Telecoms failure – lessons learned from New Zealand, Japan & 'Anytown'

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1. Executive summary

This report draws upon knowledge and data gathered from three countries; New Zealand, Japan and the UK to consider the impact of telecommunications failure and the lessons learned. The knowledge and data gained from New Zealand and Japan were taken from real events whilst the knowledge gained from the UK was gathered via the Anytown model, a simulations which brought together different sectors to consider the potential impact of a telecommunications disruption in the UK. This included discussing plans and evidence from a fictitious disruption in a representative city called 'Anytown'. The sectors/groups represented at the Anytown workshops were:- representatives from the telecoms sector, the Health Sector, Gas sector, Electricity sector, Emergency services, the Banking sector, transport sector, Government and Local Authority and academics from UK Universities.

During the earthquake in Christchurch, New Zealand, and The Great East Japan Earthquake and Tsunami, both in 2011, telecommunications infrastructures were severely damaged and hindered further by loss of other infrastructures such as power supply. Back up resources such as batteries and fuel to power generators were soon depleted. Telephone lines were severely congested in the initial period after the disasters and strategies employed included diverting the emergency service lines and asking people to avoid using mobile phones.

In terms of the population response to the telecommunication failure, the public did not seem to wait for authorities to communicate, instead organizing themselves even if this put them at risk. In both countries the public were key agents of communication, using twitter as a means of communication to organize, share news, to locate missing people and to identify damage. They also posted information on bulletin boards. Volunteers created online sources of information as well as posting it to print media.
However, individuals without access to technology were disadvantaged as were those cut off from electronic communications and they received limited information.

In the UK many sectors and organizations do have plans, including Business Continuity Plans, in place to manage a disruption, which includes the use of Airwave radio for some sectors, particularly the emergency services. However, in the event of a telecoms disruption, all sectors would be impacted at some point and the impact would range in severity. The most seriously affected sector would be the health sector which would be impacted immediately, resulting in potentially serious implications which would escalate exponentially. The impact on the health sector would be compounded by the impact on the emergency services which would also be severely affected as a telecoms disruption would lead to loss of the 999 service

Communities would also be initially affected in differing ways, with the more vulnerable being significantly more affected. Some people might become more altruistic while others will attempt to take action themselves, at times however this may be dangerous. Anxiety and tension may start to build after a few hours and this will be particularly exacerbated for certain groups, such as those who rely on specific routines. After an extended period of disruption there may be an increase in crime within the community.

The utilities sector would not be able to receive information regarding their systems and whether these are functioning, or about any disruptions to their services including gas leaks, and this would have implications for the community as a whole.

The transport sector would be impacted due to overcrowding at stations if trains and buses unable to function. There would be issues with contacting staff, and having to potentially backup critical services as well as relocate them to secondary sites. As the telecoms sector would be responsible for finding out the cause of the disruption and resolving the problem they would have to communicate with the public to reassure them.

The banking sector would be quite secure for a small amount of time, but if the disruption continued the sector would begin to become impacted and a prolonged disruption could lead to economic problems. The government would not be immediately involved unless it was a prolonged disruption. Local Authorities would struggle with staffing issues and school closures.

Conclusions: Many areas of our daily lives rely so heavily on telecoms the impact of a disruption to the infrastructure could have significant cascading impacts, particularly for the community, the health sector and the emergency services initially, but ultimately for almost all areas of life.
Communication is key in all phases of a disaster/disruption, particularly for vulnerable and 'cut-off' groups. The most used means to communicate information is via the internet and social media, in addition to noticeboards and more traditional means. However steps need to be taken to ensure the correct most up to date information is shared and that incorrect information is identified.

2. Introduction

This report draws upon knowledge and data gathered from research looking at mass population response to telecoms infrastructure failure in three countries: New Zealand, Japan and the UK. Knowledge and data gathered following the earthquake in Christchurch, New Zealand (22nd February, 2011), and the Great East Japan Earthquake and Tsunami (11th March 2011) are considered alongside two workshops held to consider the potential impact of a telecommunications failure for different sectors, organisations and the population in the UK.

In order to consider the impact a telecoms infrastructure failure in the UK would have upon different sectors/organisations and groups as well as what the mass population response would be, two workshops were held in the UK on the 16th and 19th of June 2014 utilizing the Anytown model. Anytown is a project designed and led by London Resilience which has been used to bring together experts from different sectors and organizations to discuss potential implications of disruptions to the critical infrastructure. Mathew Hogan from London Resilience states the aim of the Anytown project "is to raise awareness of the consequences of infrastructure disruption with all emergency response organizations in London – it's a way of talking about disruption to London's infrastructure, which has developed over hundreds of years, into a simple model which could be applicable anywhere in the UK."[1]

Lessons learned from all three countries are presented in each section and conclusions are drawn together across the three countries to provide recommendations at the end of this report.

3. New Zealand
Christchurch, NZ 2011

3.1 Background
Christchurch, New Zealand, suffered a devastating earthquake on February 22nd, 2011. The magnitude of the quake was 6.3 and 185 people lost their lives. A series of severe aftershocks over several months followed. It turned the city centre into "a warzone", Christchurch Airport was closed and the city centre evacuated. Buildings continued to collapse in the aftershocks. A Level 3 emergency was declared, the highest level for a regional disaster, and on the 23rd Feb a National state of emergency was declared. The telecommunications networks were severely damaged, with phone lines down and most of Christchurch without electricity and water.

3.2 Telecommunications
Telecom NZ core network continued to operate both through and after the event and the many aftershocks. Significant issues linked to other infrastructure services which hindered telecommunications were: the power

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[1] http://climatelondon.org.uk/projects/understanding-the-ripple-effect-anytown/

system; water supply (for the cooling towers of the central exchange that formed part of the national network architecture); and access through damaged streets to some network nodes (mainly Mobile sites). Communications were mostly hindered by lack of power rather than any other factor.

3.3 Response: companies and utilities

The 111 service in Christchurch was restored within hours after diverting calls to Wellington and a back-up site in Palmerston North, both in the lower North Island. Telecom also enabled free calling from 280 payphones in and around Christchurch for local, national and mobile calls. The big telcos – Telecom New Zealand, TelstraClear, Telecoms1 and 2 Degrees asked people to avoid using mobile phones if possible to prevent overloading. They advised people to send SMS messages instead. Mobile networks functioned reasonably well, using back-up power and generators. Orion New Zealand Limited owns and operates one of the largest electricity distribution networks in New Zealand (joint owned by Christchurch City Council and Selwyn District Council) and received much praise:

"...the power lines I saw explode after the June quakes: two Orion vehicles turned up before I'd managed to explain to the fire service where it was. Not to mention how well informed they kept everyone, heck Orion should have been running civil defence as well." (PaulBags blogger)[2]

3.4 Population response

3.4.1 Initial 24 hrs:

The population response in the initial 24 hours was to try and communicate but this led to call overloading issues on both the Public Switched Telecom Network (PSTN) and Mobile networks. However after the immediate aftermath panic, calling levels returned to manageable levels, as people heeded calls to limit non-essential mobile use. Whilst Emergency Service lines were working they remained heavily congested.

3.4.2 First week- population movement:

Analysis of cell phone data indicated a much larger proportion of voice calls than usual were made from outside the city in the week after the earthquake. Around 15% (55,000) of Christchurch's population are likely to have left the city over this week with the majority of the population loss being women and families with young children.

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[2] Blog Forum: Forums › New Zealand Broadband › Telecom Infrastructure Durability vs Christchurch Earthquake
http://www.geekzone.co.nz/forums.asp?forumid=49&topicid=124638 [Accessed June 2014]

3.4.3 Population response: Alternatives.

Citizens did not appear to wait for the authorities in matters of communication. They organised themselves, even putting themselves at risk to do so. People used Twitter to organise, share news and to locate family and friends. Main hash-tags: #eqnz, #chch and #eqnzcontact to find missing people. They powered their smart phones using chargers in their cars, while people drove to areas that had cell phone connectivity to access information online. Others collated this information, printed it out, and posted it to bulletin boards in central community areas. Local volunteer leaders in heavily damaged communities created websites that integrated information about national response efforts with locally relevant information. Nationally and internationally, online volunteers collected and curated information from open sources, including Tweets, SMS, email, web reports, and Ushahidi applications on Android and iPhones, making it available via publicly accessible web pages and posting it to local print media.

Within hours of the earthquake, an Ushahidi instance was established and populated with locally relevant information. The Ushahidi open source map (eq.nz.org) was posted to local print and online media, (Stuff and NZ Herald) until an authoritative Christchurch City Council (CCC) map was posted online days later (canterburyearthquake.org.nz), showing official information about bridges and road closures. Early competition existed between the two maps as conflicting information and concerns about information privacy became chief concerns of CCC officials. Digital volunteers working on the eq.nz.org map had no easy access to data on vulnerable populations and they eventually stopped maintaining the site within a month of the earthquake.

Information about the local context, e.g. available ATMs, petrol stations, and grocery stores, was the most important resource for those who were directly affected by the earthquake impacts. One of the main challenges was locating areas where volunteers were most needed. Citizens responded by organising into voluntary assistance groups for example the Student Volunteer Amy (SVA). With the help of Geoop.com, SVA designed a mobile management system whereby residents could register their need for assistance via a free call number, text message service or website. Each job was examined and prioritised by the SVA call centre. In delegating team leaders to guide small crews to these sites the SVA cleared over 360,000 tons of liquefaction in over 75,000 volunteer working hours. The Facebook page had over 26,000 followers after March 2011 and continued to act as a platform to organize and coordinate volunteers and non-skilled labourers in Christchurch communities throughout 2011.

3.5 Inequality of access to Communications

Individuals who had technology access were able to report their needs; those without access appeared to be ignored or forgotten. Those in residential zones cut off from electronic communications (e.g. heavily damaged eastern suburbs) remained without direct access to viable information from public

officials for weeks. Residents who stayed in their homes situated inside the cordoned-off central city were isolated from official sources of information. They had no power, water or sewerage. As this community was not officially acknowledged, no effective way was identified at the time to get information to these residents. Trust in information was identified as a key issue for community members who were most directly affected by the earthquake and were without lifelines to authoritative information for weeks. This indicates that communication in the recovery phase may be just as vital as communication in the earlier stages of a disaster response.

3.6 Lessons & challenges

- There are many interdependencies; telecoms most affected by loss of power
- Initial overload of the telecoms infrastructure occurred however people did later heed to requests to restrict mobile use
- People self-organized, putting themselves at risk, they did not wait for authorities to communicate
- People used social media (twitter) to locate people, organize and share information
- Most important resource was information on available resources
- There can be massive inequality of access to communications and information after a disaster, which is a significant challenge even for a developed country such as New Zealand.

4. Japan

Tohoku Region, Japan 2011 (Great East Japan Earthquake & Tsunami)

4.1 Background

The Great East Japan Earthquake and Tsunami occurred on 11th March 2011 and resulted in the third highest casualties from a natural disaster; killed 15,840, missing 3,529 & injured 5,951.[3]

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[3] As of December 6, 2011. Source: Emergency Disaster Countermeasures Headquarters, National Police Agency of Japan
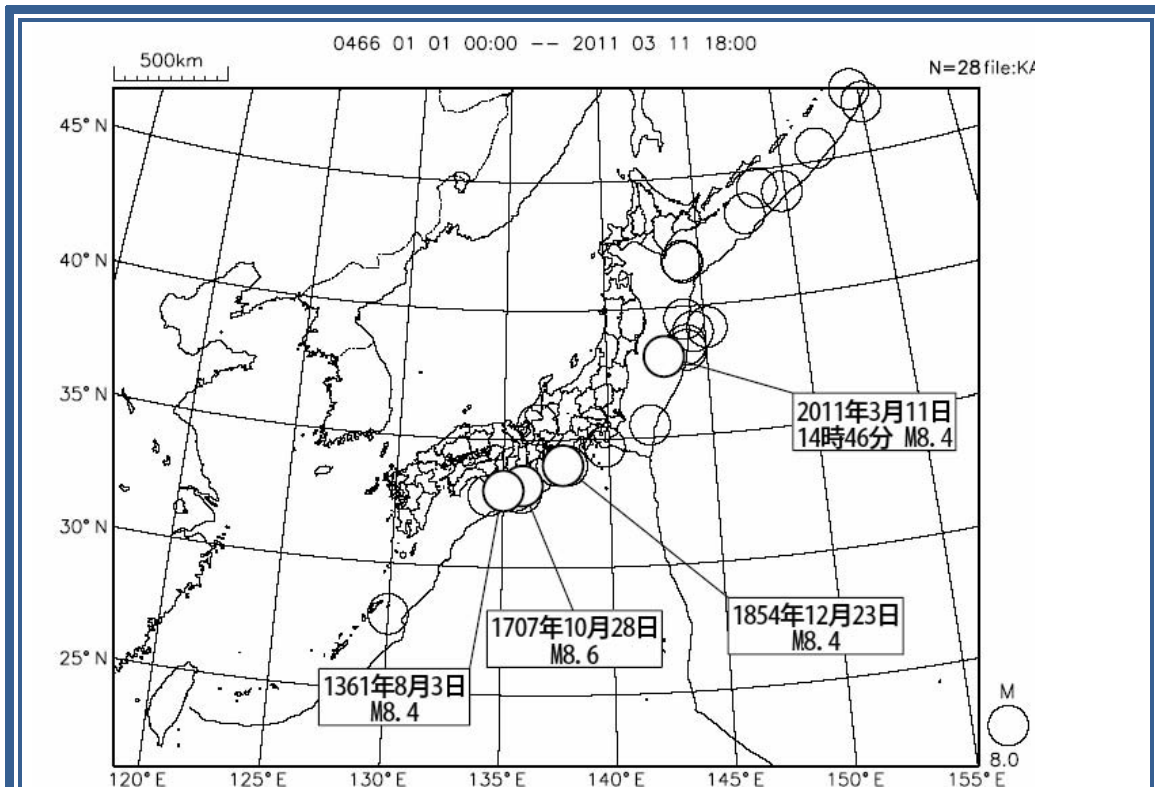
Figure 1: Earthquakes over M 8.4 or above (466-2011)[4]

4.2 Characteristics of the disaster

It was a powerful earthquake and destructive tsunami and people only half an hour to evacuate. There was a blackout over a wide-area for a few days and further difficulties were caused by nuclear accidents.

4.3 Characteristics of ICT responses

The emergency alert was highly crucial in order to evacuate from the huge Tsunami. Telephone lines were congested extensively with so many calls, not only in the devastated Tohoku region, but also in the Tokyo metropolitan area. The Telecommunication infrastructure was seriously destroyed and washed away, especially in the Pacific coast region. The batteries and fuel for electrical generators were exhausted due to the wide-spread blackout.

4.4 Enormous damage to ICT infrastructure

Damage to satellite caused landline failure to 1 million lines (out of 2.7 million in Tohoku region. Mobile and PHS were affected by the closure of 29,000 base stations, 5 companies (out of 137,500 in Tohoku and Kanto regions). Due to the congestion immediately after the earthquake mobile phone companies restricted communication. Broadcasting was affected with the closure of 120 linking stations in Tohoku and Kanto regions and postal

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[4] Source: Japan Meteorological Agency

services were affected with the closure of 583 post offices (out of 1,103) in 3 prefectures [5].

4.5 ICT response and population response

The population response to ICT failure broadly shifted from the date of the disaster (11th March 2011) through to 2014. In the immediate aftermath of the disaster real-time communication using social media was the main form of communicating and accessing information, after the initial impact of the disaster this shifted to a diversification of communication methods and it was only after some time that the information was selected and organised for dissemination. Throughout the public were the key agents of communication.

4.6 Population response

Here are some examples of how the population responded to ICT failure after the earthquake.

4.6.1 Immediately after the disaster

People used the Internet, particularly Twitter, immediately after the disaster to track down family and friends, to gain real-time information, to check the damages in the neighbourhood and to check about the transport, particularly in Tokyo. The Twitter audience grew by a third to 7.5 million during March 7-13 compared with the previous work.[6]

4.6.2 A week later

The city council of Mitaka, west Tokyo, started a Twitter account. Announcements of the possible rolling blackouts caused a spike in the city's website traffic that was too big to handle. Video streaming providers such as Ustream and video-sharing platforms such as Nico Nico Douga saw viewership climb. Ustream's audience doubled to 1.4 million, driven largely by NHK's channel featuring live coverage online. Social media offered the ideal platform for good ideas to spread quickly, supplementing efforts launched by online giants such as Google and Facebook.[7]

4.6.3 One-three months later

Selection and organization of information began. Mobile phone e-mail was used the most to communicate with friends and family, followed by mobile phone calls and social media. NHK (the equivalent of the BBC) television news was chosen as the most useful media for getting information (53.7%), commercial television news at the second most (30.6%) and the Internet (25.5%) as the third (Survey Research Centre ,2011).[8]

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[5] Ministry of Internal Affairs and Communications (2011) Summary of the Information Communication White Paper 2011,
http://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h23/summary/summary01.pdf

[6] MIC, 2011; Nielsen, NetRaings quoted in Hosaka, 2011

[7] MIC, 2011; Hosaka, 2011

[8] Jung, Joo-Young (2012) 'Social media use and goals after the Great East Japan Earthquake', *First Monday*, 6 August, 2012, Vol.17(8),
http://firstmonday.org/ojs/index.php/fm/article/viewArticle/4071/3285

Developments of software applications and support activities increased. A Web developer created 'Anpi Report' to gather and organize information posted on Twitter about missing individuals. Through Facebook and Twitter, he found more than 200 volunteers to manually sift through tweets to enter into a database. Another Web developer created a Twitter application to remind Internet users to do their part, however small. 'Setsudener' – a playful naming from the Japanese term for 'energy saving' – automatically darkens the user's profile picture from 5-8pm to cut back on power consumption during the peak demand. The municipality of Namiecho (where the Fukushima Daiichi Nuclear Power Plant is) set up a call centre to provide evacuees with the information on social welfare.[9]

4.7 Lessons and challenges

There is a need
- To establish resilient infrastructure for ICT which does not rely on electricity;
- To mitigate the digital divide;
- To control false or harmful information on the Internet which can hamper the response and recovery;
- To disseminate a number of useful tools which have been developed by diverse stakeholders.

5. Anytown

5.1 Introduction to Anytown

Phase 1 (2013) of the Anytown project looked at what the potential implications would be of a disruption to electricity and water supply and identified potential knock-on effects. The findings from the workshop (in 2013) were used to produce a ripple diagram[10] identifying the interdependencies involved in such a disruption. Phase 2 (2014) of the Anytown project focused on the consequences of a failure of the telecommunications infrastructure. In order to achieve this two workshops were held, the first in London on the 16th June 2014, hosted by Telecoms2, and the second in Newbury on the 19th June 2014, hosted by Telecoms1[i]. Representatives from the following sectors attended and contributed to the discussions and data collected:
- banking sector,
- academics from UK universities,
- utility sectors,
- emergency services,
- local government,
- health sector
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[9] MIC, 2011
[10] http://www.london.gov.uk/sites/default/files/Blog%2042%20AnytownPoster.pdf

Delegates at both events were asked to consider that there had been a serious failure to the telecoms infrastructure in the UK and were asked to consider the impact that such an event would have on a large fictional town – 'Anytown'. It was assumed that the telecommunications failure only affected Anytown and the immediate locality, not the whole country. The intention of the workshops were for delegates to consider how their sector would find out about a telecoms failure, the duration of time it would take for their sector to get this information and what the potential impacts on their sector would be at three different stages of a disruption to the telecoms infrastructure;

1) Immediate impact
2) After 3 hours disruption
3) After an extended disruption of 20+ hours.

5.2 Findings

This findings of this section of the report are based on discussions in the Anytown workshops held on the 16th and 19th of June 2014 and identify what the potential impacts would be of a disruption to the telecoms infrastructure for different groups and sectors.

5.2.1 Telecommunications Sector

Immediate impact

Due to the way in which telecoms companies are set up it is difficult to imagine an event that would cause an entire town to be without telecoms. However, if a disruption to the telecoms infrastructure did occur this initially would not be a big issue for telecoms companies, but as many other telecoms providers depend on Telecoms2 it would therefore be Telecoms2's responsibility to resolve the problem quickly. The worst scenario for the telecoms sector would be if there was a problem with the core network, but this is highly unlikely to occur due to the fact that locations of core networks are distributed across the country.

However in any event of disruption to the telecoms infrastructure, Telecom2 would immediately become aware due to the alarms coming into their centres indicating a serious problem and they would initiate an 'Incident Response' mobilising teams to investigate the problem. The next stage for Telecom2 would be an 'Incident Management' process which would involve talking to responders, the government and the press. In parallel they would be gathering internal information, in order to assess the scale of the problem and who else was affected. Additionally Telecom2 proactively notifies category 1 and 2 responders[11] when they get an alarm.

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[11] Category 1 responders:- "blue-light" emergency services, Local Authorities, Police forces, Fire services, Ambulance services, HM Coastguard, NHS PCT, NHS Hospital trusts, NHS Foundation trusts, Health Protection Agency, Port Health Authorities, Environment Agency.
Category 2 responders:- Electricity distributors and transmitters, Gas distributors, Water and sewerage undertakers, Telephone service providers (fixed and mobile), Transport, Network Rail, Train operating companies (passenger and freight), London Underground, Transport for London, Highways Agency, Airport operators, Harbour authorities, NHS strategic health authority, Health and Safety Executive, Voluntary Agencies.

After 3 hours of disruption

If the telecoms disruption had not been rectified within the first few hours, Telecom2 would begin conducting remote actions and would actively turn off masts that would now be running on battery as this makes remotely turning them back on when the power is restored easier. Blue lights services would be given priority as services begin to come back on therefore it is essential that companies who are buying their service from a secondary supplier inform Telecom2 that they are a blue light service in order that they get priority as there are regulations in place which prevent Telecom2 from bypassing these secondary services.

In addition communication can be provided via The Airwave Network, a radio system that is provided to all the Emergency services, with the main infrastructure situated in different parts of the UK, connected by a Telecom2 core. Depending on the location of the core network (assuming it isn't located in Anytown) the Airwave Network would be functioning. All of the Airwave Network sites have resilient capability, the majority of sites have 6 hours backup and parts of the network have 7 days capability to provide vehicle coverage. There are elements of Airwave that sit on the network, but the 999 service can use it in radio to radio communication without going back into the network, enabling them to change the way they work. Airwave would be monitoring situations, engineers also have Airwave radio and can manage the workforce by those.

The telecoms sector also have the capability to roll out mobile communications from vehicles that don't rely on telecoms, ensuring that some communication can be made, at this point it would be likely that they would communicate to a central point, for example a community centre using radio use to reassure that they are controlling and working to resolve the problem. Additionally they would be moving to backup power with the use of backup generators at local exchanges which would ensure that 6 hours of battery would be available to mobile phone masts and communities. Staff deployed by the telecoms companies have a duty to ensure they communicate back, this would most likely occur via The Airwave Network, or by travelling out of Anytown in order that they can access a mobile network.

Lessons learned from previous experiences indicated that Telecom1 predictions of the public's reaction to such a disruption was inaccurate. During an incident 3 years ago the public began reacting within a couple of hours, expressing their frustration on social media sites such as Twitter, Telecom1 initially thought the public wouldn't react for a couple of days. Telecom1 were however able to search the forums and respond to the public. Further lessons learned regarding public reaction occurred during the London bombings in 2005. During this event the sector learnt that text messages were the most important thing to the wider community and identified the most frequent text message as being "are you ok?". This shows that the public need reassurance, especially reassurance that their loved ones are ok, and that text messaging would work to reassure the community. However, voice and text services run on the same telecoms carrier therefore it isn't possible to get text messaging restored before voice. Telecoms providers have identified that

they are able to activate and run the 2G, 3G & 4G services independently, therefore Telecoms1 are currently splitting their 2G and 3G capabilities to different sites, ensuring that if there is a telecoms disruption at one site they may be able to switch to a different service at an unaffected site.

For the telecoms sector electricity is an essential resource, if there is loss of electricity and subsequently loss of a specific MTX (the core, a telecom data centre) the result is loss to a geographically large area. Such a loss, weather as a result of electricity or other disruption, would be a major issue for the telecoms sector, however if the MTX is not located in Anytown then the resulting issues would not be as severe. The loss of mobile/broadband/TV would however be widespread and there would be a gradual decline in power resulting in the end user being unable to use their telecommunication devices.

If Telecom2 thought that there was a possibility that the telecoms disruption would last for longer they would implement an emergency telecoms procedure.

Extended disruption

A longer disruption to the telecoms infrastructure of more than 20 hours would be considered a major incident for the industry and a national emergency for telecoms. The sector would respond by holding a multi-agency call to discuss what the impact is and the geographic spread of impact. This would include sharing of information amongst those in the sector in order to understand what has occurred and what steps need to be taken to resolve the issue, this would include gathering many people on this multi-agency call to share from a national level, including sharing with government departments and strategic coordinators.

5.2.2 Community

Immediate impact

People in the community would find out about an initial disruption to the telecoms infrastructure anywhere from one second to at least 24 hours, the difference would depend on how reliant people were on their telecommunication devices such as phones and internet, and would also vary for different groups. Upon realizing there was a telecoms disruption people may then potentially talk to other people in order to gain information before turning to the internet, TV, or radio. This can be thought of as the 'information seeking' phase with people starting to congregate, seeking other people, going to local businesses and schools in order to access information.

Different groups would be affected, and react, in varying ways in the immediate period of a disruption with the impact being the greatest for vulnerable people. For some the impact may be immediate for example if they

cannot contact people or get the emergency response they need straight away. There may even be issues with medication being delivered at this stage which will have implications for many. For people who rely on normal routines, such as people with Autism, a disruption to the telecoms infrastructure could have a big impact leading to an increase in anxiety. In addition to those with conditions such as Autism, this anxiety and slight panic would be seen in certain other vulnerable groups as well, however it would not be seen at this stage within the wider community and there would also be no increase in crime at this point.

At this stage of the telecoms disruption the interdependencies between sectors begins to become apparent, with many in the community being affected by the impact on other sectors. For example due to the systems the banking sector employs (using telecoms for their back-systems and remote access) ATM machines may not work resulting in the community being less able to access their funds which could have implications for many things such as travel and purchasing food. The knock-on effects can impact multiple infrastructures which also impact on the wider community, as many large sectors use telecoms for the back-systems and remote access. Businesses, such as local shops, and public services, will be impacted, however it may take workers a couple of hours to identify a problem as being outside of their building or local network, however they will face similar problems accessing money and may find they are unable to continue work due to many businesses relying on telecoms to function.

The impact a telecoms disruption would have on other sectors would also impact the community. People needing access to the emergency services would be immediately affected by the disruption and may find they are unable to get the help required. Similarly there may be an increase in injuries due to the traffic light system not functioning properly. As such the primary concerns for the community would be heightened with regards to accessing emergency services.

After 3 hours disruption

If the telecoms disruption lasted for 3 hours there would begin to be a 'social action' stage, where people would start helping others. Conversely as the length of disruption increased from 3 hours there may be a small rise in social disorder. Police may be more present on the street which could act as reassurance to some but could make other people anxious. Anxiety may increase at this stage as some individuals may begin to worry that the disruption is due to terrorism. As previous examples have identified, aggression towards telecoms companies might start to build at this stage, with some people going into mobile phone shops demanding the problem is resolved.

People may increasingly congregate, particularly at local places, heading to where they'd expect to find other people. People would be communicating more with others and while there will be some groups who will continue to be anxious, there may be others who enjoy the disruption. There will begin to be issues with people travelling, resulting in some being unable to get home

particularly if they are unable to access their money compounded by the potential for the transport system to fail. At this stage it may begin to affect people not located in Anytown, this may be by those in other towns having access to more information than those within Anytown if there is a media blackout. This may result in people within Anytown attempting to leave, especially if they have relatives who they need to ensure are ok. People may also begin to leave Anytown in order to access a mobile network to gather information.

Extended disruption

After an extended period of telecoms failure, such as 20+ hours, there would be more concerted social action, some of which would be pro social with people improvising by setting up noticeboards to communicate and tech systems such as CB radio or anything else accessible to communicate. Conversely some people would try to protect their property as there may be low level crime at this point as well as some organised crime hitting central businesses and some social disruption as well as a small rise in vigilantes.

As a result of the extended telecoms disruption there may also be an increase in anxiety and depression, particularly in those with existing mental health issues, or other conditions such as Autism, but also among those who, for example, cannot reach loved ones. As such it is likely that people may start to leave Anytown but it is unlikely that people outside Anytown would come in.

Further impacts at the extended disruption stage include issues with the cost of goods and resources rising. Historically in the UK, when hurricanes have occurred for example, petrol stations raised their prices of gas. Similar incidents have occurred with water costs. Therefore companies would now be needing to rectify and resolve issues quickly in addition to starting public awareness and recovery in order to show portray that steps are being taken and to keep the public informed, otherwise they risk losing business.

5.2.3 Emergency services

Immediate impact

The emergency services would be heavily impacted during the initial stages of a telecoms disruption, however when they become aware of the disruption would depend on time of day, if they check their telecoms devices and definitely when they fail to receive calls from the public. The main impact would be this loss of connection with the public, they would lose the vital information that they receive form the public but in addition the public would be at great risk. Internally there wouldn't be much of an impact initially as there are systems are in place for such an event and other locations outside of Anytown are able to take 999 calls however there may still be difficulty in passing that information to the emergency services within Anytown.

Difficulties communicating between the different emergency services would become apparent and there may be a loss of important contacts as a result of the disruption. Although locally the emergency services would be able to communicate via radio, there would be communication issues involving the emergency services being unable to communicate with their appliances via radio to wider networks/sites. Business continuity plan's (BCP) would be activated and the emergency services would be resourcing appropriately against the risk (dynamic mobilizing).

After 3 hours disruption

For the emergency services sector the impact after 3 hours would be very similar to the immediate impact; there would still be no communication or information from the public but at this stage the emergency services would be under strain which would have an impact on the wider community. As a sector, however, they would become proactive, warning and informing, through radio media, leaflet dropping and by opening stations to be a community centre to all emergency services.

Extended disruption

If the telecoms disruption continued for an extended period, (such as 20+ hours), the military would be engaged, supporting the emergency services, leading Business Continuity Plans and setting up a central hub, but they wouldn't be involved in any response.

5.2.4 Health Sector

Immediate impact

A disruption to the telecoms infrastructure would cause an immediate impact for the health sector and would be immediately apparent due to the switchboard ceasing to function resulting in a sudden lack of information. Impact on staffing in the sector would quickly become an issue, with off-site staff (such as district nurses) being unable to be contactable and maintaining staffing levels would become problematic. Further impacts on staffing within the sector would be caused by the impact the telecoms disruption had on other systems and sectors especially the banking sector meaning staff would be having trouble accessing funds impacting on their ability to travel, compounded by the possibly loss of function of oyster cards.

The telecoms disruption would cause significant and serious problems with the ability to maintain contact with patients, especially those who self-monitor from home passing diagnostic information electronically to the hospital. Additionally, relatives would be affected immediately by being unable to contact hospitals either on behalf of a patient or to check on their relative. This may result in an increase in anxiety among some and equally may contribute to an increase in people travelling to hospitals. In addition there would be an increase in 'walk-in' attendances at Accident & Emergency departments (A&E's) resulting from many services impacted by the telecoms disruption,

including the loss of the 111 triage system and even at this early stage, local GP's being forced to close. The strain on the health sector would be compounded further by an increase in road traffic accidents (RTA's) resulting from a loss of transport lights. There would additionally be issues with getting patients transported to and from hospitals, delays in transfer of care, no system of notifying hospitals of major incidents (resulting in no planning and preparing) and a significant and potentially dangerous loss of communication between blue light services.

Due to the health services potentially not having a backup of data there is a real risk they could lose their data service including diagnostic results. Furthermore there would be a loss of alarms systems, putting many patients at risk. It is clear that the health sector would be immediately impacted in significant and serious ways and these impacts would quickly escalate.

After 3 hours disruption

The impact on the health sector would increase exponentially if the disruption was prolonged depending on the scale of the outages. The sector as a whole would be under tremendous strain largely due to its immense reliance on communication systems. After 3 hours of a telecoms disruption the increase in patients attending A&E departments would continue to increase as a direct result of loss of the services of GP's and the 111 triage system. Whilst many of the immediate impacts on the health sector would continue, there would be an added strain at this point with ambulance services being unable to know of the status of hospitals and as a result many hospitals will become overloaded and unable to function adequately. Further serious impacts would include the inability to contact blood and transplant teams, affecting operations resulting in the health service looking to implement plans on blood supply.

Issues with staffing would continue and intensify as more staff would be required in order to deal with the strain the health sector was under. There would at this point begin to be consequences for the Pharmacies, impacting on prescribing and administering of drugs as no new orders would be able to be made in order to maintain stock levels. At this point is would be essential for the health service to focus on how they manage their critical care beds and specialist beds as this will become increasingly important and they may need to start holding them. It may be that hospitals begin to send patients home allowing them to concentrate on the essential. In any case everyone in the health sector would be evoking Business Continuity Plans at this point, in order that they can maintain a level of care until services are restored.

Extended disruption

During an extended period of Telecoms disruption (20+ hours) the health sector would be under significant strain and would at this point look at bed blocking, however they would be facing difficulties as there will be issues with being unable to move some patients in to the next part of the care system resulting in overloaded wards. The increased attendance in A&E departments would now be causing significant strain compounded by the impact on staffing levels, being unable to contact and source additional staff these departments would need to begin collapsing services over the following few days. The

increased levels of anxiety within the community would contribute to an increase of mental health concerns seen now, especially among the vulnerable people, as well as those who rely on or need the services of the health sector, contributing to the strain the heath sector would at this point be under. Further risks continue with the lack of functioning alarm systems and as a result there may at this point be an increase in deaths.

At this point there would be additional concerns and requirements facing the health sector as they would at this point need to consider their response to the media. There would need to be strategies for logging and maintain records for ambulance hand-overs as well as other records that would need to be maintained. It is at this point the health sector could be facing financial penalties for not meeting the 95% target, meaning that and contracts and financial implications would need to be considered and possible contract negotiations would need to take place. In addition there would be a need to forward plan, in order to prepare for among other things, when the telecoms is restored as there could be issues such as when all alarms that have not been functioning suddenly all restore at once, there could be a sudden surge resulting in further knock-on effects.

5.2.5 Utilities

Immediate impact

Electricity companies would become aware of a telecoms failure and which sites were affected relatively quickly and would mobilise standby teams in order to investigate the cause. If the telecoms disruption occurred during the day the immediate impact would be loss of contact with staff, which would have the additional impact of staff being unable to contact control centres. However sub-stations would continue functioning and electricity would still be running though circuits. Customers would be unable to contact the electricity companies to inform them of any problems and the companies would be unable to dispatch staff to resolve the problems. The only way for customers to make contact would involve them leaving Anytown to make contact with the utilities companies.

Similar initial impacts would occur for gas companies, and they would become aware of a disruption immediately as the key pressure stations have telemetry and continues to flow and operate. If the key pressure stations failed to operate and there was a lack of information being received from them the gas companies would need to issue black out plans and dispatch teams to sites.. The biggest issues facing gas companies during a telecoms disruption would be the inability to dispatch emergency gas and the inability to see gas pressure reducing equipment meaning they would be unable to see if they were functioning properly.

With the loss of telecoms the use of the Airwave Network would increase in the sector which could result in capacity issues, however overall it would not

be an immediate issue for utilities such as gas and electricity and they do have backup systems for communications. But there would be issues with how to communicate with people and how to implement plans.

After 3 hours disruption

The impact on the utilities sector after 3 hours telecoms disruption would not be different to the immediate impact, however in order to forward plan a multi-agency coordinated approach would be started at this stage, involving the emergency services. Additionally there would be a targeted approach to, communicating reassurance to the public in order to reduce tension and anxiety as well as to make suggestions as to useful strategies the public could employ such as using battery powered radios.

Extended disruption

After an extended period of disruption to the telecoms infrastructure of more than 20 hours the gas sector would start blackout plans as well as initiating back up plans to monitor sites and equipment. The gathering of information would change to a manual methods and as such would involve mobilising teams to sites to gather data to report on. In addition to this an emergency response would begin with engineers being mobilised to sites of gas escape. The major concerns with potential serious consequences would involve engineers not being aware of the locations of gas escapes. At this point there would be a need to establish a command centre emergency control room located outside Anytown for which messages could be relayed back into Anytown. Gas companies would at this point be failing to meet standards set for responding to gas escapes and therefore this would need to be managed. Electricity companies would continue to be staffed in the main sites monitoring substations but due to the disruption to the telecoms they would be unaware of the impact on their customers and particular concern would be for the more vulnerable people for which there could be potential serious consequences.

5.2.6 Transport

Immediate impact

The transport sector would be impacted initially due to not being able to make contact with staff. If the disruption had begun to have an impact on stations and travel systems causing them to cease functioning there is the potential that a large amount of people would be congregating around stations and travel points and there would be no means of communicating information to them.

After 3 hours disruption

The disruption after 3 hours would begin to impact on peoples transport plans, with many congregating trying to access information. With many people congregating and new people arriving there would be crowding issues at stations and travel sites. There would be a need to manage the situation and safely disperse crowds.

Extended disruption

After a longer disruption of 20+ hours the transport sector would need to backup critical services which would involve moving critical functions in order to maintain services. This would include implementing the business continuity plan which would include relocating major operations to a secondary site, and considering all implications to the inability to communicate.

5.2.7 Banking sector

Immediate impact

Initial implications for the banking sector would be minimal, processing payments and bills would continue but there would be implications for accessing cash at ATM's due to these functioning on only one telecoms carrier. In addition there would be loss of function of the Chip and Pin service however initial the impact would be manageable.

After 3 hours disruption

The impact on the banking sector after 3 hours of telecoms disruption would remain manageable, however there may be issues with the loss of function of ATM's as people may begin to access the few remaining functioning machines, resulting in issues with low levels of funds being available at these sites. Additionally internet sales would be impacted as purchases could not be processed.

Extended disruption

A longer disruption to the telecoms infrastructure of 20 or more hours would be more problematic and there would be an increase in demand for cash at this point. If any ATM machines had been able to dispense cash up to this point will begin to run out. However, the industry could manage this demand as other ATM's would not be getting replenished and bank branches would still be able to assist with withdrawing funds, cashing cheques and collecting pensions or benefits. More store holders would be accumulating cash on site than they are used to which would result in less being deposited in to banks. If the disruption to the telecoms infrastructure continued beyond this point there is potential that there could be a fall in share prices and as a result could result in significant problems for the banking sector.

5.2.8 Government

Immediate impact

The Government would not be involved during an initial telecoms infrastructure disruption.

After 3 hours disruption

It is only at the stage that the telecoms disruption had been prolonged for 3 or more hours that the Government would become involved, but at this stage it would only be in an 'Information seeking phase' aiming to identify and the cause of the disruption, why it had occurred, what the impacts are and what the likely duration will be. Depending on the cause of the disruption local resilience forums may become involved, this would occur especially if it was caused by weather related issues. In this instance the local resilience forums would have had advanced warning and would have met before the disruption via a teleconference. During the telecoms infrastructure disruption, the usual means of meeting by holding a teleconference would not be feasible, therefore the meeting would need to take place at a local location. Emergency services may be able to speak to each other via Airwave radio but other sectors may not as such flow of information could be problematic between agencies and Government as a whole. However, there is a telecoms failure plan with an expectation that staff will met at a designated place but this may be problematic due to travel disruptions resulting in many agencies working in isolation.

After 3 hours disruption Local Authorities (LA's) would be impacted as there would be an increase in traffic on the road and staff may need to return home. If LA's had advanced warning of the disruption they would have time to initiate plans to mitigate the impacts. In any event a strategic coordinated team would hold a face to face meeting in order to prepare the LA's message to the public and would not be dependent on online systems. LA's are aware that there is an audience not at the scene who are interested in what is going on and as such will need to communicate to the affected community as well as to the communities nationally outside of Anytown. If major commanding control points are in Anytown they would be moved and managed from outside Anytown communicating back in to Anytown if necessary.

Extended disruption

At the point of 20+ hours telecoms disruption the government would have a clear idea of what the cause of the disruption was and would be considering the scale of the event an is the only affected community. If it was found to be a national incident of the government may initiate military involvement. Additionally the government may at this point consider a strategic direction from Cobra, mitigating activities, investigating public reaction and identifying public knowledge, considering if there are public disorder issues and how vulnerable people were coping. LA's would be further impacted as all schools would close due to health and safety reasons, which would add to the immense impact on the work force in many areas compounded by the disruption caused to the transport sector and health sector particularly.

5.3. Lessons learned

The Anytown workshops have identified that despite many sectors and organisations have plans, including Business Continuity Plans, in place to

manage a disruption such as a telecoms disruption, the impacts of a disruption to the telecoms infrastructure could have significant cascading impacts due largely to the heavy reliance on telecoms in all sectors and in people's daily lives. It is identified that these impacts would become significantly more serious the longer the disruption continues and there are many interdependencies such that the impact on one sector has a cascading effect on another sector.

During the initial disruption there would be an 'information seeking' stage where members of the public seek to find out what has occurred. Similarly there would be an 'information gathering' stage in many sectors and organisations where independently and collectively they would attempt to gather information as to what has occurred, how wide spread the impact was and who was affected.

The impact on different sectors during the immediate disruption and prolonged disruption would vary with some sectors experiencing little impact initially, such as the banking sector, which would be quite secure for a small amount of time. During a prolonged disruption however the sector would begin to struggle and after a significantly prolonged amount of time share prices would fall which could lead to an economic impact if the disruption went on for days. In contrast the health sector would be impacted immediately and this would have quickly result in potential serious implications for the sector. The impact on the sector would escalate exponentially and would be exacerbated by the impact on the emergency services, the transport networks and the banking sector. The situation for the health sector would become increasingly serious in line with the duration of the disruption.

Communities however would be initially affected in differing ways, depending on many variables, however the more vulnerable groups would experience the most impact. People would become more altruistic and may attempt to do things for themselves, this can be both resourceful but can also lead to some potentially dangerous situations. Anxiety and tension may start to build after a few hours and this will be particularly exacerbated for certain groups such as those who rely on routine. Additionally, the response from the community during a longer telecoms disruption, whilst remaining to show altruistic tendencies, may conversely begin to show some public order issues as small pockets of crime will develop, this being influenced by the impact on the emergency services.

The impact for businesses, particularly smaller businesses, would be significant particularly as staff would face issues attending work. Furthermore businesses would be accumulating more cash on site than usual and may have problems processing payments through Chip and Pin services. Further impacts would be caused by the inevitable high level of absenteeism due to the impacts on transport systems and school closures.

Over all the lessons learned identify that there are many interdependencies and consequences involved in a telecoms disruption and that many areas of people's daily lives, as well as many business systems, heavily rely on telecoms and such as disruption would cause a significant cascading impact particularly on the community, health sector and emergency services in the immediate instance. While other sectors such as banking, transport, utilities and government seeming less impacted in the immediate disruption begin to become impacted after a few hours and during a prolonged and sustained disruption the impacts increase exponentially.

These workshops have allowed for important knowledge to be shared and lessons learned as to what the potential impact could be for sectors as well as how each sector is interdependent and as a result the cascading affects have been considered. The result of such a disruption in the UK, particularly if prolonged could be potentially serious for all sectors but initially for the health sector, emergency services and community.

6. Conclusions

It is clear that many areas of our daily lives relying so heavily on telecommunications that the impact of a disruption to the infrastructure could have significant cascading impacts particularly for the community, the health sector and the emergency services initially. Furthermore the telecoms infrastructure is interdependent on other infrastructures, such as power supply, that it can be affected by a disruption to a different infrastructure.

The health service will be severely impacted immediately and the cascading effect of this have serious consequences, as such it is essential that steps are followed that ensure the health service gets as much support as possible and is a top priority when it comes to remaining resources such as generators and airwave radios.

For the community the more vulnerable members will be most impacted initially as they will lose access to their much needed resources, including delivery of medication, access to support networks and are more likely to experience anxiety as such consideration of this group is essential in order to mitigate the impact upon them.

Individuals without access to technology may become more vulnerable as they may not be able to access information or communicate their needs and this includes people in rural areas in the UK as they may be isolated for a long period of time. It is essential therefore that vulnerable groups such as the

elderly and disabled as well as those who are isolated in rural locations are given targeted accurate information as soon as possible.

Communication in all phases is essential, both in the response phase and the recovery phase but also in the preparation phase as if people have access to information before a disruption or disaster they may retain that information and be able to use it when necessary. As people talk to people and therefore share information, as well as become more altruistic, this information can cascade in a positive way.

Communication during a disaster or disruption is key and it appears that the best means to communicate information is via the internet and social media initially, and official sources of information are needed quickly to ensure all people have knowledge of what is happening, what actions to take and what not to take so as to mitigate the possibility of people placing themselves in danger. However steps need to be taken to ensure the correct, most up to date information is shared and that incorrect information is distinguishable.

It is clear that there are many interdependencies in telecoms infrastructures, which need to be considered in BCP's as well as in preparation, response and recovery strategies. Back-up plans for these interdependencies need to be considered and actioned so for example if the power supply infrastructure is disrupted the telecoms infrastructure has a backup systems to run from. Even though the incidences in New Zealand and Japan as well as the consideration of an incidence in the UK suggests there are such back-up plans for example generators, it is clear these are short term (i.e. the fuel used to power them will run out in a short period of time) and that they may not necessarily be able to cope with the overload that will inevitably occur.

7. Recommendations

- To establish a resilient infrastructure for ICT which does not reply on electricity to ensure that should the power supply be disrupted information can still be accessed and shared.

- To ensure that there are non-digital information sharing platforms available.

- To educate the public before such as disruption.

- To ensure better communication immediately with the public to mitigate from any negative consequences of people trying to take action which may put them at risk.

- Targeted action to provide information and resources to vulnerable and isolated groups needs to occur immediately.

- To control false or harmful information on the internet.

- To continue to share experiences, tools and best practice between countries and between sectors to ensure that a number of useful tools and approaches can be shared and developed.

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[i] Names of telecommunications and gas companies involved in Anytown have been anonymised in this report.