

# Demonstration of Real-time Transmission of Large-scale Genome Sequence Data Using Quantum Cryptography

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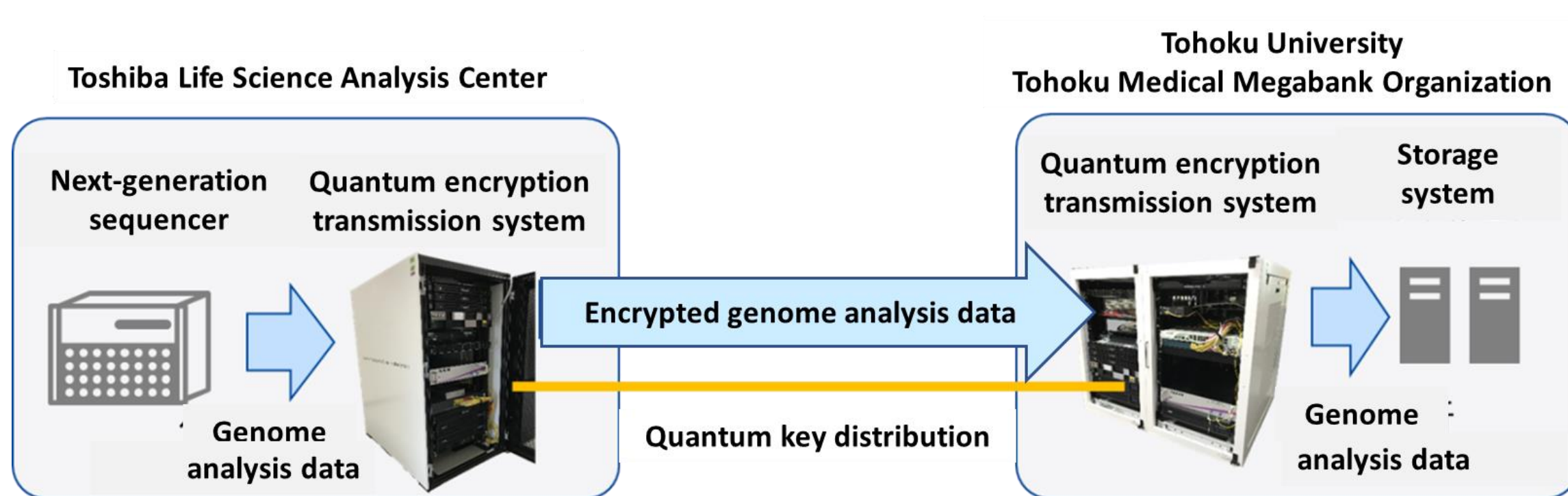
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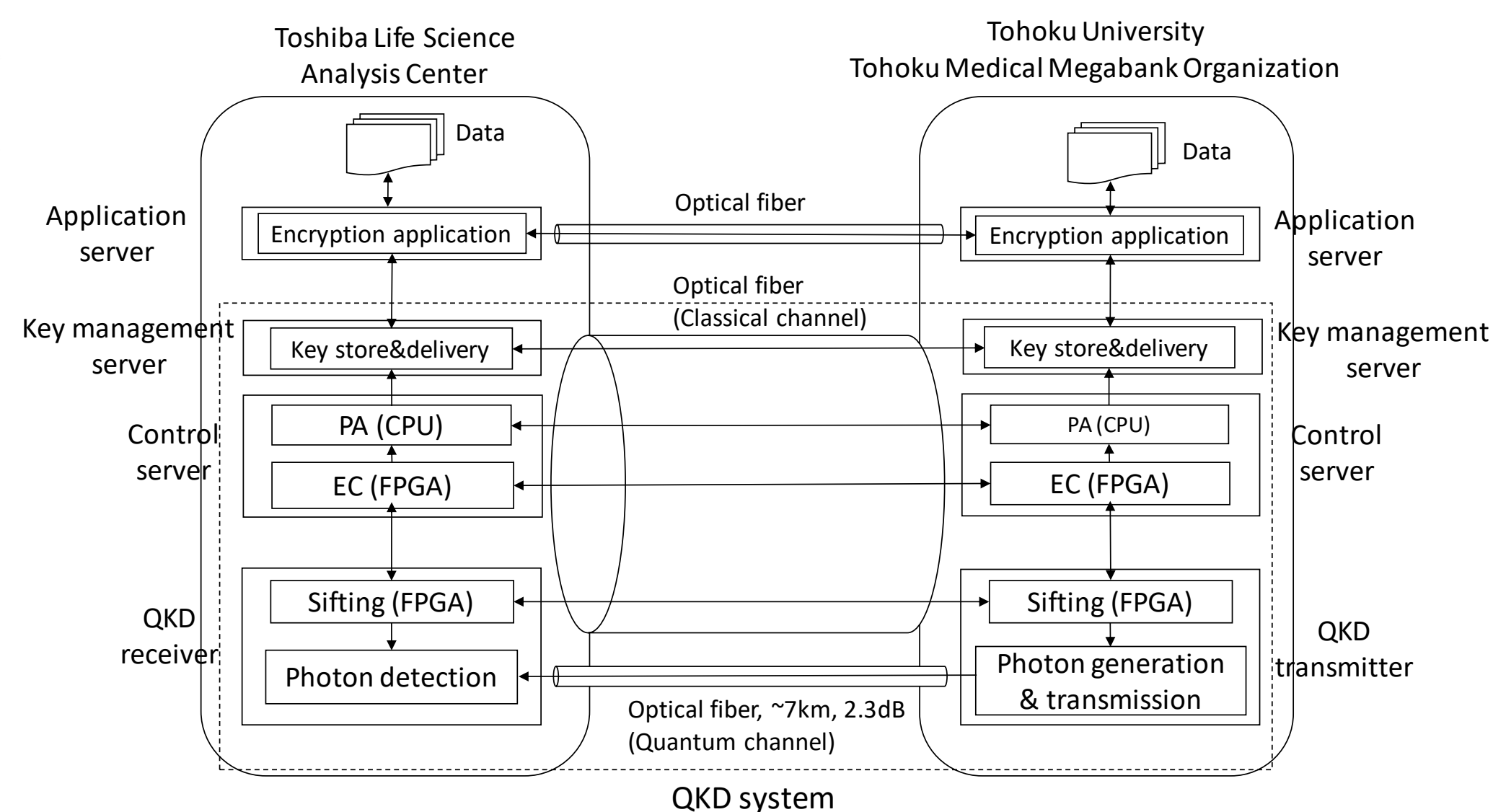
**We developed a system for real-time transmission of genome sequence data using quantum cryptography and have succeeded in the quantum cryptography transmission of genome sequence data with data volumes exceeding several hundred gigabytes. This demonstrated that quantum cryptography can transmit large amounts of data and has practical applications in the fields of genomic research and genomic medicine.**

## Methods



**Overview of the development transmission system for genomic sequence data.**

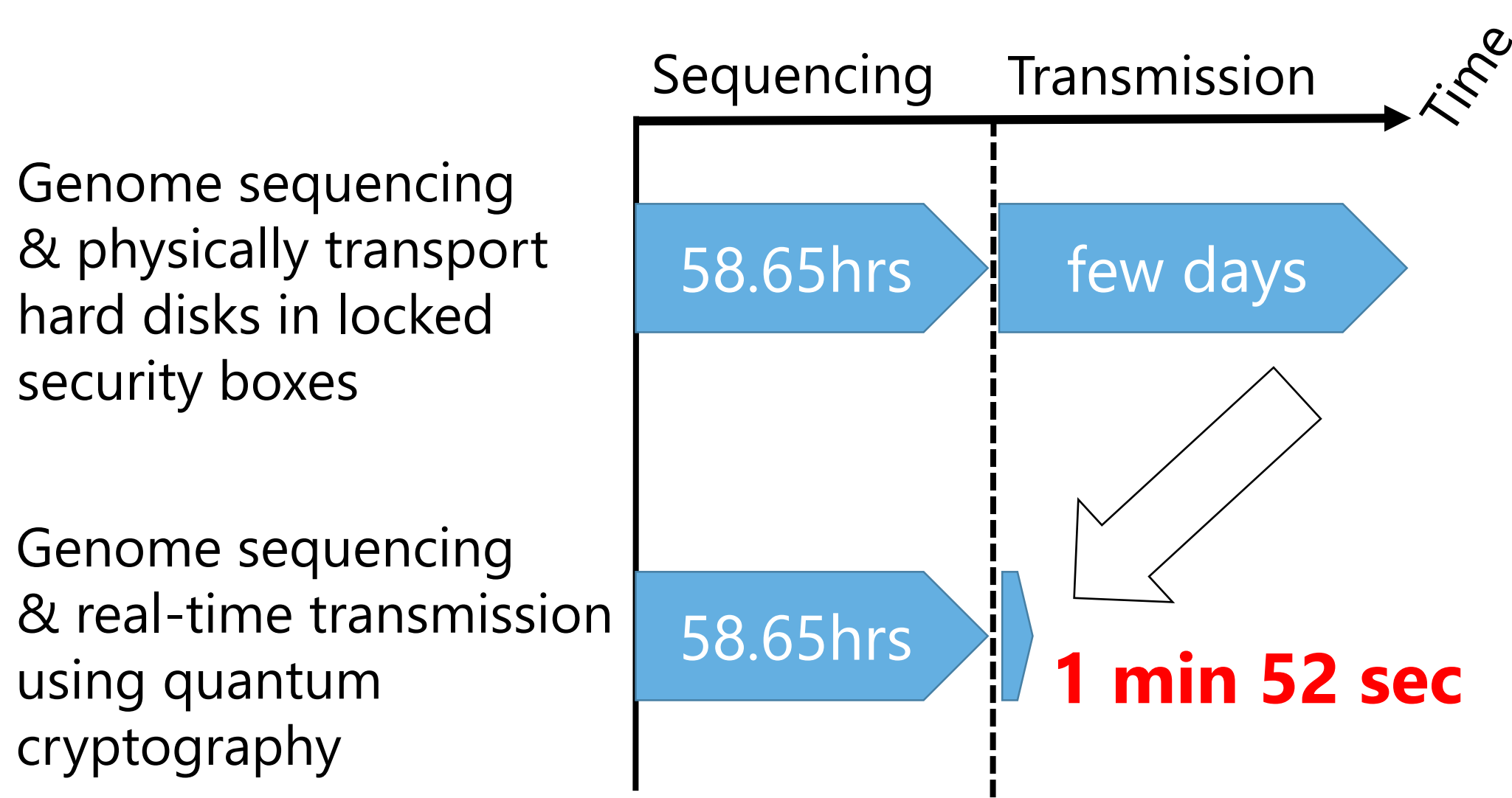
By sequentially transmitting data as it comes out of sequencers, it is possible to reduce delay in transmission processing for the large amounts of genome sequence data



**Schematic diagram of the quantum cryptographic communication system**

Efficient decoy BB84 protocol with phase encoding [1] on installed fibers (2.3 dB transmission loss)

## Results



**Results of 4 trials of transmitting genome sequence data using the quantum cryptography**

#	Data Type	Data size	Encryption	Time
1	Whole-genome	581GB	QKD+OTP	Sequencing 58.65 hrs Transmission 1 min 52 sec
2	Whole-genome	601GB	QKD+OTP	Sequencing 58.93 hrs Transmission 1 min 37 sec
3	Whole-exome	87.7GB	QKD+OTP	Sequencing 29.25 hrs Transmission 3 min 38 sec
4	Whole-exome	91.3GB	QKD+OTP	Sequencing 28.73 hrs Transmission 38 min 32 sec

**Transmission of several genome sequence data with data volumes exceeding several hundred gigabytes was completed soon after completion of analysis while few days using physical transport hard disks**

**Operation summary of the QKD system during 4 trials on installed fibers (2.3 dB transmission loss)**

Period	Average QBER	Average secure key rate	Average sifted key rate	Amount of generated quantum keys
Trial 1&2	3.2 %	9.1 Mbps	35.7 Mbps	1.4 TB
Trial 3&4	3.2 %	7.8 Mbps	33.8Mbps	0.15 TB

**A highly secure key rate was achieved during transmission of genome sequence data.**

### Reference

[1] Z. Yuan et al., J. Lightwave Technol., doi: 10.1109/JLT.2018.2843136 (2018).

### Acknowledgement

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