

Field and long-term demonstration of a wide area quantum key distribution network

Shuang Wang, Wei Chen, Zhen-Qiang Yin, Li-Jun Zhang, Guang-Can Guo, and Zheng-Fu Han

¹Key Laboratory of Quantum Information, University of Science and Technology of China, CAS, Hefei 230026, China

²Synergetic Innovation Center of Quantum Information & Quantum Physics, University of Science and Technology of China, CAS, Hefei 230026, China

Quantum key distribution (QKD) provides an automated way for distributing the key, whose security is based on the laws of quantum physics. QKD allows not only absolutely secure key distribution, but also the key to be updated rapidly. Then, QKD network was proposed to extend QKD from point-to-point configuration to multi-user and large-scale scenario. It allows multiple nodes to be connected securely, and new nodes to access dynamically.

Through sharing communication infrastructures from China Mobile Ltd., the Hefei-Chaohu-Wuhu wide area QKD network provided a secure and stable key distribution platform for subscribers in two cities that are over 150 kilometers apart. Three cities and two metropolitan area QKD networks were linked up to form the wide area QKD network (See Fig.1), in which Hefei metropolitan area network was a typical full-mesh core network to offer dynamic all-to-all interconnections, while Wuhu metropolitan area network was used to simulate a quantum access network. And, two typical applications of quantum keys, including the one-time pad encryption medium for the public switch telephone network and the symmetric encryption virtual private network security gateway, were also developed and tested on this QKD network.

The whole wide area QKD network ran for more than 5000 hours, and even the QCN-USTC part for about two years. The stable operation of the wide area QKD network has proven the reliability and robustness to the field environment. We have successfully field tested the wide area QKD network prototype, and also realized the effective integration between P2P QKD techniques and networking schemes, owing to the following developments: (1) Standardized design of QKD devices to facilitate establishment and maintenance of QKD networks; (2) Resolution of symmetry problem of QKD devices to clear obstacles in the way towards cost-effective technology for QKD, and also convenient to dynamically add new QKD nodes; (3) Seamless switching in dynamic QKD network based on stable QKD systems and networking techniques.

The Hefei-Chaohu-Wuhu QKD network is not only the first wide area QKD network, but also shows significant improvements on the QKD networking scheme and technology. These successes further enhance the competitiveness of QKD network in the field environment. And, results from this wide area QKD network demonstrate that QKD technology actually has the potential to be widely deployed.

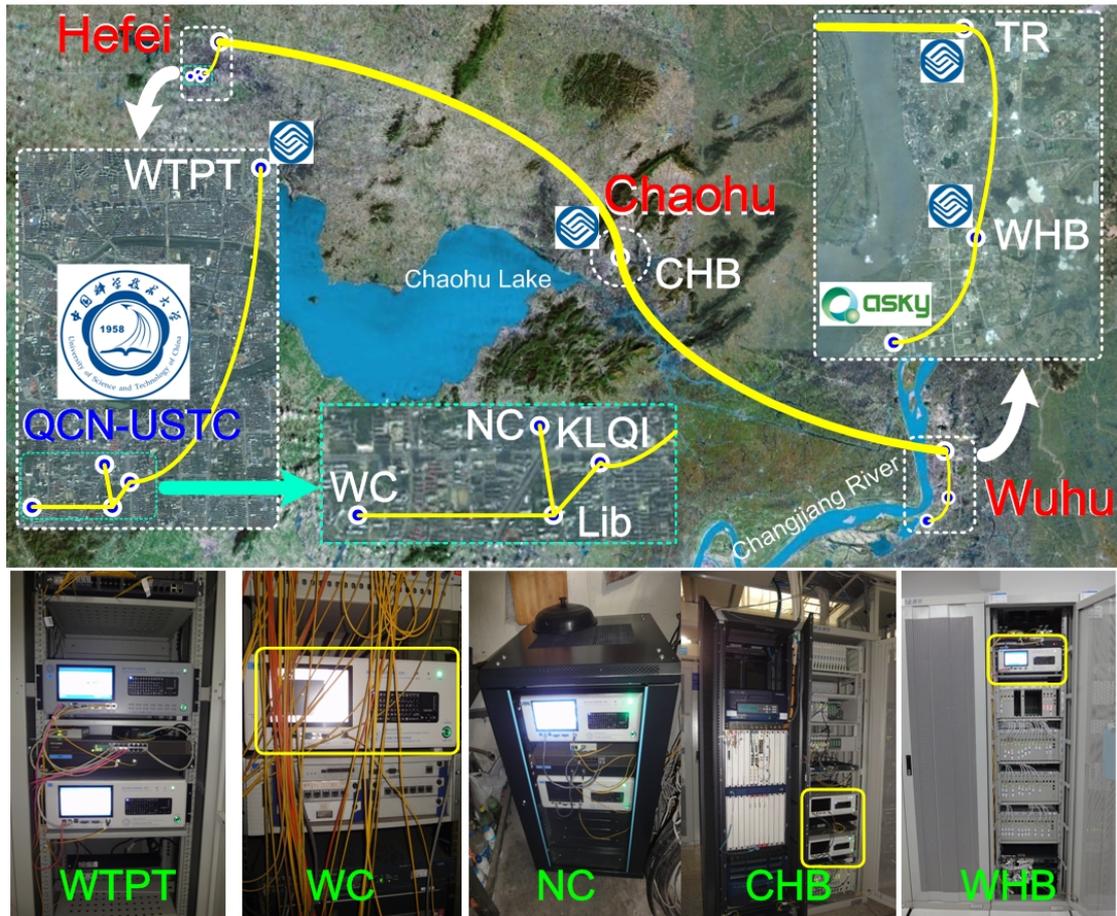


Fig.1 Geographic distribution and photographs of the wide area QKD network. Hefei, Chaohu, and Wuhu are three cities, and nodes WTPT, CHB, TR and WHB are telecommunication nodes belonged to China Mobile Ltd. Nodes WC, NC, Lib and KLQI compose the quantum campus network of University of Science and Technology of China (QCN-USTC).

For details see the following paper:

Shuang Wang, Wei Chen, Zhen-Qiang Yin et al. “Field and long-term demonstration of a wide area quantum key distribution network”, Optics Express, 22(18), 21739-21756(2014).