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Deadliest OSS: Managing Subsea Networks in a Dangerous World

By Ed Finegold

Amid discussions of the global economy and ubiquitous access to communications, we take for granted that connecting the world's continents – excluding only Antarctica – are 69 millimeter diameter cables which rest on the ocean floor. Though multiple new cable projects are in progress, there are roughly 121 subsea communications cables in service today. Major outages, which are rare but generally caused by anything from ships dragging anchor in storms to seismic events, can take weeks to repair. How subsea cable operators deal with the risks and realities of operating their networks; planning redundancies to deal with outages and disasters; and executing maintenance operations sometimes thousands of meters below the sea takes us out of the back office – where OSS usually lives – and into some of the harshest and most dangerous areas of the planet.

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Lighting the Dark Continent

The West Indian Ocean Cable Company (WIOCC)is a consortium jointly owned by 14 African telcos and partially funded by the World Bank and five other development banks. It is a wholesale capacity provider that services Tier 1 and 2 African carriers and offers a one-stop-shop for access to Africa for major global carriers that aims to "take away the pain of reaching these hard to reach places," says Ryan Sher, COO for WIOCC.

WIOCC is the primary operator of the East African Submarine Cable system (EASSy), a 10,000-km fiber-optic subsea cable that runs along the coast of East Africa from Sudan to South Africa, linking points in Djibouti, Somalia, Kenya, Tanzania, Comoros, Madagascar and Mozambique along the way. As are most subsea cables, EASSy consists of a single-fiber strand that uses SDH technology to provide 4.8 terabits of capacity.

Several things about this cable should become evident immediately. First, the 4.8 TB capacity should dispel the myth that satellites can provide back-up for subsea cable outages. "Satellite is one or two gigabit," says Sher, "so they can't restore services. They're only used where you can't get cable." Sher explains that the EASSy cable carries "a huge amount of Africa's traffic." While it's not the only cable connecting Africa to the rest of the world, if this cable suffers an outage is can mean an extended period of time without access to the economic opportunities the Internet creates for millions of people.

Fortunately, subsea cable outages are uncommon. "There are few moving parts, so it's quite rare to have equipment failure; less than 1 in 20 years," says Sher. The biggest threats to subsea cables, he says, are ship anchors and geologic or seismic events. A cable cut will result in a major outage because it almost impossible to build in physical redundancy. "Most subsea cables are single strand;" Sher says, "when you lay something thousands of kilometers deep, it's not easy to build in loops."

Generally, he says, companies that leverage the EASSycable seek what he refers to as "continental diversity" where capacity is leased on cables that run the length of both the east and west coasts of Africa. IP networks have the ability to make real-time routing decisions in case of an outage, so this kind of basic redundancy plays well in the IP world.

Continental diversity is one example of the kind of multi-cable leasing international carriers and enterprises will conduct in order to achieve network redundancy. Designing networks that rely on multiple cables that traverse different subsea channels helps minimize exposure to damage from common events.

Sher explains that, logically, subsea cables are most vulnerable in shallower water as they approach land. "You try to pick a route away from ports, fishing areas, or anchorage zones," he says, and adds that carriers work to "make it illegal to anchor where the cable is." He adds, however, that in parts of Africa, lines on maps aren't always effective enough deterrents to keep fishing boats away from the cable. In such cases, ships and radar systems are required to patrol cable zones to prevent interlopers from dropping anchor.

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Sometimes, cuts caused by ships anchors can't be avoided. "A ship in a storm can drag an anchor for several kilometers," says Sher. He explains that because the Red Sea is narrow, it's a place where multiple cables can be affected by a dragging anchor, as occurred in 2008. "In Egypt, a ship took out cables that connected the Middle East and Asia to Europe and the US and disconnected them from the Internet for a good period of time," Sher says.

Deep Water

In deep water, man is a less of a threat to subsea cables. "Below 1000 meters you don't have ships, trollers, or anchors," Sher says. Sher describes a natural activity called "slumping" which is a movement of the seabed

that can create a cable cut. This can happen as a result of an earthquake, but is also just a common geological phenomenon that's part of life at the bottom of the ocean. When a major seismic event occurs, as in Japan most recently, it can lead to multiple cable cuts in deep water.

"Subsea is a very hostile scenario," says Ron Pfaff, vice president - global network operations for Global Crossing. "Tectonic plates, mountain ranges, and volcanic activity," are among the challenges operators find deep in the ocean, so that the "magnitude of events can't always be determined," Pfaff says. Pfaff argues that simple wear and tear is a more common issue because "outside of Asia seismic activity is not the biggest concern." He says that deep water cables "aren't buried and they can lay across rock that will cause abrasion" as a result of ocean currents shifting the exposed cables around on the seabed.

Deep water cables traverse some of the deadliest terrain in the world, such as the North Atlantic where there are at least five subsea cables operating. The North Atlantic is sub-divided by the Mid-Atlantic Ridge, a major mountain range that is 1,600 kilometers wide and which separates the Atlantic into two troughs, respectively 3,700 and 5,500 meters deep. The North Atlantic is notorious for its unpredictably deadly weather along with icebergs which, most famously, sank the Titanic. It is in water and weather conditions like these that the most challenging communications repair scenarios outside of low earth orbit can occur and where submarine cable repair ships must be prepared to operate.

Rolling Ships

Subsea providers generally contract with third parties for specialized ships that are equipped for deep sea cable repair, but there are very few of them operating around the world. "If we have a cable cut, we mobilize the closest ship," explains Sher. "The ship has to find the cable, pull it up from the seabed with a hook or an ROV (a miniature, remote-control submarine)," Sher says. Sometimes cables can be trapped under debris, so ROV s are used to cut the cable and pull each side to the surface ship. Cables are then spliced and repaired right on a heaving deck. "It takes a huge amount of time to mobilize a ship and sail," Sher says. "The furthest point can be 10 days of sailing" just to reach the location of the cable cut.

In the case of severe seismic events, more than one ship may be needed to repair multiple cuts, or multiple cable outages. "Sometimes we need more [ships] than are available in a particular region," says Pfaff; in such cases, "ships are sent from another region." There's no way to plan or prepare for such scenarios because it is impossible to predict when, where or how they'll happen. "If told you two events are similar, I'd be lying; there are many scenarios that can occur," says Pfaff. He explains that subsea operators rely heavily on a relatively small group of experts to respond to scenarios as they arise and create response plans essentially on the fly. Regardless of the specifics, the plan will involve the typical OSS function of identifying where a cable is cut and following up with repair dispatch; in this case, that involves sending a ship, or ships, to the location as rapidly as possible.

When thinking about operations support systems (OSS) we typically think of software systems that live somewhere in a data center, or perhaps in the cloud. Global Marine's CS Sovereign is an OSS of a different sort. Global Marine is one of the major subsea cable repair ship operators and is the parent company for Huawei Marine. The company operates eight ships that are capable of various roles ranging from laying to repairing subsea cable.

The CS Sovereign is its multi-role ship which operates in the Atlantic Ocean. It is a Dutch-built DPS-2 vessel based in Portland, UK on the southern coast of England. It is over 130 meters in length —roughly the size of a World World II heavy

cruiser— and is fitted with an ice-breaking hull. It carries a 35 ton A-frame, a superstructure specific to cable repair work; three 5-ton cranes and two 2-ton cranes; an Atlas 1 trenching ROV that can bury cable up to 2 meters deep in the seabed; more than 1,100 tons of marine gas oil for power; and enough berths for 76 crew members, plus a two berth hospital.

Consider that a major cruise ship will cost anywhere from $300 million to more than $1 billion dollars to build, and it's easy to see how subsea cable operation and maintenance is extremely capital intensive. It is not dissimilar to undersea oil exploration and drilling. In fact, most of the companies that support subsea communications cable also support oil and gas rigs as well as ocean-based wind farms.

Subsea operations comprise one of the hard, fixed costs in communications' increasing globalization. There's no way around the fact that more than 70 percent of the Earth's surface is covered in water. In lieu of new technology emerging that does not yet exist which either makes trans-oceanic wireless a possibility, or completely changes the economics and feasibility of high capacity satellite connectivity, global interconnectivity, and the Internet itself, will continue rely on subsea cables and the small number of people, companies, and ships that are equipped to manage them.