Enhancing resilience in telecommunications - industry plan and suggested areas for collaboration with government

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Introduction

1. Following the recent severe weather events around Aotearoa the telecommunications industry has been considering how resilience to natural hazards and disasters (such as severe weather events, earthquakes, volcanic eruptions, wildfires and pandemics) can be enhanced.

2. Valuable lessons were learnt about the challenges involved when telecommunications infrastructure across a wide area is affected by flooding, landslides, roads and bridges collapsing, prolonged electricity outages, and the ability of industry to respond when faced with these challenges (for example, how to refuel generators when land access is lost).

3. This plan (presented by the New Zealand Telecommunications Forum (TCF) on behalf of its members):

    a. highlights the **investment in and commitment to resilience that is already being made** by the telecommunications industry **(Part A)**

    b. discusses the **interconnectedness of infrastructure** in resilience during an emergency, in preparing for it, and when thinking about investment **(Part B).** As part of this we ask the Government to:

        i. consider the relationship between telecommunications and other infrastructure that we rely on such as electricity, roading and fuel

        ii. recognise the critical role that telecommunications plays in responding to a natural disaster and prioritise support needed to restore services that the public and emergency services rely on

c. sets out **what we as an industry intend to do** to enhance the resilience of our networks and our collective response when immediately responding to the impacts of a natural disaster **(Part C)**

d. contains our thinking on what would be possible (or could happen faster) with **government co-investment and other forms of support (Part D)**

e. offers information and perspectives on some of the **suggestions** for telecommunications resilience that are being discussed **in the public domain** and elsewhere **(Part E)**

f. provides a **glossary** of telecommunications terms that are used in the paper **(Part F).**

4. The primary purpose of this plan is to share our thinking with government, so that ministers and officials are aware of what is already happening, what we have planned and what might be possible. The plan is also a contribution to the various policy processes government has underway on resilience issues. This work includes the Cyclone Gabrielle Taskforce (which covers both recovery and future resilience), and the various streams of advice being prepared for ministers by officials.

5. This plan has been produced with input from across the TCF membership, importantly with insights from our chief technology officers whose job it is to deliver resilient networks for their firms' customers, and the people who were involved during the recent extreme weather events.

6. If you have any questions, please contact kim.connolly-stone@tcf.org.nz in the first instance.

Part A: existing investment in telecommunications resilience

7. The telecommunications industry invests around $1.62 billion per year[1] in fibre access, mobile, core and backhaul networks, and the IT systems needed to make all this work. This investment in the performance of our networks is critical to resilience.

8. This investment has now accelerated with millions required for repair and restoration efforts across the industry. This includes:

    a. the cost of repairing damaged infrastructure including a significant number of fibre cable cuts

    b. the cost of mitigating efforts deployed during the events, such as temporary fixes, fibre overlays, re-routing, generators and fuel, additional backhaul capacity and additional personnel requirements

    c. new programmes to assess network vulnerabilities

    d. relocation and re-siting of assets that are at risk

    e. development of arrangements for new technology solutions, such as direct to satellite messaging and calling, that offer greater resilience and that are less susceptible to outages. These are discussed later in this paper.

9. As an industry we have also invested heavily in disaster preparedness. At the company level this is done through our business continuity planning. At the industry level we have established the Telecommunications Emergency Forum (TEF). The TEF (administered by the TCF) coordinates the telecommunications sector during an event or state of emergency. It is also the primary channel for updates on the status of telecommunications networks. The TEF communicates with NEMA, MBIE, local lifelines, councils and other infrastructure sectors (such as electricity) to help ensure support for restoration of telecommunications is organised and mobilised during an event.

10. Public safety during an emergency is also a focus and an area of significant investment and collaboration. For example, through Hourua, a joint initiative between One NZ and Spark, the telco industry is building a new Public Safety Network (PSN), as part of broader government work on Next Generation Critical Communications. The Hourua secure digital communications network will support the operational capability of New Zealand's emergency services staff and volunteers, to keep them and the public safer[2].

[1] https://comcom.govt.nz/__data/assets/pdf_file/0019/279100/2021-Annual-Telecommunications-Monitoring-Report-17-March-2022.pdf pp 25

[2] The services being delivered include:

- Roaming: PSN devices will be able to access either the One NZ or Spark networks, in the event the user's mobile network is unavailable.
- Priority for emergency communications: network features will ensure PSN users receive priority when accessing the cellular network. This means emergency communications will take priority over other mobile users when networks are congested or degraded, for example in the case of a natural disaster.
- Network visibility: communication/dispatch centre staff will have near real time network visibility so they are aware of the status of the network services in locations where they may be deploying staff.

Part B: resilience as an interconnected infrastructure issue

11. A number of the suggestions we make later in this paper hinge on the fact that resilience is an interconnected infrastructure issue. Events affecting one sector cause effects in other sectors. Any approach to avoiding or mitigating those events must be considered across all sectors, and action should be taken by the sector that is best able to control risk. It is therefore useful to start by considering the interdependencies, and reflecting on the critical role of telecommunications in responding to a natural disaster and what it needs to be able to do.

The interdependencies

12. The recent extreme weather events have highlighted the interdependence between telecommunications and other essential infrastructure providers such as electricity, roading and fuel, in the event of a natural disaster. Here are some examples of the dependencies:

    a. **Electricity**: the biggest issues for telecommunications network operators were caused by electricity outages. Electricity is required for fibre, copper[3] and mobile networks to operate. With only one or two exceptions, none of our cellphone towers were damaged during the recent events, but they needed power to be restored to go back online.

    b. **Roading**: road and bridge collapses took out a large number of fibre optic cables. Road closures meant we had difficulty getting generators to towers that lost power, and stopped or delayed fuel supplies and repair crews getting through.

    c. **Fuel**: we needed to refuel our generators, service stations needed electricity in order to pump fuel, and some service stations were unable to process payments so access to fuel was challenging.

    d. **Emergency services and other providers of essential infrastructure**: these parties depend on communications to know what has happened and who is affected. This is needed to support deploying of rescue efforts and fixing infrastructure.

Telecommunications was not prioritised as critical infrastructure during the recent events

13. During Cyclone Gabrielle (and the other recent extreme weather events) we saw telecommunications as the most important infrastructure service on day one. Being able to get emergency assistance, to understand what was happening or who was affected, and to find out if loved ones were safe was essential for people in affected areas and for those trying to help them. By day two or three the priority was still communications: to be able to use electronic payment systems to buy food or fuel, and to coordinate restoration work.

14. But the importance placed on telecommunications (for those affected by the events) was not properly understood by the people coordinating the emergency response, nor was it built into the framework for dealing with emergencies. For example:

- Deployables: Hourua is looking to provide end user coverage devices in situations when macro mobile coverage is not present.

[3] Copper lines were also affected by the flooding, whereas fibre is resilient to water damage.

a. Critical telecommunications equipment was unloaded from aircraft going to the affected regions (decisions were made about other items being essential).

b. A frigate left earlier than advised, meaning we couldn't get cell sites on wheels (COWs) to areas without connectivity.

c. There were no clear formalised processes e.g. to prioritise electricity restoration to key telecommunications sites.

d. Our technicians and the vehicles (including helicopters) carrying them were not considered essential so had restricted access or were sometimes denied access to affected regions to repair infrastructure.

15. The underlying issues were about **prioritisation, coordination and communication**. Government coordination with and between essential infrastructure providers (such as ourselves, electricity, land transport and fuel) was not as effective as it could have been. This contributed to the problem we had around there being no agreed prioritisation and understanding of the essential nature of telecommunications. That lack of prioritisation meant telecommunications did not receive the necessary priority in the restoration of electricity, providing access into affected areas, and helping to transport our equipment.

16. The other communications challenge we faced was that multiple government agencies were seeking information from the TCF (and from members directly) with different requirements. This multiplicity distracted key people from the business of dealing with the emergency, as the people needed to do the reporting are very much involved in the doing.

17. We return to these issues when we make suggestions on how government can help.

Part C: improvements the industry can make on its own

18. In this section we outline changes the industry is already making, intends to make or is considering to improve resilience, that do not depend on government co-investment or other support. These are in two categories:

    a. disaster preparedness and emergency management (restoring communications affected by an event as soon as possible - including both short term and permanent fixes)

    b. network resilience (building resilience and diversity for the longer term).

Disaster preparedness and emergency management

19. The TCF is seeking to improve disaster preparedness and functioning during an emergency event by:

    a. Bringing forward and prioritising the work on preparing an industry wide **Emergency Response Plan**, which we understand will be a requirement in the yet to be introduced civil defence and emergency management legislation. The National Emergency Management Agency (NEMA) will assist us with this work, which is expected to take 18-24 months.

    b. Applying lessons learnt from the recent events to the way the **Telecommunications Emergency Forum** (TEF) works. While overall the TEF functioned well, our post event debrief has identified opportunities for further improvement, including in our communications and by formalising processes.

20. We will also be seeking changes and improvements in emergency management on the government's side to ensure industry can do what it needs to do during an emergency. These are discussed in the part of this paper that talks about what government and industry can do together.

21. As part of the emergency preparedness work, we are looking to:

    a. **Work with others to understand and plan for vulnerabilities across regions.** This could include an assessment of service diversity (mobile and fibre) to identify at risk communities and inform future investment in network diversity. The issue of network diversity is covered later in this paper.

    b. **Engage with the electricity industry** to understand how it will address known vulnerabilities affecting power supply to key sites. We need to have an understanding of how long power may be out under differing scenarios, and of electricity sector plans to address resiliency and improve restoration, so we understand the potential impacts on our networks.

    c. **Pre-identify hub sites** (key cellphone towers and hardened sites such as exchanges and network operation centres) to prioritise for restoration in a disaster event. The location of these priority sites would be shared with others (e.g. electricity providers).

d. Investigate the adoption of an easy to update **tool to provide a centralised view of infrastructure and outage information for use in emergencies.** We think this would also need to include information from other essential infrastructure providers (such as electricity), councils, and local CDEM groups. We do not think this would be one technology tool to rule them all - there would need to be alternative ways to share and present this information in the event that something was offline.

e. Organise a sector-wide **crisis exercise programme** focused on various probable natural disasters. Some examples might be:

    i. Hikurangi subduction fault

    ii. AF8 - South Island Alpine Fault

    iii. A regional flooding event in the South Island.

f. Make arrangements to formally **share staff and contractors** working on restoration of connectivity. For example, where it is difficult to get people and equipment into an affected region. We already do this, but there are benefits in thinking about how best to prepare for it ahead of time.

g. Optimise and publicise how we enable **sharing of surviving network capacity** to normalise services into an impacted region. This approach was used successfully following the 2016 Kaikoura earthquake and again after the 2019 Rangitata flooding. As part of this work we would like to hear government views about services that need priority (e.g. emergency services, hospitals and other services). We would also take steps to inform consumers on how industry will optimise network capacity during events and the general approach we take to prioritising access and restoration of services.

h. Develop a process to more easily obtain and share **spares and replacement parts** for infrastructure equipment during an event.

i. Review **the way we engage with the National Emergency Management Agency (NEMA)**. This will include thinking about our representation in the bunker during a state of emergency, and NEMA's current process and approach for engaging with industry during events.

Fibre resilience

22. On the fibre side, network providers are continuing to:

    a. invest in **backhaul diversity** (including new routes)

    b. apply lessons learned to their **engineering solutions**, this includes:

        i. considering **alternative technology at the end of line spurs** for fibre resiliency where fibre diversity is not commercially viable. This includes the possibility of introducing satellite connections to remote exchanges to provide back-up (low-

capacity) connectivity during emergencies or making more use of existing Digital Microwave Radio (DMR) capacity

ii. reviewing and updating engineering standards in light of increased extreme weather events, including those for **river crossings**

iii. considering the role that **solar** can play in increasing resilience at key sites (e.g. at physically larger central offices which are used to support services)

iv. adding **secondary lease fibre to larger communities** where commercially viable. This would involve leasing a secondary pathway from another provider (following a different road or other access way than the primary fibre pathway) into a community so that if the primary pathway is cut, connectivity is maintained. Secondary lease fibre is generally not commercially viable in lower-populated areas.

Mobile resilience

23. The following initiatives, designed to enhance the resilience of mobile networks, are either underway or are being looked into by mobile network operators (MNOs):

    a. MNOs are already making arrangements to enable **direct-to-satellite connectivity,** which will enable mobile phone users to initially send and receive text messages, and later make calls, including to emergency services, if the mobile network is down.

    b. MNOs already provide **emergency roaming for 111 calls**. This means, for example, if the Spark or OneNZ networks are down, their customers can make 111 calls using the 2degrees network. Consideration is being given to whether emergency roaming should be extended outside the 111 context.

    c. MNOs already use batteries as back-up to the mains electricity supply on their cellphone networks, and are investing in **new battery technology** for key sites that potentially run for longer periods of time and require less maintenance. There are, however, limitations to this approach which is not suitable for all sites. This is due to space constraints, the purpose of the site, cost and local consenting and land access issues. If the duration of power outage exceeds battery life then local service outages are inevitable.

    d. **Shared pools of maintained equipment**, stored in known risk locations, that can be used during an emergency, including:

        i. Generators and fuel pools. We have a lot of generators - there is now a question about where to store them and how to keep them maintained. It is also important to note that while generators will help with short term power supply issues, they have limitations as refuelling depends on access to fuel supplies and navigating damaged roads.

        ii. Deployable resources such as cell sites on wheels (COWs), small cell units, and cell sites on pallets (COPs). As part of the work on COWs, we are exploring a

model that would enable these resources to extend coverage for multiple MNO networks in the same way Rural Connectivity Group (RCG) sites do.

iii. Exploring the possibility of collaborating with councils, marae, schools and civil defence centres for the storage of equipment.

24. It is worth noting that towers have largely been sold to tower companies, and MNOs now lease space on them. Resilience issues relating to matters such as land and site access will therefore be matters for tower companies.

Part D: initiatives that will need government support or investment

25. In this section, we discuss a number of possible initiatives that will significantly enhance network resilience during a natural disaster. Initiatives include duplicate routes for networks and alternative technologies that would provide a gold standard for resilience but are not commercially viable in areas with complex geography and low end user numbers. Most would need government investment. In some cases, network operators may have planned the resilience spend for coming years, but with government co-investment it could be brought forward to bring greater resilience to end users sooner.

26. Some of the options would require government to consider regulatory or planning support in the resource management area, or make changes to its emergency management policies and processes.

27. The suggestions we make here about telecommunications should be considered in the broader context of government investment in critical infrastructure across the board and what will have the biggest impact on resilience. For example, investment in electricity networks.

28. We would like to start a conversation with government about the options. They are presented in three categories:

    a. Cross industry

    b. Fibre resilience

    c. Mobile resilience.

Cross industry - recognising telecommunications as critical infrastructure

29. Government can make a significant difference to telecommunications resilience (for both fibre and mobile networks) by recognising and supporting telecommunications as critical infrastructure. It can do this through its emergency management policies and processes, regulatory settings in the resource management area, and investment in the resilience of other industries (such as electricity) that directly affect the supply of telecommunication services. Background information on the interdependencies between critical infrastructure sectors, and the criticality of telecommunications in emergency management, is provided earlier in this paper.

30. Here is our list of how government can help:

<u>The interconnectedness of infrastructure and criticality of telecommunications as part of emergency management</u>

    a. By **ensuring restoration of communications is given priority during an event**, by making some changes to the frameworks and policies that apply to emergency management so that telecommunications is understood to be part of the initial response (to enable people to contact emergency services and get information on what is happening), not just later recovery. This would enable:

i. our equipment to have priority access to planes or ships going to affected areas

ii. priority for electricity restoration and for fuel for generators

iii. our staff and contractors to get to affected areas and sites to restore connectivity (e.g. by Waka Kotahi and Ministry of Transport prioritising land transport access and access to helicopters for situational assessment and transportation of essential telecommunications equipment and personnel).

b. By doing more to **help facilitate greater coordination** between infrastructure sectors such as electricity, road, fuel and telecommunications and the people leading the emergency response as we prepare and plan, and work together during an event. For example by ensuring that NEMA or another government agency (such as MBIE) is actively coordinating infrastructure activity in the Bunker during an emergency, not just reporting information up and out.

c. On the issue of fuel, it would be useful to have a nationwide **fuel plan** that includes priority supply to telecommunications providers. There are fuel plans across different emergency management agencies, but not all, and they are not uniform.

<u>Resource management, regulation and consenting</u>

d. By making it clear (through resource management policy and legislation) that **roads are shared infrastructure corridors**. This would enable better access for telecommunications network providers to install, maintain and fix equipment. It would also move us in the direction of integrated infrastructure where roading, electricity and telecommunications providers work together.

e. By progressing **critical updates to the National Environmental Standards for Telecommunications Facilities** (NESTF) that will enable network providers to build and upgrade critical infrastructure, and make changes that will enhance resilience. These changes need to be made under the existing Resource Management Act, and in the first National Planning Framework that is proposed in the Natural Built Environment Bill.

<u>Investment in other critical infrastructure we depend on</u>

f. Investing or encouraging investment in the critical infrastructure that we depend on. **Telecommunications networks need a stable power supply**. While we can put in place backup solutions that will work for a short period, and work with electricity network providers to better understand vulnerabilities, we need government to work with the sector to build further resilience into those networks. For example:

i. It may be more effective to invest in Transpower and local electricity grid resilience than investing in alternative power supply at cell sites.

ii. There are low cost solutions to harden power supply resilience such as improving the quality of poles on local electricity networks and securing lines, including by trimming trees. Updated resource management rules will help electricity network providers do this more easily.

Reporting to government

g. By making it **easier to report in during an emergency,** which will allow our people to spend more time on restoration and less time on reporting similar information to multiple agencies in different formats.

   We will work with NEMA and associated agencies to develop a series of templates for information reporting purposes to ensure our fellow lifeline utilities and other agencies receive information that is both useful to them and does not require excessive amounts of processing by telecommunications providers. This would remove scope for overlapping, duplicative and repetitive information requests that create additional stress for operational teams undertaking important restoration and recovery work.

Fibre resilience

31. We have identified the following options to enhance fibre resilience:

    a. **Duplicate backhaul** in regions where it is uneconomic. We have an initial list of regions to discuss.

    b. **Alternative paths** for fibre routes that avoid known hazards and risk of failure by other infrastructure categories, e.g. bridges and roads. Approaches might include:

        i. **Adding fibre cables to Transpower towers** to improve fibre resilience at relatively low cost. Transpower's transmission lines tend to run in separate pathways from the road corridors used by other utilities. This is an idea government would need to explore with Transpower (an earlier approach from us was not successful). Consenting issues would also need to be addressed.

        ii. Looking at further **cross country options through private land** (which would involve land access and consenting issues). This approach has been used successfully across the Molesworth Station.

        iii. Using existing ducting built along the **rail corridor** to provide diverse fibre routes.

    c. Adding diversity to the fibre network by **improving interconnects between networks,** to provide more options for diverting traffic

    d. Providing additional diversity using **undersea cables**. While this "blue skies" option could have the most impact it is likely to be very high cost and would need to be carefully assessed. Undersea cables could, for example, provide diversity around the Auckland

region, or between the North and South Islands with landing points down the coast into vulnerable communities[4].

Mobile resilience

32. Here are some options for how industry and government could work together to improve mobile resilience:

    a. Government co-investment in **power standby improvements at specified high priority mobile sites** across the country, along with government support on planning/consenting rules to enable this.

    b. Changes to the **NESTF,** under the existing Resource Management Act and the planned National Planning Framework, to enable larger cabinets and sites to house new battery technology.

    c. Continued use of the **DMR** (digital microwave radio) connectivity as needed and where available, which can provide an alternative to fibre backhaul in an emergency. DMR provided a useful back up during Cyclone Gabrielle and is a good option in earthquakes.

    d. Support for **distributed warehousing of generators** that can be used by multiple industries and local government. While we intend to have shared pools of generators for the telecommunications industry, it is unlikely we will have all the generators we need in all places for a one in 250 year event. Local authorities may be best placed to own and distribute or rent generators for use in their area in an emergency.

[4] For example a new Aqualink providing additional fibre capacity between Auckland and Blenheim/Kaikoura. This might also have landing locations at Coromandel, Tanners Point, Tauranga, Whakatane, Hicks Bay, Tolaga Bay, Gisborne, Napier and then onto Blenheim/Kaikoura.

Part E: Some other ideas you may have heard

33. A number of ideas for telecommunications resilience are being discussed in the public domain. We thought it would be useful to provide some context and comment on some of these so government has an industry perspective on how helpful they may be.

34. Here are some of the ideas we have heard and our thoughts on them:

    a. **Solar panels on towers**: while solar power is useful in some situations it is not a viable solution for the average sized cell tower. This is because of the space it would take to locate the necessary number of solar panels (approximately a rugby field per tower) in return for generating power only during sunlight hours. During the recent cyclone, for example, solar power generation and delivery was negligible because it wasn't sunny.

    b. **Lots more generators will fix things**: generators are an important part of emergency response (and we reference them in our plan), but they need to be fuelled (on average every eight hours) and fuel may not be able to get through. Generators cannot be left on sites with diesel in them for health and safety reasons, so you still need to get a technician to a site to fuel a generator.

    c. **Satellite is the answer**: as an alternative backhaul solution, satellite is useful in some cases. But the capacity it provides is limited (due to limited bandwidth, the more people use it the slower it goes). It also needs electricity to operate and the earth stations also make use of fibre backhaul to connect, making them prone to weather events as for other networks. Satellites also suffer from degradation of service during heavy weather events and cannot connect through large areas of blockage, such as ash clouds from volcanoes.

    d. **More batteries at every cell site:** network operators already deploy batteries at key cell towers and roadside cabinets to provide backup power in the event of an emergency. But batteries will always only have a limited number of hours of power in them. Resource management regulations, as well as (uneconomic) costs, mean battery size is limited in both cell sites and roadside cabinets so the priority should always be to minimise the length of any power outage. Battery life varies depending on the amount of traffic they have to support - rural sites will last longer than urban ones - but in both cases last hours, not days or weeks.

    e. **Copper works when everything else is down**: as with all telecommunications networks, copper lines require electricity to operate. Typically this is provided by the cabinets or exchange rather than the home, and is subject to the same issue of resilience as other network types. On top of that, copper lines are more fragile and prone to damage than fibre or cellular networks due to the nature of equipment involved.

    f. **More towers in overlapping areas:** it is not commercially viable to build redundant cellular coverage in areas where it will not be used often. New towers would also have the same power supply and access issues as other sites.

35. As general context we note two further points. The first is that technology is constantly evolving, so we need to be careful to not lock ourselves into particular approaches when it comes to resilience.

36. The second is to consider the broader context of resilience in a country like Aotearoa New Zealand. We face not only increasingly dramatic weather events but also earthquakes, volcanos, tsunami, coastal inundation and other assorted natural disasters. A resolution that may work well in response to a cyclone might not provide additional resilience in response to an earthquake, for example. It is worth noting that the last national state of emergency was called in response to the COVID outbreak and the proposed responses to a cyclone would have made little or no difference in that scenario.

Part F: glossary

Backhaul	The part of a telecommunications network that connects local networks with the main backbone of the network.
Cabinet	Roadside cabinets that house electrical cabling, batteries and other telecommunications equipment.
Cell site	An installation that provides the radio equipment that communicates with cellular handsets and other mobile devices. This term can be used interchangeably with “tower”.
Central office	An interchangeable term for telephone exchange - usually a larger purpose-built structure that houses network equipment.
Copper network	A form of wired communication involving the transmission of data over copper wires.
Core networks	Also known as “transport” or “backbone” network providing inter-city/town linking, principally buried fibre links, but also some microwave radio. Includes Chorus, Spark, One NZ, 2degrees, Transpower and Kordia.
Core switches	These switches can redirect traffic through another part of the core network.
DMR	Digital microwave radio
Fibre networks	Use beams of light to transmit large amounts of data through plastic tubes.
Hardening	A term used to describe the process of building more protection into networks or to particular sites.
Hub sites	A physical location where multiple telecommunications networks connect and converge. Hub sites typically house network equipment and facilities.
Lifelines utility	An entity that provides essential infrastructure services to the community.
Link	Term for a connection between nodes.
Mobile networks	Sometimes referred to as cellular, this service provides customers with a device that is connected wirelessly to the network. Includes Spark, One NZ and 2degrees.

NESTF	National Environmental Standards for Telecommunications Facilities (secondary legislation under the Resource Management Act)
Node	Term for a network element that provides inter-connectivity for one or more links in a network.
Radio Telecommunications	Similar to cellular but running on their own frequency ranges, this includes two-way radio as used by emergency services, transport companies and the like. Sometimes called walkie-talkies or radio telephones (RT), these devices aren't compatible with the celluar service.
Tower	Telecommunications towers (or radio masts) are typically tall structures designed to support antennas for telecommunications. The term tower can be used interchangeably with "cell site".
Route	Refers to a geographical path between telecommunications central offices or sites.