CLEARSPAN 911/E911 Overview

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Revision History

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Revision Number	Date Completed	Point of Contact	Description
002	09/01/2014	Velvet Moore	Updated for Clearspan R20
001	6/7/2013	Bev Marsh	Initial Release

OVERVIEW: 911 AND E911

While the existing Public Service Answering Point (PSAP) network has remained largely unchanged in the last decade, enterprises have moved to wide-scale deployment of Voice over IP (VoIP). The PSAP relies on a legacy network, while VoIP supports a convergence of communications onto the enterprise's data network. This overview will describe the basics of 911 and Enhanced 911 (E911) and how the Clearspan platform supports the use of emergency dialing and routing services.

REGULATIONS AND STANDARDS

The Clearspan product complies with the following regulations and standards.

911

Introduced to the U.S. in the late 1960's and largely replaced by Enhanced 911, traditional 911 service was designed as a short number dialing option to reach emergency personnel. A 911 call traverses dedicated phone lines to the Public Safety Answering Point (PSAP) of the local area. The 911 operator at the PSAP had to verbally gather the emergency information and location from the caller before dispatching a response team from the ambulance service, fire department, or police department. Calls could not be routed to different PSAPs, based on the specific geographic areas that they cover.

ENHANCED 911 (E911)

Introduced in the early 1970s, E911 is a system which selectively routes an emergency call to the PSAP closest to the caller based on the caller's location, and automatically displays the caller's phone number and address at the PSAP. Therefore, the PSAP can quickly dispatch emergency help, even if the caller is unable to communicate the location. Also, if the caller disconnects prematurely, the PSAP has the information it needs to contact the 911 caller. This system uses information presented during the call (i.e. ELIN presented as Caller ID) as a reference into a local database to get a caller's physical address.

NATIONAL EMERGENCY NUMBER ASSOCIATION (NENA) I2

Nation Emergency Number Association (NENA) i2 is an interim architecture to connect callers in the IP domain with PSAPs supported by the existing E911 Service Provider network. "Interim VoIP Architecture for Enhanced 911 Services" standard document is published by NENA in December 2005. The standard diagram is shown in the following illustration. Clearspan supports IP-based routing of E911 calls via the Emergency Routing Service (ERS).

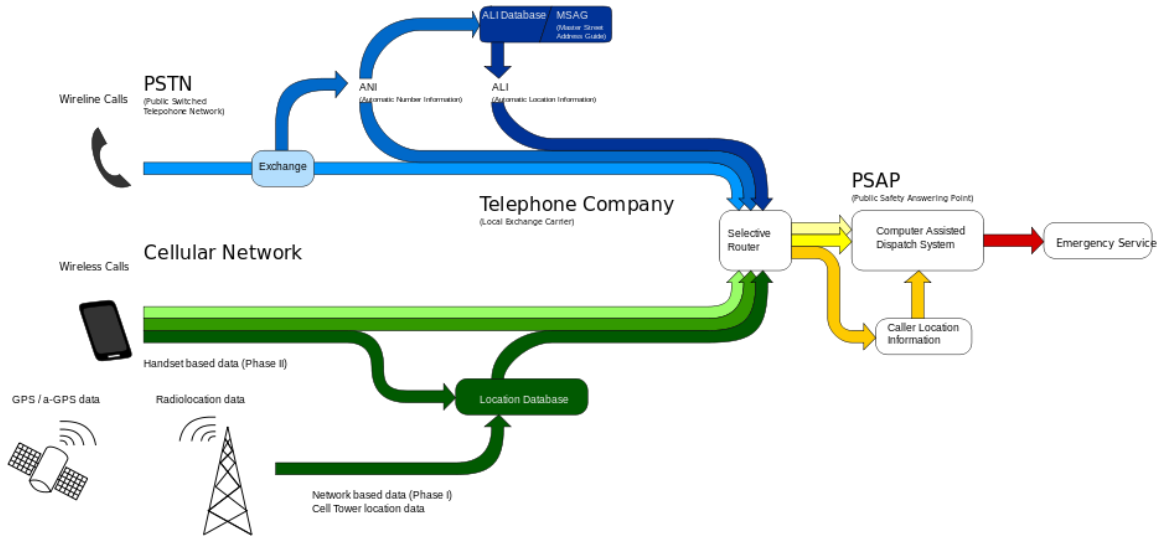

Figure 1 E911 Call Flows.

NENA I2 DEFINITIONS

Automatic Location Identification (ALI)

- A database that associates a specific telephone number to an address. The ALI accepts a PSAP query with a telephone number and then responds with an address.

Emergency Service Gateway (ESGW)

- Equipment that resides in an emergency service provider network that is responsible for integrating the SIP network with the emergency services network and routing 911 calls to the appropriate selective router based on the ESRN/ESQK it receives.

Emergency Services Query Key (ESQK)

- The ESQK identifies a call instance at a VoIP Positioning Center (VPC), and is associated with a particular Selective Router (SR)/Emergency Service Number (ESN) combination. The ESQK is delivered to the E911 SR as well as the Calling Number/Automatic Number Identification (ANI) for the call to the Public Safety Answering Point (PSAP). The ESQK is used by the SR as the key to the Selective Routing data associated with the call. The ESQK is delivered by the SR to the PSAP as the calling number/ANI for the call, and is subsequently used by the PSAP to request Automatic Location Identification (ALI) information for the call. The ALI database includes the ESQK in location requests sent to the VPC. The ESQK is used by the VPC as a key to look up the location object and other call information associated with an emergency call instance. The ESQK is expected to be a ten-digit North American Numbering Plan Number.

Emergency Services Routing Number (ESRN)

- The ESRN is used by Clearspan to route an emergency call to the correct Emergency Services Gateway (ESGW), and by the ESGW to select the desired path to the appropriate Selective Router (SR) for the call. The ESRN is expected to be a ten-digit North American Numbering Plan Number.

Location Information Server (LIS)

- An LIS serves as a repository for location information. Location information is in the form of civic address or geographical-spatial location attributes correlated with a particular physical location. The LIS is configured with mappings between individual location information and a logical representation of the physical locations with which they are associated. This set of associations is called a “wiremap”.

Public Safety Answering Point (PSAP)

- This is a physical service location able to respond to an emergency call and actually dispatch emergency services.

VoIP Positioning Center (VPC)

- The application that determines the appropriate PSAP based on the VoIP subscribers position, returns associated routing instructions to the VoIP network, and provides the caller’s location and the callback number to the PSAP through the ALI.

ACRONYMS

ALI	Automatic Location Identification
API	Application Programming Interface
AS	Application Server
CLEC	Competitive Local Exchange Carrier
CO	Central Office
DID	Direct Inward Dialing
EBS	Emergency Broadcast Server
EGW	Emergency Gateway
ELIN	Emergency Location Identification Number
ERDB	ESZ Routing Database
ERL	Emergency Response Location
ERS	Emergency Routing Service
ESGW	Emergency Service Gateway
ESN	Emergency Service Number
ESQK	Emergency Service Query Key
ESRN	Emergency Service Routing Number
ESZ	Emergency Service Zone
HQ	Head Quarter
ID	Identification
IP	Internet Protocol
LAN	Local Area Network
LEC	Local Exchange Carrier
LIS	Location Information Server

LK	Location Key
LO	Location Object
LRO	Last Routing Option
MS	Media Server
MSAG	Master Street Address Guide
NENA	National Emergency Number Association
NS	Network Server
PBX	Private Branch Exchange
PRI	Primary Rate Interface
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
SIP	Session Initiated Protocol
SNMP	Simple Network Management Protocol
TBD	To Be Defined
TDM	Time-Division Multiplexing
URI	Uniform Resource Indicator
VoIP	Voice over IP
VPC	VoIP Positioning Center
WAN	Wide Area Network
XML	Extensible Markup Language

CLEARSPAN 911/E911 FEATURES

The following features are available in supporting emergency call control, and routing and terminal discovery. Note: advanced features require the advanced 911 option outlined below.

CALL IDENTIFICATION

- Multiple emergency call sequences (e.g. 911, 8911, etc.) may be defined in the Clearspan system.
- Ability to recognize predefined emergency call sequences.
- Ability to replace the emergency call dialed digits (for example, 911) with a fully specified directory number when call originators may be in an area that does not support enhanced emergency call routing.

CALL ROUTING

- Emergency calls may be transferred to local PSAP, Emergency Routing Services (ERS), or local emergency offices.
- Global and flexible routing options are also supported. Global routing may be used when all emergency calls from an enterprise are sent to the same location. Flexible routing lets system administrators define a unique method to deliver emergency calls from each office/site.

CALL RECORDING

- All emergency calls may be optionally recorded. The recordings may be accessed by system administrators or local emergency office personnel.

NOTIFICATIONS

- Emergency email delivery is supported for all emergency calls.
- Desktop alert software is available (requires EGW appliances).

CALLBACK

- Callback from local PSAP is supported.
- Callback to a fixed number (e.g. local emergency office) or emergency caller is supported.

CALL DETAIL RECORD (CDR)

- CDR is available for all emergency calls.

CLEARSPAN 911/E911 OPTIONS

In all 911 scenarios, it's important that the customer premises be configured with a survivable Session Border Controller (SBC). The support for 911 calls is also independent of whether an Emergency Gateway (EGW) is included as part of the planned deployment. While the EGW is not a mandatory component of the Clearspan solution, it provides a wealth of benefits including Automatic Phone Tracking, Security Desk notification, Remote Employee and Phone Mobility support, amongst others.

The following sections detail the supported Clearspan emergency service configurations, call-flows, capabilities and constraints in cases where the EGW is absent and present as part of the deployment:

BASIC 911/E911 EMERGENCY SERVICES – INCLUDED IN DEFAULT INSTALLATION

The following caveats and constraints exist in the standard Clearspan deployment:

- No additional premises-based equipment required.

- A preprogrammed, user account-based ELIN/ANI is presented during an emergency call. This ELIN/ANI is an index into the PS-ALI database giving the PSAP operator location information of the caller (E911). It is the customer's responsibility to maintain the PS-ALI database with the LEC.
- ELIN/ANIs can be partitioned by group or by individual user.
    - If provisioned as a group, then all users within that group must have a common physical location (ELIN/ANI).
    - If provisioned as a group, all users within that group must have common phone number prefixes (i.e. area codes).
- No automatic location tracking for moving phones (phones may not be moved).
- Callback to a fixed party (i.e. local emergency office).
- Users should use their primary lines – no dialing of 911 from a Shared Call Appearance (SCA).
- At customer requests, mobile workers with soft clients or moving desk phones will be able to dial 911 services; however, the location information may be incorrect if the programmed ANI/ELIN does not match the user's current location.

CALL FLOWS FOR NORMAL OPERATION AND ROUTING THROUGH CENTRALIZED SIP TRUNK

The following figure shows the call flow associated with the standard Clearspan offering, configured to use a centralized SIP trunk, under normal operation:

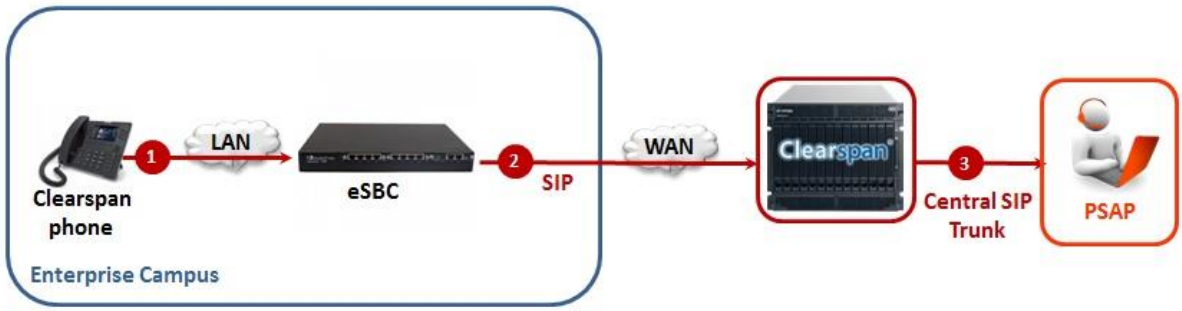

Figure 2 Basic Clearspan E911 Call Flow for Normal Operation using Centralized SIP Trunking.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) The eSBC will forward the call and deliver it to the Clearspan via Session Initiation Protocol (SIP).
3) Clearspan will deliver the call to the Public Safety Answering Point (PSAP) over a centralized trunk.

CALL FLOWS FOR NORMAL OPERATION AND ROUTING THROUGH LOCAL SIP TRUNK

The following figure shows the call flow associated with the standard Clearspan offering, configured to use a local SIP Trunk, under normal operation.

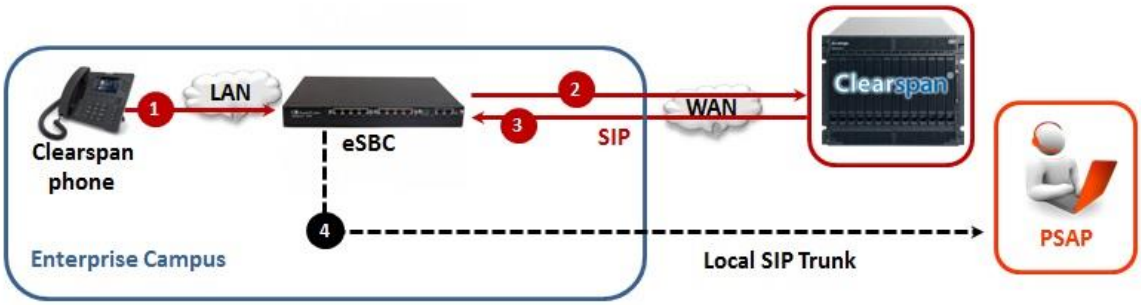

Figure 3 Basic Clearspan E911 Call Flow for Normal Operation using Local SIP Trunking.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) The eSBC will forward the call and deliver it to the Clearspan via Session Initiation Protocol (SIP).
3) Clearspan will modify the call request and return it to the eSBC.
4) The modified call request will then be delivered to the PSAP via a local SIP trunk directly off the eSBC.

CALL FLOWS FOR NORMAL OPERATION AND ROUTING THROUGH PSTN TRUNK

The following figure shows the call flow associated with the standard Clearspan offering, configured to use a PSTN Trunk, under normal operation.

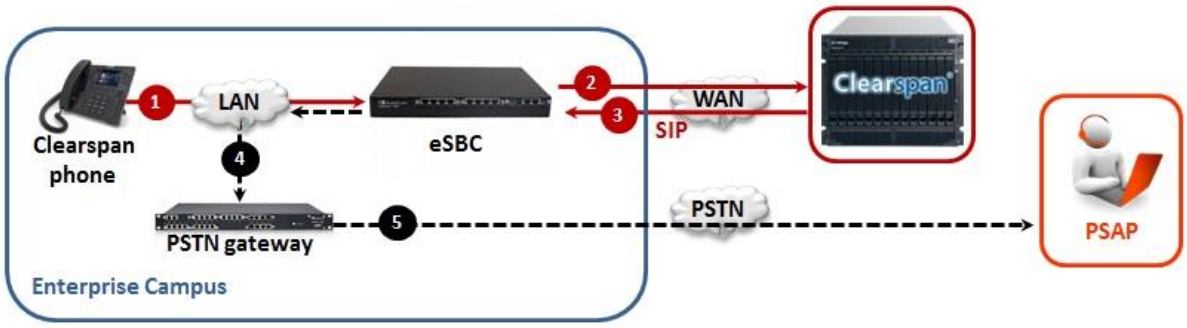

Figure 4 Basic Clearspan E911 Call Flow for Normal Operation using Local PSTN Trunking

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) The eSBC will forward the call and deliver it to the Clearspan via Session Initiation Protocol (SIP).
3) Clearspan will modify the call request and return it to the eSBC.
4) The eSBC will forward the modified call request to a Public Switched Telephone Network gateway (PTSN).
5) After the PTSN gateway receives the call request from the eSBC, it will then forward it to the PSAP.

CALL FLOWS FOR SURVIVABLE OPERATION

The following figure shows the call flow associated with the standard Clearspan offering operating under a failover or survivable situation. An enterprise Session Border Controller (SBC) is required to make this approach work and is critical in the realization of a survivable enterprise location.

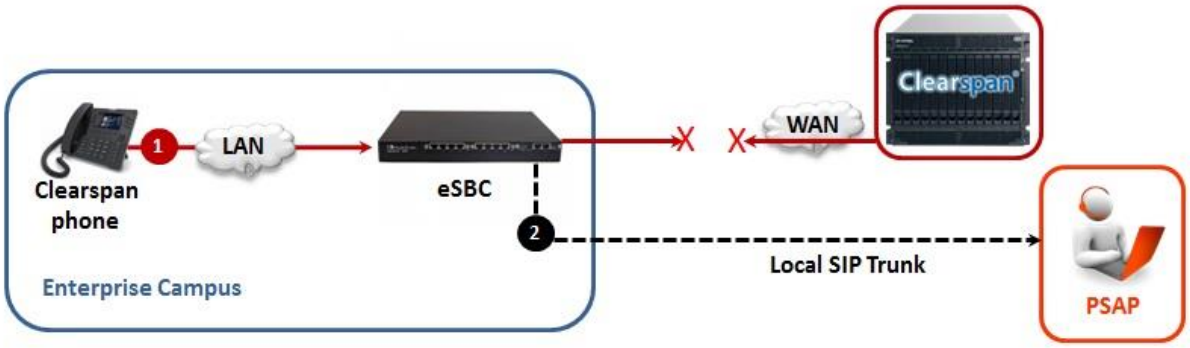

Figure 5 Basic Clearspan E911 Call Flow for Survivable Operation.

1) The Clearspan phone initiates a 911 call by sending a call request to the eSBC.
2) Even if the connection to the call server is broken, the eSBC is able to forward a call request to the PSAP via a local SIP trunk.

CALL FLOWS FOR SURVIVABLE OPERATION USING A PSTN GATEWAY

Similar to the scenario shown in the previous example, Clearspan can also operate in survivable mode in conjunction with a PSTN gateway. When operating in this configuration and mode, the enterprise Session Border Controller (SBC) will route the call to the PSAP through the optional PSTN gateway:

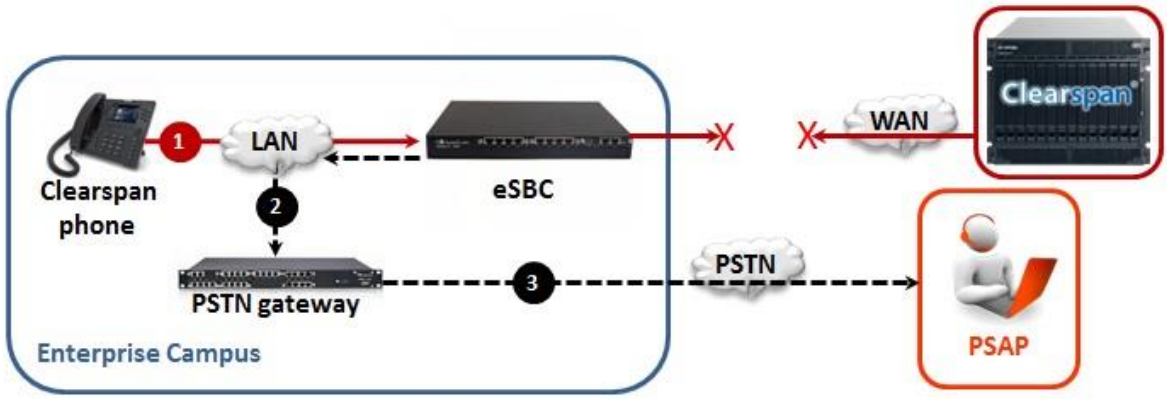

Figure 6 Basic Clearspan E911 Call Flow with Optional PSTN GTateway for Survivable Operation.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).

2) The eSBC will forward the modified call request to a Public Switched Telephone Network gateway (PTSN).
3) After the PTSN gateway receives the call request from the eSBC, it will then forward it to the PSAP.

ADVANCED 911/E911 EMERGENCY SERVICES (WITH EGW) – OPTIONAL

As mentioned earlier, the Clearspan solution can also be deployed with an optional Emergency Gateway (EGW) device. The following caveats and constraints exist in the optional Clearspan deployment using a redundant pair of EGW premises-based appliances:

- The EGW is essentially a Location Information Server (LIS) with some enhanced capacities.
- Media gateways are required in each applicable PSAP region for survivability.
- Supports emergency calls from Share Call Appearance lines.
- Supports automatic location tracking for SIP phones moving within the enterprise network when Layer-2 discovery is enabled. Ethernet switches within the enterprise are required to support SNMP query and phones are required to have MAC addresses and support auto discovery. It's the customer's responsibility to maintain an accurate, electronic, facility "wiremap" database in the EGW.
- An ELIN/ANI is presented based on the physical location of the endpoint (not the user as in the basic deployment). This ELIN/ANI is an index into the PS-ALI database giving the PSAP operator location information of the caller (E911). It is the customer's responsibility to maintain the PS-ALI database with the LEC.
- No restrictions to users assigned to a group.
- Flexible callback options (911 caller, emergency desk, etc.).
- Desktop alerting with optional desktop alerting software.
- At customer requests, mobile workers with soft clients or moving desk phones will be able to dial 911 services, however the location information may be incorrect if the programmed ANI/ELIN does not match the user's current location.

CALL FLOWS FOR NORMAL OPERATION WITH CENTRALIZED SIP TRUNKS

The following figure shows the call flow associated with the advanced Clearspan offering. An enterprise Session Border Controller (SBC) is required to make this approach work and is critical in the realization of a survivable enterprise location. In addition, Emergency Gateways (EGWs) are also required.

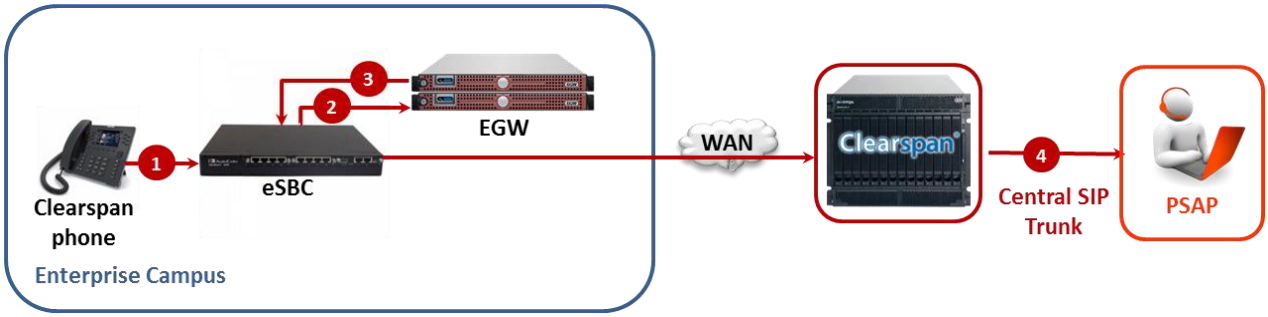

Figure 7 Advanced E911 Using Emergency Gateways in Normal Operation and Centralized SIP Trunking.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) Call gets routed directly to the EGW from the SBC.
3) The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname), and then routed back to the eSBC.
4) The eSBC will forward the call and deliver it to the Clearspan via Session Initiation Protocol (SIP). Clearspan will deliver the call to the Public Safety Answering Point (PSAP) over a centralized trunk.

CALL FLOWS FOR NORMAL OPERATION WITH LOCAL SIP TRUNKS

The following figure also shows the call flow associated with the advanced Clearspan offering. The difference between this scenario and the one shown in the previous figure is that once the call has been processed by the EGW and returned back to the eSBC, it is routed to the PSAP over a local SIP Trunk, rather than a centralized SIP Trunk in the previous case.

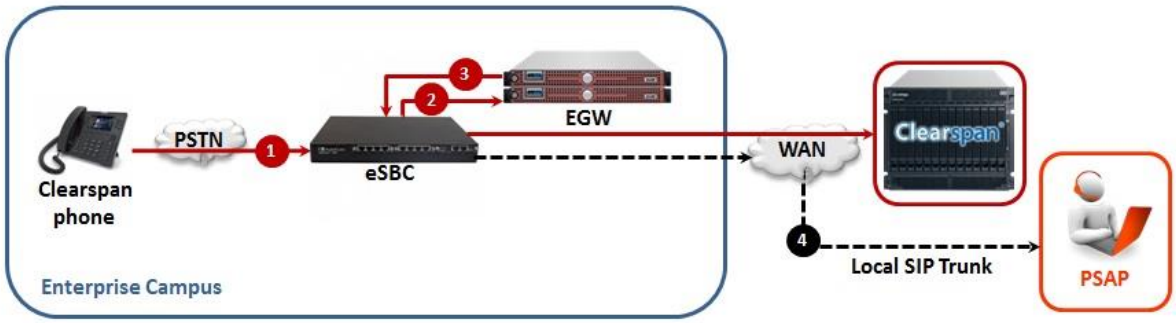

Figure 8 Advanced E911 Using Emergency Gateways in Normal Operation and Local SIP Trunking.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) Call gets routed directly to the EGW from the SBC.
3) The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname), and then routed back to the eSBC.
4) The eSBC will then route the call to a PSAP over a local SIP trunk.

CALL FLOWS FOR NORMAL OPERATION WITH LOCAL PSTN TRUNKS

The following figure shows the call flow associated with the advanced Clearspan offering. Like the previous scenario, once the call has been processed by the EGW, it is routed to the PSAP through a local connection, though in this case it would be a PSTN connection, rather than a local SIP Trunk.

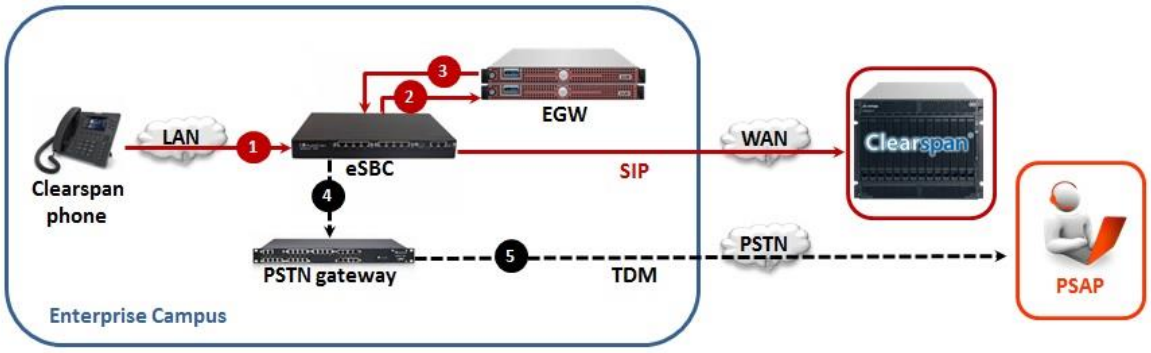

Figure 9 Advanced E911 Using Emergency Gateways in Normal Operation and PSTN Trunking.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) Call gets routed directly to the EGW from the SBC.
3) The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname), and then routed back to the eSBC.
4) The eSBC will forward the call request to a PTSN gateway.
5) The PSAP will receive the call request shortly after the PTSN gateway redirects it.

CALL FLOWS FOR SURVIVABLE OPERATION WITH LOCAL SIP TRUNKS

The following figure outlines the call flow associated with the optional Clearspan E911 Emergency Gateway operating under a failover or survivable situation. An enterprise Session Border Controller (SBC) is required to make this approach work and is critical in the realization of a survivable enterprise location.

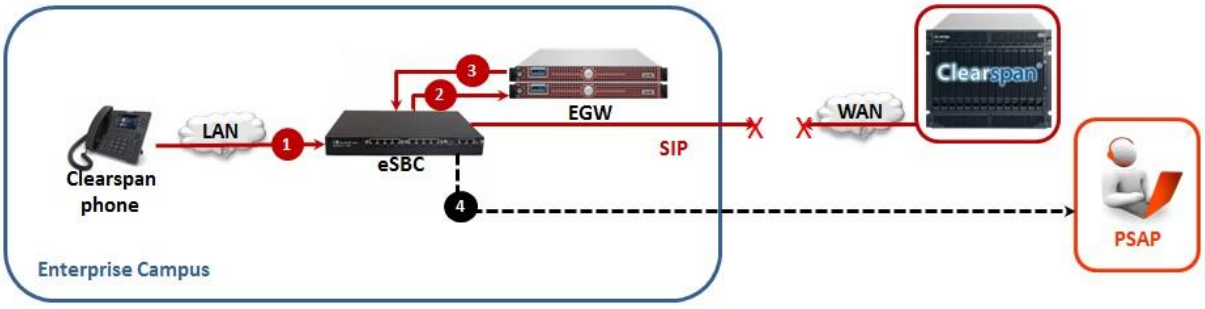

Figure 10 Advanced E911 Using Emergency Gateways in Survivable Operation and Local SIP Trunk.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) Call gets routed directly to the EGW from the SBC.
3) The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname), and then routed back to the eSBC.

4) With the connection to the Clearspan call server broken, the eSBC is able to forward a call request to the PSAP via a local SIP trunk.

CALL FLOWS FOR SURVIVABLE OPERATION WITH LOCAL PSTN TRUNKS

The following figure outlines the call flow associated with the optional Clearspan E911 Emergency Gateway operating under a failover or survivable situation. An enterprise Session Border Controller (SBC) is required to make this approach work and is critical in the realization of a survivable enterprise location. The difference between this and the preceding scenario is that in this case, after processing by the EGW, the call is routed via the eSBC over a PSTN connection, rather than a local SIP Trunk.

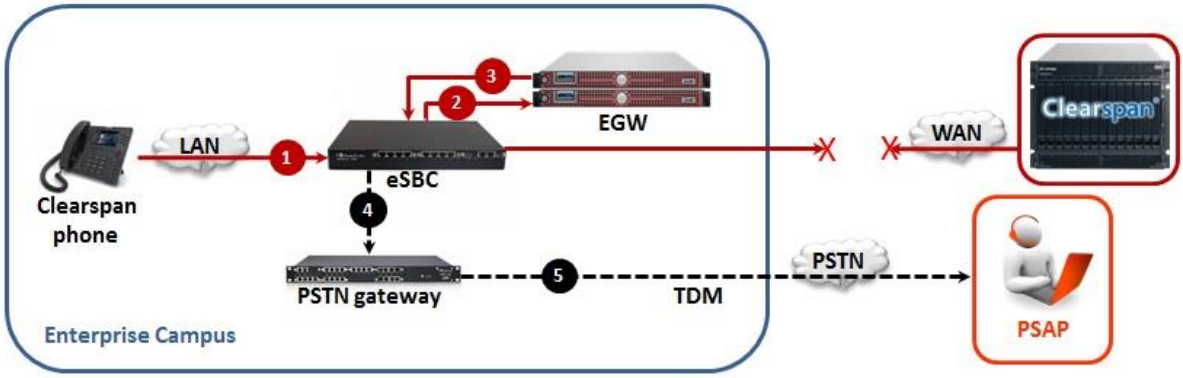

Figure 11 Advanced E911 Using Emergency Gateways in Survivable Operation and Local PSTN Trunk.

1) The Clearspan phone initiates a 911 call by sending a call request to the Enterprise Session Border Controller (eSBC).
2) Call gets routed directly to the EGW from the SBC.
3) The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname), and then routed back to the eSBC.
4) With the connection to the Clearspan call server broken, the eSBC is able to forward the call request to the PSAP to the PSTN Gateway.
5) After the PTSN gateway receives the call request from the eSBC it will then forward it to the PSAP over a PSTN connection.

THIRD-PARTY 911 EMERGENCY POSITIONING AND ROUTING SERVICES - OPTIONAL

For customers that require an all-VoIP solution, including 911, working with our partners, the Clearspan solution can be integrated with an Emergency Routing Service (ERS) as an overlay to the advanced 911 support. For customers opting for this optional service, Aastra strongly recommends that this be deployed in conjunction with the Emergency Gateway devices. If deploying this service, the following features and constraints apply:

- Redundant Emergency Gateway (EGW) units required.

- Two options for ERS support are available:
    - Option 1: Emergency calls are handled entirely by a third-party, NENA i2 compliant, emergency services provider via the enterprise SBC or the Emergency Gateway (EGW).
    - Option 2: Emergency calls are handled entirely by a third-party traditional emergency services provider via an enterprise PSTN gateway.
- Supports emergency calls from Share Call Appearance lines.
- Support automatic location tracking for phones moving within the enterprise network when Layer-2 discovery is enabled. Ethernet switches within the enterprise are required to support SNMP query and phones are required having MAC address and supporting auto discovery. It's the customer's responsibility to maintain an accurate, electronic, facility "wiremap" database in the EGW.
- Support location updates for phones moving outside the enterprise network depending on the third-party services selected.
- No restriction to users assigned to a group.
- Desktop alerting with optional desktop alerting software.

The following figure shows the potential call flows associated with the optional Clearspan ERS service with calls routed via a centralized SIP Trunk, a local SIP Trunk, or a PSTN Trunk.

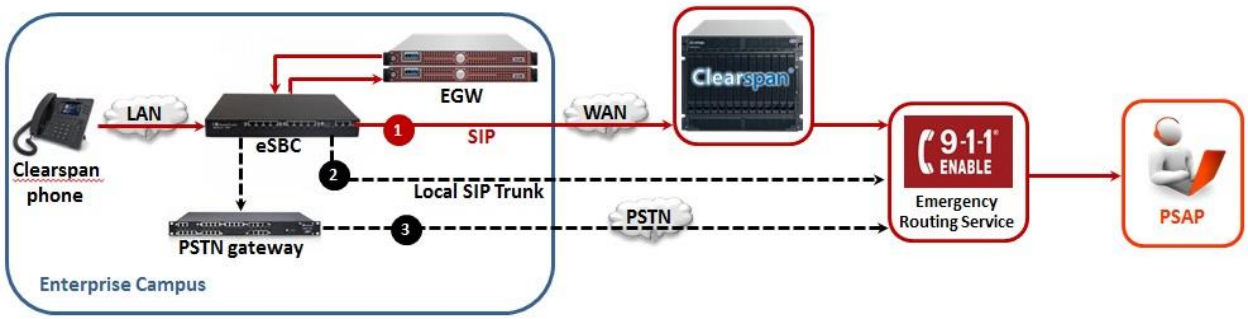

Figure 12 Advanced E911 Using Emergency Gateways and Optional Emergency Routing Service.

CONCLUSION

Clearspan presents users and system administrators with a family of standards-compliant emergency call control options. From the basic presentation of a user-based, programmable ANI/ELIN for PS-ALI lookup to advanced IP-based emergency routing services, system administrators have the architectural flexibility to craft solutions to meet and exceed end-user and regulatory requirements. For additional details contact your Aastra sales representative.