What is 5G and How Did We Get Here?

An Online Continuing Education Course for Engineers

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1. Introduction

The modern internet communication has had a remarkable effect on transforming our communication systems, but our society as well. This course will trace the development of the digital computer and the internet revolution and how it has changed the way we do things. From the patenting of the telegraph in 1836 by William Fothergill Cooke and Charles Wheatstone, to the present, widely used 4G protocol, communication has been done by dots and dashes or zeros and ones. The system is now being updated to 5G protocol. Figure 1.1 is a picture of the two English gentlemen. Cooke was an inventor and entrepreneur who wanted to exploit the invention for financial gain, and Wheatstone was an academic who wanted to make the invention available for public use. Cooke eventually bought out Wheatstone's interest for a part of the royalties. Wheatstone was also the inventor of the widely used Wheatstone Bridge. Let's do a timeline from 1836 to the present, and take a look at the future.

Charles Wheatstone **William Fothergill Cooke**

Figure 1.1 Pictures of the Inventors of the Telegraph, Wheatstone, and Cooke

By SpinningSpark (for derivative work) - Gallery of File: Cooke William Fothergill.jpg and File: Charles Wheatstone later years.jpg, Public Domain, https://en.wikipedia.org/w/index.php?curid=38613491

2. The Telegraph, Invented in 1836

As mentioned in the introduction, Charles Wheatstone and William Fothergill Cooke were the inventors of the original telegraph system. A series of dots (a short pulse) and dashes (a long pulse), could be used to send messages over long distances almost immediately. This beat runners and horses. Figure 2.1 is the coding of the International Morse Code.

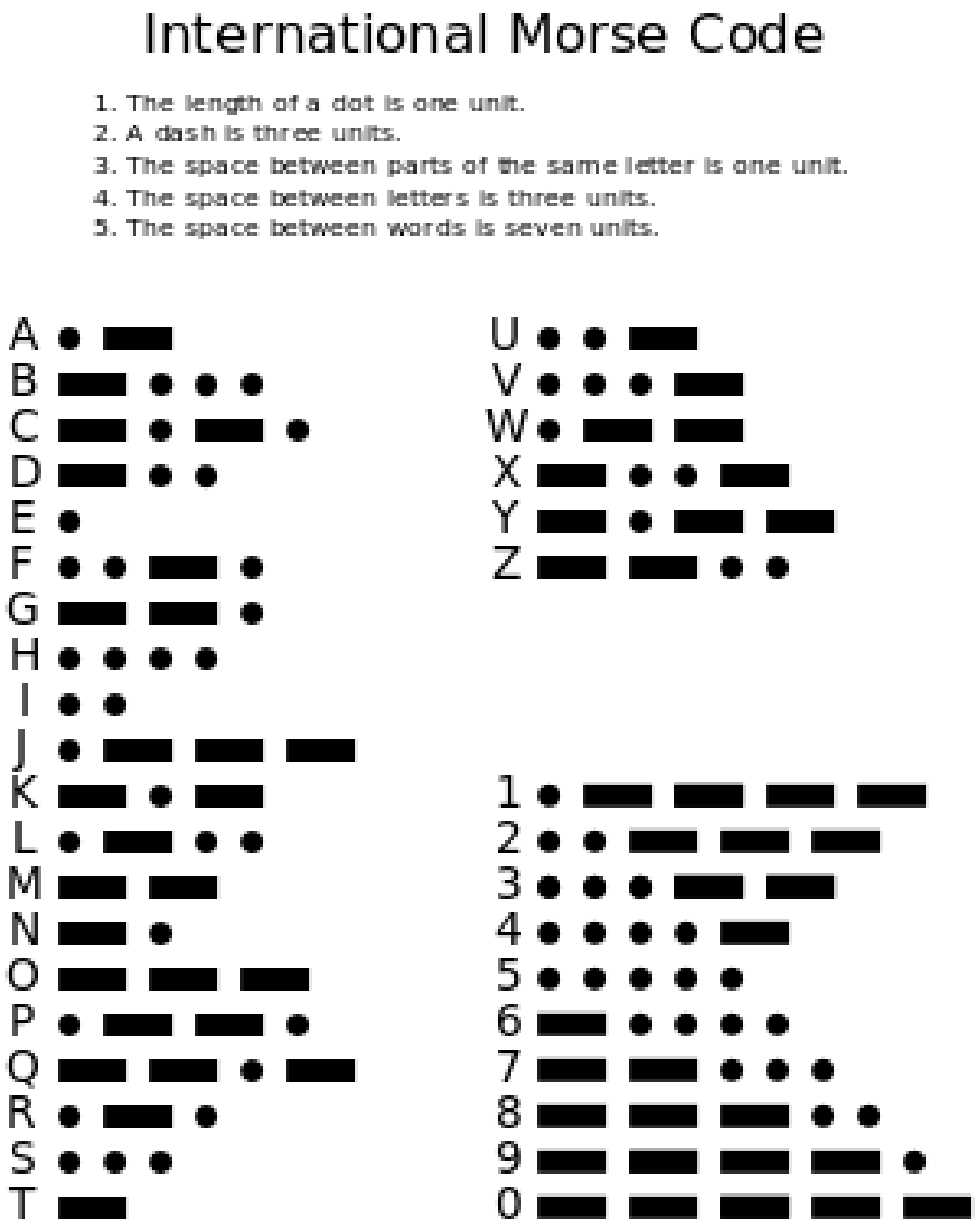
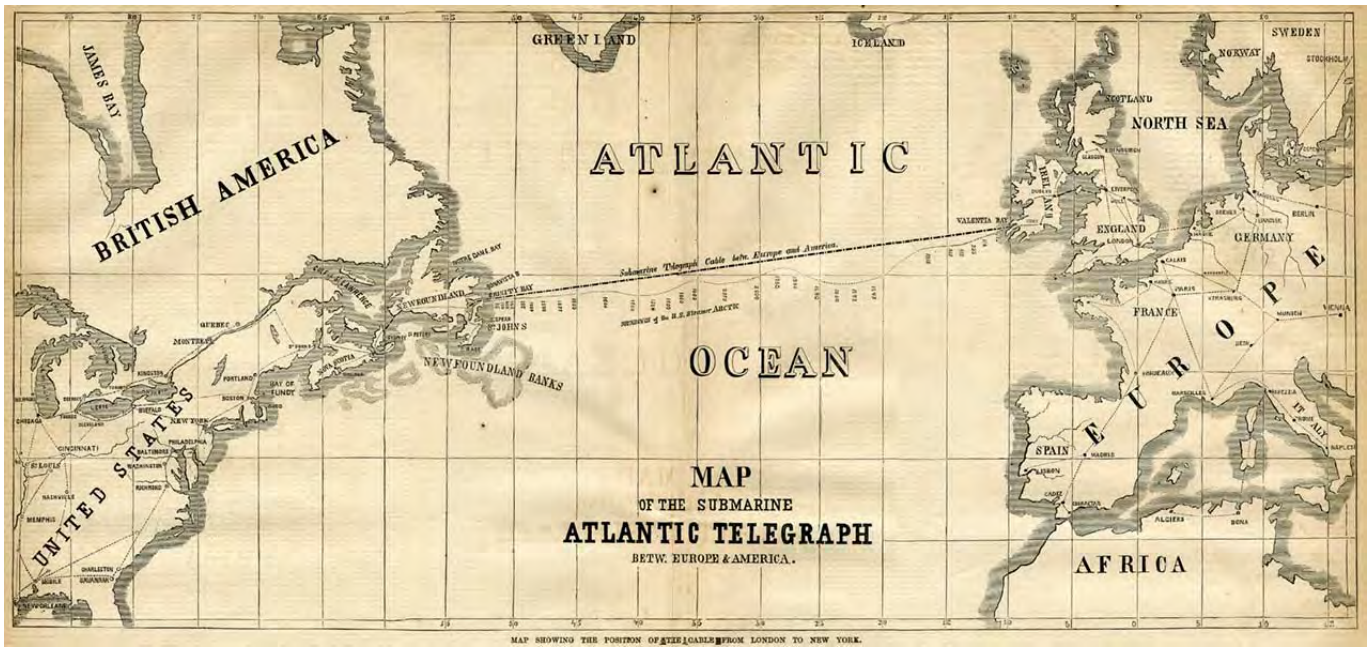


Figure 2.1 The International Morse Code

This was a phenomenal advance at the time. Experienced operators could write and translate the messages being sent and received. The famous SOS signal consists of three dots and three dashes, followed by three dots. A real disadvantage is that different letters and numbers have different numbers of dots and dashes. The most common letter in the English language is the letter "e" and is the shortest code, a single dot. Morse code is still used in certain applications. As of 2015, the United States Air Force still trains ten people a year on how to use Morse Code. The United States Navy uses Morse Code to send messages from ship to ship or ship to shore by means of a flashing light. Unless someone can see the light pulses, it is impossible to intercept the messages being sent from one place to another. Of course, with flashing lights, the sender and receiver must be within sight of each other.

3. 1858 to 1866, The Transatlantic Cable

After several attempts that failed, a Transatlantic cable was run from Ireland to Heart's Content, Newfoundland. It was completed on July 27, 1866. I was unable to find the means of transmitting information over the cable, but I would have to assume it was Morse Code. The cable cut the time for communicating from England to the United States from 10 days to a matter of minutes. Figure 3.1 shows the route of the first Transatlantic cable. Since then, as of 1997, there are over 186,000 miles of underwater cable used in the communications industry. We've come a long way since then. Of course, radio frequency and satellite communication systems are also used for many communication applications.



MAP SHOWING THE POSITION OF THE CABLE FROM LONDON TO NEW YORK.

Figure 3.1 Map Showing the Route of the First Transatlantic Cable

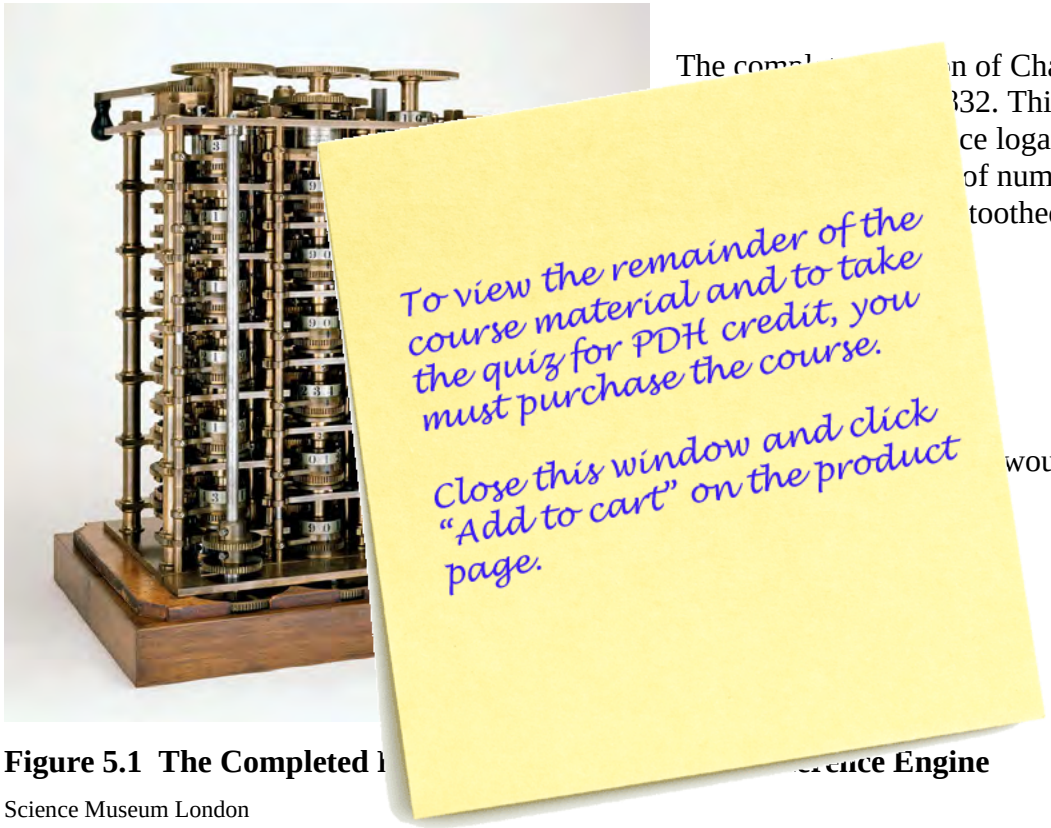
4. 1876, Alexander Bell and the Telephone

While Morse Code made long-distance communication possible, voice communication is desirable in many ways. Alexander Bell started this in 1876. Modern telephone lines allow internet information to be transmitted by digital signals that ride on the audio lines. If you listen carefully, you can sometimes hear the digital information being transmitted over the audio lines. Modems provide digital to audio conversions to allow computers to work over the telephone network. Our engineers just keep getting better and better at digital communications.

5. The First Computers

The word "computer" was first used in 1613 in the book 'The Yong Mans Gleanings' by Richard Braithwaite and originally described a human who performed calculations or computations. The definition of a computer remained the same until the end of the 19th century (about 1900) when the industrial revolution gave rise to machines whose primary purpose was calculating.

The English inventor Charles Babbage is credited with conceiving the first automatic digital computer in the 1830s. It was completely mechanical. It was never completed and only discovered about a century later from some old papers. Figure 5.1 is a picture of the Babbage Mechanical Digital Computer as eventually built.



The compl n of Charles Babbage's 32. This advanced calculator ce logarithm tables used in of numbers was represented toothed wheels marked with

would make any machinist

Figure 5.1 The Completed l ence Engine

Science Museum London