

# Quantum Communication Bit Error Rate Calibration



## Overview

This paper describes a scheme that determines both the bit- and phase-flip errors (abbreviated as 'BiP') and mitigates them for distributed and networked quantum systems. In this paper, we analyze 12 days of calibration data from IBM's 127-qubit device (ibm\_kyiv), showing the fluctuation of Pauli-X and CNOT gate error rates. We demonstrate that fixed-distance QEC can either underperform or lead to excessive overhead, depending on the selected qubit and the error. Quantum error correction (QEC) comprises a set of techniques used in quantum memory and quantum computing to protect quantum information from errors arising from decoherence and other sources of quantum noise. Superdense coding is a very popular protocol or scheme for quantum communication, which uses entangled qubits. Entangled qubits can also be used to share information using an ALOHA based protocol. Quantum electronics is a cutting-edge field at the intersection of quantum mechanics and electrical engineering, revolutionizing our approach to data processing and communication. Factors like environmental conditions, hardware quality, and signal interference impact QBER.

## Article Content

Quantum Bit Error Rate: Core Metric Defining QKD

Discover how Quantum Bit Error Rate (QBER) safeguards Quantum Key Distribution by detecting tampering and securing global communication.

Rate-adaptive reconciliation and its estimator for quantum bit error ...

The purpose of reconciliation, one of classical aspects of quantum key distribution (QKD) protocol, is to mitigate errors after the distribution of quantum information over a quantum channel. In this paper, a

Calculation of Bit Error Rates for Superdense and ALOHA based

In this paper, we calculate the bit error rates (BERs) of these two entanglement-based quantum communication schemes.

What is quantum error correction (QEC)? | Live Science

Without any additional error correction, the error rate in qubits is roughly 1 in 1,000 versus 1 in 1 million million in classical computing bits.

High error-rate quantum key distribution for long-distance communication

View a PDF of the paper titled High error-rate quantum key distribution for long-distance communication, by Muhammad Mubashir Khan and 2 other authors

Quantum error correction

Classical error-correcting codes that employ redundancy can be mapped to biased quantum codes that correct either Pauli X (bit-flip) or Pauli Z (phase-flip) errors.

What is the Bit Error Rate (BER)?

Signal Modulation Rate: Higher modulation rates imply shorter bit durations, imposing stricter requirements on the transmission channel, potentially

Demonstrating quantum error mitigation on logical qubits

In this work, we propose and experimentally demonstrate the application of zero-noise extrapolation, a practical quantum error mitigation technique, to error correction circuits on...

Quantum BER estimation modelling and analysis for satellite-based ...

In this work, we have presented a simple mathematical model to obtain the QBER of a polarisation encoded satellite-based quantum communication system by analysing the errors

QUANTUM BIT ERROR RATE IN MODELED

The quantum bit error rate is a key quantity in quantum communications. If the quantum channel is the atmosphere, the information is usually encoded in the

Modelling the Bit Error Rate (BER)

The Bit Error Rate (BER) is the number of acceptable errors you are prepared to tolerate. This is typically a number between 0.1 (every 10th bit is

CaliQEC: In-situ Qubit Calibration for Surface Code Quantum Error ...

Our evaluation demonstrates that QECali introduces modest qubit overhead and negligible increases in execution time, offering the first practical solution for in situ calibration in

Evaluations of quantum bit error rate using the three stage multiphoton ...

This work investigates the quantum bit error rate as a function of the optical channel length for quantum communication using the three-stage multi-photon protocols.

(PDF) Bit Error Rate Analysis of Digital Modulation

Performance evaluation of various digital modulation schemes for efficient wireless mobile communication system. International Research Journal

Learning high-accuracy error decoding for quantum processors

Building a large-scale quantum computer requires effective strategies to correct errors that inevitably arise in physical quantum systems 1. Quantum error-correction codes 2 present a way

Suppressing communication errors using quantum-enabled forward

Here, we show how information uniquely available in a quantum measurement can be employed for efficient error correction.

Quantum Bit Error Rate | Download Scientific Diagram

This study examines the potential application of Quantum Key Distribution (QKD) within ultrasonic network infrastructures to enable next-generation secure communication systems.

CaliQEC: In-situ Qubit Calibration for Surface Code Quantum Error ...

To address this challenge, we propose QECali, a novel framework that enables in situ calibration for surface codes. Our evaluation demonstrates that QECali introduces modest qubit

Quantum Bit Error Rate (QBER)

To sum up, the quantum bit error rate (QBER) plays a pivotal role in quantum communication and cryptography. With factors

Quantum BER estimation modelling and analysis for satellite-based ...

The quantum communication channel is considered to be eavesdropped when the signal Quantum Bit Error Rate (QBER) exceeds a defined theoretical limit and is thus considered a figure of

### Optimization of Quantum Error Correcting Code under Temporal

We demonstrate that fixed-distance QEC can either underperform or lead to excessive overhead, depending on the selected qubit and the error rate of the day. We then propose a simple adaptive

### BiP: Bit-Phase-Flip Error Mitigation in Quantum Communications

In this paper, we propose an error mitigation method, called BiP, by fully characterizing the bit and phase flip errors that arise due to noise present in a quantum communication system.

### Bit Error Rate Analysis Using QAM Modulation for Satellite ...

In this paper satellite communication link is established using Simulink tool. The Bit Error Rate (BER) analysis is performed using different configuration of QAM (Quadrature Amplitude

### Performing Digital Bit Error Rate Measurements | Keysight

RF engineers designing RF receivers may not have access to the baseband functionality required to perform coded BER measurements, which can present a

### Stable, low-error and calibration-free polarization encoder for free ...

Abstract Polarization-encoded free-space Quantum Communication requires a quantum state source featuring fast polarization modulation, long-term stability and a low intrinsic error rate.

### Reducing Bit Error Rates in Quantum Electronics: Techniques and

Explore the revolutionary field of quantum electronics, focusing on the significance of bit error rates and their impact on quantum computing systems.

### Quantum error correction

SummaryExperimental realizationOverviewImportant code familiesClassical codes as bias quantum codeEncoding logical qubits into physical qubitsApplicationFurther reading

There have been several experimental realizations of CSS-based codes. The first demonstration was with nuclear magnetic resonance qubits. Subsequently, demonstrations have been made with linear optics, trapped ions, and superconducting (transmon) qubits. • In 2016 for the first time the lifetime of a quantum bit was prolonged by employing a QEC code. • In 2021, an entangling gate between two logical qubits encoded in topological quantum error-correction codes ha

### Bit error rate performance evaluation of different digital modulation ...

This paper describes the comparative analysis of different digital modulation techniques like BPSK, QPSK, 8PSK, 16PSK and 16QAM for four Rayleigh channels which are designed. We also compare

Exponential suppression of bit or phase errors with cyclic error ...

Repetition codes running many cycles of quantum error correction achieve exponential suppression of errors with increasing numbers of qubits.

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For more information, pricing, or custom solutions, please contact us:

Website: <https://www.ourensemeeting.es>

Email: [sales@ourensemeeting.es](mailto:sales@ourensemeeting.es)

Phone: +34 685 473 921

Address: Calle de Alcalá, 25, 28014 Madrid, Spain

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