Section 7

# Resilient communications in emergencies

## Overview

7.1 The communications infrastructure plays a range of vital roles in dealing with emergencies affecting the public. This infrastructure is evolving, largely as a result of the new technologies that are affecting many other aspects of our lives. These changes bring opportunities and may save lives in the future, but some familiar processes will also change.

7.2 The key highlights are:

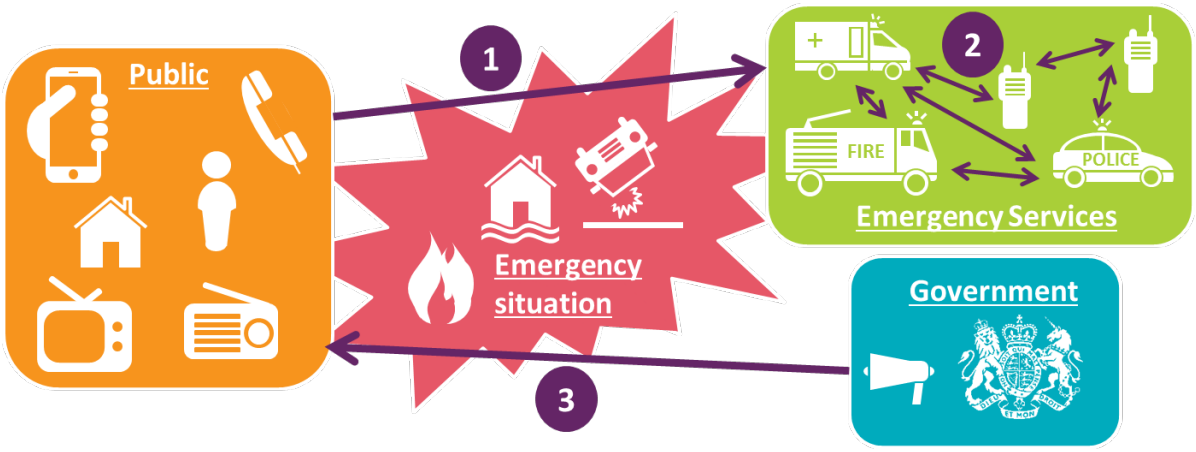
7.2.1 **The communications infrastructure is changing**: long-term plans are being drawn up by various operators to switch off the copper-based telephony network that has traditionally supported 999 calls. Similarly, the radios currently used by the emergency are due to be replaced with very different technology over the next five years. And the broadcast TV and radio platforms which can be used to communicate information to the public during emergencies are expected to gradually decline as new methods of content consumption continue to grow in importance.

7.2.2 **New technology brings new and potentially life-saving capabilities**: although emergency communications may be not be a major design consideration for many of the replacement networks, some of their new features will be useful in emergency situations. Examples include precise caller location, data from a wide range of sensors, and multimedia communications.

7.2.3 **Maximising these benefits while retaining reliability will be a challenge**: while the features they offer may not be as rich, legacy networks are generally very reliable, widely available and well understood by the majority of consumers. Ensuring that their replacements can fulfil these important criteria, while at the same time allowing their new features to be exploited, will require a strategic approach to the future of emergency communications. This is an important matter for Government, who may need to weigh the wider societal benefits of increasing the resilience of these new platforms against the cost, and consider intervening if commercial deployment falls short of its public policy objectives.

# The role of telecoms in emergencies

**Figure 37: Main roles of the communications infrastructure in emergencies**




*Source: Ofcom*

7.3 Communications systems play three important roles during emergencies, as illustrated in Figure 37:

1. **Contacting the emergency services:** The most common way to contact the emergency services is to dial 999. There are strict rules in place which require providers to offer this service and to ensure it works reliably.

2. **Communication within and between the emergency services:** the Government has announced that the contracts for the current service will not be renewed when they expire between now and 2020. Instead of using a dedicated private radio network, as they do currently, the emergency services will move to services carried on a public mobile network and made possible by new features included in 4G

3. **Warning and informing the public:** When an emergency requires information to be given to the public as quickly as possible, communications platforms are a uniquely well-placed option.

## The changing communications infrastructure presents opportunities and challenges

7.4 In all three of the roles set out above, the services and the infrastructure that underpins them are rapidly changing. New generations of technology almost always bring new capabilities with the potential to greatly benefit emergency communications.

### Mobile phones are now sophisticated communications devices

7.5 The communications capabilities of mobile phones have expanded hugely over recent years, adding text messaging, pictures, video and high speed data transfer to basic voice. Smartphones have developed many other features which can be useful in the context of emergency communications, including accurate knowledge of current location, sensors and apps able to monitor user health, environmental sensing, high-resolution cameras and large screens.

7.6 The wealth of data these capabilities make available is potentially very useful in dealing effectively with emergencies. There is an opportunity to integrate this data into the way the emergency services operate, minimising delay and errors, and at the same time greatly increasing the available information about any given situation.

7.7 Smartphones are also very flexible, offering multiple ways to make phone calls or send messages or other data. For example:

- voice calls can be made in either the traditional way (known as circuit switched), or via the internet using services like Skype or Facetime;
- video calls can be made over the internet using a variety of apps; and
- multimedia data can be sent via a range of messaging platforms, such as WhatsApp and iMessage.

7.8 This leads to greater diversity than has previously been available. Modern communications systems are also very flexible, adapting quickly to changing user demands. The unpredictable nature of emergencies makes this a valuable property.

However, there are challenges in using these new technologies for emergency communications

7.9 The motivation for many of us, particularly younger generations, to adopt new technology to better serve our day-to-day communications needs is clear. However, many of our needs in relation to emergencies don't actually change very quickly. Advice like "dial 999" and "listen to local radio" has been the same for generations and having to regularly relearn these norms in the future as technology change accelerates is likely to be challenging. Particular attention is likely to be needed to ensure that groups which are slower to adopt new technology, such as older people, are not left without the services they need.

7.10 Another challenge is the reliability of the platforms. We have already spoken about the diversity of modern communications, which serves to increase their overall resilience, but there are factors which pull in the other direction. The infrastructure is evolving to offer ever more capability, often within the constraints of finite resources like radio spectrum or copper cable bandwidth. Achieving this leads to more complex systems, often with more network equipment sited closer to the customer. This in turn increases vulnerability to threats such as mains electricity interruption, flooding, vandalism or simple hardware failure.

7.11 A recent UK Regulators Network project[63] has explored one aspect of this – the resilience of telecoms networks to widespread electricity failure – in more detail. The conclusion from this work is that the Government may need to weigh the wider societal benefits of increasing the resilience of these new platforms against the cost, and consider intervening if commercial deployment falls short of its public policy objectives.

## Contacting the emergency services

7.12 More than 75 years ago the UK was the first country to have a dedicated national telephone number, 999, which could be used to contact the emergency services. The

[63] http://www.ukrn.org.uk/?page_id=647

European equivalent, 112, is now mandatory in all member states, and similar services are present in most countries around the world. In the UK, 112 and 999 can be dialled interchangeably.

7.13 The ability for customers to dial 999, free of charge, from almost any telephone has remained largely unchanged since the service's introduction. One of the few outward signs of modernisation was the introduction of the *emergencySMS* service in 2010, which allows deaf, hard of hearing and speech-impaired people to contact the emergency services. Behind the scenes, however, there have been many improvements, and developments in communications technology suggest there could be many more.

## The regulation of emergency services access

7.14 Regulating the essential lifeline service provided by 112/999 is one of the most important things that Ofcom does. The primary mechanism for securing the service is through the General Conditions of Entitlement (or GCs), in which Ofcom sets out the legal obligations that apply to everyone who provides an electronic communications service or network[64].

7.15 The obligation to provide 112/999 access is set down in GC4. This GC applies to communications providers which provide electronic communications services to end-users, requiring them to allow free calls to the Emergency Services and to provide those services with accurate information about the caller's location. GC4 is underpinned by GC3[65] which requires that measures are taken to ensure there are no interruptions to the operation of the public communications network. GC15[66] requires mobile operators to offer the emergencySMS service.

7.16 The GCs are reviewed regularly and updated when required, for example, to extend them to cover mobile and internet telephony services. In terms of enforcement, our focus is most often on the reliability of the service and the provision of accurate location information. We have an ongoing enforcement programme looking at compliance with GC4 across the industry[67].

7.17 The performance of telecoms and its regulation play an important part in the overall user experience of the 999 service. However, these aspects extend only to the ability to make the call and have it routed to the correct emergency service with information about the caller's location.

7.18 The majority of the work in providing the service, including taking the details of the incident, deciding what help is required, attending the incident and ultimately resolving it, falls to the emergency services themselves. As a result, the successful operation of the service requires the coordination of everyone involved - all four emergency services across the many regions, various government departments and telecoms operators. Similarly, the adoption of new technology needs coordinated action from the many parties involved, which can act as a barrier to change.

[64] The General Conditions of Entitlement, or 'GCs' are made by Ofcom under section 45 of the Communications Act 2003.
[65] General Condition 3 - "Proper and effective functioning of the network"
[66] General Condition 15 - "Special measures for end-users with disabilities"
[67] http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/open-cases/all-open-cases/cw_996/

## Future opportunities for the 112/999 service

7.19 Since its launch until quite recently, the original voice-only fixed telephone service facilitated by 999 was well aligned with the telecoms needs of most consumers. One of the most significant developments in recent years, the growth of mobile, has been mirrored by the service, with over 60% of calls received now originating from mobile phones. However, it could be argued that in many other respects the service has not kept pace with changes in how people use telecoms services and devices.

7.20 For the vast majority of users, interaction with the 999 service is still entirely voice-based. This is contrast with general telecoms use, which has seen voice traffic in steady decline on fixed networks and showing minimal growth on mobile, at a time when broadband data traffic on both platforms has been growing hugely. There is a risk that for many users, and particularly younger users for whom these trends are strongest, the communications methods they turn to first will not allow them to access the emergency services.

7.21 Modern data-centric communications services offer the potential to improve all aspects of interaction with the emergency services. Some examples are given below:

7.21.1 **Advanced mobile location (AML)** is a system for smartphone users to improve the accuracy of location information provided to the emergency services[68]. When an emergency call is made, AML seamlessly sends a message to the call handler with the best location information available to the handset. The location information is calculated from nearby Wi-Fi networks or global positioning system (GPS) satellite signals. It is usually much more precise than the information received for standard mobile calls, sometimes hundreds of times better in rural areas.

7.21.2 **REALRIDER** is a ride recording smartphone app for motorcyclists. It includes a feature which uses sensors in the phone to detect if the rider is likely to have been involved in a crash. If so, it will contact the relevant ambulance control room automatically, after giving the rider the opportunity to cancel the activation in the event that they don't need medical assistance. The app was developed independently, but tested extensively with a regional ambulance service before launch.

7.21.3 **999Eye** is a system which allows a 999 call taker to send an SMS containing a special web link to callers with a smartphone. When opened by the caller, this link establishes a live video stream from their phone, allowing the call taker to more accurately allocate the correct resources to the reported incident. The system, developed by West Midlands Fire Service, is expected to enter a pilot phase with a range of other UK emergency services and local authority services during 2015.

7.21.4 **eCall** is a system developed by the European Commission, which will be mandatory for all new vehicles launched in Europe from 2018. The system will use the mobile phone system to alert the emergency services of the need for assistance via a 112 call if the vehicle's airbags are activated.

[68] AML was developed by BT, EE and handset manufacturer HTC and launched in 2014. It is now being made to other networks and handsets from other manufacturers. http://www.btplc.com/News/Articles/ShowArticle.cfm?ArticleID=F8FD34BB-7E05-499D-8778-08A3F39F6015

Although offering more basic functionality, the system is similar to the proprietary systems increasingly included by manufacturers including BMW, Ford, Mercedes, Peugeot and Volvo.

7.21.5 **NG9-1-1 and NG112** are North American and European specifications for next-generation emergency access systems. Both are based on the same technical standard for an internet-based network for contacting the emergency services. Along with other technical enhancements, this allows them to take advantage of features of mobile phones such as text messaging, still images and video capture.

7.22 It is clear that new technology offers great potential to allow emergency access to function more effectively, and ultimately save additional lives. There is no shortage of examples, ranging from small independently-produced apps through to full specifications for continent-wide next-generation systems. However, there is no current UK strategy setting out how the whole service is expected to evolve to take advantage of the opportunities presented by technology developments, or indeed how to meet the potential challenges.

7.23 A further concern is that it is not clear from where such a strategy will emerge. This issue has been highlighted several times in recent years, with the most recent effort to find a way forward being led by the IET[69]. This is an important matter for Government to consider further.

## The challenge of ensuring a resilient service

7.24 Understanding the resilience of the 999 service, whether to power cuts or other threats, is complex. But given a sufficient level of investment, all the networks discussed below can generally be engineered to offer whatever level of resilience and reliability is required.

7.25 Providers take the importance of 999, and their regulatory obligations, into account when making investment decisions. They do this in the context of needing to operate profitably and to offer customers the services and features they want and are willing to pay for. As a result, they may invest less in protection than we might wish from a public policy perspective, or if emergency access was the main purpose of the service.

### Calling the emergency services from home

7.26 While not as flexible as modern communications services, the traditional fixed phone service has other advantages, in particular its resilience to power cuts.

7.27 The network is designed to send electricity over the copper wires linking customers' homes to their local telephone exchange, sufficient to power their telephone. This, combined with the provision of large batteries and generators at the exchanges, means that the fixed telephone service, and with it the 999 service, will typically continue to work even during widespread power cuts lasting several days.

7.28 This long-established arrangement accounts for much of the historic reliability of the 999 service, but it is being challenged by current and expected future changes. Today the many households which only use cordless phones are already vulnerable

[69] http://www.theiet.org/factfiles/comms/999-digital-page.cfm

to power cuts affecting their home. This is because cordless phones cannot be line-powered, and if local mains power fails, consumers will be unable to make 999, or any other, calls.

7.29 Looking to the future, the traditional telephone network is reaching the end of its life, with BT stating that it aims to switch it off by 2025[70]. The expectation is that over time an increasing proportion of fixed voice calls will be carried over broadband connections. Consumer broadband services do not generally offer the same levels of resilience to power interruptions as the traditional phone network, as the home router requires a mains power connection.

### Calling the emergency services from a mobile phone

7.30 With around 60% of 999 calls coming from mobile phones, the resilience of mobile networks is already a more relevant consideration for many customers. The architectures are so different that a direct comparison between fixed and mobile networks is very difficult.

7.31 Firstly, mobile telephones have their own batteries rather than relying on line or mains power, as fixed phones do. This is an advantage over in-home cordless phones, but the limited battery life, particularly in the case of smartphones, means that corded fixed phones are still likely to be more reliable in longer power cuts.

7.32 The reliability of the network itself must also be considered, and in general, mobile basestations have much lower levels of back-up power provision than their fixed network equivalent, the local telephone exchange. Any analysis of likely reliability rapidly becomes complex, because a given mobile phone may receive signal from another base station, or indeed be able to move until it can. In the case of an attempted 999 call, the phone will connect to any available base station, regardless of which network it belongs to, further increasing the chances of success.

## Communication within and between the emergency services

7.33 Today, the digital radios used for the majority of communication within and between the emergency services operate on a dedicated national network provided by Airwave. This network uses terrestrial trunked radio (TETRA) technology to deliver high reliability push-to-talk voice and low speed data services. The contracts with Airwave to supply the various emergency services are due to expire within the next five years, and the Government is in the closing stages of procuring a replacement communications system, known as the emergency services network (ESN).

7.34 The three main objectives of the ESN procurement are to enable services which are:

i) **enhanced:** to provide integrated broadband data services;

ii) **flexible:** to better match and be responsive to user needs; and

iii) **affordable:** to address financial pressures on central and user budgets.

7.35 At the time of writing, the only remaining bidder for ESN is EE, and a final contract award is due shortly. The expectation is that the ESN will be hosted on the winning bidder's existing 4G network, which is already used to deliver mobile services to the

[70] https://event.webcasts.com/viewer/event.jsp?ei=1051301 – Slide 19

general public. Additional features are being added to the international 4G technical standards to better allow the technology to support the types of communication required by the emergency services.

7.36 The Airwave network was originally designed, and has been further developed during its life, to be highly resilient to a range of threats such as power interruptions, severe weather and equipment failure. Ensuring an appropriate level of resilience for ESN has been an important element in the procurement of the new network. Balancing the needs of the emergency services and public users of the network will be a significant new challenge, particularly during times of stress. In our previous analysis[71] we found that, in principle, 4G networks are capable of meeting this challenge.

## Warning and informing the public

7.37 As part of the Government's ongoing programme of work to better prepare the country for dealing with civil emergencies, the Cabinet Office leads a 'Warning and Informing' workstream. This work considers how best national and local authorities can keep the public informed during emergencies. There are a number of options which may be applicable, depending on the nature of the incident:

- police officers knocking on doors;
- audible announcements from sirens, public address systems in buildings, shops and transport hubs and loud-hailers from cars or helicopters;
- messages displayed on roadside systems;
- media announcements via radio and television; and
- automated messages to users of telecoms services.

7.38 The last two options rely on the communications infrastructure and are arguably the most effective for distributing a message quickly to members of the public nationally or regionally.

7.39 Today, and for many years in the past, national broadcast networks have achieved very high reach within the population. Analogue radio has often been seen as the communications channel of last resort in a crisis, as it is particularly resilient, with many households able to listen from their car or battery-powered receiver even during a power cut. Broadcast television, although generally requiring mains electricity for reception, has also had an important role because it is present and regularly watched in so many homes.

7.40 These platforms are expected to continue to operate and be widely received for many years to come, but listening and viewing habits are starting to change. As users spread their attention over more channels, between live and on-demand content, and from broadcast to online platforms, the best strategies to reach them mayl need to be reassessed.

[71] Assessing the Potential of LTE to Enable New Services, November 2013, http://stakeholders.ofcom.org.uk/market-data-research/other/technology-research/2013/Future-LTE-Services/

7.41 The ubiquity of mobile telephones may provide an important alternative in the future. There are already services in place, such as the Environment Agency's Floodline Warnings Direct, which use phone, text and email messages to inform registered users of flooding events. In 2014, the Cabinet Office published a report[72] on the outcome of trials of a potential new general emergency alerting system, based on the mobile phone network. If deployed operationally, the system would send information to all mobile phones within an area affected by an emergency. Similar systems are already in place in Australia, the Netherlands and the US.

72 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298687/Mobile_Alerting_Trials_Project_Report_FINAL.pdf