

## History

As a leading provider in undersea optical networking, Tyco Telecommunications has played a leading role connecting people from all parts of the globe for more than half a century. In fact, the history of undersea telecommunications reads much like a list of Tyco Telecommunications' own achievements. Not only was Tyco Telecommunications part of the team that was responsible for the first transatlantic telephone cable system in 1956, the company also developed and implemented the first transatlantic fiber-optic system in 1988. More recently, Tyco Telecommunications pioneered a number of new technologies to enable fiber optics to satisfy the rapidly growing demands of the Internet Age.

Today, Tyco Telecommunications maintains its tradition of innovation, as its research and development team, whose lineage goes back to AT&T and its Bell Laboratories division, continues to expand the boundaries of optical networking technology to deliver the finest service at a lower cost to all customers.

## The beginning of telecommunications

The phenomenal technological advances of the 19th century brought profound changes in communications, which were previously limited to primitive hand-delivery of messages or the Semaphore. The introduction of mechanically generated electricity in 1832 led to the development of the telegraph and the birth of the telecommunications industry. It was not long until the potential of undersea cables was realized and the first cable was laid under the River Thames in London in 1840.

## Early cable crossings: 1850s

After several failed attempts to lay cable across the Atlantic in the 1850s, an undersea cable was successfully installed between Ireland and Newfoundland, a distance of approximately 1,600 miles. Unfortunately, the system was extremely slow, having a "bandwidth" of just two words per minute, and it failed after a few months of operation. This failure, caused by excessive voltage, demonstrated the need for a key part of Tyco Telecommunications' current solution: repeaters that boost the signal as it traverses the ocean floor.

## Transatlantic success: 1867

It took the world's then-largest ship, the Great Eastern—with a crew of approximately 500 men, almost two years to successfully lay the next cable between Europe and North America in 1867. Shortly thereafter the Great Eastern returned to the North Atlantic, and successfully recovered a broken cable from the prior attempt and added a second connection in the summer of 1867, leading to a dramatic improvement in performance.

## TAT-1

In 1955 and 1956, Tyco Telecommunications (AT&T at the time), along with UK and Canadian partners, built and installed the first transatlantic telephone cable system, TAT-1, which could support 36 analog telephone circuits simultaneously. Demonstrating the company's proven expertise in engineering and manufacturing reliability, TAT-1 performed flawlessly for more than two decades. When it was retired in 1978, the system had not experienced a single component failure.

## Growth of coaxial analog cable systems

In 1960, the Western Electric Co. (a unit of AT&T) founded a special-purpose undersea repeater factory in Clark, New Jersey. Working with Tyco Integrated Cable Systems, formerly Simplex Technologies, the two firms served as the U.S. manufacturers of wet plant technologies. Working closely with the research and development organization then at AT&T Bell Laboratories, they invented and implemented SD analog technology, which enabled bi-directional transmissions rather than requiring a separate cable for each direction of traffic. This technology, which also increased bandwidth, was used by Tyco Telecommunications to build TAT-3, the third transatlantic telephone cable, and allowed simultaneous transmission of 148 circuits.

## SF and SG coaxial cable

A further expansion of the frequency spectrum was achieved in 1968 with SF coaxial cable, which was capable of supporting 845 circuits. This technology was implemented with the installation of TAT-5 two years later. Yet another significant breakthrough came with the development of SG coaxial cable in 1975. This cable, which supported 4,000 circuits, was used to build TAT-6 in 1976 and TAT-7 in 1982.

### **Seeing the light: fiber in the 1970s and 1980s**

By the late 1970s, Bell Laboratories' researchers began to explore the possibility of using light waves and new digital technologies to transmit voice and data. At the same time, Tyco Telecommunications was testing transoceanic fiber-optic transmissions, pursuing a notion that was scoffed at by many in the telecommunications industry. In 1985, Tyco Telecommunications installed the first optical system in the Canary Islands, and then, in 1988, across the Atlantic.

### **Catching the right wavelength**

In 1991, Tyco Telecommunications established another milestone by conducting the first successful transoceanic fiber-optic transmission using laser-pulsed light with a wavelength of 1.5 microns. This development opened the door to higher capacities by increasing the usable bandwidth. However, what may be the most significant development occurred in 1992 with the invention of the all-optical amplifier for the SL2000 system. Previously, any transmission through a cable segment was received by an optical receiver, converted from an optical signal to an electrical signal, boosted or strengthened, and then reconverted back to an optical signal before being transmitted down the rest of the segment. Tyco Telecommunications' optical amplifier based repeater eliminated this "bottle-neck," making it possible to transmit significantly more data on a single optical fiber.

### **Automatic redundancy: 1996**

In 1996, Tyco Telecommunications designed, manufactured and deployed the first transoceanic self-healing ring, TPC-5. This cable, which stretches from the coast of Oregon in the U.S. to Tokyo, Japan, was the first fault-tolerant system that could automatically switch a call from one fiber to another in the event of a breakdown.

### **The evolution from products to full service**

In 1997, Tyco International acquired AT&T Submarine Systems, gaining research and development and fleet assets, along with the manufacturing capability to produce repeaters and transmission equipment. These additional capabilities, combined with cable manufacturing at Tyco Integrated Cables Systems in Newington, New Hampshire, established Tyco Telecommunications as the world's first vertically integrated global optical network supplier, capable of developing the technology and manufacturing the components, to designing, building and maintaining systems.

### **The Internet explosion**

As the use of the Internet for communications skyrocketed, Tyco Telecommunications expanded its efforts in equal measure. The company demonstrated the first IP packet transport across a transoceanic DWDM cable in 1999, covering over 7,530km at the rate of 2.5 gigabits per second, using only optical amplifiers. Then in 2000, the company leveraged its developments in high-performance optical equipment to improve on the previous year's test by a factor of four. In this test, researchers successfully transmitted 10 gigabits per second, using IP packet transport, over a distance of more than 3,700 miles without any packet regeneration.

### **The turn of the century**

Since 2000, Tyco Telecommunications has been designing, manufacturing and implementing DWDM optically amplified systems operating with 10 gigabits per second channels. In 2003, the company dramatically increased its capabilities to transmit wavelengths from 32 wavelengths per fiber pair in 2000 to 128 wavelengths per fiber pair. Coupled with the capability to install systems with eight fiber pairs, the total capacity of a system can now reach 10 terabits, a more than five-fold increase in capacity since 1999.

Tyco Telecommunications has been a leading provider of undersea systems for nearly half a century. Since the advent of optical systems, Tyco Telecommunications has deployed more than 420,000 kilometers of cable, containing in total over 2 million km of fiber, and integrated with 7,500 repeaters.

Today, the company leverages its expertise to develop reliable, cost-efficient undersea fiber-optic communications systems. Tyco Telecommunications continues its tradition of product innovation with the introduction of 3G submarine lightwave terminating equipment. These terminal products simultaneously increase transmission capacity and transmission performance while decreasing the terminal's footprint and cost of goods.

### **Tyco Telecommunications tomorrow**

Tyco Telecommunications continues to make ground breaking advances in technologies such as OADM branching units and 40Gbs transport. With state-of-the-art facilities and dedicated employees, including its world-renowned research and development team, Tyco Telecommunications continues to expand its reach around the world, providing high-bandwidth connectivity in previously underserved regions of the globe and charting a new course to supply reliable systems for the oil and gas industry.