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Quantum Communication System

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ABSTRACT-

Quantum communication is the new technology which is developed for secure communication, enabling cryptographic protocols and communication channels that can protect from eavesdropping and hacking. This abstract presents an overview of a quantum communication system, which utilizes basic principles of quantum mechanics to achieve secure and longer distance transmission of information.

The main components of quantum communication system are quantum key distribution (QKD), quantum teleportation, and quantum cryptography. QKD plays a crucial role in establishing a shared secret key between communicating parties, this is the main thing in quantum communication system. Quantum teleportation enables the longer distance secure communication by utilizing the things in teleportation. Quantum cryptography ensures that the safe and secure communication, it encrypts the message before sending to the receiver by using cryptographic techniques.

To create quantum communication infrastructure the system integrates those three technologies. It utilizes quantum bits, or qubits, as the fundamental unit of information, employing various quantum technologies such as photonics, superconducting circuits, or trapped ions to manipulate and transmit qubits reliably. Quantum communication system also provides error correction mechanism and noise reduction while transmitting the message.

I. INTRODUCTION

The quantum communication technique provides us a safe and secure communication. Which we can even use for longer distances. It reduces noise and transmits the information. The quantum communication system uses (QKD). (QKD) stands for quantum key distribution. The sender generates the secret key between them. After generating the secret key, they can transfer information securely. A receiver who has the secret key can only eligible to open that message or read that message. If any intruder tries to read the message he cannot read it, because he don't knew the secret key which is generated by the sender and knows only for the receiver. In this way our information will be secure.

Fig.1. Basic secure quantum communication

The second main thing in quantum communication system is quantum teleportation. By using that we can achieve the transfer of message for longer distance. Not only the longer distance we can even achieve the noise reduction. When we transfer the information from sender to the receiver in the air, there might be lot of things which creates the noise. When that noise is generated the important message information might get disturbed with that noise. So, by using quantum teleportation we can achieve this and reduces the noise.

The third main concept in the quantum cryptography. In the quantum cryptography technique we will encrypt the information which is sent by sender to receiver. After encrypting the message it will send the message to the receiver , the receiver can read the message that mean the receiver can decrypt the message who has the secret key. If any intruder tries to read the message he cannot decrypt the message because he did not have the secret key with which we can open the message or to decrypt the message.

II. RELATED WORK

The main aim of quantum communication system is to generate a secret key between sender and the receiver. To generate the secret key we use quantum key distribution technique. To achieve this technique there is one process. At first the sender sends some waves to the receiver. Before sending those waves to the receiver the sender calculates the results of those waves using qubits and quantum physics. Those calculated values will be stored by the sender.

At the time the receiver receives that waves the receiver calculates the values for those received waves. After completion of calculation the receiver sends those calculated values to receiver for the reference. The sender receives those calculated values from the receiver and checks the values of the receiver with the values present near the sender. If both the values matches then the sender decides that the path is correct we can transmit the information.

If any intruder tries to interrupt those waves which is sent by the sender. The waves shape and position will be changed, and when the receiver tries to calculate that waves using quantum physics technique. The receiver will get some other values. After calculating the receiver sends those values to sender. When the receiver compares those values with the values present at the sender it will not match, because the wave shape and position and shape got interrupted and those will give some other values when he calculates that. Then the sender thinks that there is something wrong with the path so, we cannot share the secret key now. It will again try after some time.

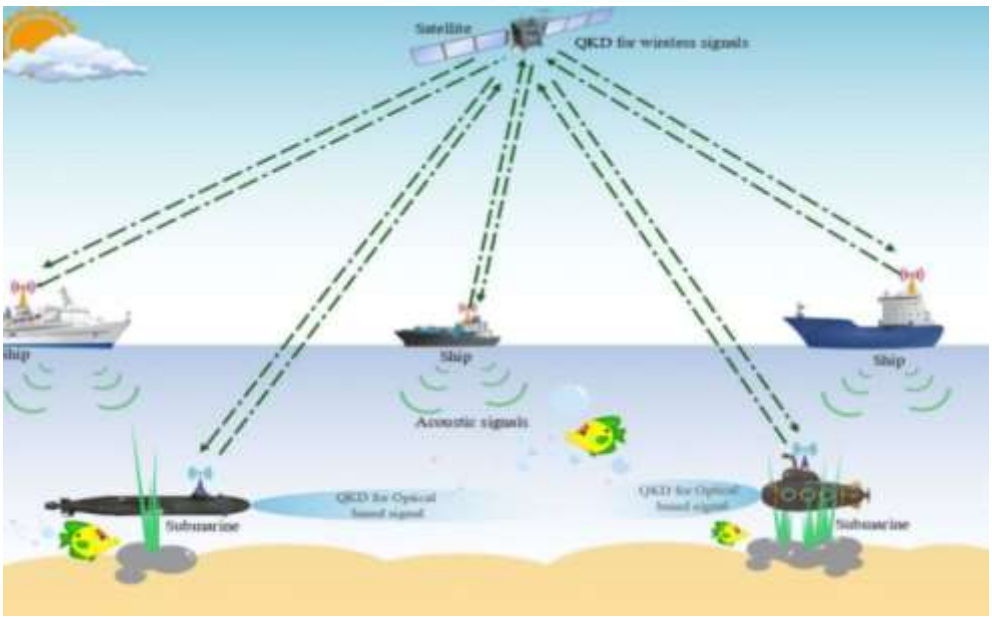

Fig.2. Underwater QKD based communication

If everything goes correct the sender sends the secret key to the receiver. They can use that secret key for the secure transmission purpose. Before the sender need to send some information or message to the receiver the sender encrypts the message. Only the receiver who has the secret key can decrypt the message and read it. If any intruder tries to read the message before it is received by the receiver he might disturbed the qubits. We have one more technology that if any other person tries to read the message in between the receiver know that someone is trying to read the message. This is the very good technology that is present in the quantum communication system. By using quantum communication techniques we can achieve many more things which are useful.

III. PROPOSED METHODOLOGY

There are few proposed methodologies in the quantum communication system.

They are:

a. Quantum repeaters

b. Quantum memories

c. Quantum error correction

d. Key distribution

e. Measurement

a). Quantum repeaters

The quantum repeaters are the critical technology which helps to gain the transmission through the long distance. This helps in amplifying and retransmission of the states. When we need to transmit the message for long distance, it disconnects the old base station and connects to the other base station. This helps in transmission of photons over long distance.

b). Quantum memories

Quantum memories have the capability to store the quantum information for some time. We can store it when we needed. After when we need our information back we can retrieve it. This kind of storing will be done by the quantum memories.

c). Quantum error correction

When the sender sends any message to the receiver the quantum error corrector corrects the message or the information which we are trying to share. The process of error correction is very tough to achieve, because for achieving this we need readability and accuracy for that information.

d). Key distribution

We know about the key distribution very well. The sender generates some quantum waves. Both the sender and receiver will calculate the waves by using quantum physics methodology. After calculating the sender verifies both the results, if that are same then the sender will be ready to generate the secret key and send it to the receiver.

e). Measurement

This is the process that happens during the key distribution. When the receiver receives the photons and calculates. The act of calculating causes a change in the photons so when the intruder tries to measure the photons, sender and receiver will come to know that someone is interrupting our communication. When the measurement occurs the information will collapse in one of the possible way.

IV. IMPACTS AND ADVANTAGES

There are few impacts and benefits of quantum communication system. The first one is unbreakable encryption. As we all know about the quantum key distribution, this provides an unbreakable encryption key. The laws in quantum communication are high, when any intruder tries to measure the quantum states, it will disturb. So that sender and receiver know about the intruder.

Along with unbreakable encryption the quantum communication system also has secure data transmission. In which we can transmit the secure information over long distances. By using quantum states the quantum communication system guarantees that the information which we are transmitting is safe and secure. It will protect from intruder and unauthorized access.

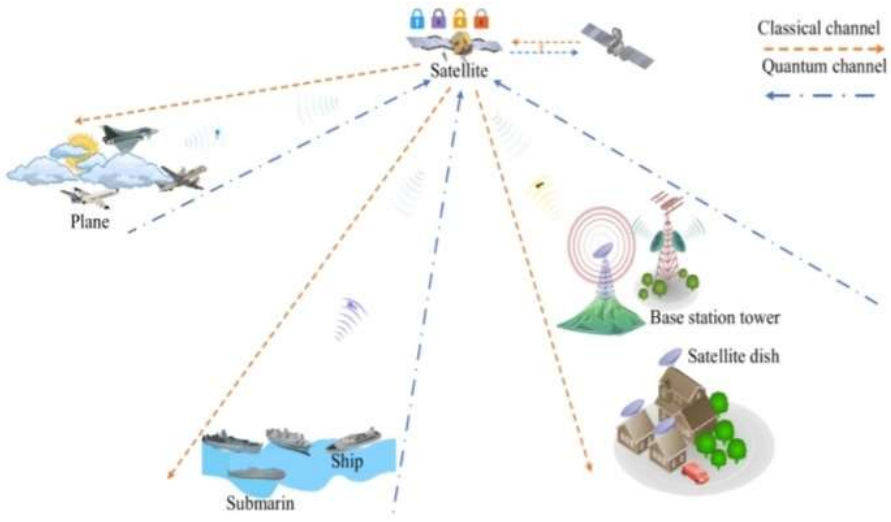

Fig.3. Quantum based satellite communication

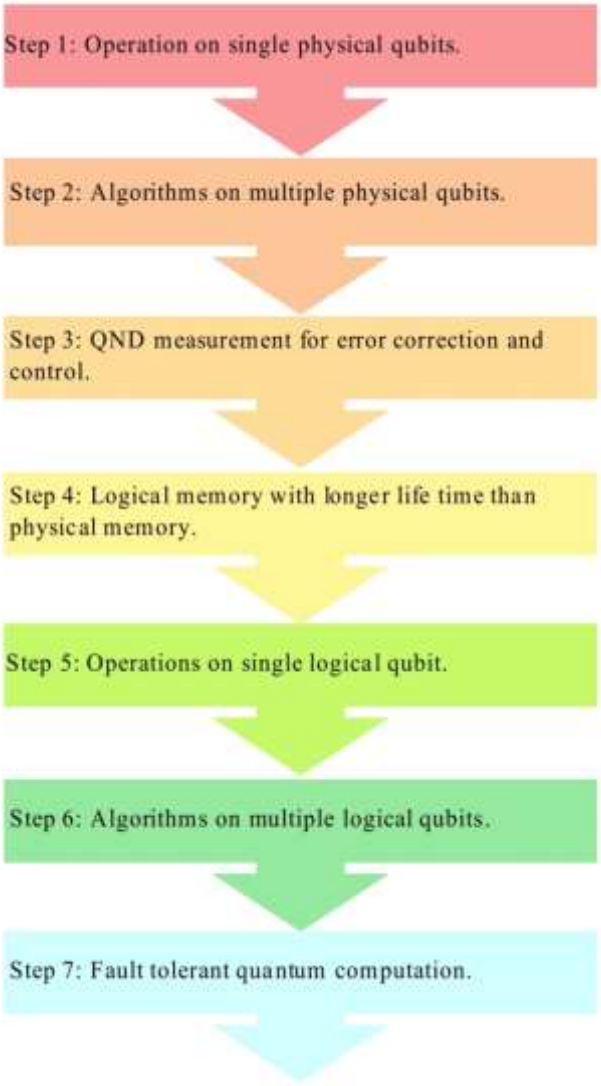

Fig.4. Working principle

It can provide better security for defense and national security. It can provide the best and safe security for military and government. For this type there might be lot of important information which they need to transmit for the others which no one need to interrupt or read the secret information. In that situation quantum communication system provides the better security to the information.

There are quite many advantages in quantum communication system. The main advantage is the security, as we all know that many people need their information to be safe and secure. The second advantage is the speed. It can transmit the information faster when compared to classical communication system. When we compared a lot more we can surely say that quantum communication system transmits the information faster than the speed of light. The other most important advantage is efficiency. There is one thing called qubits, which have the ability to be at multiple places in a single time. By using this the messages can transmit using less amount of energy.

V. APPLICATIONS

The quantum network and internet of things which is used to develop quantum networks, connecting multiple quantum devices and develop safe and secure communication between sender and the receiver. The quantum communication system also used in quantum satellite communication. As we all know that his system establishes long distance communication even globally.

VI. CONCLUSION

In conclusion quantum communication system achieves a great approach among all the classical communication system. This system provides lot of advantages including unconditional security and long distances transmission. Every sender will take care of these things before transmitting the

information to the receiver. So, this quantum communication system has the great approach and are used for military and the government communications which require major security of information and can use everyone in this universe who is waiting for better and safe transmission system.

Quantum communication system is still evolving and experimenting new technologies which it can improve even much better for giving us the secure, integrity to transmit the information. As the field progresses the quantum communication plays a vital role by providing the secure communication and still more advancements in the process.

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