TOWARDS ACHIEVING RESILIENT TELECOMMUNICATIONS: INTERIM GUIDANCE

Civil Contingencies Secretariat, Cabinet Office

INTRODUCTION

1. The response to the incidents in London on 7th July, 2005, by the media, public and emergency services resulted in increased demand for both fixed and mobile communications. In London, demand for use of the GSM (note 1) mobile networks greatly exceeded capacity and callers experienced difficulty in making and receiving calls for a few hours after the incident. This exposed some shortfalls in arrangements for those with a need for resilient communications. Although July 7 highlighted issues surrounding GSM-based communications, severe degradation or failure of telecommunications have been cited as a major concern underlying the response to many incidents including: the flooding in Boscastle (August, 2004) and Carlisle (January, 2005), and in the USA following hurricane Katrina (August, 2005).

2. This guidance is aimed at organisations with a need for resilient communications such as those with front-line response roles in the immediate aftermath of an emergency, and is being circulated to all Category 1 and 2 responders under the Civil Contingencies Act. It recommends that organisations re-assess their arrangements to ensure that they can communicate effectively in the event of an emergency with a view to reducing reliance on GSM communications.

3. There is no silver bullet to achieving resilient communications, it is as much to do with organisation and process as the technical means used to communicate. However, not relying on a single means of communication and adopting a layered fall-back approach based on the principle of diversification and can go a long way to enhancing robustness. This interim guidance is intended to enable those that need resilient communications to start work. We intend to make fuller guidance available reflecting, in particular, a greater depth of consideration of the dependency issues behind technical communications solutions (such as those identified in Box 4).

BACKGROUND

4. In and around London on 7 July by around 11:00 users of GSM public land mobile networks (PLMNs) were experiencing considerable difficulty in making and receiving voice calls and SMS messages(note 2). On the fixed-line public switched telephone network (PSTN), although the number of calls attempted doubled, callers did not experience the same degree of difficulties. This is due to the fixed network having, in

1 GSM, the most common cellular mobile telephony systems in the UK.
2 On 7 July, typically volume increased three times and messages experienced delivery delays of 90 - 150 minutes.

general, greater capacity than mobile networks. Contrary to some media reporting no network 'collapsed' under the increased call volumes neither were they 'turned off'. Communications networks continued to be managed to make capacity available to the maximum number of customers in response to a significant increase in customer demand. There was also a marked change in customer behaviour resulting in average call duration increasing four fold and many callers not 'hanging up' after their conversation resulting in tied-up network resources.

SOME LIMITATIONS OF GSM MOBILE COMMUNICATIONS

5. Society has embraced the convenience of GSM mobile communications often without pausing to appreciate the limitations. Geographic coverage is an accepted limitation. Selection of a service provider is frequently made on the areas served relevant to customer needs. This can be established using interactive maps available on network websites. In addition, handsets provide immediate and visual indication of signal strength. However, there are other limitations that are not so widely appreciated. While there is acceptance that 'getting through' at one minute past midnight on New Year's morning might be difficult, the difficulty is often incorrectly attributed to the called party already receiving a call. Economic constraints preclude communications networks from being sized for such an abnormally high level of demand. Network capacity is finite with often around 20% headroom – increased demand above this results in callers not 'getting through'. Another limitation of mobile networks, which is often not appreciated, is that service becomes increasingly degraded in the event of a power failure lasting more than about an hour (note 3).

6. Many organisation's business continuity plans seek to mitigate shortfalls with GSM communications by issuing multiple SIMs from different network operators. However this approach is not without drawbacks. Handsets can be locked to a particular service provider preventing SIMs from other operators from working. While the 'Pay as you Go' service may appear attractive, some providers reallocate telephone numbers if the handset has not been used for a period of time. Although this may not pose a problem for making out-going calls the handset may be inaccessible to incoming calls. Other drawbacks are concerned with SIMs issued by international operators. For example, when SIMs issued by the Isle of Man operator Manx Telecom (note 4) are used in the UK they are recognised as being 'international' and allow roaming onto available UK networks. However, network operators only allocate limited capacity for roaming users and permission for a handset to roam is sought by the handset from the operator issuing the SIM. This is likely to require access to international telephone circuits. On July 7th one technique that was used to manage inward call volumes was to apply limits to international trunk calls.

IMPLICATIONS FOR RESILIENT COMMUNICATIONS

7. These issues have important implications for those using the PLMNs for critical communications - **access to the network cannot be guaranteed**.

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3 Although this is somewhat dependent on call volume.

4 A popular option because although SIMs issued by Manx Telecom are recognised as 'international' in the UK destinations called in the UK do not require the UK country code prefix (00 44).

8. There is a means of providing privileged access to a mobile network by using a special SIM for the handset. However, this is not a panacea. Exclusive privileged access, sometimes referred to as ACCOLC, is only invoked under very special circumstances at the discretion of the network operator following a request by the Police Gold Commander (note 5). Invocation is implemented network-by-network and only to a specified geographic area for the shortest period of time. Additionally, on an occasion when privileged access is invoked handsets containing an unregistered SIM are unlikely to have access to their network.

Box 1
Key messages
regarding the use of GSM communications

- **GSM networks are not sized for abnormally high level of demand.**
- **Do not rely on the invocation of privileged access.**
- **Unless privileged access is invoked, a registered SIM offers no entitlement.**
- **Privileged access only applies to out-going calls from a handset.**
- **If you are entitled to privileged access ensure that your registration is current.**
- **Understand the limitations of GSM communications.**

REDUCING RELIANCE ON GSM MOBILE COMMUNICATIONS

9. Improving the resilience of communications is as much to do with the processes involved in communicating as the technical solutions adopted. Below is a simple 3 step process that can assist in assessing communications requirements and means of provision with the dual objectives of **reducing reliance on GSM mobile communications** and **promoting diversity in means of communication**. An example follows in Box 5.

Step 1: Identify your existing critical communications processes

10. A process is essentially 'what you do', for example it could involve a designated person making contact with another designated person and exchanging particular information. Critical processes are those that are essential to the effectiveness of your operations. It is helpful to pay special attention to processes that rely on communicating over the GSM, public land mobile networks.

Step 2: Identify your communications requirements

11. For critical processes assess your 'technology free' communication requirements, namely your basic requirements such as sending or receiving specific information rather

5 For further information see Chapter 4 of *Emergency Response and Recovery* available at http://www.ukresilience.info/ccact/emergresponse.pdf

than just 'phoning someone and that communication might be between equipment as well as between people or between equipment and people. Many communications tend to be information 'rich' in that much redundant information is communicated, in this assessment it is important to establish the bare minimum information requirements as this provides a starting point for selecting technologies that could be used to perform the communication. Boxes 2 and 3 identify some issues that are worth considering.

Box 2
Communication requirements
high-level issues worth considering

- **where** and **how** the communication is **initiated**
- **where** and **how** the communication is **received**
- **intended outcome of the communication**

Box 3
Communication requirements
some details worth considering

Locations of the parties communicating, whether

- **urban** or **rural**
- **inside** or **outside buildings** and whether the locations are
- **permanent or mobile**

Nature of the communication

- **'two-way' conversation** involving
  - two or
  - more parties (radio net or conference call)
- **'one-way'** and whether the information is
  - 'pushed' (such as when an e-mail or text message is sent) or broadcast to the recipient or
  - 'pulled' by the recipient (as when a voice mail message or a web page is retrieved)

Step 3: Modify process or technology requirements

10. Here the technological means to carry out the conversation are reviewed with the objective of reducing reliance on communicating over public land mobile networks and increasing diversity in the means of communication. Achieving an appropriate balance is complicated. This might be accomplished by switching to another technology or diversifying the mix of technologies used. Some possible options are contained in Box 4. In seeking diversity it might be necessary to review the earlier processes to see if communications can be achieved in a different way.

Box 4
Communication solutions
some options for diversification

'Fixed' options

- **Fixed line public voice / data network** (PSTN)
- **Virtual Private Network** (sharing PSTN capacity)
- **Private voice / data network** (eg GSI)
- **Internet–based services** (eg web pages, e-mail, voip (telephone))

Mobile options

- **Public wide-area paging systems** (Vodafone & Pageone Communications)
- **Digital Private Mobile Radio** (eg TETRA / Airwave (note 6), Tetrapol)
- **CB** (Citizens Band) **Radio**
- **Raynet** (Radio Amateurs' Emergency Network)
- **Satellite voice / data service**
- **Private Mobile Radio** (eg two-way VHF, UHF)
- **Data service** (GPRS) **enabled communicator** ('pocket PC', 'smart phone' or Blackberry type device)
- **3rd Generation mobile network** (the 3 service is provided by Hutchinson UK)
- **WiFi** (wireless local area networks)
- **Wireless data networks** (eg BT Transcomm, PacNet)

6 Airwave currently provides a TETRA radio service to Police forces, Fire and Ambulance Services and certain other organisations involved in emergency response.

Box 5

Example
Mustering a response team

Step 1: Identify your existing critical communications processes

This step might have identified a process that involves office call-out staff requesting the presence of senior staff at a fallback facility. Staff that need to be contacted tend to spend a significant amount of time away from the office, not necessarily 'on the road' but also visiting other offices. Standing instructions state that a call placed to a mobile 'phone will be used to specify the location of the fallback facility and obtain the individuals availability and an estimated arrival time.

Step 2 Identify your communications requirements

This step might identify that the actual amount of information that needs to be communicated could be relatively small. At a bare minimum, this information could be 'pushed' to the recipient (such as by a text message). The recipient might be on the move or in a building and acknowledgement of the request is required.

Step 3: Modify process or technology requirements

This step might identify that by modifying the process and adopting pre-determined procedures the bare minimum information that could be communicated is a single 'codeword' to which the recipient fully understands the response. This opens up more possible technologies beyond those providing voice communication. These might include: an SMS text message, e-mail to a fixed or mobile device and pager message. SMS text messages may appear attractive but are dependent on availability of the GSM PLMN, e-mail could be sent to fixed or mobile devices (such as e-mail enabled mobile 'phone or Blackberry(note 7) by using mobile data services) although mobile devices typically use GPRS services which share GSM network infrastructure. There are two pager services which appear to have good resilience and signal penetration in buildings.

The original process also required the recipient to acknowledge the conversation. If the PLMN were unavailable, acknowledgement could be achieved using a number of means including a fixed-line telephone or e-mail. These means could impose delay, firstly by the originator seeking confirmation that the message has been received and secondly by the responder replying.

The procedure could be further modified to mitigate this delay. Central call out staff might work down a contact list in sequence and only if mobile phone conversations resulted in no available responder being able to reach the fallback facility within the required time will resort be made to an alternative technology.

7 Equipment manufactured and service provided by RIM technologies.

NEXT STEPS

12. The communications options contained in Box 4 are intended to enable those that need resilient communications to start work on reducing dependence on GSM networks. But truly resilient communications requires greater appreciation of the often complex resilience issues that underpin each technical solution. These include: the degree of dependence of one solution on others; reliance on third party networks; dependence on electrical power; diversity of commercial suppliers; geographic coverage; interoperability etc. We intend to issue fuller guidance that considers these and other issues later in the year.

FURTHER INFORMATION

National Infrastructure Security Co-ordination Centre

NISCC have produced the *Good Practice Guide to Telecommunications Resilience* (note 8) which addresses the resilience of telecommunications networks that carry voice and data services over the fixed and mobile infrastructure in both the public and private circuit domains.

Civil Contingencies Secretariat

CCS is working with CSIA and NISCC to enhance this guidance, particularly to provide more information relating to the issues behind the options for communications technologies (as outlined in Box 4). If you have any queries about this guidance please contact us at resilient.comms@cabinet-office.x.gsi.gov.uk (when mailing please make "towards achieving resilient telecommunications" the subject).

8 Published May, 2004, and available for download at www.niscc.gov.uk follow the links to Products and Advice, then Policy and Good Practice.

Box 6
Abbreviations explained

ACCOLC, ACCess OverLoad Class is a tool that GSM network operators use to manage access to their networks. It can be used to give privileged access to front-line emergency responders in the event of congestion on networks in the immediate aftermath of an incident.

CCS the Civil Contingencies Secretariat based in Cabinet Office, visit us at www.ukresilience.gov.uk.

CSIA the Central Sponsor for Information Assurance, based in Cabinet Office. The CSIA provides a central focus for information assurance in promoting the understanding that it is essential for government and business alike to maintain reliable, secure and resilient national information systems. Visit them at www.csia.gov.uk.

GPRS, General Packet Radio Service, sometimes referred to a 2.5G, is a data service, while it is different to GSM it relies on much of the same network equipment and the two technologies are therefore not truly independent.

GSM, Global System for Mobile communication which is sometimes referred to as the second generation (or 2G) network. There are four GSM networks in the UK: O2, Orange, T-Mobile (note that the Virgin service is delivered over the T-Mobile network) and Vodafone.

NISCC the National Infrastructure Security Co-ordination Centre. Visit them at www.niscc.gov.uk.

SIM, Subscriber Identity Module.

SMS, Short Message Service, the GSM service for sending text messages to mobile handsets.

TETRA, TErrestrial Trunked RAdio, two-way digital radio technology.

VOIP, Voice Over Internet Protocol is a means of sending voice over the Internet.

DOCUMENT MANAGEMENT

Version 1.8. Comments following review by TIDO(SD).

Version 1.7. For posting on www.ukresilience.info.

Version 1.6. Changes to ACCOLC, (para 8). (26 May, 2006)