



# Incident Ground Communications Study

## **Current Situation Report**

Fire Research Technical Report 19/2008





Incident Ground Communications Study  
**Current Situation Report**

Fire Research Technical Report 19/2008

Mott MacDonald

December 2008

Department for Communities and Local Government

The findings in this report are those of the authors and do not necessarily represent those of the Department for Communities and Local Government

**Copyright in the contents, the cover, the design and the typographical arrangement rests with the Crown. This document/publication is value added. If you wish to re-use this material, please apply for a Click-Use Licence for value added material at [www.opsi.gov.uk/click-use/system/online/pLogin.asp](http://www.opsi.gov.uk/click-use/system/online/pLogin.asp).**

Alternatively applications can be sent to:  
Office of Public Sector Information  
Information Policy Team  
Kew  
Richmond upon Thames  
Surrey TW9 4DU

E-mail: [licensing@opsi.gov.uk](mailto:licensing@opsi.gov.uk)

*This publication has been approved by Ministers and has official status. The contents of this publication may be reproduced free of charge in any format or medium for the purposes of private research and study or for internal circulation within an organisation. This is subject to the contents being reproduced accurately and not in a way that implies official status. Any publisher wishing to reproduce the content of this publication must not use or replicate the logo or replicate the official version's style and appearance, including the design, and must not present their publication as being an official publication as this may confuse the public. The reproduced material must be acknowledged as Crown Copyright and the title of the publication specified.*

Any other use of the contents of this publication would require a copyright licence. Further information can be obtained from [www.opsi.gov.uk](http://www.opsi.gov.uk)

Communities and Local Government  
Eland House  
Bressenden Place  
London  
SW1E 5DU  
Telephone: 020 7944 4400  
Website: [www.communities.gov.uk](http://www.communities.gov.uk)

© Queen's Printer and Controller of Her Majesty's Stationery office, 2008.

If you require this publication in an alternative format please email [alternativeformats@communities.gsi.gov.uk](mailto:alternativeformats@communities.gsi.gov.uk)

Communities and Local Government Publications  
PO Box 236  
Wetherby  
West Yorkshire  
LS23 7NB  
Tel: 0300 123 1124  
Fax: 0300 123 1125  
Email: [communities@capita.co.uk](mailto:communities@capita.co.uk)  
Online via the Communities and Local Government website: [www.communities.gov.uk](http://www.communities.gov.uk)

December 2008

Reference number: 08 RSD 05578

ISBN: 978-1-4098-0683-7

# Contents

<b>Chapter 1</b>	<b>Introduction</b>	<b>3</b>
	1.1 Background	3
	1.2 Purpose and scope	3
	1.3 Key drivers	4
	1.4 Issues to be addressed	4
	1.5 Approach taken	5
	1.6 Contents	6
<b>Chapter 2</b>	<b>Reference Documents</b>	<b>7</b>
	2.1 Fire Research and Statistics Division (RSD) and Mott MacDonald	7
	2.2 Other organisations	7
<b>Chapter 3</b>	<b>Stakeholders Consulted</b>	<b>9</b>
	3.1 Fire and rescue services – UK	9
	3.2 Fire and rescue services – international	10
	3.3 Other organisations	11
<b>Chapter 4</b>	<b>Current Fire and Rescue Services Practices – Across the UK</b>	<b>12</b>
	4.1 Introduction	12
	4.2 The current situation in brigades and fire and rescue services	20
	4.3 Summary of current fire and rescue service practices – across the UK	31
	4.4 Conclusions of current fire and rescue service practices – across the UK	34
<b>Chapter 5</b>	<b>Current Fire and Rescue Services Practices – Internationally</b>	<b>36</b>
	5.1 Introduction	36
	5.2 Eire – Dublin Fire Brigade	36
	5.3 Singapore – Singapore Civil Defence Force	37
	5.4 Summary of current fire and rescue service practices – internationally	38
	5.5 Conclusions of current fire and rescue service practices – internationally	38

<b>Chapter 6</b>	<b>Related Fire and/or Communications Developments</b>	<b>39</b>
6.1	Introduction	39
6.2	Groups, committees and projects	40
6.3	Other issues	49
6.4	Summary of related fire and/or communications developments	50
6.5	Conclusions of related fire and/or communications developments	51
<b>Chapter 7</b>	<b>Summary and Conclusions of the Current Situation</b>	<b>52</b>
7.1	Current fire and rescue services practices – across the UK	52
7.2	Related fire and/or communications developments	53
7.3	Summary from this part of the study	54
7.4	Conclusions from this part of the study	55
<b>Appendices</b>		<b>57</b>
	Appendix A: Interview scripts, UK fire and rescue services	57
	Appendix B: Questionnaire, international fire and rescue services	60

# Chapter 1

## Introduction

### 1.1 Background

This project is one of a series undertaken as part of the Building Disaster Assessment Group (BDAG) established to consider the issues, for fire and rescue services in the UK, that have been highlighted by the World Trade Centre incident of 11 September 2001 (9/11).

The projects' aim is to provide advice and guidance on the possible types of communications infrastructure that may be needed in the built environment to support fire and rescue service intervention.

This scoping study forms the first part of that project and the study's aim is 'to review the current level of knowledge and understanding of the forms of communications infrastructure available in the built environment and the requirements for effective communications on the incident ground within the UK' [Ref. 1-1].

Mott MacDonald has been appointed to complete this study.

### 1.2 Purpose and scope

This Current Situation Report is an interim deliverable within Stage 1 of the Study, Information Gathering, and is the output of Work-streams 1.1a and 1.1b as described in our proposal [Ref. 1-2]. As such it provides information on the:

- Current Situation found in reviewing existing arrangements for At-Incident communications in operational use (Work-stream 1.1a); and
- Future Requirements for the same (Work-stream 1.1b).

The following sections summarise these findings and provide some commentary on their significance. These findings will be used as input to Stage 2 of the Study, Analysis, along with the other interim deliverable from Stage 1, the Technology Review Report.

## 1.3 Key drivers

The key drivers are highlighted in the brief provided [Ref. 1-1] as follows:

'The radios presently used for incident ground communications in the UK operate in the Ultra-High Frequency (UHF) range. As such, signal transmission between handsets can be adversely affected by the interruption of the signal by a number of factors, including the materials used in building construction. Signal problems may be encountered in any environment but are a particular issue in the built environment (especially large or complex buildings, and tunnels and other sub-surface structures) due to the nature of the construction methods used.

Problems in fire and rescue service communications may also occur where in-built systems, such as dedicated fire control centres within buildings, are adversely affected by extreme events such as terrorist activities.

The McKinsey report into the response of New York Fire Department (FDNY) to the World Trade Centre incident [Ref. 2-12] identified that any interruptions to incident ground communications, particularly in large or complex buildings, can have a severe effect upon the effective command and control of incidents and thus the safety of firefighters and occupants. The U.S National Institute of Science and Technology (NIST) NCSTAR 1-8 report (Federal Building and Fire Safety Investigation of the World Trade Center Disaster) [Ref. 2-13] also identified radio communication problems.

In the UK access and facilities for the fire and rescue service are identified through the Building Regulations, however, there are presently no general requirements for communications infrastructures to be provided to overcome communications problems as part of such facilities. The most recent consultation document on the Approved Document 'B' of the Building Regulations [Ref. 2-14] does contain some recommendations on the provision of communication systems in some circumstances.'

## 1.4 Issues to be addressed

Issues to be addressed by this study are also highlighted in the brief provided [Ref. 1-1] as follows:

'The scoping study will take the form of an international literature review and survey of current practice, nationally and internationally, to identify and quantify where appropriate:

1. The forms of communications infrastructures currently used on the incident ground by the fire and rescue service in the built environment
2. The present advice and guidance provided on communications infrastructures designed to support fire and rescue service intervention in the built environment

3. The forms of communications infrastructures and systems which are, or in the foreseeable future will be, available for use in the built environment
4. The effect that the nature, configuration and construction of the built environment has upon fire and rescue service communications infrastructures
5. The use of telemetry equipment by fire and rescue services to monitor personnel and the incident environment and the interaction of this type of equipment with the built environment
6. The need for emergency service inter-service communication on the incident ground
7. The efforts of the communications industry, and others where identified, in devising means of suppressing or restricting radio communications within the built environment and the potential impact of these activities on fire and rescue service incident ground communication
8. The communication needs of the fire and rescue service currently and the likely needs in the next five years
9. A 'gap analysis' between the needs and the provisions currently, and in the next five years.

This Current Situation Report is one part of that study of Stage 1 of this study and feeds into Stage 2 where these issues are addressed.

## 1.5 Approach taken

Given the limited time available to complete this report the approach taken was to consult a number of UK and international fire and rescue services, as well as others, by telephone and/or email using interview scripts and questionnaires prepared for this purpose and included as appendices to this report:

1. Appendix A – Interview Scripts, UK Fire and Rescue Services
2. Appendix B – Questionnaire, International Fire and Rescue Services.

It is not intended to be an exhaustive or rigorous approach but is considered to be representative and sufficient for the purpose at this time.

## 1.6 Contents

The contents of each of the following sections of this report are as follows:

1. Section 2 – Reference Documents, lists the key material referred to in subsequent sections
2. Section 3 – Stakeholders Consulted, provides details of the organisations and individuals contacted in producing this report with their contact details
3. Section 4 – Current Fire and Rescue Services Practices – Across the UK, gives a general overview of current practices followed by individual fire and rescue services details
4. Section 5 – Current Fire and Rescue Services Practices – Internationally, giving details of current practices from a selected number of fire and rescue services overseas
5. Section 6 – Related Developments – UK and Internationally, giving details of groups, projects and other issues which may impact or be impacted and thus deserve consideration
6. Section 7 – Summary and Conclusions, which draws on the previous three sections (4, 5 and 6) and lists the key findings, observations, strengths and weaknesses of current arrangements.

Note:

It is noted in completing this report that given the limited time available, as well as being unable to exhaustively review fire and rescue services, any literature review would similarly need to be constrained. As a consequence we have included references to the prominent literature which we believe is most relevant; but accept that there may be others.

# Chapter 2

## Reference Documents

### 2.1 Fire Research and Statistics Division (RSD) and Mott MacDonald

Table 2.1, below, shows the FRSD documents that are referenced in this report:

<b>Table 2.1: Reference Documents, Fire Statistics and Research Division (FSRD) and Mott MacDonald</b>	
<b>Reference</b>	<b>Title</b>
[Ref. 1-1]	'Statement of Requirement for Contract for a Scoping Study on Fire and Rescue Service Incident Ground Communications Needs within the Built Environment', Office of the Deputy Prime Minister (ODPM) – Fire Statistics and Research Division (FSRD), February 2006.
[Ref. 1-2]	'Consultancy Proposal for the Incident Ground Communications Study', Revision A1, Mott MacDonald, February 2006

### 2.2 Other organisations

Table 2.2, below, shows the other documents that are referenced in this report:

<b>Table 2.2: Reference Documents, Other Organisations</b>	
<b>Reference</b>	<b>Title</b>
[Ref. 2-1]	'Dear Chief Officer Letter 7/1990 – Fire Service Incident Channels', Home Office Fire Department, 1990
[Ref. 2-2]	'Directive 2004/54/EC of the European Parliament and the Council on Minimum Safety Requirements for Tunnels in the Trans European road Network', European Union, April 2004
[Ref. 2-3]	'Fire Policy Statement 16 – Fire Incident Channels', Home Office Radio Frequency and Communications Planning Unit, 1997
[Ref. 2-4]	'Fire and Policy Statement 18 – Inter Agency Commanders' Radio Channels', Home Office Radio Frequency and Communications Planning Unit, 1997
[Ref. 2-5]	'Joint Committee of Design and Development (JCDD) 19/2 – Requirement Specification for: Communication Equipment for Use with Breathing Apparatus (BA)', Home Office Fire and Emergency Planning Department, 1983

<b>Table 2.2: Reference Documents, Other Organisations (continued)</b>	
<b>Reference</b>	<b>Title</b>
[Ref. 2-6]	'Joint Committee of Design and Development (JCDD) 40 – Fire Service User Requirement for Radio Telemetry at Incidents', Home Office Fire and Emergency planning Unit, n/k
[Ref. 2-7]	'New National Stadium, Empire Way, Wembley London Fire Brigade Statement of Requirements for Communications', London Fire Brigade, 18 April 2005
[Ref. 2-8]	'ODPM Radiocommunications Guidance Note 9 Fire and Rescue Service "At Incident" Channels (Draft)', ODPM Fire and Rescue Service and Resilience Directorate, Not yet published
[Ref. 2-9]	'Fire Service Radio Strategy Procurement Guidance – Standard Specification for Mobile Communications', Home Office Fire and Emergency Planning Department, April 1999
[Ref. 2-10]	'Statement of Interoperability and Resilience for Radio Communications Systems of the Emergency Services', Chief Fire Officers Association (CFOA) with Association of Chief Police Officers (ACPO) and Ambulance Services Association (ASA), Draft 3 23 September 2004
[Ref. 2-11]	'Fire precautions in the design, construction and use of buildings – Part 5: Access and facilities for fire-fighting', BS 5588-5:2004, British Standards
[Ref. 2-12]	'Increasing FDNY's Preparedness [Part II Recommendations, Improve communications and technology capabilities]' McKinsey Report, 2002
[Ref. 2-13]	'Federal Building and Fire Safety Investigation of the World Trade Center Disaster – The Emergency Response Operations', National Institute of Standards and Technology (NIST) NCSTAR 1-8, September 2005
[Ref. 2-14]	'The Building Regulations 2000 – Fire Safety – Approved Document B – 2000 Edition consolidated with 2000 and 2002 amendments', Office of the Deputy Prime Minister (ODPM)
[Ref. 2-15]	'Fire detection and fire alarm systems for buildings – Part 9: Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems', BS 5389-9:2003, British Standards (BS)
[Ref. 2-16]	'Fire Service Radio Strategy Procurement Guidance – Standard Specification for Mobile Communications', Home Office Fire and Emergency Planning Directorate, April 1999
[Ref. 2-17]	'Report prepared for the Office of the Deputy Prime Minister and London Fire Brigade – 2.4GHz Wireless Mesh Network Trials: London Fire Brigade – Southwark Training Centre, 7th December 2004', Mines Rescue Service Ltd

# Chapter 3

## Stakeholders Consulted

### 3.1 Fire and Rescue Services – UK

Table 3.1, below, shows the UK fire and rescue services that were contacted and contributed in the completing of this report:

<b>Table 3.1: Stakeholders Consulted, UK Fire and Rescue Services</b>	
<b>Organisation</b>	<b>Individual</b>
Avon Fire and Rescue <b>www.avonfire.gov.uk</b>	Principal Fire Control Officer (PCFO) Bob SMITH Head of Control and Communications
Essex County Fire and Rescue Service <b>www.essex-fire.gov.uk</b>	Mr David ELWELL Communications Manager
Greater Manchester County Fire Service <b>www.manchesterfire.gov.uk</b>	Assistant Divisional Officer (ADO) Gary O'NEILL Operations Department
Hampshire Fire and Rescue Service <b>www.hantsfire.gov.uk</b>	Mr Paul TURNER Information and Communications Technology (ICT) Engineer
Kent Fire Brigade <b>www.kent.fire-uk.org</b>	Mr Charlie OUTRED Communications Assistant
Lancashire Fire and Rescue Service <b>www.lancsfireandrescue.org.uk</b>	Station Manager Ian TAYLOR Communications Officer
London Fire Brigade <b>www.london-fire.gov.uk</b>	Mr Roger TUCKLEY Radio Group Manager
Lothian and Borders Fire Brigade <b>www.lb.fire.org.uk</b>	Mr Steve DOBSON Telecommunications Manager
Northern Ireland Fire Brigade <b>www.nifb.org.uk</b>	Assistant Group Commander (AGC) Martin CASSIDY Communications Officer
Strathclyde Fire Brigade <b>www.strathclydefire.org</b>	Mr Paul SHARP Firelink Project Manager

**Table 3.1: Stakeholders Consulted, UK Fire and Rescue Services (continued)**

<b>Organisation</b>	<b>Individual</b>
South Wales Fire Service <b>www.southwales-fire.gov.uk</b>	Mr Bill LAWN Information and Communications Technology Service Manager
West Midlands Fire Service <b>www.wmfs.net</b>	Station Officer John ARROWSMITH IT Client Liaison Officer
West Yorkshire Fire Service <b>www.westyorkshire.gov.uk</b>	Mr Geoff BARBER Communications Officer

## 3.2 Fire and Rescue Services – international

Table 3.2, below, shows the international fire and rescue services that were contacted and contributed in the completing this report:

**Table 3.2: Stakeholders Consulted, International Fire and Rescue Services**

<b>Organisation</b>	<b>Individual</b>
Dublin Fire Brigade <b>www.dublincity.ie</b>	Mr Keith LEONARD Control Centre Manager
Singapore Civil Defence Force <b>www.scdf.gov.sg</b>	Mr Ivan KWOK SO Radio Communications, Technology Department

### 3.3 Other organisations

Table 3.3, below, shows the other organisations that were contacted in the completing of this report:

<b>Table 3.3: Stakeholders Consulted, Other Organisations</b>	
<b>Organisation</b>	<b>Individual</b>
Chief Fire Officers Association (CFOA) <b>www.cfoa.org.uk</b>	Mr Olaf BAARS Chair, Communications and Computing Policy Committee (C&CPC)
Draeger Safety UK Ltd <b>www.draeger-safety.co.uk</b>	Mr Ian BELL Product Manager
Department for Communities and Local Government (CLG) <b>www.communities.gov.uk/fire</b>	Senior Divisional Officer (SDO) Alison BEASLEY Team Leader FiReControl Project Team
Department for Communities and Local Government (CLG) <b>www.communities.gov.uk/fire</b>	Mr Chris BOWLING Technical Manager Fire Services and Resilience Directorate
Department for Communities and Local Government (CLG) <b>www.communities.gov.uk/fire</b>	Mr Tony BUCKSEY Senior Professional Advisor Fire Services and Resilience Directorate

# Chapter 4

## Current Fire and Rescue Services Practices – Across the UK

### 4.1 Introduction

#### 4.1.1 Requirement for At-Incident Communications

The Operational Requirement for at-incident communications was set out in the Home Office document: Fire Service Radio Strategy Procurement Guidance – Standard Specification for Mobile Communications in April 1999 [Ref. 2-16] as part of the work which led to the Firelink project.

The specification includes requirements for voice, telemetry and video.

#### 4.1.2 Outline of At-Incident Communications

Firefighters mobilised to an incident will arrive as members of an appliance crew. Each appliance will have a crew commander and one of these will be the Incident Commander for the incident.

On arrival, the Incident Commander will designate an appliance, from amongst those attending the incident, to act as the Incident Control. Using this appliance, the wide-area radio network will be used to summon any further resources required by the Incident Commander, to report progress and to report when the incident is under control.

In the initial stages, At-Incident communications is typically required to allow:

1. The Incident Commander to manage the response to the incident and communicate with the Incident Control
2. Crew commanders to communicate with the Incident Commander, with each other, and with members of their crews
3. Breathing Apparatus (BA) Entry Control Officers to communicate with and direct BA teams
4. Crew commanders to liaise with other fire services, such as the Ministry of Defence (MoD) Fire Service and airport fire brigades.

Different radio networks may be created for each purpose in accordance with pre-planned procedures or fire and rescue service practice.

If the incident develops and further appliances attend, crew commanders and crew members will join the existing networks unless the Incident Commander directs, or operational procedures require, that different networks are set up for specific purposes – such as:

1. Tactical management of the incident (the incident command may be divided into sectors each of which might use a separate network)
2. Breathing apparatus
3. Water relay management
4. Firefighter safety management.

During this process, the Incident Control may be transferred to an appliance which is specially adapted and has been mobilised for this purpose.

In addition to the voice communication requirement:

Major Incidents are likely to involve all three of the primary emergency response organisations – police service, ambulance and fire and rescue service. To assist in co-ordination between them, a common system of designation is used by the three organisations to identify levels of command across the incident – thus:

Level of Command	Description
Gold Command	Is the command level that determines the strategy for dealing with the incident. This command level will be located remotely from the incident.
Silver Command	Is the command level that for each emergency response organisation is responsible for the tactical command at the incident, carrying into effect the strategy determined by Gold Command. There is only one Silver Command for each emergency service at a Major Incident.  For the fire and rescue service, the Silver Command will invariably communicate with Gold Command using the wide-area radio scheme.
Bronze Command	For the fire service, Bronze Command is the tactical command at the incident sectors or crews, under the command and direction of the fire and rescue service Silver Command. There are likely to be a number of fire and rescue service bronze commanders at a Major Incident  For the fire and rescue service Bronze Commanders will communicate with Silver and with each other using at-incident communications.

These designations are often used for incidents which are not designated as Major Incidents.

### 4.1.3 Current At-Incident Wireless (Voice) Communications

The fire and rescue services' requirement for wireless voice communications at operational incidents is met by the use of handheld radios using six UHF channels. The channels are common to all fire brigades and fire and rescue services in Great Britain and Northern Ireland, thus facilitating national roaming and operational interventions which involve resources from more than one brigade or fire and rescue service.

Four of the channels are single frequency simplex channels allowing the temporary creation of discrete handset to handset radio networks at an incident. The remaining two channels are two-frequency simplex. These allow the creation of up to two further networks, but require a local base station/repeater to be set up for this purpose. One of the channels can also be used to provide At-Incident ground-to-air communications.

There are national recommendations relating to the primary and secondary use of each of the channels [Ref 2-1]. These are summarised in Table 4.1 below:

<b>Table 4.1: Channel Plan*</b>		
<b>Channel Number</b>	<b>Primary Use</b>	<b>Secondary Use</b>
1 FM Simplex	General Incident	Breathing Apparatus
2 FM Two-Frequency Simplex	UHF-VHF Relay	1. Incident Command 2. Breathing Apparatus (using mobile or authorised UHF fixed base stations with or without a leaky feeder)
3 FM Simplex	Breathing Apparatus	General Incident
4 FM Simplex	General Incident	Breathing Apparatus
5 FM Two-Frequency Simplex	Breathing Apparatus (using mobile or authorised UHF fixed base stations with or without a leaky feeder)	1. Incident Command 2. Air to Ground
6 FM Simplex	Breathing Apparatus	1. General Incident 2. Air to Ground
69 FM Simplex	Inter Agency Liaison	

**Table 4.1: Channel Plan\* (continued)**

Channel Number	Primary Use	Secondary Use
70 FM Two-Frequency Simplex	Inter Agency Liaison	
21 (VHF)	Vehicle to Vehicle	Portable to Portable
22 (VHF)	Portable to Portable	1. Vehicle to Vehicle 2. Air to Ground

\* Original Home Office channels (some fire and rescue services have additional).

The current spot frequency assignments are limited in number. An increase in number could be advantageous for reasons including the reduced possibility of blocking between channels. However, the channel plan using the current assignment has been devised in order to minimise that possibility.

Some fire brigades and fire and rescue services may also programme their radio equipment to re-use the six channels with different Continuous Tone – Coded Squelch System (CTCSS) tones related to the station to which they are allocated.

Reflecting the fact that firefighters work in crews or teams at incidents, the current allocation of handheld radios is usually to an appliance or a specific function rather than to an individual: i.e. not every firefighter at an incident will necessarily have a handheld radio.

Handheld radios used by the fire and rescue service are likely to be exposed to demanding environmental conditions and rough treatment. Depending on fire and rescue service preference, handheld radios are likely to be provided with a range of accessories to permit direct connexion to breathing apparatus or to provide remote microphones.

#### **4.1.4 Technical Details – UHF Channels**

The six UHF channels (around 457-460MHz) and the interoperability channels (around 462 MHz) are licensed to Chief Fire Officers [Ref. 2-3]. Handsets are Frequency Modulating (FM) and are limited to 1 Watt ERP (Effective Radiated Power) in order to allow the channels to be used at nearby incidents without cross-incident interference.

#### **4.1.5 Very High Frequency (VHF) At-Incident Channels**

Fire brigades and fire and rescue services in England and Wales have available two low-band single frequency simplex low-band VHF channels. These permit direct set to set communication between wide-area scheme radios at incidents in circumstances where the extra range potentially available with this equipment where this is required, for example in managing a water relay.

In Scotland and Northern Ireland, two high band VHF channels serve the same purpose.

#### 4.1.6 Interoperability with Other Emergency Response Organisations

Each fire and rescue service handset should be programmed with the channels intended to provide interoperability with the police and ambulance services [Ref. 2-4]. These channels are no longer used to provide interoperability with the police handheld radios following the migration of the police service to the national Airwave service. An exchange of handsets between services for interoperability is therefore used.

Individual fire and rescue services may also have programmed their UHF handheld radios with the channels used by other local organisations with which they may need to work at an incident. They may also be programmed with other channels which are licensed to the fire and rescue service to provide extra channel capacity for training or in conjunction with marine craft.

The Ministry of Defence Fire Service has access to the six national fire and rescue service channels at aerodromes and airfields to facilitate joint interventions and aerodrome fire services at Civil Aviation Authority (CAA) licensed airports have access to one of the channels as do some works fire brigades, where Chief Officer's judge that this is necessary to improve operational efficiency.

#### 4.1.7 Migration to Airwave

The police service, followed by the ambulance service and most recently the fire and rescue service are in varying stages of migrating wide area network communications to the Airwave service. Whilst the channels used before migration will not be used in standard operations after migration they do remain available at present. In theory therefore, UHF channels vacated by the police could be available to the fire and rescue service.

#### 4.1.8 Radios used with Breathing Apparatus

Effective wireless communications is particularly important for the safety and operational effectiveness of firefighters using breathing apparatus. There is a national recommendation that the At-Incident handheld radios (and associated ancillary equipment) used by breathing apparatus wearers should be *Intrinsically Safe* (IS) in that it is protected for use in potential explosive atmospheres in accordance with relevant regulations. Current regulations are the ATEX Regulations (Equipment in Potentially Explosive Atmospheres, Manufacturers Directive 94/9/EC). Similar provision would need to be made for all radio equipment which is to be used in an environment which is known to present an ignition risk. This is a potentially significant issue since such equipment is considerably more expensive to procure and to maintain, and because there is limited equipment in the market place that satisfies this requirement.

#### 4.1.9 Improving At-Incident Radio Coverage in the Built Environment

Current UHF handheld equipment, used in set to set mode, will normally provide coverage throughout all but the largest domestic buildings. Dependent on the construction, it will also provide reasonable coverage throughout small to medium commercial and industrial buildings. The actual coverage in the built environment is however not entirely predictable without a detailed building survey.

There are, however, sites where At-Incident radio coverage from set to set operation will not be sufficient for effective fire and rescue service operations or the safety of firefighters. Such sites can be: large single buildings, a building complex, such as a shopping mall; a geographically large site, where contiguous radio coverage across the whole site is operationally essential, such as a civil airport; or a site where the type construction interferes with effective radio propagation, such as railway tunnels, sub-surface railway stations, road tunnels and buildings specifically designed to prevent radio signal penetration. Note: Built Environment details are dealt with in the Technology Review Report rather than this document.

There are a number of strategies that are used to deal with these circumstances:

1. The *ad hoc* deployment of an on-site base station operating on one of the duplex channels, using:
  - a. An optimised and/or elevated antenna also brought to the site by the fire and rescue service
  - b. A radiating leaky feeder antenna also brought to the site and deployed by the fire and rescue service
  - c. An antenna system pre-installed at the site, or
2. The *ad hoc* deployment of battery powered portable repeaters which can be strategically placed along an access route in conjunction with conventional antenna or radiating leaky feeders
3. The permanent installation of a fixed base station/repeater at the site, operating on one of the two frequency channels using an antenna system, which may use radiating or leaky feeders, pre-installed at the site. Making some dedicated arrangement specific to the site or through the use of wired communications

In these circumstances the base station would normally be quiescent and activated (perhaps remotely by the fire and rescue service) only when required. However, at some sites, the base station might be in continuous operation where it was certain that this would not affect fire and rescue service operations at a nearby incident.

4. Making some dedicated arrangement specific to the site or through the use of wired communications.

Where fixed base station/repeaters are installed, they are operated under the Chief Fire Officer's Wireless Telegraphy (WT) licence.

In most circumstances where a base station is brought to the site by the fire and rescue service, and particularly where this requires the deployment of an antenna before it can be brought into use, some technical expertise is necessary. Such base stations (and the

associated antenna) are therefore often fitted to mobile control units or similar vehicles. For this reason, they are unlikely to be available in the early, and perhaps critical, stages of an operational intervention.

Deployable radiating leaky feeders may be useful in circumstances where the risk premises are linear and firefighters are likely to always be close to the feeder; for example in a tunnel. However, there is a compromise between the effectiveness of the feeder and the ease of deployment. The more effective a leaky feeder, the heavier and more inflexible it is likely to be. TV antenna cable is such a compromise, but this is likely to allow penetration into a tunnel of little more than 150 metres. This approach is confined to tunnels where a fixed installation is not provided, such as a sewer or British Telecom (BT) cable tunnel.

London Underground Limited (LUL) and Network Rail provide and maintain infrastructure to facilitate At-Incident communications in sub-surface railway stations and LUL is extending this to provide coverage in the running tunnels of its network.

The operators of the UK mainland elements of the Channel Tunnel Rail Link have made a similar provision in its running tunnels in current operation and plan a similar provision for the uncompleted railway link to St Pancras station.

Save for this, there does not seem to be any mechanism by which a site owner or occupier can be required to provide and maintain fixed equipment for fire service operational use or to allow equipment provided by the fire and rescue service for this use, to be installed. But many buildings and sites have been equipped in this way, most at no cost to the fire and rescue service.

Where a base station/repeater is provided to support one of the duplex channels, the remaining single frequency channels can normally be used outside the building risk and inside it to the extent of the available range – which may just be limited to line-of-sight.

#### **4.1.10 Sites where Normal UHF At-Incident Radio Communications cannot be used**

There are some sites where there are spectrum availability issues which preclude the use of the normal six UHF channels by firefighters. In these locations a site-unique solution has been adopted.

These include the Severn railway tunnel and the Channel Tunnel. Fuller details are included at Section 4.2 in the examination of sample fire and rescue services.

The frequency and power of equipment is governed by regulation to maximise reuse, allowing use of the same channels at the same time on separate incidents where those incidents are sufficiently geographically separated. The survey did not find any evidence of concerns regarding re-use issues.

#### 4.1.11 Very Low Frequency (VLF) Radio Communications

Equipment using a VLF assignment (Figaro) has been used to provide communications between the surface and firefighting personnel in tunnels. The equipment and the associated antenna was complex and difficult to deploy. The resulting communications were often less than satisfactory. The equipment has not been used for many years and the frequency assignment has been withdrawn.

#### 4.1.12 Breathing Apparatus Wireless Telemetry

Two radio channels (at about 862 MHz) are assigned to the fire service in the 862MHz band in order to facilitate the transmission of telemetry information for firefighters wearing breathing apparatus [Ref. 2-6]. This telemetry information includes a range of potential input data including; cylinder contents, “wearer distress” and “wearer evacuation”. There is no provision for voice.

Equipment using these channels is available from two manufacturers, but take-up of this facility is limited. All of the equipment used by the BA wearer should be certified as Intrinsically Safe in accordance with the ATEX Regulations.

The range of equipment using these channels is similar to that of handheld voice equipment. The effective range of this is similar to that of handheld At-Incident radios. Additionally, it is possible to enhance the range with self-powered “drop-down” repeaters.

#### 4.1.13 Breathing Apparatus Wired Communications

Specification JCDD 19/2 [Ref. 2-5] describes wired, battery powered, Intrinsically Safe and fully duplex equipment for providing voice communication for a breathing apparatus wearer.

The user equipment is worn by the breathing apparatus team leader who carries a cable dispenser the cable of which is paid out behind the wearer. Further cable dispensers can be carried by other members of the team and these can be inserted into the communications link as necessary. The maximum range is physically limited, depending on the number of cables that are connected together. However in practice the limit to the range is not physical but the extent to which breathing apparatus wearers can penetrate the risk area given the duration of their breathing apparatus and the nature of the risk.

This equipment allows effective voice communications independent of the radio propagation characteristics at, and complexity of, the built environment at the incident. However, deployment can be very slow and there is a risk that the cable will be damaged by doors, shutters and other objects en route and/or that the cable is damaged by the incident.

When used, the line communications equipment obviates the need for a guide line which may be deployed in buildings or risk premises larger than small commercial or domestic premises.

#### **4.1.14 Field Telephones**

In some circumstances, field telephones may provide a means for meeting some aspects of At-Incident communications. Achievable range is limited only by the ability to lay the connecting cable and can be deployed in the built environment as well as outside it. For obvious reasons, field telephones can only serve a fixed location such as a control unit, a Forward Control Point or a breathing apparatus Entry Control point.

#### **4.1.15 Potential Interactions between At-Incident Tactical Communications and the Built Environment**

Tall buildings, usually those fitted with wet or dry risers, are provided with lifts which can be used by firefighters to gain access to the upper floors during emergencies. These lifts have special controls which allow firefighters to take over their control.

The British Standard [Refs. 2-11 and 2-15] to which these lifts comply require that their control system is unaffected by radio transmissions of fire and rescue service At-Incident voice radio channels.

Given the increased need for Information Technology (IT) security, it is quite possible that a building, or part of a building, might incorporate a Faraday cage in its structure – thus rendering wireless fire and rescue service radio communications unworkable.

There are additionally potential problems in using UHF handheld radios in some parts of some hospitals since radio transmissions are considered to detrimentally affect sophisticated monitoring and patient management equipment.

## **4.2 The current situation in brigades and fire and rescue services**

A number of fire and rescue services were interviewed by telephone regarding the current provision and use of At-Incident communications. The interview sample script is attached at Appendix A. The outcome of these interviews is reported in the following paragraphs.

### **4.2.1 Avon Fire Brigade**

The Brigade has approximately 275 UHF handheld radios, all of which are IS. It has no portable base station/repeaters and has one base station/repeater installed on its mobile Control Unit.

The Brigade does not use BA telemetry.

The Brigade's communications concerns in the built environment relate to the difficulty of achieving satisfactory coverage in some parts of the city of Bristol, where medieval narrow streets are a factor. To overcome this, the Brigade has installed a fixed always-on base station/receiver on the 16th storey of a city centre building. This does not, apparently, detrimentally affect radio communications elsewhere in Avon or surrounding counties.

The Severn Tunnel has a fixed installation throughout its length, supporting three, site-specific two-frequency channels for use in the event of an incident. These channels are programmed into the UHF handheld radios of the Avon brigade and are used alongside South Wales Fire Service in the event of an incident in the tunnel.

There are no road tunnels provided with fixed installations in Avon.

The Brigade indicated that it had not modified its At-Incident communications in consequence of 9/11.

#### **4.2.2 Essex County Fire and Rescue Service**

The service has approximately 650 UHF handheld radios, of which nearly all are IS. The service is however reviewing the requirement for IS radios with a view to only radios used with breathing apparatus being IS. It therefore expects the proportion of handheld radios that need to be IS, to reduce.

The service has one portable base station/repeater and has one base station/repeater installed on its mobile Control Unit.

The service does not use BA telemetry.

Base station/repeaters and the appropriate antenna systems to facilitate on site at-incident radio coverage have been installed in the Lakeside shopping centre and at Stansted Airport.

Base station/repeaters and the appropriate antenna systems to facilitate on site at-incident radio coverage are being provided in the Channel Tunnel Rail Link (CTRL) tunnel beneath the Thames at Ebbfleet and throughout other parts of the CTRL route in Essex which are contained in tunnels. There is also a fixed leaky feeder installed in the running tunnel of the Stansted Express to which UHF handhelds can be connected in the event of an incident.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed in the Bell Common Tunnel and the Dartford Tunnel (both M25 motorway).

There is a fixed base station/repeater connected to the on site radio system provided by National Grid in its cross-Thames cable tunnel in Dartford.

The service does not have access to deployable radiating leaky feeders and does not use field telephones. It does retain BA line communications equipment, but its utility is being reviewed.

The service has experimentally used an aerial appliance as a means of achieving additional height for improving radio coverage in Epping Forest when effective range of handheld radios was reduced due the trees being in foliage.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

The service commented that in that context it had lost the interoperability with the police service that was provided by channel 69 as a consequence of Essex police's migration to Airwave.

### **4.2.3 Greater Manchester Fire Service**

The service has approximately 450 UHF handheld radios, of which approximately 70 are IS.

The service has two portable base station/repeaters and has one base station/repeater installed on its mobile command unit.

The service does not currently use BA telemetry.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed in shopping malls at the Arndale and Trafford Centres, at the Spindles and Print Works, at the Stadium and at Manchester International Airport. All the installations are activated only when required.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in road or railway tunnels in Greater Manchester although a new road scheme which may involve tunnels is scheduled for 2008-2012.

The service does not have access to deployable radiating leaky feeders. It does have access to field telephones. The service uses BA line communications equipment.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

The service described the ability to access wide-area communications using its At-Incident equipment as something which would be nice to have, but not pressing.

The service had trialled EMCOM (supplier) line-based communications equipment intended for use in mines, for At-Incident communications.

#### 4.2.4 Hampshire Fire and Rescue Service

The service has approximately 360 UHF handheld radios of which approximately 30 are IS. The service also has 120 spare handheld radios (gifted by the police) of which 50 are IS.

The service has five portable base station/repeaters and has seven base station/repeaters installed on mobile Control Units.

The service does not use BA telemetry.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed or planned for the shopping Centre at West Quay and the CAA National Air Traffic Control Centre at Swannick and Farnborough (operational) airport. Antenna systems are also installed at Farnborough air show control suite, MoD police secondary control room at Portsmouth naval docks, the Semaphore tower control room for “fires afloat” at Portsmouth naval docks and at the Maritime and Coastguard Agency (MCA) centre Leigh-on-Solent.

There are no fixed base station/repeaters to facilitate on site at-incident radio coverage in road and rail tunnels in Hampshire as there no road tunnels and only one significant rail tunnel.

The service does not have access to deployable radiating leaky feeders. It does have field telephones and BA line communications equipment.

The service has Closed Circuit Television (CCTV) cameras mounted on aerial platforms and on control vehicle for fireground use which can be received anywhere over the cellular network or viewed locally.

The service described the ability to directly access wide-area communications from handheld At-Incident equipment was not wanted. It also mentioned that the previously available interoperability with police had been lost and that its inability to communicate with the police helicopter was important, as was communication with police escorts to New Dimension convoys.

The service has purchased a MESH based system to facilitate At-Incident video voice and data.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

#### 4.2.5 Lancashire Fire and Rescue Service

The service has approximately 400 UHF handheld radios, of which approximately 70 are IS.

The service has one portable base station/repeaters and has one base station/repeater installed on its mobile Control Unit.

The service does not use BA telemetry.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in buildings or in road or railway tunnels in Lancashire. Arrangements were in place to ensure that building developments where radio communications might be difficult were referred to the communications officer for advice.

The service does not have access to deployable radiating leaky feeders and does not use field telephones. It does retain BA line communications equipment, but its utility is being reviewed.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

The service uses Airwave system for its wide-area radio scheme. This already provides a measure of interoperability with police at incidents.

#### **4.2.6 London Fire Brigade**

The Brigade has approximately 1,600 UHF handheld radios of which some 340 are IS. The London Fire & Emergency Planning Authority will shortly be considering a proposal to move to a personal issue of radios to firefighters, which will increase the total to over 6,000. The Brigade will also be purchasing additional IS radios bringing that total to around 500.

The Brigade currently has seven portable base station/repeaters for deployment at incidents on Channels 2 or 5 and intends to increase that number. There are a further two permanently installed on each of the Command Units, of which there are currently five and three permanently installed on the Brigade Control Unit.

The Brigade has telemetry equipment which it intends in the first instance to use in conjunction with Extended Duration Breathing Apparatus (EDBA), extensive trials have recently been carried out using throw out leaky feeder and repeaters to prove its capability, and checking data provided by the equipment to check cylinder content and distress signalling, the Brigade are now considering the results of the trials before moving to the next stage, the equipment is not yet in service.

As regards communicating in the built environment, the Brigade plans to increase the output power on Channel 1 (the main At-Incident channel for London) of its handheld radios to 4W ERP (non-IS radios), whilst the other channels remain at 1W. The Brigade's view is that this will give a significant and beneficial increase in performance and this ensures that effective communications is available at most incidents.

Where this is not the case, developers/occupiers are encouraged to provide, install and maintain fixed base station/repeaters using Channel 5 and to install appropriate antenna to ensure coverage. Fire Safety Officers also identify sites where this might be necessary

at the development stage. Whenever such sites come to notice, the brigade provides an output based functional specification for its requirement (example for the New Wembley Stadium [Ref. 2-7]) and liaises with the developer/owner to ensure that what is provided is acceptable. Developers/occupiers have so far appeared to be willing to provide, install and maintain fixed equipment for fire brigade use when asked to do so.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed in a number of sites in London. These include:

1. Sports stadia, such as the Wembley Stadium and the Emirates Stadium
2. Shopping complexes, such as Brent Cross
3. Heathrow Airport.

These base station/repeaters are normally only activated when required.

Base station/repeaters and the appropriate antenna systems to facilitate complete underground site coverage for At-Incident radio are also provided and maintained by LUL and Network Rail at more than 120 sub-surface railway stations in London. Coverage is also provided in the running tunnels of the Jubilee Line Extension, the East London line and the Heathrow Express. LUL intends to extend the coverage into and throughout all the running tunnels as part of its Connect project. Fixed base stations and the appropriate fixed antenna system are also being provided in those sections of the CTRL enclosed in tunnels, at ventilation and emergency access points and at CTRL stations in London.

In accordance with Department of Transport (DoT)/Highways Agency recommendations (now Transport for London), base station/repeaters for at-incident communications and the appropriate antenna system are also provided in a number of road tunnels in London, including Rotherhithe, Blackwall, Limehouse and Holmsdale tunnels.

The police and ambulance services in London also use breathing apparatus in London, and when they do so they use London Fire Brigade Entry Control procedures and brigade At-Incident communications.

There is one location where the shielding required for hospital scanning equipment prevents any radio transmissions passing through the shielding. Where security shielding is provided, for example in buildings occupied by the MoD, radio communication is achieved by providing a gap in the aerial feeder on either side of the shield. A link can be inserted into the gap and through the doorway/shield in the event of an incident requiring communications.

Additionally, the Brigade has available deployable radiating leaky feeders, for use with the

portable base station repeaters, field telephones and BA line communications equipment. It has also developed an arrangement by which a series of portable UHF base station/repeaters can be located by firefighters along access routes and linked together by line – which can also supply external power, if required. Antenna can be whip or radiating leaky feeders, as appropriate.

Given the foregoing, the Brigade takes the view that there are generally few places in the built environment where At-Incident communications cannot be provided, once problems have been brought to notice. The Brigade appears to have been particularly successful in getting developers/occupiers to provide, install and maintain fixed equipment without cost to the Brigade.

The Brigade commented that fixed installations in tall buildings could provide satisfactory radio coverage in adjoining tall buildings to overcome coverage difficulties in an incident building caused by the height of the building. It would also be potentially useful if the incident affected any base station/repeater equipment that had been installed in the incident building.

The Brigade indicated that it had not modified its At-Incident communications in consequence of 9/11.

The Brigade view was that it would not wish any review of At-Incident radio to take place without taking full account of the substantial investment that had been made by the brigade and third parties in the current equipment.

#### **4.2.7 Lothian and Borders Fire Brigade**

The Brigade currently has approximately 240 UHF handheld radios, all of which are IS. It has three portable base station/repeaters. The brigade has decided to purchase handheld new radios to provide two IS handheld radios per pumping appliance for BA users and a pool of 14 for Command Support Unit (CSU) and Incident Support Unit (ISU) vehicles. The rest of the handheld radios would be non-IS. A fifth handheld would be provided for the Water Relay/Extension (WrL/ET) appliances and radios would also be provided for senior officers.

This means that after about January 2008 the Brigade plans to have 285 handheld radios of which 114 would be IS.

The Brigade does not use BA telemetry.

The Brigade's communications concerns in the built environment relate to large commercial buildings, especially those of older construction and large shopping precincts. It reported that the reactor shielding at Torness nuclear power station prevented the penetration of radio signals.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed in the Scottish Parliament Building, Torness Power Station and Edinburgh Royal Infirmary. A fixed antenna system has been installed in the basement of the Edinburgh Central Library for Brigade use.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in road and rail tunnels in Lothian and Borders.

The service does have access to throw-out radiating leaky feeders and field telephones. It does not have BA line communications equipment.

The Brigade commented that it would like to have some At-Incident interoperability with the other emergency services. The Brigade was also examining the requirement for At-Incident interoperability with marine VHF channels.

The Brigade indicated that it had not modified its At-Incident communications in consequence of 9/11.

#### **4.2.8 Northern Ireland Fire Brigade**

The Brigade will shortly be moving its wide area communications to the TETRA (Terrestrial Trunked Radio) based 'Barracuda' system used by Police and Ambulance Services in the province and this will have an impact on the provision of At-Incident communications. In common with fire and rescue services in Scotland, the Brigade uses two single-frequency high-band VHF channels for At-Incident communications.

The Brigade has approximately 180 UHF handheld radios of which approximately 70 are IS (for use with BA Communications). It has no portable base station/repeaters but has approximately eight base station/repeaters installed on appliances.

The Brigade also has approximately 450 sets of Draeger telemetry equipment which is used with Extended Duration Breathing Apparatus (EDBA). This equipment provides data regarding cylinder content, ambient temperature and distress signalling.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in buildings or road and rail tunnels in Northern Ireland. The Brigade indicated that At-Incident communications could be problematic in certain types of structure, for example on board ships.

The brigade would like to have direct access from At-Incident equipment to the Brigade's wide-area scheme and expect that Barracuda will provide this. It also wants interoperability with other emergency response organisations and, again, expects Barracuda to facilitate this. The Brigade is researching At-Incident CCTV, particularly in conjunction with thermal imaging and it has purchased 'Argos 3' thermal image cameras.

The Brigade has reviewed At-Incident communications in consequence of 9/11 and believes that the Barracuda TETRA network will meet their future requirements for radio communications.

#### **4.2.9 South Wales Fire Service**

The service has approximately 250 UHF handheld radios, of which 64 are IS and used with breathing apparatus. The service has two portable base station/repeaters installed on its mobile Control Units.

The service does not use BA telemetry.

A base station/repeater and the appropriate antenna system have been installed to facilitate on site At-Incident radio coverage in the Millennium Stadium.

In accordance with DoT/Highways Agency Guidance, base station/repeaters for At-Incident communications and the appropriate antenna system is provided in the Butetown road tunnel in Cardiff.

The Severn Tunnel has a fixed installation throughout its length, supporting three, site specific duplex channels for use in the event of an incident. These channels are programmed into the UHF handheld radios of the South Wales service and are used alongside Avon Fire Brigade in the event of an incident in the tunnel.

The service has a procedure by which it uses IS handheld radio equipment provided by British Gas in the event of an incident at the British Gas site at Aberdare.

The service commented that it had lost the capacity to communicate with the police helicopter, since this now uses the Airwave network and no longer had access to Channel 69. It otherwise thought that the existing At-Incident provision was satisfactory but that the ability to use At-Incident radios to communicate on the wide-area network might be useful.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

#### **4.2.10 Strathclyde Fire Brigade**

The Brigade has approximately 500 UHF handheld radios, of which approximately 35 are IS. It has ten portable base station/repeaters and one installed on a Control Unit.

The Brigade does not use BA telemetry.

The Brigade's communications concerns in the built environment relate to large commercial buildings, especially those of older construction and large shopping precincts.

Fixed antenna systems to support At-Incident communications have been installed in two shopping centres, Brayhead and the Buchanan Gallery.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in buildings or road and rail tunnels in Strathclyde.

The service does have access to throw-out radiating leaky feeders and use Digital European Cordless Telecommunications (DECT) telephones in and around the Control Unit.

The Brigade commented that it considered that direct access to wide-area communications was essential for some users. It would also like to have some At-Incident interoperability with the other emergency services. The Brigade was also examining the requirement for At-Incident interoperability with marine VHF channels.

The Brigade had recently trialled satellite broadband technology for use at incidents.

The Brigade indicated that it had increased the complement of UHF radios on each appliance by one in consequence of 9/11.

#### **4.2.11 West Midlands Fire Service**

The service has approximately 500 UHF handheld radios, of which approximately 170 are IS.

The service has three base station/repeaters and has one base station/repeater installed on its mobile command units. There is one base station repeater on each of the three Command Units, programmed to operate on two selectable channels. Additionally, there are two Hazardous Substance Units each with a repeater on one duplex channel only.

The service does not currently use BA telemetry although this was being considered.

Base station/repeaters and the appropriate antenna systems to facilitate on site At-Incident radio coverage have been installed in the Bull Ring development, the International Conference Centre and at Birmingham Airport. The installation at Birmingham Airport is activated only when required.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in road or railway tunnels in West Midlands. A fixed leaky feeder antenna system for service use has been installed in a road service tunnel underneath Birmingham International Conference Centre and in a rail tunnel on the Metro system.

The service does not have access to deployable radiating leaky feeders. It does have access to field telephones. It also retains BA line communications equipment, but its utility is being reviewed.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

Wireless At-Incident CCTV is contemplated for the next generation of Command Support Vehicles. The service described the ability to access wide-area communications using its At-Incident equipment as something which would be nice to have, but not pressing.

#### **4.2.12 West Yorkshire Fire Service**

The service has approximately 350 UHF handheld radios, of which approximately 62 are IS. The service indicated that it had recently decided to procure replacement UHF handheld radios.

The service has a base station/repeater installed on its mobile command unit.

The service does not use BA telemetry although this was being considered.

Fixed base station repeaters and appropriate antenna have been installed on fire station drill premises in Moorcroft, Bradford and at the service headquarters to provide improved operational flexibility across an enhanced urban area. Their primary use is in public order situations and they are only activated when required.

There are no fixed base station/repeaters to facilitate on site At-Incident radio coverage in buildings or road and rail tunnels in West Yorkshire. A fixed antenna system has been provided for a railway tunnel to provide At-Incident communications in the tunnel.

The service does not have access to throw-out radiating leaky feeders or to field telephones. It does have BA line communications equipment.

The service indicated that it had not modified its At-Incident communications in consequence of 9/11.

The service commented that interoperability with other emergency services was desirable – it noted that the current interoperability using channel 69 had been lost in consequence of the police migration to Airwave.

The service reported that it had recently trialled 24cm microwave as a means of providing communications in a railway tunnel and had achieved a range of two miles using a 10W transmitter.

#### **4.2.13 Kent Fire Brigade – The Channel Tunnel**

The normal provision of At-Incident communications by Kent Fire Brigade is similar to that in other fire and rescue service areas. However, it and the Channel Tunnel, is included in this study for completeness.

The sub-surface parts of the Channel Tunnel (i.e. the running and service tunnels) are provided with a dedicated trunked radio system and administrative and emergency telephones at cross-passages.

In the event of an incident the on site emergency response uses the trunked radio system for its At-Incident communications – with trunked channels dedicated to specific services. As an incident develops special command vehicles with fixed base station/repeaters are sited in the service tunnel at the incident and connected to fixed antenna systems serving the running and service tunnels. These provide dedicated channels for each service. The frequency assignments for this are specially selected to avoid interference with relevant UK and French surface assignments, tunnel systems and each other in the tunnel environment.

A similar arrangement applies to the French intervention.

## 4.3 Summary of current fire and rescue service practices – across the UK

### 4.3.1 Provision

The majority of fire and rescue services have both IS and non-IS variants of UHF handheld equipment, normally as an appliance issue, with the IS radios largely being for use with breathing apparatus. Some of these radios will also be provided with accessories to provide remote microphones/headsets and to allow them to be connected to breathing apparatus.

Some fire and rescue services are reviewing the number of IS radios required, largely as a result of the additional cost of procuring and maintaining this equipment compared with non-IS equipment.

However, the proposal of the London Fire Brigade to move from an appliance issue of handheld radios to a personal issue should be noted. A number of other fire and rescue services planned to use this procurement as a means of replacing their existing UHF equipment.

All fire and rescue services have one or more portable and/or mobile base stations to be taken to incidents to support either or both of the two-frequency channels.

There are two fire and rescue services in the survey that currently use or plan to use radio telemetry with breathing apparatus. Contact with Draeger indicates that there are six fire and rescue services in total in the UK using, or planning to use, this equipment.

Some of the fire and rescue services in the survey use BA line communications equipment and field telephones.

### 4.3.2 The Built Environment

All fire and rescue services recognise that UHF radio communications will be limited in range/coverage and that this may be severely reduced by buildings and in tunnels. When required, a mobile base station/repeater with an optimised antenna is used to provide increased coverage at incidents (using either or both of channels 2 and 5) by most of the fire and rescue services in the survey. Three of the fire and rescue services in the survey also have radiating leaky feeder equipment which can be used to enhance coverage, especially in tunnels.

Two fire and rescue services in the survey have permanently installed fixed UHF base station/repeaters on high buildings to provide improved local At-Incident communications. Avon has done this to address poor communications in the centre of Bristol whilst West Yorkshire has done it to improve operational flexibility at command in areas where public order may be a problem.

A number of fire and rescue services have procedures by which planned developments come to notice and concerns about potential radio coverage can be shared with the developer. Fire and rescue services have a range of technical options for improving coverage.

The London Fire Brigade plans to increase the power of handheld transmitters to 4W ERP (non-IS radios) on Channel 1; the main incident-command channel. It reported that this had significantly improved At-Incident coverage at all incidents without significantly affecting re-use of the channel at nearby incidents.

Another strategy is to ask the developer to install equipment, either a suitable fixed antenna system or a base station/repeater (or linked repeaters) with a suitable fixed antenna system, invariably operating on Channel 5. Not surprisingly, the London Fire Brigade appears to have a significantly greater number of such sites in buildings than any other fire and rescue service in the survey, whilst three fire and rescue services have none. But it is not clear whether the smaller numbers in other cities are a result of simply a lower need or not.

A similar situation exists in relation to road and railway tunnels and sub-surface stations, the greatest number appearing to be in London.

However, there seems to be no common model for how this equipment is funded, provided, installed or maintained. In London, all costs appear to be met by the developer/site operator whereas elsewhere most fire and rescue services in the survey appear to be meeting some part of the costs.

There were a small number of locations where passive shielding of radio transmissions had been noted, these included MoD premises, a nuclear power station and a hospital area used for high powered scanning equipment. It could be assumed that this would be

replicated at other similar sites even if it had not so far come to notice. Otherwise, the fire and rescue services in the study were not aware of any circumstances where passive or active means of Radio Frequency (RF) screening was detrimentally affecting UHF handheld communications.

### **4.3.3 The Operational Requirement**

The operational requirement for At-Incident communications appears to have been last reviewed in 1999 [Ref. 2-9].

The focus of current At-Incident communications is firmly on the use of UHF radio equipment using voice. There is limited use of radio data at incidents, in the form of breathing apparatus telemetry.

A few of the fire and rescue services in the survey still keep BA line communications equipment for the few circumstances where it alone might be useful.

There was no general feeling from the survey, so far as the voice element of any fire and rescue service requirement was concerned, that it was significantly falling short of what was required for day-to-day operations, with a few respondents indicating that the ability to access the wide-area radio system and improved interoperability with police at At-Incident level was desirable or necessary. Those fire and rescue services which had used Channel 69 for this purpose commented that it was no longer available, and two fire and rescue services commented that the inability to communicate with the police helicopter, on which their operational procedures relied, was an important shortcoming.

Two respondents mentioned the potential lack of channels, particularly in a multi fire and rescue service incident and the lack of any clear guidance on how the limited channels available should be used in these circumstances.

Operational incidents are generally managed with voice only with the single frequency UHF channels, often with one channel for incident command and another for any breathing apparatus communications.

As incidents escalate, other channels are brought into use in accordance with fire and rescue service plans and mobile base stations are brought into action to facilitate the use of one or both of the two-frequency channels.

## 4.4 Conclusions of current fire and rescue service practices – across the UK

### 4.4.1 Current Situation

There are few surprises from this brief survey. The key findings relating to the current situation can be summarised as follows:

1. There is almost total reliance on UHF handheld communications to meet the voice wireless At-Incident communications requirement
2. Considerable ingenuity has been used to increase the effectiveness of UHF handheld equipment in the built environment
3. There is considerable investment in the current technology; a significant proportion of which is by third parties. If the sample is indicative of the whole fire and rescue service, a significant part of this is in London. A number of fire and rescue service in the sample were shortly planning substantial further investment, either in replacing existing equipment or to increase the scale of issue
4. It would be worthwhile examining whether:
  - a. There is any scope for looking at the existing UHF assignments to see whether it might be possible to modify the channel assignments to further minimise the potential technical limitations of the current channels
  - b. The number of UHF assignments currently available to fire and rescue services might be increased – perhaps by utilising channels vacated by the police service in its transition to the Airwave service
5. There does not appear to be any common approach for assessing whether fixed communications infrastructure is necessary to support fire service At-Incident communications, no common standards for that provision and no means of compelling third parties to make or maintain it. With the exception of road and some rail tunnels and stations, this results in an ad hoc approach to the provision
6. The migration of the police service to Airwave and the resulting loss of police access to Channels 69 and 70 has caused some local difficulties, particularly in relation to police helicopters and New Dimension convoys.

#### 4.4.2 For the Future

Key conclusions on future needs include:

1. A need to review and update the current User Requirement for At-Incident communications to take account of the developing requirement, including any New Dimension requirement, and of technical possibilities that have become available since the earlier work
2. Consideration of the need for the development of national guidelines setting out the minimum performance requirement for At-Incident communications in the built environment against which individual buildings and structures, and steps taken to improve coverage, can be assessed
3. Consideration of the need for national guidelines which clarify responsibility for facilitating effective At-Incident communications in the built environment, and maintaining it
4. Basing any decision on future At-Incident communications on a cost-benefit analysis, taking into account the overall costs of any change; not just the cost to fire and rescue authorities.

# Chapter 5

## Current Fire and Rescue Services Practices – Internationally

### 5.1 Introduction

The following were contacted by email and asked for a return within the timescale of the study:

1. Australia – New South Wales Fire Brigades
2. Canada – Toronto Fire Department and Vancouver Fire & Rescue Service
3. Eire – Dublin Fire Brigade
4. Hong Kong – Hong Kong Fire Services Department
5. Malaysia – Kuala Lumpur Fire Services Department
6. Netherlands – Netherlands Instituut voor Brandweer en Rampenbestrijding
7. Singapore – Singapore Civil Defence Force
8. South Africa – Tygerberg Fire & Disaster Management Services
9. USA – Atlanta Fire Department and Philadelphia Fire Department.

Only Eire, Dublin Fire Brigade; and Singapore, Singapore Civil Defence Force, responded although more were expected from initial contact.

### 5.2 Eire – Dublin Fire Brigade

Firefighters at the scene of an incident use handheld radios to communicate between the incident commander and crews and/or between crews and individual personnel.

These are used for voice communications only.

UHF is used for the fire ground. VHF is used for communication between Appliance and Control. There is limited use of UHF/VHF interconnect repeaters.

They do experience difficulty in using these handhelds in a built environment. It has been the experience that communication using UHF is generally line of site with a range of 800m. Any buildings with basements or reinforced concrete walls limit communications on UHF frequencies.

A leaky feeder system is being installed in Dublin Port Tunnel to support 2 existing VHF channels, 1 existing UHF channel and 1 new UHF channel that will be dedicated for use in Dublin Port Tunnel only. This system is not commissioned and they are unable to comment upon its effectiveness.

They are not aware of any building codes in the Republic of Ireland that allow the fire service or other authority to require owners or occupiers of buildings, tunnels or other structures to install equipment to enhance or facilitate firefighter communications in the event of an incident.

All the Emergency Services in Ireland have formed a group chaired by the Dept. of Finance to procure a National Digital Radio system. The specification of this system will include requirements for in building coverage, mobile base deployment for major incidents and special arrangements for tunnels and other special building structures as required. The events of 9/11 have certainly influenced the move towards procurement of a national system that can support interoperability and the extended features of digital systems in line with the best proven available technology.

### 5.3 Singapore – Singapore Civil Defence Force

Firefighters at the scene of an incident use handheld radios to communicate between the incident commander and crews and/or between crews and individual personnel.

These are used for voice and data communications.

UHF is used for the fire ground. Normal handheld sets at 1 Watt, IS handsets at 0.5 Watts and vehicle sets at 2 Watts.

They do experience difficulty in using these handhelds in a built environment.

For road and rail tunnels they have installed leaky cable whereas for identified building complexes without coverage they have installed cell enhancers to provide coverage within those buildings.

Under the Fire Safety Code, depending on the construction and nature of the building, owners of the building are to provide a one-way or two-way communication system with the fire Command centre.

The events of 9/11 have influenced firefighting with the preferred location of command and control now being outside of the building unless the fire command centre is safe for use.

## 5.4 Summary of current fire and rescue service practices – internationally

### 5.4.1 Provision

Practices in Eire and Singapore appear broadly similar to that found in the UK in that they use analogue UHF radios to provide At-Incident communications.

### 5.4.2 The Built Environment

Problems experienced in the built environment are also similar. The building regulations in Eire appear similar to those in the UK in that they do not mandate owners to install equipment. However, in Singapore building owners are to provide radio equipment in certain circumstances.

## 5.5 Conclusions of current fire and rescue service practices – internationally

From the limited responses received, the current situation outside of the UK appears similar to that in the UK.

# Chapter 6

## Related Fire and/or Communications Developments

### 6.1 Introduction

There are a number of groups, committees and projects, the work of which may have an impact on this study or are otherwise worth monitoring. These include:

1. UK Organisations:
  - a. The Chief Fire Officers' Association (CFOA) – Communications and Computing Policy Committee (C&CPC)
  - b. Communities and Local Government – The Firelink Project (Firelink)
  - c. Communities and Local Government – The FiReControl Project (FiReControl)
  - d. The Building Disaster Assessment Group (BDAG)
  - e. Communities and Local Government – New Dimension – Command and Control work-stream (New Dimension)
  - f. The Public Safety Spectrum Policy Group (PSSPG)
  - g. The Office of Communications (Ofcom)
  - h. The Interoperability Steering Group (ISG)
  - i. The Emergency Services Radio Liaison Group (ESRLG)
2. International Organisations:
  - a. Project LIAISON (LIAISON)
  - b. Project MESA (MESA).

The staff-side representative bodies would also expect to be consulted in relation to any significant change in 'At-Incident' communications, including the Fire Brigade Union (FBU).

There are also other issues which may impact on consideration of possible solutions.

## 6.2 Groups, committees and projects

The following organisations will potentially have an impact on fire and rescue service 'At-Incident' communications in the UK:

### 6.2.1 CFOA C&PC

This Committee, currently chaired by Olaf Baars, provides policy advice to the CFOA lead on operational issues and through him, the CFOA Board on matters relating to fire and rescue service communications and computing. The Committee meets quarterly and its members comprise the chairs of CFOA regional C&CPC meetings.

Its terms of reference, as regards At-Incident communications, are that:

1. CFOA's main concern about inter-service interoperability focuses on the "systems" issues surrounding the facility, rather than on the technical aspects of making it possible
2. CFOA takes the view that there is an At-Incident requirement for speech, data/telemetry and some aspects of video. CFOA does not necessarily believe that it is necessary that a single technology solution for achieving this is necessary
3. Whilst CFOA is generally content with the ongoing use of existing UHF analogue equipment for At-Incident voice communications, it also feels that the selection of Airwave as the preferred bidder for Firelink will allow examination of whether Airwave technology could benefit At-Incident communications – with Trunked Mode Operations (TMO) or Direct Mode Operations (DMO). CFOA would support such an examination.

The CFOA website is [www.cfoa.org.uk](http://www.cfoa.org.uk).

### 6.2.2 Firelink

Up until recently, each fire and rescue service in England, Wales and Scotland has operated their own individual wide area radio scheme. The schemes have used a range of make and model of radio system, which vary from low band VHF to high band VHF, from amplitude modulated to frequency modulated, and from voice only, to integrated voice and data. These radio schemes have primarily been used to enable communications between mobile resources, eg fire appliances and officer's cars, and control centres. The communications are mostly used either en-route to an incident, or to communicate from the incident. They are not traditionally used for communications on the incident ground.

The scope of Firelink is to provide a single national voice and data radio scheme across England, Wales and Scotland. Firelink will provide the following:

1. The use of a new digital radio infrastructure consisting of over a 1,000 radio base stations and a ground based network
2. A radio terminal in every appliance and officers car
3. A mobile data terminal (ie a ruggedised PC) in every appliance.

The Firelink Project Board includes representatives of key stakeholder organisations including Communities and Local Government, Scottish Executive (SE), Welsh Assembly Government (WAG), Chief Fire Officers Association (CFOA) and the Fire Brigades Union (FBU); an approach that ensures all interests are taken into account.

Early in 2006 Firelink announced that it intended to award the contract to O2 Airwave. O2 Airwave has recently built a nationwide digital radio network that is dedicated for the use of the emergency services. The network uses TETRA technology that was developed as a European standard by the European Telecommunications Standards Institute (ETSI). The technology uses UHF radio systems that operate in the 380-400MHz frequency band. The rollout of radio terminals into control centres and appliances is currently planned for completion by mid 2009.

Whilst intended for wide area communications, TETRA technology has a number of features that should be considered further with regard to At-Incident ground communications.

The Firelink scope of supply does not provide for any type of incident ground communications. However, the TETRA radio system that will be procured does offer two features that should be considered in light of At-Incident ground communications.

Trunked Mode Operations (TMO) is when two or more TETRA radios communicate via the network infrastructure. Whilst the external coverage provided by Firelink is generally of a high standard, the extent of signal penetration into buildings is inconsistent. Unless ways of extending coverage into buildings are implemented, then this method can at best fulfil only a subset of the requirements for At-Incident ground communications.

Direct Mode Operation (DMO) means that TETRA radio terminals can be used directly from set to set, without using any network infrastructure. At first impressions, this does suggest that any handheld terminals that are provided by Firelink could be considered to offer a direct replacement for the current incident ground radios. However, a more thorough analysis suggests that the way forward is less clear cut:

1. Advantages:

- a. Operational benefit from integrating wide area communications to incident ground communications
  - Operational Benefit for firefighters is due to: Reduction in the amount of equipment to be carried into a hazardous environment; Less weight is an advantage; Housekeeping activities such as battery charging and battery management are reduced; Reduction in the amount of equipment that could fail. Reduction in the amount of separate training courses that would need to be undertaken.
  - Operational Benefit for officers is due to: Reduction in the amount of equipment to be carried around the incident ground; Having a single interface for communications increases probability to be able to contact officers; Housekeeping activities such as battery charging and battery management are reduced; Reduction in the amount of equipment that could fail. Reduction in the amount of separate training courses that would need to be undertaken.
- b. Improved voice quality when good radio path exists between two or more terminals
  - When discussing TETRA radios with firefighters, usually the first comment they make is the improved voice quality.
  - The voice Coder Decoder (CODEC) used is effective at filtering out unwanted noises. For example, we have seen a firefighter stand in front of a fire appliance which has its sirens operating, and speaking over a handset. The receiving handset has had no noticeable noise from the horns.
- c. Over the air encryption offering protection against eavesdropping
  - Anecdotal evidence has been found that incident ground radio channels are monitored by certain individuals. TETRA offers an encrypted channel which would be difficult for unauthorised users to listen to.

- d. Opportunity to deploy in-building repeaters to boost radio signal strengths
  - Products have been developed for in-building repeaters and micro base stations to be deployed in a number of buildings in the UK. Anecdotal evidence indicates that this has been a requirement in Copenhagen for new builds.
- e. Data communications could be used for telemetry
  - Currently, some fire and rescue services use a telemetry transmitter to send key data back to the BA access point. This is in addition to the voice radio. By combining the two, less equipment would have to be carried into hazardous environments. This would also represent a cost saving.

## 2. Disadvantages:

- a. Operational and logistical risk from strategic commanders overriding tactical commanders
  - By combining radio scheme, there is a risk that a remote officer could override commands given by the incident commander. This is a subset of the risk that the chain of command will be compromised.
- b. Sharp drop off in voice communications, i.e. no elegant degradation of voice communications that analogue radio benefits from
  - It is a common characteristic with digital radio communication systems that voice quality has a sharp drop-off. This means that initially as signal strength declines, voice quality remains consistent. Eventually the signal strength will reach a critical value and voice quality will drop to an unintelligible level. Analogue radio schemes tend to have a noticeable drop off in voice quality as soon as signal strength starts to decline. However the received signal usually remains intelligible well beyond the point that the digital signal has practically failed.
- c. Increased cost and complexity of terminals
  - By virtue of the additional circuitry, digital radios will be more complex and expensive than analogue. No figures are available to confirm this at present.

- d. Strict limitations on the number of radio channels available for DMO use
  - At present, there are no TETRA radio channels that have been reserved for the exclusive use of the fire and rescue service. There are some multi-service interoperability channels available. Informal discussions with regulators indicate that there is a reasonable probability that channels would be made available if the fire and rescue service applied for them.
- e. Availability of intrinsically safe handsets
  - At present, the majority of major TETRA terminal manufacturers do not produce intrinsically safe terminals. A number of specialist firms such as Niros do.
- f. Limited information available on signal penetration within built environment.
  - Due to the wide variations in building materials and methods, there are no widely applicable figures that can be used to accurately predict signal penetration into buildings.
- g. Single radio dependency
  - There is an additional margin of safety in using two separate radios when compared to using a single radio for all communications.
- h. Synchronisation and re-synchronisation
  - The time between pressing to talk and being able to do so between fire-fighters in DMO may be longer than currently experienced with existing radios

### 6.2.3 FiReControl

The FiReControl project is a Communities and Local Government led project to replace the current 46 fire and rescue service mobilizing controls in England with nine regional control centres. The current scope of the project means that it does not have an impact on fire and rescue service At-Incident communications.

Nonetheless, it would be sensible in any review of the At-Incident requirement to include an assessment of whether the regional control centres generated a requirement that might reflect on At-Incident communications. In particular:

1. Whether the regional control centre needed to be able to communicate directly with an incident commander rather than through the Incident Control Point
2. Whether an incident commander or others at an incident needed to communicate directly with a regional control centre rather than through an Incident Control Point.

and, in either event, how this might best be achieved.

#### 6.2.4 BDAG

The Building Disaster Assessment Group (BDAG) has been established to consider the issues, for fire and rescue authorities and their brigades or fire and rescue services in the UK, highlighted by the World Trade Centre incident of 11th September 2001. The terms of reference of BDAG are:

*To consider the potential implications, for the UK fire and rescue service, of terrorist activities within the built environment, taking into account fire authorities responsibilities for ensuring the provision of appropriate fire precautions for buildings in use and safe operating procedures that reflect building design.*

The current study is a consequence of the BDAG work.

#### 6.2.5 New Dimension

A major incident could occur at any location, and part of the national co-ordination arrangements for a response must include the provision of regionally based vehicles for communications and co-ordination.

The New Dimension programme is working with the fire and rescue service to develop regional based vehicles to provide a mobile capacity for command and control. These will add resilience to current national and regional arrangements for incident management, and will provide a capability should a catastrophic incident wipe out other fixed communication links.

In the event of an incident, a crisis centre could be established which will reflect the needs of an incident and have the ability to scale up or down accordingly. Support facilities could include storage of additional equipment, toilets, showers, catering, maintenance and the means to manage these.

Best practice of other agencies and international organisations is being used in the development of new training for command at a catastrophic incident level to develop the capability of the service to a new national level.

#### 6.2.6 PSSPG

The PSSPG is a standing interdepartmental committee reporting to the National Frequency Planning Group (NFPG) and comprises representatives from; Ofcom, the Department of Trade and Industry (DTI), the Home Office (HO), the Scottish Executive (SE), Communities and Local Government, and the Department of Health (DoH). The PSSPG is chaired independently and its technical sub-group provides rapid and authoritative advice.

The Public Safety Spectrum Policy Group (PSSPG), in consultation with Ofcom, will be responsible in the first instance for:

1. Advising on the broad spectrum requirements to meet the essential needs of UK emergency service and public safety users now and in the future
2. Setting the policy for access to bands dedicated to emergency service and public safety use
3. Advising on spectrum that has become surplus as result of changing emergency service and public safety operational requirements, and determining the timing and manner of release of such spectrum for other applications
4. Preparing any necessary future case, for consideration and approval by the NFIG, to ensure that sufficient and suitable essential spectrum is available for emergency service and public safety use, noting that where appropriate the UK Spectrum Strategy Committee (UKSSC) may if necessary also be requested to consider approving specific recommendations for Secretary of State directions to Ofcom as provided for under section 5(3) of the Communications Act 2003.

The PSSPG position on availability of radio frequency spectrum for emergency services use is set out in its Guidance Notes. Any solution for fire and rescue service At-Incident communications that requires new spectrum will need to be submitted through the PSSPG.

### **6.2.7 Ofcom**

Ofcom is the statutory regulator for the UK communications industries, with responsibilities across television, radio, telecommunications and wireless communications services. In managing the radio frequency spectrum, Ofcom is responsible for ensuring the optimal use of the electro-magnetic spectrum.

Ofcom has a band manager responsible for the spectrum used by the emergency services in the UK.

Ofcom is currently responsible for the grant of licences to Chief Fire Officers for the use of radio spectrum, including the spectrum currently used to provide At-Incident radio communications.

### **6.2.8 ISG**

The Interoperability Steering Group is chaired by a Home Office Minister of State, as the lead responsible Minister, with the Home Office providing interoperability programme management under a technically qualified programme director.

The Terms of Reference of the ISG are:

1. To provide strategic ownership and programme management, in order to secure interoperability and resilience of emergency service communications
2. To agree the appropriate level of emergency service radio interoperability, based on sound operational advice, and to drive through its implementation
3. To co-ordinate network interoperability arrangements e.g. fleet mapping and resolve any issues arising.

The Emergency Services Radio Liaison Group (ESRLG) is a sub-committee of the ISG. The ISG supports the agreement on interoperability agreed by the Chief Officers' Associations of the primary emergency services [Ref. 2-10].

### **6.2.9 ESRLG**

The ESRLG provides a forum for identifying and examining common issues associated with the procurement of radio systems for use by the emergency services and the delivery of the national requirement for emergency service radio systems, so that these issues can be addressed by the services. In particular:

1. Issues assigned to the ESRLG by the ISG
2. Issues relating to improving multi-service interoperability in advance of the replacement of the existing radio systems
3. Technical issues associated with providing the multi-service interoperability agreed by the Presidents of ACPO, CFOA and ASA (including any arrangements that might be necessary for testing/evaluating supplier proposals for meeting this requirement)
4. Operating procedures for using the multi-service interoperability arrangements
5. Capacity requirements for multi-service interoperability arrangements
6. Opportunities for a common approach to handling and sharing data
7. Issues associated with call-signs, fleet-mapping, encryption and key management
8. Issues related to a common approach to meeting the agreed requirements for resilience and in particular a joint understanding of what the maximum credible incident might be for resilience
9. Issues associated with the maintenance of existing radio systems in advance of their replacement, including access to and sharing of sites, equipment and other facilities.

### 6.2.10 LIAISON

The Location bAsed serviceS for the enhancement of wOrking enviroNment (LIAISON) project is researching Location Based Services (LBS) for a number of scenarios including Incident Management.

ACPO is involved, as is the Corpo Nazionale dei Vigili del Fuoco, the Italian Fire Brigade.

### 6.2.11 MESA

Project MESA is a collaborative venture involving the European Technical Standards Institute (ETSI) and the Telecommunications Industry Association (TIA) representing the interests of the EU and the United States. It is producing the specifications for an advanced digital mobile broadband standard much beyond the scope of currently known technologies.

MESA represents the first such international initiative to involve users and organisations from the Public Protection & Disaster Relief (PPDR) and Peacekeeping sectors to join forces with Industry for the production of a truly global standard.

For the fire and rescue service, MESA technology will enable firefighters to secure their own peers and save the lives of citizens by using technology developed to comply with the proposed Project MESA specifications. Functional capabilities, such as the real-time monitoring of the vital signs of working firefighters, will ensure they remain safe and able to operate at peak performance.

When on site, Project MESA could allow the simultaneous operation of large fire fighting crews which could be managed and controlled through a single system capable of full-motion video surveillance; infra-monitoring, fire, chemical and smoke monitoring and IP-voice communications. This dynamic network could be rolled out, on an expanded basis, to serve as either a fixed hot-spot emergency response communication system for other first responders. These core Project MESA communications technology requirements, coupled with the proposed wireless robotics and dynamic online monitoring of the firefighters' body temperature, heart rate, blood pressure, pulse, breathing and other cardio pulmonary and respiratory activities, will ensure both the safety of the firefighters and their ability to save and protect the citizens they serve. All of these capabilities will ensure there will be full Command, Control & Communication (C3) on site.

During the very early stages of the Project's feasibility studies, it was proposed that interoperation with future broadband satellite systems was required by the users in order to overcome the limited range of a broadband radio system operating in the GHz frequency range. History has shown that fires and particularly wild land and forest fires often occur outside the traditional framework of day-to-day public protection and public safety communications systems.

Also under consideration in the Project MESA process is the potential of using the Project MESA technology platform to provide multi-dimensional individual location systems (the ability to locate a fire-fighter or other first responders in a specific place on a specific floor of a high-rise building), or Geographical Positioning Systems (GPS). Since any potential solution will require using a combination of technologies and applications now in place, and some that do not currently exist, the resolution of the problem will go well beyond the actual Project MESA specifications. In spite of that, Project MESA is committed to attempting to resolve this very complex and potentially life-saving issue.

Project MESA specifications will be written to ensure each of their technology platforms can be used when and where they are needed without regard to established wireless infrastructure.

The combined use of terrestrial and satellite modes of operation is therefore an integral part of the overall project study and a high priority in our work. Therefore, the Project MESA team is also placing a high priority on increasing the global awareness of the spectrum needs of public protection and the public safety agencies' need for additional allocations of radio spectrum that can be optimized for the technology developed from the Project MESA specifications.

The Project MESA Statement of Requirements uses as a core assumption that a fire-fighting or other first responder vehicle may be equipped to carry an integrated broadband satellite transponder to create an "island" or "hot spot" of coverage around, throughout and above the scene of the incidence. In this way, firefighters and other first responders will be able to use Project MESA's advanced technology equipment to be defined in this process, coupled with airborne and other types of transport service, to protect lives and property in both urban and extremely remote areas.

## 6.3 Other issues

### 6.3.1 London Underground Ltd

It is understood that negotiations continue on the extension of the Airwave service into the sub-surface elements of the rail system.

### 6.3.2 Channel Tunnel Rail Link

It is understood that the Airwave service will be available in the sub-surface parts of the CTRL. It is not clear whether the service would have sufficient capacity to meet the needs of the fire and rescue service At-Incident requirement.

### 6.3.3 Road Tunnels

It is likely that long road tunnels have been provided with the Airwave service, primarily to meet the coverage needs of the police service. It is not clear whether the service would have sufficient capacity to meet the needs of the fire and rescue service.

### 6.3.4 The TransEuropean Road Network

It is understood that the UK road system is not included in the Trans European Road Network (TERN). However the position of the Highways Agency and Transport for London is that EU Directives which apply to TERN should also be implemented in the UK.

Directive 2004/54/EC [Ref. 2-2] deals with road safety in tunnels, and covers communications and indicates:

*2.16.1 Radio re-broadcasting equipment for emergency service use shall be installed in all tunnels longer than 1,000 metres with a traffic volume higher than 2 000 vehicles per lane.*

### 6.3.5 London Fire Brigade Research – Mesh Networks

The Brigade has been involved in some field trials using low power wireless mesh networking technology as part of the Miners Rescue Service's ongoing research [Ref. 2-17].

## 6.4 Summary of related fire and/or communications developments

### 6.4.1 Organisations influencing requirements

The work of a number of groups and organisations may have an impact on the fire and rescue service requirement for at-incident communications, including:

1. The Chief Fire Officers' Association (CFOA) – Communications and Computing Policy Committee (C & CPC)
2. The FireControl Project (FiReControl)
3. New Dimension – Command and Control work-stream (New Dimension)
4. The Interoperability Steering Group (ISG)
5. The Emergency Services Radio Liaison Group (ESRLG)
6. The EU and the EC.

### 6.4.2 Organisations Influencing Potential Solutions

The following organisations may have an impact on the solutions to the fire and rescue service requirement for At-Incident communications, including:

1. The Chief Fire Officers' Association (CFOA) – Communications and Computing Policy Committee (C & CPC)
2. The Firelink Project (Firelink)

3. The Public Safety Spectrum Policy Group (PSSPG)
4. The Office of Communications (Ofcom)
5. Project MESA (MESA).

### 6.4.3 Other External Influences

The *de facto* installation of Airwave in the CTRL and in long road tunnels, and the proposal to install in the sub-surface parts of London Underground needs to be taken into account in considering any replacement technology for meeting fire and rescue service requirements.

## 6.5 Conclusions of related fire and/or communications developments

Fire service At-Incident communications do not exist in isolation either nationally or internationally.

At the extremes, decisions affecting the operational requirement will be affected by the influences of a number of organisations and groups. Consultation will be necessary to ensure that vital elements of requirements are not missed.

Similarly, the development of solutions will need to take into account technical developments and technical possibilities not least the interface (technical and procedural) between At-Incident communications and the Firelink provision of Airwave in varying scenarios and locations.

Additionally, consideration of solutions will need to take account of the:

1. Built environment, and in particular the extent to which any fixed installations are required and the extent to which they might, realistically, be achievable; and
2. Timely availability of appropriate and sufficient radio frequency spectrum.

It will also need to meet the needs of users and other stakeholders and satisfy any relevant regulatory requirements.

Accordingly, any work on reviewing and updating the At-Incident user requirement, determining an appropriate technical solution and facilitating the satisfactory operation of that technology in the built environment will need to involve the relevant stakeholders. It will also need to take account of known developments in providing communications for the other emergency services.

# Chapter 7

## Summary and Conclusions of the Current Situation

### 7.1 Current fire and rescue services practices – across the UK

#### 7.1.1 Current Situation

There are few surprises from this brief review. The key findings relating to the current situation can be summarised as follows:

1. There is almost total reliance on UHF handheld communications to meet the voice wireless At-Incident communications requirement
2. Considerable ingenuity has been used to increase the effectiveness of UHF handheld equipment in the built environment
3. There is considerable investment in the current technology; a significant proportion of which is by third parties. If the sample is indicative of the whole fire and rescue service, a significant part of this is in London. A number of fire and rescue services in the sample were shortly planning substantial further investment, either in replacing existing equipment or to increase the scale of issue of handheld equipment
4. It would be worthwhile examining whether:
  - a. There is any scope for looking at the existing UHF assignments to see whether it might be possible modify the channel assignments to further minimise the potential technical limitations of the current channels
  - b. The number of UHF assignments currently available to fire and rescue services might be increased – perhaps by utilising channels vacated by the police service in its transition to the Airwave service.
5. There does not appear to be any common approach for assessing whether fixed communications infrastructure is necessary to support fire service At-Incident communications, no common standards for that provision and no means of compelling third parties to make or maintain it. With the exception of road and some rail tunnels and stations, this results in an ad hoc approach to the provision

6. The migration of the police service to Airwave and the resulting loss of police access to Channels 69 and 70 has caused some local difficulties, particularly in relation to police helicopters and New Dimension convoys.

### 7.1.2 For the Future

Key conclusions on future needs include:

1. A need to review and update the current User Requirement for At-Incident communications to take account of the developing requirement, including any New Dimension requirement, and of technical possibilities that have become available since the earlier work
2. Consideration of the need for the development of national guidelines setting out the minimum performance requirement for At-Incident communications in the built environment against which individual buildings and structures, and steps taken to improve coverage, can be assessed
3. Consideration of the need for national guidelines which clarify responsibility for facilitating effective At-Incident communications in the built environment, and maintaining it
4. Basing any decision on future At-Incident communications on a cost-benefit analysis, taking into account the overall costs of any change; not just the cost to fire and rescue authorities.

## 7.2 Related fire and/or communications developments

Fire service At-Incident communications do not exist in isolation either nationally or internationally.

At the extremes, decisions affecting the operational requirement will be affected by the influences of a number of organisations and groups. Consultation will be necessary to ensure that vital elements of requirements are not missed.

Similarly, the development of solutions will need to take into account technical developments and technical possibilities not least the interface (technical and procedural) between At-Incident communications and Firelink's provision of Airwave in varying scenarios and locations.

Additionally, consideration of solutions will need to take account of the:

1. Built environment, and in particular the extent to which any fixed installations are required and the extent to which they might, realistically, be achievable; and
2. Timely availability of appropriate and sufficient radio frequency spectrum.

It will also need to meet the needs of users and other stakeholders and satisfy any relevant regulatory requirements.

Accordingly, any work on reviewing and updating the At-Incident user requirement, determining an appropriate technical solution and facilitating the satisfactory operation of that technology in the built environment will need to involve the relevant stakeholders. It will also need to take account of known developments in providing communications for the other emergency services.

### 7.3 Summary from this part of the study

The key issues for the UK from this part of the study are:

1. The lack of an up-to-date definition of requirements for At-Incident communications
2. Near full reliance on the UK mainland on UHF handheld radio equipment to meet the At-Incident voice requirement and the extent to which users appear to be content with the current arrangements
3. The heavy investment in existing technology by fire and rescue services and by other third-party stakeholders – including London Underground Limited and the CTRL
4. The apparently ad hoc nature in which fixed facilities to support At-Incident communications are provided in buildings and the lack of central guidance
5. The limitations of the radio regulatory environment, including the potential shortage of channels – particularly at large-scale incidents involving multiple fire and rescue service attendances and the apparent lack of central guidance on how this should be managed on national basis
6. The new difficulties of delivering the agreed level of interoperability (and particularly intercommunication with police helicopters) consequent on the police migration to Airwave
7. The extent to which the selection of a technology for Firelink might influence the requirement for At-Incident communications and possible solutions.
8. The extent to which the New Dimension and to a limited extent, FiReControl projects might influence the requirement for At-Incident communications
9. The influence of technical development, innovative product design and standards development in the UK and internationally might affect user expectations, the user requirement and the candidate solutions for At-Incident requirements

10. The need to apply a rigorous cost-benefit analysis to any consideration of changing the current arrangements.

## 7.4 Conclusions from this part of the study

### 7.4.1 Initial View on Strengths of the Current Arrangements

The strengths of the current arrangements for At-Incident communications appear to be:

1. The existing UHF technology goes a long way to meeting At-Incident requirements in the built and un-built environment
2. The UHF analogue technology is robust
3. The technology and the user interface of the UHF equipment is simple and for the most part understood by users
4. The equipment is in place and in service now with new/replacement Commercial Off The Shelf (COTS) equipment is available if required
5. There are temporary and permanent techniques for improving the coverage of UHF communications and telemetry in the built environment and these arrangements appear to be in place at sites where this required
6. There is a separate solution to meet the BA telemetry element of the At-Incident data requirement thus providing resilience
7. Deliberate RF shielding and the use of “jamming” equipment in the built environment is not considered to be a significant problem.

### 7.4.2 Initial View on Weaknesses of the Current Arrangements

The weaknesses of the current arrangements appear to be:

1. The UHF channel assignments are not ideal, leading to potential blocking problems – particularly where the scale of the incident requires the use of all available channels. This is down to radio equipment requiring either geographical separation in the region of 100m, which isn’t practical on larger resourced incidents, or separation in frequency by at least one channel. The problem is that the channels are contiguous making some channels unusable at an incident. This problem would also happen with digital technology, which could be potentially worse as it may require further channel and/or geographical separation.
2. The provision of fixed installations on site to provide enhanced radio coverage is generally subject to the goodwill of the site owner/occupier. Save where other authorities are involved (Transport for London, the Highways Agency, HM Railway

Inspectorate and similar) there appears to be no mechanism by which a site owner or occupier can be compelled to make provision for fire and rescue service tactical communications

3. Fixed facilities to support communications in the built environment may be damaged or rendered inoperative by the incident that the fire and rescue service is attending
4. Enhanced communications requiring fixed provision at a site is subject to the effectiveness of the management/maintenance regime of the site owner/occupier
5. Enhanced communications is usually only provided for a single UHF channel; (there is, in any case, a maximum of two channels that can theoretically be supported at single incident)
6. There is currently no way of meeting the requirement to provide bronze level interoperability with the other emergency response organisations. The 25KHz bandwidth of current channels also creates problems inter-operating with other UHF users, such as at aerodromes licensed by the CAA
7. There appears to be a lack of central direction and guidance on At-Incident communications, particularly in relation to major and New Dimension incidents.
8. A separate solution has to be sourced and maintained to provide breathing apparatus telemetry (but see strengths above)

# Appendices

## Appendix A: Interview scripts, UK fire and rescue services

### CONTRACT 226085

### AT INCIDENT – SCRIPT BRIGADE/F&RS

#### 1 EQUIPMENT

- (1) What is the total number of UHF handheld radios in the brigade (inc any IS radios)?
- (2) Within that total, what is the total number of IS radios?
- (3) What is the total number of portable/mobile base stations used by the brigade?
- (4) Of this total, how many are fitted to appliances?

#### 2 BUILT ENVIRONMENT

- (1) What known problems are there communicating in the built environment, i.e. in buildings, building complexes – such as shopping malls, or road and railway tunnels
- (2) Are there any known locations where deliberate steps have been taken by the owners to prevent the use of UHF handheld radios (or any radio transmissions (perhaps for IT security reasons) in a building
- (3) Have you taken steps to improve UHF handheld at incident communications in any building or complex of buildings? For example, are any premises fitted with
  - Fixed antenna systems
  - Fixed antenna systems & base stations/repeaters – switched off until required
  - Fixed base stations & antenna systems – turned on all the time,at the brigade's request If so what has been fitted and where

- (4) Are any sub-surface railways in your area provided with special facilities to support UHF at incident communications?

(Number/location)

[My note – please ignore the Channel Tunnel]

Are any road tunnels in your area provided with special facilities special facilities to support UHF at incident communications at incidents?

(Number/location)

Are there any other sub-surface premises/tunnels provided with special facilities to support UHF at incident communications

(Number/location)

Any other fixed arrangements

### **3 PORTABLE ARRANGEMENTS**

- (1) Does the brigade have available for use for at-incident communications
- (2) Throw out radiating feeders
- (3) Field telephones
- (4) Fixed telephones on specific sites [again ignore the Channel Tunnel]
- (5) BA line communications equipment (to JCDD 19/2 or otherwise).

### **4 TELEMETRY**

- (1) Does the brigade use radio telemetry in conjunction with BA?

### **5 SHORTCOMINGS**

- (1) Are there any requirements of your brigade/fire and rescue service that are not met by current equipment, for example
  - (a) Direct access to wide-area communications from a handheld radio
  - (b) Interoperability with other emergency organisations
  - (c) At-Incident data/telemetry.

### **6 TRIALS**

- (1) Has the brigade trialed any novel solutions for use at incidents

## 7 OTHER COMMENTS

Are there any other comments you wish to make regarding the use of existing at-incident communications in a built environment?

Name

Title

Position

Email

Telephone

For Mott MacDonald.

# Appendix B: Questionnaire, international fire and rescue services

CONTRACT 226085

## INTERNATIONAL RESEARCH – DRAFT TEXT FOR ENQUIRY EMAIL

The UK government has commissioned Mott MacDonald to carry out a study into communications between fire service personnel attending fires and other emergency incidents.

The study focuses on the telecommunications arrangements for voice and data where this is used, at and within the incident scene. It does not include any telecommunications links from the incident or a vehicle at the incident to a remote location such as a mobilising control room or a fire station.

In the UK, firefighters normally communicate radio handset to radio handset with each other at an incident creating discrete radio networks as necessary for various purposes, including incident command, water supply management, breathing apparatus control and so on. The radios operate in the UHF band and have an output of 1 Watt ERP. Where the built environment (large buildings, building complexes, underground and road and rail tunnels) prevents satisfactory radio communications, various means can be used to improve communications ranging from bringing a fixed base station and optimised antenna to the site to having a fixed infrastructure with a permanent base station connected to radiating antennas or radiating/leaky feeders.

The main purpose of this part of the study is to find out what happens in other parts of the world.

Mott MacDonald, on behalf of the UK government, would be grateful if you could arrange for the following short questionnaire to be completed. If you are not the appropriate person to deal with this in your organisation, it would be helpful if you passed this on to the correct recipient.

Timescales are pressing, and it would be very helpful if a response could be sent by return, **and in any event by 15 March 2006.**

- (1) Do firefighters at the scene of an incident use handheld radios to communicate between the incident commander and crews and/or between crews and individual personnel?

**If the answer is yes**

- (2) Are the radios used to support:
  - (a) Voice communication
  - (b) Data communication (including telemetry), or
  - (c) Voice and data communication?
- (3) Do the radios use UHF, VHF or another band?
- (4) What power output are the radios (in ERP)?
- (5) Do you experience difficulty in using these handheld radios in a built environment, particular in large buildings or building complexes, underground structures, basements and road, and rail tunnels?
- (6) Have you taken any measures to improve communications in large buildings, building complexes, underground structures and tunnels – such as installing base stations in the buildings connected to suitable antenna and/or to leaky/radiating feeders? If so, please describe the measures taken and comment on their success.
- (7) Do local building codes allow the fire brigade/service/department or other authority to require owners or occupiers of buildings, tunnels or other structures to install equipment to enhance or facilitate firefighter communications in the event of an incident?  
  
If so, what can be required and who is responsible for the cost?
- (8) Have the events of 11 September 2001 in New York caused you to review or otherwise change the way you provide firefighter communications in buildings? If so, please explain

- (9) Who completed this questionnaire:

Name	Rank/Position
Email	Telephone

(10) If Mott MacDonald have any queries relating to the completion of this questionnaire, is there someone they should talk to other than the person who completed the questionnaire?

Name Rank/Position

Email Telephone

Many thanks for taking the time and trouble to assist us.

For Mott MacDonald.



**ISBN: 978-1-4098-0683-7**  
**£20.00**