# Distribution of Single Photons for Quantum Cryptography via an Optical Switch

A single photon is so weak that it cannot be examined for eavesdropping purposes without destroying its current state. Making use of this feature, NTT has demonstrated for the first time in the world that single photons can be applied to quantum cryptography in an optical network. This has been achieved by combining a custom-designed quantum cryptography system developed in collaboration with Stanford University (USA) and an optical switch capable of controlling photons developed by NTT.

Assuming an open optical network environment such as the Internet, recent experiments have shown that (1) interference phenomena can occur even for a single photon and (2) paths can be controlled within a multi-input/multi-output cross-connecting optical switch and that strong, high-bandwidth optical data signals can be transmitted in parallel with weak photons.

The quantum cryptography system used in these experiments was a “differential-phase-shift” scheme. It features:

- Stable, high-speed one-way transmission,
- Key generation twice as fast as existing systems because all received photons are used (no wasted photons), and
- No backscattering noise such as that generated in existing two-way transmission schemes.

When a quantum cipher was transmitted over 15 km of optical fiber with an optical switch inserted halfway, a key-generation speed of about 2 kbit/s could be achieved with a bit error rate of 6%. This is sufficient for creating absolutely safe keys. It was also found that a quantum cipher could coexist with the transmission of large volumes of information within the optical switch, demonstrating that quantum cryptographic signals consisting of single photons can be transmitted over a general-purpose commercial network like the Internet.

Though the results presented here are limited to a transmission distance of 15 km, studies are underway to enhance the optical reception devices and construct a high-speed system so that transmissions can be performed over long distances at high speeds. Research and development efforts are also looking to the broad application of quantum cryptography to future optical fiber networks that will include general users and create highly secure networks.

**For further information, please contact**

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