

Delivering resilient wireless communications under potentially challenging conditions

During the floods in 2007, Gloucestershire County Council's Emergency Management Service worked with RAYNET to use their wireless communications to enhance their response

Resilience issues ...

Wireless telecommunications provide important tactical communications. However, services delivered over public 2G and 3G cellular mobile networks are not resilient - public networks can readily become congested and a power failure of grid distributed electricity renders local communications inoperable within an hour.

Private mobile radio systems, and in particular those that use licensed spectrum, can offer highly resilient point-to-point and point-to-multipoint communications. This is largely as a consequence of a high degree of control that users can exert over resilience-enhancing features.

Existing telecommunications arrangements can be augmented by the use of amateur radio equipment provided by members of RAYNET - the Radio Amateurs' Emergency Network. RAYNET's services can complement existing arrangements during major civil emergencies or related exercises and local community events. Members are licensed radio amateurs who use their own equipment to provide additional support.

Resilient telecommunications are able absorb or mitigate the effects of an event or circumstances that disrupts normal life. Disruptions can be natural events such as flooding, or circumstance that may have occurred through human intervention such as an electrical power failure or a terrorist incident.



RAYNET was formed in 1953 following the east coast floods when radio amateurs provided emergency communications. RAYNET has provided additional communications capabilities at major incidents involving aircraft, trains, flooding, evacuations, telephone exchange failures and chemical spills. They also provide safety communications for large-scale community events such as the London Marathon, charity cycle rides and long-distance walks and orienteering.

Members use predominantly VHF and UHF radios to provide local and wide area coverage from handheld and vehicle mounted equipment. Depending upon the situation they may rely solely on handheld equipment. However, since the range tends to be relatively confined they can

Case Study

RAYNET partners with Gloucestershire County Council during 2007 floods

Heavy rains started to fall on Gloucestershire on the 20th July 2007.

Two days later the county experienced widespread severe flooding which inundated Mythe water treatment works and threatened a major electricity distribution site at Walham. The County council's emergency centre and nearby radio communications site was at risk of becoming inaccessible. On the 22nd July, the Emergency Planning Team at the county council called on RAYNET to assist them with providing wireless communications. Members established a new radio station co

-located with the alternative local authority emergency centre and provided radio links to the main bottled water distribution centres and to some of the many rest centres established in Gloucester, Stroud, Cheltenham and Tewkesbury. RAYNET also provided resilient communications links to counties outside the extensive area that would be affected by power loss if the site at Walham was flooded.

Contact your local RAYNET group and find out how you can work together to enhance the resilience of response arrangements 030 30 40 10 80; chair@raynet-uk.net; www.raynet-uk.net

provide additional equipment to increase the local area of coverage or provide a radio system to provide a point-to-point link to responders in another area.

Suitably equipped High Frequency (HF) stations are able to provide coverage to a wider area and long range links across the country.

Although 'all informed' point-to-multipoint voice communications are normal, members can also provide text services and, being enthusiastic amateurs, they are always keen to develop new capabilities such as the transmission of high quality images and access to the Internet over radio links.

Under the terms of their radio licence members are permitted to pass messages on behalf of organisations that are broadly involved in assisting the public or ensuring their safety such as: the Emergency Services; HM Coastguard; British Red Cross, government departments, health authorities, Local Authority Emergency Planning Teams, St Andrew's Ambulance association, St John Ambulance, Salvation

Army, utility companies and the WRVS - essentially Category 1 and 2 responders, as defined in the Civil Contingencies Act (2004).

Points worth considering ...

- The range achieved with VHF and UHF communications is very dependent upon terrain. Forward planning improves performance through a range of measures ranging from gaining access to high vantage points from which to locate or use existing antennas, to pre-installing equipment in key premises. Establish a working relationship with RAYNET before you need to call upon them in an incident.
- Exercising improves performance. RAYNET regularly exercise with the Army and Local Authority groups.
- If RAYNET's assistance is required contact them early to enable them to appreciate the situation and co-ordinate an appropriate response.
- They are volunteers - they appreciate support.

Guard against your business being isolated by re-directing in-coming calls at the exchange

Kings' College Hospital NHS Foundation Trust has used a number of measures to enhance the resilience of their telecommunications including using GemaTech equipment to redirect incoming calls to alternate numbers

Resilience issues ...

Core telecommunications infrastructures are designed in a way so that they are inherently resilient and individual exchanges have a very high level of availability – they rarely fail.

However, the local access network - sometimes referred to as the 'local loop' or 'last mile' - that connects your premises to the local exchange is much more likely to suffer problems. If this occurs your organisation can become isolated and you will have no way of receiving incoming calls.

Equipment is available that can re-direct incoming calls to your premises. Installing such equipment remotely from your premises, in your telecommunications supplier's facilities, can prevent your business from being isolated in the event that your connection to the exchange is lost.

The 'last mile' connection from your telecommunication provider's exchange to your premises is inherently less resilient because it has to be more accessible. Accessibility increases likely means of failure or service degradation: overhead

wires can be brought down by trees in high winds; kerb-side 'boxes' - that are increasingly containing equipment that was once located in an exchange building - are vulnerable to vehicle impacts and joints below ground in foot-way boxes can suffer corrosion from water ingress - which can be exacerbated during flooding. Recent high copper prices have exposed a further vulnerability to your connection to core networks - that of cabling theft.

These problems can be circumvented by installing equipment in your telecommunication provider's exchange that can be instructed to reroute incoming calls to other phones in other locations.

'Dial plans' that describe how incoming calls are rerouted can be pre-programmed into the equipment for anticipated circumstances, such as staff being unable to gain access to your premises, for example as a consequence of flooding or transport difficulties. Re-routing could be to an individual's cellular mobile or to a call centre. Alternatively, calls can be re-routed 'on the fly' to respond to changing circumstances. Re-routing can be activated by the equipment detecting a fault or by direct intervention.

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Case Study

Kings' College Hospital NHS Foundation Trust undertakes several measures to enhance land-line resilience

The Foundation Trust have enhanced the resilience of their land-line, or terrestrial, telecommunications by taking a number of resilience enhancing measures. They have obtained telecommunications services from two different suppliers in anticipation that this will enhance seperacy and each supplier's exchange is located at independent sites. The Foundation Trust is connected to their supplier's sites by two physically diverse connections – namely that they leave their premises at different locations and are subsequently not run together, for example in the same cable duct. Furthermore, they have reduced the opportunity of a single point of failure at

their premises by routing each incoming connection to a separate internal telephone exchange, or PABX (Private Automated Branch Exchange).

They have further enhanced their resilience by installing GemaTech equipment at both suppliers' sites. In the event of a failure of one of the connections or supplier's exchanges, the GemaTech equipment can detect the problem and immediately re-route incoming calls to alternative phones or locations ensuring continuity of their telecommunications services. (January 2007)

For further information visit:
www.gematech.com

Points worth considering ...

- This type of resilience solution not only provides insurance against loss of the physical connection to your premises or inability to staff the premises, it also provides flexibility for redirecting incoming calls under business-as-usual conditions thereby maintaining investment in publicised contact numbers.
- To function, your PABX requires electricity from your building supply, in the event of local supply failure internal communications will be unavailable. It is prudent to install backup power supply equipment.
- Any resilience enhancing solution that is installed remotely from your premises relies on the continued provision of services at your telecommunications supplier's site. For example, if electrical power is lost at your telecommunications supplier's facilities it is likely that the installed equipment will cease to function.

- Case study 3 considers how voice continuity can be provided in the rare event of your service provider's exchange failing.

Keep in touch with your people as they move location through a single contact number

The MOD use BT's smartnumbers service to deliver a flexible and resilient business-as-usual solution to ensure staff always remain contactable

Resilience issues ...

Directly reaching a particular telephone number can often be a vital link in a 'resilience chain'. For example, a particular number may have been widely publicised for a specific service or the number is associated with a particular functional response or even key individual. For a number of reasons it might not be possible to establish contact. These might include: failure of a particular telecommunications circuit to your premises or even an entire telephone exchange, or, staff being prevented from gaining access to a particular premises possibly as a consequence of flooding or a police cordon.

Case study 2 looked at how equipment installed in your telecommunications supplier's exchange can help circumvent such problems arising to business continuity. This case study looks at the 'softer' staffing issues associated with supporting flexible working practices and focuses on a solution that is systemic in a supplier's telecommunications system thereby guarding against exchange failure.

Experience indicates that the likelihood of an exchange failing or services becoming

severely degraded is extremely low, however a failure, such as that of the Paddington North exchange in London in March 2010 can have wide reaching consequences. The Paddington exchange suffered a catastrophic power failure resulting in all local connections being lost as well as circuits that passed through the exchange for onward routing. The effects of the failure were felt locally by around 160,000 customers and more widely a field in Surrey and Berkshire. This rare occurrence of an exchange failure would also have resulted in failure of call redirection equipment located in the exchange (see Case Study 2) because equipment that re-routes the calls is powered from the exchange.

An alternative approach to installing rerouting equipment is to use a 'virtual number' service. There are a number of providers of these simple call-forwarding services. However, their resilience needs to be carefully scrutinised as many have an obvious single point of failure. Resilience can be greatly enhanced by using a solution that is 'systemic' in your telecommunications supplier's infrastructure.

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Case Study

Personal and team call handling service provides the Ministry of Defence with built-in business continuity and ensures calls need never go unanswered

The Ministry of Defence (MOD) attach strategic importance to voice communications. Voice services need to be flexible and adaptable to support changing work practices and staff changing role or location. Traditional arrangements were no longer suitable as they relied on telephony infrastructures assigning fixed numbers to fixed sites.

MOD adopted a single number and messaging service provided by BT smartnumbers which is delivered as part of the Defence Fixed Telecommunications Service (DFTS). New 03, non-geographic, numbers have been assigned 'for life' to roles, individuals, or teams. Staff can receive calls made to their single number where ever they happen to be, on any device capable of receiving voice calls such as a mobile, desk or home telephone, or Brent. The service provides a single voicemail system removing site specific arrangements.

The telephone number of the device onto which a call terminates can be changed individually or entire 'dial plans' for groups of staff or premises can be implemented. The service is flexible and can be used by an individual to respond to day-to-day flexible working arrangements and in response to a major incident. The service is also being used to facilitate office reorganisation, or relocation of premises - under such circumstances numbers are not normally transportable.

The service is available to all staff across the MOD, to MOD partners and other government departments.

For further information on the service available to MOD, to MOD partners and other government departments visit: www.dftssmartnumbers.com

For further information applicable to all other organisations visit: www.btsmartnumbers.com

More sophisticated call routing and distribution services such as BT's smartnumbers include features such as 'hunt groups' and 'queuing' that enhance the opportunity for a call to reach an intended person, team or function and prevent unanswered calls from being re-directed to a mobile device that may be inaccessible, or switched off, or to office voicemail which may not be accessed for some time.

Points worth considering ...

- Ensure that call routing and distribution services are not critically dependent on a

single site, such as an 'exchange' or data centre in your telecommunication service provider's infrastructure.

- The resilience of call handling is significantly enhanced where business continuity practices can be integrated with business-as-usual processes. Adoption of such practice lends itself to simplification and reduction in costs associated with staff relocation, office re-organisation and property rationalisation programmes.
- Resilience is further improved when the ability of individuals or teams to receive calls does not rely on local infrastructure or a specific exchange.

Connect together 2-way radios and computers to provide economical wide-area communications

Ribble Valley Borough Council worked with ARL Communications Ltd to enable responder's existing 2-way radio networks to be connected together using the Internet providing interoperable communications

Resilience issues ...

Two-way radios can be used to provide resilient telecommunications for responders on the move, but geographical coverage can be a severe limitation even with higher powered vehicle mounted equipment. Range can be considerably extended using a repeater station located at a high vantage point, such as a hill. Coverage can be extended further by linking repeater sites together. Conventionally this is achieved using UHF radio links or expensive land lines.

Linking repeaters together using the Internet opens up a whole range of possibilities: repeater sites need no longer be within line-of-sight and sites beyond the reach of a single radio link can be connected together. Using the Internet to provide connectivity enables computers to be connected to the voice network this provides additional functionality such as enabling connected parties to be visible to one another thereby providing the opportunity for greater interoperability.

ARL Communications Ltd worked with Ribble Valley Borough Council to deliver a system that connects existing radio infrastructures extending coverage of VHF



and UHF radio networks by providing a flexible, resilient and interoperable platform for responder organisations without the requirement to change-out existing equipment or build new networks.

The solution called EARL – Emergency Area Radio Link - uses VoIP (Voice over Internet Protocol) applications to connect existing two-way radio communications to other radio networks and computers. This enables computers running a VoIP application to join the communications network anywhere where an Internet connection is available.

Remote radio networks are securely connected together using encrypted links over the Internet or corporate intranet. EARL includes a server co-located with

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Case Study

Ribble Valley uses ARL to co-ordinate a response across many organisations

ARL has been used in Lancashire to enhance the resilience of their communications where it is part of the county's resilient telecommunications plan. First responder organisations already connected include: Lancashire District and Unitary Authorities emergency planners, Category 1 and 2 responders and members of voluntary organisations including Mountain Rescue, RAYNET (see Case Study 1) and St John Ambulance.

In addition to using EARL for responding to emergencies, Ribble Valley Borough Council uses the system to deliver business-as-usual communications to their community services teams. For example, EARL enables mobile refuse collection teams to be in

constant contact with desk-based managers and supervisors through their office computers. Medical and safety support has been delivered at outdoor events held in the region by integrating the council's communications with those of partner organisations including St John Ambulance and RAYNET (see Case Study 1).

The core objective of using EARL is to link together a community of responder organisations across the county with a level of communication interoperability that has not been achieved previously for both business-as-usual and emergency response activities. (October 2010)

For further information visit:
www.arlcomms.com

the Local Authorities IT infrastructure. A radio system VoIP gateway connects the server to responders' radio networks and their own computers. Client software installed on their computers enables them to connect over the Internet over a secure connection to the server. Using a VoIP client on the computer, conversations can be established between all connected users.

Interoperability is user defined and managed. The EARL desktop application provides the ability to dynamically create communication groups to suit the purpose, event or incident around which people need to communicate linking together the radio networks of users. The desktop application enables connected parties to be visible to one another thereby providing the opportunity for greater interoperability.

Points worth considering ...

- EARL has been developed to provide a highly cost-effective solution to its user community. Proprietary systems are also available from radio equipment and network suppliers.
- Analogue 2-way radios can provide highly resilient communications since control of resilience enhancing features rests largely with the user community.
- Licensed VHF radio spectrum, that minimises interference, is more readily obtainable for local rather than wide-area coverage. Fees are often modest.
- Since Internet links are used extensively the resilience of broadband connections must be assessed both for trunking between repeater sites and for local access, for example from a Satellite Phone or DSL connection over a land-line.

Enhancing the likelihood of staying in touch by mobile phone in remote areas

The Manx Telecom Strongest Signal Mobile service provides a UK national roaming capability without the hassle of a country code prefix

Resilience issues ...

Mobile operators all claim about 98%-99% demographic coverage. This is very different to geographical coverage which can be very patchy, especially in rural areas. Taking a service from an overseas operator that has national roaming agreements with UK networks enables a mobile to 'roam' across those networks and overcomes the coverage issues that may exist on any one network.

Generally, a major drawback of this approach is that inbound calls to the handset must be prefixed with the country access code for the service provider. This can result in confusion, since normally the country code is totally transparent. The Manx Telecom service however does not require a country code to prefix numbers – it is already set to +44 to work in the UK. In addition, since Manx Telecom have roaming agreements with all UK service providers all networks are accessible and the handset roams to the network with the strongest signal.

The wide-scale adoption of cellular mobile telephony by society and business has resulted in it becoming a compelling



communications tool, although for those who require 24 x 7 comms there are drawbacks that require consideration.

Mobile radios connected to the 2G and 3G cellular wireless networks are not resilient against failure of grid distributed electricity since the batteries in the base stations will become depleted within an hour of power loss. In addition, in the locality of a major incident, networks can become so heavily congested that they are rendered useless for voice communication and SMS messages can take several hours to be delivered.

The Manx Telecom Strongest Signal SIM through its national roaming capability and as a provider of MTPAS enabled SIMs can help to overcome some

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Case Study

Response to the Carlisle flooding in 2005 enhanced by Strongest Signal Mobile

In January 2005 Cumbria suffered the worst flooding for 80 years.

On January 8th some areas of Carlisle were already under 2.5 m water when two severe flood warnings were issued. The local district council premises, police and fire stations, sewage works and bus station were amongst the 3,000 business and residential properties badly affected by the flood water. Road access was difficult: the main arterial roads through the city centre were impassable. By mid-morning mains electricity to the city and surrounding areas was lost as a result of flooding at the local sub-station. By the afternoon most of the

mobile phone coverage in the city centre was lost, making communications between the emergency services, local authorities, health authorities, utilities and the many voluntary responders extremely difficult.

The Lake District was known to be a troublesome area for mobile coverage and the Cumbria Emergency Planning Unit already had a number of Strongest Signal SIMs for resiliency. These SIMs were able to establish a mobile connection and were deployed, thus enabling communication between key emergency personnel.

For further information visit: www.manxtelecom.com

of these drawbacks.

MTPAS – Mobile Telecommunications Privileged Access Scheme – when activated on a specific mobile network provides privileged access to handsets with an enabled SIM. A network operator, at the request of the gold commander in charge of the emergency response, can invoke MTPAS to provide privileged access to the mobile network. The scheme is only activated in very rare circumstances and then for the briefest possible time.

Strongest Signal Mobile is not designed to be an exclusive solution to all communication requirements, but rather an added dimension in providing a diverse resilient telecommunications system.

Points worth considering ...

- Manx Telecom services are compatible with MTPAS.
- MTPAS is available to Category 1 and 2 responders through their Local Resilience Forum's Telecommunications Sub-Group.
For further information visit: www.cabinetoffice.gov.uk/mtpas.
- If a message sent over a wide area paging network is not received by the pager, perhaps in the event that the device is out of range of a transmitter, the message is lost. Although paging networks have good coverage and signals can penetrate deep into buildings, the paging system only transmits signals.
- When an SMS text is sent over a mobile network and the handset cannot acknowledge receipt of the message the service will attempt to resend the message until receipt is acknowledged. There is a trade-off to be made between the higher resilience of paging systems and the store and forward characteristics of SMS.