ASSURE911

Next Generation 9-1-1 Design Plan

Developed by

Assure911.net, LLC

For

Counties of Southern Illinois

Emergency Telephone Services Boards

NG-911, Inc.

ILLINOIS INSTITUTE OF TECHNOLOGY

NG-911, Inc.
Next Generation 911
Systems, Consulting, Engineering

clearwave

December 14, 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.

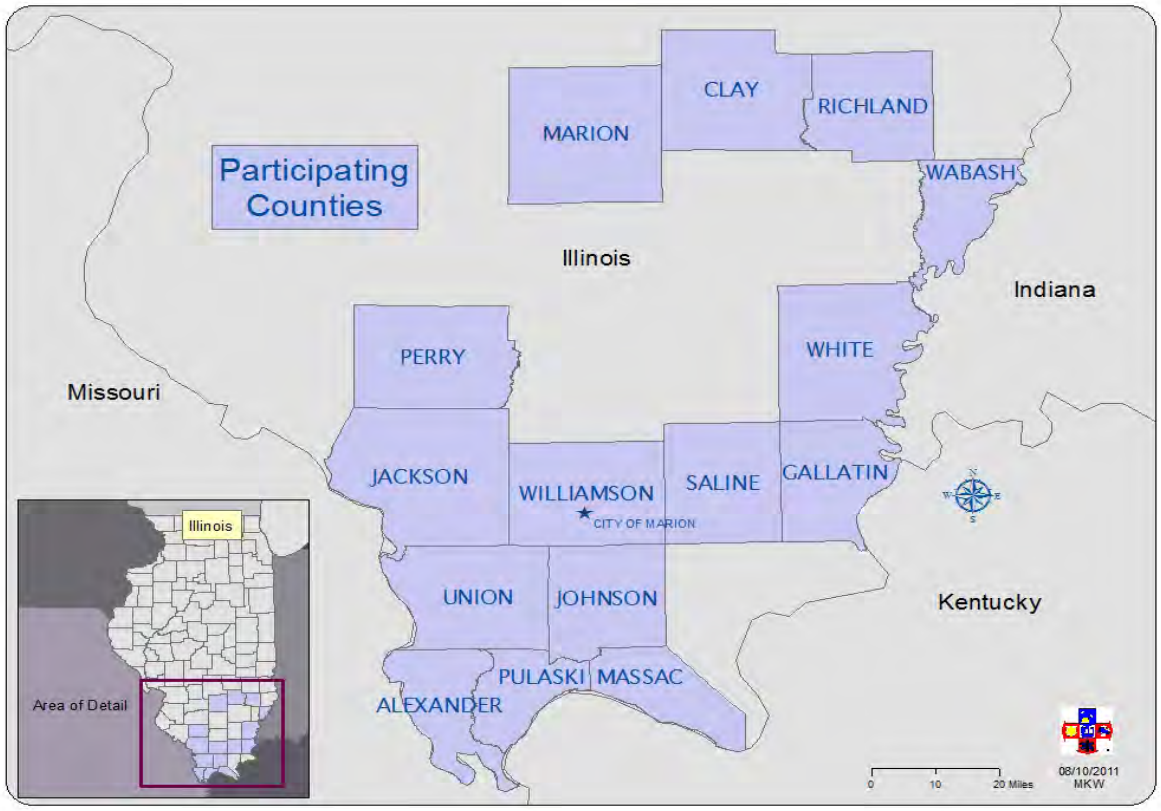
The CSI ETSBs look forward to gaining ICC approval to move forward with the Pilot Project immediately. There are several changes noted in this section of Version 2 of the Design Plan. A summary of the NG 9-1-1 Design Plan is as follows:

- CSI has contracted with NG-911, Inc. to become the 9-1-1 System Service Provider. This is a change to the original Design Plan.
- 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. NG-911, Inc. has assumed responsibility to negotiate with the Access Carriers for connectivity to the NG9-1-1 Network.
- 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 NG-911, Inc., the 9-1-1 SSP.
- 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 original 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.) With the contract for NG-911, Inc. as the 9-1-1 SSP, many responsibilities will be contracted by CSI to NG-911, Inc. The 16 ETSBs continue to manage the business of Public Safety in their communities. The CSI NG 9-1-1, Inc. Network will be managed by NG-911, Inc. Components of the ESInet reside in two (2) diverse, fully redundant Data Centers over 50 miles apart in Harrisburg and Murphysboro, Illinois.

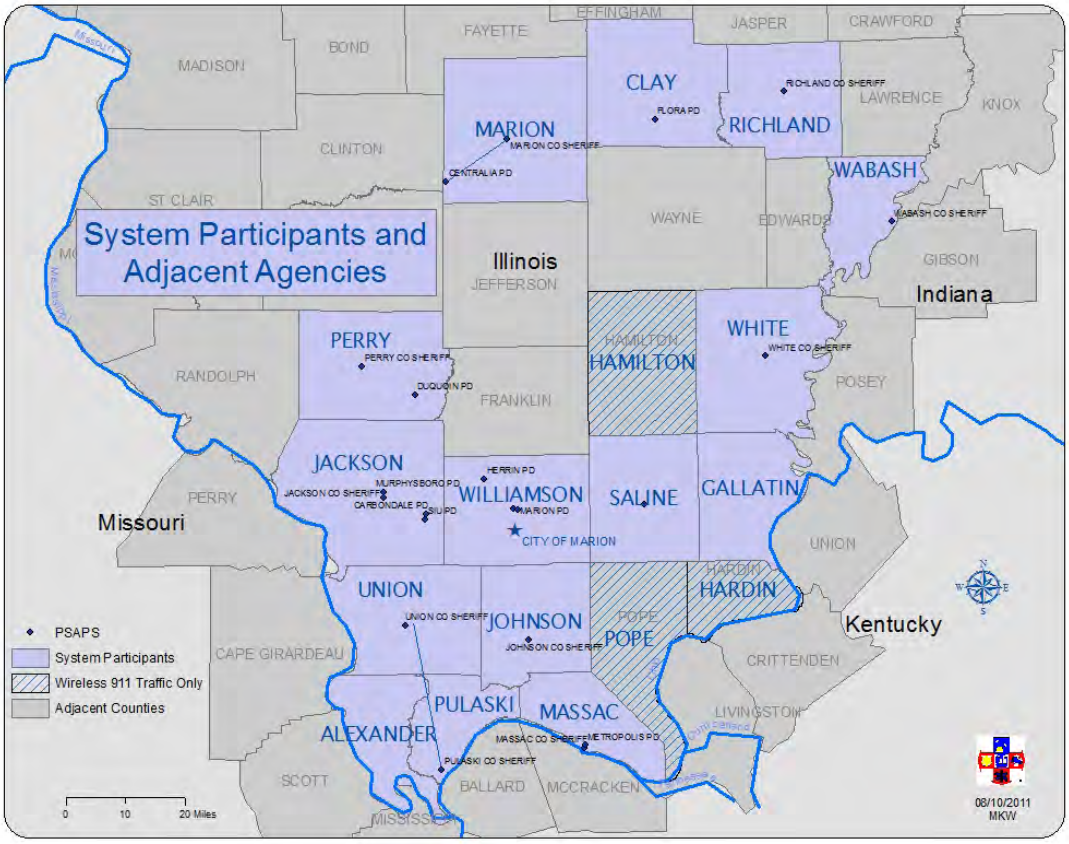
The network design is adaptable, scalable, will leverage the Clearwave Communications broadband fiber network solution, and utilize the NG-911, Inc. provided Functional Elements (FEs) based on their contract awarded solution.

Figure 1.1 – Participating Counties of Southern Illinois Map



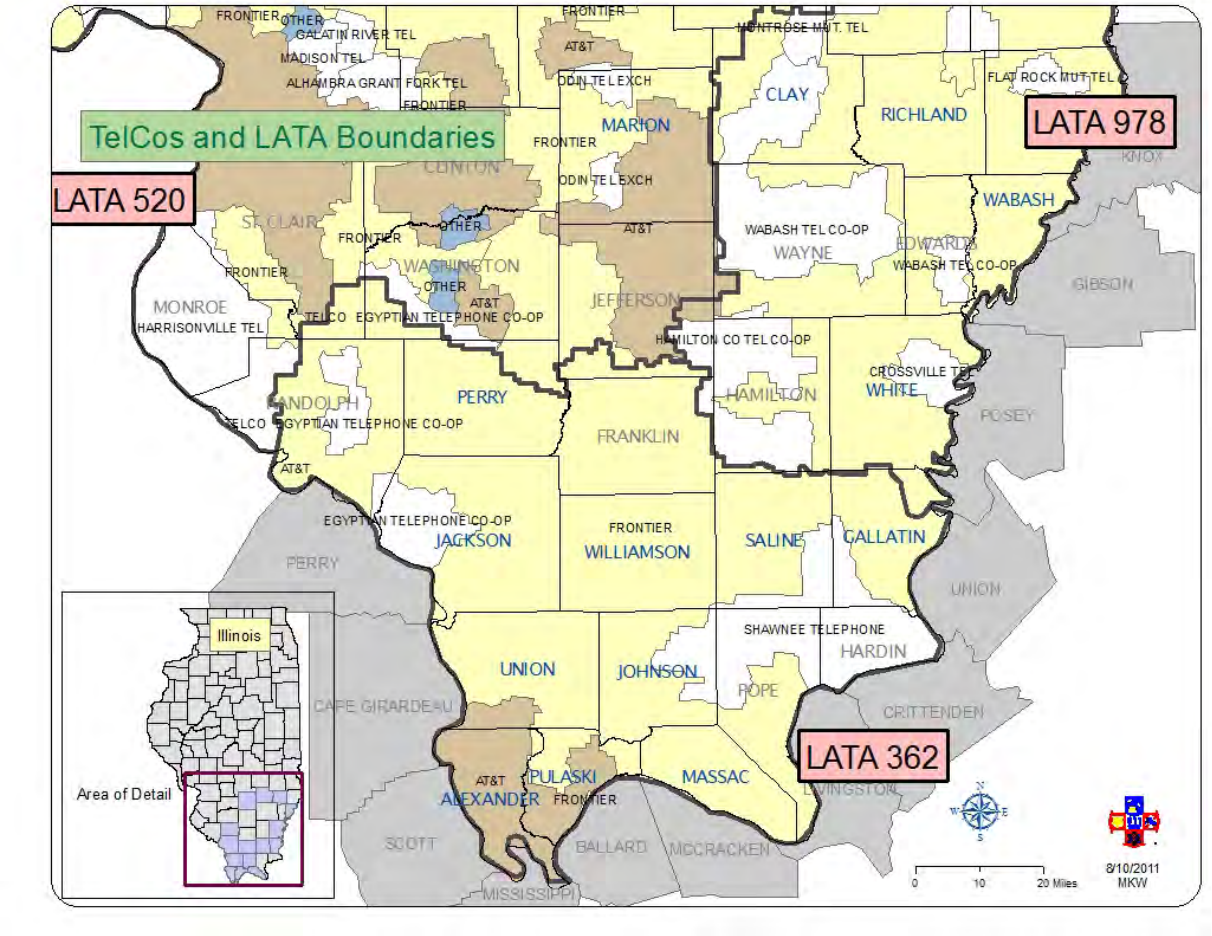
The Counties of Illinois (Plan Exhibit 1) include Alexander, Clay, Gallatin, Jackson, Johnson, Marion, Massac, Perry, Pulaski, Saline, Union, Richland, Wabash, White, and Williamson and the one municipality in the Plan, the City of Marion.

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. Carrier meetings were halted when the Design Plan was filed with the ICC. Subsequent to NG-911, Inc. assuming 9-1-1 SSP responsibilities for CSI, the Carrier meetings resumed. Details that were incomplete at the time of the initial filing are under negotiation as of this version of the Design Plan. 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 initial 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."

NG-911, Inc., the CSI SSP, is hosting meetings with incumbent Selective Router Carriers and other Carriers in the CSI footprint. Frontier has chosen to maintain their Selective Routers in the network architecture, not only in CSI but across their footprint even after NG9-1-1 is implemented. This strategy is a Company Policy and while consistent with a transition and cutover planning process advocated by NENA, violates points 4 of the 5 criteria above for the long term NG9-1-1 network. The only portion of the criteria it may not violate is number 5: the plan can be documented, provisioned and implemented.

- The Selective Router, which is a Single Point of Failure in CSI's footprint, adds a layer of physical and logical connectivity to the NG9-1-1 access network architecture.
- No costs are reduced for access.
- Any time another leg is added to the network, call set up time may be delayed, even if by milliseconds.
- The cost for CSI to build a NG9-1-1 architecture in two (2) Data Centers to reach the entire CSI footprint PSAPs are efficient and less costly over time to the Public Safety Agencies than owning and maintaining their own separate disparate E911 systems on a per PSAP basis.
- Today's PSAP typically does not have a robust Border Control Function (BCF) function. Recent events at CSI showed in the E9-1-1 legacy network that "killer trunks" were activated in the Frontier network sending hundreds of false 9-1-1 calls into PSAPS within minutes of each other,

thus using resources that may have been needed for real emergencies. The NG9-1-1 BCF will offer protection not available today against killer trunks facilities that bounce up and down causing false seizure and/or Denial of Service Attacks that can be generated in VoIP carrier networks.

- Meetings with Clearwave, the CLEC Access Carrier revealed major differences in required trunking for each exchange they serve between the Clearwave Softswitch and the E9-1-1 Selective Routers as compared with the trunking required with SIP to the CSI ECRFs in the Murphysboro and Harrisburg Data Centers. Newer signaling and advanced database capabilities allow for fewer more efficient trunk groups. Field Testing will validate these efficiencies.

These are 4 practical examples of the value of the NG9-1-1 network. NG-911, Inc. is working with each carrier including incumbent carriers to find a value proposition that is mutually beneficial and yields the best investment of the Public Safety dollar for the public.

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, Higherground, Acme Packet and Assure911.net (Assure911). Subsequent to the initial filing Michael Ramsey's Company achieved 9-1-1 SSP Certification in the State of Illinois. CSI was required to become a 9-1-1 SSP or contract with a 9-1-1 SSP. Given that the relationship with NG-911, Inc. was in place they were the logical choice. Leadership and accountability to negotiate and contract with the carriers was agreed upon, the interface with the Commissions, Provisioning, Maintenance and Oversight of the Quality of Service of the CSI network migrates to NG-911, Inc. The network monitoring capabilities that are being deployed will be available directly to NG9-1-1, Inc. to monitor the network in real time, make reports to the ICC and resolve problems with their customer CSI.

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 conducted 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

NG-911, Inc. assumed the responsibility to actively host meetings to provide education through presentations and engage in interactive dialog with the Access Carriers, Wireline, Wireless, VoIP and CLEC. CSI continues to attend the meetings to assure continuity. 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 and subsequent versions which reflect changes in responsibilities and status.

2.6 Service Quality and Benefits

The Commission holds the 9-1-1 SSP NG-911, Inc. 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 NG-911, Inc.'s 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

NG-911, Inc. and 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 NG-911, Inc. in support of an i3 NENA standards-based, IP-Based, Next Generation 9-1-1 Communication System for NG-911, Inc. and the ETSBs of 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 NG-911, Inc. and all deliverables are provided through NG-911, 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

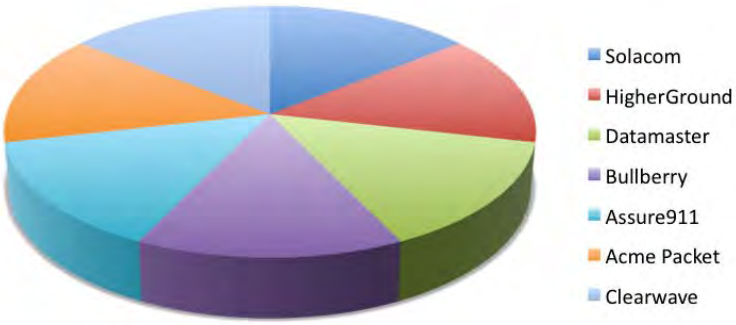
The NENA i3 Standards provide an important resource for the NG9-1-1 Project for the Counties of Southern Illinois project, as does the CSI RFP. The Design further relies on access to data from four (4) resources: (1) Clearwave Communications who was awarded the grant to build the fiber network from the 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, and (5) NG-911, Inc. as the contracted 9-1-1 SSP for CSI.

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 9-1-1 SSP, System Integrator and prime contractor for the Project is NG-911, Inc. NG-911, Inc. will serve as the 9-1-1 SSP and System Integrator for CSI under their contract for the 10 years at a minimum. Refer to the Contract Plan Exhibit 17, augmented with the 9-1-1 SSP Contract.

Figure 2.2 – CSI Vendors, managed by NG-911, 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.
- The 9-1-1 SSP will assume the role as interface to the Illinois Commerce Commission (ICC) and Federal Communications Commission (FCC) for mandatory reporting.

3.0 NETWORK DESIGN DESCRIPTION

This Design Plan is submitted for approval by the ICC, as updated December 2012. 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 longer the approval interval period to begin the Pilot Project, the further the completion of Phases until Phase 1 and 2 merge. At that point the Cutover Plan will be the defining document; this is a moving target. The NENA Standards are defined and being refined as actual testing takes place. 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 9-1-1 SSP and the CSI ETSBs, their Systems Integrators and vendors 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. This document ~~is updated at the ICC request.~~ has also been updated.

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 NG-911, Inc., the ~~S~~9-1-1 SSP, Clearwave Communications, the broadband network provider, and NG-911, Inc., the integrator and provider of the array of functional elements that comprise the Next Generation system. NG-911, 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. Information is changing as implementation proceeds with the underlying Fiber network deployment, Clearwave is making excellent progress.

As of December, 2012, The 9-1-1 SSP has contacted Clearwave to verify their current deployment status and ascertain their willingness to provide underlying access for their own CLEC Access Switch and for facilities for other Carriers from their end offices, and from the Carriers' Selective Routers to the two (2) Data Centers. Clearwave is receptive and willing to offer pricing on a route-by-route basis. They are a fiber and ethernet company with a Softswitch. They are not involved with SONET and/or circuit switched technology. Details are being discussed that can be presented to carriers who have no alternatives for reaching the 2 Data Centers. Access alternatives will be described in an updated version of the Access 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 (original website version)

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.

Figure 3.1 Diagram Notes: The Clearwave map will be slightly altered as of December, 2012. Aaron Carian and Scott Riggs indicated that Clearwave made minor modifications to their network and they are on track to complete all aspects of connectivity for the CSI network no later than early 2013. Union and Johnson Counties PSAP connectivity is in progress. Clearwave Fiber connectivity to the two (2) CSI Data Centers was completed.

- The Clay County Leg of the Fiber Network is connected directly to Wayne County. This is a change to the above diagram.
- The leg between the Wayne County and Edwards County was cancelled. This is a change to the above diagram,
- The leg between Edwards County and Wabash County is complete. It is still a spur, not part of the ring.
- Both Phase 1 and Phase 2 network infrastructure are complete with the exceptions noted.
- The fiber has not been extended into all CSI PSAPs; as of this ~~issue~~ submission, the work is on track.
- Clearwave is ready to bring traffic onto their fiber network.
- Clearwave is willing to bring other carrier access traffic from LATAs in the CSI footprint into the LATA with the Data Centers. Exception: they are not near Mattoon and a few other locations. This means ICTC end offices would continue to go to the Selective Router unless they wish to bring the traffic from their few switches directly to the 2 Data Centers via another facilities option. This is an open item being researched by NG-911, Inc.

Bluebird Communication (Illinois Network Alliance) in St. Louis is the contact and company most of the independent carriers are planning to access their fiber network. They may be able to complete the options where Clearwave is not in the footprint. Mediacom has been contacted. They partner with NewWave Communications to complete their rings in selected areas. Mediacom agreed to provide pricing for Access.

The major Carriers in the footprint, AT&T and Frontier, have been asked again if they wish to use their own fiber and/or facilities to connect to the CSI Data Centers, Quality of Service, Service Level Agreements, 24 by 7 by 365 monitoring, and price will determine the underlying Carrier Access connectivity.

Research is showing there are many more fiber routes in the ground and carriers are willing to build out for a term contract to extend those they have to landline, wireless, VoIP and Cable TV telco providers. The options are promising.

3.3 CSI Design Strategy

This section describes the function of each of these major parts of the ESInet and their interworking. The 9-1-1 SSP will implement and manage the i3 NG9-1-1 ESInet and the functional elements in 2 CSI Data Centers that are over 50 miles apart in Harrisburg and Murphysboro. The Network Design is flexible and scalable; it utilizes the Clearwave Communications Broadband Fiber Network Solution, and utilizes the NG-911, 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. In some cases Clearwave may bring or has brought fiber into the PSAP and/or Data Center. The charts and diagrams reflect the difference between Fiber and Copper network connectivity. In all cases Clearwave will provision the ESInet infrastructure for CSI. The 9-1-1 SSP 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.

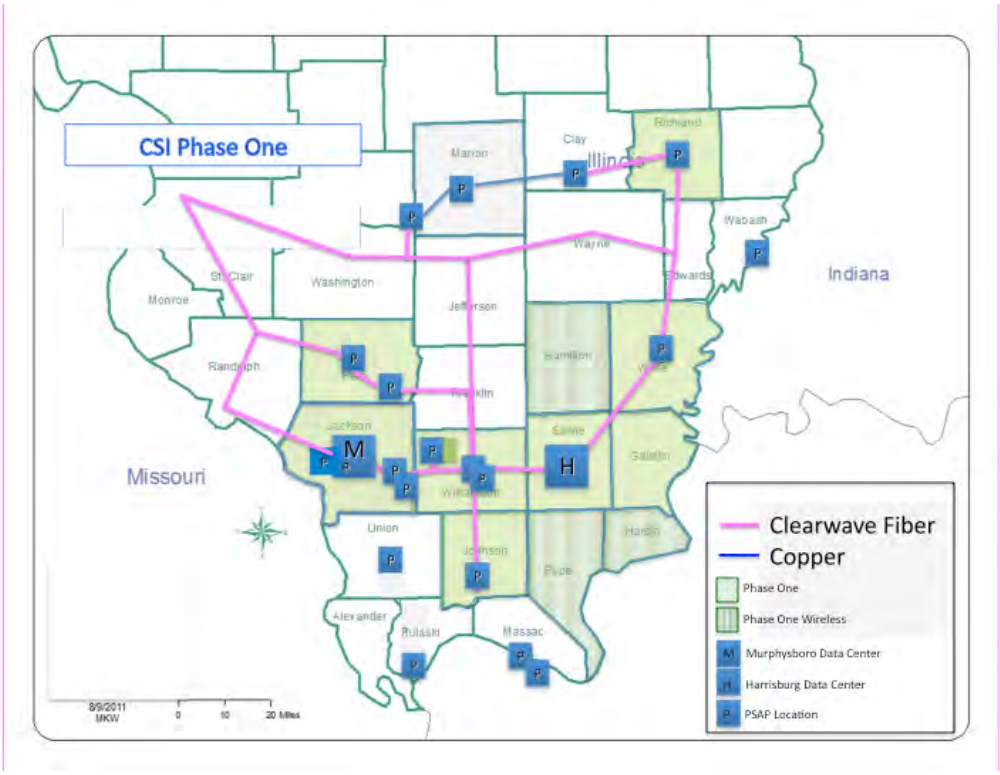


Figure 3.2 – Phase One Map (Refer to Figure 3.1 Diagram notes as of December 2012.)

	PSAPs Phase One Connectivity at Pilot Cutover – Mostly Completed
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 –in progress December 2012,target 1Q 2013
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. As of this issue, eight (8) of the 16 PSAPs will be rolled over to the Clearwave Fiber Network by December 2012, and one PSAP will connect via copper facilities. The remaining PSAPs will be cutover in early 2013.
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.

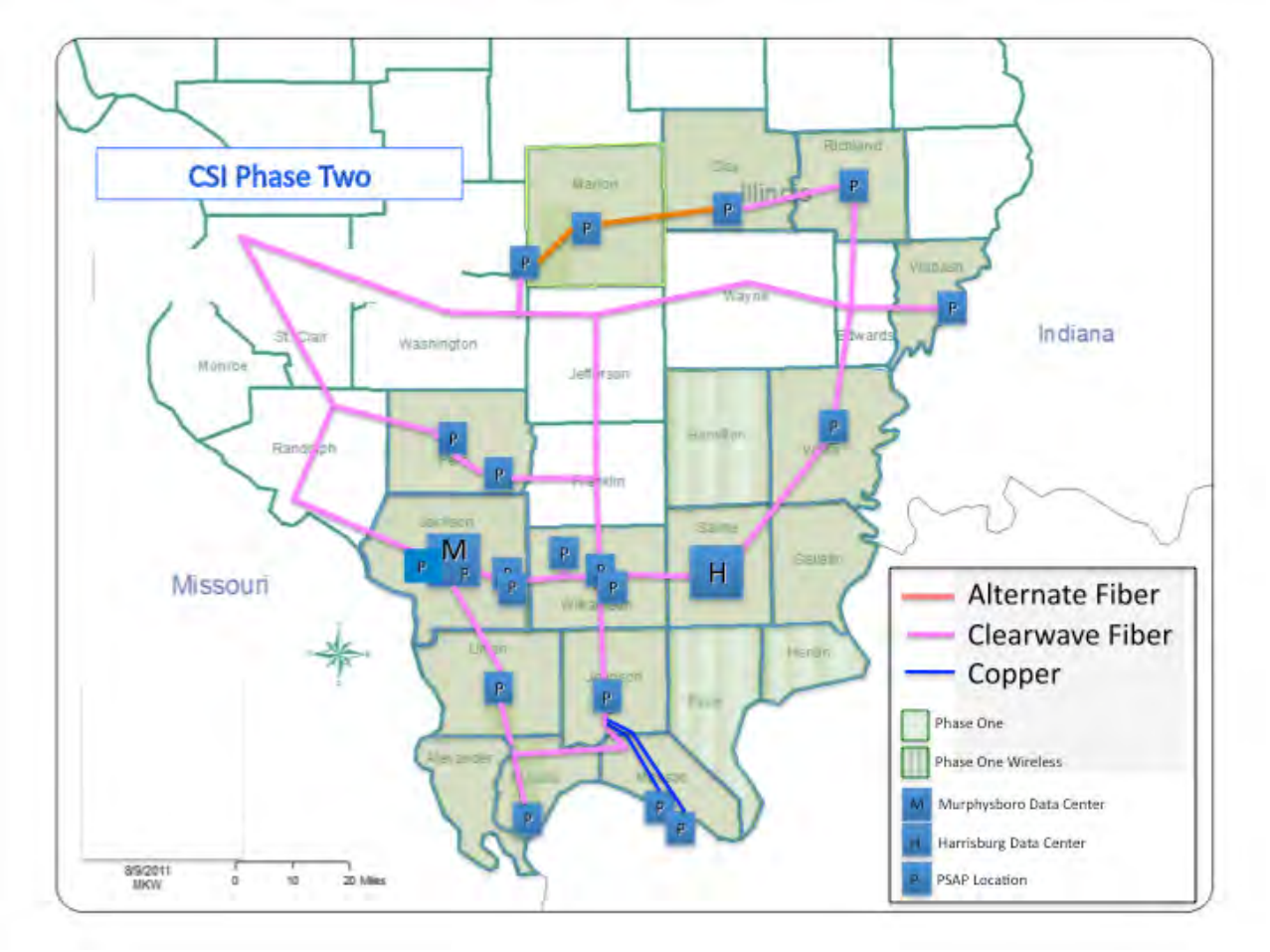


Figure 3.5 – Phase Two Map (Refer to Figure 3.1 Diagram notes as of December 2012.)

	PSAPs Phase Two Connectivity at Pilot Cutover
1	Union County Sheriff – in progress December 2012 – target 1Q 2013.
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.

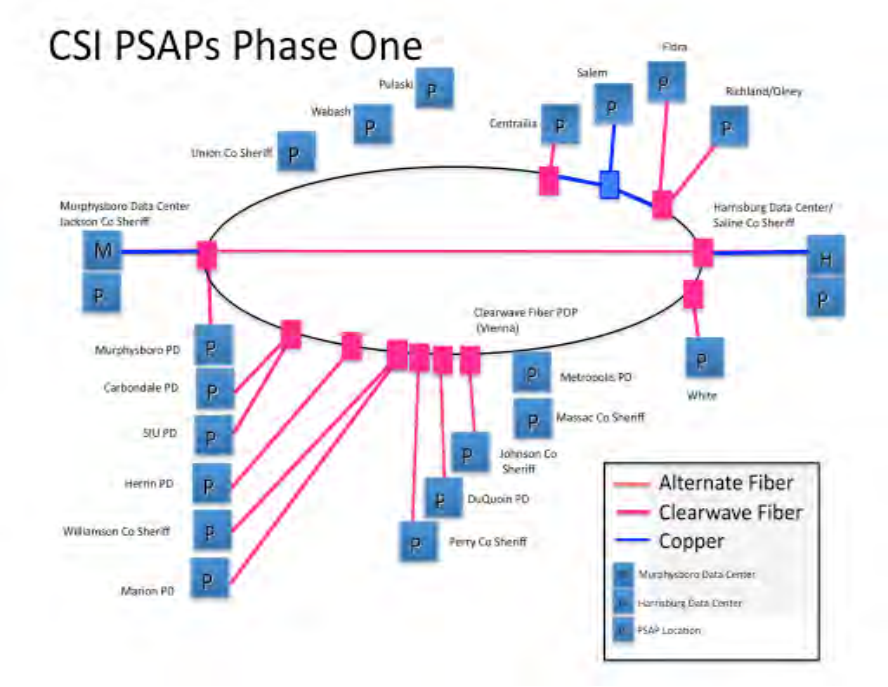


Figure 3.8 - PSAPs Phase One

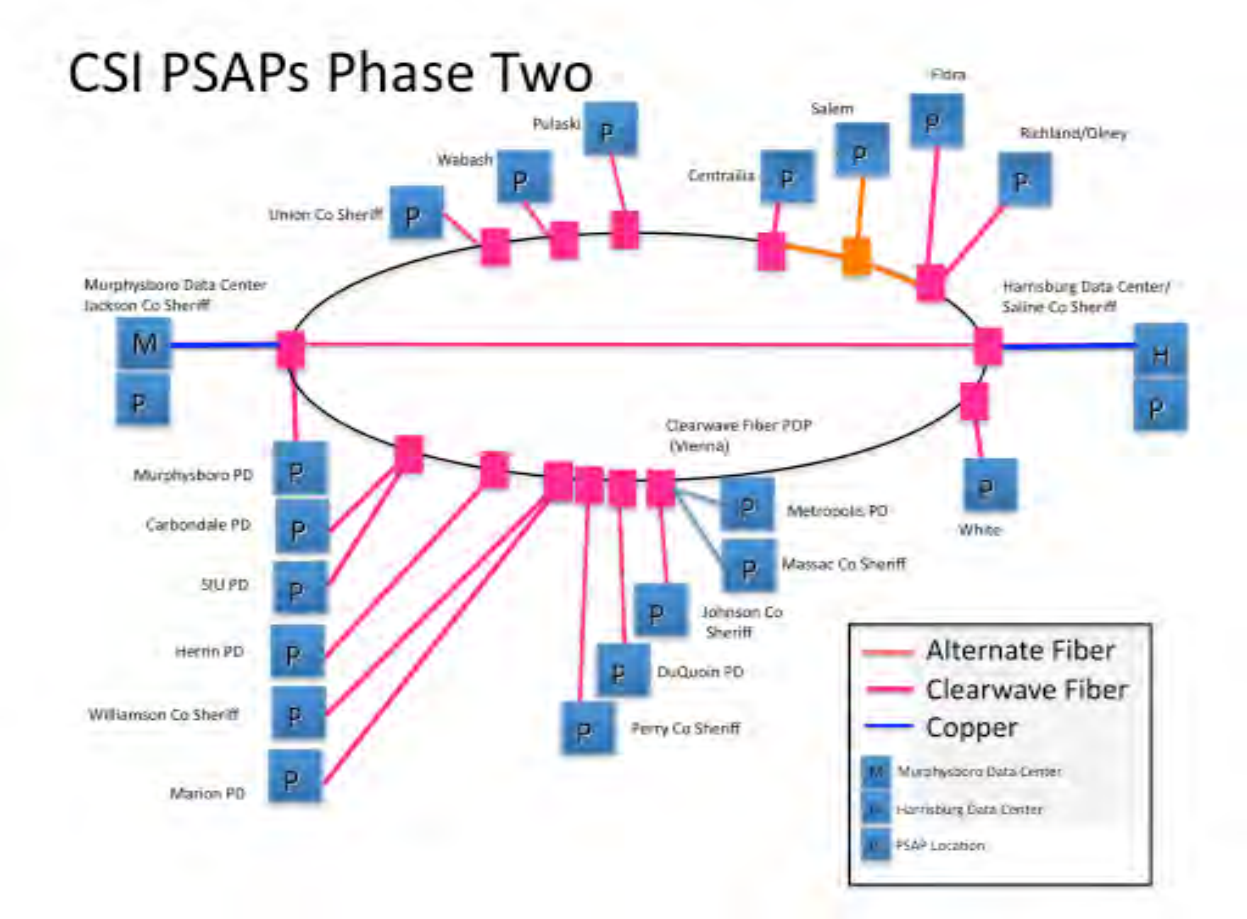


Figure 3.9 - PSAPs Phase Two

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. As facilities become available, fiber will be used.

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*

*Changes to the PSAP plans as of December 2012: Clearwave and Metropolis are working on the arrangements for bringing fiber to the city. For now, Clearwave will bring their fiber to the city limit as a condition of their NTIA BTOP Grant, and Metropolis will meet them and connect the Clearwave fiber to Metropolis city fiber at a fire station that is already connected to the Metropolis PSAP.

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.

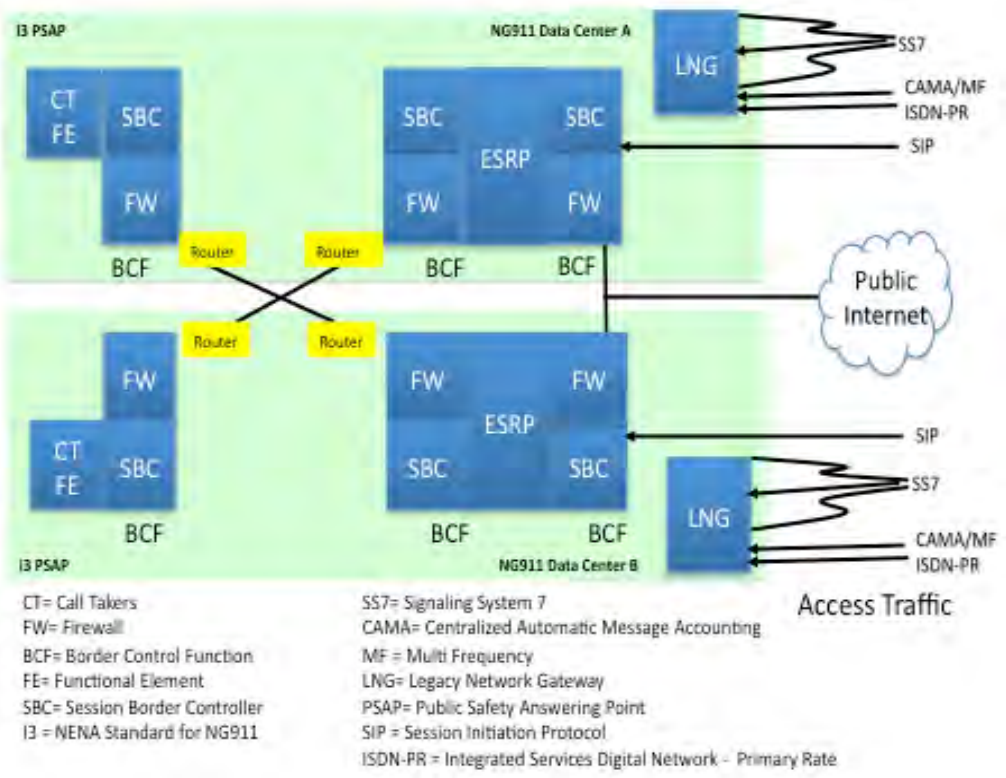


Figure 3.10 - Data Center Architecture – High Level

Diagram Note: The Firewall will be in front of the Legacy and SIP Trunking interfaces for comprehensive network protection.

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. The IIT RTCL tested access for 9-1-1 using ISDN PRI NI2 interfaces to a LNG during ICE 5 in October 2012 and it worked. Carriers with ISDN connectivity and trunking will be encouraged to connect that way if SIP connectivity is not available. This removes cost elements for SS7 if A-links and STPs are used. Carriers such as Clearwave are willing to connective via SIP trunking. Mediacom uses a combination of SIP and ISDN PRI access via Sprint today. Each carrier must be contacted and engineers need to be present or on the call. When engineers are in meetings with the marketing and decision makers the planning is more efficient.

Syniverse Address SS7 - tentative
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

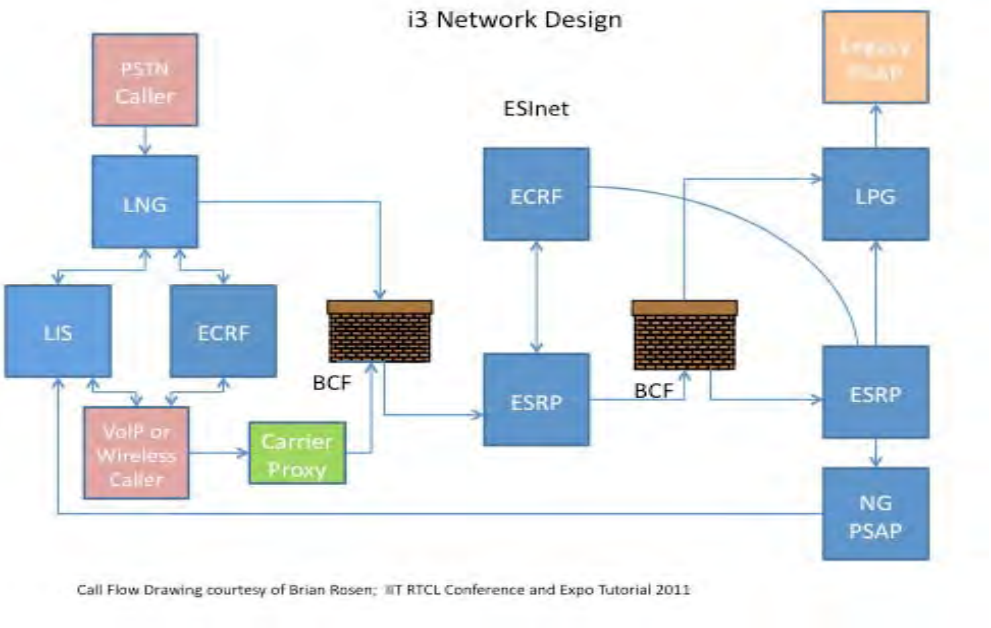


Figure 3.11 - Call Flow Diagram

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. The 9-1-1 SSP for the network and database is NG-911, Inc. This is a contractual change since the original filing.

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. The 9-1-1 SSP is deploying a mated pair of SBCs for CSI, 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

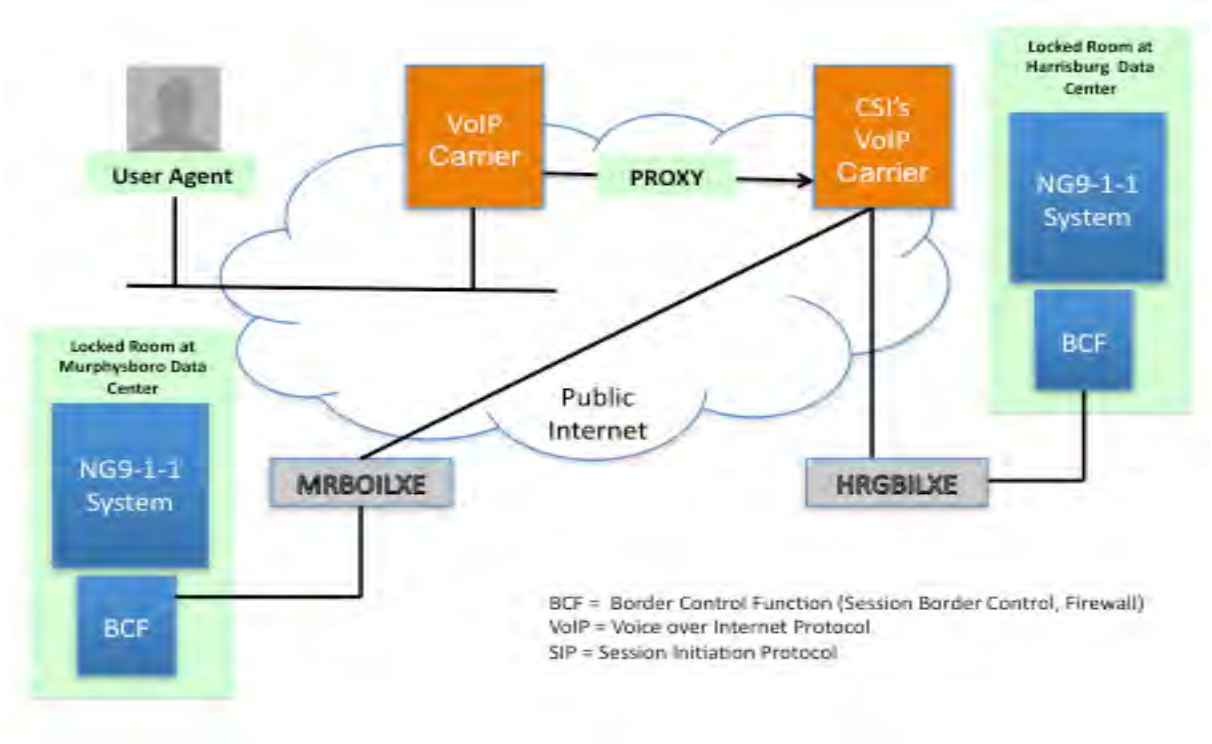


Figure 3.12 – Security

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 9-1-1 SSP and 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. As of December 2012, development of the SLAs are in progress.

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/ 1 hour response	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, number
Murphysboro	Onsite PSAP 24x7x365	Steve Dixon/CSI 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	Ryan Trusty	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 NG-911, 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.

The 9-1-1 SSP 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.

The 9-1-1 SSP 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 operates 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. Testing in the field has begun as of December 2012.

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 9-1-1 SSP is available 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 9-1-1 SSP and 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 9-1-1 SSP and/or 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 the 9-1-1 SSP and CSI.

Network Availability and System Reliability in Legacy PSAPs - NENA Draft Language, 9-1-1 SSP 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 9-1-1 SSP, and 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."*

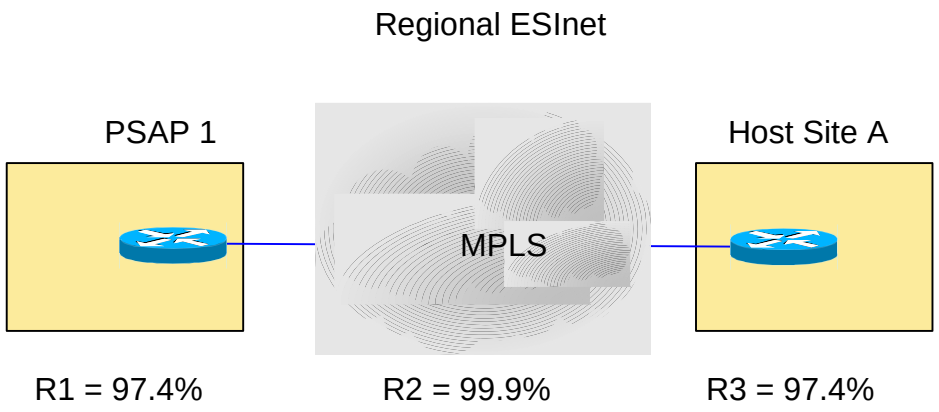
In the CSI ESInet, the use of a back up PSAP is not a failure. The calls and all related information route to the designated alternate PSAPs, thus the caller will get a similar response no matter which PSAP answers the calls**.** The primary and back up PSAP list for CSI is in Attachment 5.

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:*

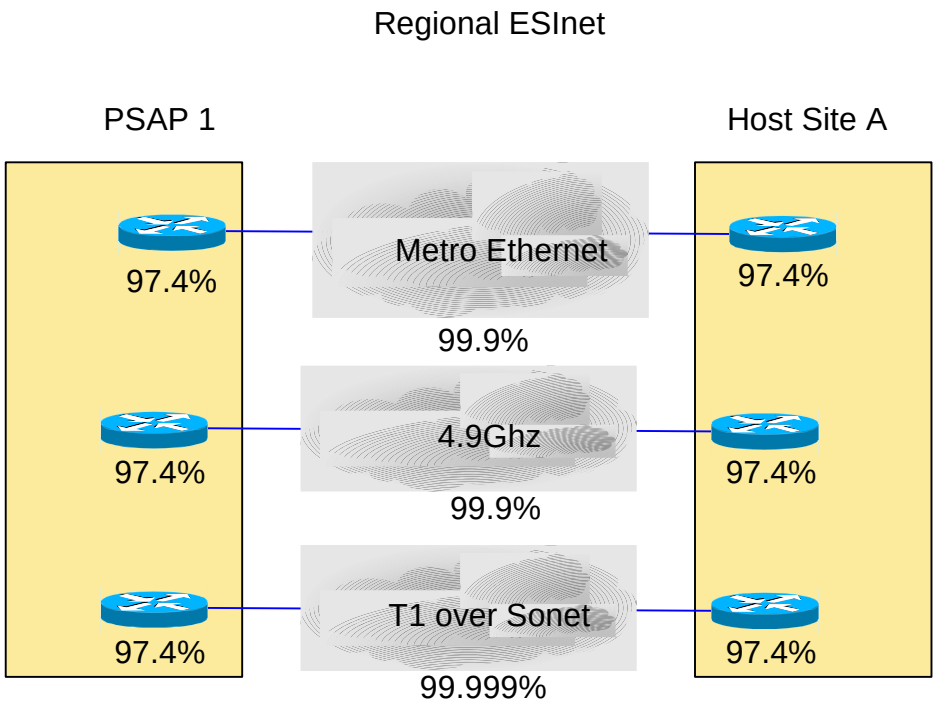
*Rs = R1*R2*R3*

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



Reference: NENA Diagram

Parallel reliability is calculated as:

*RP = 1 - ((1-Rs1) * (1-Rs2) * (1-Rs3))*
Where Rp = Parallel Reliability
and Rs1...3 = the series reliability of each independent link

So if the series reliability of each link is 94.8%, then the reliability for the 3 fully independent and physically diverse links in parallel is almost 4-9s.

*RP = 1-((1-.948) * (1-.948) * (1-.948)) = 1 – (0.052 * 0.052 * 0.052) = 0.99985*

As shown below four fully independent and physically diverse links in parallel are required to achieve a reliability of 5-9s. (Note: In order to be fully independent and physically diverse, the links must not share any components in common (i.e. not in the same trench, not running thru the same Digital Cross Connect at the Central Office, routers not from the same vendor, etc.)

*RP = 1 - ((1-.948) * (1-.948) * (1-.948) * (1-.948))*
*= 1 – (0.052 * 0.052 * 0.052 * 0.052)*
= 0.9999927

In most cases higher overall reliability can be achieved by purchasing several physically diverse low cost links (i.e. Metro ethernet, T1 over Sonet, etc.) as opposed to a single high cost service. Surprisingly, series and parallel availability are calculated using the same formulas shown above for series and parallel reliability.

So assuming all of the necessary considerations have been taken into account (i.e. environmental considerations, operational and technical procedures are developed and adhered to, equipment is replaced as it reaches end of life, etc.) a PSAP that has an ESInet that consists of 4 fully independent and

physically diverse links that have a series reliability (taking routers into account) of at least 94.8% can expect to achieve 5-9s availability (5 minutes or less of downtime per yr) on that ESInet – every year."

CSI has a limited budget; availability and reliability are primary factors, and cost is secondary factor in the Design of the network architecture. Until Clearwave received their NTIA grant, the CSI ETSBs had little hope of affording or being able to rely on a solid underlying network to build their ESInet. Clearwave received the grant in part because they agreed to support the underlying Public Safety ESInet at a reasonable cost. The ESInet standards provide for routing to alternate PSAPs and that routing is limited only to the organizations that agree to accept the calls and get them dispatched properly, not the design of the architecture. It would be ideal to have dual facilities entrances to each PSAP and to the Data Centers. The Design limitations are financially driven. The Design that has been developed is better than the existing network Design. Today's Legacy Network Architecture is not adaptable, scalable or expandable to support the myriad of new user applications required to incorporate Emergency response capabilities. The 9-1-1 SSP and CSI will measure the availability and reliability of their new ESInet architecture and continue to incorporate new processes and technical improvements. In some cases Clearwave may be able to provide dual entrance interfaces to the CSI locations. This is a negotiated work in progress as Clearwave is completing their network build.

ESInet Security – NENA Design Draft

NENA: *"The NENA 75-001 Security for Next-Generation 9-1-1 Standard (NG-SEC) contains a number of sections which apply to ESInets including; Security Policies, Information Classification, Safeguarding Information Assets, Physical Security Guidelines, Network and Remote Access Security Guidelines, Change Control Documentation, Compliance Audits and Reviews. ESInets should be NG-SEC compliant.*

The NENA 08-003 Detailed Functional and Interface Specification for the NENA i3 Solution – Stage 3 contains additional requirements for ESInets including encryption and authentication mechanisms. ESInets should comply with the 08-003 standard."

The 9-1-1 SSP and CSI have every intention of complying with the NENA ESInet Security standards. The Acme Packet SBC is a very powerful solution and the overload capability has been tested in the IIT RTCL lab. The system has proven to protect the network from Denial of Service Attacks and encryption is possible across the ESInet.

Session Border Controllers and Firewalls

NENA: *"It is a best practice to utilize Session Border Controllers on ESInets to provide firewall-like security for call signaling and call media streams. In most cases it will be necessary to put a firewall in parallel with the SBC in order to be able to process all the different types of traffic. Logs and alerts from SBCs and firewalls should be continuously monitored to identify performance issues as well as successful and unsuccessful attacks.*

SBCs and firewalls should be deployed to protect state-level i3 core services from attacks originating both from the access network and from the state-level ESInet. In order to contain virus outbreaks and/or intrusions, it is strongly recommended to deploy SBCs and firewalls at Regional host sites."

NENA: "*It is a best practice to deploy SBCs at the individual PSAPs."*

The network between the Data Centers and the PSAPs is designed as a private intra-system network, with little opportunity for external ingress. Secure access to the PSAPs will be controlled through the SBC products purchased by CSI. The CSI Test Plans include SBC level recommendations in support of the 9-1-1 SSP, NG 9-1-1.

Test Equipment

NENA: *"Active test equipment that can interrupt normal network activity should only be used on a case by case basis when needed to troubleshoot. Passive/monitoring test equipment should be treated differently than active (i.e. traffic generating) equipment. Active testing for FEs of NG9-1-1 beyond OSI layers 1-3 may help resolve outages."*

NENA: *"During implementation and ongoing management of NG9-1-1, low-level packet analysis tools may be required for performance diagnostics and trouble resolution. These tools are equivalent replacement tools for the existing trunk monitoring techniques and tools that are used in legacy 9-1-1."*

The 9-1-1 SSP and CSI will use appropriate testing tools in their network. IIT's RTCL is going to use several tools to do initial load testing. Test boxes are used in the IIT RTCL to determine what is efficient for a typical ESInet configuration and IIT's Project Managers will suggest the type of tools needed by CSI. NG-911, Inc. will be doing field testing and making similar suggestions and recommendations to CSI. Test tools are essential to any NG 9-1-1 organization.

Performance Requirements - NENA Design Draft

NENA*: "There are a number of factors that affect the overall quality of multimedia traffic on an ESInet including packet loss, jitter, and latency. This section outlines some of the important properties of packet loss, jitter, and latency as pertaining to ESInets."*

Packet Loss

NENA: *"Packets can be dropped by various devices in the network (e.g. routers, ATM and MPLS switches), or the packet may have been corrupted during transport and dropped at the destination. An overall (end to end) packet loss budget for maintaining intelligible voice transmission is about 5 %. Out of that 5% budget approximately ½ of the packet loss should be allocated for the ESInets with the remaining allocated for the origination network. It is a best practice to engineer ESInets to keep the packet loss budget under 2.5%. Audio media streams are the most sensitive to packet loss."*

NENA*: "ESInets should be designed without oversubscription. Packet loss of less than 1% should be achievable on such ESInets."*

The 9-1-1 SSP and CSI agree in principal that Packet Loss must be minimized especially in a voice environment. The ESInet is dedicated to CSI. Data Exchange with the Carriers is the only truly accurate means CSI has to ensure there is no over subscription on the network. The NG-911, Inc. and Clearwave sizing algorithms for the Fiber Ring including the bandwidth to get traffic to the 21 PSAPs, was estimated. Only field testing will give the SSP and CSI organizations the ability to test the actual network; friendly carriers' participation is ideal. The Design team agrees the SSP and CSI can do their best job on sizing going forward using the Carriers' Data and PSAPs' Data as the two definitive points of comparison. CSI will have tools on hand to measure Packet Loss. Clearwave has an SLA with CSI. Clearwave will obtain an SLA with the 9-1-1 SSP and the 9-1-1 SSP will have an SLA with CSI. This is in progress.

Jitter

NENA: *"A packet's delay varies with its position in the queues of the routers along the path between source and destination and this position can vary unpredictably. Arrival time of packets is ideally equal to the packetization period (i.e. sample rate times samples per packet). Because of the effects of queuing and because 2 sequential packets sent from the same source may not arrive via the same paths, variation in the actual arrival time of packets may occur. It is this variability in the delay that causes jitter. Jitter buffers are utilized to smooth out the variation."*

NENA: *"It is a best practice to design ESInets to maintain less than 20mS variation in the end point jitter buffers."*

The SSP and CSI's Design team accept the NENA Draft recommendation. The SSP and CSI will have tools on hand to measure Jitter.

Latency

NENA: *"Latency is the amount of time it takes for a packet to reach its destination. The one-way transit delay (i.e. end to end, mouth to ear) for real-time media packets should not exceed 150mS. (ITU-T G.114). When latency exceeds 150 mS, turn taking is significantly impaired. Because the access network is outside the scope of the ESInet, and considerable latency may be incurred, the maximum acceptable delay for packets traversing the ESInet should be less than or equal to 35 mS."*

NENA: *"It is a best practice to design ESInets to operate with less than 15 to 20 mS of latency. This allows the original encode and decode and a conference bridge in the middle of the path and still achieve the maximum 35mS or less packet delay."*

It is our experience that distance can have a significant impact on latency. The Media Server in the CSI ESInet configuration is embedded in the i3PSAP FE. Given the distance from one end of the ESInet to the other of a little over 50 miles, the configuration of the CSI ESInet is such that latency on the CSI ESInet should not be a factor. In a live test at the IIT Lab using an ESInet with FEs in Illinois, Texas and New York, latency was observable in October 2010. CSI will have tools to measure latency.

In the initial network configuration CSI has not identified a SIP Access Carrier who will send their calls via the SIP Trunking option. As of December 2012, Clearwave indicated a willingness to test SIP Access to the NG9-1-1 network. The SSP and CSI will work with each Carrier to do thorough testing. No live ESInet and SIP Access combination exists that we are aware of outside a Lab configuration to pass the 9-1-1 calls. And in any event, Access Carriers within the CSI footprint will be tested thoroughly ahead of service turn up to be sure the NENA standard and their allocation of Latency makes sense. The SBC will protect the CSI ESInet from gross overload.

Hardware/Network Elements - NENA Design Draft

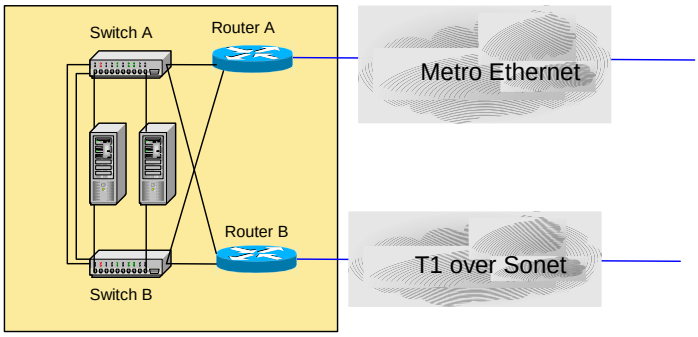
NENA: *"Some of the equipment required to build an ESInet (i.e. routers, firewalls, session border controller(s), etc.) can be leased, other components will have to be purchased. It is a best practice to purchase and/or lease equipment that meets the following criteria:*

- *Is highly reliable*
- *Has a proven track record*
- *Has a warranty*
- *Has an abundance of qualified/trained engineers that can support it.*
- *Vendor provides 24/7 support*
- *Acceptable MTTR*
- *Is scalable"*

The CSI ESInet components meet the criteria and will be subject to testing at IIT's Lab and in the field. Routers and other devices have been identified and will be purchased for the CSI ESInet. In all cases the CSI and NG911, Inc, the SSP, will have warranties, vendor contracts and escalation policies and the devices will be included in the monitoring solution set.

3.6 CSI Network Architecture Diagrams

NENA: Local Area Network (LAN) Architecture



Reference: NENA Design Document

NENA*: "To some degree the ESInet requirements extend into the LAN. In many cases vendors of the IP enabled or NG9-1-1 call taking system will provide and configure the LAN switches. This is due in part to the large number of requirements that the IP enabled 9-1-1 call taking systems place on the LAN. It is a best practice to deploy at least 2 LAN switches at each site, and to configure the switches to be Highly Available (HA). A commonly used HA LAN architecture is shown below."*

NENA: *"The workstations and/or servers shown above are typically equipped with dual Network Interface Cards (NICs). Each NIC is connected to a LAN switch. The switches are connected to each other and to a router that is attached to an ESInet. It is a best practice to utilize managed switches in ESInets. Separate networks for different vendors are not recommended. In most cases the use of multiple VLANs can achieve sufficient isolation of network components in a shared infrastructure."*

3.6.1 CSI Network Configurations

The equipment depicted in the following diagrams is the actual equipment chosen to complete the network design. The size of the facilities is an estimate based on earlier provided estimates for the traffic loads. 9-1-1 annual traffic volumes appear low and there is little "peakedness" observed by the CSI ETSBs in their daily business. There are 21 PSAPs with 47 active positions. No more than 47 calls can ever traverse the ESInet at one time and be managed in real time. Other calls can sit in queue or on hold although CSI tries never to have callers on hold. . Many times only 1 or 2 positions are staffed in any of the PSAPs today at any time. Average holding times have been provided. Call queue can be done in the PSAPs, and the PSAP operators can control the queues with Policy rules.

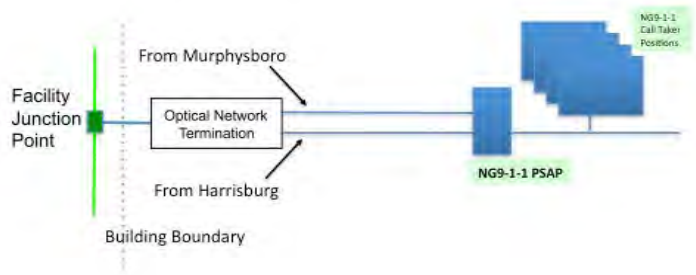


Figure 3.13 - Typical PSAP

Typical PSAP: Figure 3.13 describes the typical PSAP connected by Fiber Ring in the CSI Architecture. Clearwave has a Point of Presence in the Frontier Wire Centers located next to the 2 Data Centers. Clearwave will run Copper to each of the two Data Center.

Ten (10) Mb of capacity will go in and out each PSAP to connect to the i3 PSAP equipment. The traffic will route around the ring to complete the connection no matter which Data Center gets the call first. The database information residing at the Data Center will map the call to the correct PSAP first and then alternate route if all positions are busy. The transmission of the call to the i3 PSAP locations will be via 1 Gbps of Ethernet. A 300 Megabit Physical Fiber ring connects the 2 Data Centers from the first Phase forward.

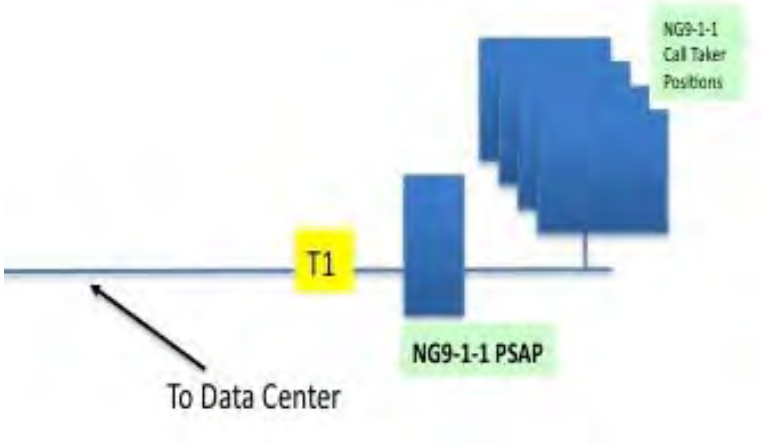


Figure 3.14 - Non-Fiber PSAP

Non-Fiber PSAP: In Figure 3.14, you see the Non-Fiber PSAP. In our example the traffic goes from the Clearwave Fiber Ring coming from the PSAP adjacent Frontier Central Office(s) where Clearwave has a Point of Interface. The facility provider converts the calls to DS1 over Copper and delivers a single facility into the Non fiber PSAPs. The DS1s will connect into the new i3PSAP equipment over Copper at the bandwidth of the Copper facilities. If the PSAP positions are busy, the ESInet will route to an alternate PSAP as designated in the equipment routing instructions for alternate PSAPs. If the DS1 is down the Data Center will route the call directly to a PSAP designated to handle the calls. As long as DS1s are involved there will be only one DS1 into the PSAP due to cost constraints. The alternate PSAP will get all of the call routing details from the ESInet Databases. Note T1 and DS1 are terms used interchangeably in this document with no intended differentiation implied.

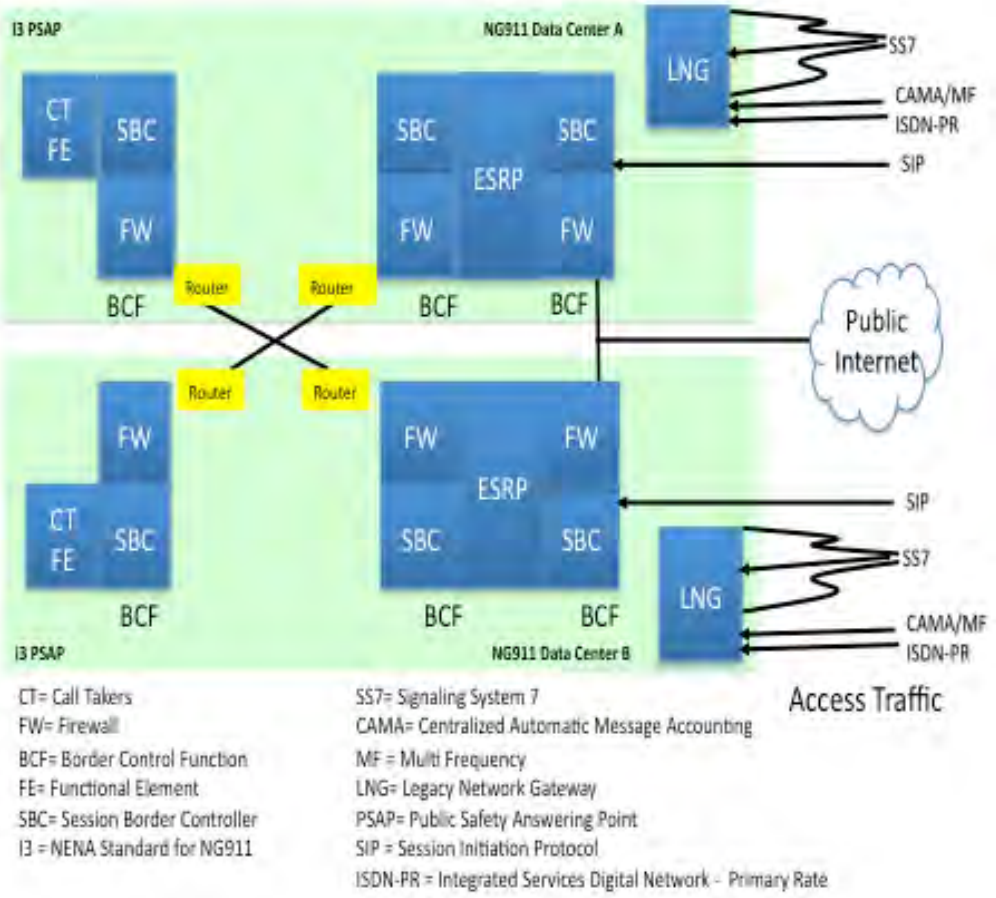


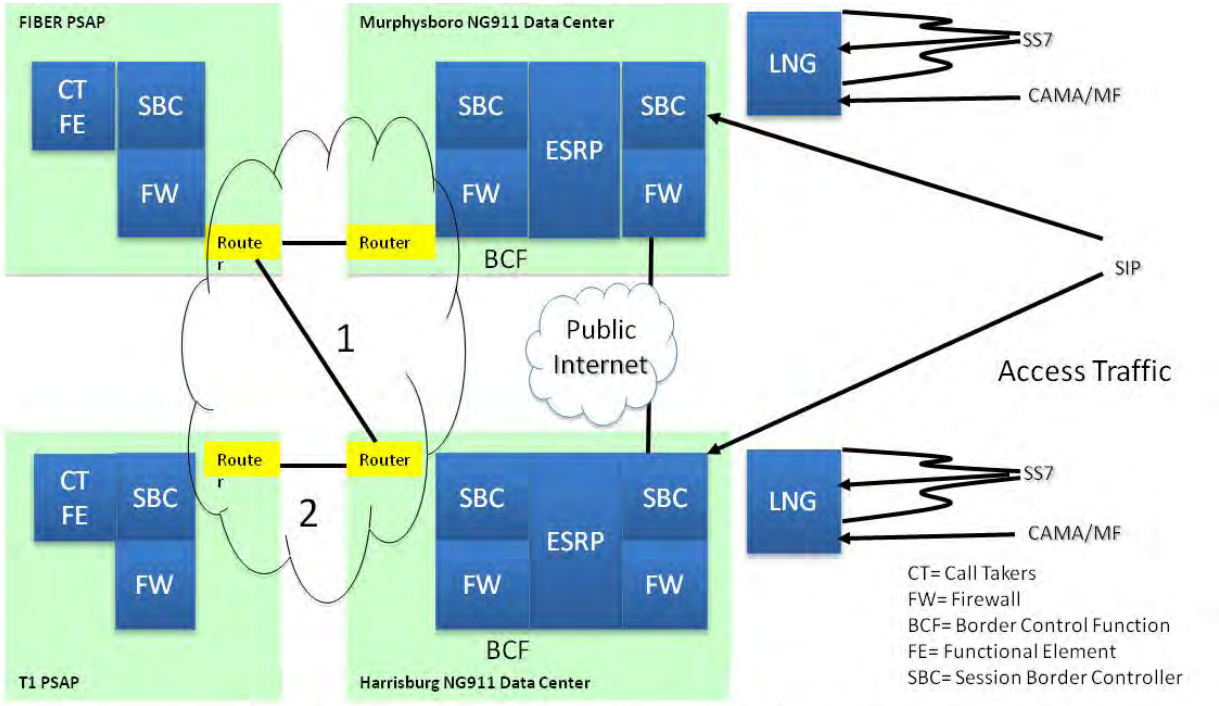
Figure 3.15 - Data Centers (Diagram Note: The BCF will protect the Legacy and SIP Components of the ESInet. This is a change from the drawing.)

Data Centers: Figure 3.15 depicts the network configuration from the Data Centers. There are actually two strands going around the ring in both directions. They are sized at 150 Mb in each direction. They connect the two Data Centers. Those two strands are carrying the full load of the ESInet traffic which has entered the network from the Carriers and has to be passed along to the 21 PSAPs

This is what would be best described as the “backbone of the ESInet.” The Access calls from the Carriers arrive at the two Data Centers and they connect right to the Gateways passing through SBCs as needed to protect the ESInet. Clearwave will bring the Fiber into the Data Centers from the nearby Frontier Wire Centers where they are collocated. Frontier will be bringing their traffic into the same two buildings through their existing Telco entrances. Eventually, all of the other Carriers will be originating their trunks from their Access Class 5 locations on trunking terminating to the same locations through designated entrances. Some Carriers may ask to contract with Frontier. Others may come on their own via Fiber or Copper and others may group themselves together and make design arrangements which are mutually beneficial. Clearwave is providing the funding for the Calix and Juniper equipment in the Data Centers. This is being changed. CSI funded the routers in the data centers and so far the equipment is made by Cisco. This change took place in October 2012.

Figure 3.16 shows the overall CSI Network Architecture. This is a diagram that pulls the Design into a single image that most closely parallels what you see in the NENA Design Standard for a Regional Network. **The layout is right to left because that is how NENA shows their Regional diagram which is inserted below.** Since there is no State ESInet in Illinois, the comparison is not exact. In Illinois the Access Carriers will be coming to each ESInet as they are built. There will be a requirement for trunks from the Selective Routers in the CSI footprint to the 2 Data Centers to allow for efficient cutover of live traffic and a reasonable transition over time. The NENA Design does not address the means to get to the ESInet and/or the Legacy Network Gateways or the SIP ESRP Gateways. Design meetings have been held with the Carriers to ascertain loads and network sizing. We believe, by being first in this regard nationally, we have uncovered access and other issues that will be surfacing across the country. The NENA transition plan is evolving and will serve as a guideline, CSI plans to have live traffic on the NG 9-1-1 network during the trial after successful testing.

Figure 3.16 - CSI Network Architecture (Diagram Note: The BCF will protect the Legacy and SIP Components of the ESInet. This is a change from the drawing.)



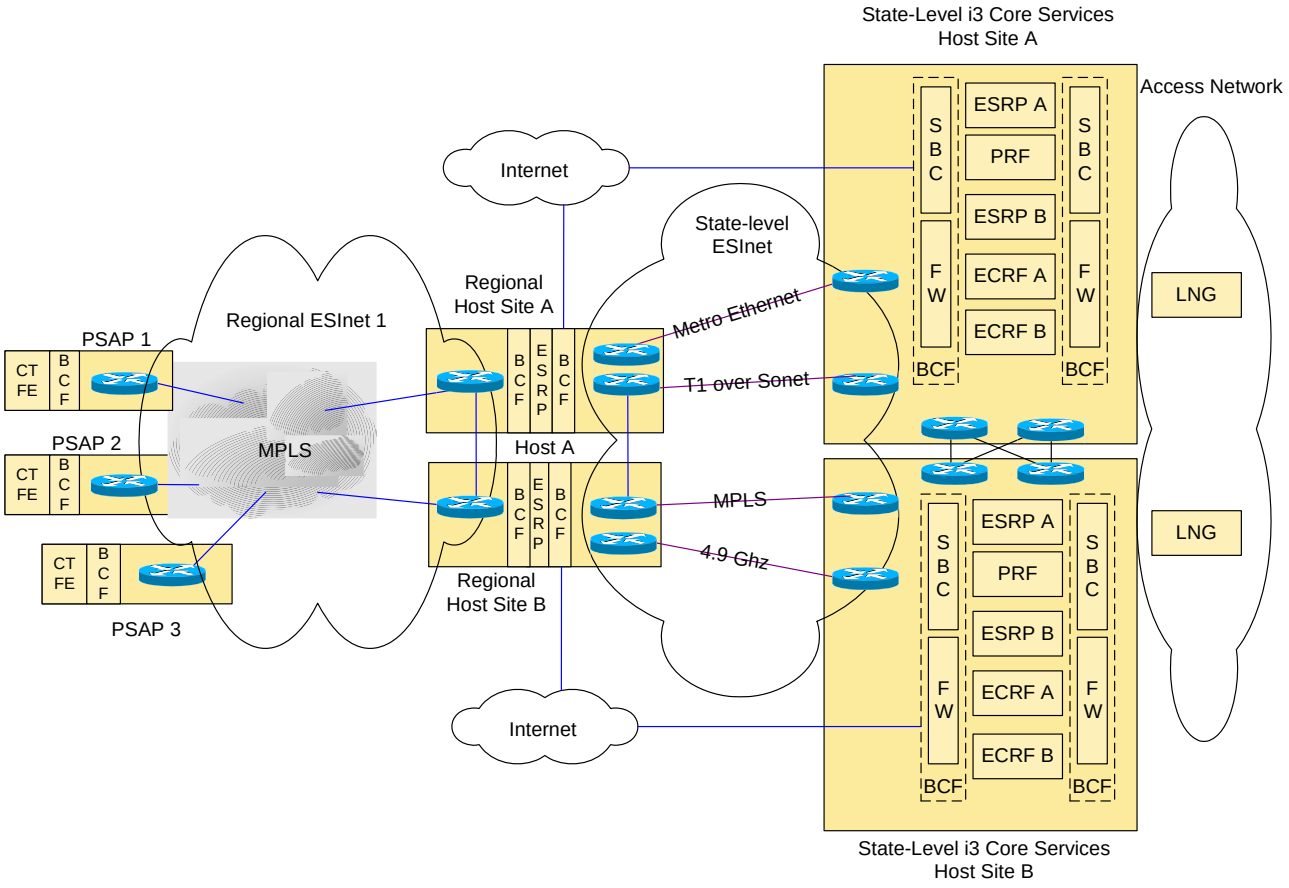
1. Fiber: Type and Characteristics of underlying transport : Fiber - Metro Ethernet
2. T-Carrier: Type and Characteristics of underlying transport : Copper

NENA Sample ESInet Architecture - Compare to the CSI Regional Network Architecture above.

NENA: *"This section covers some of the most commonly utilized ESInet architectures; some of their caveats, advantages, and disadvantages. Common objectives for ESInet architectures are to maximize availability and reliability within budgetary constraints. The diagram below shows a regional ESInet which is connected to state level i3 core services via a state-level ESInet.*[1]

Figure 3.17 – Regional ESInet I (NENA)

Regional ESInet I (NENA)

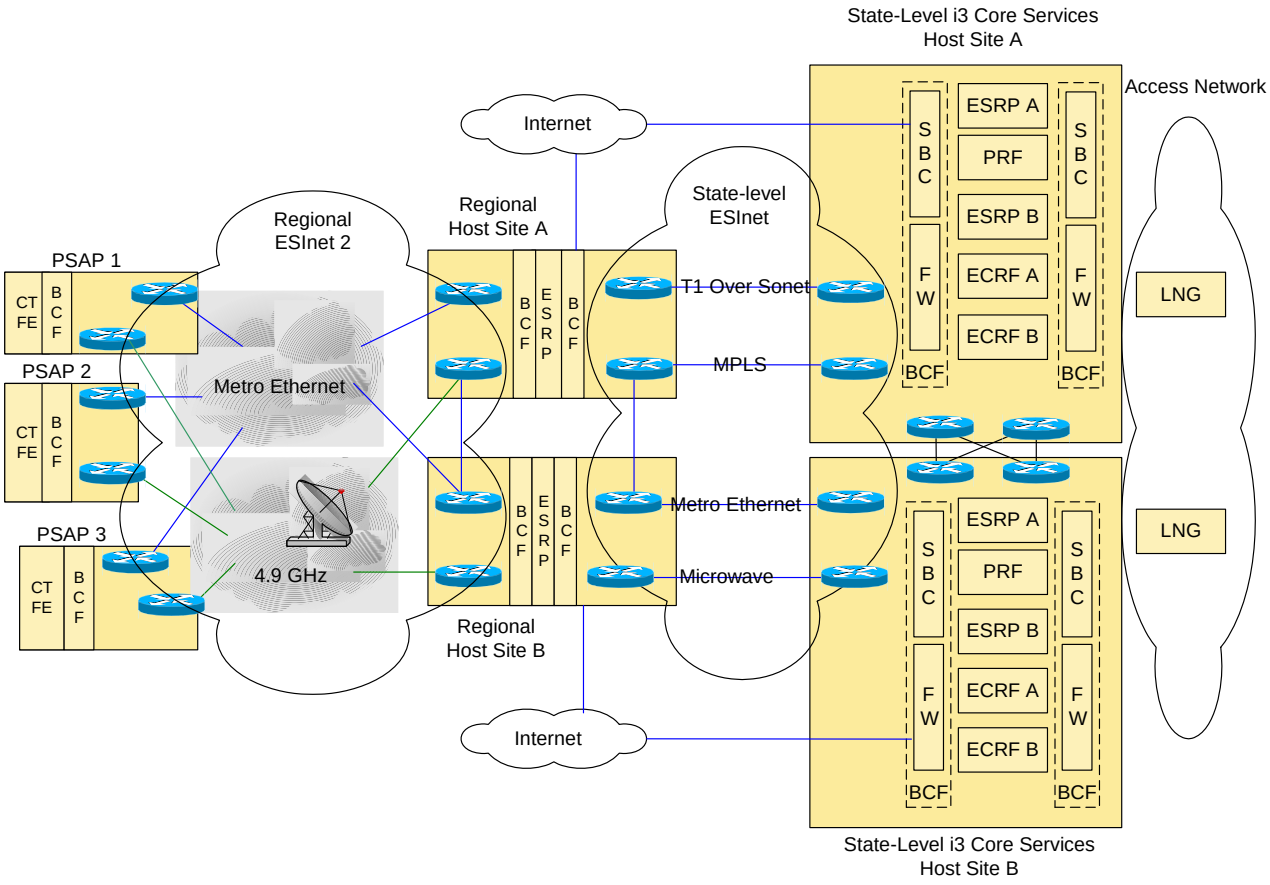


[1] In an effort to simplify the diagrams the physical connections within the sites (i.e. router to switch, switch to server, etc) are not shown.

The state-level i3 core services are located at 2 geographically diverse sites – Host Site A and Host Site B. In order to assure high availability, redundant firewalls, Session Border Controllers (SBCs), ESRPs, and ECRFs are located at each of the state-level host sites. The i3 core services (i.e. ESRP, ECRF, and PRF) and the Legacy Network Gateways (LNGs) are outside the scope of the ESInet, but it was the consensus of the authors of this document that it would to be advantageous to show how the i3 core services should be connected into an ESInet. It is a best practice to build state-level host sites and regional host sites in highly available Data Centers.

Regional ESInet I in this example is comprised of an MPLS network. The PSAPs have a single entrance facility through which all circuits are delivered. A single router that provides connectivity into the regional ESInet is located in the backroom of each PSAP. Each PSAP has one or more call taker positions and a Border Control Function (BCF) which consists of a session border controller and a firewall. As discussed, reliability engineering calculations show the reliability and availability of Regional ESInet I to be on the order of 2-9s. PSAPs utilizing this solution must therefore rely on traditional methods (i.e. back-up PSAPs and 10 digit numbers) to achieve 5-9s availability for the overall 9-1-1 service in their region. The state-level ESInet, which transports call signaling message exchanges, call media streams which carry the call's audio, and data from the state-level i3 core services to the regional host sites, is designed to achieve 5-9s availability. Connections to Internet border controllers from outside the ESInets are shown at both the regional hosts and state-level host sites. Among other things these connections could be utilized to support requirements to receive emergency 9-1-1 calls via the Internet and/or to support remote access requirements for monitoring and maintenance."

Figure 3.18 – Regional ESInet II (NENA)



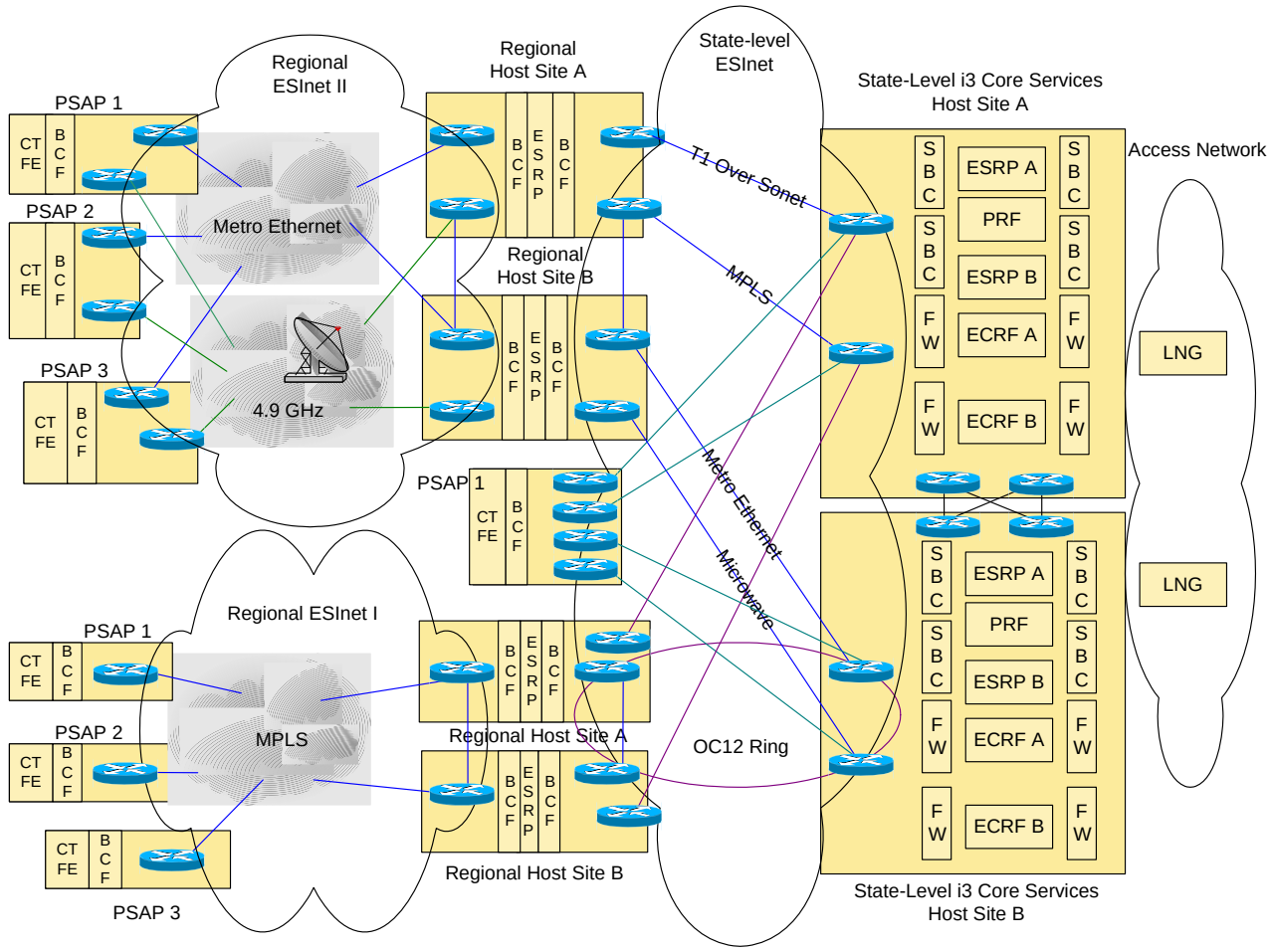
Reference: NENA Design Plan

Regional ESInet II (above) is comprised of two physically diverse and independent networks; a Metro Ethernet and a 4.9 GHz microwave network. Separate routers and entrance facilities are utilized for each of the layer 2 technologies. As described throughout this document there is a long list of other criteria which must be met, but assuming a typical PSAP environment, if properly designed and maintained, reliability engineering calculations show ESInet II to be capable of achieving 3-9s availability.

It is anticipated that many regional 9-1-1 entities and possibly individual PSAPs will connect into the state level i3 core services. The diagram below shows how the ESInets might be interconnected.[2] It is a best practice to design connections from regional host sites to state level i3 core services (i.e. state-level ESInets) to achieve 5-9s availability.

[2] Connections to the Internet are not shown.

Figure 3.19 - Interconnecting Multiple ESInets (NENA)



Reference: NENA Design Plan

NENA Conclusion

"In this document many aspects underlying the design and construction of an i3 ESInet at OSI layers 1, 2, and 3 are addressed from both a technical and operational perspective. Given that resilient networks can be built using different approaches, a variety of network architecture options and methodologies for achieving recommended reliability and availability service levels are discussed throughout the document. In addition to the specific performance requirements that are included, operational requirements such as those that relate to service level agreements for operators of ESInets are discussed, as well as several aspects of network security. Further, since ESInets must deliver high priority traffic in the face of severe congestion, this document provides a variety of traffic engineering strategies for achieving these goals which are discussed alongside ESInet network management and monitoring.

After covering and reviewing the topics above and noting that a number of the topics covered in this document are fields of study to which people devote their entire careers, this working group has concluded that the information contained in this document by itself, although helpful and educational,

does not provide all of the necessary details required to thoroughly design an i3 ESInet. It is rather a best practice document, meant to stimulate discussion and provide background and overall guidance for qualified IP network design engineers tasked with designing i3 ESInets."

9-1-1 SSP and CSI Conclusion

The 9-1-1 SSP and CSI concur: After covering and reviewing the topics above and noting that a number of the topics covered in this document are fields of study to which people devote their entire careers, we also concluded that the information contained in NENA's document by itself, although helpful and educational, does not provide all of the necessary details required to thoroughly design an i3 ESInet. It is rather a best practice document, meant to stimulate discussion and provide background and overall guidance for qualified IP network design engineers tasked with designing i3 ESInet. Actual Design takes a cooperative effort with everyone in the network architecture and 9-1-1 cannot be considered outside the context of the real world carrier and access opportunities and challenges.

3.7 Migrating 9-1-1 Service

In order to migrate the legacy E9-1-1 calls from the existing legacy network, the following deployment plan will be followed.

3.7.1 Preparation of Access Carriers

All access carriers (Wireline Carriers, Wireless Carriers, CLECs, etc.) will review the sizing of their legacy E9-1-1 trunk groups from their switching entities to the legacy SR. Each access carrier will provide their traffic engineering data and trunk group counts and type description (CAMA/MF, SS7, etc) to the 9-1-1 ESInet Design Team. Each access carrier will collaborate with the 9-1-1 SSP and CSI ESInet Design Team to agree upon the appropriate number of trunks and types from each of their switching entities to the LNG and SIP Trunking functions in each of the Data Centers. IP trunking connectivity will be utilized where ever practicable. Once the new trunking is installed, field testing will commence. The transfer of the 9-1-1 traffic load will occur after all field tests have been passed, the lab and field testing of the ESInet has been passed, the appropriate PSAP or PSAPs required to accept the traffic have been equipped with the new IP work station equipment and have passed both lab and field testing. A deployment schedule will be developed to coordinate these activities. Refer to the Access Plan Document for further details (Assure911.net-DG-CSI/NG911-002).

3.7.2 Preparation of PSAPs

All PSAPs in the trial area (13 PSAPs) will review the sizing of their legacy E9-1-1 trunk groups from the legacy SRs providing 9-1-1 traffic to their legacy call answering positions. Each PSAP will provide their traffic engineering data, trunk counts and type description (CAMA/MF, SS7, etc) and their call taker traffic loads and position requirements to the 9-1-1 SSP and CSI ESInet Design Team. Each PSAP will collaborate with the 9-1-1 SSP and CSI ESInet Design Team to agree upon the appropriate number of IP work stations required and the date (as shown by the deployment schedule) that they will be required. The PSAP IP equipment will be configured according to this data Network Design Plan. Each PSAP will also provide the traffic engineering data and trunk/line counts and type description of all incoming, outgoing and 2-way trunks/lines between their PSAP and all other PSAPs to which they connect for the handling of cross-boundary calls, misrouted calls, and failover purposes. Each PSAP will collaborate with the 9-1-1 SSP and CSI ESInet Design Team to agree upon the appropriate type and number of interconnections with other PSAPs required and the time that they will be required according to the deployment schedule in the new ESInet environment.

3.7.3 Preparation of Data Centers

The Data Centers will be ready to accept the 9-1-1 traffic loads delivered to them by the Access Carriers, processed, and delivered to the appropriate PSAP. The equipment will be configured according to the data network Design Plan. The configured ESInet will be lab tested at an appropriate level and then field tested. Lab testing will include failover testing and evaluate any lost 9-1-1 calls during failover. When all tests are passed, the first access traffic load will be accepted and delivered to the appropriate PSAP/PSAPs in accordance with the deployment schedule. Subsequent migration will occur as specified in the deployment schedule.

3.7.4 Cross Boundary Traffic

There are two types of Cross Boundary situations. One is between PSAPs which are both on the ESInet. The second is for PSAPs that are outside the ESInet Boundary and are using Legacy PSAP Equipment to receive the bulk of their calls. Refer to the CSI Access Plan. The Design accommodates Split Access. In some cases the Selective Router trunking may have to be retained for a while. This will be agreed upon once the Access Carriers provide the needed factual data.

In the case of the Legacy PSAP a Legacy PSAP Gateway, LPG will be utilized. CSI is offering to place those or a small subset called an Extended Gateway (EG) at no charge to the neighboring Legacy PSAP.

A small fraction of the calls will be managed this way.

Assuming at some point more ESInets are built in Illinois, the systems and ESInets automatically handle calls ESInet to ESInet transfers without the extraordinary interim Transition arrangements. There are Functional Elements (FEs) called the ECRFs with have LoST protocols Private and Public LoST. The calls get identified by the ECRF “Public LoST” before being ESRP routed into an ESInet and therefore get routed and handled by the ECRF “Private LoST” to complete the calls to an ESInet PSAP. Refer to the Call Flow discussion.

3.7.5 Transfer Calls Out of the Network

There is a need to Transfer calls off-net. In this case, the database entries point the call to a PSAP on the ESInet but the responsibility for the call lies with an adjacent PSAP. The call is transferred off-net via the LPG. The receiving adjacent PSAP can rebid back through the LPG. The Figure 3.18 shows the call flow process. Refer to the CSI Access Plan.

3.8 Recovery and Restoration

All ESInet configuration data and all database data will be backed-up and stored off-premise in two locations yet to be determined. One location will provide real-time restoration capability. On site backup of all configuration data will be maintained by the 9-1-1 SSP.

3.9 Emergency Power

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.

See Attachment 5 for more detail on the power configuration in the CSI project.

3.10 Gateways, Switching Equipment or Selective Routers

The Gateway functionality for incoming 9-1-1 calls resides in fully duplicated form in the two geographically separated Data Centers. The ESRP Gateways are the connection points for the Carrier Access Circuits after traffic comes through the Acme Packet SBCs.

The Carriers' Selective Router calls are routed to the CSI ETSB PSAPS from: Carbondale (Frontier), Casey (Frontier), Centralia (AT&T), Bellville (AT&T), and Mattoon (ICTC – Consolidated). Negotiation with each Carrier is critical to the timing of the migration of end office 9-1-1 traffic to the Data Centers. Selective Router Trunk groups will be required to the two (2) CSI NG 9-1-1 Data Centers until all 9-1-1 traffic is migrated. Engineering, provisioning and cutover meetings are taking place between the 9-1-1 SSP and those carriers. Details will be part of the Cutover Plan.

The SRs' calls are migrating from are in Carbondale (Frontier), Casey (Frontier), Centralia (AT&T), Bellville (AT&T), and Mattoon (ICTC – Consolidated).

Selective Router Name/LATA	**SR Carrier**	**Address (LERG On Order by 9-1-1 SSP; Work in Progress as of 12-14-2012)**
Frontier/LATA 362	Carbondale	208 W. Monroe St., Carbondale, IL 62901 (CLLI-)
Frontier/LATA 978	Casey	11 S.E. First St Casey, IL 62420 (CLLI-CASYILXC1ED)
Centralia/LATA 520	AT&T	210 N. Locust St., Centralia, IL 62801 (CLLI-)
Bellville/LATA 520	AT&T	211 Kretschmer Ave., Belleville IL, 62220. (CLLI-)
Mattoon/LATA 978	Consolidated- ICTC	121 S. 17th St. Mattoon, IL or 1501 CHARLESTON AVE 61938 (CLLI-)

3.11 Redundancy and Diversity

All components of the ESInet are fully duplicated for full redundancy. The core of the Clearwave network is a redundant ring architecture. Access trunking and the facility routes to the PSAPs are on diverse facilities where available.

Carrier Diversity is to be negotiated with the each Carrier. CSI has asked for Diverse Access. The Trunking ought to be the same from each end office to each Data Center. If the Carriers cut their trunks in half, should a single Data Center Fail, automatically only half of the Access 9-1-1 traffic can get to the ESInet. The Carriers were asked to connect their facilities and trunks directly to the 2 Data Centers in Murphysboro and Harrisburg and provide Circuit Order Layout Records and reach information for 24 by 7 by 365 problem resolution and provisioning. Carriers were asked to provide a Forecast of growth for the new and existing services for up to 5 years. An annual review of actual traffic loads has been requested. This means carriers will be doubling their trunking at baseline from the beginning and their facilities for the length of the Pilot Project or the time the ICC requires, whichever is less.

Selective Router trunking is required as a first step in the conversion process from the SR locations to the Data Centers. Some Carriers have asked to stay on the SR trunking. This is not an optimal Design Solution. The ICC is asking for information on how each Carrier plans to get to the Data Centers. Data gathering is in progress led by the 9-1-1 SSP. SRs add a layer of complexity to the routing, add call set up time, do not remove single points of failure and in fact add points of failure end to end. NENA allows the SR in the transition plan. The Design engineer recommends against it. The new services will never be achieved by SR routing,

3.12 Enterprise 9-1-1

The ESRP Gateway equipment being deployed by the vendor into the CSI Data Centers is capable of accepting ISDN PRI, SIP, SS7, CAMA and MF interconnections from Enterprise PBXs according to the NG9-1-1 standards. CSI has not identified any Enterprises who require such an interface during the Pilot Program.

PS/ALI entry is available via a web based application.

3.13 Traffic Engineering

ESInets should be designed to provide non-blocking service for high priority traffic. Bandwidth, Traffic Policing, Traffic Shaping and Quality of Service are some of the main design considerations which must be taken into account. This section describes some of the caveats to be avoided and best practices that should be observed with regard to traffic engineering in ESInets.

Dimensioning ESInet Data Circuits
Traditionally, bandwidth sizing requirements for wide area networks are based on the bandwidth requirements of the applications being utilized on that network. One of the challenges of designing ESInets today is that some of the applications that are expected to be implemented may be outside 9-1-1 and others are yet to be developed.

NENA 08-003, Section 4.8.1.2 requires support for video using the H.264 codec, baseline profile, levels 1-3. The maximum video bit rate for level 3 is 10Mbps. However, reasonable quality can be supported by less bandwidth given typical environments for emergency calls, which usually do not have rapid scene changes, and often have "talking heads".

NENA: *"Further, while best practice for PSAP design would be to support all media at all positions that does not necessarily imply that all positions must support the full level 3 bandwidth simultaneously. The bandwidth required is subject to some differences of opinion among practitioners. One possible formula is 2 Mbps per PSAP + 2 Mbps per call-center position equipped for video, but more (or less) bandwidth may be appropriate for a given ESInet. The actual bandwidth requirements for any individual installation should be properly designed by qualified network design engineers."* This number is also referenced by Brian Rosen in other section of this document and he refers to it as "Brian's Rule of Thumb." Brian is the primary author of the i3 standards.

NENA: *"It is considered a best practice to always design and deploy ESInets that are scalable with regard to bandwidth allocation."*

This way, when bandwidth intensive applications are deployed, ESInets can be quickly scaled to meet these adjusted requirements. One concept that has been discussed and generally agreed to among the authors of this document is that the bandwidth requirements will expand over time, and will use up all available bandwidth capacity. Therefore, we can recommend that

NENA: *"a fundamental best practice is to provision as much bandwidth capacity during the ESInet design phase as is reasonable for application use to cover a 2 year planning horizon, and that is economically feasible."*

The circuits upon which Internet based emergency 9-1-1 calls will be delivered have some unique design considerations. The primary factor that drives the bandwidth requirement for these circuits is a Distributed Denial of Service Attack (DDOS). Per 08-003 these circuits must be terminated into a Border

Control Function (BCF) which in this case would be a Session Border Controller (SBC). SBCs are programmed to recognize and thwart attacks, but the resources required to be able to receive an emergency 9-1-1 call via the Internet during a DDOS attack are significant. The ingress to the BCF should be designed to withstand the largest feasible attack. It is a best practice to engage qualified security professionals knowledgeable about current DDOS mitigation techniques to develop and implement strategies to protect ESInets against DDOS attacks. The Acme Packet Engineers are experienced in these areas.

In the CSI ESInet the Acme Packet SBC has been chosen to be deployed against Denial of Service Attacks and other security requirements. The agreement includes warranties and support from the vendor.

Another NENA caution from Rick Jones Operations Director in the NENA Operations Reference Document companion to the i3 Standards: Rick suggests that the PSAPs not allow all calls to overflow to all PSAPs so a single event does not take up all of the ESInet NG PSAP call takers' capacity. The PSAP users and their Managers and IT personnel will be trained and have tools to create and in real time implement policies to identify an event and move calls for that event into their own queue. Refer to Exhibit 12 for NENA Operations Documents for NG 9-1-1 Engineering.

Traffic Policing

Some of the layer 2 technologies that can be utilized to provide transport for ESInets require that the traffic that is being sent into the network conform to a number of requirements including peak and sustainable cell/packet rate. Traffic that exceeds the rate purchased from the service provider may be discarded immediately, marked as non-compliant, delayed, or left as-is, depending on administrative policy and the characteristics of the excess traffic.

Traffic Shaping

Traffic shaping is commonly applied at the network edges to control traffic entering the network. Traffic shaping is frequently required when the port speeds exceed the amount of bandwidth purchased from the service provider. For example, assume a 10 Mbps Metro Ethernet service is purchased from a service provider. If the 100 Mbps Fast Ethernet port of a router is connected to that circuit, in many cases even though the data being transmitted over a period of 1 second is less than 10 Mega-bits, the router (transmitting at 100Mbps) will exceed the rates deemed acceptable by the service provider and packets will be dropped.

NENA: *"When port speeds are not equal to the amount of bandwidth being purchased from the service provider, it is a best practice to configure traffic shaping on the routers to ensure that the traffic being transmitted is in compliance with the traffic contract."*

Quality of Service (QoS)

Quality of service is the ability to give priority to different data flows. In ESInets QoS is implemented by configuring routers and other network elements to respect DiffServ Code Points (DSCPs) as defined in RFC 2475.

Per the Detailed Functional and Interface Standards for the NENA i3 Solution Version 1.0 (NENA 08-003)

- Functional Elements must mark packets they create with appropriate code points.
- The BCF must police code points for packets entering the ESInet.
- The following code points and Per Hop Behaviors (PHB) must be used on ESInets:

DSCP	Use	Per Hop Behaviors (PBH)
0	Routine Traffic	Default

1	9-1-1 Signaling	AF 12
2	9-1-1 Text Media	AF 12
3	9-1-1 Audio Media	EF
4	9-1-1 Video Media	AF 11
5	9-1-1 Non Human initiated Call	AF 21
6	Intra ESInet Events	AF 21
7	Intra ESInet Other 9-1-1 Traffic	AF 22

See RFC 2475 for a detailed description of DSCP and PHB mechanisms and functionality.

3.14 Comprehensive Test Plan

The Test is being provided in a separate document. It should be noted that no live 9-1-1 calls will be involved at any stage of testing until Cutover. Live 9-1-1 calls are anticipated during the Pilot Project.

3.15 Network Management and Monitoring

The ESInet and NG9-1-1 systems require a large degree of reliability in order to maintain the high-availability that the public has come to rely on when communicating with emergency responders by dialing 9-1-1. Designing the ESInet with multiple diverse interfaces, sufficient bandwidth capacity, and redundant hardware to eliminate single points of failure can increase its overall level of reliability. However, because of a host of potential unforeseen circumstances and the possibility of human error, high availability requires more than the network design alone. An effective monitoring plan is needed.

Proactive monitoring and responding to faults as well as performance degradations that may interfere with completion of attempts by callers and smart devices to communicate with call takers adds to reliability. It may appear complicated as different aspects of the ESInet and NG9-1-1 System will be procured from a wide variety of suppliers. Service providers for the underlying IP network, carriers bringing calls into the system, the NG9-1-1 equipment itself can all play a part in exchanging data needed to effectively monitor the end-to-end system.

3.15.1 NENA Network Management and Monitoring Design Requirements

The NENA Board approved the ESInet Design for NG9-1-1 NENA 08-506, Version 1, standard which includes a section regarding network alarming recommendations (SS 3.6):

"Critical circuits for E9-1-1 calls (i.e. PSAP trunks and ALI circuits) are monitored. Outages may be FCC reportable. By the same token ESInet(s), which provide transport for emergency 9-1-1 calls, should also be monitored."

The various providers of underlying facilities have their own surveillance systems for monitoring circuits that they are providing to CSI. CSI is asking that information critical to these services be shared with Assure911, Inc., using a patented approach that is incorporated into the Assure911 monitoring system.

"Although there are no reporting requirements in current regulation, discussion of such regulation is underway and 9-1-1 entities should be prepared to report ESInet outages to relevant authorities."

Every event that occurs is captured by the system being deployed for CSI. Reporting requirements that must be by existing 9-1-1 system providers in the legacy selective router environment can be met by CSI.

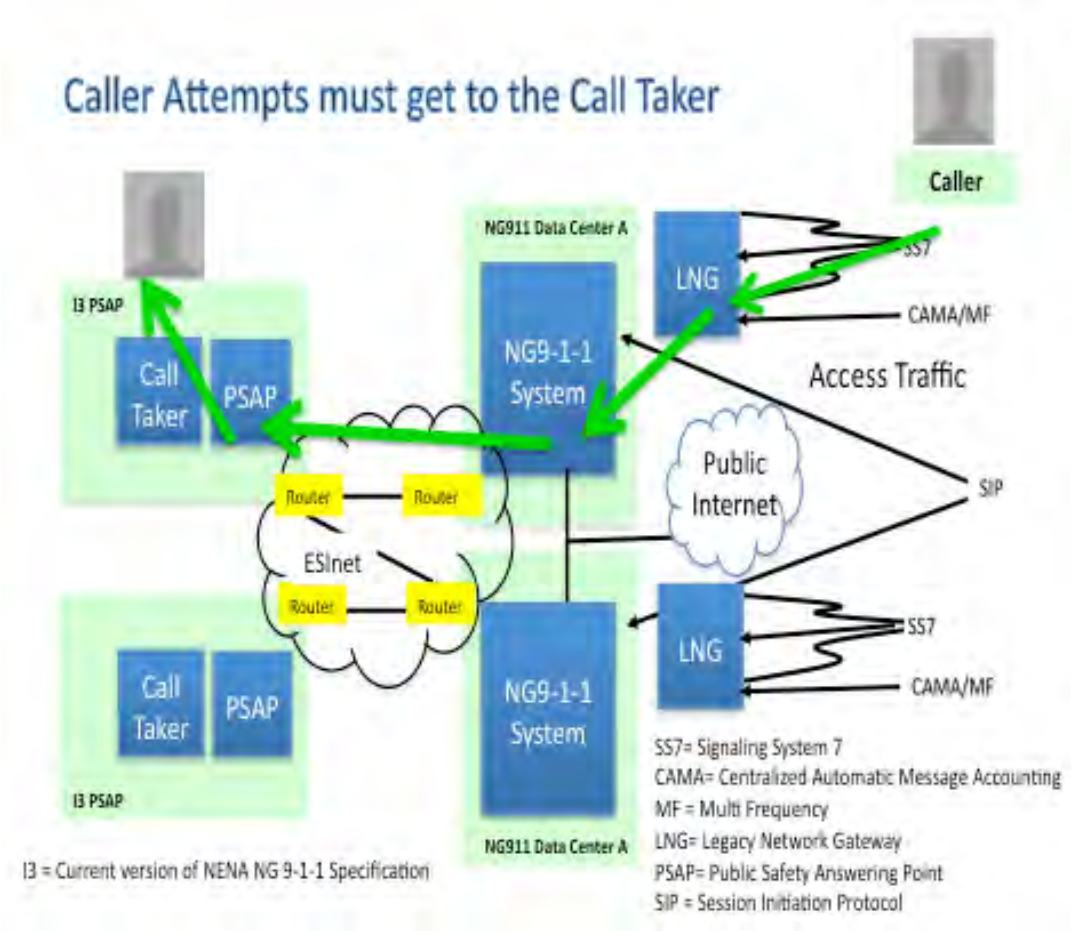


Figure 3.20 – End to End Service View (Diagram Note: Legacy calls will be protected by the SBC.)

"All data circuits and network components which comprise an ESInet should be monitored. All network components should provide SNMP traps to an approved management system."

"Vendors of all operational network components that form an ESInet should provide an SNMP MIB (management information base) for each component to organizations authorized to operate SNMP management systems. At least one SNMP based network monitoring system should be implemented by an organization with access to the resources necessary to perform effective network maintenance services. Vendors of all non-network components such as NG9-1-1 application servers should also be encouraged/required (RFP requirement to be supported by SLA) to provide element managers for their products. This would allow a network management system to monitor all of the network and applications components necessary for the reliable operation of NG9-1-1 on an ESInet. Companies that connect to the ESInet for the purpose of monitoring and/or management of devices should be NG-SEC compliant."

The 9-1-1 SSP and CSI plan to deploy the Assure911 Monitoring solution as part of their network architecture. CSI acknowledges the requirements of the Design document with respect to effective Network Management. NG-911, Inc. will be monitoring the performance of the CSI ESInet. Frontline monitoring will be done by the 9-1-1 SSP and CSI's IT organizations. The 9-1-1 SSP and CSI understand and will be compliant with the ICC and FCC reporting requirements for outages affecting 9-1-1 service.

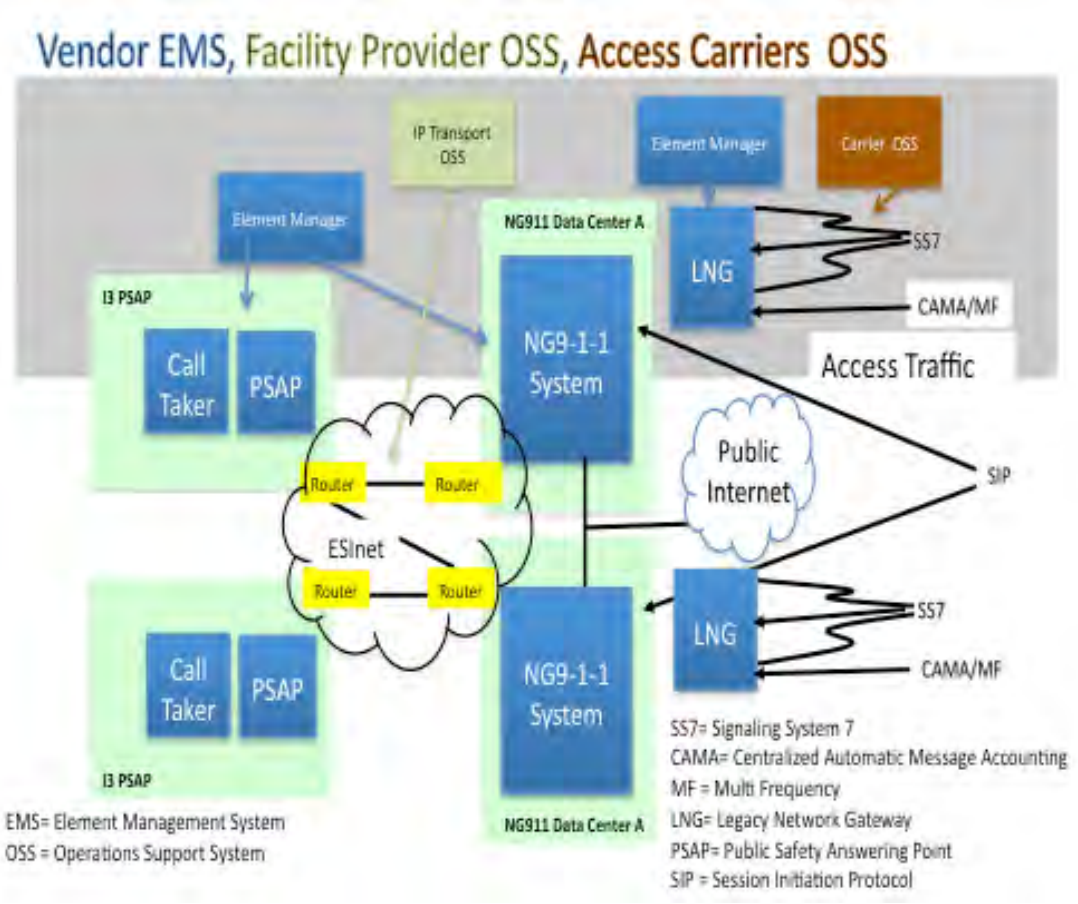


Figure 3.21 – End to End View Participants (Diagram Note: Legacy and SIP protection by SBC.)

3.15.2 Network Monitoring Approach

Effective network management requires:

- Proper/accurate documentation of the network
- Current network diagrams
- IP address range management/assignments
- Demarcation points
- Contact and Escalation lists – Vendor, Service Provider, NOC
- Near real time monitoring/alarming
- SLA benchmarks
- Capacity management / Trending Analysis
- Monitoring the state of element configuration (i.e. QoS)
- Configuration Management / Change Control

Some of the methods above can be used to measure SLA metrics, but may not be reported to the end user.

Assure911 will provide software that performs end-to-end monitoring of the CSI ESInet and NG911 System, including:

- Data collection from devices that comprise the CSI ESInet and NG9-1-1 System
- Identification of adverse conditions in real-time when possible, subject to the capabilities of the target device or intervening element management system.
- Adverse conditions can be viewed on browser-based displays and handheld smart device applications.
- Notification of adverse conditions to personnel via text message, email.
- Real-time and historic reporting of raw data and adverse conditions.

Figure 3.22 – Assure911 Monitoring Solution

The 9-1-1 SSP and CSI ETSBs are responsible for proactive reporting to the ICC when there is an outage in their area affecting 9-1-1 services. Major access carriers, those with Selective Routers today, provide reporting to both the ICC and the FCC when there are outages affecting 9-1-1 services. The initial reporting times and service levels requiring a report varies between the two bodies. In any event, if there is a requirement in the future for additional reporting by the 9-1-1 SSP and the CSI ETSBs as the 9-1-1 Gateway provider who replaces the role of the Selective Router in their ESInet, the solutions being deployed will provide data and timing for the reporting process.

The systems that make up the NG9-1-1 FEs all have information that will go to the 9-1-1 SSP and CSI for reporting capabilities. The majority of the reports assist the ETSBs in managing their responsibilities and to detect and resolve any issues in their centers. Reports can be built for external purposes and managed according to the rules and regulations specified by the Commissions. Assure911 has history of providing proactive monitoring tools to assist major wireline and wireless carriers in their Commission reporting role. More importantly the tools assist in detecting a situation within the architecture that is simplex and/or can lead to a service outage before it affects the public. This proactive tool set will be applied to the CSI ESInet. The first place such tool set was deployed in a 9-1-1 PSAP environment in the Chicago OEMC in 1997. The system being deployed by Assure911 uses a patented approach to proactive, end-to-end monitoring.

4.0 LEGAL AND REGULATORY

The 9-1-1 SSP and the CSI ESInet Design Planning teams are making every effort to be compliant with requirements of the Illinois Commerce Commission (ICC) and Federal Communications Commission (FCC.) If forbearance is required for the Pilot Project, and/or under tariff and statute in Illinois, a request will be made. In the case of the FCC, advice and counsel has been requested to ensure the Pilot Project moves successfully along and gains approval. NENA's CTO, Roger Hixson and other NENA standards leaders have been asked for advice and the NENA standards are used as the guideline for the work.

4.1 NENA Planning Guidance

The NENA standards provide good direction for the planning process. The *"Next Generation 9-1-1 Transition Policy Implementation Handbook"* [3] dated March 2010, outlines the steps necessary for a Transition to NG9-1-1. The document includes checklists and useful information for project managers.

Page 11 under "NG9-1-1 Transition Policy Issue Number Three states that the *"NG9-1-1 will not be deployed in a 'flash cutover. With that reality in mind, it is imperative that the 9-1-1 authorities at every level - as well as industry - begin now to lay the foundation for NG9-1-1 by facilitating the deployment of "dual-mode" capabilities in networks and/or IP-enabled PSAPs that can translate between the legacy circuit switched environment and the next generation environment. This will be a significant issue as NG9-1-1 will not be deployed as a single nationwide project."*

The *"Next Generation 9-1-1 Transition Policy Implementation Handbook"* is a comprehensive general reference. It addresses many of the Public Policy issues outlined by the Illinois Commerce Commission.

The NENA documents reference the role of the Federal and State agencies in the planning process.

A Cutover Plan will be documented pending negotiation with the Access Carriers, underlying network providers and vendors. A Cutover Strategy Document is provided by Assure911, LLC as part of the ICC filing. Not all details of each circuit and route will be in the overall Design Plan. Detailed Documents will be created and maintained by the 9-1-1 SSP and CSI.

4.2 ICC and Outage Reporting

Refer to the Access Plan for Operational issues including Outage reporting responsibilities.

4.3 FCC and Outage Reporting

CSI has asked for guidance of NENA and the FCC Department of Homeland Security Attorney Patrick Donavan and the FCC staff. Refer to the Access Plan for references to the FCC Reporting.

4.4 Persons with Disabilities

CSI ETSBs will retain all equipment and capabilities in place to accept calls in compliance with the American Disabilities Act. There is an expected update to the American Disability Act due soon. Given the comments received, there is a possibility that the Department of Justice will require PSAPs to support

[3] *"Next Generation 9-1-1 Transition Policy Implementation Handbook"* NENA standards dated March 2010

video in NG9-1-1. However, no draft of new rules was available at the time the NENA Standard Draft or at the time Design document was published.

Any new rules promulgated by the Commission regarding persons with disabilities and texting will be supported within the CSI ESInet capabilities once the standard is defined. Design requirements support government requirements and will be adapted as the law changes.

5.0 ASSUMPTIONS

5.1 Design

The Network Design Plan supports CSI's 16 ETSBs in transition from their current Public Switched Telephone Network (PSTN) E9-1-1 network configuration to their new NG9-1-1 Network. The Document addresses Security, Diversity, and Reliability, Monitoring, Metrics and Capacity.

ESInet major components will be located at the two CSI Jackson County Murphysboro Sheriff and Saline County Harrisburg Data Centers. This will include all servers, racks, UPS, network components, telephone equipment, cabling, and monitors.

Software will run on the servers at the two Data Centers. This will include call handling, database management, operating system, mapping, network related, anti-virus, and information management software.

Equipment will be located at the 21 existing PSAPs. This will include workstations, telephones, routers, gateways, etc. The 16 ETSBs will provide their own monitors, racks and UPS.

Software will run on the workstations at the PSAPs. This will include call-handling, mapping. Some PSAPs may choose to keep their existing GIS applications.

Remote equipment will be provided to designated adjacent PSAPs with Intergovernmental Agreements for call completion as designated with the Wireless carriers and selected carriers with split originating offices. All of this will be based on mutual agreement.

Each Access Carrier has been given an option for signaling and trunking. Options include MF, SS7, and ISDN PRI and SIP trunk signaling.

SIP is a preference for the Pilot Project and the ESInet connectivity going forward.

5.2 Test

Assure911 is developing a Test Plan for the CSI project. Access Carriers meetings have been conducted to gain cooperation with the Service Providers in the CSI footprint in deploying he first ever standards based ESInet in Illinois and the first rural test of the ESInet standards nationally and internationally. The IIT School of Applied Technology in Wheaton tested, documented and demonstrated certain elements of the ESInet design. Testing is covered in the CSI Test Plan Exhibit 10.

5.3 Service Level Agreements

Carriers and Public Safety agencies will have documented 9-1-1 Service Level Agreements in place before provisioning, testing and call completion activities begin. These agreements will specify provisioning intervals, database delivery, maintenance hours, service quality expectations, and will meet state and federal requirements for customer service.

The Clearwave SLA is essential to the reliability of the CSI ESInet. The same is true of all NG 9-1-1 vendors and connected access carriers.

Service Level Agreement as Described in Design Plan from NENA - repeated in the Access Plan document:

NENA: *"A service level agreement is a mutually agreed upon formal document provided to the 9-1-1 entity from the vendor that defines the service level commitment the vendor is offering. The fundamental commitment in an SLA is the contracted availability metric for described service or system. This is typically represented in terms of uptime (e.g. 99.9%, 99.99%, 99.999%). Uptime metrics are typically described as three nines, four nines, five nines, etc.*

The SLA typically describes where and how the measurement is made, and how often they are calculated and reported. For example, an SLA might be measured over a one-month period, a one year period, or both. It is a best practice for 9-1-1 entities to ensure that there is some provision within the SLA that will require the service provider(s) to notify the 9-1-1 entity in the event of service affecting outages."

This requirement is part of the ongoing negotiations among NG-911, Inc., the 9-1-1 SSP, CSI and the Access Carriers.

NENA: *"Service impact levels are typically used to define the severity of the outage denoted by some range of values (e.g.1 through 5). Failure to meet agreed upon service impact levels may result in pre-negotiated financial penalties to the vendor/service provider.*

ESInets are complex and may involve management of SLAs from a number of different vendor/service providers. Best practices include:

- *Where multiple service providers are involved, there should be a demarcation point that defines the boundaries of responsibilities as described in an agreement.*
- *Obtain or establish the MTTR for each piece of equipment used in an ESInet as well as an SLA for the network service. To maintain reliable service and ensure efficient testing, benchmarks should be established, documented, and periodically reviewed for accuracy.*
- *Contracted levels of service should be established to ensure adequate response times for repair.*
- *To minimize downtime critical hot spares should be identified, purchased, and maintained on site.*
- *Maintenance should include regularly scheduled audits of hardware revision levels and code compatibility (including firmware) with hardware revisions.*
- *Redundant systems should be regularly exercised by deliberate fail-over as part of routine maintenance.*
- *Escalation paths should be documented and known to the 9-1-1 entity so that responses to failures can be adequately addressed."*

5.4 Support and Maintenance

NG-911, Inc. is the 9-1-1 SSP of record by contract with CSI and ETSBs. Support and Maintenance will be provided for 10 years by NG-911, Inc. Including software and hardware provided by the vendor. CSI asked that NG-911, Inc. help them manage future requirements that come through the standards and legislative process.

5.5 Cutover Plans

The Design team is recommending the following high level processes and implementation steps for the NG9-1-1 Cutover Plan:

9-1-1 Cutover Process

The Cutover process will involve the existing Selective Routers along with 21 PSAPS. The existing 21 PSAPS will be retrofitted with new hardware to accommodate NG 9-1-1 Calls, Legacy and/or SIP. After installation, the equipment will be acceptance tested for the ability to handle the new traffic. A cutover schedule will be developed that will include all activities: establishing the Trunk Groups, SS7 A-Links, equipment installation pre and post testing. A Cutover Plan is under development. It will be provided as a separate Exhibit to be filed with the ICC.

For the End offices requiring SS7 connectivity to the ESInet both CLLI information and Point Codes must be reserved. SS7 A-Links (or possibly F Links) will need to be equipped and tested. Trunk groups from the Wireline, Wireless, VoIP and CLEC facilities based Carriers will need to be implemented and tested to the new ESInet. It is critical that initial traffic data and signaling requirements are acquired in a timely fashion to determine the actual number of trunks per trunk group as well as the overall scope of work.

Pre testing capabilities will be required and will include a preliminary test database. This will be required from each Carrier/End Office to initiate preliminary 9-1-1 test calls. The PSAPs will be notified of the pretest schedule. Communication and coordination of all activities is essential for successful cutover of each Carrier

Pre Cutover

- Identify the Selective Routers and PSAPS involved in the Cutover and notify PSAPs at least 30 days in advance
- Establish carrier end office facilities to the new ESInet Gateway
- Identify Signaling requirements, routing priorities and number of trunks
- Develop Method of Procedure (MOP) for Cutover including contacts
- Develop back out and contingency plan
- Ensure all Service Level Agreements and Escalation Policies are operational.

ESInet Cutover

- Place initial 9-1-1 test calls to verify existing configuration is working to the appropriate primary and secondary PSAP
- Verify New Trunk Groups are Active
- Reroute originating translations to the new ESInet trunk groups
- Place 9-1-1 test calls over new route configuration
- Verify appropriate PSAP answers and verify location information
- Execute complete 9-1-1-test plan following a detailed for Conversion.
- Determine the role of the SR trunking before, during and post cutover.

- Determine the viability of the Split exchange plans, test them before and validate them during cutover.
- Cutover Live Traffic.

6.0 CONCLUSION

The Counties of Southern Illinois ESInet is a standards-based network, designed to accommodate calls from the PSTN technology as well as advanced services offered today and in the future. The system is secure, redundant, resilient and reliable and is a significant improvement over the current 9-1-1 systems that serve the Public Safety Agencies in Southern Illinois represented by the CSI 16 ETSBs. The legal 9-1-1 SSP for CSI is NG-911, Inc.

The system designed as part of the CSI project meets the ICC requirements and complies with Illinois Statutes. This project brings improved 9-1-1 to the citizens of southern Illinois, to improve public safety and save lives.

Tables, Attachments and References

Attachment 1 - CSI Board of Directors

Name	Position	Email Address	Reach Information
Kenneth Smith	Chairman	WILLIAMSONCOUNTY911@YAHOO.COM	O: 618-988-6911 C: 618-925-1373
Patrick Lustig	Project Manger	PLUSTIG@JC911.ORG	O: 618-457-5911 C: 618-534-4911
Jana Fear	Secretary	UNIONCO911@YAHOO.COM	O: 618-833-5442 C: 618- 697-3757
Tracy Felty	Treasurer	SALINEE911@YAHOO.COM	O: 618-252-8661 C: 270-952-2098

Attachment 2 – Data Center Locations

Data Center	Address	Primary Contact	Reach Information
East: Saline County Sheriff's Office in **Harrisburg** (1)	1 NORTH MAIN STREET, HARRISBURG, IL. Phase 1 Fiber	Tracy Felty CSI Treasurer, Clearwave Interface	(618) 252-8661, (270) 952-2098, SALINEE911@YAHOO.COM
West: Jackson County Sheriff's Department in **Murphysboro** (2)	1001 MULBERRY STREET, MURPHYSBORO, IL. Phase 1 Fiber	Patrick Lustig CSI Project Manager, President INENA, Co Chair IPSTA	(618) 457-5911, (618) 534-4911, PLUSTIG@JC911.ORG

Attachment 3 – Primary and Back up PSAP list for CSI (Pilot Only) ICC Requested List. If CSI chooses to augment the back-up PSAPs, the ICC asked for copies of the locations for alternate routing of the calls.

21 PSAPs	Primary PSAP	Back Up PSAP	Third PSAP for Disaster Recovery	County /Phase	Facilities	Notes
1.	Pulaski County Sheriff Department, 500 Illinois Ave., Mound City	Union County Sheriff Office, 307 W. Market, Jonesboro	Johnson County Sheriff 115 N. 5th St., Vienna	Alexander, Pulaski Phase 2	Fiber/CW Home DC: East	August 2013 No Ring
2.	Flora Police Department, 123 N. Locust St., Flora	Richland County Sheriff Office, 310 S. Whittle Avenue, Olney	Salem Police Department 201. S. Rotan, Salem	Clay Phase 1	Fiber/CW Home Fiber DC: West	August 2012 Ring 2013
3. Data Center East	Saline County Sheriff Office 1 N. Main St., Harrisburg	Johnson County Sheriff 115 N. 5th St., Vienna	Williamson County Sheriff 300 W. Jefferson St., Marion	Gallatin, Saline Phase 1	Fiber/CW	August 2012 Saline accepting: Hardin, Hamilton and Pope Wireless
4. Data Center West	Jackson County Sheriff Department, 1001 Mulberry, Murphysboro	Murphysboro Police Carbondale Police SIU Police	Carbondale Police 501 S. Washington Street, Carbondale	Jackson Phase 1	Fiber/CW	August 2012
5.	Murphysboro Police 202 N. 11th Street, Murphysboro	Jackson County Sheriff Murphysboro Police Carbondale Police SIU Police	SIU Police, Murphysboro Police Jackson County Sheriff	Jackson Phase 1	Fiber/CW	August 2012
6.	Carbondale Police 501 S. Washington Street, Carbondale	SIU Police, Murphysboro Police Jackson County Sheriff	Jackson County Sheriff Department, 1001 Mulberry, Murphysboro	Jackson Phase 1	Fiber/CW	August 2012
7.	SIU Police Washington Square, Carbondale	Carbondale Police Murphysboro Police Jackson County Sheriff	Murphysboro Police 202 N. 11th Street, Murphysboro	Jackson Phase 1	Fiber/CW	August 2012
8.	Johnson	Saline County	Williamson	Johnson	Fiber/CW	August 2012

	County Sheriff 115 N. 5th St., Vienna	Sheriff Office 1 N. Main St., Harrisburg	County Sheriff 300 W. Jefferson St., Marion	Phase 1		Saline accepting: Hardin, Hamilton and Pope Wireless- Johnson reciprocates for back up and Gallatin
9.	Centralia Police Department 222 S. Poplar, Centralia	Salem Police 201. S. Rotan, Salem	Flora Police Department, 123 N. Locust St., Flora	Marion Phase 1	Fiber/CW Home Fiber DC: East	August 2012 Ring August 2013
10.	Salem Police Department 201. S. Rotan, Salem	Centralia Police 222 S. Poplar, Centralia	Flora Police Department, 123 N. Locust St., Flora	Marion Phase 1	T1/Copper then Fiber /CW Home T1 DC: West	T1 August 2012 Fiber Ring August 2013
11.	Massac County Sheriff 515 Market St, Metropolis	Metropolis Police Department 1020 Broadway St., Metropolis	Johnson County Sheriff 115 N. 5th St., Vienna	Massac Phase 2	T1/Copper Always Home T1 DC: East	August 2013
12.	Metropolis Police Department 1020 Broadway St., Metropolis	Massac County Sheriff 515 Market St, Metropolis	Johnson County Sheriff 115 N. 5th St., Vienna	Massac Phase 2	T1/Copper Always Home T1 DC:West	August 2013
13.	DuQuoin Police Department 304 E. Poplar St., DuQuoin	Perry County Sheriff Office, 12 E. Water St. Pinckneyville	Johnson County Sheriff 115 N. 5th St., Vienna	Perry Phase 1	Fiber/CW	August 2012
14.	Perry County Sheriff Office, 12 E. Water St. Pinckneyville	DuQuoin Police Department 304 E. Poplar St., DuQuoin	Johnson County Sheriff 115 N. 5th St., Vienna	Perry Phase 1	Fiber /CW	August 2012
15.	Richland County Sheriff 211 W. Market, Olney	Wabash County Sheriff, 120 E. 4th St., Mt. Carmel	Flora Police Department, 123 N. Locust St., Flora	Richland Phase 1	Fiber/CW Ring 2013 Home DC: East	August 2012
16.	Union County Sheriff Office, 307 W. Market, Jonesboro	Pulaski County Sheriff Department, 500 Illinois	Johnson County Sheriff 115 N. 5th	Union, Phase 2	Fiber/CW	August 2013

		Ave., Mound City	St., Vienna			
17.	Wabash County Sheriff, 120 E. 4th St., Mt. Carmel	Richland County Sheriff 211 W. Market, Olney	Flora Police Department, 123 N. Locust St., Flora	Wabash Phase 2	Fiber/CW Home DC: West	August 2013
18.	White County Sheriff 108 N. Main Cross, Carmi	Wabash County Sheriff, 120 E. 4th St., Mt. Carmel	Saline County Sheriff Office 1 N. Main St., Harrisburg	White Phase 1	Fiber/CW Home DC: East	August 2012
19.	Herrin Police Department 321 N. 14th St., Herrin	Williamson County Sheriff 300 W. Jefferson St., Marion	Marion Police Department 100 S. Madison, Marion	Williamson Phase 1	Fiber/CW	August 2012
20.	Williamson County Sheriff 300 W. Jefferson St., Marion	Herrin Police Department 321 N. 14th St., Herrin	Marion Police Department 100 S. Madison, Marion	Williamson Phase 1	Fiber/CW	August 2012
21.	Marion Police Department 100 S. Madison, Marion	Williamson County Sheriff 300 W. Jefferson St., Marion	Herrin Police Department 321 N. 14th St., Herrin	City of Marion, Williamson Phase 1	Fiber/CW	PSAP moves across the street after Phase 1; avoids split exchange
Data from PSAP Survey		CSI may assign a Special PSAP(s) for language and or a Time of Day PSAP. T1 PSAPs and PSAPs not on Rings require a back up PSAP homed on the alternate Data Center unless/until the back-up is on Fiber Ring. Some Fiber is not on a Ring and the Alternate PSAP must be the on the Ring or via Alternate Facilities–Assigned.				

Attachment 4 - PSAP Data Exchange Form – Master Document

Instructions: Create minimum of 21 and use all as attachments for Design Plan and for Traffic Engineering of ESInet and Access and PSAP trunking. (Data Collection in progress by PSAP as of ICC filing date)

Master Draft. There will 21 Forms for the ESInet PSAPs.
In addition we will have:
Subset for the: Transfer in and out PSAPs
Subset for: Pope, Hamilton, Hardin for Wireless completions
Subset for all adjacent PSAPs in Illinois, Indiana, Missouri and Kentucky for Cross Boundary LPG (Legacy PSAP Gateway) trunking and/or alternate terminating solution.

Use data from NG-911, Inc. Project Plan. Insert photos and/or change master layout and information as appropriate.

CSI PSAP Name	**The Data on this Short Form is needed for Design. Traffic Data to assist with Engineering.**					Completed:
Technical Contact:						
Counties Served						
Address						
Total Wireline Subscribers Served - Estimate						
Serves as Alternate PSAP for 911 Call Handling						
In case of Emergency, Calls go to Alternate PSAP						
IGA Cross Boundary Off Net with:						
IGA Accepts Transfers in Off Net with:						
Handles Calls for Agencies: i.e. County like Hardin, type, i.e. Wireless terminating etc.						
Days/Hours of Operation						
New CSI Data Center Location Y/N						
PSAP Engineering	Delete from Short Form					
Traffic Engineering- If no Actual Data – Enter Estimates and Note as such:						
Annual 911 Call Volume (enter						

year)			
Busy Day of Week			
Busy Hour of Busy Day CST			
Number of Calls Handled in Peak Hour			
Call Holding Time Range in seconds (Low to High)			
Average Call Holding Time in seconds			
Estimate of Text Calls to be Handled Per Peak Period			
Average Holding Time Estimate for Text calls to be Handled Per Peak Period			
Percentage of calls Wireless			
Percentage of Calls Transferred Out			
Percentage of Calls Transferred In			
Calls direct from Enterprise – name enterprise source(s) and any specific data.			
Text Busy Day	Enter Data as soon as a pattern emerges		
Text Busy Hour	Enter Data as soon as a pattern emerges		
Data – same as Text	Enter Data as soon as a pattern emerges		
Video – same as text	Enter Data as soon as a pattern emerges		
Telematics Calls today from Agencies – Peak Days and hours and Volumes			
Direct Telematics Volumes	Enter Data as soon as a pattern emerges		
Call Handling for TTY – Peak Day/Hour Volumes			
Call Handling for Language Peak			

Day/Hour/Volumes						
Other Call Volumes of Traffic Related Info – add rows if we missed anything						
Network Design Not on Short Form						
Signaling: SIP Trunking						
Trunk Groups to Transfer Calls On Net						
Means to Transfer Calls off net to Legacy PSAPs not on ESInet						
Frequency of Transfer tests						
Counties/Agencies Transferred from						
Counties/Agencies Transferred to						
PSAP Equipment In Service Legacy Vendor , Type and Models Not on Short Form						
PSAP Equipment to be Installed NG9-1-1, Vendor, Type and Models						
Power Needed for Design – Please Add						
Primary Electrical Power Company Source and Contact Info 24 by 7 by 365						
UPS Power – Y/N, Onsite – Location, Company Name, Size of Power Plant, Contact Name 24 by 7 by 365						
Back Up Generator Type, Size, Onsite Y/N, Location, Reach Information for Service 24 by 7 by 365, Fuel Source 24 by 7 by 365, Test Frequency, Records maintained Y/N						

Provisioning Data Base - Needed for Design– Please add						
ANI/ALI Company in Present Method Of Operation						
GIS Primary Reach Information						
GIS Alternate Reach Information						
GIS Database Polygons for Area Completed Y/N						
Method Established to receive Location Identification per Access Carrier Y/N, Enter Process						
Frontier Wireline						
AT&T Wireline						
Crossville ILEC						
Egyptian ILEC						
Hamilton ILEC						
Odin-Fairpoint ILEC						
Shawnee ILEC						
Wabash ILEC						
Verizon Wireless						
AT&T Wireless						
T- Mobile Wireless						
Allied Wireless						
Sprint Wireless						
Other Wireless - Name						
Clearwave CLEC						
CLEC Clearwave						
CLEC						
VoIP Mediacom						
VoIP Vonage						
VoIP Other Be Specific						
Enterprise Direct Be Specific						
Add Access Carriers as they are identified during the PSAP interviews.						
Dispatch						
Dispatch part of PSAP Y/N						
Dispatch Location List /Address/Methods	1.	2.	3.	4.	5.	6.
Maintenance						
First Point of						

Contact for Support, Name, All Reach Numbers						
Back Up Point of Contact, Name, all reach numbers, methods						
Proactive or Reactive Alerting Methods, i.e.,						
Reach information for Legacy SRT Carrier, Names and all reach numbers and methods						
Average Mean Time to Repair (MTTR) per Month						
Number of Outages per Month						
Outages Per Hundred 911 Customers Served, or do you know number of Lost Calls estimated based on historical data/ complaints/ expectations						
List Major Root Causes of Failures (over a year, most significant first)	1.n%	2.n%	3.n%	4.n%	5.n%	6.n%
Add detail As required.						
Information Acquired By: Date, Source, Reach Information						

Attachment 5 - Emergency Power

County	PSAP	Electrical Power	UPS Power	Generator Power	Primary Contact	Availability
1. Alexander County covered by Pulaski PSAP and Union PSAP	0	Ameren	APC Pro 150 at each position (Pulaski will be their prime PSAP when they go live with NG9-1-1)	Generac 40 kw Monitor Panel in PSAP for Generator	Contact: Primary: Becky Kleckner bekec12@gmail.com Alternate: Jana Fear unionco911@yahoo.com	Tested Weekly Alexander about to cut to E9-1-1 December 2012
2. Clay 24x7x365	1	City of Flora 662-9111 CIPS 888-789-2477 Clay Elec. 800-582- 9012 All #'s are 24x7x365	UPS – Yes Flora Police Dept 911 Center Equipment Room.	Generac Generator 3.0L 50KW CPL on Site Fuel – Natural Gas City of Flora	Jennifer Brown 618-662-7070 Office 618-676-4093 Cell	Tested. Looking into diesel generator at this time.
3. Gallatin Covered by Saline PSAP	0	Ameren**	Mitsubishi**	Onan 100K** Onan 15 K	Primary: Steve Galt (618) 269-3040 Alternate: Tracy Felty, salinee911@yahoo.com	Tested Weekly
4. Jackson 24x7x365	4	Ameren 800-755-5000	All: Best Ferrups Except : Carbondale Police APC Smart 1500 VA each server and workstations. Jackson County Sheriff, FE 4.3 kVA, Murphysboro PD,FE 1.4 kVA SIU PD FE 4.3 kVA	Caterpillar, Sheriff 200 kW, diesel Cummings, Murphysboro 70kW, diesel Generac, Carbondale 500kW, diesel Cummings, SIU 17kW, LP	Steve Dixon	Tested with load Monthly Records maintained
5. Johnson	1	Ameren**	Mitsubishi**	Onan 100K** Onan 15 K	Jim Cuff (618) 775-2535	Tested Weekly
6. Marion	2	Ameren for both	UPS for both onsite	Diesel for both onsite	Rick Nuxoll 1999 S. Marion Ave. Salem Il 62881-6175 Ph: 618-548-3685 Fax: 618-548-9539	Tested
7. Massac City of Metropolis and County	2	City of Metropolis (618) 524-2310	APC UPS 1500 KVA at all positions and at the PSAP	ONAN Generators at each location	Keith Davis (618) 638-2345 cell; approval to use	Tested Weekly; records maintained

Sheriff's Office						
8. Perry 24x7x365	1	Ameren Illinois 800-767-8048	Communication s Hut Best UPS 7 KVA	ONAN 100KVA Back Dock Oakley Services	James R. DeMent, randy@perrycounty911.com	Tested Weekly, full load, records maintained
9. Pulaski 24x7x365	1	Ameren	APC Pro 150 at each position (covers Alexander when they go live with NG9-1-1)	Generac 40 kw Monitor Panel in PSAP for Generator	Contact: Primary: Becky Kleckner bekec12@gmail.com Alternate: Jana Fear unionco911@yahoo.com	Tested Weekly
10. Saline 24x7x365	1	Ameren**	Mitsubishi**	Onan 100K** Onan 15 K	Tracy Felty, salinee911@yahoo.com	Tested Weekly
11. Union	1	Ameren	APC Pro 150 at each position	Generac 40kw Monitor Panel in PSAP for Generator	Jana Fear, unionco911@yahoo.com	Tested Weekly
12. Richland	1	Ameren CIPS (888) 789-2477	Size 10-30kVA 208V, American Power Conversion @ 800-555-2725.	Standby/Auto Transfer, Size 400 HP Cummins Diesel/300 kw Generator, Fehrenbacher Truck (618) 395-1380, Fuel Source – Diesel 250 gal.	Juanita Kramer richlandcounty911@gmail.com	Chief Correctiona l Officer Tests UPS and Generator monthly; maintains records
13. Wabash	1	Mt. Carmel Public Utilities (618) 262-5151	UPS / Individual desk units. Tripp-lite 900VA Run time 45 minutes 6 surge only and 6 UPS Surge outlets and 420 Joules--Have one on all cad stations plus main server	Evapar services Generator. (812) 867-9900 – Automatic generator comes in within 15 seconds of power outage	Dennis Poland, wabash911@gmail.com, 618-262-2501 (office) 618-838-2205 (cell) 618-262-4186 (dispatch) with permission	Tested Weekly, records maintained
14. White	1	City of Carmi (618) 382-5015	UPS / Individual desk units. APC BX800 on their local Server and APC BX 1000 at each workstation	AC Delco Detroit 40/60Max Kevin Gire (618) 384-7178	Julie L. Irwin, White County 911 Coordinator,314 E. Cherry Street, PO Box 339, Carmi, Illinois 62821, Office: (618) 382-8911 x 240, Fax: (618) 382-2351,Cell: (618) 384-7184 julie@whitecounty911.com	Tested Weekly, records maintained
15. Williamson 24x7x365	1 W	Ameren	APC 700 at each work station. 618-925-1373.	On site	Ken Smith williamsoncounty911@yahoo.com 618-925-1373 with permission	Tested Weekly
	1 H	Ameren	APC 700 at each work station. 618-925-1373.	On site	Ken Smith williamsoncounty911@yahoo.com 618-925-1373 with permission	Tested Weekly
16. City of Marion	1 (2)*	Ameren CIPS	APC 1250 at each work station. 618-925-1373.	Generator: KATOLIGHT Diesel 15KW 60HZ	Sgt. John Clarida, mpdcomm@yahoo.com, 618 993 2124 with permission	Tested Weekly, running time one

24x7x365						hour records are kept
		**1 Form – Handles Saline Gallatin Hardin Pope and Hamilton	**1 Form – Handles Saline Gallatin Hardin Pope and Hamilton	**1 Form – Handles Saline Gallatin Hardin Pope and Hamilton		

Attachment 6 - Primary Contacts (Note: Add main telephone numbers for PSAP Tier One in each column.

Data Center Location		First Tier Name/Company/Reach	Second Tier Name/Company/Reach	Third Tier Name/Company/Reach
East	Harrisburg	Onsite PSAP 24x7x365	Steve Dixon/CSI/ 618-457-5911 or cell 618-534-9536 Ryan Trusty/CSI/ TBD 1 hour response	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey,855-668-6491
West	Murphysboro	Onsite PSAP 24x7x365	Steve Dixon/CSI/ 618-457-5911 or cell 618-534-9536 Ryan Trusty/CSI/TBD 1 hour response	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey,855-668-6491

PSAP Number/Location		First Tier Name/Company/Reach	Second Tier Name/Company/Reach	Third Tier Name/Company/ Reach
1.	Pulaski County Sheriff Department, 500 Illinois Ave., Mound City	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
2,	Flora Police Department, 123 N. Locust St., Flora	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
3.	Saline County Sheriff Office 1 N. Main St., Harrisburg	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491r
4.	Jackson County Sheriff Department, 1001 Mulberry, Murphysboro	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491r
5.	Murphysboro Police 202 N. 11th Street, Murphysboro	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
6.	Carbondale Police 501 S. Washington Street, Carbondale	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
7.	SIU Police Washington Square, Carbondale	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
8.	Johnson County Sheriff 115 N. 5th St., Vienna	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
9.	Centralia Police	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-

	Department 222 S. Poplar, Centralia			911/ 319-350-8430, alternate Michael Ramsey, number
10.	Salem Police Department 201. S. Rotan, Salem	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
11.	Massac County Sheriff 515 Market St, Metropolis	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
12.	Metropolis Police Department 1020 Broadway St., Metropolis	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
13.	DuQuoin Police Department 304 E. Poplar St., DuQuoin	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, number
14.	Perry County Sheriff Office, 12 E. Water St. Pinckneyville	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
15.	Richland County Sheriff 211 W. Market, Olney	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
16.	Union County Sheriff Office, 307 W. Market, Jonesboro	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
17.	Wabash County Sheriff, 120 E. 4th St., Mt. Carmel	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
18.	White County Sheriff 108 N. Main Cross, Carmi	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, number
19.	Herrin Police Department 321 N. 14th St., Herrin	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
20.	Williamson County Sheriff 300 W. Jefferson St., Marion	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491
21.	Marion Police Department 100 S. Madison, Marion	Onsite Personnel 24x7x365	PSAP Manager	Travis Stender/NG-911/ 319-350-8430, alternate Michael Ramsey, 855-668-6491

Vendor Equipment	First Tier Name/Company/Reach	Second Tier Name/Company/Reach	Third Tier Name/Company/Reach
All CSI Locations			
Acme Packet	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Acme Packet 781-756-6920 866-226-3758
Assure911	Assure911 888-829-6377 24 x 7 x 365	Assure911 888-829-6377 24 x 7 x 365	Assure911 888-829-6377 24 x 7 x 365
Bullberry	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	BullBerry 866-447-4968
Calix	Clearwave Repair 877-552-9283 24x7x365 - 1 hour response time	Clearwave - 877-552-9283 24 x 7 x 365	Chief Technology Officer, then President/CEO
Cisco Routers	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Chief Technology Officer 319-430-1670
Clearwave	Clearwave Repair 877-552-9283 24x7x365 - 1 hour response time	Clearwave 877-552-9283- 24 x 7 x 365	Chief Technology Officer, then President/CEO
Datamaster	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Datamaster 913-469-6401
Higherground	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Higherground 818-251-5277
Juniper	Clearwave Repair 877-552-9283 24x7x365 - 1 hour response time	Clearwave -877-552-9283 24 x 7 x 365	Chief Technology Officer, then President/CEO
NG911,Inc	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Chief Technology Officer 319-430-1670
Solacom	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Solacom 888-765-2266
SS7 Provider Syniverse	CSI Technical Staff	NG-911, Inc. (855)-668-6491 24 x 7 x 365.	Syniverse 800-892-2888

References

Documents filed by CSI

1. Next Generation Design Plan, Assure911.net-DG-CSI/NG911-001
2. Next Generation Access Plan, Assure911.net-DG-CSI/NG911-002
3. Test Plan Document, Assure911-STP-CSI/NG911-001
4. NG9-1-1/CSI Cutover Strategy, Assure911-STP-CSI/NG911-002

Title 83 Administrative Code Part 725:

1. http://www.ilga.gov/commission/jcar/admincode/083/08300725sections.html

NENA and SIP References, included in the filing as Exhibit 12

1. NENA i3 standards, “Detailed Functional and Interface Standards for the NENA i3 Solution Version 1.0,” Standard number: 08-003 v1“, approved June 16, 2011, http://www.nena.org/stories/technical/executive-board-approves-i3-standard
2. NENA Glossary of terms document, http://www.nena.org/sites/default/files/NENA%2000-001_V16.pdf.
3. NENA: “The NENA 75-001 Security for Next-Generation 9-1-1 Standard (NG-SEC) contains a number of sections which apply to ESInets including; Security Policies, Information Classification, Safeguarding Information Assets, Physical Security Guidelines, Network and Remote Access Security Guidelines, Change Control Documentation, Compliance Audits and Reviews. ESInets should be NG-SEC compliant. http://www.nena.org/?page=ng911_security&terms=security+and+standards
4. NENA Operations Standards for NG9-1-1, NENA 57-750 NG9-1-1 System and Operational Features and Capabilities Requirements pdf. Rick Jones - lead.
5. Access Trunking Reference IP-PBX / Service Provider Interoperability, *"SIPconnect 1.1 Technical Recommendation",* SIP Forum Document Number: TWG-2
6. NENA ESInet Design for NG9-1-1 draft document NENA 08-506 Version 1, August 16, 2011.
7. ESInet Design for NG9-1-1 NENA 08-506, Version 1
8. CSI Narrative including Future Benefits not covered in CSI ICC Pilot application Design Plan

List of Exhibits included in this filing:

1. Exhibits 1-9 Legal and Regulatory References.
2. Exhibit 10 Assure911 Test Plan
3. Exhibit 13 CSI RFP - 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.
4. Exhibit 14 Design Plan
5. Exhibit 15 Access Plan
6. Exhibit 16 Cutover Strategy
7. Exhibit 17 CSI Contracts