Flattened Flexible Non-blocking Switching Node with Quantum and Classic Optic Coexistence

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Abstract: Quantum key distribution provides an unconditional physical layer for secure communication.Study on switching and large-scale Networking problems in Quantum Communication could promote QKD communication to industrialization and practical. The current quantum switching nodes can only handle the wavelength of a specific bandwidth and have a strong constraint on the path of the transmission. And the spectrum reuse rate is very low. So it can't meet the demands of build large-scale network. This paper will present a WSS-based flattened flexible and non-blocking switching node that could support quantum communication and classic optical communication at the same time with multi-granularity.

OCIS codes: 000.0000, 999.9999.

1. Introduction

QKD uses non-orthogonal coded single photon states, such as single photon polarization, phase or angular momentum, to provide secure information exchange for two remote users. These all can be transmitted and switched same as classic optic signal in the fiber. So far, the study on point-to-point QKD communication based on fiber-optic links has been quite mature. More and more researchers have turned to large-scale and multi-user QKD communication network systems based on existing optical devices, dnd strive to make QKD communication network and existing optical network one integration. In 2003, Paul Toliver experimented with the optical switching system of the QKD communication based on the 4x4-based 2-D MEMS switch array under the B92 protocol and reached a transmission distance of more than 10 km at the time of the device attenuation of 5.9 dB. But this system can not achieve the singals with the existence of multiple wavelengths in one fiber are transmitted and switched, only can provide signal switching services for the fiber that only contains one signal. In 2010, Shuang Wang et al. Of China University of Science and Technology proposed a wavelength-saving quantum signal switching device composed of a three-port looper and wavelength division multiplexer, and this scheme has lower power loss and higher stability than using active device. However this cheme alse adopted the real-time full connection, increased the complexity of the network, and is difficult to expand. Although the wavelength can be reused, but the reuse rate is relatively low. the schme above two have a certain routing path compared with the using of beam spliter, but neither considered to integrate the quantum network with the existing classical optical network. This paper presents an quantum switching node scheme supporting the coexistence of quantum signals and classical optical signals based on WSS and coupler and providing more flexible spectrum allocation and non-blocking switching for any wavelength with any bandwidth in any input port.

1.1. Typographical Style

Margins and type size will be set by the OSA LaTeX commands for title, author names and addresses, abstract, references, captions, and so on. The `osameet2.sty` package references `mathptmx.sty` for Times text and math fonts. Authors who require Computer Modern font may modify the style file or, preferably, invoke the package `ae.sty` or similar for optimum output with Computer Modern.

1.2. Author Names and Affiliations

Author names should be given in full with first initials spelled out to assist with indexing. Affiliations should follow the format division, organization, and address—and complete postal information should be given. Abbreviations should not be used. United States addresses should end with ", USA."

1.3. Abstract

The abstract should be limited to no more than words. It should be an explicit summary of the paper that states the problem, the methods used, and the major results and conclusions. If another publication author is referenced in the abstract, abbreviated information (e.g., journal, volume number, first page, year) must be given in the abstract itself, without a reference number. (The item referenced in the abstract should be the first cited reference in the body.)

1.4. OCIS Subject Classification

Two Optics Classification and Indexing Scheme (OCIS) subject classifications should be placed at the end of the abstract with the `\ocis{}` command. OCIS codes can be found at http://www.osapublishing.org/submit/ocis/.

1.5. Notation

1.5.1. General Notation

Notation must be legible, clear, compact, and consistent with standard usage. In general, acronyms should be defined at first use.

1.5.2. Math Notation

Equations should use standard LaTeX or AMSLaTeX commands (sample from Krishnan *et al.* [1]).

$$
\begin{aligned}
\bar{\varepsilon} &= \frac{\int_0 \infty \varepsilon \exp(-\beta\varepsilon)\,\mathrm{d}\varepsilon}{\int_0 \infty \exp(-\beta\varepsilon)\,\mathrm{d}\varepsilon} \\
&= -\frac{\mathrm{d}}{\mathrm{d}\beta}\log\left[\int_0 \infty \exp(-\beta\varepsilon)\,\mathrm{d}\varepsilon\right] = \frac{1}{\beta} = kT.
\end{aligned} \tag{1}
$$

2. Tables and Figures

Figures and illustrations should be incorporated directly into the manuscript, and the size of a figure should be commensurate with the amount and value of the information conveyed by the figure.

Fig. 1. Sample figure with preferred style for labeling parts.

Table 1. Sample Table

One	Two	Three
Eins	Zwei	Drei
Un	Deux	Trois
Jeden	Dvě	Tři

No more than three figures should generally be included in the paper. Place figures as close as possible to where they are mentioned in the text. No part of a figure should extend beyond text width, and text should not wrap around figures.

3. References

References should be cited with the `\cite{}` command. Bracketed citation style, as opposed to superscript, is preferred [1–7]. The `osameet2.sty` style file references `cite.sty`. Comprehensive journal abbreviations are available on the CrossRef web site: http://www.crossref.org/titleList/.

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