

Standards Initiatives for Emergency Telecommunications Service (ETS)

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ABSTRACT

This article presents the functional requirements, features, and objectives for the Emergency Telecommunications Service (ETS) in newly emerging telecommunication networks. The ETS is an extension of the International Emergency Preference Scheme (IEPS) of ITU-T Recommendation E.106 and includes additional provisions for multimedia services through a packet-based telecommunications environment. Efforts are underway in the national standards bodies and International organizations to identify, establish, and apply a comprehensive family of ETS standards for the next generation of telecommunication services, which are expected to be a blend of new packet technology with traditional circuit-based infrastructure.

INTRODUCTION

The Emergency Telecommunications Service (ETS) is for disaster recovery operations to save lives, restore the community infrastructure, and return the population to normal living conditions after serious disasters and events, which include floods, earthquakes, hurricanes, and terrorist attacks. The ETS is intended for authorized users who will be involved directly in disaster recovery. Priority communication services will be provided through shared resources from the public telecommunications infrastructure that is evolving from a basic circuit-switched configuration of today's conventional telephone networks to merge with Internet-based packet-switched technology. The new ETS will also provide a richness of communication capabilities. Timely establishment of an effective ETS has now been given significant urgency because of the September 11 terrorist attacks in the United States.

Many challenges and considerations need to be addressed in defining and establishing the functional capabilities for the ETS in the emerging generation of telecommunications services. This article presents an overview of the basic requirements, features, concepts, and standards initiatives for an ETS. Merged circuit, packet, and third-generation (3G) mobile technologies are capable of providing a comprehensive ETS,

and ETS requirements must receive careful attention during the process of the convergence of these technologies. Specific solutions are not offered, but this article is intended to stimulate innovative thinking and productive discussion in industry standards bodies leading to development, establishment, and deployment of appropriate standards for the evolving telecommunications services.

Disaster situations can occur any time, any place unexpectedly. These natural and man-made events often significantly damage the community infrastructure and severely disrupt daily living. Recovery requires rapid response by authorities, immediate reaction from utility service providers, and support from local medical, construction, fire, and police resources. Effective priority communications are essential to facilitate the myriad activities for coordinating lifesaving efforts concurrent with reestablishing control in the disaster area. A sudden disaster requires immediate response operations to focus on saving lives, protecting property, and meeting basic human needs.

ETS OPERATIONAL REQUIREMENTS

Public telecommunication services are universally available and are provided by a massive infrastructure throughout most nations, except in the most remote and unpopulated regions. These critical telecommunications resources, therefore, must be depended on by the emergency responders for supporting the organization and coordination of initial, as well as ongoing, recovery activities. It is possible to readily realize these capabilities by leveraging the resources that are ubiquitous and most likely to be immediately available any place, any time. This includes the use of wireless services as mobile networks expand their coverage. Dedicated or special government telecommunications resources, on the other hand, do not generally have the immediate global reach to be responsive initially to disaster events.

Two Recommendations of the International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) present the basic requirements for international emergency

telecommunications. ITU-T Recommendation E.106, "Description of an International Emergency Preference Scheme" (IEPS) [1], applies to telephony services provided by the public switched telephone network (PSTN), integrated services digital network (ISDN), and public land mobile network (PLMN). ITU-T Draft Recommendation F.706, "Service Description for an International Emergency Multimedia Service" (IEMS) [2], applies to all modes of telecommunications service, including telephony, over the newly emerging telecommunication networks, including packet-based Internet Protocol (IP) technology and 3G mobile networks. The ETS can be used in both national and international contexts, and includes the provisions of the IEPS and IEMS.

Conventional circuit-switched telecommunications services are rapidly merging with the connectionless packet-switched technology. Wireless technology is also evolving toward the new 3G capabilities for seamless provisioning of services over and across the heterogeneous fixed and mobile networks. A substantial transition period is underway as these technologies converge. As a result, there will be many critical issues of transition and interoperability to address. The newly emerging technologies will provide greatly enhanced capabilities that can be leveraged and can benefit emergency recovery operations during serious disaster situations. The packet-based technology provides a very new environment that must be applied for providing effective and economical public telecommunications services, and supporting ETS capabilities.

When a disaster event strikes, the public telecommunications infrastructure generally sustains damage, experiences excessive traffic loads, and is subject to external interference that may severely limit the ability of emergency responders to communicate. Therefore, special provisions to facilitate effective communications for the emergency activities are necessary. This includes priority establishment and processing of communications through the telecommunication resources that remain available. ETS traffic must receive preferential use of the surviving capacity of the impacted network.

Many nations do not have any emergency capability today except for their public telecommunications infrastructure in its present state. In the United States, the Government Emergency Telecommunications Service (GETS) supports emergency recovery operations. However, it only provides priority establishment and routing of telephone calls through the PSTN for specifically authorized users who expect to be involved in emergency recovery operations. GETS fulfills the basic functional requirements of ITU-T Recommendation E.106 [1].

The ETS also has international aspects. Disaster situations are often regional and involve multiple nations. In these cases, disaster recovery assets from other nations may be necessary to respond to one specific event. Also, in the increasingly "global" world, many nations often provide support for recovery operations for emergency disasters contained within the borders of another country. ETS traffic, therefore,

needs to receive favorable treatment at international gateways as well as within national networks providing an ETS.

The emergence of new telecommunications technologies and their application for telecommunication services in the evolving telecommunication networks provides great promise for the realization of an enhanced, comprehensive, and effective global ETS. ITU-T Draft Recommendation F.706 presents requirements for multimedia services to support emergency operations. Not only will voice telephony services need to continue, the inclusion of broadband services like video broadcast and conferencing will also be beneficial. In addition, narrowband capabilities such as instant messaging and presence as well as email will facilitate short, rapid command and control information interchange, and will enhance recovery operations. This will be particularly useful during periods of limited bandwidth availability and as a last resort to communicate when conditions become most severe.

As indicated earlier, ubiquitous telecommunications resources that provide services to the general population provide the basis for readily available capabilities for an ETS. Since public telecommunications resources are normally at hand, emergency operations activities do not have to wait for deployment of special facilities. However, as emergency operations get underway, supplemental capabilities could also be of significant benefit, particularly when public telecommunications resources become seriously stressed and limited. Therefore, it would be desirable to have a telecommunications infrastructure that can readily be integrated with transportable, redeployable, and fully mobile facilities, such as personal communications service, cellular, satellite, and high-frequency radio. Interoperability and interfaces among selected government or private facilities, systems, and networks would be very beneficial. It is also highly desirable that ETS resources be as robust as possible to support surviving users under a broad range of circumstances, including widespread damage during natural and man-made disasters.

The availability of the ETS for authorized users could also be specified in a service level agreement (SLA). The ETS could always be available for use at any time and at any place in a specific network. This would allow fast response access immediately when the disaster strikes. Some networks, on the other hand, may only activate the ETS on declaration of an emergency by the appropriate authority. This could cause a serious delay in the ability for response and recovery forces to communicate effectively. Some in between capability could also be possible, where a basic preferential service would always be available and then enhanced features could be activated on declaration of an emergency.

The European Telecommunications Standards Institute (ETSI) describes four different scenarios of interoperation [3]. Because of the variety in configurations, it is necessary to establish the interfaces for interworking between the signaling systems of today's telephone networks, and the new call control and signaling protocols

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of evolving telecommunication networks. This needs to be accomplished without negatively impacting the fundamental operation or infrastructure of existing and future packet-based networks. As new networks with the basic emergency service priority capabilities come into being, it will be important to provide enhanced services by leveraging the new capabilities of the emerging packet-based networks.

In addition to ensuring transition and interworking between existing public telecommunications services and the new generation of networks, new applications made possible through advancing technologies will also be adopted to enhance support of recovery operations. One application of particular interest is the I Am Alive (IAA) distributed database for registration of survivors and identification of the missing. IAA was developed by Japan to support recovery from serious earthquakes as experienced in Kobe in 1995. The applications instant messaging and presence for recovery operations were used very effectively during the September 11 disaster in New York.

ETS CONSIDERATIONS

There are a number of important considerations that need to be studied in order to best use the connectionless packet technology for the ETS in the new telecommunication capabilities. The advantages and inherent characteristics of the packet-based technology need to be leveraged and not impeded. It will be necessary to define and establish the appropriate quality, availability, and reliability of service guidelines for the various modes of multimedia communications. There are many formidable challenges that need to be addressed in the fulfillment of the functional requirements that have been established in ITU-T Recommendations E.106 and F.706. They serve as the principal objectives to meet in provisioning a truly comprehensive and effective ETS. More specific considerations in seeking the necessary mechanisms and solutions for ETS are:

Selection of multimedia and telephony services. The basic service defined in ITU-T Recommendation E.106 is telephony as provided by PSTNs, ISDNs, and PLMNs. The emergence of integrated voice/data services of evolving telecommunication and 3G mobile networks need to not only support telephony services but also provide a variety of enhanced modes of communication including instant messaging and presence, email, Web and database access, video, and teleconferencing. These additional services can also be used effectively for emergency communications. This will enable emergency recovery operations to have a comprehensive menu of supporting communication capabilities.

Rapid authentication of authorized ETS users. The ETS is intended for use only by authorized users involved with emergency recovery operations. The appropriate authority of each nation or community would authorize these designated users. Upon initiation of an emergency communication request, an authentication process needs to verify the user's identity to protect the telecommunication resources

against excessive use and abuse during an emergency situation. In the United States, a personal identification number (PIN) similar to the application of credit card calling in the PSTN currently authenticates authorized GETS users. For the future ETS, it is desirable to establish an innovative method for a streamlined and rapid user authentication in the emerging telecommunications and 3G mobile networks. The passing of authentication as the ETS communication travels across networks also needs to be addressed.

Security protection of ETS traffic. Security is a major concern with the evolution of packet-based networks. In addition to the many basic security provisions already under consideration, ETS has additional security provisions that require special attention. Security protection is necessary to prevent unauthorized users from accessing scarce resources needed to support emergency operations. This includes such threats as spoofing, intrusion, and denial of service. In addition, the identity and location of certain authorized users of the ETS need protection. Sensitive and classified information present in some specific ETS traffic needs protection from eavesdropping.

Preferential access to telecommunications facilities. There are a number of ways to access telecommunication resources for obtaining ETS capabilities. These include PSTN wireline, wireless, satellite, cable, digital subscriber line (DSL), and optical fiber. There will be a significant advantage for an emergency operations user to be able to obtain access to these various telecommunications services on a priority or preferential basis. This will enable more rapid initiation of emergency communications.

Today the PSTN service has no general provision for offering a special dial tone on a priority basis for authorized callers to initiate emergency calls. However, specially marked lines or specifically provisioned "off-hook" services could provide preferential access, but that would only be by line and location, not per ETS request. Dial tone for the PSTN comes only on a nonselective demand basis from a limited selection of ports. As a result, heavy demand can delay access if the supply of ports is exhausted. Therefore, a provision for preferential access to services in packet-based telecommunication networks is a capability that requires consideration.

As with the PSTN dial tone ports, cellular services have a limited number of channels in each cell to accept call initiation from an end device. When a disaster event occurs in a particular local area, floods of call attempts generally occur. This severely reduces the probability of access. Therefore, a priority access service for designated users or end devices is also needed for cellular services.

Appropriate technical mechanisms inherent in the infrastructure need to be applied to enable preferential access via the various methods for initiation of ETS communications. It is imperative that authorized emergency operations have the ability to respond rapidly to disaster events in a timely and efficient manner.

Preferential establishment of ETS communi-

cations. A communication may consist of a single unit of information transiting from source to destination, or a flow of information via a series of packets or stream of data. In technologies that support connection-mode operation, an end-to-end path for the communication to transit is established upon entry of the address, or telephone number, at the destination terminal. In connectionless operation, individual packets may transit the network over different paths. When the total communication involves a series of packets, they are assembled and processed together at the destination.

Emergency communications must have a high degree of assurance of successfully reaching the destination, regardless of the networks they transit. Therefore, the ETS traffic needs to be uniquely identified and receive preferential treatment over nonemergency traffic. This provides a priority service for authorized communications in the ETS. In a PSTN, once a connection is established, the call is effectively "hard-wired" in the form of a circuit-switched connection and does not require continuance of preferential status. In a connectionless packet network environment, however, it is necessary to maintain the ETS identification for all respective packets. ETS identification also needs to be conveyed to each of the transit networks, regardless whether they support ETS. Telecommunications service providers (SPs) must be able to identify and prioritize emergency communications according to their SLAs with the service customer (SC) and other SPs.

Preferential routing of ETS traffic. Routing of packets is a continuing process for an instance of communication until the session has reached completion. As indicated above, the priority status and identification of emergency communications must be maintained until session termination. If the path being followed becomes congested or fails, the network or application layer mechanisms could be applied to dynamically reroute ETS traffic through remaining operational resources. While additional delay may result from the rerouting process, ETS traffic will still have a higher probability of reaching its destination.

Preferential use of remaining operational resources for ETS traffic. During disaster events, infrastructure damage and heavy traffic demand can severely limit public telecommunications. Therefore, ETS traffic needs to have preferential use of the appropriate amount of operational infrastructure required to effectively support recovery operations without impeding the inherent traffic flow throughout the connectionless packet network. To this end, a scheme of preferential treatment needs to be defined that will accommodate various types of priority services for authorized users as well as for general public emergency use (i.e., 911/999/112 emergency calling service). The appropriate balance of traffic flow needs to be maintained to ensure support of emergency traffic, while the remaining capacity can be used for nonemergency applications.

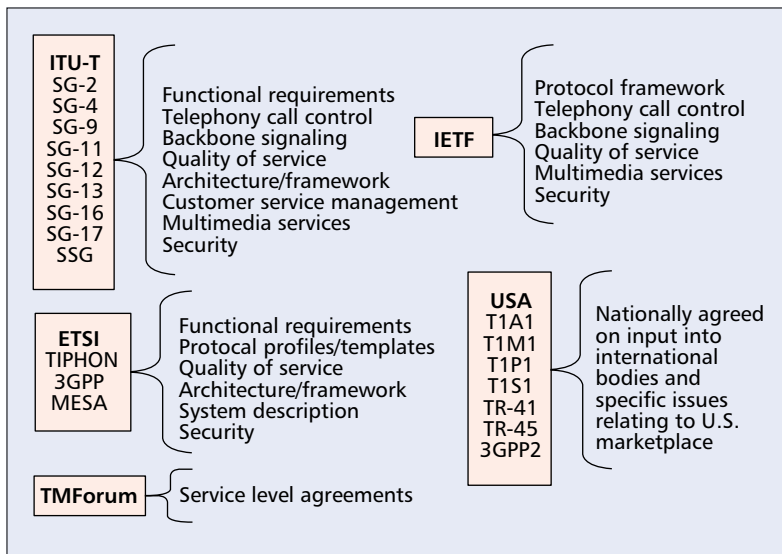
Preferential completion of ETS traffic to destination. In addition to considering the issue of preferential establishment, routing, and main-

taining an ETS communication, it is also necessary to establish provisions to facilitate completion of the emergency communication to the destination terminal. When an end terminal can handle multiple sessions, its inherent packet multiplexing feature naturally allows the incoming ETS communication to be delivered. When the terminal device can only handle a single session, such as a cell phone, the user needs to receive an overriding indication of an incoming ETS communication. The destination could then suspend nonemergency communications to free bandwidth for the incoming emergency communication. If preemption were an option, nonemergency communications to the destination could be terminated. Should the destination have call forwarding initiated, the network should then continue to reroute and process the emergency communication with preferential treatment to the new destination.

Optional preemption of nonemergency traffic. ITU-T Draft Recommendation F.706 identifies the process and concept of preemption of nonemergency traffic by ETS traffic. While the concept of preemption typically applies to circuit-oriented communications, its application in connectionless packet network services, if determined viable, needs to be studied and defined. The basic ETS provisions do not include the concept of preemption of nonemergency traffic to free bandwidth and resources for emergency traffic. The intent is to have ETS traffic receive basically preferential treatment. If the communication encounters congestion or a blockage, it should be rerouted if possible. Any nonemergency communication in progress is normally allowed to continue until completion. However, some nations or private networks may allow preemption of nonemergency traffic to enable processing of emergency communications. Therefore, in these cases preemption may be allowed only as an option, which could be invoked as specifically prescribed by that authority.

Allowable degradation of service quality for ETS traffic. Various levels of quality of service (QoS) are defined for different applications and modes of operation. Each may have multiple classes from the very best QoS to lesser levels. The QoS for different ETS services would typically be designated the best available to ensure clear communications and conveyance of important information. However, when the telecommunication resources experience severe stress, an allowable degradation of QoS could be acceptable. This would occur only when resources have become unavailable to the point that the network cannot support nonemergency traffic, and sufficient bandwidth and resources are not available to support the normally acceptable QoS level for emergency traffic. Rather than lose the ability to communicate, emergency operations need to continue to convey critical information, even if with difficulty. Any possibility of getting information through is better than none at all. The ETS needs to continue operation when only best effort service is available. Therefore, a special or supplemental class of QoS for ETS is necessary to define the conditions and terms for allowable degradation of service.

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■ **Figure 1.** Standards organizations and ETS issues pursued.

Interchange of critical telecommunications service management information. During emergency operations, interaction between the SCs and SPs through sharing of critical information related to availability and status of telecommunication resources would be beneficial. SCs could maintain knowledge of service availability, and provide reports to SPs of service problems and failures. SCs could also have a view of resource configurations supporting the operational needs at hand. SPs would be able to provide reports of status and availability of resources, failure points, recovery notices, and alerts of lost capabilities. When the ETS is only activated during a declared emergency, the SC can directly notify the SP online to activate the ETS service for the area impacted. An effective service management interface and a simple data interchange mechanism are needed to provide this important capability.

ETS STANDARDS INITIATIVES

Currently, prominent international standards bodies are developing new standards for the telecommunication infrastructure that is expected to be deployed over the next several years. It is imperative that the specifications of these networks include support for the functional requirements of a comprehensive ETS before equipment and systems are designed, manufactured, and deployed.

The transition to integrated circuit-based, packet-based, and 3G mobile services for new telecommunication services will involve a number of issues, one of which is to ensure orderly and transparent continuance of the basic E.106 emergency preference capabilities. During the convergence period, the different schemes or interworking between the two technologies must be considered. For example, voice calls from the telephone or mobile network may transit voice-over-IP links and then terminate in either the telephone network or directly in a packet-based network.

Figure 1 identifies the national and interna-

tional standards bodies that are actively addressing the ETS requirements for fulfillment through existing standards and those standards under development. The objective is to fulfill the ETS requirements through adjustments in established or new standards rather than create a separate family of specialized standards. This approach should enable implementation with minimal effort and cost as well as avoid costly retrofits to existing network resources.

Agreement has been reached in all these prominent standards development bodies to address the requirements for ETS in evolving networks. A number of proposed draft standards are under development that fulfill ETS requirements. Specific issues being addressed include:

- Priority access to wireline and wireless services
- Protocol mechanisms in IP-based networks to convey an ETS priority indicator in session control and gateway signaling
- Congestion control
- Mapping of ETS priority indicator at international gateways
- QoS provisions
- User authentication and ETS traffic security
- SLAs
- Interworking between public networks and supplemental transportable/contingency telecommunication capabilities

The ITU-T has initiated work in nine study groups where issues related to ETS are addressed. The ITU-T is also establishing an umbrella effort to ensure consistency between the many activities within the ITU telecommunication, radio, and development sectors, as well as other organizations including those identified in Fig. 1, the United Nations, and Red Cross. With the ITU being an international treaty organization for telecommunication services among the nations of the world, it is taking the lead in the overall ETS work. Visit <http://www.itu.int> for more information on the international standards work.

The Internet Engineering Task Force (IETF) is the principal organization for development of protocol specifications and practices related to the Internet. They have now formed a new working group called Internet Emergency Preparedness (ieprep) and have an email exploder list for discussing the issues. Visit <http://www.ietf.org> for more information on the ieprep Working Group and email list.

The European Telecommunications Standards Institute (ETSI) has established three projects that are international in scope and participate in addressing ETS issues along with their other assigned work items. Project Telephone and Internet Protocol Harmonization Over Networks (TIPHON) has a major work item to perform an analysis of the user community requirement for disaster recovery and develop a systems description on how the various standards provisions are fulfilling the requirements. The Third Generation Partnership Project (3GPP) is developing specifications for the new generation of wireless service, which will include priority access for authorized users. ETSI and the Telecommunication Industry Association (TIA) established the Mobility for Emer-

gency and Safety Applications (MESA) Partnership Project. MESA is developing a broadband capability for supporting disaster recovery and public safety. Visit http://portal.etsi.org/Portal_Common/home.asp for information on these three activities.

There are two principal standards development activities in the North America that have recognized the ETS requirements for work programs:

- Standards Committee T1, Telecommunications, sponsored by the Alliance for Telecommunications Industry Solutions (ATIS), is taking the lead in development of contributions to the ITU-T work as well as addressing specific national issues. Visit <http://www.t1.com> for information on the T1 Technical Committees.
- The TIA is dealing with priority service issues for wireless networks and enterprise systems. Visit <http://www.tiaonline.com> for information on technical committees TR41 and TR45.

The TeleManagement Forum (TMForum) is a large international association that addresses telecommunication management and operation support system (OSS) issues. They have developed a first edition *Service Level Agreement Management Handbook* for the telecommunications industry. The second edition will include provisions for obtaining ETS from the SPs in the marketplace. SLAs will become the means of specifying services provided to customers and other network operators. *The SLA Management Handbook* (GB971) is available at <http://www.tmfcentral.com/va.asp?articleID=248>.

CONCLUSIONS

The establishment of meaningful standards to make ETS a reality requires dedicated cooperation and collaboration among industry and government. Initial ETS capabilities, as defined by ITU-T Recommendation E.106, exist in some nations today and can be deployed in the basic telephone systems that are in place. The evolution of telecommunications technology to provide more effective, efficient, and economical

facilities in newly integrated networks provides both a challenge in transition and an opportunity to apply greatly enhanced capabilities for a national and an international ETS. Some of the ETS requirements addressed in this article may already be satisfied without change or addition to existing standards. These capabilities need to be identified, and their application to the ETS needs to be defined. Where capabilities for ETS do not exist, new standards or additions to existing specifications must be developed. It is imperative that any specifications include support for the functional requirements of a comprehensive ETS before equipment and systems are designed, manufactured, and deployed. None of these new specifications shall cause change or impairment of operation of existing emergency capabilities or to the basic packet-switched infrastructure. ETS is multidimensional and includes many critical technical issues as well as policy, legal, regulatory, and operational issues that need to be resolved. Close cooperation between government and industry will lead to timely establishment or identification of meaningful standards and deployment of ETS capabilities in the evolving telecommunication and 3G mobile networks.

Please visit <http://www.emtel-standards.net> to track the progress of work.

REFERENCES

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BIOGRAPHIES

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