Undersea Cables

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Abstract

Undersea or submarine cables run along the ocean floor and link countless countries and different areas of the world through telecommunications. They have a long history, beginning with the telegraph in the mid-1800s, but only recently have these cables transformed the world of communication. Submarine cables quickly transmit large amounts of data from one point to another and are crucial for our daily lives. We want to explore the different aspects of these cables, including the complex infrastructure required for them on land and sea, the structure of the cable and how their multi-layer design provides resiliency against the harsh environment in the ocean, as well as the techniques used to send data along these cables and recent innovations which have made them even more powerful. Through researching this somewhat unrecognized feat of engineering, we hope we can create a better appreciation for the technology that makes our modern world function.

Cable Design

Undersea cables can affect Internet speeds by enabling data transfer and Global Communication. Global Communication will be reduced without Undersea cables, and the variety and number of optic fibers in the cables will keep increasing as network demand increases and technology progresses. The more optical fibers in a cable, the more expensive cable networks can be, but cable networks can also improve reliability and speed for data transmissions.

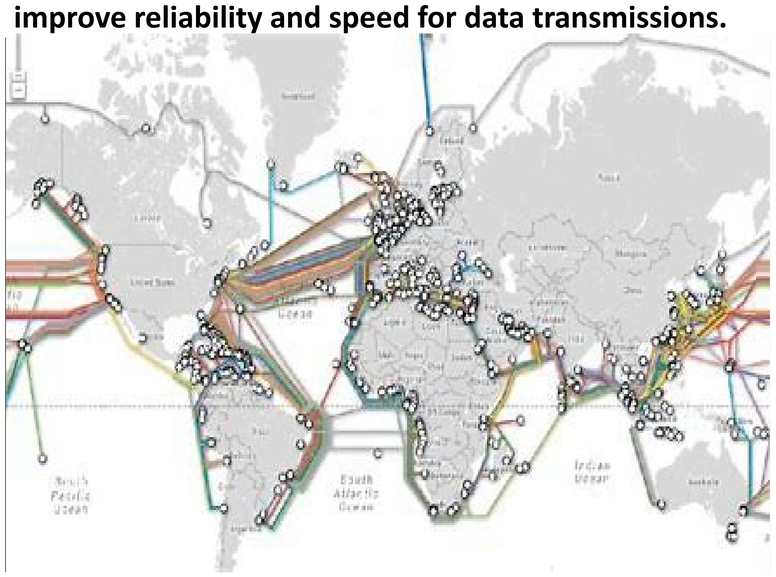

Figure 1. Diagram of an Undersea Cable's Paths.

Cable Composition

The fiber optic is a crucial part of a submarine cable, made of pure silica (glass) falling in the G.654 family of fiber optics, specialized for low signal loss. Surrounding a central copper-covered wire, it adds structure to the cable with a small diameter of about 2.5 millimeters. Enclosed by UV-hardened resin, it forms the optical fiber unit, further encased in a steel pipe to resist pressure. Steel wires wrap leftward for tension resistance, followed by a copper pipe for power delivery to repeaters. The outer layers include low-density polyethylene insulation, high-density polyethylene sheathing, with a diameter of 22.5 millimeters. Armor layers can be added or removed for different underwater environments.

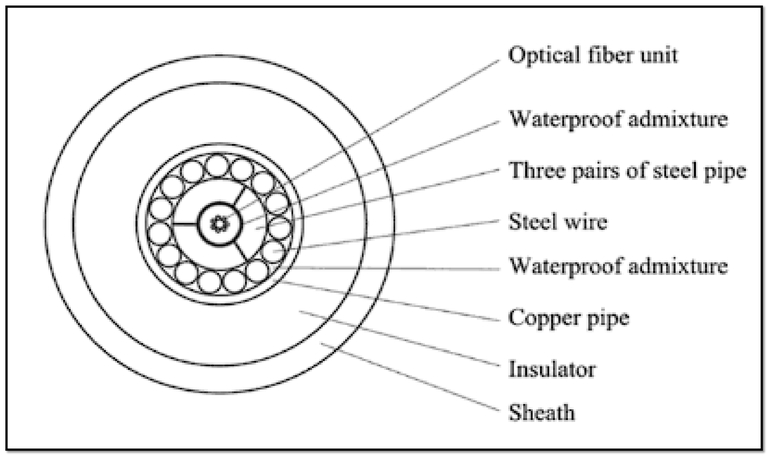

Figure 2. Cross section of an undersea cable.

Data Transmission

Fiber optics transmit data using pulses of light where the absence or presence of a pulse encodes binary data. A method of increasing cable capacity called Dense Wavelength Division Multiplexing is shown below.

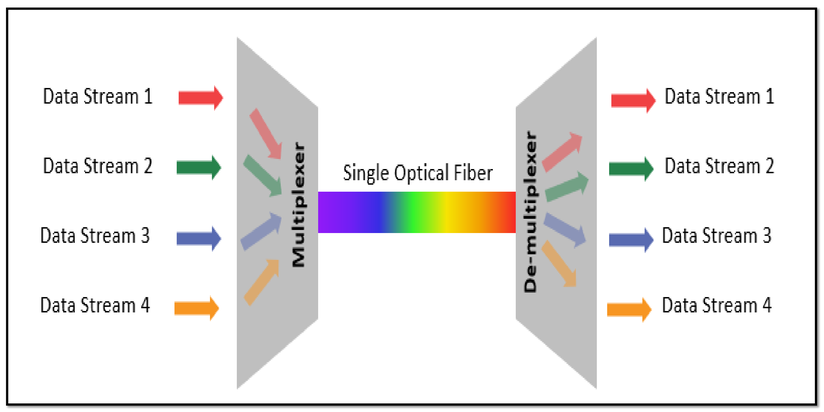

Figure 3. A basic diagram depicting how wavelengths are separated into channels of data.

Infrastructure

The dry plant is the terrestrial section of an undersea cable system, spanning from the cable landing station to the beach manhole without repeaters. The cable landing station is onshore and where sea cables terminate. Submarine line terminal equipment (SLTE) manages signals between cables and inland facilities like provider points-of-presence (POPs) or interconnection sites. Beach manholes connect submarine cables to the landing station, typically supporting two cables. The wet plant spans between beach manholes, often requiring tunneling near manholes and trenching at sea for cable laying.

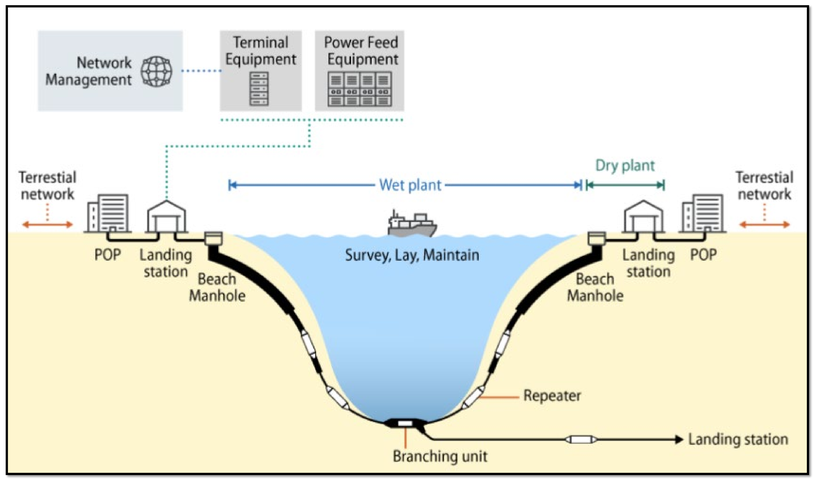

Figure 4. Diagram of an undersea cable's infrastructure.

Recent Innovations

The fastest cable in use today is Amitié, a transatlantic cable between the US and Europe. The Japanese company NEC seeks to build another transatlantic cable that will breach half petabit speeds. They will accomplish this by solving the complex engineering and logistical issues of cramming 24 fibers into one cable.

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