Redundancy lesson for Japan's comms infrastructure

E&T examines how, even under the twin onslaughts of a devastating earthquake and tsunami, Japan's communications infrastructure continued to operate

Engineering lessons learned during previous disasters have helped lessen the impact of the 11 March earthquake and tsunami on Japan's communications infrastructure. Although no amount of preparation could protect communications systems in the worst-hit areas, elsewhere a combination of redundancy, resilience and disaster planning appears to have paid-off.

Undersea cables

In the immediate aftermath of the quake at least four major undersea communications cables were reported to have been damaged. Tim Stronge, head of research at TeleGeography Research, tracks the development of global telecommunications infrastructure. He says damaged cables included two-transPacific links (the Japan-US Cable Network and Pacific-Crossing 1) and two intraAsian cables – (APCN-2 and EAC-C2C).

'The industry seems to think that the earthquake caused a landslide on the seabed, which damaged the individual portions of cable,' Stronge says. This is what happened in 2006 during an earthquake south of Taiwan, which damaged an intraAsia cable.

'This sort of damage is not at all unusual,' adds Stronge. 'Disruption is not as widespread as with the Taiwan earthquake. Some cable owners have had to scramble to move traffic on to other cables. There may have been an increase in latency but there have been no major blackouts in Asia.'

Stronge added that individual cables were often part of a larger system designed for redundancy by routing cables in separate undersea trenches and bringing them ashore at different places to help maintain service.

Stuart Wilson, cable-route engineering manager for Global Marine Systems, which plans, installs and maintains undersea cables worldwide, points out that routes are designed to avoid hazards including seismic activity, existing cables, shipping lanes, fishing areas and single points of failure.

'As part of the process of route-planning you would look to establish diverse landing points so that you don't end up with everything coming ashore to one place,' he says, but adds there are places where it is hard to avoid every risk: 'The Pacific is particularly difficult because it is sitting on the 'Ring of Fire', which is seismically active and coincides with lots of other cables.'

Cables that are hit by a submarine landslide 'don't stand much of a chance,' says Wilson. 'They get torn to bits and buried under tonnes of rock and sediment, and they are usually so deeply buried that it's almost impossible to uncover them.' Repairing them means sending out a cable ship, at a cost of $40,000 to $80,000 a day, to find the two broken ends and reconnect them.

Pacific Crossing says the northern and western arms of its PC-1 cable were damaged. At time of writing its cable repair ship the CS Lodbrog is in port at Kagoshima, south west Japan, for additional preparation due to the radiation levels in the work area. The ship will repair the northern arm of the cable before moving on to the western arm.

According to James Cowie of Renesys, the agency that analyses the state of the Internet, international data traffic to the island nation seemed little affected by the cable damage: 'The engineers who built Japan's Internet created a dense web of domestic and international connectivity that is among the richest and most diverse on earth,' he reported in a 14 March blog posting. 'It looks like their work may have allowed the Internet to do what it does best: route around catastrophic damage and keep the packets flowing.'

Wilson added: 'Some would argue that [the route planning] has worked in this case. The quake hasn't taken down Japan's international telecoms infrastructure.'

Wireless is more

Wireless networks, are an important part of Japan's disaster preparedness strategy, but they have not fared as well. Those basestations and networks that survived the quake were soon overwhelmed with calls, and later some went out of service as they lost mains power and their back-up batteries ran down.

According to Japan's Telecommunications Carriers Association, there are 118.2 million cellular subscribers among Japan's 127.6 million population. NTT Docomo has 57.7 million, KDDI 32.6 million, and Softbank 24.6 million. Of these, 96 million have some sort of Internet service on their phones. According to Akiyoshi Ishiwata, a principal research analyst at Gartner in Tokyo covering Japan's mobile networks, each of the three major operators have something between 60,000 and 70,000 basestations.

NTT Docomo reported on 15 March that 2,470 of its basestations were unavailable, although Ishiwata said on 22 March that this had later fallen to 'around 1,000'. He said that both KDDI and Softbank had between 500 and 700 basestations out of commission on the same date.

By 24 March, Japanese news service Nikkei was reporting that 90 per cent of the basestations in the Tohuku region – where the quake struck hardest – were back up.

Each operator has disaster plans that were put to work once the quake struck, with message boards on their service through which users could message family and friends without overloading the network with voice calls. Operators at one point had to start prioritising emergency service calls on their networks, resulting in up to 90 per cent of calls begin rejected, according to the Nikkei report. Each operator also started sending mobile basestations into the affected areas to restore coverage, as well as delivering portable generators to power surviving basestations.

The disaster may prove to be an opportunity to change the architecture of Japan's cellular network so that it is more robust. According to Ishiwata, 'each of the operators are actively installing small cells and picocells in buildings, subways and indoor areas'. These miniature basestations improve indoor coverage, and improve a network's resilience by using more diverse power supplies and backhaul connections. Ishiwata said operators are considering using femtocells as the basis of a national machine-to-machine communications network that could also include earthquake sensors.

Mike Grant, a UK telecoms consultant at Caru Ventures, points out that one challenge with the introduction of femtocells is that their services are usually only available to customers of the operators that provided them: 'It's one of the issues that has held back deployment,' he suggests. During disasters, Grant argues, operators could open up to any user 'creating a much more distributed, more resilient network'. *

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