

## **“A Brief 3-Millenia History of Digital Wireless”**

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Telecom has come a long way in just a few short millennia. Communications over distance began as wireless. Lightwave based, or photonics signals, have employed digital code throughout most of this amazing history. Analog was used briefly, but just about everything has returned to efficient digital.

About 3,000 years ago, long-distance messages were sent using a series of signal fires, one after another. A lighted fire was a “1” and no fire was “0”. Paul Revere used better coding with “One if by land, and two if by sea”. While the actual signals traveled at the speed-of-light, relay stations added a big delay, bandwidth was ultra-narrow and daytime messages were a problem. Smoke signals were a clever alternative and they worked in daylight. Coding was easier and rate was higher, but there were obvious limitations. Besides, everyone else could see the signals from these chemically powered transmitters.

Then, a communications genius made a breakthrough when he combined photonics and electronics. His two-way optoelectronic (OE) wireless system modulated an intense beam of light with voice. The analog signal traveled through space to a receiver, often on a ship, and was detected by a new marvel called a photocell. The selenium receiver varied the electrical voltage in response to light fluctuation to power a “speaker” that produced sound heard by the wireless operator. The year was 1880, the source was sunlight and the inventor was Alexander Graham Bell. His Photophone (he considered calling it radio) increased the data rate but distance was limited, a non-passive source was needed and true success would wait for the laser. Bell considered this to be his greatest invention – more significant than his popular wire-constrained telephone.

Marconi and others developed powerful radio frequency (RF) transmitters shortly thereafter. These RF signals could travel great distances and did not require line-of-sight like wireless photonics. Long-distance communications quickly became routine and passenger ships were outfitted with radios. The Titanic sent its fateful message on a Marconi wireless using Morse code - a digital mode!

While RF wireless, especially cell phones, continue to improve using more sophisticated digital multiplexing, photonics also advances. Today, fiberless photonics is used to send broadband data over a few kilometers in metro areas. The economics is often better than for wire, fiber or RF. More data can be packed into a light beam than a radio wave because of much higher frequency (bandwidth is proportional to frequency). These invisible (infrared) data beams don't need licenses from the FCC or other communications regulators. Yes, distance is limited and severe weather reduces rate, but the new digital wireless systems are thriving. Central units are placed on buildings and customers link through small transceivers on the inside of their windows. Someday, your cell phone, laptop and PDA may link to the Internet through infrared beams. Redtooth?

**[Figures: PhotoPhone - Fiberless optics transceiver]**