burglary, which may have several 9-1-1 calls associated with it. The EIDD is used between FEs in a PSAP and between PSAPs to pass data about an incident.

3.3.3.14 The Bridger and Logger have to handle multimedia i3 standards.

3.3.3.15 Additional Data:
Refer to NENA i3 Standards page 194 Figure 7-1 for a Diagram.

3.3.3.16 Dispatch - *There are no ESZ/ESNs in NG 9-1-1*. The PSAP queries the ECRF with the location of the caller and a "service URN" for the service they want: police fire, EMS, poison control, mountain rescue, coast guard, etc. Service areas will be driven by Polygons in the GIS. Adding new services and Polygons is relatively easy. There are standard mechanisms to do Call Transfers or send data EIDD to the dispatched agencies.

3.3.3.17 CAD – There are new and expanded interfaces to CADs. The standards allow the call taker CAD exchange. Any call can be answered by any PSAP and all data to manage the call is included.

3.3.3.18 Summary

No one deserves a busy; triage is possible only if a PSAP call taker answers the call, gets the information from the caller and gives it to the first responders. By answering EVERY CALL, first responders will be able to effectively prioritize their limited resources. You (and the caller) get no data from a call that is sent a "busy"; you have to answer each call to know if the call is from a bus driver with a bus full of kids about to fall off a barrier, or a random driver annoyed by the delay.

Not all systems will be converted at once. So MSAG and PIDF data are able to be exchanged and will co-exist. Conversion functions are possible with the new GIS system.

Security is a big deal. i3 provides extensive security mechanisms, but they must be deployed and managed to be effective. There is a public key infrastructure that assigns secure credentials to each agency and employee. There is a single sign-on mechanism. Every protocol interaction should be encrypted.

There is a Test Call facility within the CSI deployed NG 9-1-1 standard architecture which allows a fully automated test by an end device. It includes a complete test of the signaling and media path.

Reference**:** NG 9-1-1 Call Flow – Text adapted from Brian Rosen's Presentation Slides from the October 4, 2011, IIT RTCL Conference, NG9-1-1 Tutorial in Wheaton Illinois. Refer to page 194 Figure 7-1 of the NENA i3 Standards for more detailed Diagram

3.4 Cyber Attack Protection

The Session Border Controllers (SBCs) are new Network Elements in the ESInet architecture. CSI is deploying a mated pair of SBCs, one in each of the Data Centers. The Mated SBC pair will have dual power supplies and each of the SBCs is engineered to handle the complete load of the network should one of the SBC pair fail while restoration is being managed

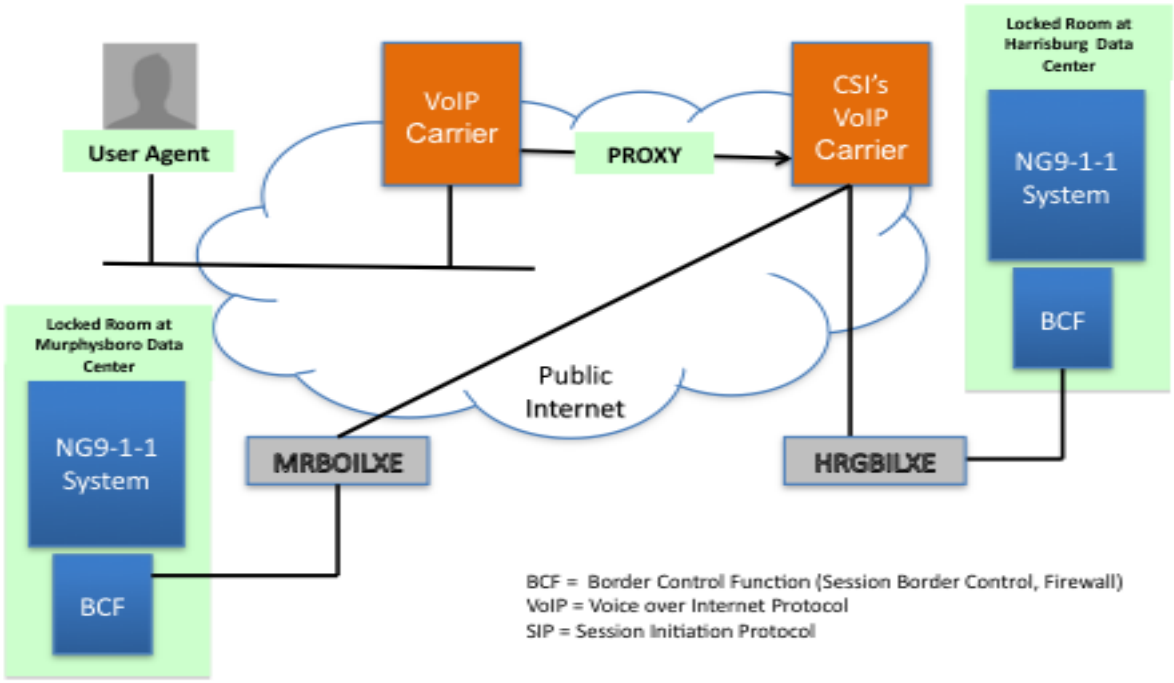


Figure 3.12 – Security

3.4.1 Security of IP network

Logical Security CSI has IT staff across their existing territory with IT leadership and back up support provided by Jackson County. Full login and password security will be managed when the Vendor equipment is installed and Databases are built.

The solutions which are being installed will have Network Element Management interfaces and alarms across the networks. The vendor Assure911 is providing a monitoring solution to CSI with the capability to provide real time alerts to the designated Management and IT staff so that even small simplex failures or anomalies can be investigated and resolved before they become service affecting.

Physical Security Each of the locations where CSI has a Data Center and/or a PSAP is in the same building as a Sheriff Department and/or Police Department in Southern Illinois. Various layers of physical security are in existence today from armed guards to locked and/or coded access doors.

3.4.2 Safe, Continuous, and Uninterrupted Service

Each of the Data Centers and PSAPs has electrical power from their local power companies. In addition, each of the locations has Uninterrupted Power Service (UPS) onsite. As a further back up, each of the Data Centers and PSAP locations have back up fuel powered Generators. The person in charge of each site is responsible to ensure the emergency generators are tested at least once a month and they have security measures in place to ensure the fuel tanks are kept secure and contracts to ensure the tanks are filled as needed.

The PSAP agencies at the direction of the local ETSBs have frequent table top exercises to test the reliability and security of their organizations under stressful situations and events either manmade or natural.

Power: Existing power backup systems and processes are adequate for the ESInet design. Details of the Power back up systems for CSI are listed in a Table in Section 3.11 of this document.

The two (2) CSI Data Centers are on the same Electrical Power Grid. Ken Smith contacted the Power Company and learned there has only been one (1) outage which impacted both Murphysboro and Harrisburg in the last 30 years. In the case of CSI Data Centers, if the single electrical power grid fails, each Data Center has an onsite backup generator which will support the Data Center loads until the Power Grid is restored. "Most of the state is on the 'smart-grid' so that at any given time, Ameren does not know where the power it is distributing originated. At any given time, the power to Harrisburg and the power to Murphysboro are probably coming from different sources, but there is no way to tell." Ken Smith.

Grounding: Each Building is properly grounded against electrical storm surges. For further information refer to CSI.

Timing and Synchronization: The ESInet equipment and all associated Routers and Mediation Devices are synchronized to an external Clock. For further information refer to CSI.

3.4.3 Internet Protocol Standards

The ESInet standards from NENA include a requirement for several newer protocols to be operational as part of the network. The heart of the Emergency Services Internet Protocol (ESInet) is Session Initiation Protocol (SIP.)

The essential SIP standards include:

The main SIP Protocols are included in the IETF RFC 3261++. SIP is the logical equivalent of the SS7 Signaling ISDN User Part, ISUP Standard with much greater flexibility. It is the only logical technical choice to build IP based communications for NG 9-1-1 and it forms the basis for most IP Telephony including 3GPP and IMS Standards. SIP separates session management from media, not unlike how SS7 works but media can be voice, video, text and tones. SIP has messages such as "INVITE, 200 OK," and each message has headers. SIP was enhanced to include location in the signaling with the call.

Access Trunking Reference: IP-PBX / Service Provider Interoperability, *"SIPconnect 1.1 Technical Recommendation",* SIP Forum Document Number: TWG-2.

RFC 3550: The Real Time Protocol (RTP)
RFC 3261: Session Initiation Protocol (SIP)
RFC 4566: Session Description Protocol (SDP)
RFC 3264: The SDP offer/Answer model and many more.

References that may be helpful:
RFC 3665: SIP call flows
RFC 3666: SIP – PSTN call flows
RFC 4346: Transport Layer Security

Standards Organizations that support SIP:
IETF, ITU-T, ETSI, 3GPP, and OMA

The Internet Protocol Architecture is made up of Protocols, Addressing, Routing, Applications and Security.

3.5 CSI Emergency Services IP Network Design

Per NENA 08-003, an ESInet is defined as follows:

"ESInets are like other IP networks in that they are a collection of routers and links between routers in which there are multiple paths such that failures leave at least one path that the network can use. ESInets, however, must be designed to meet more stringent requirements for security and reliability service levels than most other IP networks."

"An ESInet is 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)."

3.5.1 OSI Model for CSI Network

This segment of the document covers the design of ESInets at Open Systems Interconnection (OSI) layers 1, 2, and 3. Network architecture options and methodologies for achieving recommended reliability and availability service levels are discussed. Performance requirements and other aspects of service level agreements for operators of ESInets are covered, as well as several aspects of network security. ESInets must deliver high priority traffic in the face of severe congestion. Traffic engineering strategies for achieving that goal are discussed. Network management and monitoring of ESInets is also covered.

Layer 1: Physical is a real network of Copper, Fiber, Wireless capabilities OSI Layer 1
CSI's ESInet Design will use the following Physical Layer 1 options for their ESInet provided by Clearwave.

- Fiber
- Copper

Layer 2: Data/Link Network with protocols such as Ethernet, OSI Layer 2

CSI's ESInet will use Metro Ethernet provided by Clearwave. Metro Ethernet provides a scalable, high performance broadband platform that supports next-generation voice, data, and video.

Layer 3: IP – Internet Protocol (the addressing scheme is currently IP Version 4)

CSI's ESInet will use internal network routing addresses (i.e., 10.x.y.z). Network elements that will have a high rate of data exchange will be assigned the same subnet addresses. The internal addresses were privately assigned to the equipment. Public IP addresses were obtained in a block from the CSI ISP.

3.5.2 SIP Trunking

In the CSI network access architecture we have identified several access carriers with Softswitch technology in their Class 5 originating Central Offices. In the case of those companies, an end to end SIP

connection can be made for the first time for 9-1-1 callers to the 9-1-1 capable PSAPs. Wireline carriers without Softswitches in their Class 5 End Offices can choose to build SIP trunks to the ESInet if their Central Offices have been equipped for that option. Initial indications are that many Carriers may continue to use ISDN PRI, SS7 or CAMA trunks to reach the ESInet. The SIP standard referenced by the CSI NG911 project is listed in the references at the end of this document, SIP Access Standard: SIP-PBX / Service Provider Interoperability "SIPconnect 1.1 Technical Recommendation" , SIP Forum Document Number: TWG-2.

3.5.3 NENA Design Criteria and CSI Design Implications

Because the CSI ESInet is the first standards-based NG9-1-1 deployment, it is important to address the details of the existing and emerging NENA standards and how they apply and are being implemented to the project. It is included here as part of the design documentation.

Availability and Reliability

NENA: *"Availability and reliability are key concerns for 9-1-1. It is well known that the availability objective for 9-1-1 service is five nines (99.999%). It is not well known that this standard typically has not been met in terms of network connections to the PSAPs in legacy 9-1-1 (i.e. CAMA trunks and ALI circuits). ESInets provide an opportunity for 9-1-1 entities to build to a higher standard, though the resources required to do so must not be assumed, and must be factored in the design phase.*

In this section the [NENA] definitions of reliability and availability are given. The formulas used by reliability engineers to design and calculate the reliability and availability of systems are described; examples are given showing the application of each equation. What it takes to achieve 5 – 9s availability on network connections is examined. And a description is given of how 5 – 9s availability for 9-1-1 service has been achieved in legacy 9-1-1 while operating on networks that are less than 5 – 9s is given. Failure metrics for ESInets are discussed. And finally the formulas used to calculate series and parallel availability and reliability are covered and applied to an ESInet." Reference: NENA Design Draft August 2011.

Definitions and Equations

The difference between reliability and availability is often misunderstood. High availability and high reliability often go hand in hand, but they are not interchangeable terms.

Reliability is the ability of a system or component to perform its required functions under stated conditions for a specified period of time [IEEE 90].

For example, the primary goal of an airline is to complete the flights safely - with no catastrophic failures.

Availability, on the other hand, is the degree to which a system or component is operational and accessible when required for use [IEEE 90].

For example, if a lamp has 99.9% availability, there will be one time out of a thousand that someone needs to use the lamp and finds out that the lamp is not operational either because the lamp is burned out or the lamp is in the process of being replaced.

NENA: *"An attribute of reliability is where attempts = successes + failures"*

For example, if there were 99,999 calls completed to 9-1-1 out of 100,000 attempts, you could claim 99.999% reliability.

Mean Time Between Failure (MTBF) is a basic measure of a system's reliability. The higher the MTBF results in higher the reliability of the system. The equation below illustrates this relationship.

Where e = the mathematical constant e or 2.718281828459045, and Time = time of the mission in hours When time is set to 8760 hrs (1 yr), the formula above yields the following results.

Reliability	Time (hrs)	Required MTBF (hrs)
0.9	8760	83,143
0.99	8760	871,613
0.999	8760	8,755,619
0.9999	8760	87,595,620
0.99999	8760	875,995,620
0.999999	8760	8,759,995,620

Typical commercial grade routers often have an MTBF ranging from 240,000 to 340,000 hrs. (It should be noted that MTBF is often computed using methods that may not correlate to actual results. Thus depending on the methods used by the manufacturer to calculate the MTBF it may be necessary to reduce the MTBF by as much as half.)

Availability, in its simplest form, can be calculated as:

Availability		Downtime
90%	(1-nine)	36.5 days/year
99%	(2-nines)	3.65 days/year
99.9%	(3-nines)	8.76 hours/year
99.99%	(4-nines)	52 minutes/year
99.999%	(5-nines)	5 minutes/year
99.9999%	(6-nines)	31 seconds/year

Availability is often thought of in terms of downtime per year according to the table.

Mean Time to Repair (MTTR) is the time to recover from a component failure, a failed system upgrade, operator error, etc. The formula below illustrates how both MTBF and MTTR impact the overall availability of the system. As the MTBF goes up, availability goes up. As the MTTR goes up, availability goes down.

Inherent availability looks at availability from a design perspective:

When an outage occurs, what's the probability that the redundant system will fail during the MTTR?

NENA: *"If the MTTR is low (e.g. one hour), then the probability for redundant system failure during the outage is low. "*

NENA: *"Repair and response times are key factors in achieving high availability for ESInets. It is a best practice to have a spares plan and SLAs on response time."*

NENA: *"The procedure for software upgrades to the system must also be taken into account. If not properly designed, taking the system offline to upgrade the software may put the Service Level Agreement (SLA) in jeopardy. Another aspect of designing for 5-9s availability in an ESInet is the*

requirement that software upgrades can be installed without taking the system down, or requiring the system to be offline for a very short period of time."

NENA: *"Another consideration is that software upgrades sometimes fail. There must be a procedure to back out the change. [Therefore] system repair procedures must include policies and procedures for software upgrades."*

The CSI ETSBs understand the definitions of *Availability* and *Reliability* and the day to day Operations responsibilities include measuring MTBF and MTTR, maintaining logs and working closely with their vendors to resolve any problems rapidly, incorporating new fixes and software patches carefully into the ESInet architecture in appropriate maintenance windows using planned MOPs (Methods of Procedures) signed off by all involved parties, including vendors and shared as necessary with Clearwave and the Access carriers delivering 9-1-1 calls to the network. Service Level Agreements (SLAs) will be prepared with all parties as required.

All CSI Data Center and PSAP locations are staffed 24 by 7 by 365. The onsite PSAP personnel will be given basic training in how to reseat and replace circuit packs and reset equipment as directed by a well qualified maintenance person. There will be designated First Tier Maintenance, Second Tier Maintenance and Third Tier Maintenance for each of the Data Centers and PSAPs in the ESInet.

Data Center Location	First Tier Name/Company/Reach	Second Tier Name/Company/Reach	Third Tier Name/Company/Reach
Harrisburg	Onsite PSAP 24x7x365	Steve Dixon/CSI/ Rusty/CSI/tbd, 1 hour response	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, number
Murphysboro	Onsite PSAP 24x7x365	Steve Dixon/CSI Rusty/CSI/tbd, 1 hour response	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, number

PSAP Location	First Tier Name/Company/Reach	Second Tier Name/Company/Reach	Third Tier Name/Company/Reach
Saline County Sheriff	Onsite Personnel 24x7x365	To Be Named	Travis Stender/NG-911/ 319-350-8430
Carbondale PD	Onsite Personnel 24x7x365	To Be Named	Travis Stender/NG-911/ 319-350-8430

These and additional Contacts, some of which are yet to be named at the time of this writing, are listed in Attachment 6.

NENA: Achieving 5-9s Availability in 9-1-1 Networks

NENA: *"Historically, Telcos have strived to provide 5-9s availability on emergency 9-1-1 services (i.e. Selective Routers, DBMS, ALI, Dual Mated Tandems, etc) – which equates to 5 minutes downtime per year.*

In order to achieve 5-9s availability using 2 fully independent systems, telcos implemented a strict set of technical and operational standards for their employees and central offices which include the following:

- *Utilize NEBS Level 3 Compliant Equipment*
- *DC powered*
- *Redundant fans and power supplies*
- *Highly reliable components, tested at environmental extremes*
- *Installed in secure, environmentally controlled facilities*

- *Engineered to deal with a variety of common issues for failover and recovery*
- *Monitored by a NOC 24 x 7 x 365*
- *Spare parts available on site or within 1 hour*
- *Approval for use testing"*

The CSI ETSBs have completed a survey of their Data Centers to ensure the environment is ready to accept the equipment and is managed in a manner and environment consistent with Data Center requirements. The locations are the exact locations serving the 9-1-1 community today.

CSI understands that there are many differences between a historical telco environment and the standards and environment necessary to own and manage an ESInet environment. As of September 2011, NENA has not made a firm recommendation for the environment of an ESInet Data Center per communications with NENA's CTO.

Based on the expertise and advice available to CSI's ETSBs and the experience of the NG911, Inc., Assure911 and IIT RTCL team we believe the following items reflect a solid plan to manage and maintain the ESInets in the CSI Data Centers at Murphysboro and Harrisburg. If and when NENA and the Industry gain more experience and have more solid recommendations, CSI will review the recommendations.

CSI is not building new buildings and their track record in supporting PSAP equipment in their 21 locations has been excellent.

CSI intends to track performance of the network at all levels and report proactively to the ICC when required. CSI will hold all vendors accountable for performance warranties. Outage reporting requirements will conform to all FCC and ICC requirements.

CSI will work in good faith openly and actively with all Access Carriers in their footprint to maintain a highly available and reliable environment for 9-1-1 operating within SLAs and adhering to all 9-1-1 applicable state and federal guidelines and laws.

CSI's position to the specific items NENA listed above:

Utilize NEBS Level 3 Compliant Equipment

NEBS is a Telcordia Telco Standard for Central Office environments. The CSI Data Centers are neither Telcos nor do they need to be built and operated the same as Telco environments. Data Centers: each location is secure both physically and logically. The equipment is being installed in standard data cabinets in locked Telco rooms without water sprinklers and with appropriate fire suppressant systems. The rooms will be heated and cooled to ranges compliant with the vendors' specifications. The equipment will be mounted securely with full understanding that Southern Illinois is susceptible to moderate earthquake activity from the New Madrid Fault. The buildings are solid; both Data Centers are homed inside the Sheriff Departments for their Counties and as such meet all Federal and State Code requirements. The equipment is server based and small units can be easily mounted anywhere. The two Data Centers exist and are over 50 miles apart; this is a level of diversity not found in any of the Selective Routers locations in any Telco in Southern Illinois today. Note: The SRs do have inter SR trunking but that does not count as a reliable and diverse option in the case of an SR failure.

DC powered

Modern ESInet equipment is not DC powered. DC power is an artifact of the Telco environment not directly consequential to the ESInet standards or environment. Many components of modern Telco owned equipment are no longer DC powered. CSI has UPS, Uninterrupted Power Supply equipment in all of their PSAPs. They also have onsite active generators at each Data Center and at PSAP location. Many Telcos do not have as highly reliable power back up systems in place today; often portable

generators have to be brought to a site and that can take hours or power drops. Many Access Central offices are not manned and it can take anywhere from 2 to 4 hours to dispatch someone to begin to restore service if onsite work is required. The CSI Data Centers are manned 24 by 7 by 365.

Redundant fans and power supplies

Fans and power supplies in the ESInet vendor equipment: First, all of the equipment is redundant in each environmentally correct Data Center. Second, the cabinets are Data Center cabinets with cooling and power supply connectivity as required in any Data Center.

Highly reliable components, tested at environmental extremes

As a primarily software-based solution, the NG9-1-1 system FEs operate on widely available computing platforms, in office environments. The environmental ranges of the Data Centers are expected to meet or exceed the requirements where they will be installed.

Installed in secure, environmentally controlled facilities

The Harrisburg and Murphysboro Data Centers have housed the current PSAP equipment for portions of Jackson and Saline Counties successfully for many years. In 2010, tornadoes and floods were significant across the area, requiring the emergency operations centers in both locations to be manned several times. In all cases, the 2 Data Centers were stable and their emergency power plans worked when required. No flooding or environmental problems caused 9-1-1 outages. The Data Center locations are secure and environmentally controlled.

Engineered to deal with a variety of common issues for failover and recovery

The design of the i3NENA standard provides for redundancy and resiliency. IIT Lab testing followed by field testing will provide results. The tests are measuring actual performance against standards and real failovers are being created to observe performance before live service is placed on the CSI network.

Monitored by a NOC 24 x 7 x 365

The NENA network management and monitoring standards are under development. Assure911, LLC is a subcontractor for the CSI network access, design and testing plans. Assure911 is a network monitoring company with a patent in 9-1-1 assurance and a history of supporting major wireline and wireless carriers, major ILECs and CLECs and the City of Chicago 9-1-1 center for many years. CSI will have a system to monitor the NG 9-1-1 network end to end. In meetings with Clearwave and the Access Carriers, they were invited to interface to the same monitoring solution so anyone along the path of the NG 9-1-1 call can be alerted if there is a problem which could affect service whether it is simplex or duplex.

The CSI network is manned 24 by 7 by 365. The IT staff will have access to the NOC-like tools 24 by 7 by 365. Much of the system information in the form of alerts will be sent to the IT support personnel's' hand held devices and the managers' devices as problems occur. The concept of a person sitting in front of NOC screens watching the network is no longer a requirement for many carriers.

Spare parts available on site or within 1 hour

There are 2 fully redundant Data Centers. A spare parts and spare and return policy is negotiated with each vendor. NG911, the System integrator is responsible for the parts inventory and getting service/parts to the Data Centers as needed within 2 hours to support the onsite personnel. A complete set of replacement components are not kept as spare in any telco environment. Spares must be maintained in an environmentally correct location and the location while secure must be accessible to

trusted and trained personnel on site at the PSAP so they can handle a replacement or be walked through replacement by a remote qualified technician as until the CSI technical IT person arrives.

Approval for use testing

Testing is the subject of the CSI Test Plan. When the draft NENA Design document provides additional Design testing requirements, they will be reviewed by CSI.

Network Availability and System Reliability in Legacy PSAPs - NENA Draft Language and CSI

NENA: *"5-9s availability is a widely accepted standard for emergency 9-1-1. This objective is achieved for call completion within legacy 9-1-1 systems primarily thru the use of backup PSAPs and 10 digit numbers.*

5-9s availability was rarely achieved at any individual PSAP largely due to limitations at the physical layer (i.e. a single entrance for facilities into each PSAP, CAMA trunks and ALI circuits in the same trench from CO to PSAP, etc).

The availability achieved by most legacy PSAPs for network is on the order of 2-9s. Every other year or so there is a fiber/cable cut and the PSAP is offline for more than 8 hours. Availability varies by region, year, and service provider."

The CSI ESInet Design recognizes the inherent nature of the single entrance to facilities. Each major FE in the NG 9-1-1 network ESInet is redundant. The highest risk for 9-1-1 callers today comes from the originating network where there is only a single route to the SR in Southern Illinois and no load sharing in the SR network architecture.

Defining Failure Metrics for an ESInet - NENA Draft Design

NENA: *"One of the considerations that must be taken into account when designing and calculating ESInet availability and reliability is to determine what constitutes a failure. A failure could be defined as one of the following:*

1. *The termination of the ability of the overall 9-1-1 system to perform its required function within a specific geographic region.*

2. *The termination of the ability of any individual PSAP to perform its required function but not the termination of the ability of the overall 9-1-1 system to perform within that specific geographic region."*

For example, if the circuits from the PSAP to the Central Office are all located in the same conduit, and there is a fiber cut, typically one of two things will happen:

1. NG9-1-1 Call handling system automatically routes calls to backup PSAP.

2. Someone at the PSAP will throw a make busy switch (or call their service provider) and reroute the 9-1-1 calls to a 10 digit number or back up PSAP.

The failure does not prevent 9-1-1 calls in that region from being completed. However the failure does prevent the calls from being delivered to the primary PSAP. Therefore, according to definition 1, this is not a failure, but according to definition 2, it is a failure.

NENA: *"9-1-1 entities should define what constitutes a failure within their system, and thereby determine how availability and reliability will be calculated."*

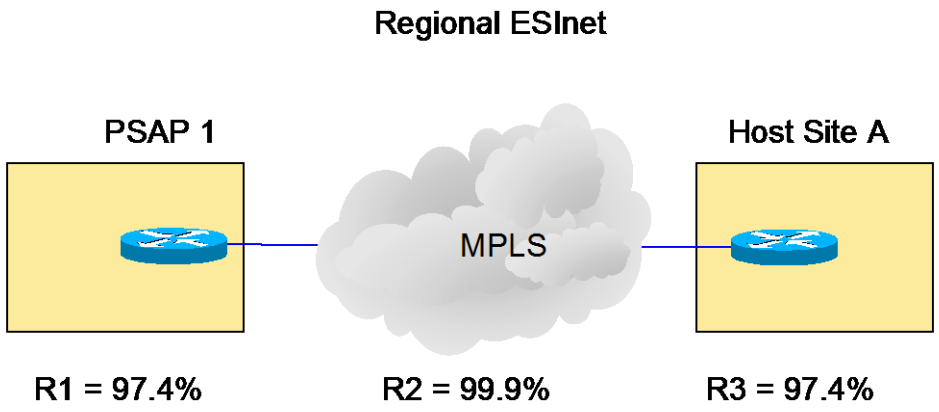
In the CSI ESInet, the use of a back up PSAP is not a failure. The calls and all related information route to the designated alternate PSAPs, thus the caller will get a similar response no matter which PSAP answers the calls**.** The primary and back up PSAP list for CSI is in Attachment 5.

Series and Parallel Reliability and Availability in ESInets - NENA Draft Design

NENA: *"Series and parallel reliability and availability are key components to the design of highly reliable ESInets. Series reliability is calculated as:*

*Rs = R1*R2*R3*

For example, the series reliability of the ESInet shown below is:
*.9743 * .999 * .9743 = .948*



Reference: NENA Diagram

An interesting property of series reliability is that it is always less than the least reliable component in the series. For example a 2-9s router connected to a 3-9s circuit yields an overall reliability of less than 2-9s. What would be the impact of adding 2 additional fully independent and physically diverse 94.8% links to the ESInet shown above