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DISSEMINATION LEVEL		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

CONTENTS

1 INTRODUCTION

1.1 PROJECT SCOPE

The CHORIST project will propose solutions to increase rapidity and effectiveness of interventions following natural hazards and industrial accidents, in order to enhance citizens' safety and communications between rescue actors.

1.2 PURPOSE OF THE DOCUMENT

This document aims at providing the results of the assessment on the perspectives of the project. It starts from a list of projects results as identified by the CHORIST Consortium. It is then followed by a set of recommendations and guidelines for the future, so that follow-up activities can be planned.

This document is released at the end of the project.

The release at the end of year 1 is the SP0.D6.

The release at the end of year 2 is the SP0.D19.

The release at the end of year 3 is the SP0.D29.

1.3 DOCUMENT VERSIONS SHEET

Version	Date	Description, modifications, authors
1.0	03/07/09	First released base on second year assessment (SP0.D19) Additions: - Several recommendations added by ESNFR after the field trials and the assessment by end-users of the prototypes. - Input added by O2M - Corrections by AVAN
1.1	21/10/09	- Comment about the recommendations reworded to explain better that they deal with future projects rather than with failures in the project. - Recommendations (section 4) expanded

Table 1 : Document versions sheet

2 REFERENCE DOCUMENTS

2.1 REFERENCE DOCUMENTS

[1] CHORIST Description of Work

2.2 DEFINITION

None

2.3 ABBREVIATION

3GPP	3rd Generation Partnership Project
ADSL	Asymmetric Digital Subscriber Line
AVAN	Avanti Communications Ltd
BAPCO	British Association of Public-Safety Communications Officers Limited
CAP	Common Alerting Protocol
DAB	Digital Audio Broadcasting
DVB	Digital Video Broadcasting
EDATA	Elsag Datamat S.p.A
EDS	EADS Defence and Security Systems
EENA	European Emergency Number Association
ERAW	Environmental Risk Awareness
ESNFI	EADS Secure Networks Oy
ESNFR	EADS Secure Networks
EURE	Institut Eurecom
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
JRC	European Commission Directorate General Joint Research Centre
KOMC	Komcentra s.r.o.
LTE	Long Term Evolution
MAC	Media Access Control
MBMS	Multimedia Broadcast Multicast Service
MHP	Multimedia Home Platform
O2M	one2many B.V.
PHY	Physical layer
PMR	Professional Mobile Radio
SPMM	Stichting Platform Mobile Messages
THC	Thales Communications SA

TKK	Teknillinen Korkeakoulu
TRAD	Tradia Telecom SA
TUD	Technische Universiteit Delft
TV	Television
UMTS	Universal Mobile Telecommunications System
VODA	Vodafone España SA
XML	Extended Markup Language

3 PROJECT RESULTS

The section lists all the results of the project as identified by the CHORIST consortium.

Category		Expected results within project timeframe	Contractor
Industrial products	Risk assessment report systems (SP2)	Multi-risk and interoperable early warning system	EDATA / AVAN
		Scenario-based simulator of events for training systems	JRC
	Communication to the citizen system (SP3)	Integrated system to warn the general public over various means that complement one another to increase the reach and impact of the warning. This system allows the authorities to warn population with no need of the press.	VODA / TRAD / SPMM / KOMC / O2M /
		DVB (alert messages with MHP application) and DAB solution	TRAD
		Investigate and develop a CAP based Message Creation & Dispatching Alert system	SPMM
	Emergency communication systems on crisis site (SP4)	PMR application for rapidly deployable ad-hoc broadband networks	ESNFR
		Advanced routing protocols integrating quality of services and built-in optimizations for group communications over mobile ad hoc networks	THC / EURE / TKK
Knowledge	Intellectual property rights	*None*	
	Fields of research	Voice application protocols in mobile ad-hoc networks	ESNFR
		Use of XML protocols to carry warnings and sensor data	ESNFR
		Applicability of Service Oriented Architectures to multi-risk early warning systems	EDATA
		Study on the use of MBMS in a public warning environment	VODA / O2M
		Advanced routing protocols integrating quality of services and built-in optimizations for group communications over mobile ad hoc networks	THC
		Enhancement of MAC/PHY mechanisms/features to support quality of services	THC
	Standards	Propose interoperability solutions for mobile ad-hoc networks	ESNFR
		Propose inputs to the CEN/WG202 Task Force 9 for the use of satellites in Communication to the citizen systems	ESNFR
Relationship	with users	Set of user requirements collected from documents	TKK / ESNFR
		Control centre visits arranged to assist industry understand processes and requirements, supplemented by visit reports to record findings Integration of the 112 call centres procedures in the ERAW system	BAPCO / AVAN / EDATA / EENA
		Stimulated consciousness of the importance of emergency communication in citizens' community	EENA
		Identification of small number of 'key' users to assist in formulation of initial high level user requirements, and of providing feedbacks to industr & research partners of CHORIST.	BAPCO
Other		Study of emergency scenarios, natural hazards and industrial accidents, emergency plans organization in Catalonia and Murcia.	TRAD
		Favoured the acknowledgement by the industrial community, represented in the consortium, of citizens' issues, in particular of the importance of the improvement of the 112 within Europe	EENA
		Highlighted the importance of a valid education and training to the population on the correct behaviour in case of emergency, in order to make the warning system more effective	EENA

Table 2 : Project results

4 RECOMMENDATIONS AND GUIDELINES

In this section are provided recommendations and guidelines for the future. It proposes a set of research topics and actions to be carried out in the frame of the early warning; it also gives a set of experiences learned by the Consortium which is thought to be important to take note of to carry industrial or research projects and studies in the domain of the early warning and emergency services.

These recommendations are considered as hints and guidelines for the future, and shall not be considered as elements which should have been studied in the CHORIST project which failed to be: These are ideas provided by the CHORIST Consortium for future projects only.

Category		**Recommendations and guidelines for the future**
Industrial products	Risk awareness and systems assessment report (MODULE 1)	Develop models for the forecast of the situation: These models should be able to run in real time and to deliver situation forecast so that decision making is possible. Also: Consider multi-events models (chemical cloud + wind) *Models of natural hazards as well as industrial disasters exist today, but they are complex as they take many input parameters and as they simulate all the details of the event. Morever, they often use huge computers such as the ones used for weather forecasts. In systems which allow authorities to take decisions in the minutes following an event, it would be worth considering to develop simplified models that would provide rough results in the minutes after an event is detected; they would work on "standard" PCs for instance. These models could then run longer to provide more accurate results, or they could be even supplanted by other more complex models to predict details of the forecasts.* *Depending on the area which is monitored, some events may occur simultaneously: For instance, a chemical gas leak in an industrial zone during strong winds conditions. The simulation models should be able to predict the evolution of hazards related to multi event occurrence as well as their impact on the population.*
		Develop interfaces to existing raw sensor networks, environment and industrial monitoring agencies and 112 call centres to retrieve data workable by simulation models. *Many agencies which already monitor events and predict forecasts exist around the world (e.g. weather monitoring agencies). These agencies provide the results of their activities on Web site for instance in a way which is readable by human beings. For instance, weather monitoring agencies provide maps showing the predicted wind speeds and direction, other maps with predicted temperatures and so on. The problem is that simulation models work on data and not on maps: Concerning winds, they rather need a 3D matrix of wind vectors (direction, amplitude) to perform calculations. Interfaces to the agencies monitoring events and providing forecast data shall be developed.*
		Consider voice phone calls (from population, from mayors, from civil protection) as the carrier for information. *Most of the information is not received by the authorities by means of forms or measured data flows by sensors, but by phone calls: These calls either come from the population or from bodies dedicated to the surveillance of natural or industrial areas (forests, chemical plants…). So, an operator of an civil protection center shall be able to feed the system with the information received from the call: The system shall be versatile enough to take as much information from the caller as possible. Moreover, a software processing the incoming information shall consider that the information is not necessarily accurate and authentic: The simulation models shall also consider these fuzzy inputs.*
		Develop a structured presentation of the input events with the least manual operations possible (classification by location, type of event…). *During field tests, civil protection operators asked that a new system should help them dealing with repetitive tasks. One of them concerns the processing of the massive information coming from sensors, especially when no event is detected: The MODULE 1 shows the raw information in a single list mixing all data. The system should present*

		the operator with a synthetic and hierarchical view of the raw incoming data, highlighting only troubles. Presenting the information through maps dedicated to one risk with green/orange/red dots seems to be welcomed by end users.
		Develop different kinds of Common Operational Picture (COP): static / animated, synthetic / detailed, for authorities / for the population. *The COP is used by the operators to visualise events and their consequences on the population. It is used to detect if further action needs to be taken or not, and if so, who to escalate to.* *It is also used by decision makers to decide what to do in the police and firebrigades field teams deployment, and how/when/where to warn and inform the population: As a lot of information is presented on the COP and as it presents also forecast, several views, different subviews should be created.* *Finally, the COP is used to inform the population. The information provided to the population consists of a simplified view of what is presented to the civil protection people (not all details on the event, no/little information provided on the field teams locations).*
	Communication to the citizen system (MODULE 2)	Develop a set of predefined text messages for public warning *When the decision to warn the population has been taken, the authorities have little time to decide about the content of the messages. Studies and end-users recommendations show that templates would help to create warning messages in very little time. This would simplify the structuration of the message and the wording: Wording is essential when dealing with multiligualism (as operators do not have the same skills), but mostly to trigger the right behaviour of the population.*
		Governments should involve all TV and radio broadcasters in CHORIST solution to coordinate the alert broadcast in all their transmission networks. *The technical solutions proposed in CHORIST have been created by industrial partners. However, these solutions have to be in line with actual TV and radio networks in terms of technology, costs and operational constraints. As such, authorities shall agree with broadcasters (public and private) to set up reliable and economic warning channels.*
		Information provided through all means shall be coordinated with the warning messages sent through Warning system. *Warning messages are short and usually ask -among other things- to redirect to other communications means to get more information (such as a national TV channel, or an internet web site). As the warning message has to be sent in a few minutes to the population once an event is detected, the same timing constraint applies to the sending of well-developed information to these national broadcasters and web site. So, the design of a short warning message to the population shall be made in parallel to the design of a information bulletin.*
	Emergency communication systems on crisis site (MODULE 3)	Develop autonomous and robust mobile ad-hoc equipments with full features (voice+video+data) for their unrestricted use by on-field users *The ad-hoc equipments used during the CHORIST field tests were based on laptop PCs; several ones were used at each node because of technical constraints. However, end -users want standalone, autonomous, small and low-consumption devices. The activities on telecommunication aspects have to be done in parallel to the design of hardware devices that suit field teams needs: The only way to convince end-users of the usefulness of new technologies is that their use do not burden them more than it helps them.*
		Develop field user applications that consider both the requirements from the users as well as the constraints (limitations) of the telecommunication equipment. *The technical activities carried out on the MODULE 3 focused on the telecommunications, i.e. on the transmission of data information between field teams, from field teams to control room and from control rooms to field teams. However, end users are not interested into transmitting IP packets but rather by the applications that use these networks: In other words, they are in the same position as the population of the early 2000s when told about the technical advantages of the UMTS (bandwidth of xxx Mbps) rather than about the advantages that this technology would bring them in*

		terms of ease of life, better access to information. "Killer applications" have to be developed. *As each technical solution has its own transmission capabilities in terms of bandwidth, range, mobility, number of end users, easiness to change topologies, deployment constraints… these end users applications (cartography, images, videos, access to databases…) have to be adapted to fit with the telecommunications constraints.*
Knowledge	Intellectual property rights	*none*
	Fields of research	Investigate homogeneous data fusion and heterogeneous data correlation algorithms. *The various flows of incoming information to risk awareness and assessment systems are usually of different natures (air temperature, wind vectors, chemical product density…). The processing of this incoming information has to merge the information of similar natures so that the operators are presented consistent raw data. Then, depending on the correlations to be studied (atmospheric events, land hazards…), these data have to be harmonised and then merged to provide added-value information to operators, or data useable by algorithms.* *The data fusion and correlation depend on the characteristics of the inputs (data formats and source) and on the consumers (operator and algorithm), and it has to be done on each use case.*
		Consider the reliability factor of the information received by the ERAW. *The incoming information of an ERAW is not necessarily accurate and authentic: The simulation models shall also consider these fuzzy inputs.*
		Investigate use of multi media messages in public warning *Initiated in the frame of the CHORIST project, multimedia means such as MMS and web sites shall be used to provide warning and information to the population. Though cell broadcast is already standardised, the same has to be performed in the domain of the broadcast of multimedia messages.*
		Develop models of population behaviour to check scenarios for sending warning messages. *Simulation models of natural hazards and industrial accidents allow authorities to understand how a situation is likely to evolve in the coming hours so that they can take decisions on what to do, and what to tell the population. However, depending on the content and on the target area, sending warning messages to the population may have bad impacts (such as civil unrest) or even be counter-productive (like asking people to leave an area, which would stuck them into traffic jams, thus being more vunerable to an event than if they had been asked to stay home). It could be interesting to assist authorities with simulation models of the impacts of warning messages on the population. These "population behaviour" models would be combined with the "natural and industrial hazards" models so that decision making is more accurate.* *These models could also be used during training to decide about the best strategy to adopt when alerting the population.*
		Investigate the transmission of high resolution video through DVB improving the video drip considered in the MHP standard and the possibility of include video with audio embedded.
		Investigate the possibility to send not only audio files but also alert messages to the DAB receptors. *CHORIST studied to replacement of a sound flow of a radio station by a voice warning message. DAB allows the transmission of data, and this could be interesting to study the possibilities and the constraints of sending warning message through that means.*
		Investigate new DVB set top box receivers that could return acknowledgment of the alert message received trough a new return channel (nowadays not available) such as ADSL, UMTS, etc. *Broadcasting networks (TV, radio) are used in one way from the broadcaster to the population. However, authorities may want to get feedback from the population they have alerted. Several technologies could be used for this purpose, but this has to be studied from the technological point of view, but mostly from the operational one.*
		Investigate IPv6 in mobile ad-hoc networks

		The CHORIST prototype was developed with both the IPv4 technology (for the applications) and the IPv6 tecnhology (for the ad-hoc network). This showed to work well and so that dealing with legacy applications was possible. However, a full IPv6 solution that addresses all the requirements and constraints of field rescues teams would be interesting to be studied.
		Investigate mobile IP in mobile ad-hoc networks *The nomadic use of telecommunication devices is both the concern of the general public and of the public safety. Ad-hoc networks provide an interesting way to elaborate evolving networks topologies, providing a kind of wireless backbone for communications to be set up. Moreover, as people move, their point of contact to that evolving backbone may also change over time. As packets have to be reoriented, Mobile IP (in the IETF terminology) is a technology suitable to address this mobility of people on top of the evolution of the backbone topology.* *Studies of Mobile IP in the domain of mobile field rescue teams working in an IP adhoc network made of nodes carried by vehicles and pedestrians is a standalone study which would be interesting to investigate from the theoretical and from the experimental point of view.*
		Investigate self-organized network services/approaches to increase interoperability capabilities and to reduce human intervention in network management operations on the crisis-site telecommunication infrastructure *The CHORIST prototype proposed a static definition of routes between nodes: These nodes have to be configured to address the topology. The operational constraints make it impossible for end-users to configurate nodes each time they set up a system: They want the system to be autonomous. The automatic set up of the network routes is a mandatory feature to be developed for the ad-hoc network technology to be suitable with end users needs. This has to be conducted with security constraints so that malicious users cannot connect to the network.*
		Develop/adapt other applications than voice applications for on field users of mobile ad-hoc networks. Study net-centric application architectures with distributed rather than server-based information. *Voice applications were developed in CHORIST. It was proved that group calls with speaker arbitration can be set up and used on an IP network without any need of a central server. This was based on the fact that the nodes working together share the same information and the same decision algorithms.* *This concept should be expanded to other applications than the voice applications in the same way that peer-to-peer applications run on Internet. This is particularly important because ad-hoc networks are not as reliable as wired backbones, and so applications have to be designed to take into account these constraints.*
		Study security issues in mobile ad-hoc networks *Experimental networks do not focus on security, as was the case in CHORIST. But security is the key issue for the use of ad-hoc networks by public safety people. The network shall prevent external people to use it; it shall prevent the information to be twisted and to be understood by third parties.* *Though solutions to address security are well known between applications (authentication, end to end encryption…), it has to be studied along with the proposal of layer 1, 2 and 3 protocols of the ad-hoc network.*
	Standards	Develop a standard for the Common Operational Picture (COP) and the underlying GIS. *Operators working in a control room are "used to" have different tools provided by different software providers: Typical setup is a tool to monitor weather, a tool to monitor car traffic, a tool to display field teams location… They'd like that a common tool is developed so that all information is shown on the same map.* *Moreover, cooperation between provinces (at country level) and between countries (at international level) would be eased if the information was shared and presented in the same way to operators.*
		Standardise the interface between the Message Channel Dispatcher and the Gateways.

		Some proposals were made by the CHORIST consortium in the definition of the protocols to be set up between the entity where warning messages are created and the gateways at the entrance of the broadcasting networks. To ensure interoperability, and multi-vendor solutions, it is necessary to create standard protocols between this equipments.
		Standardise the content of the warning messages. *The warning messages are useful is correctly understood by the population. So that people react quickly to these messages and do not misinterpret them, it is mandatory that these messages following strict guiding rules concerning their content.* *And because of travellers who should know what to do in case they receive a warning message, these messages shall be standardised over -at least- Europe.*
		Standardise the way the warning messages are presented to the population. *Reactions of people is very dependant of the way the warning messages are presented to the population: Text, mages and sound are likely how the information will be carried. However, each end device can display this information in different ways: This depends on the imagination of the designer of that end device, or simply on the flaws left in documentation. So, in order to have all mobile phone behaving in the same way, all TV sets behaving in the same way… when receiving a warning message, the presentation of that information to end users shall be clearly standardised.*
		Collaborate with the 3GPP and IEEE standardization organizations to include effective mechanisms to disseminate warning messages trough the communication systems of their influence, especially in those with high number of users. *The dissemination of warning messages are add-on features of cellular networks and TV networks. To ease the development of the transmission of these messages, standards have to be created for each potential channel.*
		Specify a (cell) broadcasting capability in LTE *The emerging LTE technology shall be enhanced with cell broadcast feature in the same way GSM and UMTS cell broadcast for public warning have been standardised (3GPP TS 23.041 for UMTS).*
Relationship with users		Develop contingencies for user participation, including preparation of draft requirements that can be assessed and validated by representatives of the user community. *The involvement of end users is of great interest if research is intended to lead to develop tools to be used in a near future by these end users ! However, it is difficult to involve them in a Consortium because it means long-term (several years) partnership, a heavy administrative burden (for a few hours of actual work) and also because the involvement of end-users consist more of people than of a whole organisation. So, CHORIST experimented another way to involve end users in research projets: Two end-user associations were included in the Consortium (BAPCO and EENA) and they attracted a set of end users based on the long-term relations they had developed priorly to the project: These end users only participated to several one or two day sessions to provide feedback on the consortium's proposals.* *However, at the early steps of the project - when these external end users are not yet involved, but also in case questions coming from the consortium address topics which are not of direct concern of these end users (such as the definition of scripts for demonstration scenarios), the support of the end-user associations (member of the Consortium) showed to be of actual interest.*
		Ensure early engagement focuses on the likely benefits and where possible make use of technology demonstrators to illustrate business improvements. The activity of collecting user requirements (starting from a blank page) at the early stage of the project failed. *At the initial steps of the CHORIST project, it was expected to collect lots of user requirements in the domain of the early warning and the emergency telecommunications. However, it did not work because not many users (police, firemen, ambulance) could be approached, and because those approached were not able to spend too much time on that, and because end-users were not understand what they*

		were asked for. To start from a blank page failed. *So, it seemed then more useful to submit solutions (images, explanations, small demos, case-studies…) to end users, and then to get their feedbacks. And this showed to work.*
		Educate and regularly train population. *In order that warning messages be correctly processed by the population, education (though TV adds, brochure, school sessions…) as well as training is necessary. This required time and money from the authorities, but this would help saving lifes.*
Other	Project organisation	Have a more hierarchical organisation of tasks' and deliverables' responsibilities. Focus member"s responsibility over a list of deliverables and concrete results rather than having small and shared responsibility across all projects' work packages. In other words, distribute the work on concrete objectives (-->produce this) rather than on activities (--> work on that). Be objective driven. *WBS as defined in project management best practises lead to create tasks ending with the production of deliverables, and the setup of milestones.* *The actual implementation of the CHORIST research project showed that the description of these tasks was of very little interest of the Consortium: First from the partners point of view because partners knew what to do and did not need what was written in the Description of Work. Second from the point of view of the project coordinator and of the workpackages leaders because distance between partners makes it impossible to judge the progress on other things than deliverables (documents and prototypes). Third because when the subcontracting of a task supposedly well defined in the Description of Work to a third party occurrs, it turns out that this description is only understandable by the (few) writters and so it cannot be used out of the project's context.* *It showed to be efficient to follow the progress of the release of deliverables as well as their actual content.* *The milestones were totally useless because delays and achievements were already tracked through deliverables. Milestones are useful to communicate out of a consortium, but not inside it.*
	Regulations	According to general purpose of the Written Declaration n. 100/2007 adopted by the European Parliament, warning messages to population shall be regulated at European level so that these systems are conjointly deployed and exploited. Political constraints may arise, but they have to be overcome for the benefit of the population.
		Frequencies regulation used in ad-hoc networks shall be agreed at European level, and implemented coherently in equipments. *So that equipments are identical in Europe, so that interoperability is facilitated, so that public safety people rely on their own resources and do not compete with the market, some MHz of spectrum are needed. Requests have been made by industrial partners through the PSCE, and this will be continue by the same group.*

Table 3 : Recommendations and guidelines for the future