Canadian High Probability of Completion

Feasibility Study

Version 1.3

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For :

Industry Canada

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Revision Sheet

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Rev. 0.0	September 15, 2002	High level plan
Rev. 0.1	September 30, 2002	Detailed Plan
Rev. 0.2	October 15, 2002	Preliminary Input
Rev. 0.3	October 31, 2002	First draft
Rev. 0.4	November 29, 2002	Second draft
Rev. 0.5	December 20, 2002	First preliminary draft release
Rev. 0.6	January 19, 2003	Second preliminary draft release
Rev. 1.0	January 21, 2003	First draft release
Rev. 1.1	February 14, 2003	Minor changes
Rev. 1.2	March 27, 2003	Addition of need analysis
Rev. 1.3	May 16, 2003	Minor changes

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1 INTRODUCTION

1.1 Purpose

The 'High Probability of Completion (HPC) technology' was developed for the Emergency Telecommunication Service (ETS) of the United State called GETS. The purpose of this document is to assess if HPC could be used to enhance the current Canadian ETS and, in the affirmative, to define the best cost/benefit improved ETS system, to evaluate the cost of implementation and maintenance, to list the impact, to estimate a timeline for deployment and finally to validate that Canadian emergency preparedness groups would benefit from the enhancements.

1.2 Scope

To complete this study, a lot of extremely sensitive information was gathered from Canadian carriers and from telephone switch manufacturers and, although the report was completed for Industry Canada, it was critical to have the feedback from all the people involved (government, carriers, vendors, users) making this document a public report

The impact is that no company specific information is revealed in this document and that only high-level information is presented. Any details on prices or justification on decisions could compromise non-disclosure agreements with companies.

Also, input was gathered from the Federal and Provincial governments whom are the users of such a system and all comments were taken into account to design the suggested system, including some modifications of the current PAD system to fully integrate it into a new Canadian ETS system.

Section 2 presents the new suggested Canadian enhanced ETS system including a few suggestions on user management and, although it touches on a few cost sharing strategies options, it does not include the possible funding sources. Section 3 briefly lists the feedback from Canadian carriers and from Federal and provincial government. Section 4 presents the various impact of the suggested system including time and cost estimate. Section 5 dives into more details and list the rationale for the recommendations including the alternate system considered. Finally, the conclusion summarizes the result of the analysis.

1.3 Points of Contact

An important part of this study was to gather feedback from the telecommunication industry and from potential users of the system. The following are the people that were made aware of this study either by a document, by conference call or presentation and who provided input.

ACTQ	Serge Desy	Aliant	Milt Larsen
AGCS	Ron Walsh	Bell Canada	Robert Martin
	Stuart Goldman		Doug Kwong
Alberta Gov.	Ron Wolsey		Allain Lalonde
	Pat Henneberry		Larry Ryan
	Dave Redman		Claude Eliott

British Columbia Gov.	Paul Crober
	B.J. Phillips
	Andrew Bryan
	Bob Bugslag
Canadian Gov. (IC)	Jan Skora
	Michel Milot
	Carole Diotte
	John Kluver
	Robert Simpson
	Nigel Bell
	John Nosotti
	Dave Egilo
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	Dan Lemoine
	Wendy Wu
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	Rolf Ziemann
	Barry Kram
	Peter Chau
	Maggie Lackey
	David Proulx
	Dave Gates
	Cheryl Slack
	Barry Kram
	Phil Amirault
	Rae Bradford
	Gordon Garland
	René Guérette
Canadian Gov. (CRTC)	Chaouki Dakdouki
	Louis Lepage
Canadian Gov. (OCIPEP)	Jan Donnais
	Devin McNaugton
	Shawn Clarke
	Anne King
	Brian Klotz
	Jerry Janes
	Len LeRiche
	Mike McWade
	Peter Schlitter
Canadian Gov.	Yves Lanthier
	Ginette Gervais
	Mike Sharpe
	Tom Murray
	Brenda Munro
	Karen Osborne
	Andrea Hutchinson
	Carl-David Fraser
	Ray Massie
	Howard McBride
	Sylvie Kornel
	Jeff Bigelow
	Jocelyne Monette
	Rick Bellwood
	Joanne Charron
	Mike Léveillé

	Dave Taylor
	Michel Tremblay
	Jim Gervais
	David Dorsey
	Francois Viens
DynCorp (NCS)	Dennis Berg
	David Cain
East Link	David Caldwell
FuturWay	Jay Gowans
Group Telecom	Gilbert Bennett
Lucent	Jeff Churchill
	Jeff Robinson
	Stephen Pichocki
Manitoba Gov.	Chuck Sanderson
	Andrea McDonald
	Larry French
Microcell	Simon-Pierre Olivier
New Brunswick Gov.	Art Skaling
	Gus Marche
	Andy Morton
	Ernie MacGillivray
	Gisèle Chiasson
	Andrew Ingraham
	Patti Morrison
Newfoundland Gov.	Frederic Hollett
	Dennis Shea
	Nancy Emberly
Nova Scotia Gov.	John Perkins
Nortel	Glen Brownridge
	Pete Streng
	Rick Garvin
	Richard Dacosta
Ontario Gov.	Tom Kontra
	Chris Pittens
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	Maureen Griffiths
PEI Gov.	Barry Folland
	Dave Campbell
	Larry Avery
Québec Gov.	Lise Asselin
	Hugues Daveluy
	René Dagnault
	Johanne Latulippe
	Robert Bégin
	Jean-Pierre Bazinet
Saskatchewan Gov.	Colin King
	Crystal Frisk
SAIC (NCS)	Ken Erney
Telus	Garry Wilson
	Sam Yung
	Craig Miller
	Craig Nesbitt
	John Makaryshyn
US Gov. (NCS)	Frank Suraci

Vidéotron	Louis Lamarre

Members of the emergency departments of the Canadian telecommunications industry were also informed.

2 CANADIAN EMERGENCY TELECOMMUNICATION SERVICE (CETS)

This section presents the suggested new Canadian Emergency Telecommunication Service (CETS) that combines the current PAD system and the High Probability of Completion (HPC) technology.

With the enhancement presented, Canadian emergency personnel would have access to two distinct emergency telecommunication services:

- Canadian ETS PSTN Access Priority
- Canadian ETS PSTN Network Priority

Together, these services would ensure that Canadian emergency personnel have all the essential network features necessary for successful operation as defined in E-106:

- Priority to dial tone
- Priority call set-up including queuing schemes
- Exemption from restrictive management controls

The first section describes in more detail both services from the public switched telephone network point of view; the second section describes the management system and the last section presents times to consider for the evolution of Canadian ETS.

2.1 PSTN services

2.1.1 Access Priority

In the Canadian network, this service is currently known as PAD and gives priority to dial tone to specific line. The exact method to give priority varies depending on the switch type, but the objective is the same: allow selected phones to have access to the telephone network in any situation even when switches are overloaded.

To ease terminology throughout this document, a CETS user that is subscribed to the 'CETS PSTN Access Priority' service is also known to have the *Access Privilege* or *Access Priority*

This service is aimed for people that are working from pre-specified locations in emergency situation and is valuable when the call is originated near the disaster area because it is expected that only switches located close to a catastrophe might have problems serving (giving dial-tone) the connected lines.

Depending on the type of work of an emergency responder, lines that should have access priority include but are not limited to:

- Office phone(s)
- Personal home phone(s)
- Other frequently used phone(s)

From a user point of view, nothing needs to be done to activate the service, it is always activated and the users only need to either remember or identify the phones that have the *Access Privileges*.

2.1.2 Network Priority

This new service, based on HPC technology developed for GETS, increases the probability of completing the call in a congested and/or a managed network. To ease terminology throughout this document, a CETS user that is subscribed to the 'CETS PSTN Network Priority' service is also known to have the *Network Privilege* or *Network Priority*.

The proposed service is very similar to a calling card with the difference being that the call made would benefit from the High Probability of Completion (HPC) network feature.

Following is a technical summary of the HPC capability requirements defined in GR-2931[1] issue 1, July 1996:

- Call should be flagged HPC if the called party number matches one of a maximum of 5 predefined patterns (originating from a line or a trunk).
- SS7 calls should be flagged HPC if the CPC parameter of the incoming IAM is set to NS/EP (11100010) as defined in T1.631.
- Outgoing SS7 HPC call should set the IAM priority to '1' otherwise the priority should be set to '0'.
- Outgoing SS7 HPC call should set the CPC parameter of the outgoing IAM to NS/EP.
- SS7 HPC calls should be exempted of the cancel-to control option of Automatic Congestion Control (ACC) as defined in section 3.1.4.12 of GR-317
- AIN HPC calls should bypass all Automatic Call Gap (SCP overload control) except when GapInterval = stopAllCalls
- HPC calls terminating on a busy trunk group should be put in a FIFO queue for a predefined amount of time to seize the next available trunk member.[2]
- HPC calls that queued for the predefined amount of time overflow to the next trunk group in the list.
- HPC calls should be exempted from the following Network Traffic Management (NTM) controls:
    - Manual code control
    - Manual cancel-to control
    - Automatic Congestion Control (ACC) cancel-to
    - Trunk Reservation (TR) cancel-to
    - Selective Incoming Load Control (SILC)
- HPC calls should be subjected to the following NTM controls:
    - Manual skip control
    - ACC skip control
    - TR skip control
    - Reroute control
    - Cancel-From control
- Measurements of HPC call activity should be done on an office level basis and trunk level basis.

[1] Some capabilities developed are not included in this version of the requirements
[2] Other variant of queuing exists

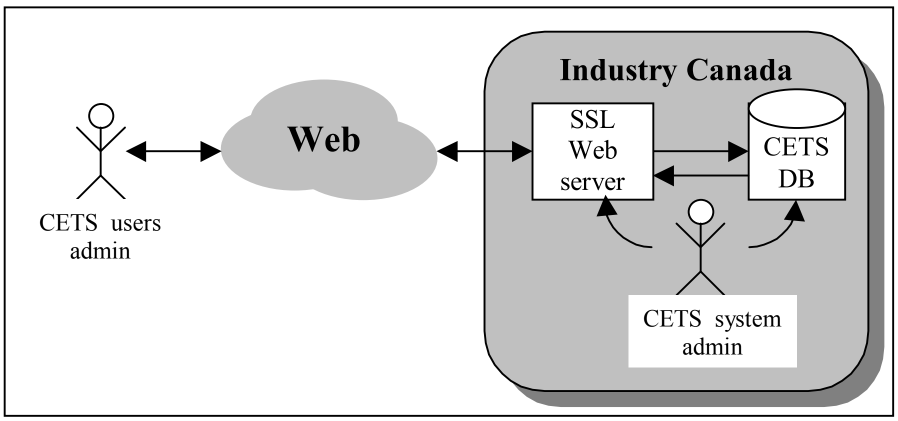
The service would be accessible by dialling a specific 800 number (for example 888-CETS-NET) and the call would get 'Priority Call Set-up' including queuing schemes and exemption from restrictive management controls in the public switched telephone network. The user would then be prompted for a CETS PIN number and a destination number.

As a normal calling card, the owner of the cards (municipalities, provincial or federal governments) would be charged for long distance call.

CETS cards and CETS personal identification numbers (PIN) would be issued directly to emergency personnel (for more information on the process and management, please refer to section 2.2).

2.2 CETS management system

The new CETS management system would be developed, owned and maintained by Industry Canada and would be very similar to the one currently used for PAD. The following figure illustrates the high level components:



Industry Canada would own and manage a database with all CETS users' information such as: e-mails, addresses, phone numbers (with or without *Access privileges*), job type, group names, administrative rights, *Network Privileges*, etc…

An SSL server would give the CETS users administrator a secured web interface to access and modify the database. IC staff would do all system administration tasks internally.

2.2.1 Access Privilege Management

Although this study is mainly aimed at the Network Priority service using HPC, a few comments on PAD were gathered during this study and a few suggestions, applicable to PAD are made in this section.

Establishing number of users

The current PAD system has more than 180 000 lines in its database and it was recommended by many people to review the list of people that are subscribed to this service.

Note that the total number of Access Priority lines has no direct relation to the waiting time to get dial tone because the quality of the *Access Privilege* is related to the percentage of priority line per switch and not to the overall total number. For example, if the total number of Access Priority line is reduced to 30000 but that 15000 of these lines are connected to the same end office, the quality of the Access Privilege service on that switch could be impacted.

The number of users should be revisited mainly because there is some indication that the lists may be outdated.

Because of the nature of the *Access Privilege*, the maximum should be a percentage of lines with priority to dial tone on a switch. For example, no switches should have more than 0.5% of lines with Access Priority (including pay phones).

Assigning the privilege

For each switch, the data needed to calculate the percentage of Priority lines are the number of line with Access Priority and the total number of lines on the switch. Because only carriers have this information, further discussion with them would be needed to determine how this maximum could be managed. Ideally, the data would be given to IC and an automated system could identify which switches have reached capacity and contact, via e-mail, IC and the group administrators impacted. A solution would have to be worked on a per carrier basis.

Service subscription

Adding or removing a user or a line in the database is simply done through the web by the group administrator. The carriers would get the new phone number in its regular update procedure and would assign the appropriate feature to the subscriber’s line.

Maintenance

Maintaining an accurate list of lines with Access Priority is a very challenging task mainly because the service is completely transparent to the user.

For the list of user with the access privileges, each group manager should review the list every 3-6 months. If the number of users in a group is too important, an attempt should be made to split into sub-groups and to delegate the management responsibility.

2.2.2 Network Privilege Management

Establishing number of users

The basis of the Network Privilege services is priority over normal user. Having too many priority users would jeopardize the value of the services and this is why it is critical to fix an overall limit to the number of people having *Network Privilege* (maximum number of CETS card). Three criteria need to be taken into consideration when establishing the maximum number of CETS cards issued:

The first criterion is the number of cards needed by all Canadians involved in emergency situations. A preliminary need analysis was completed for this study and the major concern was the limited number of CETS cards issued. A detailed analysis for each province and for the federal government is required to ensure that the specific needs of each region and organization are fulfilled.

The second criterion is the percentage of the Canadian population having *Network privilege*. This number depends mainly on the usage of the service and should be refined with a detailed need analysis. For example, if four CETS cards were given to each municipalities (mayor, policeman, fireman, medic), you would assume that the primary usage of these cards would be for local emergency and that the chance to have many simultaneous CETS Network call amongst these users would be very small. So even with 18,000 CETS cards (4 * 4500 Canadian municipalities), it should not be a problem because the main usage will be 'local emergency'.

On the other hand, extra care must be taken for the people that are involved in national emergencies because even with a number as low as 1000 CETS cards, if all these people call in the same location within a minute, the quality of the Network service might be impacted.

As a preliminary number, it is considered that no more than 0.1% of Canadians should have access to the *Network Privilege*.

The third criterion is the ratio between the number of CETS cards and GETS cards. There are dependencies between these services and it should be taken into consideration before establishing the numbers of CETS users. For more information, please refer to section 5.1.6.

Finally, there is a relation between the number of CETS cards submitted and the cost per user. For example, if the service cost $20 millions to develop and there is a maximum of 20,000 users, it translates to $1,000 to have the privilege to get increased call completion in the PSTN. This number could be used to validate the cost/benefit ratio.

Further analysis is required to determine the precise need of the Canadian population and it should be the basis for establishing the number of CETS cards.

Assigning the privilege

Once the maximum number has been determined, the privileges need to be assigned to people. For the purpose of the discussion, we assume that the maximum number of Canadians with the network privilege is fixed to 20,000 (0.064% of the population).

The following table illustrates an example of distribution of CETS cards. The number of CETS cards assigned to federal and provincial organizations is an arbitrary fixed number (based on a further Detailed Need Analysis) and the numbers assigned to municipalities[3] is simply proportional to the population[4]

[3] For the benefit of provincial EMOs, further refinement could be done for every Canadian city

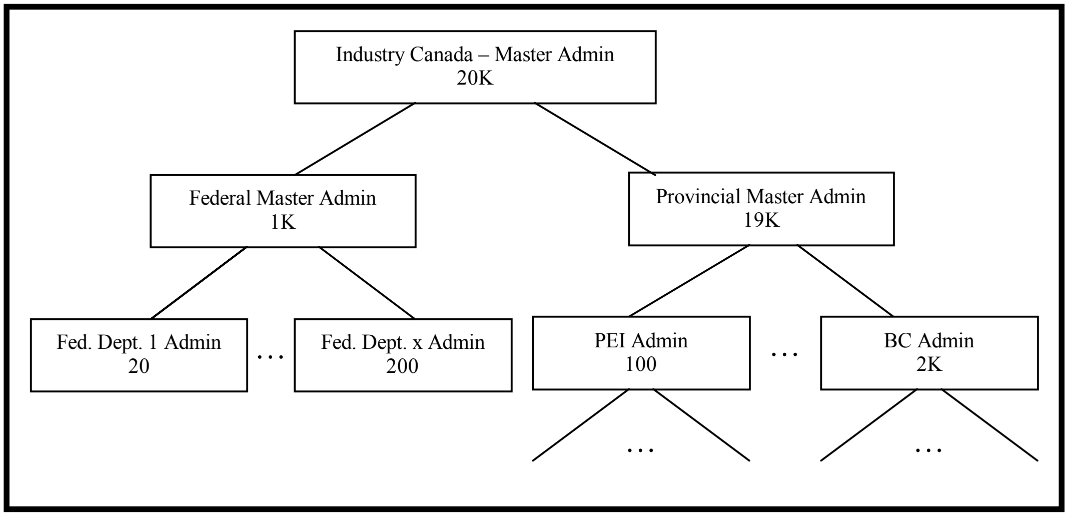
[4] Probable that a minimum per city should be given independently of the population

	Population		CETS Network user		
	#	%	Fix	Prop	Total
Canada	**31,081,900**	**100%**	**1,350**	**18,650**	**20,000**
Govt. Federal			400		400
Newfoundland & Labrador	533,800	1.72%			336
Govt. Provincial			16		
Municipal				320	
Prince Edward Island	138,500	0.45%			93
Govt. Provincial			10		
Municipal				83	
Nova Scotia	942,700	3.03%			594
Govt. Provincial			28		
Municipal				566	
New Brunswick	757,100	2.44%			477
Govt. Provincial			23		
Municipal				454	
Quebec	7,410,500	23.84%			4,672
Govt. Provincial			225		
Municipal				4,447	
Ontario	11,874,400	38.20%			7,478
Govt. Provincial			353		
Municipal				7,125	
Manitoba	1,150,000	3.70%			723
Govt. Provincial			33		
Municipal				690	
Saskatchewan	1,015,800	3.27%			639
Govt. Provincial			29		
Municipal				610	
Alberta	3,064,200	9.86%			1,926
Govt. Provincial			87		
Municipal				1,839	
British Columbia	4,095,900	13.18%			2,574
Govt. Provincial			116		
Municipal				2,458	
Yukon	29,900	0.10%			28
Govt. Provincial			10		
Municipal				18	
Northwest Territories	40,900	0.13%			35
Govt. Provincial			10		
Municipal				25	
Nunavut	28,200	0.09%			27
Govt. Provincial			10		
Municipal				17	

By no means, should these values be final; it is only a simplistic view and does not include other factors like the risk of a disaster, the area of the region, the number of cities in a province, the minimum number of cards, etc. It should only serve as a start and human interpretation is certainly needed (as always) to validate.

The task of assigning the service to specific users would be delegated to a group administrator. The group administrator would have a certain number of CETS cards to assign to members of his group (either sub-dividing to other group administrator or assigning the services directly to users). The group administrator would be responsible for assigning the CETS cards and would be ultimately accountable for the proper use of the service.

The following figure, illustrates an example of the first levels of service distribution assuming there is a maximum of 20,00 users with network priority.

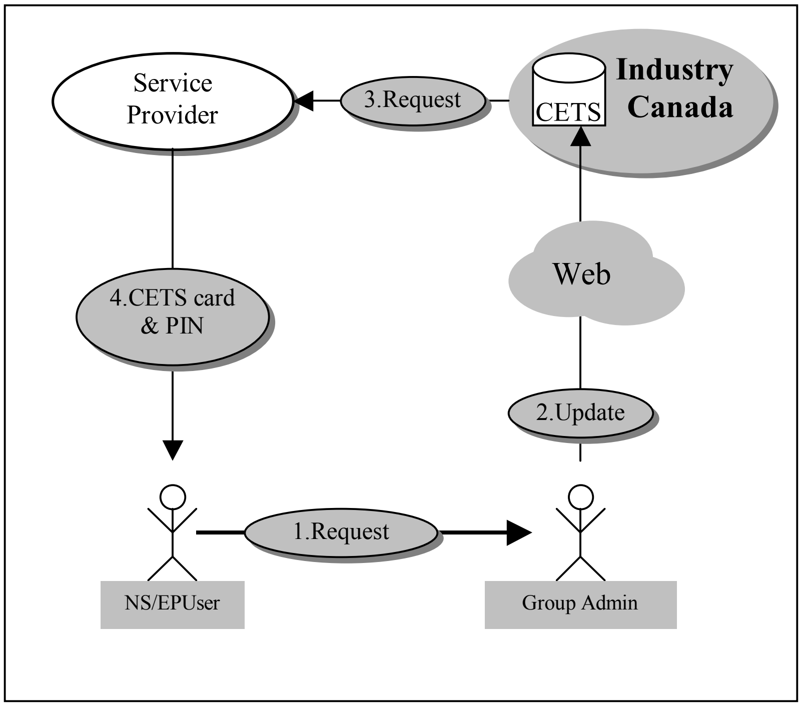


The actual numbers should be established based on a Detailed Need Analysis that should take into consideration the specific need of each agency and province. Also, the analysis should establish criteria, guidelines, and recommendation to help and support the group managers.

Service subscription

When someone wants to get the Network privilege, a request would have to be sent to the group administrator. Assuming the group administrator has not reached its maximum, the requested service could be assigned to the user using the Web interface by updating the Industry Canada database.

Industry Canada would send a CETS card request to the service provider supporting the CETS card system and the service provider would send the new CETS card directly to user. The communication of the PIN would be done as if it was a regular calling card. The next figure illustrates the entire process for issuing a new CETS card.



Maintenance

Constant maintenance is critical to ensure that the system is never out of date. In this section, a list of suggestion is made to define a light but rigorous method to help maintain accurate data in the system. The basic rule is to make every user accountable and most importantly to ensure that all users take the *Network Privilege* seriously.

Each CETS card should be assigned to a physical person and not to a department. When someone changes job or function, the card would be cancelled and another card would be issued to the replacement person if applicable. Although it adds some processing, it reduces the overall maintenance significantly because each user would be responsible of his/her own CETS card and of its usage. Also, group administrators would be responsible for maintaining an accurate list of CETS users in his/her group and ultimately accountable for all users in the group.

For the following three reasons, it is suggested that each user with the *Network Privilege* perform test calls regularly (for example once a month):

- The first reason is to keep the awareness of CETS as high as possible. By using it on a monthly basis, it ensures that the people will be talking about it and will know about CETS.
- The second reason is to ensure that all users understand how to use the service and to ensure that the card and PIN are not simply dropped into a drawer to be forgotten. In times of emergency, it is critical to be able to make calls as quickly as possible and looking for a CETS card or PIN for 30 minutes before making a call defies the purpose of the service.

- The third reason is for ongoing testing of the overall system. It is also recommended that IC organize occasionally, a nationwide synchronized CETS tests. The objectives of these nationwide tests would differ from time to time (i.e. network feature, reports generations, performance of the authentication system) and could involve the participation of some Canadian carriers.

Automated report based on data from Operational Measurements (OMs) given by the Carriers and data from CETS card service provider should be generated on a monthly basis to verify the usage of the *network privilege* and special detailed reports should be generated after every emergency situation and every nationwide test.

To ease management, a series of tools should be developed. As an example, an automated system could send E-mails to CETS Network users who have not performed test calls in a long period to verify if the person is still working in an emergency group (copying the group administrator). Additionally, a note could be added automatically in the database and an automated follow-up e-mail could be sent when the user or the group administrator has performed the appropriate action. It is suggested to put considerable effort to define and specify a system easily manageable with integrated management tools.

Finally, as a possible option, a fixed fee per month or per call could be charged to enforce a certain management of the list. This could have the double effect of making this service more appealing for service providers (some kind of cost sharing) and ensuring that the users of the service really need it.

Security

From a user point of view, the usage of the service in non-emergency situations is very similar to a calling card; the security guidelines are the same as a standard calling card and are known by all.

The only exception could be the multiple/simultaneous usage of the same card but even in that case, it is not suggested to block the call because it could needed in an emergency situation and the impact of blocking could be important. Instead, the owner of the card would be notified automatically by E-mail (not necessarily real time) and would be requested to justify. Based on the reasons, the group administrator would perform the proper action: either assigns additional cards, request more cards for the group, cancel the card, etc…

2.3 Evolution of CETS

With the huge international effort underway to define emergency services with E.106 and F.706, it is envisioned that many new services will be developed and it is suggested that the new CETS system be done to support these future services. Even if it is premature to define a system when specifications are still incomplete, this section lists some flexibility to support the envisioned next generation emergency telecommunication services.

Following are examples of new emergency services that should be available in the future:

- PSTN Access (preference level)
- Wireless Access (preference level)
- Internet Access (preference level)
- National PSTN routing (preference level)

- International PSTN routing (preference level)
- Internet routing (preference level)
- DNS lookup (preference level)
- E-Mail (preference level)
- File transfer (preference level)
- Interactive video (preference level)

For each service, there is a preference level that could be used to distinguish the level of priority between users. Additionally, a list of user category could be define, for example:

- Diplomatic
- Medical support
- Police
- Fire department
- Government
- Emergency network operator
- Army
- Etc…

For each category, a list of services and preference levels could be assigned depending on the typical usage of the emergency personnel in that category. Each user could be assigned to one or more categories and a list of preferential treatment would be associated to that user by default. That is not to say that the management system should be developed to support these future enhancements but simply to mention that it should be designed with these functionalities in mind.

Following carrier's network evolution is critical. For example, some carriers are changing their network for packet switched network and although some vendors already offer HPC on packet switch, more work is required to understand the possibilities and the implications. As a next step, it is recommended to further analyze HPC on Packet Switch in one of the incremental improvements.

Also, new emergency services are being developed for other technology. For example, the US is very aggressively working on priority access for wireless (Wireless Priority Service – WPS), which is very similar to PAD for cell phone. As a first step, Industry Canada has initiated a new study to understand the possibilities for similar service in Canada. Although there could be some benefit in integrating WPS and HPC, these are independent services and should be treated as separate activities.

Finally, various standard bodies are currently defining new emergency telecommunication services and it is important for the Canadian government to participate and understand where the industry is going with respect to ETS.

3 PRELIMINARY NEED ANALYSIS

Once the possibilities of using HPC in Canada were analyzed and understood, it was important to determine if the possible services would be beneficial to the Canadian emergency community. As a first step, a presentation was done to emergency preparedness responsible and to a subset of potential Network Priority users (federal and provincial) and the simple following questions were asked to participant:

- WHO in your agency would use an HPC enhanced C-ETS?
- WHAT is good or not about HPC enhanced C-ETS for you?
- WHEN would HPC enhanced C-ETS be useful for you?
- WHERE would HPC enhanced C-ETS be used?
    - From office /dedicated phone?
    - From residential phone?
    - From everywhere (nowhere in particular)?
- WHY would HPC enhanced C-ETS be or not be good for you?
- HOW would you like to see HPC enhanced C-ETS used or deployed?
    - To specific people?
    - To groups of people?
    - To only a select few in a group?
- $$$$$
    - How should this project be funded?
    - Would you be willing to contribute?
    - Would you be willing to enter a cost-sharing agreement?

Overall 30% of the participants formally answered the survey and the following section summarizes the answers received.

3.1 Summary of answers received

3.1.1 WHO in your agency would use an HPC enhanced CETS?

Most respondents identified key executives and depending on the nature of the work, identified specific departments, person and locations.

3.1.2 WHAT is good or not about HPC enhanced CETS for you?

All but one respondent answered that increasing call completion in the PSTN would be a good thing and some added that it would be an improvement to PAD. The fact that it could be used everywhere and that it was re-using technology developed by US was also identified as a benefit.

The two major drawbacks of the system identified by the participant were the high price (cost versus benefit) and the limited number of users of the system[5].

[5] To respect the Canadian/US ratio, it was presented to participants that 9000 could be the maximum number of Canadian users but based on feedback received from this survey, alternatives were found to decouple the number of CETS users from the number of GETS users. With the current proposed system, there is no more hard restriction for the maximum number of users.

Some other disadvantages were described by a few individual answers such as that the system was depending on telephone network, that it was not available in all Canadian location, that the calling card system was too complex to use, and that in-house coordination was needed to manage the users.

One respondent mentioned that the PSTN was not congested often enough to justify HPC and that private networks could offer sufficient service to fill emergency personnel's needs. Also, they identify wireless as being a more important problem and that money should be invested in a wireless priority service[6] instead.

Finally some answers included a few suggestions for improvements, namely the addition of a wireless priority, the possibility of user level priority and the possibility of pre-empting calls.

3.1.3 WHEN would HPC enhanced CETS be useful for you?

Overall, the answers did not favour one type of emergency situation from another. It was evenly distributed amongst local, regional, national and international emergency situations.

3.1.4 WHERE would HPC enhanced CETS be used?

In all the answers, it was desirable to be able to use the service from no pre-specified location and some answers mention that the service would be invoked from predefined location as well (home, specific location, office).

No answers specified the proportion of time from where the service would be invoked but according to answers given, it is considered that the ubiquity of the service would be a benefit.

3.1.5 WHY would HPC enhanced CETS be or not be good for you?

The reasons for which HPC would be used were various and following are a sample of what was given in answers:

- Be useful during any emergency
- Increase efficient during crisis management
- Help to provide support more adequately
- Improve information sharing
- Enhanced response effectiveness
- Ensure that internal and external communication get through.

3.1.6 HOW would you like to see HPC enhanced CETS used or deployed?

All respondents mentioned that HPC capability would be given to specific people but some also desired the capability of assigning HPC capability to groups of people.

[6] Another study on wireless priority service was done by Industry Canada and it concluded that, to offer end-to-end WPS as defined by WPS FOC Industry Requirements, HPC in the PSTN is required.

3.1.7 $$$$$

All but one respondent answered that no funds were available and the majority thought that it should be a federal government funded program. More specifically, several respondents mentioned that the infrastructure should be paid by the Canadian government, in which case they were willing to pay for using the service.

Alternatively, individual answers suggested that the cost should be shared between private industry and different level of government, or that the program should funded in part or in whole by each level of government who adheres to the system and lastly one mention that the program should be paid by all rate payers.

4 IMPACTS

This section describes the impact of the selected system. First, it describes the impact on Industry Canada mainly about the time and cost estimate, and then it describes the impact on the carriers, the vendors, the calling card service provider and finally the government (provincial and federal).

4.1 Industry Canada

The funding source is still unknown at this time. To compute the cost estimate, a lot of technical and pricing information was requested to vendors and most Canadian carriers but at the time this report was produced (2003/01/21), there were still answers missing from Carriers.

The overall cost estimate for the service on the PSTN was produced by taking the total number of switches of each type in the Canadian network given by the vendors, refined with carrier specific information and taking into account all other input provided. When information was missing, the estimate was completed by taking prices given by other carriers, by converting the cost on a per switch basis and by assuming the same price range for carriers that did not provide the information. Note that all prices were significantly increased (50%-100%) to cover for uncertainties and unknowns.

Because of the sensitive nature of costing, no detailed information is given in this report. Some of the companies that provided input for the cost estimate were very concerned about the possible interpretation and the potential information revealed in this report and imposed strict conditions before giving the requested information.

Following is the list of items that were considered to establish the price estimate of the suggested system:

- Project management
- System Integration
- HPC Right-To-Use (RTU) on all Canadian GTD-5, 5ESS and DMS
- Integration and interoperability testing
- Validation office testing
- Documentation and Training (Carrier, User, Administrator)
- HPC feature activation and provisioning on all Canadian switches
- OM collection
- CETS user management system specification, development, equipment and testing
- CETS card system management
- System for report generation (based on OMs and on calling card data)

It has been estimated that the first phase of the project could be completed within two years and would cost between: $15 millions and $25 millions covering between 50% and 80% of the Canadian population.

The ranges are present not only to cover for the uncertainty of the estimate but also to take into account that, before any formal agreements, it is not guaranteed that all vendors and all carriers would be included in the first phase of the project.

Additionally, it has been estimated that $1.5 to $3 million dollars should be invested every year for the incremental improvement for three years. Because of the changes in the industry and in the technology, it is recommended to review the program every 5 years. The yearly maintenance costs of the suggested system should be between $25,000 and $100,000.

As stated previously, the new management system will be hosted, owned and maintained by Industry Canada and some effort will be required for the system transition and for the training but it is expected that the maintenance will require little extra effort from what is already in place for PAD.

Finally, some legal procedure or agreement should probably be considered by the Canadian government to ensure that the HPC feature be reserved for emergency purposes and prevent carriers from offering the service directly to the population without any control.

4.2 Carriers

Because the suggested system is based on the PSTN, it is completely dependent on the Canadian carriers and their participation is required for the deployment of the system. This section describes some high level tasks needed for the deployment and the maintenance of the system.

4.2.1 Internal Testing

Although the level of testing might differ from one carrier to another, internal testing is very often needed before activating a feature on a network. Depending on the carrier, it might encompass lab testing, interoperability testing, system testing, validation office testing and other various procedural testing.

4.2.2 HPC provisioning

The HPC provisioning is the manual operation needed on each switch to 'define' the HPC functionality. There are three operations needed:

- Priority of the IAM message: an HPC specific office parameter needs to be provisioned to set the IAM of HPC call to 1 and another existing office parameter might need to be modified to set the IAM of POTS call to 0 (please refer to section 4.2.4).
- HPC pattern: a simple operation is needed to set a single number (i.e. 888-CETS-NET) to have the HPC pattern (operation varies depends on switch vendors).
- Trunk Queuing: queuing information (maximum queuing time with no announcement) needs to be added on every trunk where queuing is required.

Optionally, the T^{IAM} timeout value might need to be modified through an office wide parameter (please refer to section 4.2.4).

4.2.3 Translation

Translation is the action performed by the switch to convert the digit dialled to a specific route into the PSTN network. Using a standard 800 number instead of a new NPA (i.e. 710) reduces or even eliminates the translation work.

4.2.4 Interconnectivity

There are three interconnectivity issues that are discussed in this section.

The first is the reception of an IAM message with the CPC set to NS/EP (11100010 - which is how an HPC call is identified) by a non-HPC capable switch. This is not a problem because 'unknown' CPC value is already supported and, in some ways, it is already tested when GETS calls are made in Canada because the CPC value is never reset.

The second is the T^{IAM} timeout value. When an IAM message is sent from the originating switch, a timer is started to ensure that if a message is lost (IAM or ACM), the call will be terminated automatically. Because the HPC call can be queued in the network, the time of setting up an HPC call can be increased. It is recommended to increase the T^{IAM} timeout value to a greater value (i.e. 60 seconds).

The third is the setting of the IAM priority. IAM of HPC call is set to 1 to increase the probability of setting up an HPC call but at the condition that the priority of the IAM of normal call is set to 0 (as defined in the standard). Verification will have to be done to determine to which values the Canadian carriers are setting the IAM priority of their normal calls.

4.2.5 Network Management

Because the HPC call bypasses the network management control, the CETS users would have more chances of completing their calls in a strictly managed network. Although queuing is a functionality to increase call completion in an unmanaged network, there are some cases where queuing will not be activated. The higher the percentage of normal calls blocked at the entrance of the network, the higher the chances of completing an HPC call.

4.2.6 Maintenance

The only expected ongoing maintenance for carriers is the distribution of the OM to Industry Canada for analysis.

4.3 Vendors

Vendors were extremely cooperative and gave a lot of extremely useful information for the study but because there is no development required for the first phase of the study, the impact on the vendors is minimal. The only implication is the writing of the contract for Right To Use of the Basic HPC functionality. Ideally, for both parties, the RTU would be nationwide because there could be some cost saving and some simplification in the process.

4.4 Calling card service provider

Specific CETS card would be needed to distinguish from regular calling card. The card should have a logo identifying it as a CETS card and, optionally, for the benefit of the calling card service provider, a logo of the company could be seen as well.

There is most probably a custom definition of the relationship that will need to be defined between the calling card service provider and IC for issuing the CETS card and for providing detailed reporting information.

4.5 Government

For the deployment of the new ETS system, some effort would be required by the government (both provincial and federal) to promote the service and to offer proper training.

In the suggested system, the CETS card management responsibility has been distributed to the user of the system. It has the main advantage of giving the control to the agency and the provinces to ensure that the cards are given to the appropriate personnel but it has the disadvantage of requiring certain effort for the management of the cards. A set of tools and guidelines should be given to ease the management.

5 RATIONALE FOR RECOMMENDATIONS

A lot of criteria were taking into account to come up with the recommended system and a lot of options were considered to refine the recommendation. One of the most important factors was the cost effectiveness and it had an influence on most decisions. The second most important factor was the possibility of an early deployment and incremental improvements, which ease the adaptability of the system. Finally, the other factors that are more related to a system based on the PSTN are the availability of the service, the ubiquity of the service and the minimal equipment owned by government.

5.1 Alternate system

Another system was analyzed in detail (including cost and time estimate) and was presented in the need analysis. The alternate system was based on a new line feature to enable all calls from a pre-specified line to be HPC. That option follows the same model as the PAD system and was completely transparent for the user. On one side, transparency is good because no extra steps are needed to make an HPC call but on the other side, transparency can lead the user to forget about the service.

On the functionality side, the disadvantage of this option is that HPC would only be usable on pre-specified location and it would not allow mobility. But the decisive factor for not selecting this solution was the cost. Not so much the cost to develop the new feature but the cost to upgrade all the switches to be able to get the new functionality. It was roughly estimated that $80 million would be needed just to upgrade the network

Also, the time required to deploy this system would be considerably longer than the selected system because the feature would have to be specified by IC, custom developed by vendors and deployed by Carriers. It has been estimated that 4 years would be required to complete (it took roughly 5 years for the US to complete a similar process).

Overall, it was estimated that this solution would cost between $100 millions and $200 millions.

5.1.1 Activation of HPC in the network

The complete set of HPC functionality was done in multiple releases. In the first release, available around 1999, the functionality described in GR-2931 was completed and about two years later, the HPC egress queuing was done to ease provisioning.

The cost of upgrading the switches to use the latest HPC functionality has been estimated to $40 millions. It is obvious that getting the latest version of the HPC software would be beneficial but it certainly does not justify the cost.

It has been estimated that more than 95% of the Canadian telephone network has a software release that has the basic HPC functionality defined in GR-2931 and, as a first phase, the basic HPC functionality brings sufficient value to be activated as is.

5.1.2 Access number

As for GETS, a separate NPA like the 710 could be opened in the Canadian network to have a specific access number (something like 610-CETS-NET).

Opening a new NPA is not only a carrier issue but it involves modification of all telecommunication equipment doing some digit processing before accessing the PSTN (like PBX, public phone, etc) and, because of that, a complete nation wide coverage would require, even with a new NPA, the use of an additional 800 number in the interim. Having two numbers to access the same service would most probably create confusion among the CETS user.

For GETS, the ‘710’ number triggers the Alternate Carrier Routing functionality (ACR) using Advanced Intelligent Network (AIN) and this capability is not available for CETS.

Apart from the ‘marketing’ side of having a dedicated NPA for CETS, there is another slight advantage of using a separate NPA but the explanation cannot be given in this report because of confidentiality.

It is considered that the effort required to have new NPA accessible by all Canadian phones does not justify the benefit of a separate NPA.

The addition of the new NPA could be done in a later phase.

5.1.3 Calling Card System

To ease management and to simplify deployment, a standard calling card system is suggested. It would be one offer by an existing service provider and, as a normal calling card; the owner of the card (municipalities and department of the provincial and federal governments) would receive and pay the long distance bill. As with regular calling cards, the service provider would do the management of the PIN number.

Although the ideal authentication system of CETS has additional requirements compared to a standard calling card system, the cost for a custom authentication system is considered too high for the early deployment. It has been estimated that an additional $10-$30 million dollars would be required to develop a system that would meet specific CETS needs not counting extra maintenance costs.

Also, specific operator service could be created for the CETS users but the benefit does not justify the effort in training and the cost of such a service.

5.1.4 Announcement

As an option, an announcement can be played when the call is put into a queue waiting for a trunk member to be available. The purpose of the announcement is to give feedback to the user but the chances to queue long enough to hear the full announcement is very low and for that reason, it is not recommended to provision an announcement in the first phase of the project.

Although the chances of being queued for a long time is very small, it is recommended to inform the *Network Privilege* users that the set-up time of an HPC call can be higher than a normal call.

In the next sub-section, we present a theoretical model to evaluate the estimated waiting time of an HPC call.

5.1.4.1 A little theory on queuing

Using the queuing theory, the following identifies the variables:

λ_{normal} Mean arrival rate of normal call (Poisson distribution)
λ_{HPC}: Mean arrival rate of HPC call (Poisson distribution)
$1/\mu_{call}$: Average time of a call (exponential distribution)
m: Number of trunk members
n: Number of active call

Taking the **M/M/m** model, we know that the service rate of a trunk is:

μ_{trunk} $n\mu_{call}$ (n=0, 1, 2, … m)
$m\mu_{call}$ (n = m+1, m+2, …)

In time of congestion, we know that λ_{normal} will be very high (certainly higher then $m\mu_{call}$ meaning that the trunk will be full) making the service rate of a trunk to be at its maximum: $m\mu_{call}$

Because the number of HPC calls is expected to be very low (very small λ_{HPC}), the chances to have multiple HPC calls queuing on the same trunk is very small. The implication is that as soon as an HPC call is queued, it is going to seize the next available trunk member that will be available, on average, at the service rate of the trunk.

For example, if the average time of a telephone call is 5 minutes (300 seconds) and there are 128 trunk members on a trunk group, on average the HPC call will be queued for 2.3 seconds. (Average time of a call / Number of trunk members)

The following table illustrates other calculated queuing time:

Average call duration (mn)	Size of trunks (members)	Average queuing time (secs)
5	24	12.5
5	96	3.125
10	240	2.5
10	1200	0.5

Important note: it is critical that the HPC feature is reserved to a very limited number of people and Industry Canada should have the "exclusivity" of this feature.

5.1.5 Incremental improvement

The suggested system does not cover the entire Canadian telephone network and it is possible that some calls might not benefit the entire set of HPC functionalities from beginning to end. The specific limitations cannot be discussed in this report because of the sensitive nature of the information but incremental improvements could be done over the years to remove these limitations and to increase the coverage of the HPC feature in the Canadian network.

5.1.6 Joining GETS

It would have been technically possible to join the GETS program. The idea would have been to activate HPC, to open 710 in the Canadian network and to use the GETS authentication system. This solution was not considered viable for many reasons:

<u>Cost Saving</u>: No cost saving advantages because the bulk of the price of the suggested system is to activate HPC in the Canadian network and it is required even if we join GETS.

Billing: US are paying all long distance charges for GETS calls and using the same system for Canada would, most probably, require software changes in the US system to split GETS and CETS call. Alternatively, a political agreement could simplify the billing but it would still require that the Canadian government pay the long distance charges, which is not recommended.

Authentication: All CETS calls would need to access the GETS authentication system located in US and owned by US IXCs. This would increase considerably the resources needed to complete a CETS call and decrease at the same time the probability of completing it.

Maintenance and management: The maintenance and the management of the GETS system is done by two US consulting firms: SAIC and Dyncorp. Adding Canadian ETS to GETS would certainly require extra charge by these consulting firms.

Privacy: US government would have access to all call records of Canadian ETS users and it could be an issue for some agencies.

Politics: Using the same system as the one used in the US would make Canada completely dependant on the US for its emergency telecommunication service and although US and Canadian telecommunication network are currently similar, nobody knows what will happen in the future.

5.1.7 CETS and GETS interworking

In the suggested system, the flag that carries the HPC identity in the Canadian network is the same as in the US network. That means that a GETS call made in Canada will be treated as a CETS Network call and vice-versa.

In other words, it would be a North American wide emergency telecommunication service. The main advantages is that in time of crisis where international help is needed, emergency groups from Canada and US would benefit from the inter-working of both National emergency telecommunication services.

On the other end, because there is no mechanism to distinguish GETS call and CETS call in a given network, an agreement between Canadian government and US government might be needed to ensure that the ‘transparency’ is acceptable. For example, both countries might want to agree to keep the number of ETS users (CETS and GETS) below a certain percentage of the population to ensure that the ETS users of the neighbour country do not flood the national network preventing local ETS users from completing calls. The following table illustrates the calculation of the number of CETS users based on the US ratio of GETS users.

	Population		HPC	
	#	%	#	%
United States	280,073,071	90.01%	90,000	0.032%
Canada	31,081,900	9.99%	9,988	0.032%

If the views of each country differ for the usage of HPC, it is possible to modify the software in the US/Canadian border switches to reset the identity of the HPC call to Normal call or alternatively, the authentication mechanism could prevent long distance calls made in the US.

In the future, additional functionality could be added to distinguish National ETS users from International ETS users (national ETS user would be allowed to make HPC calls only within the country).

6 CONCLUSION

International Telecommunication Union (ITU) invites all member nations to apply measure to their national emergency telecommunication service to offer three essential network features on the normal telecommunication system to a list of authorized users.

The current Canadian emergency telecommunication service named Priority Access Dialling (PAD) offers the first essential feature to authorized users:

- **Priority to dial tone**

High Probability of Completion (HPC) offers the two other essential network features to authorized users of the American Emergency Telecommunication Service called GETS:

- **Priority call set-up, including priority queuing schemes**
- **Exemption from restrictive network management**

The addition of HPC into the current Canadian Emergency Telecommunication Service would make Canada one of the first nation to offer all the ITU recommended network features on the public switched telephone network to emergency preparedness personnel nationwide.

The Canadian and the American telephone networks are very similar and a large portion of both networks uses the same switching equipment. The advantage is that the HPC technology that was developed for GETS is available now in most Canadian telephone switches and can be activated as is.

Knowing that the technology and telecommunication network are evolving constantly, the appropriate way to include a new nationwide service is a phased approach. On one end, attempting to offer the ideal ubiquitous service in a single step would be extremely costly (over $150 million) and would most probably be out of date within 5 years and on the other end, waiting for a uniform technology to stabilize before creating a new service is not recommended, as it will most probably never happen.

The cost of an early implementation of the system very similar to GETS, including a limited activation of HPC in the Canadian network and the modification of the current Canadian system to support HPC is estimated between $15 million and $25 million and would cover between 50% and 80% of the Canadian population.

A phased approach is recommended and significant effort should be put upfront to define a system that will support the ongoing evolution of emergency services (like Wireless Priority Service).

Additionally, to ensure that the Canadian ETS provides the desired functionality over time, it is suggested to continuously follow the evolution of the Canadian telecommunication network and to contribute to the development of standards for new emergency services in the industry.

Based on feedback from federal and provincial governments, the Industry Canada initiative to improve the current ETS with HPC was appreciated by all and the new functionality was considered very useful and most welcome.

7 ANNEXE

7.1 Acronyms and Abbreviations

CCPC:	Civil Communication Planning Committee
CCSF:	Canadian Carrier Service Forum
CDC:	Conference on Disaster Communications (CDC-2001)
CEPTAG:	United State/Canada Civil Emergency Planning Telecommunications Advisory Group
CISC:	CRTC Interconnection Steering Committee
CPC:	Calling Party Category (parameter in the IAM message)
CRTC:	Canadian Radio-television and Telecommunications Commission
DETO:	District Emergency Telecommunication Officer
EAPC:	Euro-Atlantic Partnership Council
EMO:	Emergency Measure Organization
ETS:	Emergency Telecommunication Service
ETSI:	European Telecommunication Standards Institute
FEMA:	Federal Emergency Management Agency
GDIN:	Global Disaster International Network
GETS:	Government Emergency Telecommunication System
HPC:	High Probability of Completion
IAM:	Initial Address Message (ISUP message for call set-up)
IEPREP:	Internet Emergency Preparedness
IEPS:	International Emergency Preference Scheme
IETF:	Internet Engineering Task Force
ISDN:	Integrated Services Digital Network
ISUP:	ISDN User Part of SS7
ITU:	International Telecommunication Union
ITS:	Institute for Telecommunication Science
MPLS:	Multiprotocol Label Switching
NATO:	North Atlantic Treaty Organization
NCS:	National Communication System
NECA:	National Exchange Carrier Association
NETF:	National Emergency Telecommunication Forum
NGN:	Next Generation Network
NS/EP	National Security and Emergency Preparedness
NS/EPC:	National Security and Emergency Preparedness Communications
NIIF:	Network Interconnection Interoperability Forum
NNOC:	National Network Operations Center
OCHA:	Office for the Coordination of Humanitarian Affairs
OCIPEP:	Office of Critical Infrastructure Protection and Emergency Preparedness
OCN:	Operating Company Number
PAD:	Priority Access Dialing
PIN:	Personal Identification Number
PLMN:	Public Land Mobile Network

POTS:	Plain Old Telephone Service
PNOC:	Provincial Network Operations Center
PSTN:	Public Switched Telephone Network
RAO:	Revenue Accounting Office
RETO:	Regional Emergency Telecommunication Officer
TIA:	Telecom Industry Association
WGET:	Working Group on Emergency Telecommunications
WTSC:	World Telecommunication Standardization Conference

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7.2 Internet links

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