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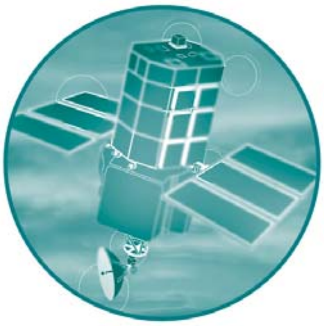
Flood and Coastal Defence R&D Programme



Flood Warning Dissemination Technologies

Technology Comparison report

R&D Project Record – FD2202/PR

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Food and Rural Affairs

Environment Agency

Defra/Environment Agency
Flood and Coastal Defence R&D Programme

Flood Warning Dissemination Technologies – Technology Comparison Report

R&D Project Record FD2202/PR

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Dissemination Status

Internal: Released Internally.
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Statement of use

The principal outputs are presented in the Technical Report and its project record listed below. These provide information on methods currently in use around the world for dissemination of all types of warning including flooding, chemical release and security alerts. Further research into emerging technologies is also included for consideration for future use. Each method has been assessed and ranked against pre-defined criteria for their suitability.

It is recommended that the reports are used in 2 main areas:

- Expanding the warning dissemination and information channels to the Environment Agency's Multi Media Warning Dissemination Service
- Recommendations to the Cabinet Office from the National Steering Committee for Warning and Informing the Public

Keywords – Coastal flooding, Flood forecasting, Flood warning, Sea defences, Flood risk.

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Further copies of this report can be obtained from the Environment Agency's National Customer Contact Centre by emailing enquiries@environment-agency.gov.uk or by telephoning 08708 506506.

EXECUTIVE SUMMARY

Project FD2202, also know as the T15 program has had three previous work packages.

WP1 - Technology Comparison
More than one solution should be sought for flood warning dissemination. This is due to the following reasons:

- No one solution can address all audiences in all situations.
- Redundancy of communication channels gives resilience to the system as a whole.
- People seek confirmation of warnings through multiple reliable sources.

This means that messages may be best propagated through a multi-tier approach. Top tiers can have highly robust broadcast capabilities and lower levels can have unicast (one to one) with finer targeting.

WP2 – Requirements Analysis
Details the Environment Agency's requirements for systems that trial channels used to warn or inform the public and certain organisations in regards to flooding. The MMWDS is used as a reference so that those requirements that pertain to the channels rather than the encompassing management system can be understood.

Three user types of trial messaging systems have been identified: EA system operators dispatching messages, trial message recipients and users of the trial systems findings (i.e. T15 & MMWDS boards and panels).
The requirements of these user types are based around their needs, roles and responsibilities.

The identified alerting service aspects which improvements can be categorised by are: audience coverage, targeting, speed, cost, content, presentation and receipting.

Some concept and state modelling of trial channel systems is also provided.

WP3 – International Perspective
Details the key warning dissemination systems in use around the World and planned enhancements. Information was mainly sought via Internet World Wide Web but was often also confirmed and improved via e-mail communications with key people where appropriate. Review of the systems in Australia, Austria, Canada, Denmark, Finland, Japan, The Netherlands, Norway, Sweden, Switzerland and finally the United States of America is made.

A suggested way of maintaining the relevance of the document is with international channels of communication made via the National Steering Committee for Warning and Informing the Public. Systems that operate between nations are also covered which should be part of the committee's focus for international dialog.

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List of Tables

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List of Abbreviations

AVM	Automated Voice Messaging
ACA	All Channel Alert
AVM	Automated Voice Messaging
C-ADESS	Central Automated Data Editing and Switching System
CAN	Community Action Network
CAP	Common Alerting Protocol
CBC	Canadian Broadcasting Corporation
CEMCN	Central Emergency Management Communication Network
DTMF	Dual Tone – Multi Frequency
EA	Environment Agency
EAN	Emergency Alert Notification
EAS	Emergency Alert System
EBS	Emergency Broadcast System
EPWS	Emergency Public Warning System
EU	European Union
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing System
FM	Frequency Modulated
GDIN	Global Disaster Information Network
HSA	Homeland Security Agency
HMA	Hazard Management Agency
IDNR	International Decade for Natural Disaster Reduction
IEEE	Institute of Electrical and Electronic Engineers
IPA	Important Public Announcement
IP	Internet Protocol
JMA	Japanese Meteorological Agency
L-ADESS	Local Automated Data Editing and Switching System
LP	Local Primary
MMWDS	Multi-Media Warning Dissemination System
NEOC	National Emergency Operation Centre
NSC WIP	National Steering Committee for Warning and informing the Public
NOAA	National Oceanic and Atmospheric Administration
NP	National Primary
NWR	NOAA Weather Radio
NWS	National Weather Service
PA	Public Address
PEP	Primary Entry Point
PPW	Public Partnership for Warning
QoS	Quality of Service
RDS	Radio Data System
SAME	Specific Area Message Encoding
SAWS	Simultaneous Announcement Wireless System
SBC	Swedish Broadcasting Corporation
SEWS	Standard Emergency Warning Signal
SLA	Service Level Agreement
SP	State Primary

SR	State Relay
SR	Software (or System) Requirement
SRD	Software (or System) Requirements Document
STC	Swedish Television Corporation
SOS	Save Our Souls
TETRA	Trans European Trunked Radio
U.S	United States
UR	User Requirement
URD	User Requirements Document
USGS	United States Geological Survey
VIRVE	Viranomais Verkko 'Network for Authorities'
WHCA	White House Communications Agency

Glossary

Asynchronous

Asynchronous communications are achieved without both parties participating at the same time. For example, a message on an answering machine is asynchronous, from a human perspective.

This is true for many forms of modern communications, they are asynchronous from a human perspective (news groups, SMS, email etc.).

Examples of asynchronous channels would be print, and radio broadcasts.

See also synchronous below.

Bandwidth

Bandwidth describes the amount of frequency used by an electromagnetic signal. Can be used as part of QoS measures.

See also data rate.

BER

Acronym for Bit Error Rate. This refers to how often one bit of a digital communications channel will be interpreted wrongly against those that will be received correctly as a statistical probability ratio. Error correction technologies are designed to reduce the impact of this and can appear to reduce BER but this is usually at the expense of ‘useful’ data rate (some bits are being used for correction rather than data). Can be used as a QoS measure.

See also data rate.

Broadcast

The type of multiplicity where one sender can send a message to many receivers at once with no additional effort involved per recipient.

See also multicast, unicast, multi-unicast, multiplicity and fusion-cast.

Data Rate

A quantitative measure of bandwidth commonly used in digital communications. It is usually measured in bits per second (a bit being an encoded 1 or 0).

See also bandwidth.

Duplex

Duplex communications are ones where both parties are able to send and receive at the same time, hence they are always synchronous.

See also half duplex, simplex and synchronous.

Fusion-cast

Relates to agents that are combining several channels into one more useful channel. These agents are usually implemented in software, but the mass media for example provides this function with different emphasis for different areas of coverage.

See also broadcast, unicast, multicast, multi-unicast, and multiplicity.

Half-duplex

Half-duplex communications are ones that are synchronous where only one party can transmit at any one time.

See also half duplex, simplex and synchronous.

Multicast

Esp. Internet, a form of multiplicity where highways are set up to reduce the amount of packets sent. Special nodes act as broadcasters for otherwise unicast links.

See also broadcast, unicast, multi-unicast, multiplicity and fusion-cast.

Multi-unicast

Several parallel unicast channels esp. across the Internet.

See also broadcast, unicast, multicast, multiplicity and fusion-cast.

Multiplicity

Refers to the numbers involved in a communications link. For example one broadcast sender to many broadcast receivers.

See also broadcast, multicast, unicast, multi-unicast and fusion-cast.

PSTN

Acronym for Public Switched Telephone Network. This term refers to all intervening equipment that joins two members of the public when they make a telephone call.

Pull

Pulled communication is that which the receiver has sought for. The main message sender is only communicating on request. Usually the first message sent is a small/short request followed by main message/s sent as a result. An example is someone seeking information from Teletext.

See also push and user triggered push.

Push

Pushed communication is that which the receiver has not sought for. The only message is that from the sender; a siren is an example.

See also pull and user triggered push.

User Triggered Push

A push of information, the sending of which has been defined by the recipient (rather than simply by the position of their dwelling).

Simple pushes have no precursor message. User triggered pushes have an initial request message from the recipient then a main message.

Initiation may be complex and can even be a dialogue rather than a single message. The recipient does not know when the main message (such as a warning) will be pushed. Usually there will be a significant delay between the initiating message and the push.

Different channels are sometimes appropriate for the initial and the main message. For example you initially use an Internet form and receive the pushed information via SMS and e-mail.
See also pull and push.

QoS

Acronym for Quality of Service. This term refers to the measurement of performance of a service, such as a communications service or link.

See also data rate.

Simplex

Simplex communications are ones where only one party can send messages and the other party receives; usually, but not necessarily, broadcast.

See also half duplex and simplex.

Synchronous

Synchronous communications are achieved with both parties participating at the same time.

Unicast

The type of multiplicity referring to a channel in which one sender can send a message to one receiver; receiver may be able to reply.

See also broadcast, multicast, unicast, multi-unicast and fusion-cast.

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1 INTRODUCTION

1.1 Purpose

Under the terms of its operation, the Environment Agency (EA) is the lead agency in warning the public about flooding issues. Despite the EA's efforts, most years sees millions of pounds of damage done to some of the 1.9M households recognised by the agency as being at risk from flooding. Targets have been set from central government to reduce the amount of damage caused by flooding. As well as investing in defences, public education and forecasting etc. a cost-effective way of reducing the damage could be to better inform the public; allowing them to respond accordingly. Sections 3-11 of this document relate to the output of WP1: Comparison Report.

1.2 Document Structure

Section 3:
This sections introduces WP1

Section 4:
This section defines communication in the context of flood warning dissemination in the UK. Several popular communication theories are explained in order to define the scope of the definition of communication for this report. The simple Sender Message Channel Receiver (SMCR, see below) model is adopted for the report. Where other models are appropriate they will be explicitly referred to.

Section 5:
This section describes the different circumstances under which warnings will be disseminated. It should be noted that the scenarios have some overlap. For example, a portion of the audience may be travelling on foot during a catastrophic event.

Section 6:
This section provides detail of technologies that are currently used to disseminate flood warnings in the UK.

Section 7:
This section deals with well-understood communication technologies that could be used for flood warning dissemination, but are not currently used in the UK for flood warning dissemination.

Section 8:
This section deals with technologies which are either

- still under development;
- have had little use;
- have yet to be used in a analogous business case;
- would need significant re-engineering.

Section 9:
This section provides the tables of analysis for existing and possible technologies as well as an explanation of the criteria used.

Section 10:
This section provides the conclusions from WP1.

Section 11:
This section provides the recommendations from WP1.

Section 12:
This section introduces WP2

Section 13
This section explains how requirements engineering can be managed. These are taken mainly from Mazza et al 1994 but are made more appropriate to the project. It provides the engineering approach taken

Section 14:
This section describes the problems the MMWDS addresses from the different identified user's perspectives.

Section 15:
This section describes the assumed requirements of the final national flood warning system requirements i.e. that of the MMWDS. These at present are not available in a suitable form.

Section 16 & 17:
This section details the generalised requirements for a channel trial system.

Section 18:
This section present WP2 conclusions

Section 19:
This section present WP2 recommendations.

Section 20:
This section introduces WP3 and covers the approach taken.

Sections 21-31:
Similar Systems
These sections of this document relate to T15 Deliverable 3, the output of WP3: "Similar Warning Dissemination Systems". Refer to project plan QinetiQ/KI/COM/PMP021253 V1for more details. They describe public warning dissemination systems in use or planned within particular nations.

Section 32:
This section covers systems that operate internationally i.e. across several national boundaries.
This report is part of project T15. Refer to project plan QinetiQ/KI/COM/PMP021253 V1.0 [1]. This document relates to the output of WP3 –Report (Deliverable 3).

2 WP1: TECHNOLOGY COMPARISON – INTRODUCTION

2.1 Approach to Work Package 1

The approach taken to achieve the purpose follows these steps:

1. Define scenarios focused on particular ‘users’.
2. From each scenario determine appropriate presentation of warning.
3. From presentation determine required message content.
4. From message content determine communication requirements.
5. From requirements score each technology.

2.2 Emphasis

The work undertaken tries to concentrate on the most pertinent criteria, *not* the easiest to measure; e.g. messages throughput rather than data rate as bits per second.

This has lead to a tendency towards qualitative rather than quantitative measurement and judgement. It is hoped that this will make it easier to spot mistakes and misconceptions in the analysis, rather than having them obscured in tables of numbers.

3 WP1: TECHNOLOGY COMPARISON – COMMUNICATION MODELLING

3.1 Introduction

This section defines communication in the context of flood warning dissemination in the UK. Several popular communication theories are explained in order to define the scope of the definition of communication for this report. The simple Sender Message Channel Receiver (SMCR, see below) model is adopted for the report. Where other models are appropriate they will be explicitly referred to.

Please refer to the glossary to ensure you are familiar with all of the terms.

3.2 Sender Message Channel Receiver

The most common model for communications is information theory developed by Shannon and Weaver (1949). This model recognises four elements: a **Sender**, who passes a **Message**, through a **Channel**, to a **Receiver**. Those developing technology (e.g. telephony and computer systems) as well as those involved in communication process engineering/management have successfully used this model. This simple approach can be used to analyse the technical, business and social issues.

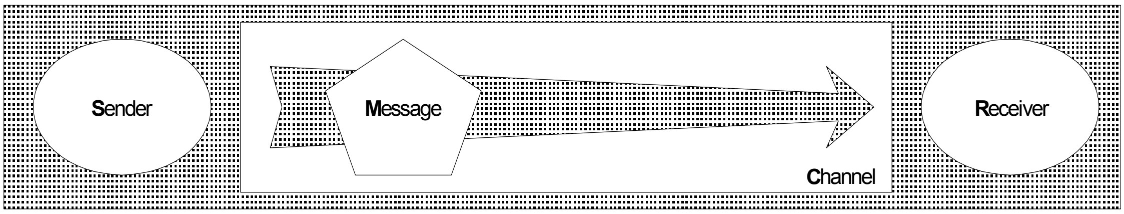

Figure 0-1 The SMRC communication model

3.3 Weaknesses of the SMCR model

Although the model is easy to apply and is well known, it tends to assume that the sender and receiver are roughly similar. The meaning of the message is lost if there is insufficient common understanding between these parties. When applied to two computer systems, such problems should be both easy to discover and address. However when two cognitive, reactive individuals are the parties, receipt of the message alone does not mean that communication can be assumed to have taken place.

Communication between people (or groups) is more than just the flow of a message, it is the transfer of meaning. The successful transfer of meaning is usually undertaken to have effect on the recipient. This is certainly the case for flood warning, i.e. to take appropriate action for the threat (e.g. protect dwelling, evacuate etc.).

3.4 Constructivist model

Unlike the SMCR model, the constructivist model (Bennett 1987) takes into account differences between parties. It seeks to find the differences in understanding between the parties, to empathise with both of them, and to evaluate whether the communication is fit for purpose from both viewpoints.

However, given the large matrix of senders, recipients, channels and message types dealt with in this report, it is impracticable to perform constructivist analysis.

3.5 Communication relationships

Messages have two levels (Bateson 1979) if the content is explicit, it is the 'actual' message. Who the sender is and the relationship between the sender and the recipient is usually implicit but usually greatly affects the interpretation of the message.

In the context of flood warning dissemination this means that channels (or the messages themselves) should make apparent who the sender is and that the communication has a foundation that is credible to the audience, and that credibility is always maintained. In particular communication should be as timely, precise and accurate as possible.

If this cannot be maintained, the communication by any means becomes less effective.

3.6 Risk communication

At its most basic, risk communication is the communication of the probability and impact of a possible event.

The implication of sections 3.3 to 3.5 is that risk communications play a major part of the success of flood warning dissemination, as it will greatly shape the audience's response.

Examples of different approaches for describing risk in terms of probability are "One in a hundred years", "One per cent chance this year" and "Will probably occur in your lifetime".

Risk communication is applicable before an event as part of public education; this could be thought of as risk preparation or reduction. It could also be applicable during an event if message content was expressed as a risk. In doing so the maintenance of credibility can be achieved more easily e.g. warning of the *possibility* of further rise or inundation.

Risk communication can also be visual. For example in some states in Australia rings are placed on telephone poles at the high points of previous floods.

3.7 A heterogeneous approach

There can be no one magic solution. None of the technologies can address all identified scenarios. So the only way forward is to have a heterogeneous approach; one that has a mix of technologies to provide as wider audience as possible.

Furthermore, redundancy gives resilience. The more channels that exist to propagate messages, the higher the probability that the intended recipients will receive the message: even if some channels fail, others may succeed.

Research shows that members of the public who have received warnings typically seek confirmation via consistent and multiple reliable sources before taking requested action (Drabek 1986). Whichever message is received first will make the audience more receptive to following messages. This increase in receptiveness will hopefully be to the level such that the audience actively seeks confirmation messages (e.g. turns on a radio). If only one message is received, or if messages are received via only one channel, there is a chance that no action will be taken by the public.

Lastly an advantage of using multiple channels is that it allows for a multi-tier approach. This could be of the form:

Tier 1 - Most reliable, most essential, those that EA and its key partners rely upon to perform their functions.
Tier 2 – Secondary propagators, sub systems or bodies that perform highly desirable or generally required warning dissemination.
Tier 3 - Lower priority signals. These may be less reliable than above but may be more convenient, have better content or are more easily filtered by the public.
A multi-tier approach is in itself a desirable approach as it can allow the mixing of otherwise mutually exclusive properties. For example channels that are broadcast in nature have large throughput of messages and require less precise data. Unicast channels allow finer granularity of targeting but can require very accurate data that may not be available.
By choosing the correct channels for each tier, characteristics that would be difficult to achieve can be more easily tailored.

3.8 Areas for further analysis

The basic approach chosen is a form of features analysis. Those aspects of the possible choices which are considered important are explicitly and individually judged and reported upon. Other forms of analysis could also contribute to the overall analysis but are considered as likely to be beyond the scope of the covering contract.
Petro analysis uses Petro's "law" which implies that 80% of effects can be attributed to 20% of the constituents of a system. Effort can then be focused on the 20% of a system that counts most.
Cause – effect analysis starts with a single effect (such as 'successfully evacuated') and highlights the possible causes. These causes are then considered to be effects themselves and causes for them are sought. The process continues until the nuance of the domain studied is resolved to the satisfaction of the context at hand. This approach can be further refined by applying "% contributes" and "cost to address" figures to all the causes so that effort can be best placed to obtain the desired effect (or to avoid an undesired effect).
Spatial models of perception should be considered for the exact nature of the presentation of messages. The audience's focus is considered to determine how likely they are to notice the information that is competing for attention with information from other sources. Though this is usually simple common sense, the application of the model can verify the legitimacy of the presentation used (Cheverst et al 2001). Any extra complications due to multiple languages and physical abilities would also need to be addressed.

4 WP1: TECHNOLOGY COMPARISON - SCENARIOS ADDRESSED

4.1 Introduction

This section describes the different circumstances under which warnings will be disseminated. It should be noted that the scenarios have some overlap. For example, a portion of the audience may be travelling on foot during a catastrophic event.
Whilst reading this it is useful to consider the heterogeneous approach from section 3.7. For example, the messages received from the technologies employed to cope with Scenario B will reinforce the messages received from the technologies from Scenario A.

4.2 Scenario A: Catastrophic event with short lead time

This is included as a worst case to test the message delivery rate limitations of the technologies. It will therefore favour broadcast channels (or multi-tiered systems with a broadcast channel).
This is considered to be a high impact, low probability event, affecting many people, most likely in an urban area. The implications of covering a wider area should also be considered.
A large body of evidence shows that panic often portrayed in disaster movies is a myth. In fact the more in danger of harm a group of people believe they are, the more altruistic they become. So rapid, clear warning of impending peril should trigger great social response.

4.3 Scenario B: Travelling user on foot – warning of current location

This is included to show the weaknesses of technologies that favour static recipients and may have poor propagation (in terms of physical range) to reach mobile audience members.

4.4 Scenario C: Travelling user in vehicle – warning of current location

This is included to show the weaknesses of technologies that favour static recipients and may have poor propagation to mobile audience members whose needs, for safety reasons, are subtly different to other groups.

4.5 Scenario D: Travelling user remote location

This scenario covers those who wish to know of flooding in a particular place regardless of their location.
Certain cases have been identified to justify the inclusion of this scenario:

- Flooding on highways, route planning.
- Help someone else, especially those vulnerable or interdependent.
- Protect property while absent (at work or a holiday home for example).

These personal circumstances will lead to different preferred channels, for example some may prefer an e-mail alert while others may have no access to such communication.

4.6 Scenario E: Static person in own dwelling

The most commonly regarded scenario is that of people in their homes. It is a crucial focus to address this scenario as it is a stipulated requirement of the EA from central government.

4.7 Scenario F: Static person at place of work

A fair proportion of many people's lives is spent at work. Strictly speaking a mix of technologies to satisfy the other scenarios should also address the needs of those at work. However, the fact that those at work are in special circumstances and may need to know about flooding at work and at home justifies their inclusion as a specific scenario.

4.8 Scenario G: Inter-organisation warnings

The need for inter-organisational warnings is understood. However to do each inter-organisational link justice would require a study of similar (if not greater) size to the initial stage of T15. This is further compounded when particular organisations (i.e. the police) have different structures in different areas around the country that may require different presentation of available information. The Agency has an associated project, the MMWDS, which will explore this scenario in the depth required.

5 WP1: TECHNOLOGIES IN USE

5.1 Introduction

This section provides detail of technologies that are currently used to disseminate flood warnings in the UK.

5.2 Automatic Voice Messaging

Automatic Voice Messaging is a key technology for flood warning dissemination in the UK.

A system typically consists of controlling stations with multiple phone lines. Recorded messages are then conveyed over the phone lines to those registered users who are affected. Some solutions offered have priority lists and GIS capabilities that can be useful institutions where flash flooding can be predicted. The number of lines provided largely determines the cost.

The main drawback of the system is that it has to be opted into for compliance with the data protection act. Dependant on the system, the message, the numbers of lines and how quickly people answer etc, propagation time can be large (several hours). This may be unacceptable especially for flash and tidal flooding.

Systems cost many tens of thousands of pounds.

5.3 Loud hailers

Flood warning dissemination uses loud hailers in situations where it is too costly to permanently install Public Address (PA) systems or where there is an unexpected event. They are often used in serious situations where AVM take up is low.

These may be handheld or mounted on special vehicles. They vary in directivity, power and therefore range.

The main drawback is in terms of deployment. Precious time may be lost, exposing more risk to the public and the operators may be exposed to hazardous conditions.

Where deployment time is acceptable this technology can satisfactorily cover many scenarios.

Each unit costs several hundred pounds.

5.4 Sirens

Typically, the effective range is several orders of magnitude larger than for loud hailers (though still hundreds of meters rather than several kilometres). Portable sirens exist but are uncommon, they are usually permanently sited and most suitable for scenario A due to the lack of required deployment time.

The main drawback is that sirens only alert to the existence of an event, not its nature i.e. no message content. This can be tackled with large-scale public education and using different tones, sounding times etc. However, this is generally unacceptable and this approach would need backup from a secondary channel such as radio.

Each unit costs several thousands of pounds and can be expensive to maintain due to their exposed locations. Whole networks of sirens are required to cover most populations and require significant investment.

5.5 FAX

Fax is an ideal channel for use in dissemination to other organisations as it allows cheap, clear, concise and asynchronous communication (freeing time up for both parties). This is practical given the ubiquity of the fax machine for business use.

However, this does not preclude the use of fax to the general public where such facilities are available.
Templates for predicable events should be drawn up in advance to help speed message throughput. It should also be possible to produce cover-all forms. The use of a PC and fax modem would be preferred to allow for a fully automated system.
Depending on the exact nature of the receiving system, and the procedures in place, this channel's output can easily go unnoticed.

5.6 Conventional Broadcast Media

Many of the other technologies in use are meant as a primary means of *alerting* the public. The *warning and informing* element requires richer and explicit content over ubiquitous receiving equipment. This is best served by conventional broadcast media such as radio or television.
Such channels are important propagators and require robust primary (top tier) channels.
It should be transparent and therefore irrelevant if the broadcast is made using digital or analogue encoding. All that matters is that receivers are readily available and the channel is robust.
Weaknesses lie in the lack of control the EA has over the channel and the potential poor co-ordination in times of crisis. This is where the American government's Emergency Alerting System (EAS) system shows its strength. The Federal Communications Commission (FCC) has specified how messages can easily be injected into the system and appropriately propagated without recourse to the broadcasters concerned (the broadcast is controlled by government).

5.7 Flood Wardens – door knocking

Example of a propagator, flood wardens will need their own primary communication channel that should be robust, and allow rich content; fax can suffice.
In common with loud hailers the use of door knocking exposes personnel to hazardous conditions. This, coupled with the large amount of human effort and the potential for poor message throughput, means that this is often a last resort.
Realistically this form of warning is failsafe (as long as house frontages can be reached) and it is doubtful that its use could ever be precluded.

5.8 Internet – pulls

The EA has invested in an Internet site that allows the public to ascertain details of flooding that are important to them. This service is unique as it allows great detail over the whole country to be available to everyone. Though it does not use the e-Envoy Deployment Team's architecture, it does align to central government's targets for open government.

5.9 Teletext

It provides access to textual, tabular and basic graphical information that can be pulled at will by the public. This service is available on many types of televisions and is very cost effective for the EA.

5.10 Special Signage

This system has little use at present but it has a unique and simple form of presentation. The system allows the display of the current flood status and related information. When there is no flooding activity the sign can be displays of public education/awareness

material. The system is being introduced in particular areas after a successful pilot study in Sussex. It may prove very useful and reassuring to the public.
The different messages are fixed onto rotating panels in the unit. Which message is displayed is controlled by dial up access via the PSTN.

Figure 0-2 Example Of Special Signage (© EA)

6 WP1: POSSIBLE TECHNOLOGIES

6.1 Introduction

This section deals with well-understood communication technologies that could be used for flood warning dissemination, but are not currently used in the UK for flood warning dissemination.
It draws from the evaluation section, but only details the most pertinent information for the given technology.

6.2 Text messaging - SMS

Simple Messaging Service allows for messages up to 162 characters long. Receipting is possible without intervention from the recipient and throughput should be many orders greater than existing AVM. Though not as erratic as e-mail, the variance in delivery times makes SMS unsuitable for a primary channel.
Given the widespread use of mobile phones it may be a preferred channel for scenario D, travelling user (remote location).
SMS Cell broadcast (para 6.3) provides a better mechanism for scenarios A and B.

6.3 Wireless Application Protocol

Wireless Application Protocol (WAP) uses Wireless Mark-up Language (WML). It can be thought of as Internet access via mobile phone. Most WAP services have a simple text only interface. On the whole, the characteristics mirror that of Internet Pull in the previous section.

6.4 E-mail

Long textual messages and binary attachments. Receipting is possible without intervention from the recipient and throughput should be many orders greater than existing AVM.
Variance in delivery times can be erratic, ranging from under a second to several days depending on the configuration and availability of intermediate equipment.
Particular problems such as spam mail and viruses that reduce the effectiveness of e-mail alerts plague e-mail users. Spam filters could easily target mass mailings as nuisance and remove them. Virus attacks make the use of attachments undesirable.
E-mail is unsuitable for a primary channel, but given its widespread use by the public and business it may be a preferred channel for scenario D. Indications from new media alert offerings in California suggest that e-mail is the preferred option in many cases.

6.5 Internet – pushes

As well as using an Internet connection to seek information as in Internet pulls, the same connection can be used to push information. This usually requires special applications on the receiver to interpret the message and present it to the audience. The Common Alerting Protocol (CAP) should prove a suitable standard for this.
Broadband Cable and ADSL adapters mean that computers can be continuously on-line, even woken up out of sleep mode via the serial port. Take up for broadband now outstrips 2G mobile phone sales.

6.6 Advanced Signage

New information can be pushed out to displays instantaneously. Internet pages could be used as a source for an automatic template and/or source for switching from advertising to warning modes, reducing cost and to preventing delays when updates are required.

6.7 Tickers on standard TV

A useful way of presenting textual alerts over TV can be tickers. These are displayed as part of the transmitted picture and do not have to be activated like Teletext. It can be arranged that they are only added in the relevant regions.

6.8 Digital TV

Digital TV has already been covered as a conduit in the sense that conventional broadcast media can route transmissions, including warnings, to both analogue and digital receivers. This is a good platform from a technical standpoint as it adds much functionality into many households.
Over 10M homes (includes free-to-view) have Digital Video Broadcast (DVB) receivers usually as interactive TV (iTV) set-top boxes. These can use satellite, cable or Digital Terrestrial TV (DTT) conduits. Satellite is the most popular with Sky Digital having over 6.1M users.
The interactive elements of Sky Active have 500K hits per day. There have been over 140 interactive advertising campaigns ('press the red button') with over 1.5M responses. Revenue per user, currently £6 per month, is predicted to rise to over £60 per month by 2006 [Datamonitor].
BBC have their interactive portal on Sky and digital terrestrial TV so if a DVB / iTV option was sought, an arrangement with them would be an obvious solution.
Analogue TV is due for switch off by 2010 (though the schedule is often amended). Prior to this time it may be prudent to check whether better use of the digital technology available could be made.
Free to view digital TV systems are now available with receivers costing in the region of £100.

6.9 RDS

The Radio Data System (RDS) uses a digital sub-carrier to the analogue FM stereo audio that defines program types and allows for other digital content.
Program Type 31 indicates an emergency warning. This takes the receiver out of standby mode, if not fully switched on, and changes channel if tuned elsewhere so that the broadcast cannot be avoided.
Sweden, Finland and Germany use RDS for warning purposes, utilising dedicated receivers in homes as well as the more common RDS radios fitted in vehicles.

6.10 Digital Audio Broadcast

Digital Audio Broadcast (DAB) is a new form of radio agreed by international standards. Audience growth continues and DAB receiver product-lines continue to expand.
DAB differs from RDS in that all content including audio is delivered in a digital form.
DAB has an EWS ODA taken from the RDS specification that could be of use and may be well implemented in available receivers (awaiting confirmation).
An interesting aspect of DAB at the moment is its possible use in delivering rich content messages. The EA and the BBC have a Memorandum of Understanding (MoU) which

allows the EA to use the BBC's DAB capability. The intention is to broadcast a stream of TpegML messages each describing a flood event.
TpegML does have its weaknesses, mainly its simplistic geospatial definitions and the need for a XML interpreter. TpegML's geospatial definitions could be strengthened by linking from message and out into more precise information (which could be served by a DAB carousel).
PC cards and a sub assembly from Roke Manor Research should provides means of developing cost effective prototypes.
DAB also has the potential of delivery of applications to remote portable devices (e.g. to a Java PalmOS device) via data carrousels. This could be of use to flood wardens and community response teams.

6.11 Power Line Communications

Power Line Communications (or Power Line Carrier Communication/Modulation) uses the mains electricity distribution network as the bearer for communications by various modulation schemes. Most promising is the use of 'Code Domain' schemes that produce a wide band or spread spectrum. Schemes that produce a narrower band are prone to causing interference in other equipment.
The modulation of mains is well understood and researched. It has been used for remote meter reading, other Supervisory Control And Data Acquisition (SCADA) type roles, domestic computer networks and even video distribution.
Dedicated domestic alarms are under commercial development. Their usefulness would be in providing a simple alert in the home for a few tens of pounds. The provision of a data stream seems beyond the remit of the research they are undertaking at the moment.
Systems usually require extra equipment installed at distribution nodes, such as substations, due to de-coupled transformation of voltage.

7 WP1: ADVANCED TECHNOLOGIES

7.1 Introduction

This section deals with technologies which are either

- still under development;
- have had little use;
- have yet to be used in a analogous business case;
- would need significant re-engineering.

7.2 Fire alarm look alike concept

This concept is centred on a simple presentation method akin to a fire alarm. As well as providing a wake up siren, a PA facility could be implemented for the delivery of explicit voice based messages.
There are many analogies that could be used from existing domestic equipment that would make the unit more easily understood and enrich the facilities; for example, the ability to remotely record messages as in digital answering machines.
PSTN could be used as a channel but, using caller ID to greatly improve throughput, different ID's would trigger different messages. Some units could act as hubs and use domestic radio phone technology to send messages to neighbouring houses.

7.3 SMS Cell Broadcast

SMS Cell Broadcast uses a single message that is received and displayed on all handsets logged with the transmitter (exact transmitter depends on service provider and ranges). This makes negligible demands on network traffic and makes the message local to a cell (a useful level of granularity for those in scenarios A and B).
The Cell Broadcast Forum lobbies Global-Disaster Information Network and cell phone manufacturers towards a standard that is the most useful for warning the public. For example they seek to have a special ring tone common to all handsets.
There would be no built in receipting.

7.4 3G and 4G mobile phones

The Social Issues Research Centre reported that 2G mobile phone users use the platform mainly for gossiping and questions why the public would seek to use 3G over 2G. Multiple modular functions and location-based services may make the platform compelling in the long term, but some reports suggest that 3G will not become profitable for at least ten years.
Multi-media Messaging Service, user location and the probability of onboard computing capability does make this channel interesting. However, it is unlikely to be of use (other than with backwards compatibility with 2G services such as SMS).

7.5 Bluetooth

Bluetooth is a short range, medium power, and high data rate wireless protocol. Its range is in the order of meters and so it is of little use in most scenarios.
However its probable inclusion in telematics (e.g. Ford plans to equip its vehicles to allow drivers to communicate and use the Internet without using their hands) makes Bluetooth's future use of significance to scenario C. See www.wired.com/news/technology/0,1282,49090,00.html.

Microsoft has announced plans to offer native Bluetooth support in future versions of Windows XP, which should aid its uptake.

7.6 ZigBee

ZigBee is longer in range than Bluetooth and is a low power, low data rate wireless protocol. Its range is hundreds of meters and it fits well with Peter Ward's vision of ubiquitous communication chips inside all domestic and personal equipment.
It features less in the media than Bluetooth and the 802 protocols but ultimately could be more prevalent.

7.7 Ad hoc networks

Very similar to the above. They are interesting in that they make very robust and versatile channels. This is similar to the principle of TCP/IP and the Internet defined by the American Department of Defence. The arena is very immature at the moment and standards are competing. It would be useful to consider the applications that are possible, but it would be difficult to pick out the winners at this time. One example system is described below.
BT has been conducting radio mesh trials from early 2002 in 100 Cardiff households. Each household has a transceiver that aligns its four antenna to other transceivers in range.
A control centre has an optical-fibre trunk and acts as a conduit for the network of transceivers. 28GHz is used between transceivers, though there are plans to move to 40GHz which will improve antenna gain, directivity and instantaneous bandwidth. At the higher frequency, Radiant Networks, who have patented the system, have developed continuous network wide 4Mb duplex links for a density of 600 users/Km2.
The health concerns are reduced given the tight beam-width, directivity and power levels of less than one watt.

7.8 Other Wireless Protocols

The IEEE has formally approved its air interface standard for fixed broadband wireless systems. Standard 802.16, which is applicable for 10- to 66-GHz systems, is aimed at supporting the rapid development of wireless high-speed metropolitan-area networks for last-mile access. http://www.eet.com/story/OEG20011207S0095

7.9 Light as a medium

QuComm, an EC IST programme that is encouraging commercial applications of free space optical communications, including "last mile" delivery of very high bandwidth.

7.10 Ultra wide band

Useful in avoiding interference e.g. on Power-line Carrier Communications (PCC) and radio transmissions. However, the relevant protocols and the nature of the receivers have a bearing of whether any particular channel is useful.

7.11 Software Defined Radio

Software-Defined Radio (SDR) makes the characteristics of any radio signal easily re-configurable. Modulation schemes and whole transceiver configurations can be transmitted and even remotely controlled. This allows equipment to cope with the unpredictable dynamic characteristics of highly variable wireless links, achieve efficient

use of radio spectrum and power, inter-operate, nimbly jump from one radio standard to another, and customise radio devices to individual needs.
Such flexibility could prove very useful when mature standards emerge.

8 WP1: TECHNOLOGY COMPARISON - EVALUATIONS

8.1 Introduction

This section provides the tables of analysis for existing and possible technologies as well as an explanation of the criteria used.

8.2 Explanation of Criteria

Marks are given between zero and five; five being good zero being bad, poor or not applicable. Where the criteria is likely to vary significantly due to other concerns 'wv' is used to mean "will vary."

Ability to verify reception judges the level of granularity of the ability to know if a message has been delivered to its intended recipient.

Ability to detect non-reception judges the level of granularity of the ability to know if a message has *not* been delivered to its intended recipient. Usually the inverse of the above.

Cost effective in relation to technologies currently in use.

Vulnerability to external disruption judges how robust the channel is to interference. Those that are special to the technology are highlighted and atmospheric effects are always considered.

Multiplicity judges the number of simultaneous recipients that can be connected with a channel (see glossary for fuller explanation and other terms used e.g. broadcast). No mark out of five is given.

Likely message throughput judges how many messages can be expected to have been delivered.

Data rate gives the likely data rate(s) in bps for digital channels. Analogue channels do not have a data rate but do take up bandwidth.

Propagation delay gives an estimate of the delay from a message being sent to it being received by the recipient. It does *not* include the delay from being received to being read by the end-recipient.

Estimated availability gives an estimate for the percentage of audience members that could potentially be reached using the given delivery method.

Estimated access gives an estimate for the percentage of audience members that have actually got access to the given delivery method. For instance, a broadcast medium such as television has an estimated availability of close to 100%, but estimated access would be lower than this (as recipients may be at work for example).

Message types allowed states the types of data that can be conveyed by the delivery method, e.g. text, data, etc.

Synopsis of technical risks (where not covered elsewhere) briefly comments on any technical risks associated with the delivery method.

Level of technology exposure required judges how technically competent the recipient needs to be to use the delivery method.

Training required details the level of training required for the recipient to use the delivery method.

Peripheral device connectivity gives an indication of how adaptable the delivery method is to include requirements for recipients with special needs, e.g. visual indicators on a telephone for recipients whose hearing is impaired.

Scenarios addressed details the scenarios for which the delivery method can be used. This criteria does not have an associated score.

Installation requirements judges how much work would be involved by a recipient to install any technology required.

Precise warning judges how targeted the message content is to the recipient. For example, a broadcast medium would have a lower score than door-to-door which would have a high score.

User filtering is a measure of the recipients' ability to control the content delivered.

8.3 Automatic Voice Messaging

Table 0-1 Automatic Voice Messaging

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception down to individual audience members can be receipted.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected.	5
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on nature of exchanges in the PSTN but generally very good.	5
Multiplicity.	Multi-unicast.	The number of channels depends on system deployed.	wv 3?
Likely message throughput.		See above.	wv 3?
Data rate.	BPS, only suitable for data message types.	Not a digital channel.	N/A
Propagation delay.	Zero.	worst case without retries = (recipients / channels) * 30-90 seconds.	wv 2?
Estimated ***availability***.	100%	Close to 100% for those that are not travelling.	5
Estimated ***access***.	100%	Depends on proportion of audience travelling (will vary with time of day).	wv 4?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Voice.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	None, public education may help though.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	Some scope for expanding the system.	2
Scenarios addressed.	All, though this is believed not to be feasible.	Scenario E.	
Installation requirements.	No extra requirements.	Close to none.	5
Precise warning.	Warning area /reach specific.	Precise to individual needs. How in this case new messages would have to be composed (this could be done by an automatic process however).	4
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None other than general 'opt in' rules. However the system could be adapted to a 'push on a pulled trigger'.	2

8.4 Loudhailer

Table 0-2 Loudhailer

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Disruption to the means of transport for the hailer is possible during flooding. Rain will affect propagation to some degree.	5
Multiplicity.	Broadcast.		
Likely message throughput.		One rolling message lasting many seconds. Number of recipients depends on 12.	5
Data rate.	BPS, only suitable for data message types.	Not a digital channel.	N/A
Propagation delay.	Zero.	*After initial deployment*, worst case < (2 * duration).	wv 2?
Estimated ***availability***.	100%	Close to 100% for those capable of hearing and understanding the language used.	5
Estimated ***access***.	100%	Depends on power, directivity of hailer and on acoustic properties such as attenuation introduced by structure of buildings.	wv 2?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Voice.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	None, public education may help though.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	None.	0
Scenarios addressed.	All, though this is believed not to be feasible.	Not suitable for A if there are deployment times. B, C, E & F are suitable.	
Installation requirements.	No extra requirements.	None to audience.	5
Precise warning.	Warning area /reach specific.	Precise to audio broadcast range produced from equipment in given setting.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None.	0

8.5 Siren

Table 0-3 Siren

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Dependant on underlying control channel (though rain will affect propagation to some degree).	wv 5?
Multiplicity.	Broadcast.		
Likely message throughput.		Near instantaneous (unless multiple sounds/meanings used).	5
Data rate.	BPS, only suitable for data message types.	Not a digital channel.	N/A
Propagation delay.	Zero.	Dependant on underlying control channel. Should be none noticeable.	5
Estimated ***availability***.	100%	Close to 100% for those capable of hearing.	5
Estimated ***access***.	100%	Depends on power, directivity of siren and on acoustic properties such as attenuation introduced by structure of buildings.	wv 4?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Binary.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies for siren systems.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Public education is highly desirable to give meaning. Hopefully audience would seek and obtain warning from a secondary source.	3
Peripheral device connectivity.	Readily available with no interfacing costs.	None likely.	0
Scenarios addressed.	All, though this is believed not to be feasible.	A B, C, E & F.	
Installation requirements	No extra requirements.	None to audience.	5
Precise warning	Warning area /reach specific.	Precise to audio broadcast range produced from equipment in given setting.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None.	0

8.6 Fax

Table 0-4 Fax

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception down to individual audience members can be receipted.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected.	5
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on nature of exchanges in the PSTN but generally very good.	5
Multiplicity.	Multi-unicast.	The number of channels depends on system deployed.	wv 3?
Likely message throughput.		See above.	wv 3?
Data rate.	BPS, only suitable for data message types.	14+kbs	N/A
Propagation delay.	Zero.	Worst case without retries = (recipients / channels) * 30-90 seconds.	wv 2?
Estimated ***availability***.	100%	100% for those with fax machine. < 20% of households but > 95% of businesses and organisations.	5
Estimated ***access***.	100%	100%	5
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Mainly text but some other (e.g. diagrams).	3
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Limited.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	Some with PC fax modem.	1
Scenarios addressed.	All, though this is believed not to be feasible.	F & G (Possibly E).	
Installation requirements.	No extra requirements.	Close to none.	5
Precise warning.	Warning area /reach specific.	Precise to individual needs. How in this case new messages would have to be composed (this could be done by an automatic process however).	4
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None other than general 'opt in' rules. However the system could be adapted to a 'push on a pulled trigger'.	2

8.7 Door to Door

Table 0-5 Door to Door

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception down to individual audience members can be receipted.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected.	5
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	May be hampered by flood waters.	3
Multiplicity.	Multi-unicast.	Equals number of knockers.	wv 3?
Likely message throughput.		Knockers * knock rate (wartime average 6 minutes each.).	wv 3?
Data rate.	BPS, only suitable for data message types.		N/A
Propagation delay.	Zero.	worst case without retries = (recipients / channels) * 30-90 seconds.	wv 2?
Estimated ***availability***.	100%	<100% ability and languages barriers possible as well as flood waters.	5
Estimated ***access***.	100%	50%	vw 3?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Mainly voice but could include a mail drop.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Limited.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	N/A	
Scenarios addressed.	All, though this is believed not to be feasible.	E	
Installation requirements.	No extra requirements.	Close to none.	5
Precise warning.	Warning area /reach specific.	Precise to individual needs. How in this case new messages would have to be composed (this could be done by an automatic process however).	4
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None other than general 'opt in' rules. However the system could be adapted to a 'push on a pulled trigger'.	2

8.8 Conventional Broadcast Media

Table 0-6 Conventional Broadcast Media

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective	Cost/recipient = or< existing.	Is existing	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Dependant on underlying communication channel, which are general robust. Rain will affect propagation to some degree but analogue transmissions are usually left discernible.	5
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.	Not a digital channel.	N/A
Propagation delay.	Zero.	Dependant on underlying control channels (including some inter organisation communications), severity of event and broadcast schedules.	wv 2?
Estimated ***availability***.	100%	Close to 100% disregarding language issues.	5
Estimated ***access.***	100%	Depends on how many receiving units are tuned to broadcast (will vary with time of day).	wv 2?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Primarily voice, others possible e.g. maps, video on TV.	3
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well-established technologies for conventional mass media broadcast systems.	5
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	None likely.	0
Scenarios addressed.	All, though this is believed not to be feasible.	A, C, E. Feasible but few of B.	
Installation requirements.	No extra requirements.	None to audience with TV and radio.	5
Precise warning.	Warning area /reach specific.	Precise to audio broadcast range produced from equipment in given setting.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None other than turning receiver over/off.	0

8.9 Special Signage

Table 0-7 Special Signage

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	Is existing in some areas.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	None.	5
Multiplicity.	Broadcast.		
Likely message throughput.		Depends on number of people noticing signs.	wv 2?
Data rate.	BPS, only suitable for data message types.	Not a digital channel.	N/A
Propagation delay.	Zero.	For a given message: zero. For message changing: dependant on underlying control channels (PSTN), few seconds per sign.	5
Estimated ***availability***.	100%	Close to 100% of people passing (depending on possible language barriers and audience's ability to see).	5
Estimated ***access***.	100%	Depends on location/position/impact of signs and the make up of the audience but should be close to availability figure.	5
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Primarily text, others possible e.g. diagrams.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Novel use of established technologies (remotely controlled actuators).	4
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	Some possibilities.	1
Scenarios addressed.	All, though this is believed not to be feasible.	B only. Motorway signs for C if liase with Highway Agency.	
Installation requirements.	No extra requirements.	None to audience.	5
Precise warning.	Warning area /reach specific.	Precise to given setting and predetermined message. Suitable for many frequently affected areas.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None.	0

8.10 Internet Pull

Table 0-8 Internet Pull

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception can be detected if user access control or 'cookie' system in place.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception can be detected if a database of pulls is kept.	2
Cost effective.	Cost/recipient = or< existing.	Is existing.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on connection to ISP, usually based on robust PSTN technology.	5
Multiplicity.	Unicast.		
Likely message throughput.		Depends on architecture deployed, should be several hundred per minute.	wv 2?
Data rate.	BPS, only suitable for data message types.	28 - 100s Kbs.	N/A
Propagation delay.	Zero	For a given message: a few seconds at most. To change content: dependant on back end connectivity and software.	wv 4?
Estimated ***availability***.	100%	Around 50% (check with ETD figures) have internet access at some part of the day.	3
Estimated ***access***.	100%	Depends on public to seek information and doing so at the appropriate time.	1
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Rich data.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Most Internet deployments can utilise well tried and tested architectures and software.	3
Level of technology exposure required.	Low.	Medium – high.	2
Training required.	None.	Low depending on how 'intuitive' the front end is.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	Few possibilities, information could be parsed by agent type software and then control any hardware connected to the computer in question.	1
Scenarios addressed.	All, though this is believed not to be feasible.	D, E, F & G. Note inclusion of D.	
Installation requirements.	No extra requirements.	PC, modem ,ISP etc.	3
Precise warning.	Warning area /reach specific.	Precise to areas of interest and chosen information granularity of service.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on service but should be as to user requirements.	5

8.11 Radio Data System Program Type 31

Table 0-9 Radio Data System PTY 31

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	Low cost, none 'per recipient', SLA needs agreement in an MoU.	5
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Dependant on underlying communication channel, which are general robust. Rain will affect propagation to some degree but analogue transmissions are usually left discernible. Effects of rain on the digital sub carrier will need investigation.	5
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.	Digital sub-carrier is at 1.1875 kb/s.	N/A
Propagation delay.	Zero.	Dependant on underlying control channels these *could* be controlled remotely by the EA though.	vw 4?
Estimated ***availability***.	100%	Investigation shows > 80% for cars since 1993 & < 5% of homes.	
Estimated ***access***.	100%	Under investigation *believed* to be highly served and suitable for scenario C.	
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Analogue voice and short text possible also.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies for RDS specification. Exact nature of implementations needs confirmation.	vw 4?
Level of technology exposure required.	Low.	Low.	5
Training required.	None.	Low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	Some home units have special interface.	wv 4?
Scenarios addressed.	All, though this is believed not to be feasible.	A, C, E.	
Installation requirements.	No extra requirements.	None to audience with correct radio equipment.	5
Precise warning.	Warning area /reach specific.	Audio broadcast range produced from equipment in given setting.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None. PTY 31 switches on all equipment with power and can not be overridden (when specification is adhered to).	0

8.12 Radio Data System Emergency Warning System

Table 0-10 Radio Data System EWS

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	High specialised equipment required as well as inter-organisation communications likely to be necessary.	1
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Dependant on underlying communication channel, which are general robust.	5
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.	Digital sub-carrier is at 1.1875 kb/s	N/A
Propagation delay.	Zero.	Dependant on underlying control channels these *could* be controlled remotely by the EA though.	vw 4?
Estimated ***availability***.	100%	Under investigation believed to be > 80% for cars since 1993 & < 5% of homes.	TBA
Estimated ***access***.	100%	None known. Traffic Messing Channel (TMC) receivers *may* be compliant (though believed not to be).	TBA
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Digital broadcast.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	TMC has been adopted (part of the same family of standards)	vw 4?
Level of technology exposure required.	Low.	Depends on presentation.	wv 3 ?
Training required.	None.	Low.	1
Peripheral device connectivity.	Readily available with no interfacing costs.	Units could have special interface.	wv 4?
Scenarios addressed.	All, though this is believed not to be feasible.	A, C, E. B highly unlikely. E, F and G possible.	
Installation requirements.	No extra requirements.	Specialist receivers required.	1
Precise warning.	Warning area /reach specific.	Precise to audio broadcast range produced from equipment in given setting.	5
User filtering	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on receiver design.	0

8.13 Digital Audio Broadcast

Table 0-11 Digital Audio Broadcast

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected.	0
Cost effective.	Cost/recipient = or< existing.	Specialised but available equipment required as well as further inter-organisation communications likely to be necessary.	2
Vulnerability to external disruption (atmospheric effects).	None other than direct physical damage.	Should be robust with error correction.	4
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.	Digital sub-carrier is at 128 kb/s	3
Propagation delay.	Zero.	Dependant on underlying control channels and DAB method (i.e. streamed or carousel).	vw 4?
Estimated ***availability***.	100%	Under investigation believed to be < 10% of homes. Several receivers available. Market believed to be due for large expansion.	TBA
Estimated ***access***.	100%	None known. BBC has an experimental TpegML over DAB service running. No known subscribers.	TBA
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Digital broadcast.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	TMC has been adopted (part of the same family of standards)	vw 4?
Level of technology exposure required.	Low.	Depends on presentation.	wv 3 ?
Training required.	None.	Depends on presentation.	wv 3 ?
Peripheral device connectivity.	Readily available with no interfacing costs.	Units could have special interface.	wv 4?
Scenarios addressed.	All, though this is believed not to be feasible.	Due to this being a digital channel with any message content afforded could fit all. (Though any particular presentation method is unlikely to be able to for fill this).	wv
Installation requirements.	No extra requirements.	Specialist receivers required.	1
Precise warning.	Warning area /reach specific.	Depends on message and	5

		presentation type. TpegML has some weaknesses but is believed to be less than errors in information available.	
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on receiver design.	wv

8.14 Simple Messaging Service

Table 0-12 Simple Messaging Service

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception down to individual audience members can be receipted on supported equipment & networks.	4
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected only through deduction (total audience - those received).	3
Cost effective.	Cost/recipient = or< existing.	Several pence plus mainly SLA needs agreement in an MoU. May be able to get help from EDT.	5
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Rain will affect propagation to some degree. Most effects will be due to physical surroundings.	5
Multiplicity.	Unicast.		
Likely message throughput.		Depends on operator/network.	2
Data rate.	BPS, only suitable for data message types.		
Propagation delay.	Zero.	Requires confirmation, believed worst case without retries = (recipients / channels) * several (2?) seconds.	2
Estimated ***availability***.	100%	Under investigation believed to be ~ 80% in some urban areas. Otherwise uptake varies downwards, but is supported by all 2G (and better) handsets and operators.	
Estimated ***access***.	100%	Under investigation *believed* to be highly suitable for scenario B.	
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Text.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies for SMS.	vw 4?
Level of technology exposure required.	Low.	Medium.	3
Training required.	None.	Low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	Potential for cheap GSM sub assemblies.	wv 4?
Scenarios addressed.	All, though this is believed not to be feasible.	A, B, D, E & F. Danger via distraction exists for those in C. Note inclusion of scenario D (though this may be a low priority).	
Installation requirements.	No extra requirements.	None to audience with 2G - 3G receiver.	5
Precise warning.	Warning area /reach specific.	As precise as necessary.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be	Precise to individual needs. How in this case new messages would have to be composed (this could be done by an	0

	to the level of inclusion as well as exclusion.	automatic process however). User may be able to set up a Push on Pulled Trigger type alert.	

8.15 SMS Cell Broadcast

Table 0-13 SMS Cell Broadcast

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected finer than cell level and cell occupancy. A SMS reply slip may be possible.	0
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception cannot be detected finer than cell level and cell occupancy.	0
Cost effective.	Cost/recipient = or< existing.	Low cost, none 'per recipient', mainly SLA needs agreement in an MoU.	5
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Rain will affect propagation to some degree. Most effects will be due to physical surroundings.	5
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.		
Propagation delay.	Zero.	Should be mainly dependant on underlying control channels these *could* be controlled remotely by the EA though. Otherwise only a few seconds.	vw 4?
Estimated ***availability***.	100%	Under investigation believed to be ~ 80% in some urban areas. Otherwise uptake varies downwards, but is supported by all 2G (and better) handsets and operators.	TBA
Estimated ***access***.	100%	Under investigation *believed* to be highly suitable for scenario B.	TBA
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Text.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technologies for SMS.	vw 4?
Level of technology exposure required.	Low.	Medium.	3
Training required.	None.	Low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	Potential for cheap GSM sub assemblies.	wv 4?
Scenarios addressed.	All, though this is believed not to be feasible.	A, B, E & F. Danger via distraction exists for those in C.	
Installation requirements.	No extra requirements.	None to audience with 2G - 3G receiver.	5
Precise warning.	Warning area /reach specific.	Down to GSM cell level.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	None. Other than powering down unit.	0

8.16 Wireless Application Protocol Pull

Table 0-14 Wireless Application Protocol Pull

Evaluation Criteria	**Optimum Performance**	**Performance as measured against criteria**	**Score**
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception can be detected if user access control in place.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception can be detected if a database of access against users is kept.	0
Cost effective.	Cost/recipient = or< existing.	Similar if not less to Internet pull.	N/A
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	General.	5
Multiplicity.	Unicast.		
Likely message throughput.		Depends on access channel (e.g. GSM). Rain will affect propagation to some degree. Most effects will be due to physical surroundings.	wv 2?
Data rate.	BPS, only suitable for data message types.	14 - 128 Kbs.	N/A
Propagation delay.	Zero.	For a given message: a few seconds at most. To change content: dependant on back end connectivity and software.	wv 4?
Estimated ***availability***.	100%	Believed that around 50% of 2G handsets **in use** have WAP capability. So around 40% at best in urban areas. Other channels can allow WAP/WML transfer but very few are actually used.	3
Estimated ***access***.	100%	Depends on public to seek information and doing so at the appropriate time. WAP has had a far lower than anticipated utilisation, mainly due to GSM charges.	1
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Rich data possibilities but mainly text.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	WAP is tried and tested. WML is a relatively simple language defined in XML.	3
Level of technology exposure required.	Low.	Medium.	2
Training required.	None.	Low depending on actual interface design.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	Few possibilities, by far overshadowed by that of a GSM sub assembly with SMS alerts.	1
Scenarios addressed.	All, though this is believed not to be feasible.	D, E, F. Note inclusion of D.	
Installation requirements.	No extra requirements.	WAP enabled device (nearly all **currently available** 2G	4

		handsets).	
Precise warning.	Warning area /reach specific.	Precise to areas of interest and chosen information granularity of service.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on service but should be as to user requirements.	4

8.17 E-mail

Table 0-15 E-mail

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception down to individual audience members can be delivery receipted.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected.	5
Cost effective.	Cost/recipient = or< existing.	Cost is very low assuming existing web servers can be used for message creation.	5
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on connectivity, for public will be mainly via PSTN.	4
Multiplicity.	Unicast.		
Likely message throughput.		Many per second should be feasible.	3
Data rate.	BPS, only suitable for data message types.	Depends on connectivity, for public will be mainly via > 28Kbs.	3
Propagation delay.	Zero.	Worst case without retries = (recipients / servers) * message creation rate. Should be in the order of an hour for several 100k of messages. As emails must be sought actual delay can be very large.	2
Estimated ***availability***.	100%	> 50%.	3
Estimated ***access***.	100%	As above.	2
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Primarily text, but rich data attachments allowed.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technology.	Vw 4?
Level of technology exposure required.	Low.	If via a PC medium-high, if by dedicated email unit medium.	wv 2 ?
Training required.	None.	Low.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	Few possibilities, information could be parsed by agent type software and then control any hardware connected to the computer in question.	2
Scenarios addressed.	All, though this is believed not to be feasible.	D, E, F & G.	
Installation requirements.	No extra requirements.	PC, modem ,ISP etc or a dedicated email unit.	2
Precise warning.	Warning area /reach specific.	As precise as necessary.	5
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Precise to individual needs. How in this case new messages would have to be composed (this could be done by an automatic process however). User may be able to set up a Push on Pulled Trigger type alert.	5

8.18 Internet Push

Table 0-16 Internet Push Evaluation

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception can be detected down to an individual recipient.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Non-reception down to individual audience members can be detected.	5
Cost effective.	Cost/recipient = or< existing.	Cost is very low assuming existing web servers can be used for message creation. Additional costs of software development.	vw 4 ?
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on connection to ISP, usually based on robust technology (usually PSTN for the general public).	4
Multiplicity.	Multi-unicast or multi-cast.		
Likely message throughput.		If multicast is used throughput is effectively that of broadcast.	wv 5?
Data rate.	BPS, only suitable for data message types.	> 28Kbs.	wv 5?
Propagation delay.	Zero.	For a given message: a few seconds at most. To generate new message: dependant on back end connectivity and software.	wv 4?
Estimated ***availability***.	100%	All of relevant organisations have internet capabilities. Around 50% (check with ETD figures) have internet access at some part of the day.	3
Estimated ***access***.	100%	Should be same as above.	1
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Rich data.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	A message formats may cause some limitations, TpegML, GML or CAP are likely candidates.	3
Level of technology exposure required.	Low.	High.	1
Training required.	None.	High.	1
Peripheral device connectivity.	Readily available with no interfacing costs.	Specialist software would need to be developed, this could also control extra hardware connected to computer systems.	4
Scenarios addressed.	All, though this is believed not to be feasible.	D, E, F & G. Scenario G would be very well served (second only to FAX?) allows great flexibility. Could even address scenario A, depending on software / hardware.	
Installation requirements.	No extra requirements.	Computer system and dedicated software.	1
Precise warning.	Warning area /reach specific.	Precise to areas of interest and chosen information granularity	5

		of service. NJB has joined the Common Alter Protocol working group.	
User filtering.	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on service but should be as to user requirements.	5

8.19 Digital Interactive Television

Table 0-17 DiTV Evaluation

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Reception cannot be detected. However receivers are *normally* connected to PSTN via a modem (giving some possibility).	2?
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	See above.	2?
Cost effective.	Cost/recipient = or< existing.	Appears prohibitively expensive at the moment.	1
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	Depends on channel: satellite and DTT have definite Vulnerability, cable should be better however.	wv 2?
Multiplicity.	Broadcast.		
Likely message throughput.		Very large.	5
Data rate.	BPS, only suitable for data message types.	Depends on channel but as meant for DVB very large.	5
Propagation delay.	Zero.	Depends on channel satellite worst case and still under a minute. If using a data carrousel could be longer.	wv 4?
Estimated ***availability***.	100%	> 30% anticipated close to 100% by 2010	5
Estimated ***access***.	100%	Depends on how many receiving units are turned on. Confirm ability to power up (if FlashROM upgraded).	wv 2?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Rich data possible.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Established and up and coming technology. Heart of the 'new media' technologies with much commercial investment.	5
Level of technology exposure required.	Low	Low-medium.	4
Training required	None	Low-medium.	4
Peripheral device connectivity.	Readily available with no interfacing costs.	Confirmation sought from DTG & Panasonic.	2?
Scenarios addressed.	All, though this is believed not to be feasible.	E.	
Installation requirements	No extra requirements.	DiTV receiver.	4
Precise warning	Warning area /reach specific.	Postcode based warnings can be delivered.	5
User filtering	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	May be possible with dial up configuration.	4

8.20 Power Line Communication – what is technically feasible.

Table 0-18 Automatic Voice Messaging

Evaluation Criteria	Optimum Performance	Performance as measured against criteria	Score
Ability to verify reception.	Reception receipting down to the level of individual receivers is possible.	Down to individual units.	5
Ability to detect non-reception.	Non-reception down to the level of individual receivers can be determined.	Down to individual units.	5
Cost effective	Cost/recipient = or< existing.	Simple units £10s, with network adapter up to £100. Network would also need to recoup some installation costs.	2
Vulnerability to external disruption (esp. atmospheric effects).	None other than direct physical damage.	One of the few hardwired connections into homes with PSTN and Cable (if fitted).	5
Multiplicity	multi-unicast.	The number of channels depends on system deployed. A broadcast protocol could also be developed.	
Likely message throughput.		See above.	Wv 3?
Data rate	BPS, only suitable for data message types.	Will vary, 100KBs is possible	Wv 4?
Propagation delay.	Zero	worst case without = (recipients / channels) * 1-2 seconds.	wv 2?
Estimated ***availability***	100%	Depends on take up.	5
Estimated ***access***	100%	Should be close to figure above.	Wv 4?
Message types allowed.	Binary, text, voice, rich data (therefore any) or other.	Rich data is possible.	
Synopsis of technical risks (where not covered elsewhere).	E.g. mobile mesh networks are an emergent field with few large scale deployments.	Well established technology in other parts of the world (e.g. India).	5
Level of technology exposure required.	Low	Depends on unit's presentation – unit in development low.	5
Training required	None	Depends on unit's presentation – unit in development low.	5
Peripheral device connectivity.	Readily available with no interfacing costs.	No reason why a voltage free dry contact output could not be provided.	4
Scenarios addressed.	All, though this is believed not to be feasible.	Scenario A, E.	
Installation requirements	No extra requirements.	Depends on unit's design – unit in development plugs in to mains socket.	5
Precise warning	Warning area /reach specific.	Can be down to individual unit.	4
User filtering	Recipient can fully filter incoming messages to own requirements. This should be to the level of inclusion as well as exclusion.	Depends on unit's presentation – unit in development other than unplugging, low.	1

9 WP1: TECHNOLOGY COMPARISON - CONCLUSIONS

The most important issue is to address the public's needs. This means that the nature of presentation of flood warning messages is adequate for the public in the identified scenarios.

A mix of technologies should be sought for the reasons stipulated in 3.7. The final work package should consider gaining the maximum audience for the minimum cost. This will have to include checking the scenarios served for given selections. The figure below shows which technologies could be applicable against each scenario; these will be ranked in a later revision.

	Automatic Voice Messaging	Loudhailer	Siren	Fax	Door to Door	Conventional Broadcast Media	Special Signage	Internet Pull	RDS Program Type 31	RDS Emergency Warning System	Digital Audio Broadcast	SMS (Mobile Text Messaging)	SMS Cell Broadcast	WAP Protocol Pull	E-Mail	Internet Push	Digital Interactive TV	Power Line Communications
Scenario A Catastrophic Event			🗐			🗐			🗐	🗐		🗐	🗐					🗐
Scenario B User on Foot		🗐	🗐				🗐				?	🗐	🗐	🗐				
Scenario C User in Vehicle		?	?			🗐	?		🗐		🗐	🖰	🖰	🖰				
Scenario D Travelling User (Remote)								🗐				🗐		🗐	🗐	🗐		
Scenario E User at Home	🗐	🗐	🗐	?	🗐	🗐		🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
Scenario F User at Work		🗐	🗐	🗐				🗐		?	?	🗐	🗐	🗐	🗐	🗐		
Scenario G Inter-Organisation				🗐				🗐		?	?				🗐	🗐		

Figure 0-3 Matrix of applicability

Scenario A - *Catastrophic event with short lead time* is likely to be costly and/or have limited coverage if using traditional means alone (e.g. siren). More economic means, could give coverage to most people to a suitable level of satisfaction. The final analysis document will address this issue.

There is an obvious advantage to certain mobile technologies such as SMS cell broadcast, which could also address Scenario B: *Travelling user on foot, warning of current location*, too.

The selection of some technologies can have multiple benefits. For example, with RDS, which gives a uniquely strong coverage for *Scenario C: Travelling in vehicle*, but can also address Scenario E: those at home.

Scenario D: *Travelling user remote location* brings special concerns and demands very fine targeting. This is likeliy to favour SMS and e-mail in particular.

Scenario F: *Static person at place of work* may be able to be addressed via HSE legisation and risk assessing.

Scenario G: *Inter-organisation warning* should be able to be addressed by a two stage approach. Firstly selecting a coverall channel (e.g. Internet Push/Pull) and secondly by developing applications that utilise this channel but have specific presentation.

10 WP1: TECHNOLOGY COMPARISON - RECOMMENDATIONS

10.1 Join relevant forums

Joining relevant forums should allow shaping direction from the inside and give special concern to emergency alerts and information.
Key technologies could include:
- RDS;
- DAB;
- SMS Cell Broadcast;
- Common Alert Protocol.

Other domain specific groups should allow to include specific relevant knowledge and this must include international concerns such as:
Partnership for public warning;
International Association of Emergency Managers.

10.2 General

- Discover which technologies have been successfully levered into warning dissemination in other parts of the world.
- Check which technologies are being tested in the UK and whether a warning aspect could be added (e.g. 3G, public 802.11 and radio mesh).
- Test possible special applications for credibility both technically (via dialog with manufacturers) and as being suitable for use by the public (via workshops).

10.3 Advanced Technologies

Maintain a list of possible useful channels, maintain dialog with key players and seek to add warning capability where practicable.
There are so many technologies at present, especially last mile, that a digest directory and review will suffice at present.

11 WP2: REQUIREMENTS - INTRODUCTION

11.1 Purpose

The main purpose of WP2 is to define the scope of any (communication) channel trial systems and formalise how these should relate to the EA's MMWDS project. The requirements of a particular channel trial system will be particular to the channel, message protocols, message presentation and most importantly the information that is sought by the trial.

WP2 attempted to generalise requirements of channel trial systems in a useful manner so that a set of requirements and a framework for their management can be established, reviewed and understood in advance of any channel trial system being sought by the EA.

A significant source against which review could be actively pursued is the MMWDS, which has more comprehensive requirement analysis and should have many useful outputs that can be aligned next to T15. This could be done to verify the acceptability of the outputs of both projects.

It is expected that this document will be a significant input to any future channel trial system and is authored with this intent.

11.2 Scope

An average of 1.2 billion Euro of damage are done each year to some of the 1.9M households at risk from flooding. Targets have been set from central government to reduce the amount of damage caused by flooding. As well as investing in defences, public education and forecasting etc. a cost-effective way of reducing the damage could be to better inform the public; allowing them to respond accordingly.

The EA is the lead organisation in warning the British public in regard to flooding.

The warning process can be simplified as follows.

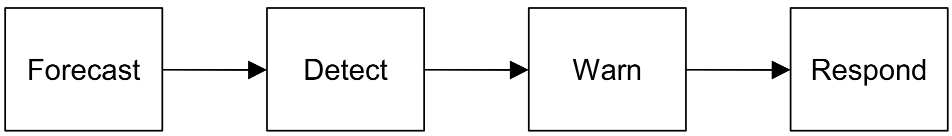

Figure 0-4 Simplified Warning Process

Any requirement of the final system or a channel trial system should be traceable to the need to inform the public in order that they can take necessary response. Professional partners of the EA entrusted with public welfare are also recipients and need to be included as a special concern.

There are two system types referred to by this requirement report:

- The prime focus: systems that trial candidate communication channels.
- The final national systems and services for local flood warning which the channel trial system requirements must be engineered in light of.

The requirements for the channel trial systems are this document's prime concern.

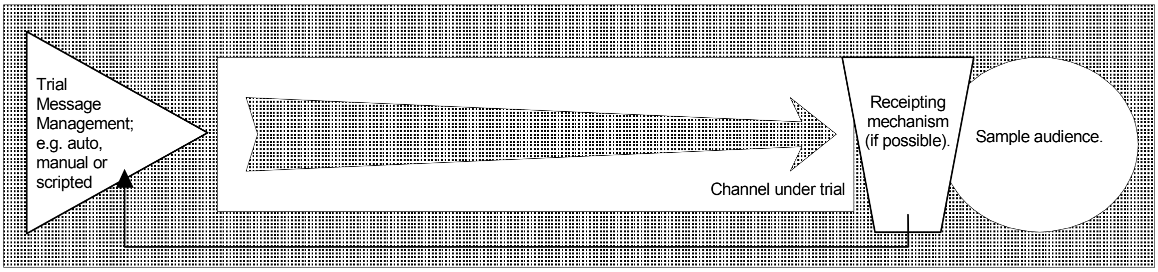

Figure 0-5 A view of a general channel trial system

(Document's prime concern)

This document assumes that the MMWDS, as it is understood at this stage, is a fair model of any final national system.

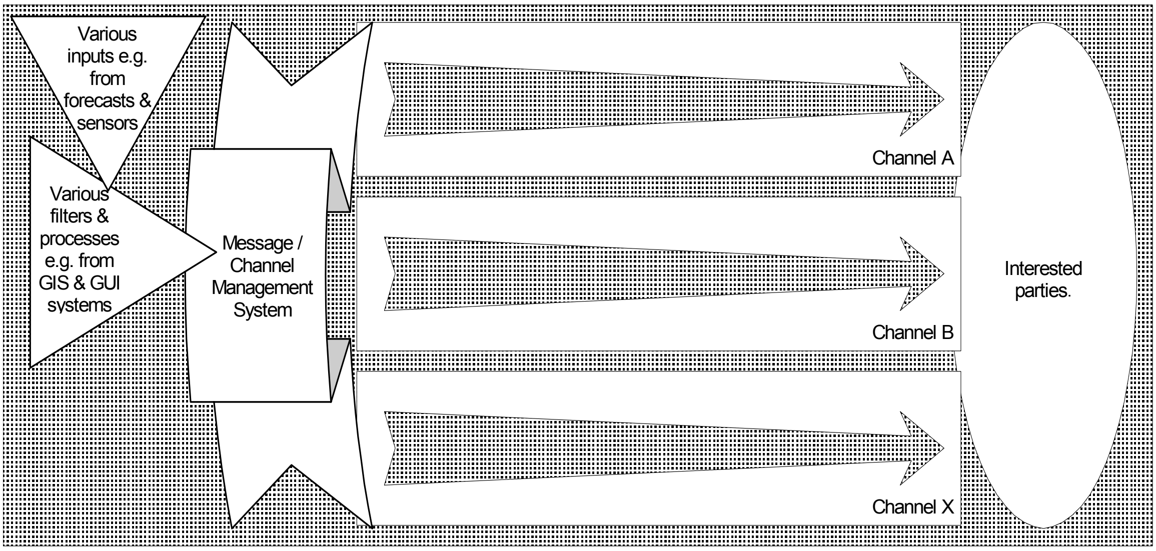

Figure 0-6 A possible view of a final national system

(NOT the focus of this document)

Both system types have to be considered to prevent requirements from falling into a gap between the MMWDS and the channel trial systems. As both are concurrently developed, this can easily occur if designers of each system assumed that the responsibility for some desired feature or effect lies elsewhere.

Documents that specify and control the interface between a channel and the supply of warning messages from the rest of the MMWDS are a particular point of concern. These are the documents where boundaries, interoperation and information flow with the channel and the controlling systems will be dealt with.

The trial systems are temporary systems, meant only to quantify and qualify several predetermined characteristics of a channel. The characteristics could vary in nature and cover many aspects including technical, audience coverage, social impact and other areas such as cost.

Due to their temporary nature trial systems should be able to be engineered with less stringent standards and at a lower cost than if they were required permanently. Such cost reduction would require managing so that systems operate satisfactorily and correct, representative information is provided. As well as negating the validity of the data required, excessive failure could harm public perception and confidence of the EA and its warning services.

Some trials may concentrate on gathering data on the effectiveness of the final presentation rather than the Quality of Service (QoS) of the communications channel alone. These would measure how accurately and timely warnings were *interpreted* rather than *received* (see "Weakness in the SMCR model").

For interpretative study, it is anticipated that the relevant interested parties (e.g. members of the public) will have to have questioned by using questionnaires, focus groups, interviews etc. Careful sociological and psychological considerations should be made so the responses can be relied upon. Effects relating to participants knowing they are being studied, their interests and expectations can falsely skew findings. There is much academic research and guidance in publicly available literature regarding this. Studies should select a recognised approach appropriate to the information output requirements to help mitigate this area of risk.

11.3 Approach to Work Package 2

The proposed software engineering standards are taken from Mazza et al 1994 deviations from these standards or other additional information are supplied in section 2.1.

Actual requirements for particular trial systems will vary from case to case. They depend on the information sought, the nature of channel, its protocols, and the message content, presentation etc.

This document does not attempt to capture completed requirements for all trials, or for any particular channel trial system. It sets a top-level framework for future reference by other more detailed documents pertaining to particular trial systems. Such future documents should be more readily understood in light of this document.

There are strong links between T15 and MMWDS. T15 can serve as guiding and verifying input to MMWDS; and T15 channels must be feasibly of use in MMWDS. For this document to have real value it has to take on the task of separating the requirements of the final system from those of the channel and to any system that trials a channel.

The approach taken to achieve the purpose follows these steps:

Identify the users of the systems and their roles.

Identify the *assumed* requirements of the flood warning service and the MMWDS.

Identify the requirements that relate to the trials of communications channels.

12 WP2: REQUIREMENTS ENGINEERING APPROACH

12.1 Introduction

This section explains how requirements engineering can be managed. These are taken mainly from Mazza et al 1994 but are made more appropriate to the project.

Mazza 1994 is a practicable candidate approach because it is very concise, explicit and prescriptive, leaving little in doubt. Where it needs to be deviated from, a simple explanation of the difference and the reason for it being necessary should be provided.

Mazza 1994 is based on the European Space Agency's experience of applying international standards such as those from the IEEE. The standards and approaches presented in Mazza et al 1994 are for projects representing several man-years to develop.

The scale and effort to design and deliver channel trial systems should be much shorter than standards are designed for. In this case it is proper to reduce the scope of the standards in order that the management tasks do not place a disproportionate burden on the cost of the development. This assumes that risks to the channel trial system's success are not *unduly* increased.

The EA requested one requirements document rather than two as per Mazza et al (user and software requirements). A single document is more desirable in the time scales allowed and should help the understanding and focus consensus on the requirements per se rather than if separated.

Issuing several documents could compound confusion due to the different roles of the MMWDS and channel trial systems. Bringing them together in a single source for ready comparison and discussion should address this.

Requirements of particular channel trial systems may also benefit from a single document for the same reasons.

12.2 Identification and Classification of Users

The term 'user' requires clarification given the very different roles involved. Where 'user' is used in this document it is meant as a term to cover any and all of those concerned with the channel trial systems.

Specific sub types have been identified:

- EA system administrators, those who manage and configure the message dispatch systems.
- EA system operators, those who dispatch messages.
- Message recipients, the relevant members of the public.
- Trail stakeholders, e.g. T15 & MMWDS board members and panels members interested in trial findings.

12.3 EA System Administrators

Administration duties are considered to be able to be reduced to the level by which the only real concerns are how channels can be configured: parameters, thresholds, and operator permissions etc.

The nature of these requirements will be important to both actual and trial systems but will largely depend on the capabilities of the channels in question; they are considered to be mostly beyond the scope of this document.

12.4 EA System Operators

EA system operators are responsible for the dispatching of warnings to the public. Their roles are likely to change as the MMWDS is introduced, used and better understood.
The requirements imposed by these users are based on these roles and may also change; but will remain related to the control of message dispatch.
For some trials it could be acceptable to send messages automatically reducing the cost. The use of real sensor/forecast data could be avoided to reduce costs further; e.g. a script could control the dispatch of warnings.
Where no EA System Operator users are involved in the running of trials, their needs and impact will still need to be assessed to judge the suitability of particular communication channels and systems using them.

12.5 Message Recipients

The public recipient end user type is very complex and can be broken down in many ways. These include, but are not limited to, by scenario, by geographic and demographic constraints.
Trials could be concerned with many aspects of warning, such as improving message content, presentation and delivery targeting. Even if a trial is primarily concerned with the technical communications aspects of a channel, it should seek to determine as precisely as possible the audience reached; not just in numbers but also the nature of those people reached.
Sometimes this may be a prime purpose of a trial: to determine how audience coverage could be expanded. When the results of several trials are combined an understanding of who is covered by which channels will be possible.

12.6 Trial Stakeholders

Members of the T15 project board and panel are users of trial systems in the sense that they need to be confident in the trial system and its conclusions. Related projects will have an interest, in particular the MMWDS; and professional partners such as the Met Office may also use information learned.
When considering the total coverage of the audience, time and care should be spent ensuring how overlapping of possible channels best serves the public need with best value. This will be the main thrust of the last work package of T15's report "D5, Final Analysis" which pre-empts how to achieve best value coverage.

12.7 Software and Systems engineering

Software Engineering is a term that covers a number of management approaches that cover the development of software. The software may or may not be part of a larger system that requires System Engineering.
The term System Engineering covers a number of management approaches to develop a physical system. Most complex systems today have some software element, and the system may not be easily identified as a single entity. Hence most systems developed today also include Software Engineering disciplines to manage the software aspects.
The main outputs of both software and systems engineering are documents and processes to ensure the specification and quality of the final product.
From the overall perspective of MMWDS (and supporting systems), there is a place for significant systems engineering. From the T15 perspective, the development of channel trial systems may require mainly software engineering due to the more limited scope of their operations. This will vary and should be reviewed with each trial.

12.8 User Versus Software requirements

User requirements describe what users need; they define the problem being addressed. These are usually arranged so that a concept or environment of operations of the system can be understood from users needs as a whole.

Davis identifies two processes that match Mazza et al 1994. These are 'problem analysis' and 'product description', which is a useful way to consider the difference between user and software requirements.

Pressman uses 'requirements analysis' as an umbrella for many similar processes that can be translated on to the two-stage philosophy.

In Mazza et al 1994 there are two general categories of user requirements:

- Capabilities.
- Constraints.

User requirements need to be verifiable and have a simple test for proof of compliance. It is not enough to specify "the software will be easy to use". Something that can be qualified or quantified is required such as "A person having under gone the supplied training will be able to dispatch a warning to a particular geographical area with in ten minutes".

Many software-engineering methodologies recommend the creation of the final acceptance test plans during the user requirements phase for this reason.

The main thrust of user requirements is to determine what the system is to do on behalf of the users.

The software (or system) requirements analyse what is required in order to meet the users needs: it defines how the user requirements can be met.

See section 4 for more thorough treatment of software requirements.

All system requirements need to be realistic, and quantified such as "A dispatcher should be able to use the system knowing at least 90% of recipients will be reached within 30 minutes of initiating the dispatch process."

12.9 Relation to T15 and MMWDS

The requirements for the MMWDS and the Channel Trial Systems need to be understood both in isolation, and in relation to each other. If a common way of categorising these can be used the process will be more easily comprehended and effort will be reduced.

The ESA standards from Mazza et al 1994 & 1996 are widely used baseline. If other means of categorisation are used it is recommended that a tractability paper is drawn or addition is made to this document describing how the requirements can be considered against each other. The categorisation used is believed to be comprehensive and largely self-explanatory.

12.10 "Analysis Paralysis"

The term analysis paralysis is used in engineering when it is considered that further analysis will be fruitless even if the analysis appears incomplete. This can be an indicator that more prototyping or consumer research needs to be undergone before the analysis can be resolved. Sometimes there is no other cost-effective way forward than to proceed to product design with caution and more frequent reviews.

For a trial system the impacts of such a course of action are slight compared to that of the final system. Proper confidence in the perceived requirements and resulting designs will be necessary before further development work is undertaken.

Another technique for managing the problems that malformed requirements and designs can bring is by staging an incremental delivery of the system. Higher priority features can be tackled first. The spiral development model recommends higher risk features should be tackled first if there is doubt weather a project is practicable at all.
Darfman 1999 has many papers which explore these issues.

13 WP2: ASSUMED USER REQUIREMENTS OF SERVICE

13.1 Introduction

This section describes the problems the MMWDS addresses from the different identified user's perspectives.
User requirements describe what users need; they define the problem being addressed. These are usually arranged so that a concept or environment of operations of the system can be understood from users needs as a whole.
Most of the user requirements engineering is assumed to be covered under the MMWDS project. Only an overview treatment is provided in this document to enable comparison with channel trial systems. It is envisaged that channel trial systems will improve at least one of the service aspects identified later in this section.

13.2 EA Operator Requirements

From the EA operators' perspective, most of the user requirements will be operational capability requirements defining the tasks undertaken with the system.
There will be other sources of concern as well such as the HMI design and the resources required for the running of the system. All of these are beyond the scope of T15 and are being well served under the MMWDS project. Further treatment is assumed to be unnecessary here.

13.3 Trial Stakeholders Requirements

For treatment of the trial stakeholder requirements of the trial channel systems see sub-section 0. This section deals with the trial stakeholder requirements on the MMWDS.
From the perspective of those interested in trial results the main requirement on the final service is that it is as flexible as possible. Improvements made (e.g. new communication channels, message content/presentation technologies and targeting techniques etc) and knowledge gained from trials needs to be integrated into the existing services.
Open-ended flexibility as a requirement is unsatisfactory because it is unachievable, it is unclear what is really meant, and can not be tested for compliance.
A practical solution would be to place an interface constraint on the system. Given the current technology capabilities and trends a prudent specification could be to align itself with web based services. This would identify open Internet Protocol (IP) based standards already approved by recognised bodies that the system should be able to interface with. This would allow use of a vast amount of research and widely used standards as an accepted bridge from the MMWDS channel management functions to the channels themselves.
For particular channels and other service improvements such an IP bridge may be inappropriate. In such cases interfaces that are relevant need to be identified and referred to.

13.4 Message Recipient Requirements

The rest of this section dedicates itself to the message recipients. To the T15 project service improvements for message recipients from the final system are the most important. These are shown in the perspective to be of use to channel trial systems.
Co-ordination has been undertaken with the MMWDS project manager to ensure minimum overlap and maximum leverage from both projects providing EA with better value for its research objectives.

The following diagram shows how individual channels used by the MMWDS can be modelled from the recipient's viewpoint with a heterogeneous approach. Here the different channels also are likely to be of different nature so they can be optimised for purpose (e.g. a siren for alerting and a free phone help line for informing).

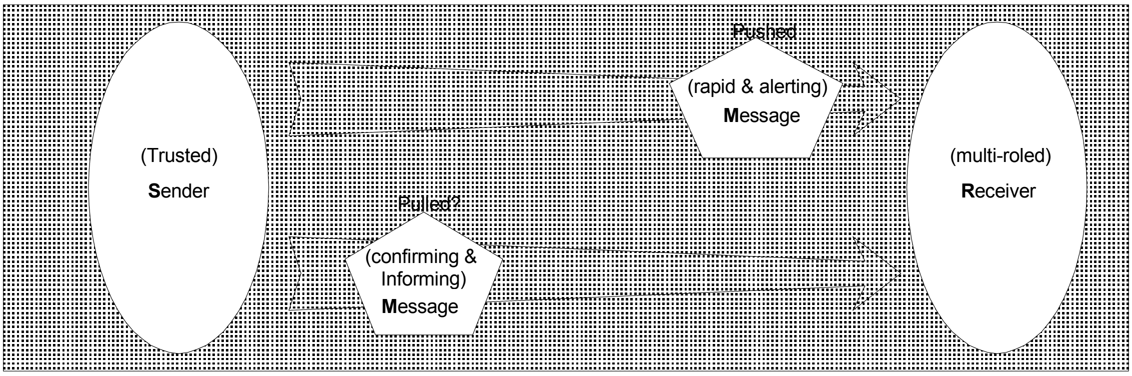

Figure 0-7 Ideal SMRC model (end recipients view)

The channels have been intentionally omitted from this diagram. Strictly speaking the recipient does not require the channels, only the messages they bare. 'Channels' are such an obvious system requirement that it is fair to consider them at user requirements (or problem description) phase as they are simply the means of delivery and are unavoidable. By including them, user requirements that pertain to the channel rather than the message can more easily be implied.
The scenarios identified are only one way to consider whether those that needed to know have been told; sub section 3.6 "Coverage" gives treatment to other ways the audience should be considered.
It should be noted that the scenarios have some overlap, for example a portion of the audience may be travelling on foot during a catastrophic event (Scenarios A & B). Whilst reading this it is useful to consider the heterogeneous approach, using multiple channels to reach recipients is desirable for redundancy, confirmation and usually sought by recipients.
Some channels will favour alerting only (if rapid dissemination but poor content), some as confirming or informing only (slower dissemination but richer content), and some channels may have qualities that match most requirements.

13.5 Aspects of Service

As well as the different scenarios different means of sub-grouping the audience needs to be identified and agreed. These could include:

- Socio-economic, religious, ethnic or cultural differences
- Language differences
- Physical ability
- Exposure/resistance to technology

For each recipient type and scenario there are several aspects of the warning service that can be measured and improved.
The desired level of service could be decided down to a very fine granularity. For example: per aspect of service, per scenario, per recipient demographic/geographic

group. As there are 7 aspects and 7 scenarios this would give 49 measures per recipient sub-group.

The challenge of the task can not be avoided but this level of granularity seems impracticable and may even obscure results without special tools such as discrete event computer simulations.

The simplest way to approach this is to generalise wherever acceptable. For example with the targeting aspect of service it could be acceptable to have three levels of QoS which are applicable to all the audience sub-typing and scenarios, each QoS level matching many combinations of audience sub-type and scenario.

This will be the main work for T15 work package 4, deliverable 5: Final Analysis.

13.5.1 Audience Coverage

A simple percentage can measure those members of the UK at risk who are covered. Such a number would be misleading unless it takes into account the different sub-groups of recipients, the scenarios they are likely to be in, and whether they are matched by at least one, preferably two channels of dissemination. Also the rate of delivery must be checked in order that for a given channel all those that required communication had received such while still having time to respond (see “Speed” below).

Sub grouping that includes non-English speaking and the sensory impaired need treatment, otherwise the assumed level of coverage would be falsely high.

Such issues could arguably be included under the “Presentation” heading. However if the reason for a particular presentation method is to prevent the exclusion of certain recipient sub-groups it should be headed under “Coverage” as that is its true purpose.

It is unrealistic to expect to approach 100% coverage.

Any figure decided upon as reasonable at this stage can be expected to increase in the long term. This assumes the promises of “pervasive” or “ubiquitous” computing are realised and gradually adopted into society. In these visions consumers are able to use services from any provider, with any device, and through any communication channel available in a world where computers and communication channels are “everywhere” (e.g. part of all their electronics goods in a "networked home" and even in people’s clothing as "wearable computers").

Despite the complexity in verification of coverage, this aspect can be based on a ratio of those who *should* have received a warning to those who *did* receive a warning.

13.5.2 Targeting

This aspect is in regards to the proportion of people receiving warnings that actually required warning. For example a television broadcast is bound to reach audience members who are not affected and do not require any warning. This aspect could be measured as a percentage; based on a ratio of those who received a *required* warning and of those who received an *unnecessary* warning.

Many technologies make the request for messaging easy for some recipients, providing very fine grain, controllable targeting. These are especially useful for modern unicast (or multi-unicast) messaging services such as e-mail and SMS, This is termed a user-triggered push in the T15 project.

Such unicast signalling is also possible in a broadcast channel. Some receivers can be configured to ignore most messages and only present those that are relevant to the recipient. This can be thought of as a multi-tier system where the processor is acting as a channel, filtering the broadcast communications and converting them into what is unicast from the recipient’s perspective. Where recipients can individually be identified by those dispatching messages (e.g. by postcode / house number or an arbitrary system)

the messaging can be perceived as unicast from the sender's perspective too; messages can be sent knowing they will be received by a single recipient.
Multi-cast messaging is courser grained that unicast. Instead of per recipient it can be thought of as per sub-group. This could be done geographically for example and one message sent to a whole street. This is equally possible in a broadcast channel and should increase the message throughput capability in comparison to unicast in direct proportionality to the size of the groupings (10 recipients per group == 10x throughput).

13.5.3 Speed

This aspect is simply the measured rate of warning delivery. Ideally it would include only properly targeted (see above) messages any measurements.
From the recipient's perspective, messages need to happen at least before it is too late to respond. It is assumed that the only reason a warning could be too early is if forecasts have changed and new messages are then made necessary. It is assumed that this is dealt with by elsewhere i.e. in forecasting systems so the certainty is measured against the impact of the event and the necessary lead-time for any response. The levels of warning could also be used to address this issue. If certainty of forecast is not sufficient or that the period is large, watches can be issued rather than warnings or alerts.
The mode of communication will be a prime deciding factor in the speed of delivery of the message where in general broadcast systems may be favoured.
Unicast messaging in a broadcast channel may introduce a small amount of delay depending on the amount of processing required and more significantly, the amount of messages to be dispatched and the bandwidth for the channel.

13.5.4 Cost

The costs of all interested parties should be minimised as much as possible. Any costs to recipients may deter message reception which needs to be avoided. Ideally there would not be any tariff to the recipient associated with the reception of a warning. It is believed that ongoing costs such as a being charged monthly, or on a per message basis, would be less acceptable than a small one-off charge. An initial charge could be offset against cheaper household insurance for example.
Third parties would include those who forward messages such as radio and television broadcasters; and others that contribute to the service who are not paid message delivery contractors. It is assumed that such matters will be undertaken by both sides when Service Level Agreements (SLAs) are being agreed.
Costs to the EA need to be easily controlled and be understood in terms of the QoS provided i.e. the value returned. One way to help control costs is to educate the public to expect only one pushed message and then to use broadcast pull methods for confirmation purposes; push channels can be particularly expensive to communicate across.
Where multiple push channels are required receipts could be used so that further channels/messages are used in the event of delivery failure intelligently using the channel redundancy.
This aspect could be measured as the cost per message, the cost per recipient or the mean total cost per incident. Costs should be identified for all interested parties. Cost may vary with the size of audience for and incident. It would require full messaging simulation understand the costs per flood event, per sub group, per scenario, per channel; particularly intelligently managing multiple push channels as mentioned in the paragraph above.

13.5.5 Content

Many channels have no choice of content type. AVM for example can only convey audio (voice) messages. Channels that are essentially digital data links typically can carry any digital data, such as encoded voice, video etc.

Such content rich methods of delivery can sometimes be further enhanced by the use of presentation devices that are flexible and configurable by the recipient. For example Tpeg-EIA systems can display messages in any language regardless of that of the originator.

A subjective scale is probably the most meaningful measure for this aspect. For certain scenarios and/or audience sub-groups, it may be possible to define more objective scales than would be possible for one that attempted to cover all.

Separation of the content and presentation can be ambiguous if not properly addressed.

13.5.6 Presentation

This mainly covers recipient interpretation, suitability to particular scenarios and audience sub-groups. Determination and measurement of this aspect will often rely on feedback (e.g. by questionnaire or interview).

A simple set of categories and heuristics is probably the most meaningful measure for this aspect. For certain scenarios and/or audience sub-groups, it may be possible to define objective scales.

Spatial models of perception should be considered for the exact nature of the presentation of messages. The audience's focus is considered to determine how likely they are to notice the information that is competing for attention with information from other sources. Though this is usually simple common sense, the application of the model can verify the legitimacy of the presentation used (Cheverst et al 2001). These parts of the presentation aspect may have their own measures if deemed necessary.

13.5.7 Receipting

Receipting has several uses:

Determining QoS as some measure of audience coverage and message reception rate.

Multiple push channel management (see 0).

Targeting door knocking to those not yet received a message (can be thought of as a form of the above point).

Per-recipient receipting may not be practical or cost effective for large-scale dissemination or for particular channels. For example, if receipts were being delivered over a data link they would decrease available bandwidth and could complicate management systems. If Per-recipient receipting is not under taken for a particular channel, samples could used to determine rate of successful delivery for QoS measurements.

Receipting mechanisms for partner organisations (e.g. the emergency services or BBC) is crucial to operations. The impact of non-communication with such organisations will be far greater than that of not informing any one particular member of the public.

A measure for receipting aspect could be borne from the cost per 1000 messages receipted and also a measure of certainty (e.g. if samples are used). The actual Level of *reception* itself is dealt with in the "Coverage" aspect above.

14 WP2: ASSUMED MMWDS SYSTEM REQUIREMENTS

14.1 Introduction

This section describes the *assumed* requirements of the final national flood warning system requirements i.e. that of the MMWDS. These at present are not available in a suitable form.

The requirements in this section are not meant to be aimed at any channel trial system. Many requirements will be satisfied by the MMWDS *and* the channels it ultimately utilises. However it is recognised that the nature of any particular communications channel should not be to the detriment of the requirements of the overall service.

At this time it is imagined the controlling management system will be the MMWDS. The requirements areas identified in this document should be considered with those identified for the MMWDS to verify validity.

The following diagram shows how individual channels used by the MMWDS can be thought of in light of the Sender Message Receiver Channel communication model. Here the MMWDS is issuing three messages through three channels. The depicted recipient only receives two of these successfully.

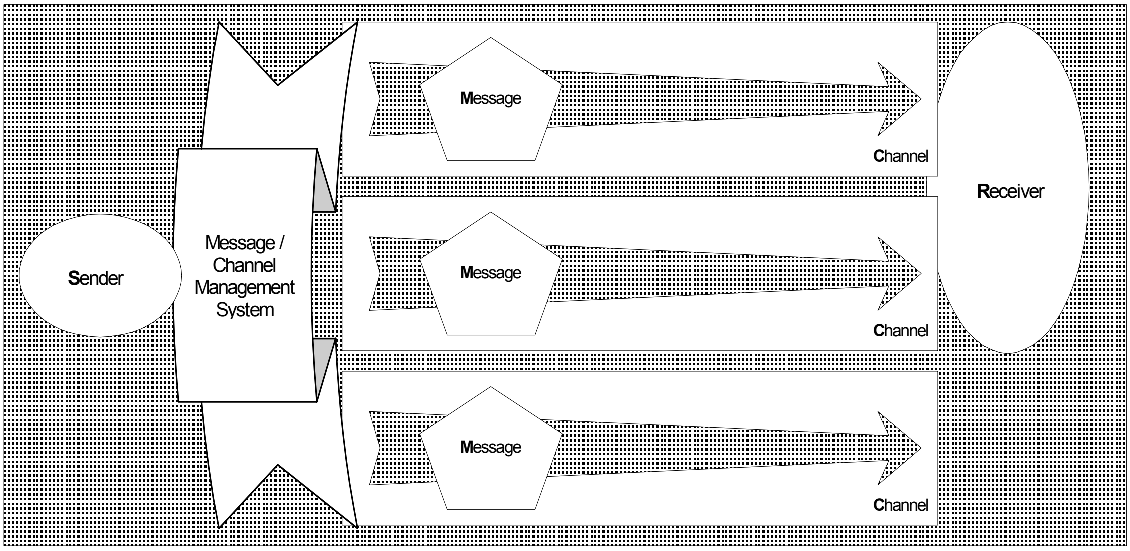

Figure 0-8 Adapted SMRC communication model

This diagram is highly simplistic, e.g. it does not depict the multiple information sources the MMWDS needs to be reactive to. Individual channels can be thought of in isolation from the overall system using the simple SMCR model.

Before this document is fully released an interface control document should be sought that explains, using common standards, how a trial system could receive messages to disseminate from a source that is believed to be similar to that of the MMWDS. It is anticipated that this could be by receipt of messages through an TCP/IP socket using a language described in extensible meta-language (XML) called the TPEG- EIA and developed by the MMWDS team.

14.2 Source of Service's Requirements

The source of the requirements as they are understood comes from dialog with the EA and T15 panel members. Many of the original criteria proposed did not address the channels directly but more to the system that utilised and managed them.

The discrepancy between those criteria that can fully map onto channels and those proposed criteria that were more related to the management system became the main source for the requirements identified below.
System requirements can be split into six main sections:

- Overall service requirements
- EA operator flood warning dispatching input
- Recipient registration and input
- Recipient database requirements
- Message delivery
- Delivery reporting and management

The order of requirements in sub-section 14.3 are roughly the same order as the original source. Requirements are also referred to the common means of classification in Mazza et al 1994 in sub-section 14.4.6. In the final requirements documents it may be prudent to use both methods of groupings or to supply a table showing mapping from the method adopted (e.g. Mazza) to the problem areas.
At the time of this draft document, many of the requirements cannot be specified to a level by which they can be clearly tested. They are incomplete in this state. Before official issue of this document these requirements will need completion via consensus of the T15 panel and board. It is assumed that MMWDS may be referred to for requirement details.

14.3 Service System requirements by problem area

14.4 Introduction

This sub section details how it is assumed the EA view service requirements. They are simple statements that are drawn from conversation and documents provided by the EA.

14.4.1 Service coverage

'*Service must be available to (%TBC) of the flood risk population*'. Here, 'available' is assumed to mean that messages could be received. To be included in the measure a member of the public would have a receiving device already; they *could* receive a message.
'Service must be accessible to (%TBC) of the flood risk population'. Here, *'accessible'* is assumed to mean that messages *would* be received. To be included in this measure a member of the public would be able to make use of a receiving device if they had one.
'Service have a probable audience of (%TBC) of the flood risk population'. To be included in this measure a member of the public would have to receive the message (i.e. have the receiver on etc.). This will need extensive qualification to prevent ambiguity and justification for any figure quoted. Comparing figures from different channels may not be possible in a like for like manner.
'Warnings shall be unambiguous and concise'. A test could be in the form "TBC% of the audience not having received any training obtain the correct meaning and targeting of the message". To address this and the conciseness of messages template messages could have to obtain the accreditation for use of language from an appropriate organisation. It is assumed that 'concise' does not mean as short as possible, more that messages are not convoluted.
'Warnings should be delivered *at least 2 hours before a flood event'.*

It may be useful to integrate co-ordinate and manage the door-to-door warnings with the MMWDS as well.

14.4.2 Support

'Service infrastructure shall be fully supported, e.g. 24-hour engineer support and help-line'. Different delivery methods may need different support options, but each will generally take this form.

Requirements of this nature mitigate the risks that are usually controlled by reliability requirements (see 14.5.13).

14.4.3 Special Devices

'Fully integrates *with mobile forms of communication'*. An interface test to be should be sought for particular possible technologies in a way similar to section 13.3.

It is felt that this requirement would be given best treatment with its own requirement classification group as in suggested in sub-section 14.5.11.

'Interfaces with other *warning technologies or peripheral devices'*. These would include special actuators and devices for those with impaired sensory perception abilities such as the hard of hearing.

Requirements based on this will generally relate to the presentation or coverage aspects of service and to the requirements covered by both 14.5.4 (MMWDS – channel – peripheral device) and 14.5.5 (peripheral device – recipients).

14.4.4 Recipient's Costs

'Information should be low cost to the recipient, ideally it will be free'.

'Installation requirements for the recipient should be low, ideally no installation of extra equipment would be required'.

14.4.5 Recipient registration and database requirements

'Recipients shall be able to register for the service via the Internet, the telephone or via the postal service'.

'EA shall be able to amend recipient registration details on behalf of the recipient'.

'Recipients shall be able to amend their registration details via the Internet'.

'Recipient stored details to include: name, address, Email address, telephone number, and mobile telephone number'.

14.4.6 Recipient preference requirements

"Recipients will be able to choose certain dissemination channels" channels TBC. Note some channels will be broadcast pushes and not recipient triggered i.e. reception is unavoidable (e.g. sirens).

"For certain dissemination channels recipients will be able to set a preferred language" languages choices and channels TBC.

"For certain dissemination *channels recipients will be able to set preferred formats"* formats and channels TBC.

"For certain dissemination channels recipients will be able to set preferred regions/rivers of interest" regions/rivers and channels TBC.

Some chronological constraints may also be useful, e.g. making a region only applicable on weekdays.

14.4.7 Message Delivery

"As part of a message dispatch task EA operators should be able to select from categorised template messages." Categories and templates TBC.

"Messages should be fully editable before sending."

"Chances of delivery must be predictable for given weather conditions." This will be dependent on delivery method and conditions. By understanding this against costs, recipients can be targeted for best chance of reception and value.
"Message shall be rapidly transmitted to the recipient."
"Message delivery sub-system shall be modular, allowing new delivery methods to be added, as they become available." For a test to be possible particular technologies or sub-types of the identified scenarios would need to be specified (in a way similar to section 13.3).
"The technology of the delivery method should be understood and trusted by TBC% of the recipient base." This would require feedback and would need checking against sub-groups to obtain best coverage.
"Message delivery through unicast channels should be able to be delivered in a prioritised manner." How and with which heuristics priorities are set would need full treatment. An example where this can be important is where a surging inundation is predicted to have a path; those being affected first should be the first to receive a warning (assuming it is not too late).

14.4.8 Delivery Reporting and Management

*"*Performance *summary of delivery shall be available."* This should be available in several forms, as simple summaries, by scenario and or sub-group and with costs as well as min, max, mean times of delivery and warning – flood lead times.
"Verification of message delivery to the recipient should be able to be made available if possible per channel." By being able to enable/disable receipting the communications resources can be more fully managed avoiding possible system failures. This may be required to be active in a more complex way such as using categories and prioritisation so only certain recipients receipts are sought.
"Failure of delivery should be reported." The issue of message/channel failure is distinctly different from that of accepting/seeking receipts. It would require its own set of requirements.

14.5 Service System requirements by SRD category

14.5.1 Introduction

This sub section deals with requirement areas as defined by Mazza et al 1994. It is included to provide a perspective that is likely to be more familiar to those actually developing channel trial systems.
Another useful purpose is to provide a source and a framework for identifying and exploring requirements.
Ideally the MMWDS would have clear traceablility between the aspects of service (similar to sub-section 13.5), the areas of business (similar to sub-section 14.3) and a standard framework such as this sub-section.

14.5.2 Functional SRs

This category defines what the software has to do; ideally referring to models. Most of the capability URs and the textual detail that can be surmised from the functional (and workflow) models developed should map onto this category of SR.
This is likely to be the largest category in terms of number of individual requirements.
Trial stakeholder requirements are not likely to feature but those of EA operators and recipients will.

14.5.3 Performance SRs

These are quantitative requirements that verify the operation of the system usually in terms of time taken (or rate) for operations to occur.

For example, given the importance of the rate of message delivery this is an obvious source of candidate system requirements.

14.5.4 Interface SRs

This category defines the machine – machine interfaces. For each interface there should be an documented exact specifications that can be implemented without further design. Ideally these should be open international standards.
The main interfaces are to the data fusion inputs relating to forecasting, sensors and data acquisition. And the communication channels.
Multi-tier systems will have to define the intermediate interfaces.

14.5.5 Operational SRs

This category defines the human – machine interfaces. Workflow and business processes undergone by the operators of the system will be a useful source for requirements of this category.

14.5.6 Resource SRs

These relate to the resources that are required to support the system. These could include amount of man hours per EA operator type, computing power or storage, space, network bandwidth; any finite resource that will require planning and management by the EA.
This category could also include the amount of recourse to other services such as forecasting.

14.5.7 Verification SRs

These are requirements that relate to ensuring performance before actual use of the system.
They will include the usual testing activities; unit testing, integration testing and acceptance testing.

14.5.8 Documentation SRs

These are requirements that relate to what documentation is necessary. The purposes of documents are usually also traceable to the quality or maintainability categories. This is in the sense that documents exist to ensure the project executes satisfactorily and of the correct quality when the product is made. The product can also easily be understood and adapted so it is better for purpose or suitable for another purpose in the light of this document.
Documents likely to be necessary are:

- Project plans
- Requirements documents
- Acceptance \ test plans
- Detailed Designs
- Final reports
- Project history documents

14.5.9 Security SRs

Security cannot realistically be added as an afterthought. To make a system optimally secure there will be many opportunities for consideration at the requirements and design phases. Given the potential audience, importance of the system and the likely resulting media attention the MMWDS will be a very attractive target to attack from groups such as "hackers".

Such attacks often claim to be in the public's interest, to highlight weakness in systems. However it would be damaging to the public's perception of the service and could be very costly to resolve after delivery rather than at the design stages.
Security must be pervasive across all boundaries within the system including individual communication channels. For example if interactive signage was used then this needs to be secure as a separate sub-system as well as the service as a whole being secure.

14.5.10 Portability

This category relates to how the delivered systems can be made to operate on new platforms. This would include the platforms that execute the management functions. It does *not* cover the mobility of message recipients (see below).

14.5.11 Mobility

This requirement type is not identified in Mazza 1994; however it is included as two of the scenarios cover recipients who are or may be mobile.

14.5.12 Quality

This category deals with adopted standards and the level of auditing required.

14.5.13 Reliability

No system can really claim 100% reliability. The requirements should cover what level of reliability is required and how much time, effort and money is required to overcome failures in the system and services.
These need to be aligned to the impact of failure; so appropriate risk can be run. The impact of failure of trial systems will be much smaller to that of the final systems. The main importance to the trial system is that the results are not invalidated or reduced significantly in any way.
It is most important that any failures and their impact can be detected.

14.5.14 Maintainability

May be read as how easily corrective changes can be made (once discovered after delivery). From T15's perspective it is also important to measure flexibility to add features. New communication channels and warning presentation types are obvious candidates for explicit inclusion.
For the overall system however, there are many more areas that would be covered by this concern. A starting point would be to use the interface SRs as identifiable sources of change. Complete consideration of the use-cases and concept of operation cannot be avoided though, as there will be many other areas where the system may require change. For example the areas and shapes a GIS can scope when targeting messages is another possible source.
Not all eventualities should be sought, as these would only obscure those requirements that are known to be likely to change or grow.

14.5.15 Safety

There will be two main categories of SR for safety. Those relating to the possibility of harm to civilians and those that relate to property damage mitigation.

14.5.16 Scalability

Though not in Mazza 1994 and though it could be the case that other categories may cover issues of scalability, it requires special treatment. Experience from Internet ventures has shown that like security, it is difficult and expensive to try and bolt on scalability as an afterthought.

15 WP2: CHANNEL TRIAL USER REQUIREMENTS

15.1 Introduction

This section details the generalised requirements for a channel trial system.

15.2 Standards Compliance

For compliance with Mazza 1994 a user requirements phase should have:

- A documented, clear understanding of what operations users will undertake and what the software is expected to do.
- EA with ownership of the requirements, and for all known requirements to be included.
- Each requirement being verifiable, unique, identifiable and showing its priority (essential requirements marked as such) and its source (e.g. from EA operator interview report).
- The impact of failure for each requirement should be documented so the true importance of the requirements can be understood (in light of its priority and impact).
- All external interfaces defined and documented.
- When believed complete all outputs shall be reviewed together by the EA and supplier.
- Completion and review before other development work is undertaken.

15.3 EA Operator Requirements

It should be the aim of any channel trial system that the running costs are kept to a minimum. This should mean that the use of EA operators as a resource is kept to a minimum.
Where the use of EA operators cannot be avoided for a trial, it would be ideal if a set of interfaces could be reused.

15.4 Message Recipients Requirements.

If the channel trial system is going to disseminate actual flood warnings in real time, many of the requirements will mirror that assumed for the MMWDS. The risks of failure would require mitigation. Having existing means of warning that could also be relied upon would reduce the impact of failure of a trial channel.
If test messages (not real time flood warnings) are to be disseminated then recipients involvement can be determined and scoped to best suit the trials' information needs.
In general, the requirements for recipients of trial systems would be that the use of their own resources was kept to an acceptable level; in particular the time they would have to dedicate.

15.5 Trial Stakeholder Requirements.

The main requirement for those interested in the results of trials is that results have known accuracy, are valid and can be of use in improving the warning service delivered to the public. This would mean that maintenance or addition to the MMWDS could implement the improvements.

15.6 Requirements For Particular Trials

The requirements for particular trials will vary greatly with the information sought and the service aspects that are hoped to be improved.

It is hoped that often these can be drawn from those areas identified in the previous sections of this document especially 3.4 Message Recipients Requirements.

16 WP2: CHANNEL TRIAL SYSTEM REQUIREMENTS

16.1 Introduction

This section details the generalised requirements for a channel trial system.

16.2 Allowing channel characterisation

A top-level user requirement of the trial system would be “to learn as much as possible about a system: the strengths, weaknesses, cost and potential, with known assumptions, accuracy uncertainties”.

16.3 Role of MMWDS

If interface to the MMWDS were not available, some system with a similar interface would be necessary.

Both system types have to be considered to prevent requirements from falling into a gap between the MMFWS and the channels that the trials will scrutinise. As both are concurrently developed, this can easily occur because each systems engineer’s assume that the responsibility for some desired feature or effect lies elsewhere.

Section 1 and its accompanying figures give treatment to the scoping of the systems.

The trial systems are temporary systems, to quantify and qualify several predetermined characteristics of a channel. The characteristics could vary in nature and cover many aspects including technical, audience coverage, social impact and other areas. Due to their temporary nature trial systems should be able to be engineered to a lesser standard at a lower cost.

Some trials may concentrate on gathering data on the effectiveness of the final presentation rather than the Quality of Service (QoS) of the communications channel alone. These would measure how accurately and timely warnings were *interpreted* rather than *received*.

Actual requirements for given trial systems will vary from case to case; for example they will depend on whether its purpose is to scrutinise the QoS of a channel, the presentation of a warning etc. This document does not attempt to capture completed requirements for all trials, or for any particular trial. It sets a top-level framework for future reference by other more detailed documents pertaining to particular trial systems.

16.4 Concept modelling

The concept of operation should be able to be inferred from the URs. This is usually enhanced with concept models that define the scope of operations of a system in a standardised means.

The figure below is an example figure of a communications channel trial system. It uses the notation specified by Pressman for concept modelling.

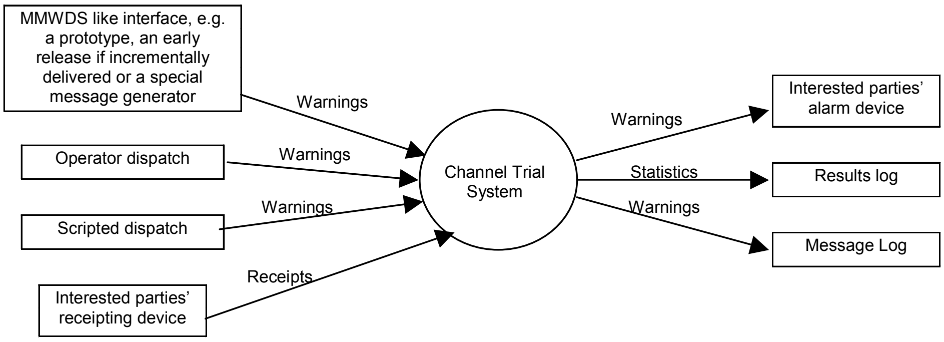

Figure 0-9 Context Diagram for Channel Trial System

(Document's focus)

The figure shows the high level inputs and outputs of the system. With more detailed requirements it may be useful to have a hierarchy of concept models; the MMWDS would certainly benefit from such treatment.

16.5 State modelling

The concept models are used as the basis for state models that identify the different states of operation the system will have to undergo.
The figure below is an example figure of a communications channel trial system. It uses the notation specified by Pressman for state modelling.

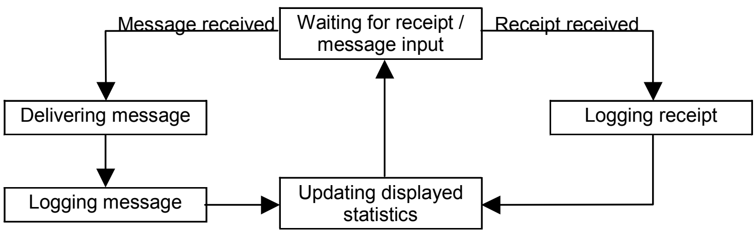

Figure 0-10 Trial System State Transition Diagram

The figure shows the states of operation the trial system will have to undergo. These will need several layers of development in a hierarchy that will form the basis of the detailed system designs.

17 WP2: REQUIREMENTS - CONCLUSIONS

All requirements must be traceable back to the publics need to respond or to have action taken on their behalf by the EA's professional partners.
The boundaries of scope and responsibilities of the T15 and MMWDS need to be fully understood and agreed upon.
The full treatment of requirements for the system will be provided by the MMWDS project.
The EA tend to view requirements and problem areas in the following categories:

- Service Coverage
- Support
- Special Devices
- Recipient Costs
- Registration and Database Systems
- Recipient Preference Requirements
- Delivery Reporting and Management

The identified alerting service aspects which improvements can be categorised by are:

- Audience Coverage
- Targeting
- Speed
- Cost
- Content
- Presentation
- Receipting

Full treatment of requirements for any particular trial system will be undertaken as part of the development of that system.
Generalised, high level concept and state models can be realised that cover many possible trial systems

18 WP2: REQUIREMENTS - RECOMMENDATIONS

Consensus of the correctness of this document and its assumptions should be sought. This will have a positive impact on the final report and the future trials.

This document should be used as a common reference for future trial systems and their documentation.

The tractability should be explicit across stages of development (e.g. in tables of references between documents).

Any future trial system must address at least one of the aspects of service identified.

The risk, cost and development approach of future trial systems should be carefully managed with regard to identified impacts and made appropriate to the scale of the system.

19 WP3: INTERNATIONAL PERSPECTIVE - APPROACH

19.1 Introduction

This document describes the key warning dissemination systems in use around the World. Where information has been available, planned enhancements to existing systems are also discussed.

Information gathering was mainly conducted via Internet World Wide Web searches. Such searches are often convoluted and were supported by e-mail communications with key players where appropriate.

19.2 Problems of Information Gathering

A common feature in many countries is that the responsibility of flood risk management is spread across the boundaries of several organisations. These organisations often are more fragmented than is probably desirable, so the information gathering task is not simple.

Discounting language barriers, the information available from these multiple sources is often obscured, out of synch or contradictory. This report attempts to provide a clear concise view of each nation's perspective. The distribution of responsibilities and the internal structures of the contributing organisations are made as transparent as possible to the reader so that the philosophy of the intended operation of the warning systems can be more easily understood.

19.3 Way Forward for Document Maintenance

The office of Civil Defence in Singapore is reportedly developing technologically advanced warning system. A dialogue is being sought via the UK government's cabinet office. If any useful information is gained this will form a new section of the document.

The document covers many rapidly changing information sources and it will be necessary to review and maintain this document for it to remain up to date and fully relevant. An approach to manage this would be to collaborate with the National Steering Committee for Warning and Informing the Public (NSC WIP) so that international relations can be fostered with the view of sharing international intelligence.

The committee would act as a hub so that knowledge is distributed internationally with trust and integrity. The committee would then forward information nationally to relevant organisations such as the EA. The committee could also deal with and forward any queries such parties may have.

See section 15 for some indication of international dialog that could be sought.

20 AUSTRALIA

20.1 Overview

Australia does not have a national warning system. The only national system in place is the Standard Emergency Warning Signal (SEWS) that is used in television and radio broadcasts immediately preceding major emergency announcements.

Emergency Management Australia has issued guidelines to be used for Flood Warning Systems that are the responsibility for each state. A number of states are investigating the use of flood warning dissemination systems.

20.2 Standard Emergency Warning Signal (SEWS)

The Standard Emergency Warning Signal is a distinct sound substantially different from any other emergency signal or siren. It does not relate to any particular emergency situation. SEWS should only be used in threatening situations when it is necessary for the population to take action to prevent or reduce potential loss of life or property.

The SEWS sound should be broadcast immediately preceding major emergency announcements on the radio, television and other communication systems to alert the population to the importance of the information message that follows. The emergency announcement that follows SEWS is intended to instruct the population to take, or be prepared to take, specific action in order to protect life, property and/or the environment [2].

To maintain the status and effectiveness of the signal, the use of SEWS should be limited to significant events as determined by the Hazard Management Agency (HMA). These may include the following:

- Tropical Cyclones
- Severe Thunderstorms
- Gale Force Winds
- Major Flooding and/or Dam Burst
- Earthquakes
- Tsunamis
- Hazardous Material emergencies
- Major Pollution emergencies
- Major Urban and Rural Fires
- Civil Defence emergencies

The decision to use SEWS and to broadcast an emergency announcement is the responsibility of the HMA in consultation with the relevant State, Metropolitan or County District Emergency Co-ordinator.

20.3 Emergency Management Australia Guidelines

Emergency Management Australia has issued guidelines to be used for Flood Warning Systems [3]. Included in these are specific guidelines for dissemination modes, which are split into two categories:

- ***General Modes*** are mainly represented by the mass media.
- ***Specific Modes*** provide warnings to individuals, groups or organisations.

The guidelines state that the two categories should be seen as complimentary; specific warnings serve to reinforce and confirm the general warnings typically available in a developing flood.

A number of flood warning systems like the one in use in the towns of Euroa and Benalla in Victoria, use Automated Voice Messaging (AVM). When a flood is expected to reach a certain level, the relevant local council calls the nominated telephone service provider, enters a PIN number and records a message to alert receivers of the situation and to advise them to listen to the local radio station.

Recipients can be grouped by street block, zones of addresses or by floor height relative to the key river height warning gauge. The system reports on those telephones that did not answer or were engaged at the time the call was made. Doorknockers can then target those premises.

Door knocking should be carried out if radical action (including evacuation) is necessary. Door-knockers should, ideally, deliver printed material giving advice on how to prepare for the coming flood and should specify what people should do before leaving home and what they should take with them.

The final choice of dissemination modes depends on what has to be achieved in the given timescale. This depends on the following:

- Warning requirements in terms of critical height and update frequency
- Flood severity
- Available warning time
- Target audience
- Available resources
- Time of day and day of the week
- Required reaction

Although specific modes of dissemination require more resources, they should be used where practical and appropriate.

21 AUSTRIA

21.1 Overview

Austria has 9 provinces, with each province having its own parliament and government. The provinces are divided into 2304 city and country municipalities. A Federal Alarm Centre has been installed in the Federal Ministry of the Interior, and Provincial Alarm Centres have been set up in the provinces.

During a crisis, depending on the scale of the event, the Provincial or Federal Alarm Centres become involved. The task of the Provincial Alarm Centres is to warn and alert the public in case of imminent danger and to co-ordinate rescue and relief operations. Should a supra-regional or international crisis occur, the Federal Alarm Centre serves as a co-ordinating point for the provincial alarm centres and a message relay centre for the National Crisis Management Board.

In addition to an outdoor alarm system, the Austrian government has also installed an Early Radiation Warning System consisting of 340 measuring stations with a maximum spacing of 15km between stations.

21.2 Outdoor Alarm System

The outdoor alarm system is still under development, but currently consists of approximately 7000 sirens covering 60% to 80% of the population. Sirens can be triggered by the following:

- Federal Alarm Centre (or alternate Federal Alarm Centre)
- Provincial Alarm Centre (or alternate Provincial Alarm Centre)
- District Alarm Centre
- In rural districts by the local volunteer fire brigade stations.

In addition to its other communications networks, the Federal Ministry of the Interior has installed an independent, fixed, dedicated telephone network connecting the Federal Alarm Centre with its Provincial counterparts and other relevant bodies.

Agreements exist with the Austrian Radio and Television Corporation to broadcast information in a crisis situation allowing around-the-clock operation with central and regional broadcasting stations. However, these measures are intended for war crises rather than natural disasters.

21.3 Planned Enhancements

There are plans to enhance the outdoor warning system with an indoor warning system that will be able to take into account the needs of special vulnerable groups, e.g. people with hearing or visual disabilities. However, these plans have not progressed any further than an investigation into the warning technologies currently available.

22 CANADA

22.1 Overview

There is currently no national public alert system. Different provinces use differing methods for public warning dissemination. The most advanced of which is Alberta's Emergency Public Warning System (EPWS).

Environment Canada has carried out a number of pilot studies into the use of a *WeatherAlert* system that displays videotext crawlers on broadcast television stations, warning of impending, extreme weather conditions.

22.2 The WeatherAlert System

In the spring of 1997, Environment Canada in partnership with Rogers Cable, the Weather Network, the Canadian Broadcasting Corporation (CBC) and other participating local television broadcasters, held a pilot of the *WeatherAlert* system in certain districts of the Greater Toronto area.

All Channel Alert (ACA) technology was installed at cable-head ends to insert text crawlers on participating channels. Participating local broadcasters such as the CBC inserted the crawlers directly. A public opinion survey conducted during the pilot study showed that the general public felt that an emergency broadcasting service was beneficial and should be implemented.

Following the pilot study, a six month field trial was launched in December 1997, covering four locations:

- Windsor, Ontario
- Regina, Saskatchewan
- Vancouver, British Columbia
- St. George's / Thetford Mines, Quebec

During the trial period, test messages were sent once a day, although not at the same time every day. During the one-to-two-hour period, the messages scroll once every 15 minutes, taking approximately a minute for the messages to scroll three times across the bottom of the television screen.

In the event of an actual warning, the number of times the message will be displayed will depend on the severity of the warning. If a tornado warning is in effect, the messages will scroll continuously for the duration of the warning period. Messages for other warnings will scroll several times in short succession, once every ten or fifteen minutes, for the duration of the warning period. The message across the bottom of the television screen will be short and concise. For example, the message for a tornado will read: "ENVIRONMENT CANADA HAS ISSUED A TORNADO WARNING FOR HALTON AND PEEL." Local broadcasters may add a trailing message telling viewers where to get more details.

Following the successful field trials of *WeatherAlert*, no national system has yet been put in place. An application by Pelmorex Communications Inc. (The Weather Network) for an All Channel Alert System was rejected by the Canadian Radio Television and Telecommunications Commission citing a number of issues that needed to be more fully addressed:

- Provide evidence to support the costs associated with establishing and operating the service.

- Include consultations with local broadcasters and distributors.
- Address the needs of the visually impaired who would be unable to read the text-crawlers.

A number of concerns were also raised by the distribution industry which also need to be addressed:

- A methodology needs to be developed to ensure that messages inserted on inter-connected systems only reach the intended audience.
- Cost effective solutions need to found to allow the insertion of warnings on channels that are not distributed at baseband.
- Investigate the issues involved with implementing an ACA system on digital distribution systems.

22.3 Emergency Public Warning System

The province of Alberta in co-operation with all of the local TV and radio stations has installed the Emergency Public Warning System (EPWS) into the Edmonton and Calgary areas of the province. The system was developed after the 1987 Edmonton tornado and has been fully operational in these areas since 1995.

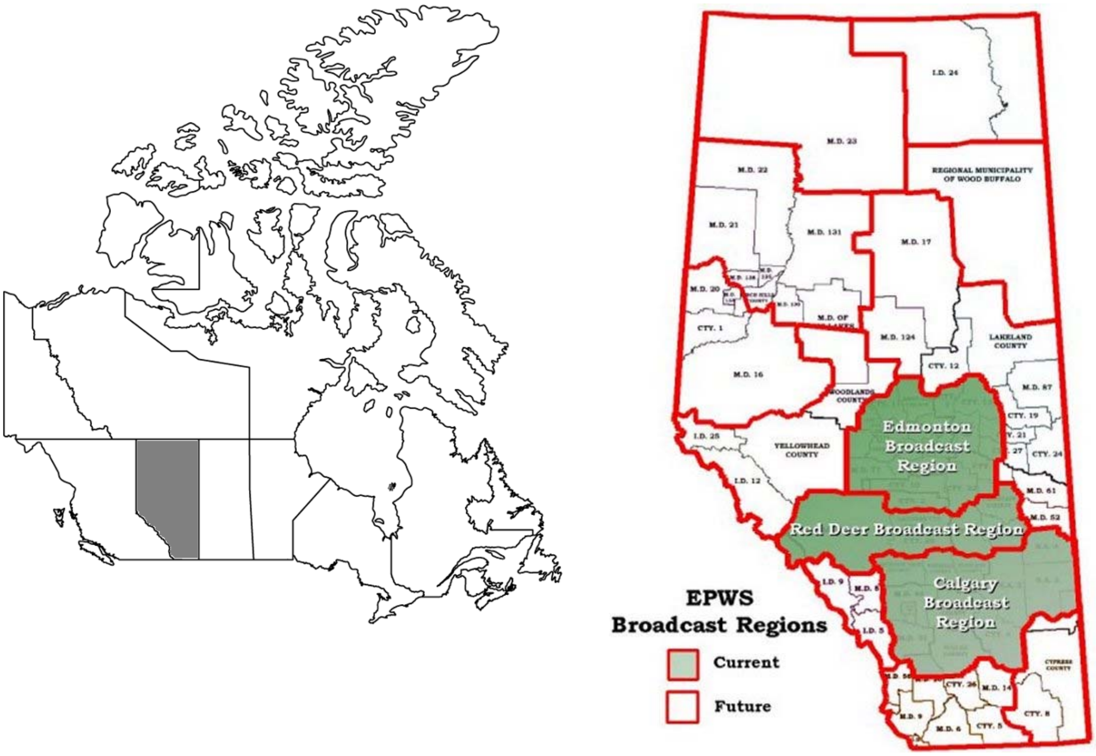

Figure 0-11 EPWS Broadcast Regions (Current and Planned)

The EPWS consists of a network of local broadcasting stations working in voluntary co-operation with the provincial rescue services in Alberta. The broadcast stations have agreed to install a special receiver that enables government officials to interrupt normal programming. All broadcasters in Calgary, Edmonton and Red Deer have indicated their willingness to participate in the EPWS. Broadcasters are not *obliged* to automatically air the warning messages, but in Calgary, almost all broadcasters do so. In the Edmonton area, about 70% of broadcasters do so.

In its history, the EPWS has been activated six times; five times by Environment Canada to warn of extreme weather conditions and once by the Town of Drayton Valley when it was suspected that the municipal water supply had been contaminated.

Now that the Red Deer area has also been added to the EPWS, the system now covers 192 municipalities covering the central corridor of the province. The EPWS will be expanded to cover the entire province by 2004.

EPWS is a secure system with access being limited to authorised users. Each community linked to the system appoints local officials as EPWS users. To become an authorised user, a candidate must attend a training course as well as attending annual half-day refresher courses. The system can also be activated by officials from Environment Canada's severe weather department and by Alberta's rescue services. All authorised users have an area-specific personal code that means that a user can only activate their local receiver, and the warning message is transmitted locally.

Users can activate the system using a touch-tone (or mobile) telephone. The user calls a central computer at the CKUA-FM Radio Network. The computer records the message and transmits it on a FM sub-carrier signal across the CKUA Radio Network to receivers in broadcast outlets. All receivers pick up the recorded public alert, but the area code determines the region over which the message is broadcast.

Broadcasters can configure the receiver to either automatically break into their programming until the warning message has been aired, or they can replay the warning manually. The preferred method is to configure the receivers for automatic operation as this reduces the number of people involved in the transmission and broadcast of the warning, reducing the possibility of error and shortening the time to air, which could be vital in a disaster situation.

The message is transmitted 66 seconds after having been recorded. The recording must not last longer than one minute [4]. The guidelines require the message to contain the following information:

- *What?* The danger must be clearly described.
- *Where?* The area the warning covers.
- *How?* Clear instructions on what actions the public should take.
- *When?* The time or duration of the event (if possible).

After the message has been recorded, the user is to contact the provincial rescue services to give a more detailed description of the situation. A telephone answering service is then set up which contains all available information. The media can then contact this service for more information.

CKUA operates the system and also provides technical support and maintenance services. On-air tests of the EPWS are held once every quarter, on the fourth Wednesday of every third month, at precisely 1:59 PM and last for one minute.

22.4 Community Action Network (CAN)

Sometimes it is necessary to use alternative means of alerting the public. For example, if it is necessary to evacuate a whole residential area in the middle of the night, and if the area is too large to have time to carry out door-to-door calls, a telephone based system is a possible alternative.

Both Canada and the United States of America utilise commercial solutions where companies carry out warning dissemination on the basis of a signed agreement. One

such commercial solution it the Community Action Network which is used in four of the Canadian provinces and in numerous places in the United States.
CAN provides telephone messaging services in times of crisis. The system is used for a range of purposes from potentially life-threatening situations such as tornadoes or floods to alerting a neighbourhood of a missing child. To date, CAN has been used in over 3000 genuine crisis situations in Canada and the United States.
When there is a requirement to warn the public of an impending situation, an authorised user contacts the CAN centre and specifies the area that should be called. The CAN centre then records a warning message (or selects a pre-recorded one) to be disseminated. The centre then calls all of its subscribers in their databases that are in the affected area.
The subscribers are called in a priority order, with the most urgent calls being made first. It is possible to communicate different messages to different groups of subscribers. The warning message can be given in a number of different languages with subscribers choosing which language to receive warnings in.
CAN controls two network centres, one in New York and one in Nevada which gives it some degree of redundancy and the ability to handle two crises simultaneously. However, the system is totally dependent on the telephone network. The CAN centres can make 250 simultaneous telephone calls and can reach up to 45000 people an hour [4].
A weakness that is common to all telephone-based warning systems is that the network easily becomes overloaded in the event of a crisis situation as most people use the phone to obtain further information or to call and warn friends and relatives.

23 DENMARK

23.1 Electronic Warning System

Denmark's Emergency Management Agency has installed a new system of electronic warning sirens. The system consists of 1077 sirens placed in areas having more than 1000 inhabitants. The sirens are placed at the top of buildings or on masts. Approximately 80% of Denmark's population can be warned using this system. Mobile sirens mounted on police cars warn the remaining 20% of the population.

The sirens emit a powerful sound that can be heard over large distances as well as being audible indoors. They all have their own power supply, so remain operational during a power outage.

The electronic sirens are linked into a nation-wide data network that allows them to be activated remotely. Police stations are capable of activating the sirens within their locality should the need arise, e.g. a chemical incident. If a nation-wide incident occurs, the Emergency Management Agency also has the ability to activate the warning system.

When the sirens are activated, the public are to go indoors, close all doors and windows, shut down ventilation systems, then listen to Radio Denmark for further information and instructions. Radio Denmark is connected to the same data network as the sirens. This ensures that the population will receive the necessary information and instructions via the radio at the same time as the sirens are activated.

The sirens are tested electronically every night, without actually producing any sound. A full test is carried out once a year on the first Wednesday of May.

24 FINLAND

24.1 Overview

Finland uses two complimentary warning systems; an outdoor alarm system using sirens and an Radio Data System (RDS) based alerting system. The control system for the outdoor alarm system is currently being upgraded, allowing it to be controlled using the new VIRVE (Viranomais Verkko translated as 'Network for Authorities') public authority radio network

In addition to the national network of sirens, industrial complexes that use hazardous materials have installed and operate warning systems of their own. Finland also has a nationwide radiation-monitoring network consisting of approximately 300 automatic measuring stations which take readings every 15 minutes.

24.2 Outdoor Warning System

The outdoor warning system consists of a network of approximately 1500 sirens, covering the main population centres. Scattered settlement areas have plans in place to use mobile speaker cars to alert the local population of emergency situations.

The country has been divided into 13 alarm districts for emergency planning purposes. By 2006, the emergency response centre operations of the rescue services, the police and the social welfare and health services will be transferred to the Emergency Response Centre Authority run by the State. The new emergency response centres will replace those maintained by the police and the municipalities.

The sirens can be activated either from emergency operations centres, wartime command and control centres, or they can be locally activated from fire stations. The control system is currently being upgraded to incorporate it into VIRVE; the new national Trans European Trunked Radio (TETRA) based radio network.

24.3 VIRVE

The VIRVE network is the World's first digital, national public authority network based on the TETRA standard. This network will replace existing, analogue radio networks by 2003. The VIRVE network will be used by the police, the rescue authorities, the frontier guard (Finland's border with Russia is more than 1000km and is the European Union's longest border with a non-European Union country), the defence forces, the social welfare and health authorities and other safety organisations.

Although the network operates as an internal system for each respective authority, it will greatly improve intra-agency communications. The VIRVE network is Internet Protocol (IP) based and can carry data as well as voice communications.

The VIRVE network is being implemented in stages. The network's first section was commissioned in 1999 and the last section, covering Lapland is due to be commissioned in early 2003. The network is already being used operationally.

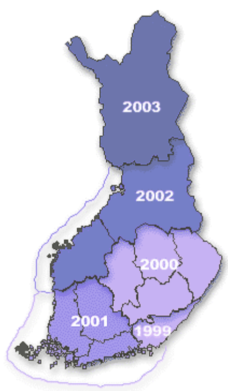

Figure 0-12 Planned rollout of the VIRVE network

24.4 Radio Data System (RDS) Alerting System

An RDS warning system has been developed for the country's local radio network that automatically cuts into all broadcast stations with a warning message. Finland's Ministry of Transport and Communications has financed and supplied RDS receivers for all private local radio stations.

The state-owned broadcaster, YLE transmits an audio warning message with the RDS PTY31 emergency signal being transmitted on an FM sub-carrier. The other local stations then pick up this signal with their RDS receivers, thereby cutting into current programming with the emergency warning message.

Approximately 90% of the population are covered by this RDS warning system. The system is flexible as the PTY31 signal can be localised exclusively to the affected area or areas. The RDS warning system undergoes testing once a year.

25 JAPAN

25.1 Tsunami Warning System

Japan is a nation that is exposed to frequent seismic activity which often generates tsunamis. Japan has developed one of the most extensive tsunami warning systems in the Pacific region.

The Japanese Meteorological Agency (JMA) is responsible for issuing tsunami warnings. The JMA has one main observatory in Tokyo and five regional observatories, all of which are authorised to issue warnings. The stated goal is to broadcast a warning within five minutes from the initial sensing of an earthquake.

If an earthquake occurs offshore, the observatories close to the epicentre will issue a tsunami warning bulletin to their areas of responsibility. The bulletins are sent to the prefectures (similar to a U.S. state) and to the main observatory via the Local Automatic Data Editing and Switching System (L-ADESS) which is a system used by the JMA to exchange forecast data. The main observatory will then issue bulletins to other prefectures and alert other government agencies via the Central Automated Data Editing and Switching System (C-ADESS).

If required, the JMA notifies the Central Emergency Management Communication Network (CEMCN) whose members include the Ministry of Construction, Tokyo Electric Power and the Nippon Broadcasting Corporation. The CEMCN then transmits the warning to their regional offices.

The prefectures receive the warning bulletin at the same time as the CEMCN. The prefectures then disseminate the warning to local governments whose responsibility it is to warn the public. A number of local warning systems are used within Japan which are described below.

25.2 Simultaneous Announcement Wireless System (SAWS)

SAWS is a dedicated communications network installed and maintained by local authorities for transmission of warning messages. SAWS transmitters are located within local government offices, and receivers are issued to emergency management offices, hospitals, schools, fire stations and other public buildings.

Some receivers have been connected to public address systems installed on streets and rooftops of government and commercial buildings. Receivers are also available for purchase by the general public. These consumer units are similar to the tone-alert radio systems used within the United States.

SAWS effectiveness has been shown to reduce by up to 20% during bad weather as people close their windows and do not hear the warning message.

Areas without SAWS use fire engines mounted with loudspeakers which cruise their local areas transmitting the warning message repeatedly.

25.3 Sirens and Bells

A number of villages rely on sirens or bells to warn the residents that an emergency situation exists. On hearing the warning sound, residents should turn on their radio or television for further information.

25.4 Broadcast Media

Broadcast television and radio stations receive tsunami warning bulletins from the main observatory via C-ADESS or from regional observatories via L-ADESS.

On television, a message is either displayed at the bottom of the screen, or within a window overlaying the current programme. The window can also be used to display a map showing the area for which the warning applies. However, the map cannot be shown quickly enough in the case of a local tsunami. On radio, tsunami warnings interrupt current programming which has more impact than a message on a television screen.

26 NETHERLANDS

26.1 National Warning System

A nationwide public warning system has been in place since the 1950's. This old network of electro-mechanical sirens was replaced under the supervision of the Ministry of Interior with a new national warning system. The new system consists of 3500 sirens with uninterruptible power supplies. Approximately 95% of the population are covered.

The system is controlled from 45 regional control centres, one for each of the Fire Service regions. In an emergency situation, local authorities authorise the use of the siren warning system. The regional control centre then activate the sirens, choosing exactly which sirens sound. The activation signal is encrypted and sent via modem to the crisis management radio network, which transmits the activation signal to the chosen sirens.

When the system is activated, the sirens sound for a period of 15 minutes. Upon hearing the warning siren, the public should immediately go inside, close all doors and windows and turn on the radio or television to receive further information and instructions.

There is no standard emergency announcement message, but some regions have elected to use a standard tape which is played on local radio as soon as the sirens are activated.

Silent tests of the sirens are carried out monthly and public exercises are carried out annually.

26.2 Planned Enhancements for the Hearing Impaired

Sirens cannot be used to warn the deaf or hard of hearing. Therefore a supplementary warning system must be used which is activated at the same time as the sirens. It is proposed to install additional equipment at each of the regional control centres that can alert people using a text-phone.

When the sirens are activated, a signal is sent to a text-phone control centre that then warns individual text-phone users. Only users within the catchment area for each siren are alerted.

27 NORWAY

27.1 National Warning System

Norway's system for warning the public of emergency situations consists of a network of approximately 1200 sirens that cover approximately 45% of the population. Three different systems are used to control the sirens:

- Local activation,
- VHF radio system covering mainly the south of the country, and
- RDS radio system covering the middle and the north of the country, with a control receiver at each site.

To activate the system, either an order is sent via VHF Dual Tone – Multi Frequency (DTMF) radio to the local authority to activate a specified siren, or the system is activated via a coded RDS signal. The system is currently being upgraded to allow all sirens to be activated via an RDS signal. National activations can only be authorised by the military Chief of Joint Forces or the Prime Minister. For local activations, authorisation has to be given by the police Chief Constable.

On hearing the sirens, the public should go inside, close all doors and windows and turn on the radio or television to receive further information. In places with no siren, church bells will be rung.

28 SWEDEN

28.1 Introduction

In Sweden the main system for warning the public utilises the FM broadcasting network. The Radio and Television Act entitles the authorities to request a transmission of a message important to the public on all four of Sweden's broadcast television stations. The Local Radio Act also gives all authorities the right to request transmission of announcements, which must be of importance to the public, direct on all commercial radio stations. This system is complimented by a network of 4800 sirens, and special indoor warning systems that are installed around Sweden's four nuclear power plants.

28.2 General Outdoor Warning System

The general outdoor warning system is installed in about 250 municipalities, and consists of approximately 4800 sirens. It is mainly concentrated on centres of population with more than 1000 inhabitants [5].

The sirens are activated when there is an actual or potential threat to life, property or the environment. The signal is a call for people to go indoors, close all doors and windows, switch off ventilation systems and to listen to the radio. The signal is immediately followed by an Important Public Announcement (IPA) on television and radio.

Tests of the sirens are carried out four times a year. The test is immediately followed by a radio and television message explaining the significance of the signal and informing people that it is a test.

28.3 Important Public Announcement

The National Rescue Services Agency has signed an agreement with the Swedish Broadcasting Corporation (SBC), the Swedish Television Corporation (STC), the commercial channel TV4 and the Swedish Commercial Broadcaster's Association to allow public warning and information to be transmitted as quickly as possible in times of crisis. The IPA agreement is intended to complement the Radio and Television Act, the government's broadcasting licences and the Local Radio Act [4].

There are two levels of IPA, *alert* and *information*. An alert IPA is usually preceded by an activation of the outdoor warning system and should be transmitted immediately. It is activated in situations where there is an immediate threat to life, property or the environment. An information IPA does not need to be transmitted immediately but can wait until a suitable occasion. It should be requested to prevent or limit harm to people, property or the environment.

An IPA must be requested through a regional SOS alarm centre that then passes it on to a central alarm centre, SOS Stockholm. The request is then passed onto the SBC's network director via a permanent secure line. When SOS Alarm makes a call on this line, a blue lamp flashes in the Network Direction office. This message is then relayed to STC, TV4 and commercial radio stations. Commercial radio stations transmit the message immediately and then repeat it after 2-5 minutes, with instructions to tune into SBC's local station for the area in question and await further information.

The following people are entitled to request an IPA:

- Head of Rescue Services
- Chief of Police
- Chief Rescue Officer
- County Council
- Regional Director of Civil Defence
- National Coast Guard
- National Civil Aviation Administration
- National Police Board
- National Rescue Services Agency
- National Maritime Administration
- On duty municipal fire officer
- On duty police chief / police officer
- Establishments that have been authorised by the county council, e.g. chemical plants.

Although an IPA Alert has never been issued, IPA Information messages have been issued many times. On several occasions there has been confusion over the procedures to be followed and there is apprehension about requesting an IPA, even when the situation has warranted one. This has highlighted the need for additional training and clearer regulations governing the issue of IPAs [4].

28.4 Indoor Warning System

Special indoor warning systems have been put in place within the inner planning zones around Sweden's four nuclear power plants. The warning system utilises (RDS) receivers that were given out free of charge to each household.

Figure 0-13 An RDS Early Warning Receiver (Source: www.2wcom.com)

The RDS Early Warning receivers look like normal clock radios (see Figure 0-13), but have two tuners. One acts as a normal FM radio and the other listens for the PTY31 RDS emergency signal. If an incident occurs at the nuclear power plant, an RDS signal is broadcast on local radio stations. The receiver emits an 80dB warning tone and instructions appear on the receiver's display. Further instructions then follow on the

same radio station. The receiver is equipped with a rechargeable battery so that it will continue to function during power outages.
This special RDS warning system is used in conjunction with the general outdoor alarm system and IPAs broadcast on local television and radio.

28.5 Testing

Both the outdoor and indoor warning systems are tested on the first Monday in the months of March, June, September and December. The outdoor system is tested at 15:00 and the indoor system at 19:00. The tests include a simultaneous announcement on radio and television stating that it is a test of the system.

29 SWITZERLAND

29.1 Outdoor Alarm System

The Swiss government has installed a network of approximately 4300 stationary sirens that are complimented by approximately 2700 mobile sirens mounted on police vehicles. This network of sirens covers about 95% of the Swiss population.

Sirens can be triggered either by the local emergency services or by the National Emergency Operation Centre (NEOC). If triggered by the NEOC, a warning message is distributed to the cantonal police headquarters, who then trigger the sirens.

A project financed by the Federal Office for Civil Defence is introducing a new remote control system that should be in place by 2005. Currently, about half of the stationary sirens can be triggered remotely (mainly in larger towns and municipalities). The new control system communicates with the sirens using Infranet, a security network run by the Swiss telecommunications provider, Swisscom. The new control system will allow the sirens to be activated from both regional control centres and from the NEOC.

There are three different types of alarm sounds used in Switzerland, with each having a different meaning. Instructions for the different alarm types are published in telephone directories. The General Alarm consists of a warbling tone that lasts for one minute. Upon hearing the alarm, the population are to go indoors and listen to the radio for further instructions.

In areas around nuclear power stations, a nuclear alarm can be sounded which consists of a warbling sound lasting for 12 seconds, followed by 12 seconds of silence. This sequence is then repeated several times. Upon hearing the alarm, the population are to immediately go to a cellar or a shelter and listen to the radio for further instructions.

In areas around dams, a water alarm can be sounded in the case of dam breaks. This alarm is a constant tone lasting for 20 seconds, followed by 10 seconds of silence, which is then repeated. Upon hearing the alarm, the population is to evacuate immediately and follow instructions on official leaflets.

Sirens are tested on first Wednesday in February at 13:30. There are no public exercises.

30 UNITED STATES OF AMERICA

30.1 Emergency Alert System (EAS)

The Emergency Alert System (EAS) which came online in 1997 replaced the 1963 Emergency Broadcast System (EBS). The EBS was originally created to allow Federal authorities to warn the American public of a national emergency via the nation's broadcast TV and radio stations. Although the EBS was never used for an actual national emergency, it was activated thousands of times at a state level to warn of local, natural or manmade threats.

The old EBS required that an official called the primary EBS broadcast station with the warning message to be broadcast. The primary EBS station would then activate special EBS tones that would unlock EBS alert decoders in every radio and television station tuned to that station.

This reliance on the "domino" effect was a major weakness of the old EBS system as many broadcast stations operated unattended, making the relay of warning messages impossible.

There were a number of problems or shortfalls with the EBS that led to the development of the EAS by the Federal Communications Commission (FCC) working in co-operation with the Federal Emergency Management Agency (FEMA), the National Weather Service (NWS), broadcasters and equipment manufacturers.

30.2 EAS Operation

All broadcast stations and cable systems are required to have a FCC approved EAS encoder/decoder. The encoder/decoder unit is capable of transmitting and receiving digitally coded emergency messages. Each encoder/decoder unit is assigned to monitor at least two different sources for incoming emergency messages.

All EAS messages are preceded by a digital data burst which contains the following information:

- The ***Originator*** of the message, e.g. National Weather Service, Civil Authorities,
- The ***Event Code*** identifying the type of emergency, e.g. tornado warning, civil emergency, flood warning,
- The ***Area*** affected by the emergency. The area is encoded as a Federal Information Processing System (FIPS) code. It consists of three parts, a state code, a county code, and an additional one digit 'P' code that can be used either for specific hazard sites, e.g. a nuclear power plant, or for a defined geographical area. 'P'-codes are currently not used in the EAS system,
- The ***Valid Time Period*** of the message, and
- The ***Date and Time*** the message was issued.

EAS decoders can be configured to filter the header code data and activate only for specific emergencies in given geographical areas. Decoder units automatically filter out duplicate activations if the same EAS message is received from different sources. Decoders can be run in manual or automatic modes. In manual mode, the EAS decoder notifies an operator that an EAS message has been received. The operator must then press a button to transmit the alert. In automatic mode, the decoder will automatically interrupt program audio and/or video with any incoming EAS message.

30.3 EAS Activation Points

The EAS can be activated at national, state or local levels. At the national level, the EAS can only be activated by the President of the United States or his constitutional successor. A White House Communications Agency (WHCA) Trip Officer contacts FEMA, at the President's direction. FEMA then activates EAS equipment at 33 Primary Entry Point (PEP) broadcast stations. These broadcast stations are designated as National Primary (NP) sources within the EAS [6].

PEP stations all have an emergency generator and fuel on standby. The coverage area of the PEP stations is 95% of the continental U.S. population, plus the territories of Guam, Puerto Rico and the U.S. Virgin Islands. State Primary broadcast stations and State Relays (SR) are used to retransmit EAS messages to Local Primary (LP) broadcast stations. All of the other participating broadcast and cable stations activate the EAS upon receipt of the Emergency Alert Notification (EAN) event code from the LP stations.

During a national EAS activation, all participating national radio and television stations and cable systems are required to interrupt programming and transmit the national emergency message. Any station with a Non-Participating National (NN) authorisation must sign off the air for the duration of the EAN message.

The EAS can also be activated at a state or local level by state officials or by the (NWS). When the EAS is activated at this level, normal programming does not have to be interrupted and many stations choose to display the warnings as a video text crawler at the top of the screen (preventing interference with any closed captioning system).

30.4 EAS Responsibilities

The FCC is responsible for the inspection of all radio, TV and cable stations to ensure they are compliant with the Commission's EAS rules. In addition, all national, state and local EAS plans must be reviewed and approved by the FCC.

FEMA co-ordinates all EAS activities relating to government agencies, including integration of EAS into emergency telecommunications policies, plans and programs.

The NWS prepares and issues warnings for potentially life-threatening weather events and disseminates earthquake warnings from the U.S. Geological Survey (USGS) via NOAA Weather Radio (NWR), NOAA Weather Wire and telephone.

NWR uses Specific Area Message Encoding (SAME) which is identical to the EAS digital signal. Therefore, a consumer receiver that monitors NWR, radio and television can use the same decoding circuitry [6].

31 WP3: INTERNATIONAL SYSTEMS

31.1 Relevant Organisations

International organisations with remits that cover disasters include the United Nations, the International Federation of Red Cross and Red Crescent Societies, G7, and the European Union. Work seems to be focused on disaster prevention and mitigation using lessons learnt internationally rather than developing international alerting systems.
Examples of such mitigation work are;

- The United Nations International Decade for Natural Disaster Reduction (IDNDR),
- The World Meteorological Organisation (WMO), and
- ReliefWeb, the UN Department of Humanitarian Affairs (DHA) project to disseminate prevention, preparedness and disaster response information.

It appears that ad hoc networks of dedicated people within and between such organisations are the lifeblood of co-ordinated response. There are no real, dedicated systems that umbrella organisations to communicate warnings or to enable communities of those responsible for managing disasters such as floods. Usual public channels of communication are used.
Knowledge sharing and coronation are enhanced by initiatives such as the International Association of Emergency Managers and its peripheral community that is linked together by an automatic e-mail listing facility (iaem-list@iaem.com).
Particular types of disasters have systems in place to share information such as disseminating warnings between parties interested in Tsunami. Communities as such as Floodsystems@yahoogroups.com also form around such domains. There appears to be no purposeful co-ordination of these from the international organisations.
Ultimately the global broadcast media industries are the channels for alerting, warning and informing the public.

31.2 Global Disaster Information Network

The Global Disaster Information Network (GDIN) was proposed as part of president Gore's initiatives. It seeks to provide and integrated solution that would allow international warnings to be broadcast and to also enrich the constituent existing systems.
The money was solely American and the GDIN was affiliated with other American initiatives such as the Partnership for Public Warning (PPW). This would indicate that the GDIN line would closely follow the PPW ideals and proposed standards such as the Common Alerting Protocol (CAP). Some members are shared appointment with GDIN and PPW; these would be ideal candidates for the NSC WIP to target for dialog.
The Homeland Security Agency will be a new organisation that is being planned and will integrate many American agencies such as FEMA and WHCA. It is a radical change similar to the formation of the Department of Defence, designed to make the USA more resilient to disasters, in particular to terrorist attacks.
The USA are in many respects world leaders of public warning and represent the largest amount of expenditure in research, development and deployment. The formation of the HSA should been monitored and aligned with if possible, to best share knowledge for the common good.

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Internet links

Over five hundred web sites were used in the gathering of information, documents and opinion. Links to some of the more general ones are given below.

http://www.alertsystems.org American flood warning systems.

http://www.bbc.co.uk/rd/ BBC Research and Development.

http://cindi.usgs.gov Center for Integration of Natural Disaster Information.

http://www.cellbroadcastforum.org forum for SMS Cell Broadcasts.

http://www.colorado.edu/hazards academic *Disaster Research* resource that has a monthly newsletter.

www.dartmouth.edu\artsci\geog\floods\index.htm includes a flood observatory.

http://www.disasterlinks.net includes many disaster-related links.

http://www.edis.ca.gov Internet push & pull of emergency warnings in California.

http://www.fema.gov Federal Emergency Management Agency.

http://www.fhrc.mdx.ac.uk Middlesex University's Flood Hazard Research Centre.

http://www.floodforum.net hosted by the Parliamentary Office of Science and Technology.

http://www.hse.gov.uk\hid\land\comah\level3\5c99212.htm relating to warning signage.

http://www.incident.com hosts definition of Common Alerting Protocol.

http://www.nnic.noaa.gov/CENR Committee on Environment and Natural Resources.

http://www.partnershipforpublicwarning.org a Public Private Partnership for warning the public, previously headed by Peter Ward.

http://www.plca.net the Power Line Communication Association.

http://www.ukdigitalradio.com UK resource for DAB.

http://rds.org.uk UK RDS forum.

http://sdcd.gsfc.nasa.gov\DIV-NEWS\earth_alert.htm Earth Alert project.

http://www.wdc.ndin.net The Western Disaster Center.

http://www.worlddab.org Digital Audio Broadcast resource.

ESA Disaster Management Database

http://earth.esa.int/applications/dm/disman/

Emergency Broadcasting, Industry Canada Region Emergency Telecommunications http://spectrum.ic.gc.ca/urgent/htms/brdcst.htm

Community Notification Solutions

http://www.telcordia.com/

Emergency Public Warning System

http://www3.gov.ab.ca/ma/ds/epws.cfm

Danish Electronic Warning System

http://www.beredskabsstyrelsen.dk/uk/warning/warning_system_info.htm

Emergency Services in Finland

http://www.pelastustieto.com/2001/pt501-6.html

VIRVE Communications Network

http://www.virve.com/english/tekninen_kuvaus/tekninen_kuvaus.html

RDS Early Warning System

http://www.2wcom.com/

Swiss Alarm System

http://www.zivilschutz.admin.ch/e/zivilschutz/information.html

Emergency Alert System

http://eas.oes.ca.gov/Pages/whatseas.htm