# *Developing a Roadmap for the Migration of Public Safety Applications during the All IP Transition*

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This report expands upon the results of the ATIS Public Safety Related Applications (PSRA) Task Force's Request for Information (RFI) and addresses future roadmap considerations related to other ATIS initiatives. It was developed for the Technical and Operations (TOPS) Council and is subject to change.

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# 1 Introduction

The migration of Public Switched Telephone Network (PSTN) based telecommunications networks to IP is already well underway, including the development of next generation public safety systems. However, it is also understood that a large percentage of existing public safety applications are currently provisioned on PSTN-based circuits served by legacy copper facilities.

This paper provides useful information regarding the roadmap of IP-enabled solutions that could support the transition of specific public safety applications to a wide range of IP media, products, and services. This assessment, conducted by the Alliance for Telecommunications Industry Solutions (ATIS), is based on a collection of public safety requirements by sector, an assessment of current and future solutions available across the industry, and a summary of findings. These findings include specific details of IP-based solutions, as well as new capabilities that could be provided to the public safety industry as the transition to all-IP takes place. Additional information is provided to allow emergency management agencies and others in the industry to obtain more detailed data regarding each solution, as well as to allow manufacturers and network operators to contribute new developments in the future regarding their products and services.

# 2 The All-IP Transition

Most market or technology driven transitions actually begin many years before the term “transition” is applied by the industry. This was the case with the all-IP transition, as the first step in this evolutionary process was to support network growth demands with this next generation infrastructure. Beginning over a decade ago, network operators began to deploy significant amounts of IP-based hardware and software to meet the rapid growth demands of new services and applications. The most challenging part of a major network transition is the migration of existing infrastructure to a solution that can offer the true and intended benefits. Without this critical step, the cost and complexity of maintaining dual networks will eventually outweigh the benefits of the transition.

IP transition is generally understood to mean the evolution from circuit-based “PSTN” to an IP-enabled network that will integrate with the next generation of services and network capabilities. A closely related transition is the migration of the existing copper-based network to a broad array of new IP-based media alternatives, including coax, fiber, microwave, satellite, and wireless. However, there is no single prescriptive solution or timeline for these migrations, as network operators are proceeding with the set of approaches deemed to be most efficient for their network and most beneficial to their customers.

While the benefits of migration to all-IP have been well documented in the industry, there are additional future benefits yet to be fully realized. This includes the ability to leverage new capabilities, such as virtualized network elements, software defined networking, new devices supporting the Internet of Things (IoT), greater horizontal integration of applications, and better network resiliency through distributed networks and diversification.

In recognizing the many facets of the transition to all-IP, ATIS has launched a broad program of standards development and projects that deal with the key issues. This includes areas such as network interconnection, emergency services, next generation E911, and the subject of this paper: migration of public safety applications.

# 3 Pursuit of a Roadmap for Migration

In 2014, ATIS launched the Technology and Operations Council (TOPS) Public Safety Related Applications (PSRA) Task Force as part of the all-IP transition program to assist the industry in identifying a roadmap of solutions for migrating public safety requirements from PSTN-based legacy copper to IP-

enabled media. The first step in the process was to identify the key applications and provisioning methods that exist today. This process led to partitioning these requirements into a series of public safety sectors (discussed in Clause 4 of this paper). A necessary next step was to begin an outreach program to the many associations and organizations that represent the various public safety sectors to assist in identifying the underlying requirements and to validate information that had been gathered this far. Subsequently, a decision was made to undertake an industry Request for Information (RFI) to provide more timely and specific information to the industry regarding the range of existing and planned roadmap solutions in the public safety sector.

As part of the RFI process, technical requirements and questions were shared with the industry and transmitted to manufacturers, network operators, application developers, and emergency management operators. Given the public nature of this RFI, cost and pricing were not addressed in this process.

ATIS undertook the RFI process in the first half of 2015 and developed a set of relevant questions on transportation, building alarms, energy / utilities, and public safety communications. In addition, a section was developed that addressed horizontal solutions, acknowledging the emergence of smart city approaches in many municipalities and recognizing the opportunity to integrate public safety applications in the future. In reply to the RFI, over 20 responses were received addressing various aspects and sectors of industry. The responses were received from a variety of transport and access manufacturers, network operators, integrators, and emergency management agencies and are summarized in Clause 5.

# 4 The Current State of Public Safety Applications (& the Network)

Public safety applications represent a broad range of capabilities and touch many industry sectors. In this paper, the migration of public safety related applications is focused on the requirements of transportation, energy and utilities, building alarms to fire and police, and public safety communications. Although equally important, capabilities such as E911 and emergency telecommunications services are being addressed as part of other industry initiatives, and are outside the scope of this paper.

The first step in evaluating the migration path is to understand the current provisioning methods and the underlying requirements of the public safety applications. Although public safety needs vary greatly, a large percentage of such circuits have traditionally been provisioned over the copper-based PSTN network and include the following circuit types:

- Voice grade circuits.
- Digital data services (DDS).
- Metallic (contact closure) circuits.
- Circuit-based paging systems.
- Private line automatic ringdown circuits.
- Other legacy circuit types.

A necessary next step is to explore the applications and basic requirements of each public safety sector. The following is a summary of each application class based on network operator and manufacturer input, and investigation and outreach to the organizations that represent and support each sector.

## *4.1 Energy & Utilities*

Legacy circuits supporting the electrical, oil and gas refining industries, and water and waste management cover a wide range of applications, infrastructure, and provisioning methods. The energy and utilities applications are provisioned over a variety of low speed data circuits, voice grade circuits for communications, and metallic circuits for control functions. Examples of these applications include:

- Low speed data over digital data services (DDS) circuits for supervisory control and data acquisition.
- Metallic circuits supporting sensor devices at remote locations.
- Metallic circuits provisioned to shut down or control downstream circuit breakers and stations.
- Communications circuits deployed over voice grade circuits for remote dispatch.

Since today many of these circuits support the electrical utility sector, an additional level of assessment should be focused on the primary applications. These include Supervisory Control and Data Acquisition (SCADA), synchrophaser data, protective relay, radio control and dispatch, and telephone voice grade lines. Key requirements in this area include low latency for control functions and data acquisition purposes, reliable data transmission collected from numerous remote locations, and communications to technicians as part of dispatch operations.

## *4.2 Building Alarms to Fire & Police*

The majority of building alarm circuits connected to fire and police agencies are provisioned over voice grade or metallic (closed contact) DS0 special services. Voice grade circuits typically rely on the generation of tones from customer premises equipment to alert a police or fire department of events such as unauthorized entry or fire alarms. In other cases, metallic circuits transmit a contact closure alarm from customer equipment to identify events such as out-of-hours opening of doors or triggering of fire alarm panel relays. In both cases, secure and reliable transmission of alarms from multiple building locations to a remote management station is the key application. Although these circuits are provisioned from a building location through network provider facilities and central offices to a police or fire agency, it is recognized that, in some cases, these circuits may be connected through a third-party central station. However, consumer-based security alarms to a security monitoring agency are not within the scope of the public safety applications assessed in this paper.

The following alarm applications may apply between a protected premises and either a central station or dispatch center:

- Large public venues and high-rise buildings.
- Schools, campuses, and universities.
- Human care facilities.
- Correctional facilities.
- Locations where loss of life or property would be high risk.
- Government buildings.

In all cases above, alarm circuits may be providing alarm or annunciation signals, or intercom services. Another important consideration in this area is the existence, applicability, and adoption of specific building codes as transitional solutions are designed and implemented.

## *4.3 Transportation*

Applications in this sector vary greatly and are provisioned across a broad range of circuit types, including metallic control circuits, communications circuits and, to a lesser extent, low-speed data services. The specific applications include:

- Circuits monitoring the state of railroad crossing apparatus.
- Extensions of underground communications in subways and railroad tunnels.
- Point-of-sale operations for subway, light rail, and railroad systems.
- Public address systems.
- Passenger information systems.
- Centralized traffic control.

- Analog train radio.
- Tunnel automation and train supervision and control systems.
- Circuits supporting airport towers and alarms.

Circuit equipment supporting these applications is often installed in remote locations and ruggedized environments. Commercial power may not be available in all situations. The circuits often report to a centralized management center and must be highly reliable given the underlying public safety implications surrounding public transportation systems. Legacy services would typically have a demarcation or user network interface (UNI) at each end. However, one UNI may aggregate services from several locations, e.g., fare collection systems aggregated into a single UNI at master site.

## *4.4 Public Safety Communications with FEPE*

This public safety sector covers the broad set of Fire, EMS, Police, and Emergency Operations Center (FEPE) related applications currently provisioned over legacy copper infrastructure. Given the diversity of the applications, the provisioning methods include circuit switched voice (POTS), 4-wire leased lines, analog fax and modem lines, and data services such as DDS. While integration with Next Generation E911 and emergency services requirements is important in this area, the scope of this analysis is not focused on specific E911 requirements, as this activity is being addressed in other industry initiatives.

The performance criteria for public safety communications with FEPE generally require high availability, low latency, and automatic-switched redundancy. In terms of network evolution, important considerations include the ability to remotely monitor end-to-end status in real-time, and prevention of unauthorized access through data encryption or other secure solutions to protect emergency operations. It is recognized that the evolution of public safety communications has already begun and that sharing of best practices adopted by emergency management operations would be very beneficial toward advancing public safety needs.

## *4.5 Summary*

A common thread across the public safety sector is the need to achieve a high level of reliability and maintain a consistent continuity of operations with any technology migration. Public safety entities are facing the same infrastructure challenges as network operators. Many current products (e.g., customer equipment) are being discontinued and/or replaced in the marketplace with innovative offerings with higher capacity, new interfaces built to emerging standards, and a wider set of media options. Public safety entities are presented with various alternatives to migrate to IP-enabled solutions, but must assess the full complexity of each solution as it relates to their specific operations.

It is this challenge that that has formed the basis for further assessment and information sharing covering IP migration paths for public safety related applications.

# 5 Summary of Key Findings

Respondents to the RFI were informed, in advance, that information collected during the RFI process would be made public, with the goal of informing the industry. The following clauses summarize the key findings that were collected for each public safety sector:

## *5.1 Energy & Utilities*

Two different technology solutions were identified in the RFI process to address the range of data, control, and communications applications contained in the requirements. Although these requirements

were primarily developed around the electrical utility sector, it was acknowledged that the solutions could support a broad range of electrical, oil and gas refining, and water and waste management industries.

- IP private line solution:
  - Applicable across multiple IP-based media types (fiber, copper, microwave).
  - Designed to meet carrier grade specifications between transmission end points.
  - Can be deployed as replacement for existing analog/data services over copper.
- Wireless solution:
  - Allows utilities to deploy managed private wireless network across entire grid.
  - Periodic reporting of performance metrics (e.g., latency, average data rate).
  - Includes network monitoring and system back-up capabilities.

## *5.2 Building Alarms to Fire & Police*

In response to the Building Alarms requirements, two distinct architectures were provided, which included an IP module that connects to the customer control panel and transmits alarms, and an M2M-based network solution customized for alarm applications.

- IP Digital Alarm Communicator/Transmitter solution:
  - IP-based point-to-point and point-to-multipoint solution.
  - Transmits alarms from building and monitors connection with IP receiver.
  - Supports network back-up option in connection with alarm reception center.
- M2M-based solution for alarm monitoring:
  - 3G/4G-based M2M modules provide monitoring and secure connections.
  - Network-based control center allows real-time access to device diagnostics.
  - Monitor device status, event reporting, and notification of unauthorized access.

## *5.3 Transportation*

This sector of public safety contained a diverse set of transportation-related requirements that included railroad/mass transit crossings, underground communications in subways and tunnels, traffic management applications, and others. Two approaches to the transportation area were provided: wireless enhanced push-to-talk based solution and an Ethernet-based solution.

- Wireless enhanced push-to-talk solution:
  - Targeted to replace voice grade circuit and automatic ringdown circuits.
  - Integrated dispatch – includes mapping of users, group communications, etc.
  - Compatible with broad range 3G/4G/WiFi devices.
- Ethernet-based solution:
  - Designed to replace voice grade, metallic, DDS, and broad set of legacy services.
  - Integrates with MEF and GigE architectures; provides MEF 2.0 and IEEE.q UNIs.
  - Point-to-point/multipoint, star, and mesh over coax, copper, fiber media.

## *5.4 Public Safety Communications*

The public safety communications sector returned the largest set of responses and included solutions from network operators and manufacturers, as well as currently deployed implementations from emergency management operations centers. The solutions included a wide range of media options, including coax, copper, fiber, microwave, satellite, and wireless, and provided integration options with existing E911 and emergency services centers. The following is a summary of the solutions offering a migration to next generation emergency services.

- Roadmap solutions from manufacturers and network operators:
  - IP-based dispatch console system that integrates with radio dispatch and central host via IP network.

  - NG911 suite of products that supports migration of analog to IP-based communications.
  - Electronically Stored Information (ESI)-based routing call delivery solution that utilizes softswitch routing, secure IP network, and enhanced call handling.
  - Switched Ethernet service supporting remote dispatch locations, Emergency Operation Center (EOC) data links, and network monitoring.
  - Virtual Private Network (VPN) service providing Multiprotocol Label Switching (MPLS)-based shared networking solution supporting remote dispatch locations, EOC data links, and network monitoring.
  - Microwave radio-based turnkey transport network including radios, routers, switches, antennas.
  - Multiple broadband access solution (including satellite) providing communications between state and federal emergency management agencies.
- Emergency management centers with solutions in operation:
  - Statewide shared radio system with regional integrated voice, data, and applications system with P25 and Network First gateways.
  - Municipal fire department using 911/E911 Public Safety Answering Point (PSAP) communications and dispatch with Voice over IP (VoIP) hosted call handler.
  - County-wide radio control and dispatch using microwave, coax, and fiber with redundancy.
  - Municipal fire department using NG911 remote dispatch and PSAP communications over wireless, microwave, coax, and fiber.

## *5.5 Horizontal Solutions*

Horizontal solutions addressed the integration of public safety applications with the broader deployment of smart city capabilities. It was recognized that, in most cases, public safety is not the basis for smart city design and initial implementation, but future opportunities do exist for leveraging such deployments to support public safety. Two responses were provided covering a broad set of applications.

- Operator-based smart city connected solutions:
  - 4G LTE, global IP, cloud compute platform, and security.
  - Targeted to buildings/venues, energy and utilities, government, and transportation.
  - Initially focused on traffic management and parking, smart street lighting, security and video surveillance, mass notification.
- Integrated platform connected over IP-based media:
  - Provides routing, unified communications, video conferencing and surveillance, wearable networks.
  - Connectivity, Data aggregation and management, analytics, cloud services, customer interface.
  - Traffic management and parking, smart street lighting, intelligent buildings, security or video surveillance, mass notification, medical (lifeline) services.

# 6 Additional Solutions

The goal of the ATIS RFI was to solicit input from the industry on solutions that could support the migration of PSTN to all-IP and legacy copper circuits to IP-enabled media. The results contained under the Key Findings clause of this paper represent the industry feedback that was directly responsive to the RFI. However, it is also acknowledged that other customized solutions exist in the industry that will support the overall migration of DS0 specials (over legacy copper) to higher speed facilities and other media types. The following are examples of alternative solutions:

- Alarm collection blocks which provide multiple alarm points for collecting alarm events and report alarms via a 10/100BaseT Local Area Network (LAN) interface for LAN transport over IP media.

- Specialized building security systems that are remotely configurable and can report intrusion events or surveillance over HFC/fiber or wireless connections.
- Industrial hardened LAN routers with PSTN interfaces and low speed modem ports that provide data over secure IP connections.
- Protective relay devices for electrical utilities that incorporate an Ethernet interface for monitoring and reporting.
- Devices that could be integrated into Transportation-related applications and provide a HFC/fiber, wireless or satellite interface over secure connections.
- Channel bank devices that provide PSTN-based channel units and connect to the network over fiber or T1 over IP Ethernet.

# 7 Future Roadmap Considerations

The migration of public safety applications will not only be influenced by the current view of roadmaps, but also the future aspects of network evolution. In addition to the obvious technology innovations around new opportunities like IoT, cloud applications, and software defined networking, two ATIS programs may contribute to the long-term roadmap for public safety applications: 5G evolution and cybersecurity.

In 2Q15, ATIS launched a 5G evolution analysis for North America. An important part of this initiative is to identify unique North American marketplace requirements, including cellular-based critical communications. While 5G is still under development by the industry, there appears to be significant opportunities in the future to address evolving public safety needs. These may include enhancements to redundancy and resiliency, security across networks, and capacity management during planned events and emergency response situations. As a result, the available roadmap of solutions for the public safety sector will evolve as the industry introduces new capabilities enabled by 5G developments.

In addition, ATIS is also assessing the cybersecurity landscape as it intersects with network evolution and new user capabilities. Given the key needs of the public safety sector relative to secure and reliable communications and data transmission, it is anticipated that the findings of this initiative can contribute to a longer-term vision of how developments such as network virtualization, software defined networking, cloud architectures, and enhanced end-user control can contribute innovative cybersecurity solutions in the future.

# 8 Establishing a Pathway for Public Safety Migration

Although the migration of public safety applications to IP is well underway, it does not obviate the need to develop a partnership across the industry to facilitate a transition pathway for these critical applications. The IP roadmap addressed in this paper provides insight into the specific types of solutions that are being developed and deployed by manufacturers, network operators, and emergency management agencies. However, it is equally important to take a longer-term view of how this network evolution will present new opportunities and benefits that could be realized by the public safety sector. In the future, important attributes such as reliability, resilience, diversity, etc. will not be bounded by the performance characteristics of a single copper circuit. IP-enabled networks and devices will provide additional capabilities and media alternatives that, if designed properly, can provide a next generation of public safety applications. This includes the design of point-to-multipoint topologies to enhance public safety communications and better utilize facilities. Diversity and resiliency improvements can be achieved through multiple media options and distributed data designs. Data needs can be better serviced through more flexible data-rate options with IP alternatives. Opportunities exist to evolve from single-purpose circuits to solutions that can share, store, and correlate data across applications. At an application and device level, public safety could leverage new cloud-based capabilities to process information and IoT devices to support remote and dispersed locations.

The goal of this analysis was to share solution level information across the public safety industry and to provide a higher level of insight into the directional changes that could be enabled by the transition to all-

IP. While network providers and public safety agencies will need to continue to work together during this transition, ATIS can help to focus the larger industry on the important challenges and the beneficial opportunities that will ultimately exist with the all-IP transition.

# 9 Where Can I Find Additional Information?

Detailed results and RFI questions are publicly available via the link below:

http://www.atis.org/topsc/psra.asp

Through that link you can access an excel version of the PSRA RFI questions that can be downloaded and filled out by companies wishing to submit further information. Please submit any responses or questions to psra@atis.org.