Building the Foundations for Quantum Industry RFI

Sean(Seunghwan) Kwak

Head of Quantum Tech. Lab, SK Telecom

October 10, 2017

1. Building wired QKD trial network

Quantum information and communication technology is the most remarkable technology in recent years. Globally, quantum computers, quantum communications, quantum sensors, etc. are being developed by many research institutions and companies. And it is hard to say which of these technologies is the most important.

Quantum computers are showing dramatic improvements in recent years. QKD has been commercialized in China, Korea and Switzerland.

The development of Chinese's quantum information and communication technology demands a global revival. China announced the construction plan of a $ 10 billion quantum technology research institute in last month.

South China Morning Post also reported that Chinese will use quantum computers for military cryptanalysis. Even Kim Il Sung University in North Korea is conducting research on quantum computers with the support of Chinese researchers[1].

Professor Michele Mosca of Waterloo University predicted that if the sum of the

[1] "Transport properties of a single plasmon interacting with a hybrid exciton of a metal nanoparticle–semiconductor quantum dot system coupled to a plasmonic waveguide", https://arxiv.org/abs/1601.02559 and more papers from Kim Il Sung Univ. QIS lab.

time which includes development and deployment of the quantum resistant cryptography technology against quantum computers is longer than the quantum computer development period, it will make the big chaos. It is an urgent matter to develop cryptographic techniques that can counteract quantum computers in all cryptographic communication as well as military aspects.

Even North Korea has already completed the development of Quantum Key Distribution system and is known to commercialize it soon[2].

Cryptography technology that can resist from quantum computers are largely divided into QKD and post quantum cryptography. QKD and PQC each have advantages and disadvantages. These two technologies can provide a multi-layered security technology, so they can be complementary rather than competitive.

The United States has attracted more attention to wireless QKD and PQC than wired QKD due to the wide land, lack of optical fiber networks and the disadvantages of wired QKD. However, the high price, which is the disadvantage of wired QKD, and additional dark fiber issues are getting resolved. China, Switzerland and South Korea can be submitted as evidence. They are getting rid of the issue of dark fiber with WDM technology and the wired QKD system is also smaller and cheaper by photonic integrated circuit technologies. South Korea, which has a well-established optical fiber network, is targeting even Quantum To The Home(QTTH) service.

On the other hand, PQC still needs proof to prove that it is truly safe for quantum computers. Moreover, the algorithms of quantum computers are evolving day by day, so we cannot say that the safety of PQC is eternal yet.

Many US components are used in wired QKD systems developed in the mentioned

---

[2] http://www.38north.org/2017/04/mwilliams041217/

countries like phase modulators, polarization controllers, variable optical attenuators, FPGAs, programable delay chips, etc. The US companies already has the key technology like photonic integrated circuit for small and cheap QKD system. This proves that the QKD industry in the US has sufficient potential. For the unconditional cyber security in the US, now we need to pay more attentions to the wired QKD systems which can make the new industry in the US.

To address the threat of quantum computers and to boom up the QKD industry, a wired QKD trial network is needed to be installed in the United States. South Korea and Switzerland are ready to cooperate with the wired QKD industry in the United States.

2. Organization Global Quantum Industrial Partnership

The biggest challenge to be overcome by the industrialization of Quantum ICT is sharing and cooperation among industries. For this, partnerships of interested industries are needed right now.

There has been an industry partnership behind all the technological innovations. 3GPP and GSMA are examples of mobile communication, and OSA is an example of optical communication.

The best APD technology for single photon detectors in a certain country is used only in that country and is not well known around the world. The world smallest and cheapest QRNG chip has been developed in South Korea can make another chance for modern and future cyber security industry in the US for all kinds of communication devices. The sharing of information and cooperation in these technologies can promote the development of the Global Quantum ICT industry with a big synergy.

Quantum information and communication technology has certainly not seen partnership to date. Korea's SK Telecom and Deutsche Telekom have announced the formation of the Global Quantum Alliance at MWC this year[3], but they are not making positive progress and the partnership between AT&T and Caltech[4] is not making any clear progress yet.

Quantum computers are still a fast way to refer to international standards, but QKD is moving toward standardization in ETSI and ITU. However, it can be said that the academic movement is stronger than the industry-oriented global standardization.

When it comes to the international QKD industry, it is time for partnerships and cooperation between companies that are interested in this technology. The partnership of companies interested in QKD can lead the quantum information and telecommunication industry and it will be desirable to expand into companies interested in the quantum computer as soon as possible.

NIST can organize and coordinate this partnership. However, since this partnership is for the industry of Q-ICT, it should be focused on the enterprise and each company should be able to cooperate with schools and national labs. We need to successfully distinguish between basic science and engineering to succeed in the industrialization of quantum information and communication technology.

---

[3] http://www.convergedigest.com/2017/03/sk-telecom-and-deutsche-telekom-launch.html

[4] http://about.att.com/story/beyond_quantum_computing.html