UNDERSEA CABLES

By what means do you think data, emails, money transfers and digital communication travel to Europe or Asia? If you answered 'via satellite,' you're wrong. Virtually all trans-oceanic data travel by undersea cables. At one time, satellite was the cheapest and fastest method for trans-oceanic communication, but this is no longer the case – undersea cables transmit almost 99% of all trans-oceanic data.[1] Nowadays, satellites carry only a tiny percentage of it because the quality of data transferred is better and there is much higher capacity and speed via cable, and cables are more reliable than satellites.

Cables for the purposes of communication have been laid under the seas since the 1840s. Why? Well, when they were first laid, trading companies wanted to be able to communicate with their ships so they could give directions on where to go and what to pick up. The British government, an early leader in submarine cables, wanted to improve communication with its far-flung empire. And countries wanted to be able to communicate with their diplomats and militaries in war-time to receive information and give instructions.

The earliest cables spanned short distances – across a river, across the English Channel, across a harbour, for example. The success of the early ventures led to attempts to cross greater distances. People began contemplating the huge task of laying cable across the Atlantic Ocean in the 1840s. An early plan was to lay cable from Ireland to Newfoundland as the closest land points, and from there to the mainland. As daunting as the task seemed, investors were found.

While few people doubted the importance of the task, there were many obstacles. In 1853 when US Navy Lieutenant Matthew Maury, who had done survey work off the east coast of the United States, was asked if he thought it was possible to lay undersea cable across the Atlantic Ocean, he replied that, yes, the undersea conditions made it *possible*. But, he continued, "I [do not] pretend to consider the question as to the possibility of finding *a time calm enough, the sea smooth enough, a wire long enough, a ship big enough*, to lay a coil of wire sixteen hundred miles in length."[2] The early enterprises had difficult technical problems to solve. How would the cables be laid? How would they be insulated? How could the signal be boosted over such large distances? These questions took a few expensive failures to answer. Cables first crossed the Atlantic in the 1850s (although this original cable failed very quickly), connected Britain to India in the 1880s, and crossed the Pacific in the early 1900s.

The cables began by carrying telegraph messages, then telephone traffic and now they carry telephone, internet, money transfers, and other data and communications. Improvements in technology also increased the speed of data transfer. The early cables had a rate of telegraph transmission of about 10-12 *words per minute*. In our time this seems painfully slow but it was significantly faster than sending a letter which could take weeks. Today the speed of transoceanic communication is not measured in words per minute but by huge chunks of data transferred at almost the speed of light.

Laying submarine cables is expensive and it has historically been undertaken by private

[1] Kathryn Young, "The Economic Importance of Submarine Cables," *Semaphore*, Issue 2 (2012); also Sea Power Centre – Australia, Australian Communications and Media Authority (5 February 2010).
[2] USN Lieutenant Matthew Maury, quoted in Bill Glover, "History of the Atlantic Cable and Underseas Communications," emphasis in the original.

consortia of operators. This continues, and most lines are owned by private telecommunications companies, including giants like Google and Microsoft. With new technology – fibre-optic cables for example – and thirst for information, there was a scramble in the 1980s/1990s to lay cables. Billions of dollars were spent, and the cable system expanded as new lines were laid and old ones were replaced. The focus since the early 2000s has shifted from the Atlantic to the Pacific Ocean.

So why do we care about submarine cables? For one thing, the undersea cable infrastructure allows the international financial system to function. Each day, the Society for Worldwide Interbank Financial Telecommunications (SWIFT) "transmits some 20 million messages to more than 8,000 banking organizations, security institutions, and corporate customers in nearly 200 countries, reconciling trillions of dollars' worth of assets across global financial markets."[3] We rely on the information passing through these cables, and that means they are an important piece of our economic infrastructure. But they are also important for social reasons – to communicate with family in other countries, for example.

As the cable infrastructure grew, it became clear that there were security implications. The British, the pioneers in undersea cables, were quick to realize that cables were important communication devices, but they were also vulnerable during war-time. They were a security risk and could be cut to interrupt communication or tapped into for information.

As the world began to rely on the cables, multiple cables were laid so that the loss of one did not shut the entire system down. However, building total redundancy into the system is expensive, and cables tended to be located in roughly the same place because operators clustered around the optimal route from A to B. This meant an accident or attack in that area could damage more than one cable. To get around this, modern undersea cable systems are now usually arranged in ways to increase redundancy, such as having dual landing points and 'mesh networks' to transfer services between networks if a path becomes inoperable.

Faults in the cables are surprisingly rare, but even at the bottom of the ocean cables are vulnerable. To make them less vulnerable, in the 1980s operators began to bury the cables. Nonetheless, they can still be accidentally damaged by fishing nets, anchors, dredging and offshore oil exploitation, or by earthquakes and ocean currents. For example, the earthquake off Japan in 2011 led to significant damage to cables. In another example, unmanned US surveillance flights in Iraq had to pause in 2008 because an anchor had snagged a undersea cable hundreds of miles away. The severed cable linked controllers based in continental United States with unmanned aircraft flying missions for coalition forces in the skies over Iraq.[4] Luckily, as on land, technology exists to pinpoint where a cable has been broken/damaged so repair can be done quickly.

Intentional human actions to damage undersea cables have been rare but they occur. The Convention for the Protection of Submarine Telegraph Cables was signed in 1884 to ensure that states do not purposely damage cables but it still occasionally happens. The British and the Germans attacked cables in both the First and Second World Wars to destroy communications of the other side. During the Cold War, Soviet 'fishing' trawlers 'accidentally' dragged and cut US communication cables, and the United States tapped into Soviet cables. There was concern in the West in 2015 and 2018 about Russian ships 'lurking' over the location of subsea cables, and

[3] Robert Martinage, "Under the Sea: The Vulnerability of the Commons," *Foreign Affairs*, Vol. 94, No. 1 (January/February 2015), p. 119.
[4] "Concern over Russian Ships Lurking around Vital Undersea Cables," CBS News, 30 March 2018, www.cbsnews.com/news/russian-ships-undersea-cables-concern-vladimir-putin-yantar-ship/.

Russian submarines operating near the cables.[5] In response, the 2018 US defence budget authorized construction of a second cable-laying/repair ship to supplement the only one in US military service.

There have been no confirmed terrorist attacks on submarine cables, but in 2007 pirates stole an 11-kilometre section of a submarine cable that connected Thailand, Vietnam and Hong Kong, and attempted to sell it as scrap. As well, there have been delays to cables being laid into Africa because of piracy off the coast. Cable-laying (and repair) ships can be vulnerable to attack as they are big, slow and follow a specified route. Security officials worry because maps of cable routes are accessible to the public on the internet which could make them a tempting target for malignant actors.

With the exception of Antarctica, the world is now spanned by undersea fibre-optic cables. These cables are important to citizens, businesses and militaries. Militaries these days are very reliant on information and the interruption of the cable network could have consequences for military operations and exercises. Undersea cables could be a tempting target for a state-based attack (asymmetric and/or hybrid warfare) or non-state actors. If we are doing vulnerability assessments, we would be wise to keep in mind that although they are out of sight, submarine cables are a vital information, economic and strategic link for Canada. Protecting them is another task for navies.

[5] See, for example, "Fears over Russian Submarine and Spy Ship near Vital Undersea Internet Cables," *Daily Mail*, 25 October 2015, https://www.dailymail.co.uk/news/article-3289303/U-S-concerned-Russian-operations-near-undersea-cables-NY-Times.html; "Concern over Russian ships lurking around vital undersea cables," CBS News, 30 March 2018 and Sebastien Roblin, "Russian Spy Submarines are Tampering with Undersea Cables that Make the Internet Work. Should We be Worried?" *National Interest*, 19 August 2018, https://nationalinterest.org/blog/buzz/russian-spy-submarines-are-tampering-undersea-cables- make-internet-work-should-we-be.