ORNL teams with Los Alamos, EPB to demonstrate next-generation grid security tech

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The EPB Control Center monitors the company's assets such as substations and buildings. Credit: EPB

A team of researchers from the Department of Energy's Oak Ridge and

Los Alamos National Laboratories has partnered with EPB, a Chattanooga utility and telecommunications company, to demonstrate the effectiveness of metro-scale quantum key distribution (QKD) as a means of secure communication for the nation's electricity suppliers. This initial milestone is part of the team's three-year project focused on next-generation grid security.

QKD harnesses the inherent randomness of quantum mechanics to authenticate and encrypt data. The technology allows two parties to share a secret "key" and alerts both parties to any third-party intrusion, a critical security capability as more of the nation's grid is modernized and data are moved online.

The goal of this initial demonstration, conducted by ORNL's Nick Peters and Phil Evans, Los Alamos's Ray Newell and Glen Peterson, and EPB's Tyler Morgan, Ken Jones, and Steve Morrison, was to prove the interoperability of disparate QKD systems. ORNL senior scientist Peters said that because utilities are largely regional, providers use a mix of components and have fluctuating upgrade schedules. Ensuring that different utility providers can operate in sync across the nation's electric grid is critical to realizing the potential of QKD on a national scale.

To prepare for the demonstration, the ORNL researchers modified a commercial QKD system while Los Alamos developed its own custom system in-house; both systems generated separate keys that, when interfaced at a "trusted node," or secure information exchange, generated a third key, which was then distributed between the Los Alamos and ORNL systems.

"This demonstration accomplished two things: it showed that different systems can operate together and it established the functionality needed to relay keys over larger distances often encountered on the electric grid," said Peters, leader of ORNL's quantum communications team.

Added Ray Newell, Los Alamos research scientist and leader of their quantum communications team: "Recent demonstrations at Los Alamos have shown that QKD systems can operate on existing electric infrastructure in real-world settings, including during a historic snowfall. Our partnership with ORNL and EPB shows that utilities can realize the benefits of quantum security using a mix of distinct but interoperable communication systems."

Both ORNL and Los Alamos have dedicated many years to developing quantum communications systems, and several technologies developed by the laboratories are currently licensed to industry.

The demonstration took place at EPB, which, according to ORNL's Evans, is an ideal partner because the utility has deployed a fiber optic network in concert with its electrical distribution infrastructure. Besides that, "they are engaged with us on multiple projects for facilitating next-generation technologies to secure our nation's infrastructure," he added.

"For EPB, partnering with Oak Ridge and Los Alamos National Laboratories is an opportunity to field test new technologies and best practices to help maintain the security and reliability of the power grid for everyone in America," said Steve Morrison, EPB's Director of Information Security. "We're honored to do our part to assist the progress of this important effort."

Despite the demo's success, however, there is still work to do. Next, the researchers will work toward overcoming QKD's notorious distance limitations.

Much like electrical resistance reduces the amount of electricity being transmitted as distance increases across traditional power lines, increasing the distance of fiber optic transmissions reduces the throughput of quantum communications. For the nation's electric grid,

increasing the distances over which these QKD systems can effectively be used is critical, and for that the researchers will once again rely on trusted nodes, in this case EPB's electrical substations.

The eventual goal is to implement QKD systems in numerous substations, which are placed at intervals and are capable of relaying the quantum keys. ORNL's Evans compared it to a relay race, in which one runner passes the baton to another, with each runner carrying the baton for a certain interval. By passing the baton at each substation before the signal is lost, the signal is refreshed for the next journey and so on, potentially expanding the range of QKD technology significantly.

Provided by Oak Ridge National Laboratory

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