The ESWG 12-month Consensus Report on Nomadic VoIP

Technical and Operating Impediments to

9-1-1/E9-1-1 Service Delivery in Canada

24 May 2006

Executive Summary

The ESWG proposes to file, **within six (6) months of Commission approval of this report, a functional architecture for the implementation of VoIP E9-1-1 in Canada** for Commission approval. This architecture will be **consistent with the NENA i2 standard**, adjusted as necessary for implementation in Canada and, subject to vendor availability, and **include a timeline for implementation of the key deliverable elements**. This will include **specifying roles and responsibilities of all emergency services industry participants**, particularly those of the new operating elements being proposed. **Following the Commission's approval of the proposed architecture, the industry will require a minimum of 12 months to implement the Canadian i2 solution.**

The technical details for this solution have yet to be determined and will be part of subsequent implementation and architecture plans.

This *ESWG 12-month Consensus Report on Nomadic VoIP Technical and Operating Impediments to 9-1-1/E9-1-1 Service Delivery in Canada* is in response to the mandate given to CISC by the Commission in Telecom Decision CRTC 2005-21, *Emergency service obligations for local VoIP service providers*. This 12-month Report follows up upon the issues identified in the *ESWG 6-month Report on Fixed/Non-Native VoIP Technical and Operating Impediments to 9-1-1/E9-1-1 Service Delivery* as it was the conclusion of the ESWG that the impediments in Canada were common between the fixed/non-native and nomadic VoIP 9-1-1/E9-1-1 service delivery.

The ESWG concludes that it is crucial to act quickly to determine a course to deliver a practical and sustainable solution for nomadic and fixed/non-native VoIP 9-1-1 calls for Canadians and requests that the Commission continue their practise of fostering advancement in emergency services by providing deadlines for the accomplishment of specific tasks through decisions and order the commencement of this deployment as quickly as is practical.

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1. Introduction

Nomadic Voice over Internet Protocol (VoIP) presents a new challenge to the Public Safety Answering Points (PSAPs), and emergency response agencies in particular, as well as the telecommunications industry and VoIP end users. The CRTC Interconnection Steering Committee's Emergency Services Working Group (ESWG) concludes that it is crucial to act quickly to determine a course to deliver a practical and sustainable solution for nomadic and fixed/non-native VoIP 9-1-1 calls for Canadians.

2. Background

2.1 Decision CRTC 2005-21 Mandate

This *Emergency Services Working Group (ESWG) 12-month Consensus Report on Nomadic VoIP Technical and Operating Impediments to 9-1-1/E9-1-1 Service Delivery in Canada* (the 12-month Report or the Report) is in response to the mandate given to CRTC Interconnection Steering Committee (CISC) by the Commission in Telecom Decision CRTC 2005-21 as follows:

> *72. The Commission remains of the view that, as these are technical and operational issues, the most effective approach to resolving them is through the CISC process, provided that CISC is guided by a fixed timeline.*
>
> *73. Accordingly, the Commission requests CISC to submit to the Commission, within six months from the date of this Decision, a report identifying the technical and operational issues that impede 9-1-1/E9-1-1 service delivery when local VoIP service is offered on a fixed/non-native basis, and, within one year from the date of this Decision, a similar report with respect to local VoIP service offered on a nomadic basis. Each report should identify all viable solutions and recommend the preferred solution(s), with supporting rationale, and a proposed timeframe for implementation.*
>
> *74. The Commission notes that certain parties suggested that CISC may benefit from participation in the NENA process in the United States. The Commission recognizes that the progress made by other national telecommunications regulators, with respect to the provisioning of emergency services with local VoIP services, may be of value to the Canadian industry and encourages CISC to monitor the reports and progress being made in other jurisdictions on this important issue.*

This 12-month Report follows up upon the issues identified in the *ESWG 6-month Report on Fixed/Non-Native VoIP Technical and Operating Impediments to 9-1-1/E9-1-1 Service Delivery* (the 6-month Report) as it was the conclusion of the ESWG that the impediments in Canada were common between the fixed/non-native and nomadic VoIP 9-1-1/E9-1-1 service delivery.

2.2 ESWG 6-month Report on Fixed/Non-Native VoIP Technical and Operating Impediments to 9-1-1/E9-1-1 Service Delivery

On 3 November 2005, the ESWG filed Identification of Issues for Provision of 9-1-1/E9-1-1 Service to Fixed/Non-Native VoIP Customers, 27 October 2005 (ESRE0041) (the 6-Month Report). The ESWG submitted that the working group is currently exploring and evaluating alternative technologies to provide E9-1-1 solutions for nomadic VoIP services and that these technologies may also resolve the problems related to E9-1-1 service delivery to fixed/non-native VoIP customers. The ESWG recommended that the Commission review and consider the proposals to be put forward in the ESWG report on nomadic 9-1-1/E9-1-1 services before giving directions to the Industry on what solution(s) should be implemented. This was done in order to ensure that 9-1-1/E9-1-1 services are provided in an effective and efficient manner to all VoIP local service subscribers. The 6-month report was approved by the Commission in Telecom Decision 2005-73, *Consensus report on 9-1-1/E9-1-1 services provided to fixed/non-native VoIP subscribers*[1] on 20 December 2005.

[1] http://www.crtc.gc.ca/archive/ENG/Decisions/2005/dt2005-73.htm

2.3 NENA in the United States

The National Emergency Number Association (NENA), a joint industry and public safety body which promotes research and planning into the development of 9-1-1 service in North America identified the following stages in the evolution of the current 9-1-1 system as it relates to VoIP[2];

- **Immediate methods for Voice over Internet (i1)**
  Route Voice over Internet calls to the correct PSAP outside the current E9-1-1 system network, optionally with caller ID. No Automated Location Information (ALI) provided.
- **Intermediate methods (pre i2)**
  Solutions termed `pre i2' appear prior to the availability of full i2 interim solutions. These pre-i2 cases are subsets of the i2 characteristics and may not support automatic location determination capabilities.
- **Migratory (Interim) solution for VoIP (i2)**
  Route Voice over Internet and other types of VoIP calls into the current E9-1-1 systems and to the correct PSAP with correct Automatic Number Identification (ANI) and ALI, accommodates both fixed and nomadic users, provides MSAG valid location information. Utilizes a method for nomadic user location either through an automated process or user input via a service prompted web based form or equivalent. Mobility (wireless VoIP) not supported beyond base station location identification. Provides a single industry adopted solution.
- **Next Generation Enhance 9-1-1 (NG E9-1-1) (a.k.a. i3)**
  Enable end-to-end IP based E9-1-1 design, supporting VoIP originated call delivery, and the transition of current wireline and wireless service providers to IP interface technology. Support IP mobility users, and all capabilities of i2. Utilize extended capabilities of IP to provide location and other information with the call, as well as other sub-sets of relevant data (Future Path Plan tier 3 and beyond). Provide a standard NG E9-1-1 solution which incorporates all requirements of E9-1-1, and the potential to easily support future IP-based communications devices.

[2] Adapted from http://www.nena.org/pages/Content.asp?CID=71&CTID=11: the "i" terms are the abbreviations used by the NENA VoIP/Packet Technical Committee in referring to the sequence of development and methods to integrate IP into E9-1-1 design. NENA's Mission is to foster the technological advancement, availability and implementation of a universal emergency telephone number system (9-1-1). In carrying out its mission, NENA promotes research, planning, training and education. The protection of human life, the preservation of property, and the maintenance of general community security are among NENA's objectives.

2.4 Federal Communications Commission (FCC) Relevant Ruling (FCC05-116)

On 3 June 2005 the FCC adopted an Order[3] imposing E9-1-1 obligations on "interconnected" VoIP providers whose service enables subscribers to receive calls from and terminate calls to the public switched telephone network. All interconnected VoIP providers must:

- Automatically provide E9-1-1 services as a standard mandatory feature;
- Subscribers do not have to specifically request E9-1-1;
- VoIP providers may not allow subscribers to "opt-out" of E9-1-1 service.

Before an interconnected VoIP service provider can activate a new subscriber's service providers must:

- Obtain (from the subscriber) the physical location at which the service will be used;
- Provide means for a subscriber to update the physical location they have registered if it changes.

Interconnected VoIP providers must transmit to the appropriate PSAP or other designated answering point, limited to their capability of processing:

- All 9-1-1 calls;
- Call back number;
- Caller's registered physical location;
- Route the calls through the use of ANI via the dedicated wireline E9-1-1 Network;
- Make the Registered Location available from or through the ALI Database.

Interconnected VoIP providers must:

- Take appropriate action to ensure that their subscribers have a clear understanding of the limitations, if any, of their E9-1-1 service;
- Specifically advise new and existing subscribers the circumstances under which E9-1-1 service may not or may be in some way limited by comparison to traditional E9-1-1 service;

[3] First Report and Order and Notice of Proposed Rulemaking, FCC 05-116, WC Dkt. Nos. 04-36, 05-196 (rel. June 3, 2005)

- Distribute labels to all subscribers warning subscribers if E9-1-1 service may be limited or not available and instructing subscribers to place the labels on and/or near the equipment used in conjunction with interconnected VoIP service;
- Obtain and keep record of affirmative acknowledgement by new and existing subscribers of having received and understood the limitations, if any, with the interconnected VoIP service.

Finally, the *VoIP 911 Order* required each interconnected VoIP provider to file with the Commission a Compliance Letter by 28 November 2005 detailing its compliance with the FCC 9-1-1 order. The FCC also acknowledged the work being done by NENA in the provision of guidelines to assist companies in complying with the FCC orders.

2.5 Comparison to the Canadian situation

There are four major differences between the Canadian situation and that present in the United States:

1. The regulatory environment;
2. The difference in size and complexity of the Public Switched Telephone Network (PSTN);
3. The 9-1-1 systems framework including PSAP equipment and their interfaces, and;
4. The funding model.

The Commission in Telecom Decision 2005-28, *Regulatory framework for voice communication services using Internet Protocol*, provided specification on what constituted a VoIP service, VoIP service categories, the appropriate legislative framework, and application of the regulatory framework for local competition. The Commission dealt with the emergency service obligations for local VoIP service providers in Decision 2005-21 dealing with: the provision of E9-1-1 to fixed/native callers; the provision of basic 9-1-1 to all other callers on an interim basis; customer notification; and directing the production by CISC of the 6- and 12-month Reports.

Unlike the US situation where FCC05-116 ordered the immediate implementation by VoIP providers of the user information (ALI), use the routing (ANI or pseudo-ANI/ p-ANI) requirements and to provide a method for customers to update their registered location, the Canadian situation is to provide basic 9-1-1 on an interim basis where and when E9-1-1 cannot be

provided. The US is essentially in a pre-i2 phase with vendors working to develop and market i2[4] capable system components.

The second difference between Canada and the US is the size and complexity of the PSTN. The Canadian population, and therefore number of subscribers, municipalities and PSAPs is roughly one tenth the size of that in the US. Additionally, there are only five main regional 9-1-1 service providers in the Canadian marketplace and far fewer Competitive Local Exchange Carriers (CLECs) and Voice over IP Service Providers (VISPs). Through the various CISC working groups, these stakeholders have a common forum in which to share ideas and come to consensus on any current and future 9-1-1/E9-1-1 implementations. It is anticipated that any inter-carrier considerations regarding call handling procedures would be more easily accommodated in Canada than in the U.S. due to the direct relationship between the 9-1-1 Industry participants.

The 9-1-1 systems framework (including PSAP equipment and their interfaces) constitutes the third difference. While most states are broken down into many small 9-1-1 networks operated by the PSAPs, the Canadian model was designed and implemented to support provincial 9-1-1 networks operated by the Incumbent Local Exchange Carriers (ILECs). Furthermore, unlike the US concept where most PSAPs are set up using trunk-based interconnecting equipment requiring an ALI "PULL" data environment; in Canada, most PSAPs are using line-based equipment allowing ALI "PUSH" data[5].

The fourth difference is the funding model. In the US, the local 9-1-1 entity is mainly responsible to manage all 9-1-1 surcharges and to remit tariff-based network costs to equipment suppliers and interconnecting carriers. In Canada, 9-1-1 service is funded by monthly end-user charges and/or taxes, which vary regionally. In the US, the federal government has further

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[4] *Interim VoIP Architecture for Enhanced 9-1-1 Services (i2) NENA 08-001, Issue 1* was issued 6 December 2005 and provides the guide for the designers and manufacturers of systems that are used for the purpose of processing emergency calls.

[5] Database concept used for determining the location of an emergency caller (landline geographical address or wireless cell site/sector location information) using the landline Calling Line Identifier (CLI) or wireless Emergency Service Routing Digit (ESRD), as provided by the network operator's customer database. Database specifications exist for both:

- a PUSH scheme, whereas the address is automatically pushed with the initial call to the emergency centre together with the voice call;
- a PULL scheme, whereas the emergency call centre shall be able to access (retrieve) the data information during the call from a database using the landline calling line identification number or wireless ESRD.

NENA Next Generation ENHANCE 9-1-1 (NG E9-1-1) Program web page (http://www.nena.org/pages/ContentList.asp?CTID=14)

established a 9-1-1 Fund that will be available for E9-1-1 upgrades to implement the US ENHANCE 911 Act. No similar fund exists in Canada.

2.6 NTWG Review of the ESWG VoIP 9-1-1 Access Architecture Proposals

Prior to the issuance of Telecom Decision CRTC 2005-21, the ESWG received two proposals for VoIP 9-1-1 Access Architecture and forwarded them to the Network Working Group (NTWG) for technical review. On 19 July 2005, NTWG responded with, *Report on VoIP 911 Architecture Technical Evaluation* (NTRE034), an evaluation of the two VoIP 9-1-1 proposals. The NTWG review concluded that many aspects remain to be investigated by the emergency service industry participants if either architecture is to be pursued.

2.7 Progress on Identification of Major Issues and Impediments

Methodology

An issues matrix was used as a working document to initiate, organize, and capture discussion within the ESWG regarding the 12-month Report. Issues were suggested during the early plenary sessions of the ESWG regarding the 12-month Report and were amended and appended subsequently as needed. The matrix discussion was used to clarify the issues, develop alternatives for addressing the issues, and then evaluate these alternatives with regard to effectiveness and feasibility. The matrix issues were primarily technical in nature and included alternatives that were in addition to i2 and NG E9-1-1 capturing the challenges of Canadian implementation of E9-1-1 for VoIP.

The process of ranking alternatives, which involved rating the effectiveness and feasibility of each, provided the basis of whether consensus developed around a particular alternative. In addition, the matrix consensus items were identified within the separate major tasks (TIFs). Further details on each of these TIFs can be found within each of those diaries[6].

[6] TIF diaries from CISC ESWG can be found on the web at http://www.crtc.gc.ca/cisc/eng/cisf3e4_20.htm

PSAP Funding (TIF 42)

PSAP funding emerged as a major issue, as it brought into focus the regional variation in funding that PSAPs receive and the limitations of that funding to address new system and process requirements.

PSAPs in seven provinces (British Columbia, Alberta, Saskatchewan, Quebec, New Brunswick, Nova Scotia and Prince Edward Island) have access to the application of call answer levies to fund their operation. Compared to wireline subscribers, due to the nature of IP networking and nomadic potential of the end-user equipment, some VoIP subscribers make smaller or no contributions to PSAP funding. Therefore, any migration from wireline to VoIP will result in a decrease in PSAP funding from call answer levies. From a PSAP perspective, a solution that addresses VoIP E9-1-1 technical and operational issues is incomplete if it ignores the issue of PSAP funding.

Due to the nature of IP networking and nomadic potential of the end-user equipment, unlike wireline callers, VoIP caller locations may not be directly associated with the PSAP in which they require service. The migration of a caller from wireline or wireless LEC service to VoIP can therefore potentially result in a loss of the associated call answer levy funding to the PSAP.

Members of the ESWG agreed that subscribers should continue to contribute to 9-1-1 funding if they switch to VoIP. It was agreed that the ESWG should continue to develop a recommendation for a practical and equitable PSAP funding model for VoIP E9-1-1 through ongoing efforts on TIF 42.

VoIP 9-1-1 Caller Location Identification (TIF 45)

Identification of the location of a VoIP 9-1-1 caller is crucial to determining:

1. The designated PSAP for proper call routing;
2. In determining where to dispatch the emergency resources required.

NENA i2 requires that VoIP end-user equipment have an automated process for location awareness, support downloadable location information, or use a location key. This represents one of the major issues for E9-1-1 deployment in a nomadic VoIP environment. Millions of already deployed VoIP end-user devices worldwide (tens of thousands in Canada) do not currently support this functionality.

Since location determination is the key component for E9-1-1 achievement, development of these technologies by the equipment manufacturer / software industry is expected to continue. Location determination technologies and related solutions are still at an early[7] developmental stage, and the industry is working diligently on the problem. Carrier based or third party based solutions are technically feasible but not commercially available at this time.

VoIP 9-1-1 Caller Routing to PSAP (TIF 46)

TIF 46 dealt with routing of a VoIP 9-1-1 call to the designated PSAP.

NENA i2 provides a method of routing VoIP 9-1-1 calls to the designated PSAP by introducing new network elements to the existing infrastructure and databases.

This new infrastructure delivers no additional information to the PSAP than is currently provided with E9-1-1 capability.

Deployment issues related to specific network interfaces have yet to be finalized.

VoIP 9-1-1 Caller Information to PSAP (TIF 47)

TIF 47 dealt with the provisioning and delivery of information to the PSAP.

NENA i2 has no impacts on the caller information delivered. However, due to current limitations specific to IP signalling, specific E-9-1-1 call control features, where available today, may operate differently or may not be available altogether. These could include certain call control features such as Called Party Hold, Calling Party Switch-Hook Status, Ring Back and Forced Disconnect. Any failure in routing the call would result in the call being treated as a Basic 9-1-1 service.

3. Identification and Analysis of All Viable Solutions

3.1 NENA i2

The NENA i2 architecture was designed to support the interconnection of Voice over Internet Protocol (VoIP) domains with the existing Emergency Services Network infrastructure. This

[7] The word “early” was added at the request of Cogeco and Videotron.

overview will describe the functional elements and call flow of a VoIP 9-1-1 call over the i2 architecture.

The NENA i2 architecture was also designed to utilize existing 9-1-1 voice and data links to all existing Public Safety Answering Points (PSAPs). With the addition of the new network elements described below, the existing 9-1-1 network can support VoIP Enhanced 9-1-1 calling (including nomadic and non-native).

A traditional 9-1-1 call involves multiple network elements as well as separate voice and data paths over several different protocols. The routing of a VoIP call is no different. The delivery of a VoIP 9-1-1 call over an i2 architecture can be broken down into the following steps which have been separated into 2 categories, *Pre-9-1-1 call* and *During 9-1-1 call*.

Pre-9-1-1 call

STEP -3 Emergency Services Query Key (ESQK) shell record files are transmitted to targeted Emergency Services Providers so they can upload these in the appropriate Selective Router Databases and ALI (Automatic Location Identification) systems.

Example: 905-211-9111 + 023 + Ontario + vpc@operator.ca

ESQK	ESN	Province	VoIP Positioning Centre ID

STEP -2 Location information (civic addresses) are loaded in the Location Information Server (LIS) and formatted per the Street Address Guide rules.

Example: 123.fake.st.west.Mycity.Ontario has an activated broadband service.

STEP -1 Location information is validated against the Validation Database (VDB).

Example: Is **123.fake.st.west.Mycity.Ontario** a routable address for 9-1-1?
VDB response: **Yes**

STEP 0 The VoIP end point (assuming it is location capable) acquires its location information either by value or by reference from the Location Information Server.

Example: LIS, I am **<this device>** running on **<this network>**, please provide me with my location value and/or reference (key).
LIS response: I found it, here it is: **16612324** (location key in this example)

During 9-1-1 call

STEP 1 The VoIP endpoint/user agent originates an emergency call by sending a call initiation request to the VoIP Service Provider's Call Server. The call initiation request will contain call back information and a Location Key or Value (fully formatted civic address).

Example: VoIP subscriber dials 9-1-1

STEP 2 The VoIP Service Provider's Call Server receives the call initiation request and sends a routing request to a VoIP Positioning Centre using the information received in the call initiation request.

Example: 16612324 + 416-NXX-XXXX → 911

STEP 3 The VoIP Positioning Centre queries the Location Information Server(s) using the Location Key provided in STEP 1.

Example: 16612324 = ?? Civic Address

STEP 4 The Location Information Server returns a Location Object to the VoIP Positioning Centre, based on the Location Key.

Example: 16612324 = 123.fake.st.west.Mycity.Ontario

STEP 5 The VoIP Positioning Centre uses the Location Object obtained from the Location Information Server(s) to determine the Emergency Service Zone routing information from the appropriate Emergency Routing Database. The VoIP Positioning Centre receives the Emergency Service Routing Number, Emergency Service Number and Contingency Routing Number from the Emergency Routing Database.

ESRN	ESN	CRN

Example: 123.fake.st.west.Mytown.Ontario = 905-123-4567 + 023 + 0-ECRS

The VPC uses the received routing information to allocate an available Emergency Services Query Key from a pool appropriate for the Selective Router and Emergency Service Number associated with the caller's location.

Example: Ontario + 023 = 905-211-9111

PROV	ESN	ESQK

If no location is found, the call can be default routed using the Contingency Routing Number.

STEP 6 The VoIP Service Provider's Call Server will use the Emergency Service Routing Number received in the response from the VoIP Positioning Centre as the basis for selecting the designated Emergency Services Gateway. It then sends the call over the facilities to the Emergency Services Gateway with the Emergency Services Query Key as the pseudo-ANI (pANI) and the Emergency Services Routing Number as the called number.

Example: 905-123-4567 = Emergency Services Gateway for Ontario Selective Routers = selective-router-on1@bell.ca, Calling # 905-211-9111, Called # 905-123-4567

STEP 7 The Emergency Services Gateway uses the received Emergency Service Routing Number to select an outgoing route (i.e., trunk group) to the designated 9-1-1 Selective Router using outgoing (SS7 or MF) signaling. The called number, Emergency Services Routing Number, is replaced by the digits 9-1-1 by the trunk group options so the call can now enter the traditional 9-1-1 Network as a 9-1-1 dialed call originating from the assigned Emergency Services Query Key. The Emergency Services Query Key acts as a traditional Automatic Number Identification (ANI) for call routing.

The Selective Router receives the emergency call, uses the Emergency Services Query Key to query the 9-1-1 Selective Routing Database for the associated Emergency Service Number (ESN), and uses the ESN to identify the designated PSAP for the call.

Example: 905-211-9111 = Selective Router A + ESN 023 Ontario = Primary Public Safety Answering Point B

STEP 8 The Selective Router then delivers the call to the designated Primary Public Safety Answering, signaling the Emergency Service Query Key as the Automatic Number Identification (ANI) information. This causes a "PUSH" of the ANI to the ALI (Automatic Location Identification) computer. The ALI computer recognizes the ANI as an Emergency Service Query Key and steers to the VoIP Positioning Centre so it can build a properly formatted ALI record based on the information compiled by the VoIP Positioning Centre including the Call Back Number. Other Enhanced 9-1-1 information such as VoIP Service Provider will be available in

the same way the 9-1-1 service provider offers it on wireline/wireless 9-1-1 records.

Example: 905-211-9111 = 123 Fake St West, Mytown Ontario 905-NXX-XXXX

The result of this process is a VoIP 9-1-1 call that is routed to the appropriate PSAP with ANI/ALI information delivered in standard form regardless of caller location (In Canada), with no changes to PSAP networks, systems or equipment.

3.2 NENA i2 Functional Elements

NENA i2 introduces five (5) network elements required to support all classes of VoIP as envisaged in Canada. Access security and authentication will be required to maintain the integrity for all elements.

LIS - Location Information Server

The wire map version will contain the physical address information for all broadband access service locations. This will provide location information regardless of the underlying access medium (cable/Digital Subscriber Line/Fixed Broadband Wireless Access).

A LIS is:

- A repository of location information;
- Configured with mappings between individual Location Objects and a logical representation of the physical locations with which they are associated (i.e. a wire map);
- Provides mechanisms for either the client or a Network node and the VoIP Positioning Centre to retrieve location information;
- Supports validation of civic location information via a query interface to the Validation Database.

Canadian Consideration for the Location Information Server

Because of Canada's 9-1-1 Service Provider structure, the Street Address Guide or equivalent data used for 9-1-1 will be required for Location Information Server development. A close relationship between the Location Information Server, Validation Database and Street Address Guide will be required to ensure designated routing, accurate data and database synchronicity. Special arrangements and designations may be required in some areas where no SAG has been implemented.

ERDB - Emergency Routing Database

This will contain Master Street Address Guide (MSAG) data and 9-1-1 routing information associated with the coverage area of the Emergency services Provider. It will be used by the

VoIP Positioning Centre to find designated routing based on the location information. This will ensure that any changes to a 9-1-1 Service Provider's Selective Router, Emergency Service Numbers or Primary Public Safety Answering Points will be made in real-time.

An ERDB:

- Supports storage of the boundary definitions for Emergency Service Zones and the mapping of civic address or geo location information to a particular Emergency Service Zone;
- Processes routing requests from the VoIP Positioning Centre;
- Based on the received Location Object, the Emergency Routing Database determines the designated Emergency Service Routing Number, Emergency Service Number and Contingency Routing Number for each VoIP 9-1-1 call.

Canadian Consideration for the Emergency Routing Database

The data in the Emergency Routing Database is dependant upon the Master Street Address Guide, 9-1-1 Network configuration and the 9-1-1 Service Provider's onboard Selective Routing Database. Coordination and a close relationship between the Emergency Routing Database, Selective Routing Database and Master Street Address Guide will be required to ensure designated routing and database synchronicity.

ESGW - Emergency Services Gateway

This will provide IP access to the existing 9-1-1 selective routers for 9-1-1 call delivery to the designated Public Safety Answering Point. By connecting through an Emergency Services Gateway, the VoIP 9-1-1 call will follow any network changes or activity made by the 9-1-1 service provider (reroute, outage). This will also allow VoIP 9-1-1 calls the same treatment, including diversity, offered to wireline and wireless 9-1-1.

An ESGW:

- Converts between VoIP signalling and traditional signalling (SS7 or CAMA/MF);
- Determines the designated outgoing trunk group based on the received Emergency Services Routing Number;
- Transmits the received Emergency Services Query Key to the Selective Router over the designated trunk group.

Canadian Consideration for the Emergency Services Gateway

Because of Canada's 9-1-1 Service Provider structure, gateways to the 9-1-1 Selective Routers can be provisioned per province or per 9-1-1 service provider. A relationship between the VoIP Service Provider and Emergency Services Gateway provider will be required in order to have a voice path to 9-1-1.

VDB - Validation Database

This will provide a means of civic address validation for addresses stored in the Location Information Server(s). The Validation Database requires that daily changes to civic addresses

are synchronized with the existing 9-1-1 routing schemes (boundary changes, new streets, street name change, municipal amalgamation).

A VDB:

- Validates received civic address against the Master Street Address Guide;
- Provides error responses;
- Supports a web services interface to enable civic address validation from the Location Information Server(s).

Canadian Consideration for the Validation Database

The data in the Validation Database is only as accurate as it is current. Due to the different provisioning and update processes across 9-1-1 Service Providers in Canada, the Validation Database function will require almost real-time synchronicity with numerous Street Address Guides or equivalent across Canada. A mismatch in the Validation Database will cause a validation error and record rejection in the Location Information Server. This process is simplified in the wireline/wireless world by deriving all pertinent data from one dynamic source, the Master Street Address Guide.

VPC - VoIP Positioning Centre

This is the mechanism which will provide a VoIP Service Provider with IP selective routing functions through multiple Emergency Routing Databases for national 9-1-1 routing and thus, facilitate the delivery of Enhanced 9-1-1 data to the designated Public Safety Answering Points.

A VPC:

- Processes routing requests from call server/routing proxy/redirect server;
- If location by reference has been used, query the appropriate Location Information Server to retrieve the Location Object;
- Determines the designated Emergency Routing Database based on the received Location Object;
- Receives Emergency Service Routing Number, Emergency Service Number, Contingency Routing Number from the Emergency Routing Database;
- Allocates designated Emergency Services Query Key for the call;
- Responds to queries from ALI with Call Back Number and Master Street Address Guide formatted location;
- De-allocates Emergency Services Query Key when the call is terminated.

Other Canadian Considerations for i2

Civic vs. Postal Address

- i2 allows for Postal address format in Location Information Servers;

- Since Canadian Master Street Address Guides use Geo-Civic data, there may not be a need to develop postal translation.

Push vs. Pull

- In the U.S., most 9-1-1 systems are in a PULL arrangement;
- In Canada, most 9-1-1 systems are in a PUSH arrangement;
- i2 can support both PUSH or PULL arrangements as well as hybrid networks that use both;
- i2 will not introduce a requirement to change from PUSH to PULL or vice versa upon implementation.

On-board vs. Off-board selective routing function

- In the U.S., most 9-1-1 systems are using off-board selective routing arrangement to support location sensitive network structure;
- In Canada, all 9-1-1 systems use on-board selective routing arrangement;
- i2 can support both arrangements.

RDO (Root Directory Operator)

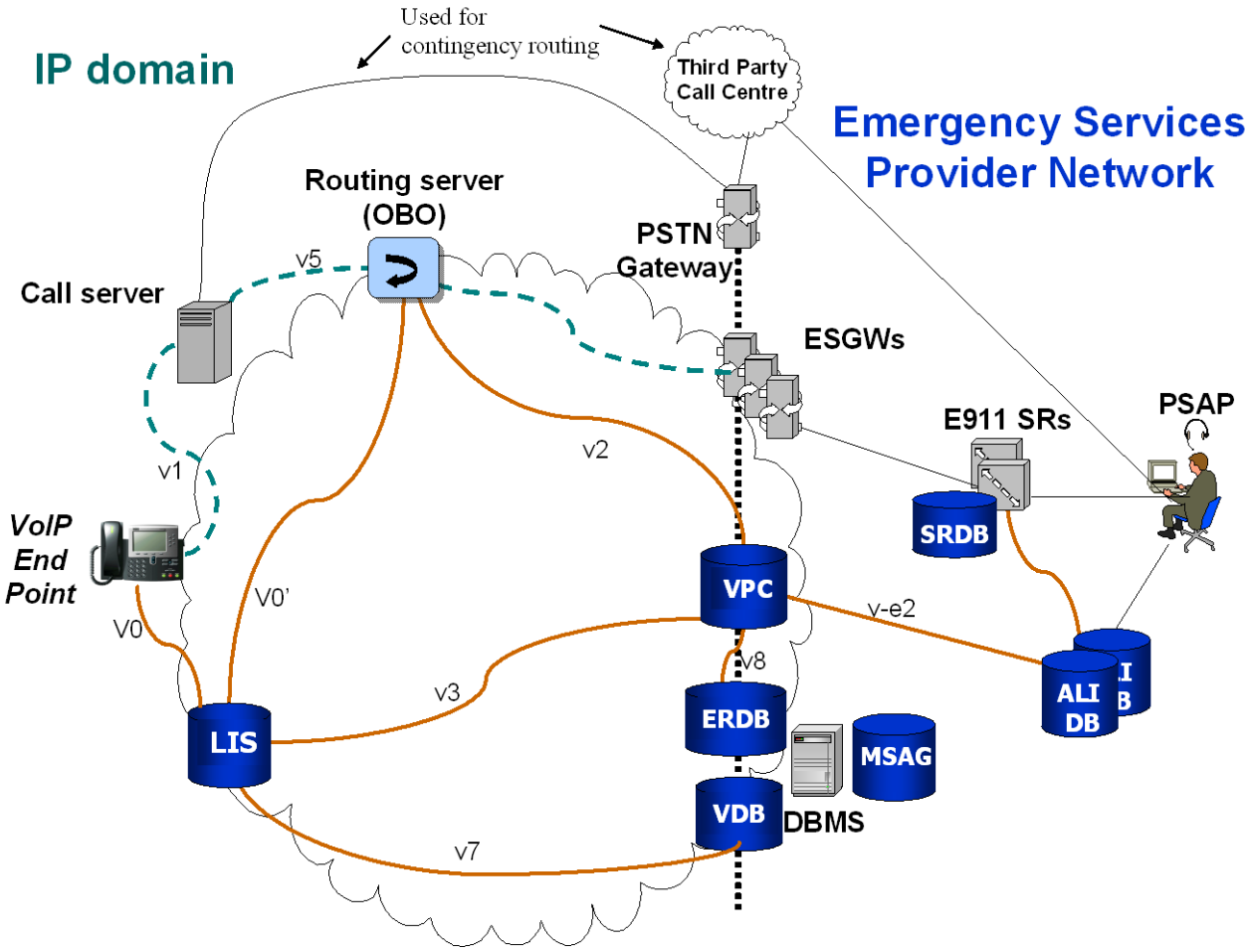
- Because of loosely coupled US 9-1-1 implementation, a Root Directory Operator is required in order to discover who can provide Validation Database services;
- In a Canadian implementation, this would not be required because of direct relationship between various Operators.

VoIP Location Awareness

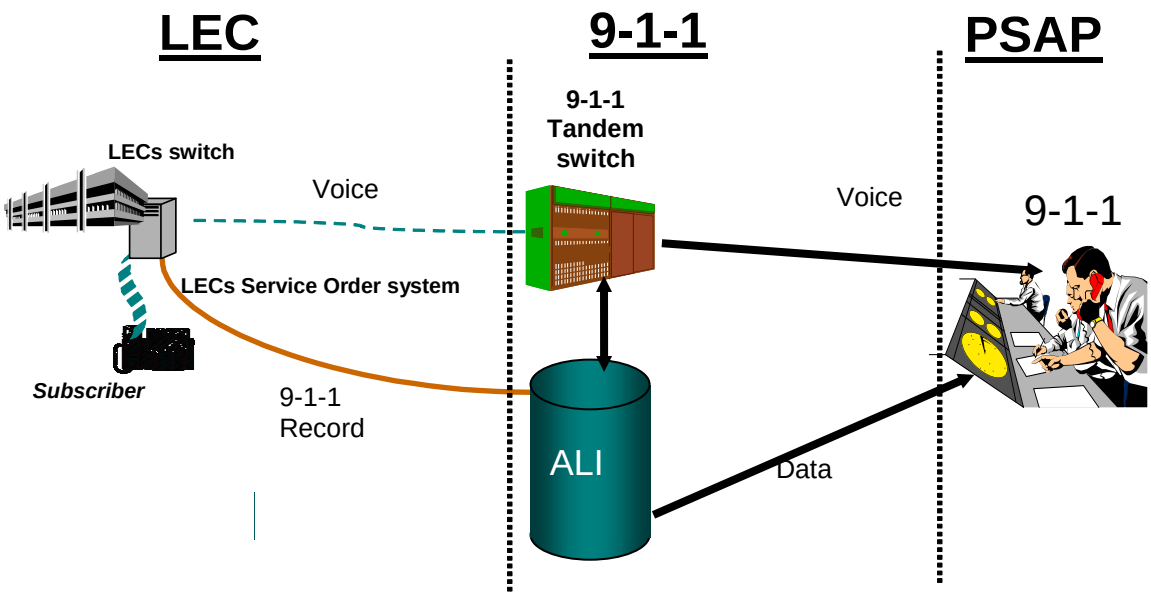
- In i2, a VoIP end point/user agent provides its civic location to the VoIP Positioning Centre from data it collects from the Location Information Server. VoIP end points do not presently support this feature, therefore a mechanism is required to gather location data from the Location Information Server (on behalf of the VoIP end point/user agent);
- Products available to perform On-Behalf-Of (OBO) function (Presented to CISC ESWG ESCO0249);
- Standards being drafted by IETF (Internet Engineering Task Force) and Industry to allow VoIP end points/user agents to support this function without assistance as the devices evolve;
- The unique Canadian 9-1-1 landscape allows VoIP end points/user agents to overcome their location unaware limitation by incorporating an On-Behalf-Of Engine as part of the

9-1-1 network. Alternatively, VoIP Service providers could each implement their own (subject to further technical investigations).

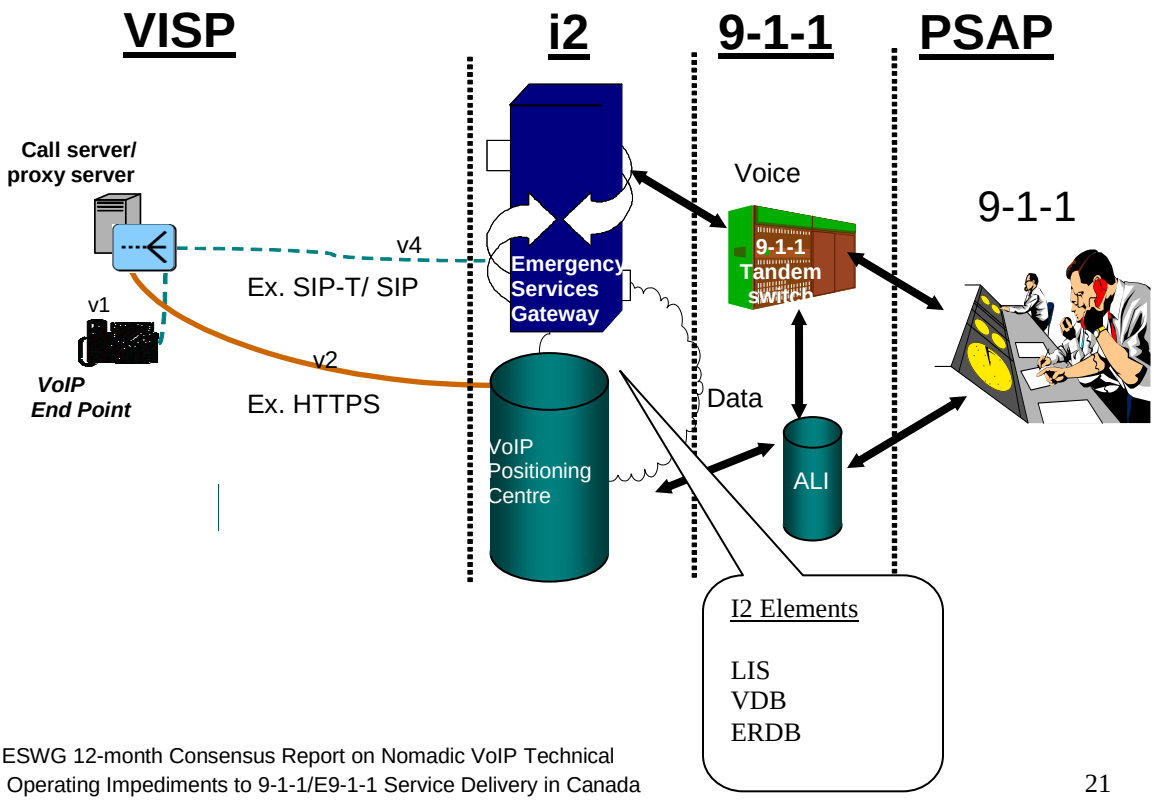
CANADIAN I2 MODEL



Current E9-1-1 Interconnections



VoIP Service Provider i2 Interconnections



3.3 Next Generation ENHANCE 9-1-1 (NG E9-1-1)

The ESWG undertook a high level review of NG E9-1-1 (also referred to as i3) and concluded that:

- NG E9-1-1 could be a viable long term solution for Canadian 9-1-1 requirements;
- The specification of components that make up NG E9-1-1 is not yet complete;
- Major infrastructure investments will be required by all affected parties, including PSAPs.

In light of the above, NG E9-1-1 should not be considered a viable option for near term implementation.

4. Recommendation: A Canadian Implementation of NENA i2

4.1 Major Points

The ESWG recommends the implementation of a Canadian version of i2 as described in this report for nomadic and fixed/non-native VoIP service.

Technical details for this solution have yet to be determined and will be part of subsequent implementation and architecture plans.

The ESWG recommends that the components of the i2 system be implemented in a coordinated sequence to ensure functionality testing, system security, and an orderly migration.

4.2 Interim Solution

The interim solution mandated in Telecom Decision CRTC 2005-21 must be phased out as the primary method for 9-1-1 routing once the final i2 solution is ready for use.

5. Proposed Timeline for Implementation

5.1 Major Milestones and Immediate Orders Requested

The ESWG believes it is in the public interest to implement the recommended solution as soon as practicable.

The ESWG proposes to file, within six (6) months of Commission approval of this report, a functional architecture for the implementation of VoIP E9-1-1 in Canada for Commission

approval. This will include specifying roles and responsibilities of all emergency services industry participants, particularly those of the new operating elements being proposed. This architecture will be consistent with the NENA i2 standard, adjusted as necessary for implementation in Canada and, subject to vendor availability, shall include a timeline for implementation of the following key deliverable elements (in rough order of precedence):

1. All 9-1-1 LIS Operators shall provide LIS capability, and have access to the SAG or equivalent data presently used for wireline 9-1-1 service for the purposes of LIS validity checking (VDB), subject to amendment of the local government authority agreements as necessary.
2. All VPC Operators will require access to an ERDB function, which shall contain the 9-1-1 routing data presently used for wireline 9-1-1 service.
3. All 9-1-1 Service Providers shall implement enhanced ANI steering capability by modifying the existing ALI systems to be consistent with the agreed upon Canadian i2 architecture.
4. All 9-1-1 Service Providers shall provide Emergency Services Gateways (ESGWs).
5. All local VoIP Service Providers shall implement an interface to the VPC.
6. All local VoIP Service Providers shall interface with the ESGWs.

Following the Commission's approval of the proposed architecture, the industry will require a minimum of 12 months to implement the Canadian i2 solution.

5.2 Cost Recovery Consideration

During deliberation in producing this 12-month report, the ESWG did not discuss the development of a cost recovery mechanism. Some members have suggested that cost recovery be a part of the proposed architecture plan while other members believe that the CISC is not the forum for such discussion and that it does not influence the proposed technical solution. The ESWG requests that the Commission in its disposition of this 12-month report provide instruction on whether CISC ESWG in the development of the architecture plan should include cost recovery and if so, to what level of detail. If not, the ESWG requests that the Commission provide an indication as to where and how this issue will be addressed.

6. Conclusion

The ESWG concludes that it is crucial to act quickly to determine a course to deliver a practical and sustainable solution for nomadic and fixed/non-native VoIP 9-1-1 calls for Canadians.

The ESWG recommends the deployment of a Canadian implementation of i2. The ESWG also requests that the Commission continue their practise of fostering advancement in emergency services by providing deadlines for the accomplishment of specific tasks through decisions and order the commencement of this deployment as quickly as is practical.

Acronyms

ALI	Automatic Location Identification
ANI	Automatic Number Identification
CAMA	Centralised Automatic Message Accounting
CISC	CRTC Interconnection Steering Committee
CLEC	Competitive Local Exchange Carrier
CRN	Contingency Routing Number
CRTC	Canadian Radio-television and Telecommunications Commission
DSLAM	Digital Subscriber Line Access Multiplexer
E9-1-1	Enhanced 9-1-1
ENHANCE 9-1-1	Ensuring Needed Help Arrives Near Callers Employing 9-1-1
ERDB	Emergency Routing Data Base
ESGW	Emergency Services Gateway
ESN	Emergency Service Number
ESQK	Emergency Services Query Key
ESRN	Emergency Services Routing Number
ESWG	Emergency Services Working Group
FCC	Federal Communications Commission
HTTPS	Hypertext Transfer Protocol Secure
IETF	Internet Engineering Task Force
ILEC	Incumbent Local Exchange Carrier
IP	Internet Protocol
ISP	Internet Service Provider
LEC	Local Exchange Carrier
LIS	Location Information Server
MF	Multi-Frequency
MSAG	Master Street Address Guide
NENA	National Emergency Number Association
NG E9-1-1	Next Generation Enhance 9-1-1
NP	Number Portability
NTWG	Network Working Group
OBO	On Behalf Of
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
SAG	Street Address Guide
SIP	Session Initiation Protocol
SIP-T	Session Initiation Protocol for Telephones
SR	Selective Router [*a.k.a., E9-1-1 Tandem, or E9-1-1 Control Office*]
SRDB	Selective Routing Database
SS7	Signalling System 7
VDB	Validation Data Base
VISP	Voice over Internet Service Provider
VoIP	Voice over IP
VON	Voice On the Net
VPC	VoIP Positioning Centre