Industry Common Mechanisms for MLTS E9-1-1 Caller Location Discovery and Reporting Technical Information Documents (TID)

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Prepared by:
National Emergency Number Association (NENA) Data Technical Committee, Multi Line Telephone System (MLTS) Working Group

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NENA's Technical Committee has developed this document. Recommendations for change to this document may be submitted to:

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1 Executive Overview

Recent technology innovations have made it critically important for organizations to address the challenge of identifying the location of the users of communications systems during emergencies in the Multi Line Telephone System[1] (MLTS) environment. This paper and the accompanying diagrams will discuss many of the issues related to the location of individuals during emergencies in the MLTS environment. It will further outline the current suggested methods of dealing with the challenge using commonly available technology as recommended in this document by the National Emergency Number Association (NENA).

Much public dialogue has taken place about locating individuals when they dial to signal that an emergency is in progress from cellular telephones or other mobile devices including Voice over the Internet Protocol (VoIP). Less discussed, yet as critically relevant is the large numbers of individuals who on a daily basis might use their office telephone or other device in an MLTS environment to dial for help.

Identifying the location of individual callers during an emergency is a challenge that involves the individual, the organization, the governmental organizations responsible for providing public safety services and other third-party entities including those delegated various responsibilities by the government.

The purpose and scope of this document is to help policy officials as well as MLTS Operators/Managers to understand the issues related to identifying the location of users of the system during emergencies. The document points out a number of methods of dealing with this challenge giving reasons to implement and pointing out the benefits of implementing the suggested methods.

This document supports the *NENA 02-xxx Technical Requirements Document on Model Legislation E9-1-1 for Multi-line Telephone Systems* reissued in 2008 as well as supplements TID 03-502.

[1] The National Emergency Number Association defines Multi-Line Telephone System (MLTS) to mean “A system comprised of common control unit(s), telephone sets, and control hardware and software. This includes network and premises based systems. i.e., Centrex and PBX, Hybrid, and Key Telephone Systems owned or leased by governmental agencies and non-profit entities, as well as for profit businesses.”

2 Introduction

2.1 Operational Impacts Summary

No operational impact is anticipated by this document.

2.2 Security Impacts Summary

No security impact is anticipated by this document.

2.3 Document Terminology

The terms "shall", "must" and "required" are used throughout this document to indicate required parameters and to differentiate from those parameters that are recommendations. Recommendations are identified by the words "desirable" or "preferably".

2.4 Reason for Issue/Reissue

By request of NENA the *NENA 06-750 Technical Requirements Document on Model Legislation E9-1-1 for Multi-line Telephone Systems* is being reissued and updated to reflect recent changes in technology that are now commonly available that were not generally deployed at the time of the original issue. This TID is to accompany that work; however, each document will be updated individually as determined by NENA.

NENA reserves the right to modify this document. Upon revision, the reason(s) will be provided in the table below.

Version	Date	Reason For Changes
Original	10/25/2008	Initial Technical Requirements Document

2.5 Recommendation for Additional Development Work

This document is a supporting document to *NENA 06-750 Technical Requirements Document on Model Legislation E9-1-1 for Multi-line Telephone Systems* reissue. No standards development work is recommended by this document.

2.6 Date Compliance

All systems that are associated with the 9-1-1 process shall be designed and engineered to ensure that no detrimental, or other noticeable impact of any kind, will occur as a result of a date/time change up to 30 years subsequent to the manufacture of the system. This shall include embedded application, computer based or any other type application.

To ensure true compliance, the manufacturer shall upon request, provide verifiable test results to an industry acceptable test plan such as Telcordia GR-2945 or equivalent.

2.7 Anticipated Timeline

Deployment or implementation will take place at as required by the MLTS Operator.

2.8 Cost Factors

Not Applicable.

2.9 Future Path Plan Criteria for Technical Evolution

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

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

Criteria to meet the Definition/Requirement:

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

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

2.10 Cost Recovery Considerations

Normal business practices shall be assumed to be the cost recovery mechanism.

2.11 Additional Impacts (non cost related)

The information or requirements contained in this NENA document are not expected to have additional impacts, based on the analysis of the authoring group.

2.12 Intellectual Property Rights Policy

NENA takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights.

NENA invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard.

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2.13 Acronyms/Abbreviations/Definitions

This is not a glossary! See NENA Master Glossary of 9-1-1 Terminology for a complete listing of terms used in NENA documents.

Acronyms and definition specific to MLTS, MLTS Policy and the technical supporting documents are reflected in the NENA Master Glossary and the Recommended Model Legislation E9-1-1 got Multi-line Telephone Systems (MLTS).

3 Introduction: Industry Common Mechanisms for E911 Caller Location Discovery and Reporting

Locating a person during an emergency who has dialed 9-1-1 depends upon an established system in which a database containing information about the location of a person is queried using a telephone number. The Private Switch/Automatic Location Information (PS/ALI) database is maintained on behalf of public safety agencies by various third-party entities and contains a mapping of telephone numbers to elements of information including street address that is used to locate emergency callers.

The Operator/Manager of or leadership of the organization who gains benefit from the services of an MLTS is ultimately responsible to ensure that the information contained in the PS/ALI database is accurate. The PS/ALI database is the primary source of information used by public safety officials to locate individuals during emergencies.

Understanding who is responsible for providing and maintaining accurate PS/ALI database information about the location of end-user devices within the MLTS environment is not always clear cut. When an MLTS system is privately owned, it is the Operator/Manager of the asset who is ultimately responsible. There are also cases where an organization may use the services of an MLTS, but not own the asset. An example of this is the case in which an organization receives MLTS services on a contractual basis from a third-party. In this case, it is the Operator/Manager of the organization receiving the service that has the ultimate responsibility to ensure accuracy of the location information in the PS/ALI database for the end-users of the services provided by the MLTS.

Given this potential complexity, this document will use the term “MLTS Operator/Manager” as defined in *NENA 06-750 Technical Requirements Document On Model Legislation E9-1-1 for Multi-line Telephone Systems* as issued on 10/25/2008 The NENA model legislation defines MLTS Operator to mean, “The entity responsible for ensuring that a 9-1-1 call placed from an MLTS is transmitted and received in accordance with this legislation regardless of the MLTS technology used to generate the call. The MLTS Operator may be the MLTS Manager or third-party acting on behalf of the MLTS Manager.”[2]

[2] Please refer to NENA 06-750 NENA Technical Requirements Document on Model Legislation E9-1-1 for Multi-line Telephone Systems, issue date 10/25/2008 for information on the definition of MLTS Manager and other terms of art relevant to a clear understanding of these concepts.

Location identification can be a regulatory issue for the MLTS Operator where states and local governments have prescribed regulations. Many, but not all, local governments have established such rules. Whether or not an organization operates in one or more of the jurisdictions with legal location requirements there are many reasons for organizations to employ the tools and techniques needed to locate callers who have dialed 911 when an emergency is in progress.

For all organizations, it is prudent to be able to prove the organization has done everything reasonably necessary to provide for rapid and accurate determination of the location of users of an MLTS during emergencies.

Before recent technological advances and in legacy telephony environments[3], locating a person who has signified an emergency is a challenge. As modern organizations expand and use new communications tools including the Internet Protocol (IP), complexity deepens and organizational leaders need to be informed on the issues.

MLTS Operators within large and small organizations are required to ensure that their organizations are executing on the techniques that can mitigate the obstacles associated with locating people in peril.

The challenge is multifaceted. In legacy telecommunications, one might imagine a telephone connection as a virtual wire stringing between the caller and the receiver. Although there is not a physically contiguous wire, the concept of Time Division Multiplexing (TDM) allows designers of telecommunications networks to approximate the conditions that might exist if it were possible to string an individual wire for each conversation.

TDM based telecommunications rely on a centralized source of timing which allows each manufacturer of an MLTS to build systems that send information across the telecommunications network based on defined rules. A simplified discussion of how this works is that the sending telecommunication device samples the sounds entering the mouthpiece and breaks the conversation into pieces. These segments can be a voice or other audible sounds, such as, the distinctive tones of a telecommunications Device for the Deaf (TDD).

[3] The term “legacy telephony environments” is used here to mean telecommunications generally in use before the recent wide adoption of packet-switched telecommunications. Examples of legacy telephony include the use of protocols such as analog, digital such as Integrated Services Digital Network and other Time Division Multiplexing (TDM) based concepts.

The segments of the original sound are sent along the telecommunications circuits at regular time intervals. In this way, many different conversations can travel along the same sets of wires with no one conversation monopolizing the available network facilities. Each sender and receiver and each point of connection communicates based on the universal timing. At the receiving end, the receiving telecommunications system reassembles the sound segments based on the universal clock and plays them for the receiver.

Telecommunications systems also allow for the transmission of information other than sounds. Digits may be represented. When a person in a legacy telecommunications environment dials 9-1-1, accompanying the sounds are information including a ten digit number that can then be used by the receiving entity for various purposes. The public safety agency receiving the 9-1-1 call uses the ten digit number to query the PS/ALI database.

Third-parties maintain the PS/ALI databases at the direction of the local government. Typically the interfaces to the organizations that have been granted stewardship by the government of the PS/ALI database are the providers of network services. These may include Local Exchange Carriers (LEC), Competitive Local Exchange Carriers (CLEC) or in the case of VoIP, the Internet Service Provider (ISP). The LEC, CLEC or ISP is responsible for accurate location information up to the point of the demarcation. From the demarc, the responsibility for establishing and maintaining the MLTS with the required or desired level of location accuracy falls on the MLTS Operator/Manager.

Here is where the location challenge begins for the MLTS Operator/Manager. Today, the demarc can represent a single address such as an office building. The demarc may also be the beginning of a complex deployment of thousands of end-user communications devices. Even when the demarc identifies a single office building, there can be great complexity in identifying the location of a caller during an emergency such as when there are multiple walled offices or large numbers of distributed cubicles.

In the MLTS environment, the demarc signifies the beginning of the responsibility for providing accurate location information about a caller.

In jurisdictions that have passed legislation, the granularity of this information is often dictated. This can mean that an organization is responsible for providing accurate information about a caller within a specific physical area or other geometric criteria.

Even when not legally obliged, MLTS Operators bear the responsibility to provide some level of information for the PS/ALI database. It is the MLTS Operator's responsibility to determine how specific that information needs to be. Factors that contribute to this determination include the individual organization's tolerance for risk and the extent to which resources may be dedicated to the tasks of administration.

In North America, the specification of what can typically be populated in the PS/ALI database is governed by national standards set forth in NENA Document 02-010 and 06-003 which may be seen at https://www.nena.org/?page=Standards.

Compelling action today, to deal with the MLTS location challenge, are the many newer methods of communications that have emerged and that are adding complexity to the MLTS location challenge. One of these technology changes is the trend towards the transmission of telecommunications using packet-switched technologies. This trend is being driven by increased efficiencies, flexibility and the diversification of resources available in the packet-switched telecommunication model.

The trend is significant. Unlike private residences where a modest growth in the use of VoIP is occurring, enterprise telecommunication systems are seeing multiplicative growth in the use of similar technologies.

In the enterprise system the use of the Internet Protocol for telecommunications is referred to as IP Telephony. In 2007, we saw IP Telephony based circuits deployed within enterprises outstrip the deployment of traditional telephony circuits. According to TechTarget, "A new survey by Forrester shows that 23% of North American companies have fully deployed or are in the midst of deploying IP telephony this year, versus just 14% in 2006."[4]

According to the In-Stat research report, *Worldwide PBX Market Update: It's All About IP*, "In the first half of 2007, 11.1 million IP lines were shipped worldwide, comprising over 80% of total shipments."[5]

In packet-switched telephony, rather than the imagined wire of the TDM environment connecting sender and receiver there are many different devices both at initiation, termination and along the trip of a communications circuit that contribute to the functioning of the system. Packet-switched technologies including the Internet Protocol depend upon intelligence that travels across the network with the sounds of a conversation. It also depends upon individual intelligent devices along the trip making independent decisions as information flows across the telecommunications network.

An analogy to packet-switching is the system for delivering express packages. Envision a delivery truck. In the rear is the payload which, in this example, would be the sound samples captured by the sending device. The cab of the truck contains the information about the ultimate destination of the delivery truck and other information to assist the truck along the

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[4] http://searchcio.techtarget.com/news/article/0,289142,sid182_gci1269455,00.html
[5] http://www.instat.com/catalog/ncatalogue.asp?id=18#IN0703643CT

route. The packet referred to in the term “packet-switched” in the analogy is represented by both the cab of the truck and the payload.

In IP Telephony the originating system loads up many trucks with individual segments of the conversation and sends them along the data networking highway. In the cab of each truck (technically known as the header) is information about its origination and its final destination but not the roadmap for the entire trip (other information may be contained including the urgency of the shipment).

In the example, unlike a real delivery truck, the decisions about where each truck goes along its route are not made by the driver. Each truck encounters stops along its route at specialized computers known as data networking routers and switches. In this example we might think of these as tollbooths along the highway. Instead, rather than exacting a payment, each tollbooth gives each truck individual directions to its next tollbooth along the route to the final destination.

Where each packet travels next along the route to the final destination is a decision that is made independently by each tollbooth at each stop. The decisions are based on factors that include how busy various routes along the way may be. Not all trucks belonging to the original conversation will follow the same route.

Unlike the TDM example where a central source of timing is used, when the individual trucks containing the original conversations arrive at the ultimate destination they are reassembled based on the information contained in the truck cabs (headers) and other intelligence carried in the data network.

Packet-based telecommunications are highly efficient, require less infrastructure investment and are more flexible than TDM based networks and have created new economic models for telecommunications connectivity. Many organizations are taking advantage of packet-switching to become more and more geographically distributed. In the past, organizations who wished to distribute employees across distance yet have their operations simulate a contiguous whole would need to invest in expensive circuits.

Today, packet-switched technologies are making it economically attractive for organizations to geographically distribute workers yet keep those operations remaining as part of a virtual logical whole.

These new economics are driving rapid adoption of this new way to connect telecommunications systems. As organizations become more and more distributed and communications more and more diversified the urgency for decision makers to understand the implications of how an individual is located when an emergency is in progress in a distributed system is increasing.

Another rapidly expanding trend, are situations of employees who are individually geographically distributed. In the past, in the legacy telecommunications environment, the demarc might have represented the address at which a caller physically resided. Today the user's telephone number might signify that the person is logically in one location, however, in realty they may be a continent away on travel, at a temporary work location or in a home office or other non-traditional work environment.

Even what is an MLTS today can be a subject of discussion. For instance, the legacy single cabinet mounted on a wall or standing as if a refrigerator in a closet still exists. However, in many cases, the refrigerator like cabinet has been transformed into diverse new form factors. The MLTS can be a single cabinet with few to many communication devices directly attached. It might also be a series of cabinets either in a single building, distributed across a campus or even distributed across great distances. The MLTS can be a distributed series of data networking servers and gateway devices or the MLTS can be a software program running on non-specialized servers. The point is there are many new concepts of organization of what was already an environment requiring thought and administration related to the location of users during emergencies.

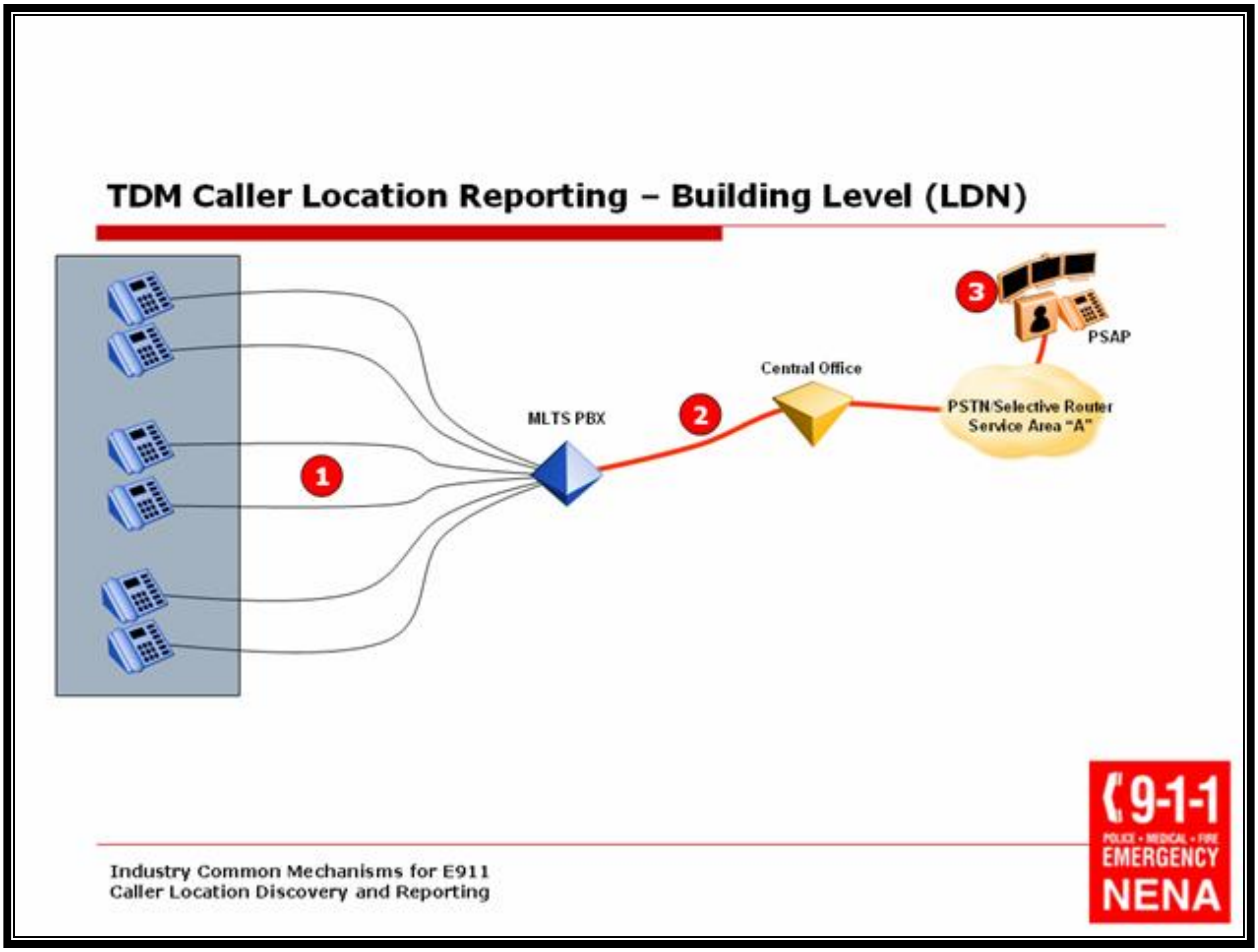
Organizations need to be cognizant of these and other issues. The overall purpose of this document and the accompanying diagrams is to highlight many of the significant issues and to provide guidance as to the methods and degrees of caller-location specificity available to organizations.

It is most important to note that the MLTS Operator has the ultimate responsibility to provide accurate information necessary for locating users during emergencies. MLTS Operators must establish and maintain PS/ALI records. This administrative complexity may be managed by the MLTS Operator with software and other tools that automate processes or through a third party.

The following figures and descriptions detail specific potential scenarios pointing out the preferred application of techniques to deal with the location challenge. The numbers within the figures below represent the logical call flow of a 9-1-1 call.

4 TDM Caller Location Reporting – Building Level

Figure 1 TDM Caller Location Reporting – Building Level (LDN)



In North America when a caller dials 9-1-1 from a telephone the call should be directly routed to a governmental operation known as the Public Safety Answering Point (PSAP). There are over 6,000 PSAPs in North America and each has the responsibility to answer the calls for help from a specific geography. The PSAP plays the key role to provide information to the appropriate public safety organization(s) responsible for delivering assistance in that geography. If a person dials 9-1-1 from their home, a payphone, or their cell phone their call should go directly to the PSAP.

In the MLTS environment, the recommended policy is that a user should be able to dial 9-1-1 and their call should go directly to the responsible PSAP. Although, some organizations make policy decisions that put in place alternative procedures, such as, different dialing codes or additional digits that need to be dialed before the call originates to the PSAP, this is not considered a best practice. The fact that these alternative policies are legislatively prohibited in some jurisdictions bears this out. The risks and benefits of such policies are additional questions that should be on the minds of the MLTS Operators.

In today's distributed organizations, telephones and other communication devices exist in many ways. In the most traditional sense, there may be devices distributed in a single building. This might be a small office or a large multi-story building. In the example depicted in slide two a caller using a TDM system dials 9-1-1 from a single building and the call routes to the PSAP responsible for providing public safety services for the geography in which the building is located.

In the MLTS environment, each physical device or communications application will typically be identifiable within the system with its own unique extension number or other designation. Although sometimes related to an externally published telephone number, in many instances those designations might not be available to the outside world. An example is an organization that publishes a single Listed Directory Number (LDN) and funnels all calls to users within the organization through a centralized switchboard.

In the example depicted in Figure 1above, along with the caller's voice, the MLTS sends a ten digit number. Unlike the example of a residential telephone or a cellular phone, the MLTS may not send a distinctive telephone number associated with the device that a caller might be using. Instead, the MLTS system can substitute some representative number. In this example the MLTS substitutes the main LDN of the physical building.

This technique may be an acceptable practice when an organization is small and the challenge of locating a caller is not complex within a single physical facility. In larger organizations whose physical premises may be extensive such as those that may span floors and/or exist as part of a campus or multi-tenant building this technique is not appropriate.

When an emergency call initiates across the Public Switched Telephone Network (PSTN) from an MLTS it travels over specialized telecommunications circuits. These circuits may be analog Centralized Automatic Message Accounting (CAMA) or Integrated Services Digital Network/ Primary Rate Interface (ISDN/PRI).

In the fabric of the PSTN are specialized telephone switches know as Selective Routers that interpret the data traversing the PSTN in CAMA or ISDN/PRI circuits and make decisions on which public safety agency has responsibility for the location of the originating caller.

The Selective Router sends the call to the appropriate PSAP. The PSAP then uses the provided ten digit number to query the PS/ALI database for the corresponding location information.

Here is a critically important point. CAMA and ISDN/PRI circuits do not have the ability to transmit location information. This information is only available if it has been pre-populated and kept up-to-date by the MLTS Operator in advance of any emergency calls being dialed.

The basis of accurate location information depends upon the responsible parties having provided that information in advance to the agencies in charge of the stewardship of the PS/ALI database. The potential implications of any failure to perform due diligence related to the population and accurate upkeep of the location information resides with the MLTS Operator.

Relying on TDM Caller Location Reporting – Building Level has many drawbacks. Most importantly, when the call arrives at the PSAP only the physical address of the building in which the device is located will be displayed for the public safety official. No more specific information, such as, floor, suite or doorway is available to aid public safety official in locating individuals in peril.

Care must also be taken when any change of location of telecommunications equipment takes place. For example, when an office moves from one address to another where a new LDN becomes necessary if the system is not administered to send a new LDN and the new LDN identified to the appropriate PS/ALI administrator, problems will occur.

In almost all cases it is no longer considered sufficient to populate the PS/ALI database with only the main LDN information for MLTS. States who have enacted legislation and enlightened organizations realize that in emergency situations the more information granularity the more effective the response. Locating a caller can be complex even in a single building: there are multi-tenant situations, and there can be significant challenges in a maze of offices or cubicles.

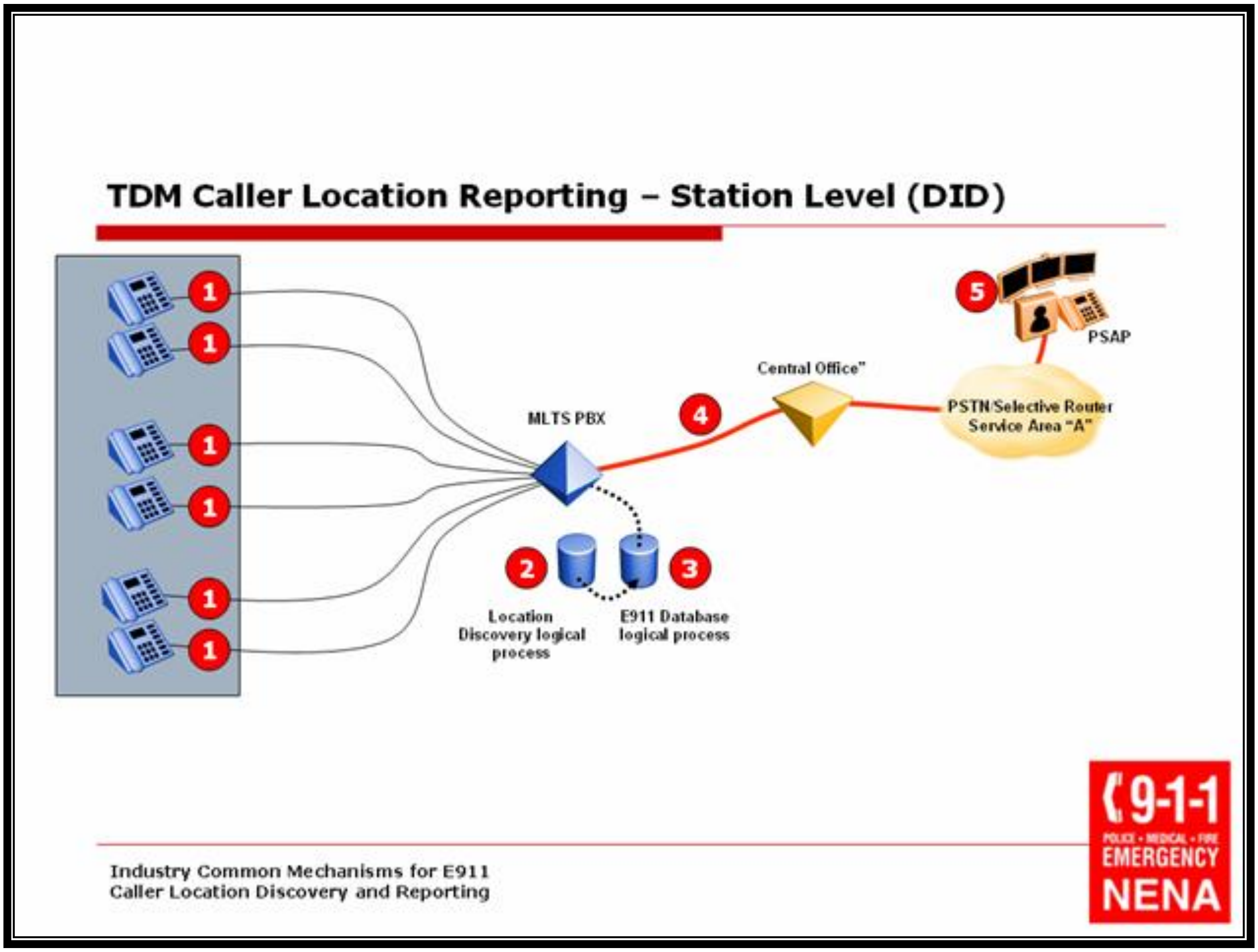
Recent headlines have demonstrated the significance of this problem.

According to the Washington Post, “On April 19, 2006 Dr. Kaafee Billah experienced chest pains while in his office in the Medimmune biotech complex in Gaithersburg, Maryland. After telling the emergency responder that he was having chest pains, he was no longer able to speak. Emergency personnel raced to the building address that appeared on the screen at the Public Safety Answering Point Center. After combing the building and finding no one, they determined there was no emergency. Ten hours later, cleaning personnel found the body of Dr. Billah on the floor of his private office in a different building."[6]

[6] Washington Post, April 21, 2006; p. B04.

5 TDM Caller Location Reporting – Station Level

Figure 2 TDM Caller Location Reporting – Station Level



Sticking with the single building analogy, where more granularity than the LDN of the building is desired the next layer of location specificity is accomplished using the TDM Caller Location Reporting – Station Level.

Most modern MLTS include the ability to internally process specific device level identification. Depending on the MLTS manufacturer this may be accomplished in a number of different ways. For purposes of discussion these logical processes will be referred to as the Location Discovery Manager and E911 Database Manager. In this document these are logical distinctions and do not prescribe any specific technical implementation.

These logical processes may be software in the MLTS or they may take place in separate devices or systems. It is important for MLTS Operators to understand the processes for logical determination. The MLTS Operator should consult their vendor for specifics on how this is accomplished for the particular circumstance.

TDM Caller Location Reporting – Station Level means that each individual physical device has assigned to it either an individually published telephone number or a representative telephone number that uniquely allows the PSAP to query the PS/ALI database for location information.

There are two scenarios possible. A representative telephone number is often referred to as a Direct Inward Dial (DID) or a Direct Outward Dial (DOD). DID and DOD are service offerings available from the providers of network services. The MLTS may send the specific telephone number of the device if the device has been assigned a unique telephone number such as a DID or DOD. It is not necessary for an MLTS responsible party to subscribe to DID or DOD services to utilize the TDM Caller Location Reporting – Station Level methodology. Telephone numbers can be purchased in various ways from many providers. The key is that some number that has been uniquely identified in the PS/ALI database is used.

Alternatively, in the case that each device has not been assigned a unique telephone number, the logical processes of the Location Discovery Manager and E911 Database Manager of the MLTS may substitute a representative telephone number that can be related by personnel in the PSAP with the location information in the PS/ALI database.

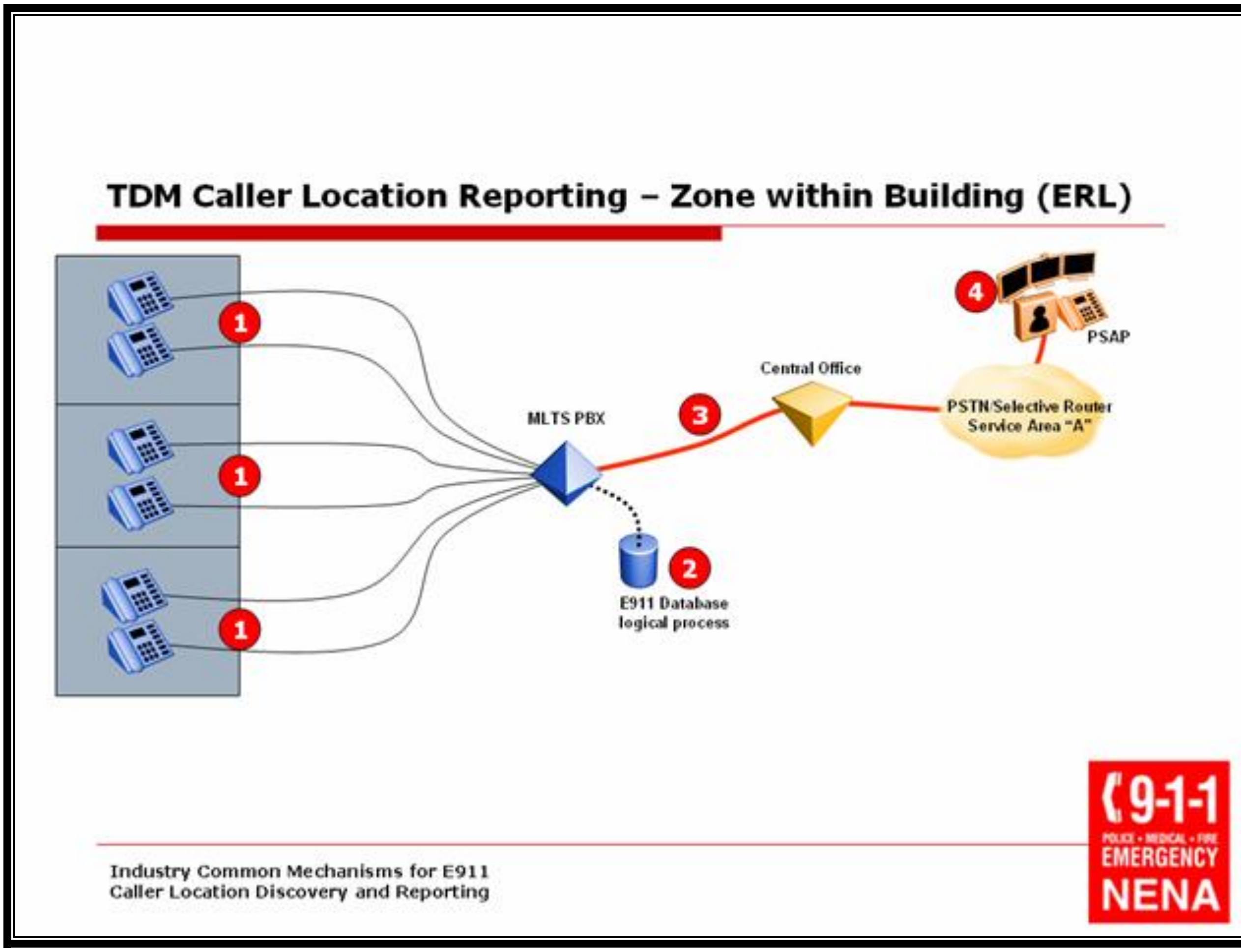
The TDM Caller Location Reporting – Station Level methodology allows the organization flexibility of choices. Thorough planning allows MLTS Operators to provide the public safety organization responding to an event various levels of specific information about the location of a device beyond the main address. Here the opportunity exists for organizations to provide specific information about the physical location of each device.

As in each case, with each methodology, the choice and the responsibility of the level of information granularity provided in application of these methodologies belongs to the MLTS Operator.

MLTS manufacturers provide ways to help the MLTS Operator/Manager reduce the complexity of this administration. MLTS Operators should consult with their MLTS manufacturers and other third-party technology providers for specific recommendations.

6 TDM Caller Location Reporting – Zone within Building Emergency Response Location (ERL)

Figure 3 TDM Caller Location Reporting – Zone within Building Emergency Response Location (ERL)



Again sticking with the single building analogy, a less precise methodology than specific device location information that organizations might choose to deploy is Zone Level reporting. In this case, the organization might determine groups of devices that are identified by a single phone number that refers to a group of devices in proximate vicinity. This might be all devices located on one floor or an area on the same floor or some other geometric vicinity.

A particular type of Zone level reporting is often defined as an "Emergency Response Location" (ERL). In NENA 06-750 *Technical Requirements Document on Model Legislation*

E9-1-1 for Multi-line Telephone Systems, NENA defines ERL as, “A location to which a 9-1-1 emergency response team may be dispatched. The location should be specific enough to provide a reasonable opportunity for the emergency response team to quickly locate a caller anywhere within it.”

NENA further states that,
In evaluating the acceptability of a proposed alternative method of notification, consideration should be given to whether and how the building is occupied outside normal working hours.

Rationale:
The minimum recommended number of ERLs was developed in the interest of being cost efficient and as not to place an undue financial burden on the MLTS Operator or MLTS Manager. Conversely, there is no reason that would preclude an MLTS Operator or MLTS Manager of assigning additional ERLs as deemed sufficient to adequately cover the workspace, regardless of square footage involved. .

The creation of ERL boundaries should not exceed fire alarm zones.

Exceptions:

(a) This limits the burden on small business most of which will be less than 7,000 sq. ft. In addition, emergency response teams can generally search areas less than 7,000 square feet quickly.

Key Telephone Systems (as opposed to Hybrid and PBX) use direct line selection and it is not practical to segment lines in a way that differentiates building floors. Since Key Telephone Systems generally serve only small workspace areas, there will not be many situations where the desired level of ERL information is not provided. Other MLTS, such as PBX's and Hybrids (Systems that incorporate the functionality of both Key Telephone Systems and PBX), are not subject to this exemption even though they may utilize some direct line appearances that appear on more than one station set. The MLTS Operators should inform individual system users of the appropriate 9-1-1 dialing procedures for their telephone sets.[7]

In Figure 3, similar to the TDM Caller Location Reporting – Building Level scenario where the main LDN is substituted for each internal extension, a represented set of telephone numbers are chosen to signify groups of telephones. These groups or zones may be some number of telephones that could be in a department or on the same floor of a building or generally located near one another. The point is to make it easy for public safety officials responding to an

[7] Soon to be published update to, NENA Technical Information Document on Model Legislation E9-1-1 for Multi-line Telephone Systems.

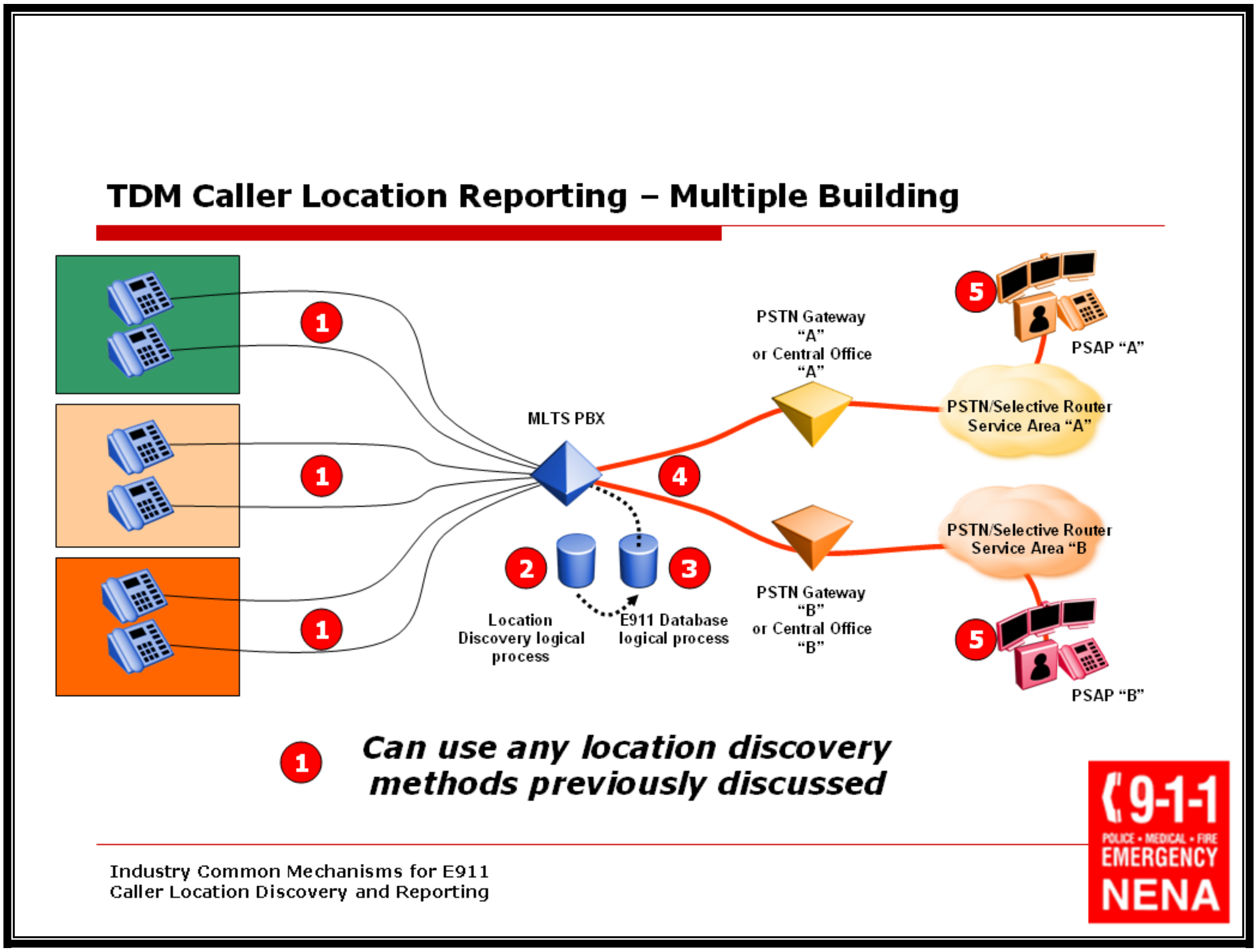
emergency to be able to locate the caller(s). It is critical that the PS/ALI data is continually maintained with accurate location information.

When 9-1-1 is dialed the MLTS system transmits the telephone number designated for the zone for each device in the zone across the CAMA or ISDN/PRI circuits. The Selective Router uses the zone telephone number to route the call and the PSAP uses the zone number to query the PS/ALI database.

This method does not provide the granularity of detail that the TDM Caller Location Reporting – Station Level scenario provides, however, it provides significantly more specificity than the TDM Caller Location Reporting – Building Level method.

7 TDM Caller Location Reporting – Multiple Building

Figure 4 TDM Caller Location Reporting – Multiple Building



In Figure 1 we discussed the challenges of providing granular location detail in a single physical facility. Figure 4 adds complexity to this example by expanding to the multi-building campus or geographically distributed locations that are part of a single logical whole MLTS.

Here it becomes more important to have specific actionable location information because different buildings on a campus might be served by separate public safety organizations.
In the previous examples, we talked about single buildings. Here we have added multiple buildings on the left side of the diagram as well as complexity on the right side of the diagram.

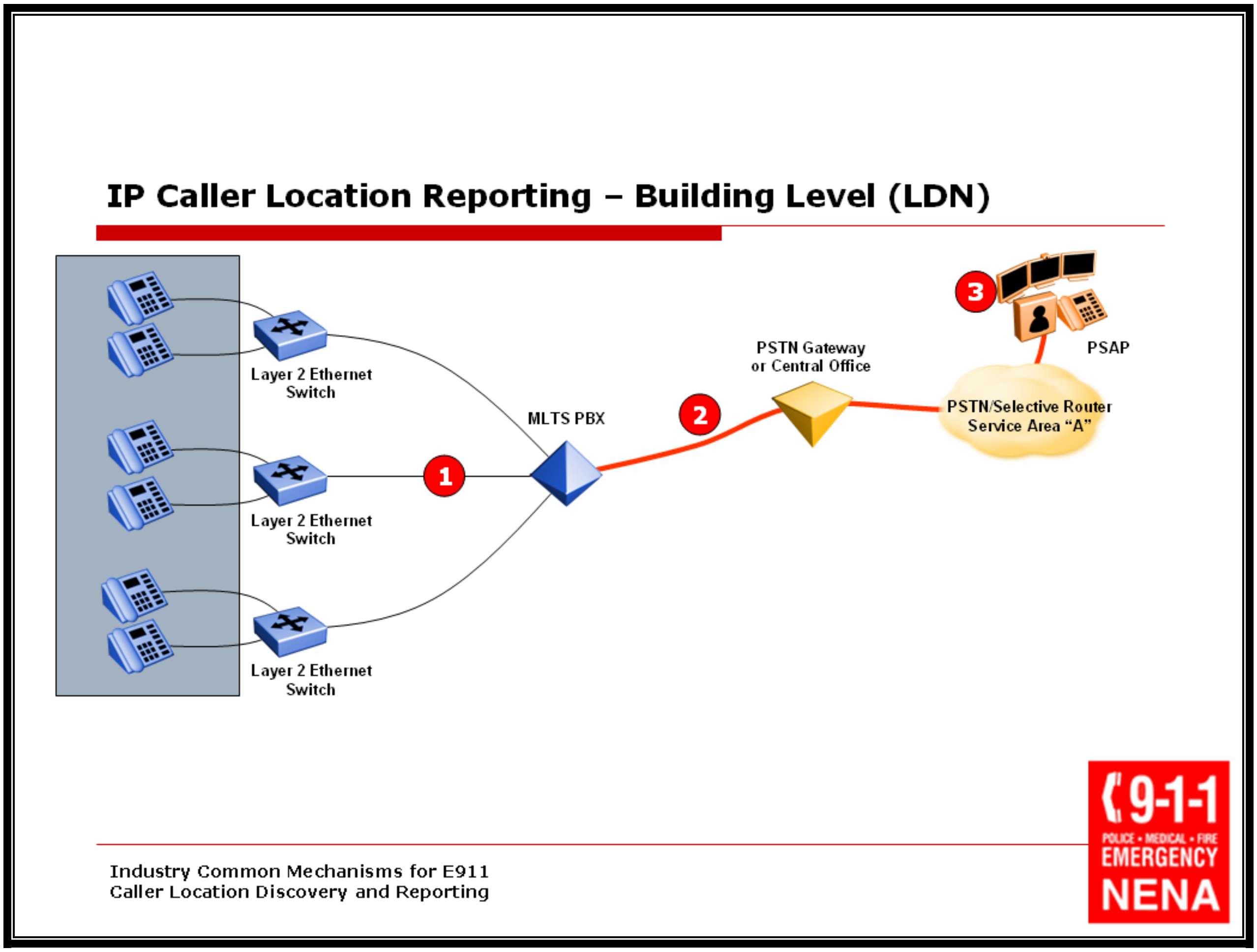
The MLTS system must discriminate between buildings as well as be able to decide which building's calls are sent across which CAMA or ISDN/PRI circuits. Therefore, the proper routing takes place in the PSTN to promptly and accurately deliver the call to the appropriate PSAP.

In this methodology, choices may be made from a number of the concepts described above. Devices may be identified using the TDM Caller Location Reporting – Station Level method described in Section 5 where each station may be assigned a unique number. In this case, the important processing will occur in the logical processes of Location Discovery Manager and E911 Database Manager to ensure that the calls are routed to the appropriate CAMA or ISDN/PRI circuits so that the proper public safety organization may respond.

Zone level identification as described in Section 6 may also be used. Using Zone level identification, the Location Discovery Manager and E911 Database Manager logical processes substitute the appropriate representative telephone number that is associated with the zone to ensure the correct routing takes place across the appropriate CAMA or ISDN/PRI circuits.

8 IP Caller Location Reporting – Building Level (LDN)

Figure 5 IP Caller Location Reporting – Building Level (LDN)



Before, we discussed in some detail the added complexity that the use of packet-switch protocols contributes to the challenge of location. Figure 5 proposes the first of several methods to deal with this added complexity.

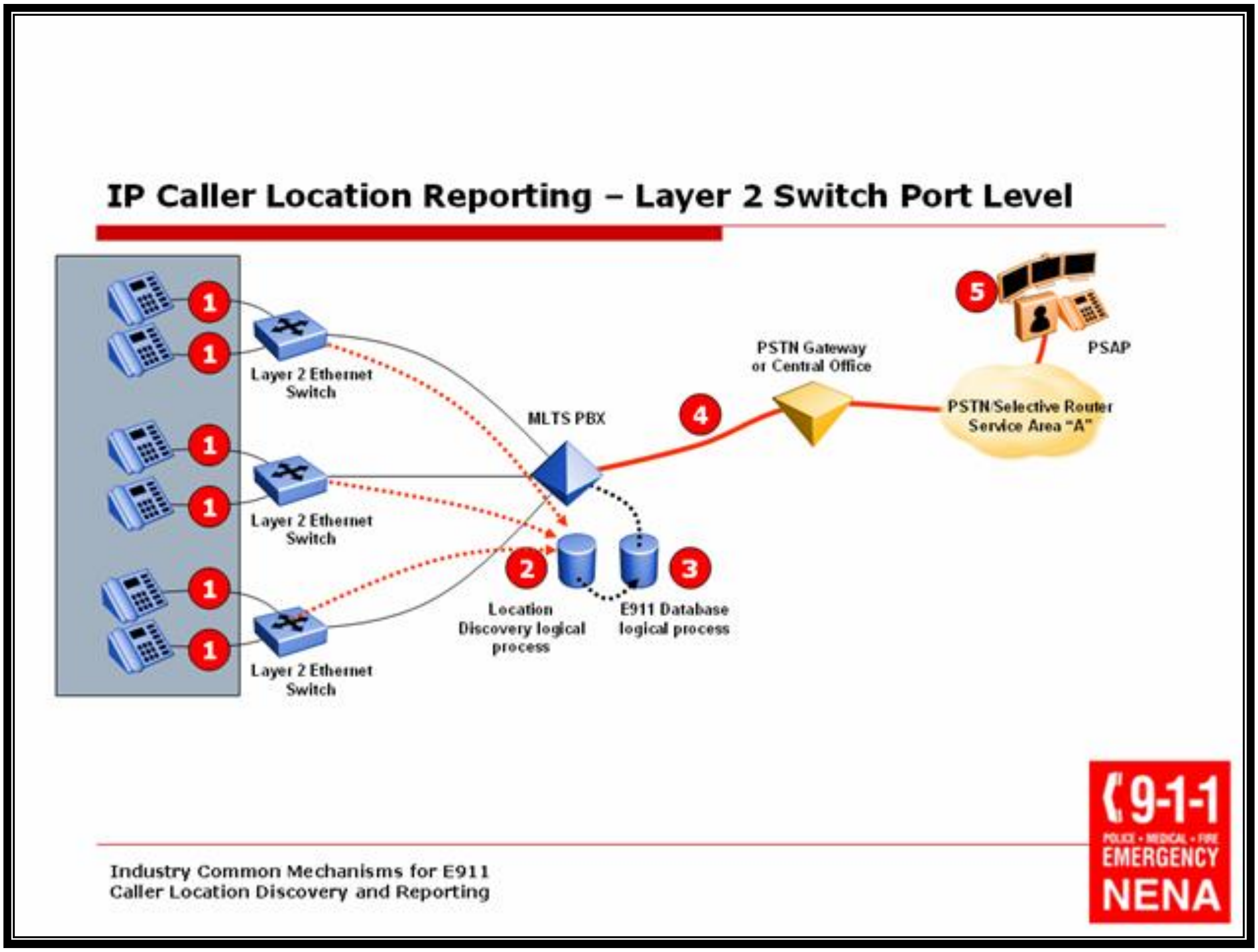
On the left side of Figure 5 you see communications devices that are connected to data networking switches. These switches then connect to the MLTS environment using packet-switched protocols such as IP.

Identical to, and with the same limitations and benefits described in Figure 1, only the main LDN of the building is transmitted for every device on the left side of the diagram.

9 IP Caller Location Reporting – Layer 2 Switch Port Level

Please note: The term IP literally means the Internet Protocol. In common dialogue the term has also come to mean a large number of disparate technology concepts including the strict technical definition of the Internet Protocol. In this document, the term IP is used in the liberal sense representing a number of different ways that telecommunications systems connect devices in a network.

Figure 6 IP Caller Location Reporting – Layer 2 Switch Port Level



Here we added additional granularity of detail in the IP environment.

The first thing to understand is that IP connected devices differ from TDM connected devices in the way that they are recognized by the MLTS. Unlike TDM systems that identify endpoints exclusively with telephone numbers, packet-based systems use IP addresses.

In IP Caller Location Reporting – Layer 2 Switch Port Level there are a number of deployment options. Because data networking switches communicate with the endpoint devices using IP addresses, choices of where to relate telephone numbers to the endpoint need to be made. The closer that telephone number is assigned to the location of the end-user, the more promptly a public safety first responder can find the person during an emergency.

Telephone numbers might be assigned to the individual connection points between the device and the data networking switch. These are called ports. Each port may have an individual telephone number assigned to it. Telephone numbers might also be assigned to a group of ports or a single number could be assigned to the entire switch.

The decision of where telephone numbers are assigned is critical. This is because data networking switches may be deployed to serve an entire small office. They may be deployed to provide connectivity to a floor in a building, several floors, or an area of one floor of a building. Deployment of hardware depends on a number of business and technology decisions. These deployment decisions must include careful consideration of the need to provide accurate and actionable emergency location determination.

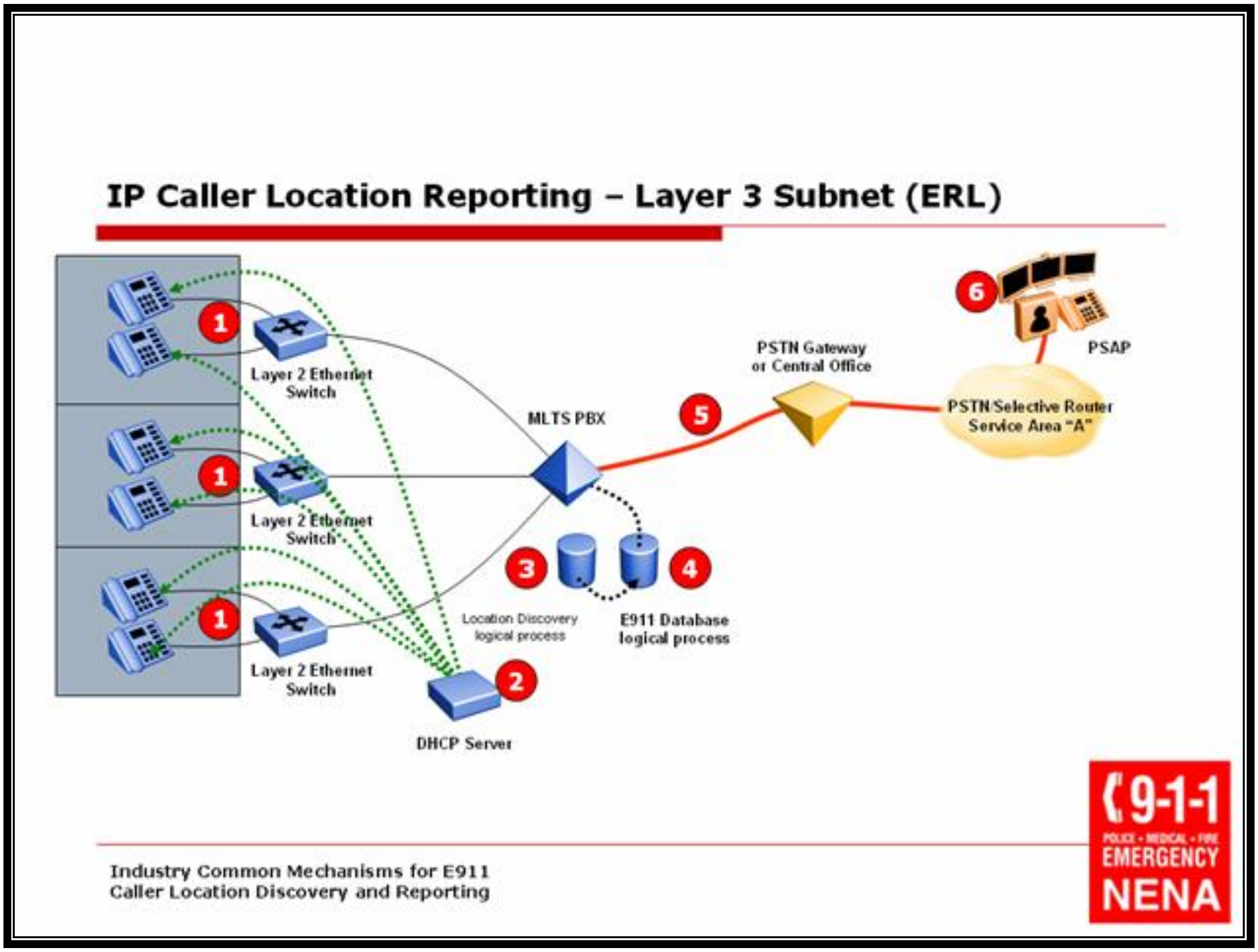
If an emergency is signaled from one of the devices in this scenario, the Location Discovery Manager and E911 Database Manager substitute the telephone number associated with either the port, group of ports or switch and the telephone number is reported.

This methodology gives the MLTS Operator many choices. For instance, assigning each port a telephone number approximates the TDM Caller Location Reporting – Station Level method. Assigning telephone numbers to groups of ports or the entire switch approximates the Zone technique.

As in all of these examples risk tolerance, operational realities and other factors weigh in deployment decisions.

10 IP Caller Location Reporting – Layer 3 Subnet (ERL)

Figure 7 IP Caller Location Reporting – Layer 3 Subnet (ERL)



In Section 9 known in the telecommunications industry as the Open Systems Interconnection (OSI) model. The OSI model describes increasing levels of complexity in the technologies used to transmit information in telecommunications networks.

Layer 2 is a designation of the capabilities close to the physical attributes of the data network. We talked above about port assignment of telephone numbers.

On Figure 7 we introduce higher levels of abstraction in the OSI model. Here other concepts are brought into play including the Dynamic Host Configuration Protocol (DHCP). DHCP is a software process that allows portability of endpoint devices within data networks such as Local Area Networks, Wide Area Networks or Enterprise Networks.

Prior to DHCP each device on a data network had a statically assigned IP address. This would be a relatively permanently assigned designation encoded in the software of the device.

A DHCP server houses a table that maps between the endpoints and the available IP addresses. With DHCP, the IP address becomes dynamically assigned. Rather than a hard coded IP address, the software of the device is set up to receive an IP address during a registration process that takes place when a device is activate on the network.

Software processes like DHCP open lots of possibilities. Figure 7 shows how a combination of DHCP and other logical process can be used to help deal with the location challenges.

> *Please note:* DHCP does not eliminate the need to initially populate or possibly update the information in the PS/ALI database should the ERL geometry change. DHCP gives additional flexibility in the application of an emergency numbering scheme within the MLTS environment.

Another concept used in data networks is the concept of subnets. Subnets are further divisions of data networking schema allowing data networking administrators to organize devices for logical reasons. As an example, businesses may use subnets to organize data networks in relationship to organizational structure.

For instance, each device used by an engineering department might be assigned to a particular subnet. This allows network managers to dedicate resources and manage networks in ways that might include carving out bandwidth for particular purposes such as the engineering department who might be working on a project that passes a great deal of data traffic at a certain time during the day. A business decision might be made to sacrifice the bandwidth of another department at certain times during the day and provide that bandwidth to the engineering department's subnet.

The IP Caller Location Reporting – Subnet methodology proposes that subnet logic be used to facilitate emergency location. Here subnets may be assigned representative telephone numbers and devices assigned to those subnets can be labeled with the chosen representative telephone number designating their location as identified in the PS/ALI database.

As in the examples above, the MLTS Operator has many options in the ways in which subnets might be aligned with telephone numbers. For instance the zone principles combined with logical assignment of telephone numbers provides a great deal of flexibly.

11 IP Caller Location Reporting – Multiple Building

Figure 8 IP Caller Location Reporting – Multiple Building

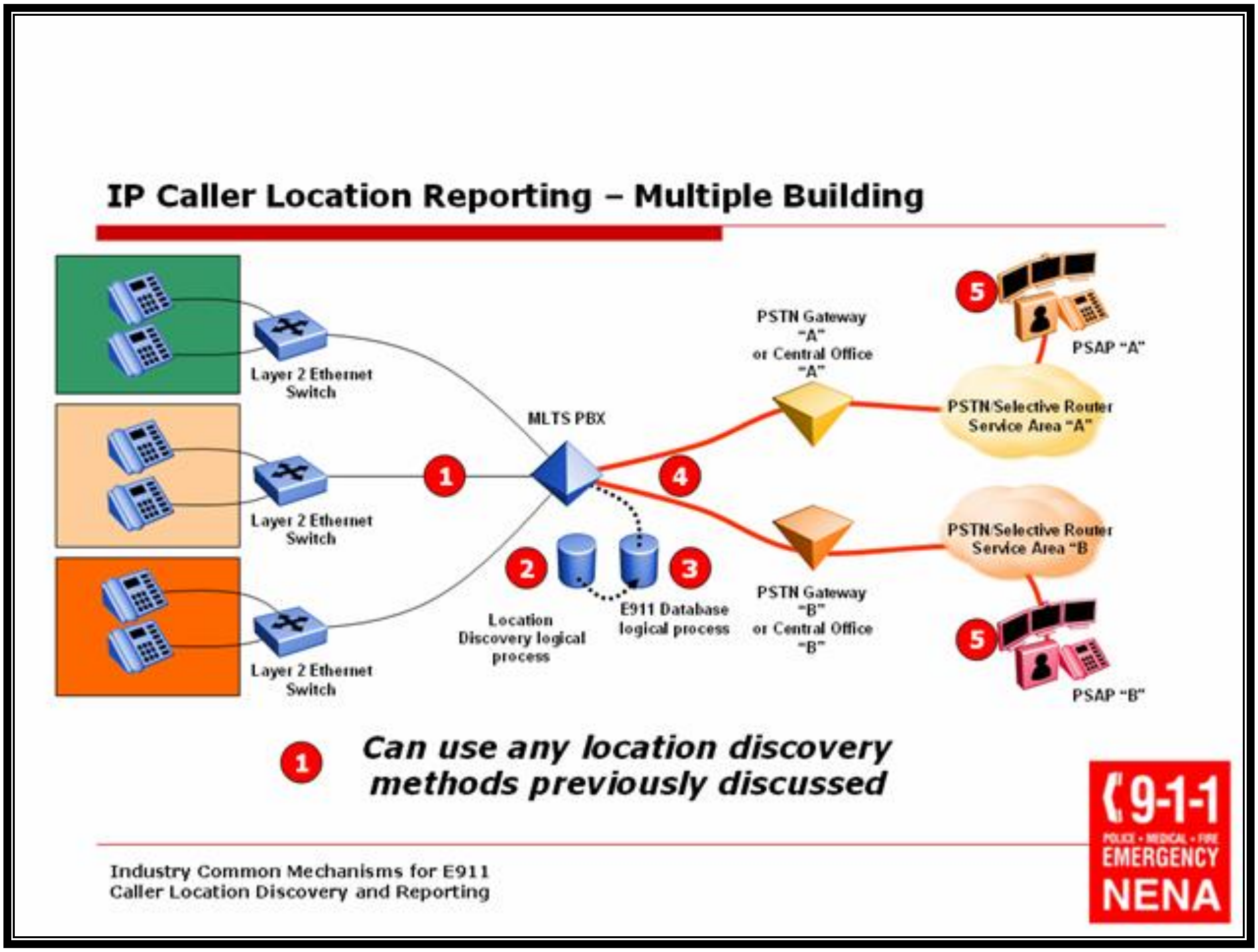


Figure 8 applies the principles of multiple buildings as detailed in Section 7, TDM Caller Location Reporting – Multiple Building to the IP environment. The mapping of representative telephone numbers to IP devices takes place and the logical processes of the Location Discovery Manager and E911 Database Manager verify that the calls are sent across the PSTN to the right public safety organization.

12 References

References are noted throughout the document as footnotes on the relevant page.

NENA 02-010, NENA Standards Data Formats for ALI Data Exchange & GIS Mapping

NENA 03-502, NENA Technical Information Document Trunking for Private Switch 9-1-1 Service

NENA 06-003, NENA Standards for Private Switch (PS) E9-1-1 Database

NENA 06-750, NENA Technical Requirements Document (TRD) on Model Legislation, Enhanced 9-1-1 for Multi-line Telephone Systems

13 Exhibits