www.pipelinepub.com
Volume 19, Issue 3

Commercializing Quantum

By: **Duncan Earl**, **David Wade**

From the return of the "Quantum Leap" TV show to the Nobel Prize, 2022 seemed to be the year when "quantum" reached a whole new level in the popular consciousness. In November, EPB and Qubitekk joined that conversation on a more business-minded level with the launch of America's first industry-led, commercially available quantum network designed for private companies and other technologists to run quantum equipment and applications in an established fiber optic environment with the goal of accelerating the commercialization of quantum technologies. So, what are quantum technologies and why do they matter for your company and ultimately your customers?

Quantum-based communications reproduce a naturally occurring phenomenon in which light particles (photons) can be linked or "entangled" such that any change in one of the photons is instantaneously mirrored by its "twin" even when they are separated by great distances. In contrast to conventional computing and networking, which rely on sequential processing, entangled photons called qubits can be used to process multiple parallel paths of data at the same time. And these are just some of the ways quantum technologies hold the promise of breaking through current physical limits on existing computing, networking and sensing technologies.

The power of quantum technologies

Although the full realization of these possibilities will take decades, the development of quantum technologies continues to draw global interest and billions of dollars of investments because we have begun to make real strides in moving toward practical applications that represent groundbreaking possibilities to advance cybersecurity, sensing and next-generation computing. This holds the promise for revolutionary benefits in protecting people from cyberthreats,

launching a next-generation Internet and developing new advancements in healthcare, finance and other industries.

For example, quantum technologies open the door to experiencing augmented reality and the future metaverse in ways that exceed even today's science fiction films. Just think: instead of showing your children your wedding album, they can experience the festivities as you did.

Quantum isn't just a faster version of the Internet. It holds endless possibilities. Imagine modeling new vaccines and medical treatments with the power of quantum computing. Or using artificial intelligence and advanced predictive modeling to enhance your company's competitiveness. Quantum could create more interactive educational opportunities through photo-realistic virtual reality. The speed of the technology could make instantaneous multilanguage translations systems possible. Warnings could be issued before tornadoes, earthquakes, tsunamis and other natural disasters happen. Even gravitational waves could be used to explore the universe. We're only beginning to appreciate the endless possibilities quantum can open.

In this context, protecting proprietary and personal information becomes even more important. Fortunately, through the entangled nature of paired photons, quantum key distribution offers a completely new approach to cybersecurity and threat prevention that eclipses even our best measures today.

And yet, the US is in danger of falling behind other global players in the development of quantum technologies, and this places an even greater urgency on the national priority to make more rapid progress.

One of the current challenges for private companies aiming to innovate in the emerging quantum industry is that foundational quantum networking equipment is expensive and primarily located in government and academic lab environments. As we've seen since the launch of the Internet, some of the biggest gamechangers came from independent entrepreneurs pursuing solutions to some of our most common daily issues. That spirit of innovation and enterprise has been essential to the launch of some of our country's most successful and most recognizable companies. That's what drove us to launch EPB Quantum Network powered by Qubitekk.

Sharing quantum states

If you're familiar with EPB, you know we're a municipal electric and fiber optic utility located in Chattanooga, Tennessee. Given that context, the launch of this new quantum network may seem strange, but this project actually builds on more than a decade of effort.

In 2008, EPB began to deploy a community-wide fiber optic network which would serve as the communications backbone of Chattanooga's Smart Grid, a next-generation electric system to reduce outages, improve response time, reduce theft and help customers manage their electric power usage. With the onset of the Great Recession later that year, the Department of Energy supplemented EPB's initial investment with a $111 federal stimulus grant, allowing EPB to accelerate its 10-year plan for building out the fiber-optic-based Smart Grid such that it became accessible to every home and business in our 600-square mile service area in just two years.

What came next changed the region and prepared Chattanooga for its unexpected role as "Gig City." Utilizing its fiber optic smart grid infrastructure, EPB launched America's first community-wide Gig speed Internet service in 2010. In 2014, DOE named EPB a living lab for Smart Grid Research. Since then, EPB has partnered with Oak Ridge National Laboratory along with other national labs and private companies on a range of efforts to bring research technologies out of the lab and into the real world. Today, EPB continues to build upon Chattanooga smart city infrastructure with a $70 million system-wide upgrade that facilitated the launch of America's first 25 Gig Internet service last summer. All of these efforts also serve as the basis for the recent launch of a new project to help accelerate the development of quantum technologies.

EPB Quantum Network

In 2017, EPB and Qubitekk collaborated to participate in an R&D 100 award-winning effort with Oak Ridge and Los Alamos National Laboratories that ran quantum encryption technologies across real-world fiber optic loops that EPB established between some of its electric substations. Achieving a proving ground of transmitting qubits in a test-bed environment then led EPB and Qubitekk to build EPB Quantum Network powered by Qubitekk^{SM}, a comprehensive quantum network solution.

As a result of this work, EPB Quantum Network integrates a fiber optic infrastructure with the latest foundational quantum equipment and software to accelerate the process for bringing quantum technologies to market. It is designed to generate, distribute and measure qubits on EPB's established 100 percent fiber optic network while:

- Allowing users to maintain their Intellectual Property
- Providing secure individual physical workspaces
- Staffing with expert Qubitekk quantum engineers
- Providing network flexibility to accommodate virtually endless uses
- Maintaining an easily scalable fiber optic network

EPB Quantum Network architecture features equipment hubs that house common-use quantum equipment, with nodes across Chattanooga that will facilitate exchanging qubits across a dedicated fiber optic network. At the heart of the network is Qubitekk's Bohr IV^{TM} platform that provides innovators access to the latest generation equipment and technology to validate their developments, which can be easily scaled to support growing demand, including:

- Photonic qubit sources
- 4 parallel qubit channels
- Single photon counting detectors
- Quantum-compatible fiber optics switches
- Flexible, software-defined network architecture
- Dedicated fiber optic lines for distributing qubits
- Precision timing

Network configuration is designed to be flexible to accommodate multiple uses from validating quantum product performance to testing new quantum technologies and confirming equipment

interoperability to running quantum security applications. This will accelerate the deployment of near-term business applications, provide verification of emerging quantum devices, and support the larger technical goals of the quantum information science community.

Ultimately, to speed the development, adoption and integration of quantum products across the marketplace, innovators, businesses, entrepreneurs, researchers, government agencies and universities must be able to connect to the quantum future. That's what EPB Quantum Network seeks to do by providing a place for public and private sector quantum innovations to be run in an established fiber optic environment.

What's next

EPB's investment in Smart Grid technology continues to demonstrate the future-proof nature of fiber. Quantum networking wasn't on the drawing board when EPB built out Chattanooga's fiber optic network more than a decade ago, but fiber optics continue to keep our community on the cutting edge of networking technology.

Beyond a point of pride for the region and our industry, EPB Quantum Network will support groundbreaking work that will be difference-making for generations. Through the development of new technologies only possible in the quantum age, it will advance new kinds of jobs, new educational opportunities, better healthcare solutions and much more.