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# Efficient controlled quantum broadcast protocol using 6$n$-qubit cluster state in noisy channels

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**Abstract**
This article introduces two controlled quantum broadcast protocols which they utilize 6-qubit and 6$n$-qubit (generalized scheme) cluster states as the quantum channel, respectively. The proposed protocols involve Alice broadcasting a defined transition state to the recipients under Charlie's control. Simulations conducted on the IBMQ platform and Qiskit library demonstrate the efficacy of the proposed protocols for random input states and various measurement shots. The impact of different types of quantum noises on the protocol are analyzed, and the fidelity metric is employed to evaluate the quality of broadcasted states over a noisy channel. Furthermore, suggestions regarding security risks and the robustness of the proposed protocols under various attack scenarios are presented in this article.

**Keywords** IBMQ · Noise analysis · Qiskit · Quantum broadcast protocol · Quantum noise

## 1 Introduction

Quantum communication utilizes photons for transferring quantum states between remote places. Quantum teleportation, as an advent field in this area, involves transmitting qubits without physically moving the particles (Kazemikhah and Aghababa 2021). To send unknown quantum states, quantum teleportation relies on the combination of quantum entanglement and classical communication channels. The qubit state is reconstructed at the receiver end, while the initial state is destroyed at the sender end. There are different methods for achieving this, utilizing different quantum channels and resources. Most schemes are established on bidirectional quantum teleportation (BQT) (Kazemikhah and Aghababa 2021; Sadeghi Zadeh et al. 2017; Hassanpour and Houshmand 2016; Mafi et al. 2022; Zadeh et al. 2018; Chen et al. 2020; Sang 2016), but some involve a supervisor called Charlie for controlled transmission of information (BCQT) (Duan et al. 2014; Chen 2015;

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