NEW ZEALAND'S AQUALINK NETWORK: A SUBMARINE SOLUTION FOR DOMESTIC HIGH-SPEED INFRASTRUCTURE

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1. ABSTRACT

Ericsson Communications NZ Ltd. and Telstra Saturn have embarked on an ambitious venture to provide high-speed telecommunications connectivity to major population centers using a submarine cable infrastructure in New Zealand. Through a teaming approach consisting of Ericsson, Telstra Saturn, 3U Technologies and Seaworks Ltd., the Aqualink Long Distance Trunk Network Project is on schedule, except for commencement delays resulting from unforeseen issues raised during the permitting process. This paper discusses the particulars and challenges of the project as well as new permitting issues and conditions that could have broad impact on the industry as a whole.

2. INTRODUCTION

With telecommunications deregulation comes business opportunity. And nowhere has deregulation developed more opportunities than in New Zealand. New Zealand was among the first country to embrace deregulation and liberalization of their telecom structure. That move has resulted in current registration of 9 Network Operators, 20 Broadcast Operators and 21 International Operators competing for New Zealand's voice, mobile, high-speed Internet and video/broadband traffic. Perhaps most noteworthy among the recent competitive surge of infrastructure development is the ambitious collaborative project by Telstra Saturn NZ and Ericsson Communications NZ Ltd. to build a submarine and terrestrial network linking Auckland on the North Island and Christchurch on the South Island with numerous points of presence along the way.

The success to date of Aqualink is attributed to the strong collaborative team that Ericsson formed early in the planning stages that included Saturn Communications (now Telstra Saturn NZ) as owner and TELCO operator and broadband provider, 3U Technologies LLC as Marine Consultant, and Seaworks Ltd. as installer. The combination of Saturn's desire to expand their Cable TV coverage within New Zealand and Ericsson's prominent position as a leading supplier of telecommunications infrastructure came together to spawn the Aqualink concept.

Ericsson developed the original concept of the submarine system and was ultimately responsible for cable route planning, cable supply and installation, and Telstra Saturn assumed responsibility for transmission equipment and permitting through New Zealand's Resource Management Act (RMA) process. Nortel OPERA DWDM 4 was selected for terminal transmission equipment, and Ericsson submarine and terrestrial cable with 48 fibers (52 fibers in one link), was selected for cable. Ericsson Cables AB, located in Sweden, has a long history of supplying submarine cables to the submarine cable industry, including the recently commissioned Domestic Submarine Cable Network in Thailand for CAT. This paper discusses the advantages of a collaborative business model in a tight schedule environment, and the challenges and solutions that made Aqualink a reality.

Author's note: at the time of this writing, only the Wellington to Kaikoura link had been completed, with schedule completion of the entire project for June 2001.

Figure 1:Aqualink Cable Route

3. PROJECT PLANNING AND PREPARATION

3.1. Route Planning

New Zealand was formed by violent volcanic and seismic activity roughly 26 million years ago, as were many landforms on the Pacific Rim. Its 11,000 kilometers of coastline is some of the most beautiful in the world, it is also composed of rugged bluff interspersed with sandy beaches. New Zealand is particularly interesting for geologists because it was formed exactly at the convergence of the Pacific and Australian tectonic plates. From a cable route planner's perspective, building a coastal festoon in this chaotic geosystem is a challenge. As beautiful as the rocky bluffs are above ground, the similar undersea landscape can be a treacherous curse for submarine cables. Thus, the challenge for Aqualink was to find landing sites that could sustain business cases for points of presence, as well as accommodate submarine cable route installability and survivability. Connectivity between Auckland, New Plymouth, Wellington environs and Christchurch were considered absolute. Major geological hurdles included the Cooke Straits dividing the North and South Islands, and the Kaikoura Canyon and Conway Trough. The only viable routing was entirely on the shallow shelf, that also supports an active fishing industry.

Thus, a route was selected that festooned down the west side of North Island and east side of South Island, snaking through the Cooke Straits to avoid unsuitable slopes, escarpments and other geology unsuitable for cable burial. The serpentine route across the Cooke Straits actually followed the ridge of the shelf connecting the two islands, bordered by cliff on either side. The marine survey, conducted by BTW Associates Ltd., of New Plymouth, NZ, determined that most of the route would support cable burial to 1 meter. An area where burial was found to be impossible was between Hawera and New Plymouth. The approaches into Hawera were rocky and generally unfriendly to any cable installation let alone burial. After repeated attempts to locate a suitable landing site and offshore route, the Hawera landing was dropped and a terrestrial route between Wanganui and New Plymouth was substituted. The 200-kilometer terrestrial route traversed four district jurisdictions and three roads authorities that further complicated the permitting process.

The slopes and geology of the Kaikoura Canyon presented another major challenge to route planners. The solution was to avoid the canyon by landing at Kaikoura, transit overland to Oara, and then continue with a sea route to Christchurch. The land passage is also challenging, requiring mole ploughing, horizontal drilling, and open excavation for 24 kilometers, much through hard granite.

The approach into Auckland from the west coast was another major challenge. The logical route from Raglan, north was through the Manukau headlands and Manukau Harbor to Onehunga. An alternate route was considered that would land south of Manukau headland at Hamilton Gap, and run terrestrially across land to Manukau Harbor. The terrestrial alternative would add significant cable length, expense and permitting obstacles, while the marine entrance to Manukau Harbor is perhaps one of the more dangerous in the world. It is marked with strong currents, breaking waves, narrow channel, shifting seabed, high-energy tidal environment and boasts over 100 wrecks. Manukau harbor is also very shallow, with over 10 kilometers of the cable route requiring shallow draft barge lay and burial. The sea route was selected.

The final route plan, shown as Figure 1, consists of 6 submarine links, 2 terrestrial links and 735 kilometers of submarine cable and 224 kilometers of terrestrial cable.

3.2. Cable Engineering

Because all 735 kilometers of the submarine cable route would require burial due to the shallow water depth and fishing hazards, both Ericsson's slotted core 40-tonne Double Armour (DAH) and 15-tonne Single Armour (SA) were selected for use. Figure 2 shows the cable cross sections. The cable route distances are shown in Table 1.

Table 1

Landing Point	Landing Point	Type	Distance, Km
Auckland (Onehunga)	Raglan	Submarine	120
Raglan	New Plymouth	Submarine	166
New Plymouth	Wanganui	Terrestrial	200
Wanganui	Waikanae	Terrestrial	109
Paraparaumu	Titahi Bay	Submarine	30
Wellington (Lyall Bay)	Kaikoura	Submarine	169
Kaikoura	Oara	Terrestrial	24
Oara	Christchurch (Waimairi)	Submarine	140

3.3. Project Planning

To reduce time from inception to RFS, both the owner's and installer's project specifications were prepared by Ericsson. Frequent meetings and reviews by Telstra Saturn ensured the owner's interests were not compromised, and frequent meetings and reviews with the installer ensured installer buy-in to the requirements, terms and conditions. The end result was total team commitment and compression of the overall time line resulting from parallel planning at all levels.

4. PERMITTING

Telstra Saturn initiated permit requests under provision of New Zealand's Resources Management Act (RMA). The RMA process consists of a rigorous hearing process after which the permit is issued with special terms attached, as applicable. After its issuance for a three-week period, an appeal can be lodged by any person or group. Appeals have been known to take up to three years in court. For this reason, extensive negotiation takes place during the hearings in order to avert appeals. Since Aqualink spanned the jurisdictions of several regional councils, the country was divided into three permitting regions. Delay in issuance of permits for the southern segment, beyond what was allocated in the project schedule, necessarily delayed the project start date. Permits for the central and northern segments are also lagged behind schedule. The total time from submission of the permit applications to issuance of first permit, followed by the time for appeal, was 9 months.

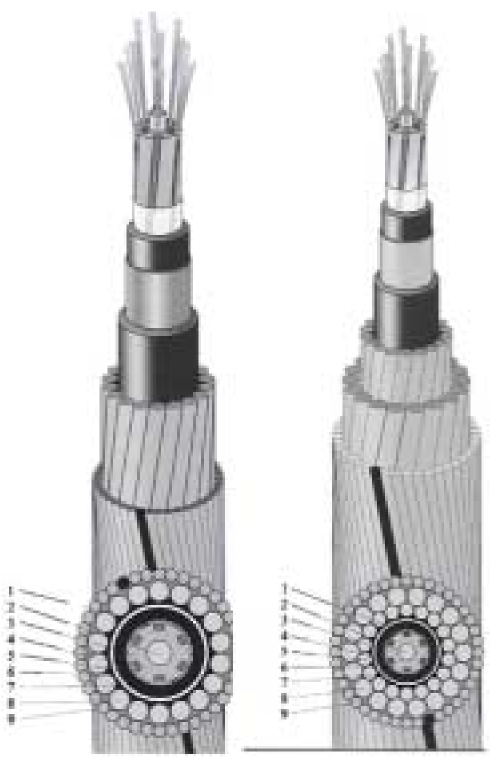

Figure 2: 15-t SA and 40-t DAH armoured cable

The primary issue raised by the district councils during the RMA hearings was the affect the submarine cable would have on the fishing industry. Notwithstanding the fact that the seabed generally consisted of medium to dense sand and the specified burial depth was 1 meter (a generally acceptable burial depth under those seabed conditions), the Councils and the fishing industry wanted greater assurances that the cable would not interfere with fishing grounds. The resulting terms of the permits were unfortunately consistent with the regulatory trends and political rulings that have been occurring in other places around the world. The permits changed the project requirements by requiring (1) best endeavors to bury to 1.5 meters throughout, with a guaranty of 90% of cable to be buried to greater than 1 meter, and (2) inspection and verification of burial depth at 18 months after installation and every fives years thereafter until end of life.

The ramifications to the industry are obvious: such rulings overrule the results of considered competent cable engineering and planning efforts, increase installation costs very late in the process, can delay the start of installation and completion, and significantly add to life cycle costs with life cycle post lay inspection (PLI) requirements. Added to this is the technical difficulty of tracking and accurately verifying burial depth for cable buried deeper than 1-meter using conventional equipment and techniques.

5. INSTALLATION

Transport of the first cable segments from Sweden was economically facilitated aboard the lay vessel, M/V Sea Ranger, which was conveniently located in the North Sea at the time. The second load of cable to the mobilization site in Wellington was via freighter.

5.1. Installation Spread

Installation for Aqualink was provided by Seaworks Ltd., of Wellington. Seaworks employed their recently converted Sea Ranger as the lay vessel. The Sea Ranger is suitably sized for coastal festoon projects with its 78-meter length and relatively shallow 5-meter draft. It was outfitted with a single cable tank, two Dowty linear cable engines, Lebus UK tow winch, Engineering Business (EB) A-frame and EB cable plough (Figure 3). The shallow water variant of the EB Sea Stallion cable plough was employed for Aqualink. Outfitted with a 1.5-meter share, the Sea Stallion was fortunately capable of performing to the new burial depth specifications required by the RMA permitting rulings.

The vessel was converted and outfitted with its new plough and all new cable equipment in four months from award of contracts. Qualification sea trials were conducted in the North Sea and New Zealand.

Figure 3: Sea Stallion cable plough aboard Sea Ranger

5.2. Cable Installation

The biggest challenge to date was the lay across the Cooke Strait. The Cooke Strait, separating the North and South Islands, is among the most turbulent bodies of water in the world. Connecting the Tasman Sea and South Pacific Ocean, it typically has a current approaching 3 knots. Once a year, the earth's magnetic forces line up to form a King Tide condition, where currents reportedly increase to 8 knots. In addition to the current, the Tararua Ranges funnels high velocity westerly winds through the straits to further complicate precise positioning and navigation. Thus, Wellington has assumed the name 'Windy Wellington' by most New Zealanders.

As luck would have it, with the delay in the issuance of the permits, the Cooke Strait crossing happened to coincide with the King Tide, accompanied by very high winds. The conditions caused an installation slowdown, but positional accuracy was maintained to within the ±10-meter corridor on the seabed throughout the crossing.

5.3. Shore Landings

At the time of this writing, only the Wellington (Lyall Bay), Kaikoura and Oara cable landings were completed. Where possible, the cable will be ploughed directly off the beach after it is landed. Figure 4 shows the Sea Stallion commencing burial operations off the beach at Oara. It is our opinion that ploughing from the beach provides superior long-term quality and quality control, and is also economical in most cases. Cable buried by post burial techniques, especially in surf zones, is often likely to reappear sometime during the life cycle of cable.

Figure 4: Ploughing shore end off beach

Figure 5 shows preparation for a conventional jointless shore landing at Kaikoura.

Figure 5: Landing trench preparation at Kaikoura

6. CONCLUSIONS

Opportunities exist for traditionally land based TELCOS, broadband providers and ISPs to expand their regional operating areas using submarine cable infrastructure. A variety of business models are available to achieve this goal including the one presented in this paper of a collaborative approach, utilizing the skills and expertise of equipment suppliers and specialized marine consultants.

The permit process can introduce significant schedule delay and changes in project requirements. It is becoming increasingly common for permits to require greater burial depth than the industry might consider necessary, and to also require accurate post burial verification. Owners and installers should give consideration to new methods of locating and verifying burial depth during their cable system planning process, in anticipation of the requirements that might be levied upon them at the last moment.

7. ACKNOWLEDGEMENTS

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