Next Era for Satellite Communication

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Abstract— When we do conversation with our abroad friends, we feel trouble due cutting of voice result of satellite delay of 240 milli seconds. This Document Shows that how can we improve the Satellite Communication by the idea of Higgs Boson to minimize latency and the Quantum Computing to minimize processing and queuing delay. This document also describes the current way of Satellite Communication with a little legacy. We approach this problem by using the idea for carrying data using Higgs Boson particles and Quantum computing to enhance computation at earth stations and satellite.
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1. Introduction

Satellite Communication is a way to communicate through-out the world. There are currently three kinds of Satellites, geostationary orbit (GEO), medium earth orbit (MEO) and low earth orbit (LEO) Satellites. The GEO satellites are three in number to cover the whole world with 120 degree all around the world moving with speed equal to rotational speed of earth so that's why they seem like stationary. But they take a little much time to communicate to computers on earth with minimum latency of 240ms with the speed of light. This is actually pretty large time. But until now, there weren't any advance technology to reduce this amount of time. But in 2012, we've found another idea to communicate through "Higgs Boson" particle. It is said that we can travel a particle even faster than the speed of light[3]. And the other thing that will reduce the amount of time which computer takes like processing and queuing delay. It is possible by using Quantum Computing which we'll discuss later in this document.

1.1 Current Satellites Communications:

The satellites which are around us in these days are just pretty simple and kind of the legacy style; which means that it is the same mechanism which was designed and used originally back in 1958. We're not talking about the exact same thing, but the basics are same, Let me elaborate that even further, it means that the technology have been changed so far, but it didn't changed enough that you could say that it's the next era of Satellite Communication or anything like that. These days, the satellites are of three major kinds which effect all communications within the world. One of them is GEO satellites and the others are LEO and MEO satellites.

We used to say this kind of communication is optical satellite communication.

The optical Satellite Communication is actually a stationary satellite which means that it moves from its place with respect to space and so why it seems like that it doesn't move. This kind of Satellite Communication uses the light speed to perform its communication, which is actually pretty fast. And in this communication the speed of satellite and the spin motion of earth both are equal. This means satellites move with the earth so doesn't change its position.

But the other one which is LEO Satellite is pretty close to earth. So, it changes its position constantly. But there are benefits of both of the satellites. The GEO satellites are only 3 with the distance of 120 degree in each. But the problem is that they are too much at the high position which is about 35,863 km from earth. But the real problem is that if we used to go further than 35000 km's from earth, then we will get the weak signals, and we don't have any other choice like to improve the satellite communication or anything like that. The delay is approximately 0.24 seconds. This delay can be manipulated, it means that if the distance is more, then the delay would be compromised and vice versa.

Solution is MEOs with min delay 77 ms and LEOs with min delay 60 ms, and Quantum Computing and teleportation of data and Higgs Boson (proposed idea) as data carrying particle.

So, why they cause slow-data speed and delay is about 240ms, which is pretty slow. So why Scientists put the other kind of satellites known as LEO and MEO Satellites, which are close to earth and speed-up the data rate and delay becomes 154ms and 120 ms respectively. Which is about half of the GEO

Satellites, but the only problem is that LEO Satellites are pretty costly. They are more in number than GEO, and they are takes more fuel, they all consume energy, use computers, so overall these satellites are pretty expensive. When MEO and LEO change their position, the connected earth base stations have to face connection handover to upcoming in range satellite. Now, this is the current legacy style communication of satellites right now.

1.2 Satellite Major Uses:

There are a lot of major uses of satellites, like we use satellites for internet communication. All mobile phone companies use satellite communications for phone service. Satellite Communication is used for Drones, Air-Plane Flights Communications and for all other Wireless Communications through-out the world[1].

In today's world, it is likely that satellite is the very much major component of all kind of network communications. Without them, we can't communicate anywhere, can't watch live shows, or anything like that. So, let's discuss about their improvements next.

2. How can we improve satellites communication with Higgs Boson?

Higgs Boson was originally discovered in July 4th 2012 and Peter Higgs and Englert won Nobel Prize[9] on Oct. 8th 2013. The Higgs boson named after Scottish theorist Peter Higgs.

"If you were able to manipulate a Higgs field over a large region so that it had energy, it would be gravitationally repulsive. It would cause that region of the universe to accelerate and move things apart faster than light, which is pretty neat," Krauss said[3].

So it may be used as data carrying particle at more speed than light so delay would be minimized. To make satellites faster and more advanced, we can use Higgs Boson model to increase the speed of communication to satellite. Basically Higgs Boson's Speed hasn't out there yet because scientist are working on it and they said that they will confirm it until mid 2013 which is about to come. So, I will publish in later paper.

3. Mathematical Model:

The latest model for mathematical proof for channel of satellite is described in the following fig. 1[8].

$$C = A(f)e^{-j2\pi\phi(f)}$$

$$A(f) = A[a_0 + a_1(f - f_0) + a_2(f - f_0)^2 + a_3(f - f_0)^3 + a_4(f - f_0)^4 + a_5(f - f_0)^5 + a_6(f - f_0)^6]$$

Fig.1 Mathematical model of satellite link channel

Now, the way how we can find the end to end delay of Satellite Communication is this,

$D = t_t + t_{up} + t_i + t_{down} + t_s + t_q$

Where the way to find the delay of satellite communication from earth station to satellite is this,

$t_{up/down}$ = Source Satellite Distance / Speed of Light

So, In Higgs Boson, it will be this,

$t_{up/down}$ = Source Satellite Distance / Higgs Boson Speed

So, this is how we could define the actual speed of satellite communication. By substituting the speed of Higgs Boson the delay will be calculated.

4. How can we improve satellite communication with Quantum Computing?

Now, right now, the Quantum Computing isn't in use in satellite communication. But Quantum Computing is coming in satellite until 2020 which is not a lot of time actually. And even regarding to cnet.com, it is coming within couple of years. Now, Quantum Computing is just the new era of computing, which is thousand times faster than the normal computing.

Now, in these days computing of satellite is traditional semi conductor computing which works in queuing delay in case of bulk of data. So, it simply means that it waste times while processing in queues and connecting to other servers which is a pretty noticeable amount of time, but fortunately, we can reduce it with the help of quantum computing. Quantum computing actually doesn't use to make queues, because even if it does, then those queues will be far much less then the queues are right now. And the other thing is processing power to connect and communicate to other servers and satellites. So, quantum computing can reduce this time too. So, that's another solution. Overall, we can save a lot of time with the help of quantum computing.

4.1 How does Quantum Computing work?

Here's a picture Fig. 2[4] which presents working model of Quantum Computing.

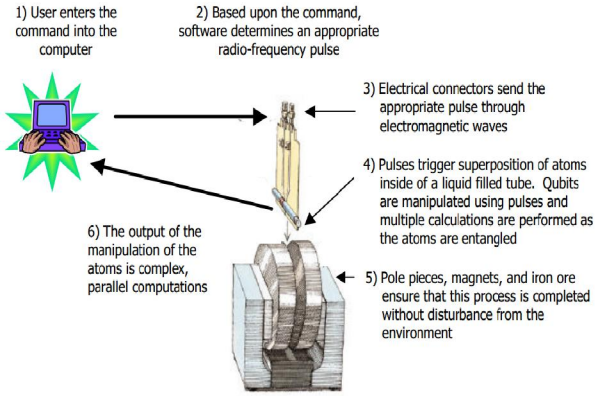

Fig.2 Quantum Computing

Comparison between classical computing and Quantum Computing is as in Fig.3[4]:

Point of comparison	Classical Computing	Quantum Computing
Information representation	A bit: either 0 or 1	A qubit: a superposition of 1 and 0
Number of simultaneous calculations	1	Multiple
Method of calculation	Moving bits through logic gates	Altering states of atoms
Information delivered	Information can be copied without being disturbed	Information cannot be copied or read without being disturbed
Information behavior	One single direction	Spread-out to many routes simultaneously like overlapping waves
Noise tolerance	High: Information can be carried in a noisy channel	Low: The delivering channel needs to be noiseless
Security	Lower: Eavesdropper can break into the communication with high computing power	Higher: Any interruption of communication will be detected by communicating parties
Computation/ Communication cost	Higher as computing or communication volume increases	Lower as computing or communication volume increases

Fig.3 Comparison between classical and quantum computing

4.2 What are the Benefits of Quantum Computing?

There are actually a lot of benefits of Quantum Computing, but here, we're just going to discuss three of them.

1) Increase in computing power,
2) Security enhancements,
3) And the science fiction concept of teleportation.

So, now, let's discuss the concept of teleportation.

IBM promises a ten-bit computer will emerge soon. And also, IBM is the only company which is officially working on Quantum Computing right now, and Quantum Computing name itself has also come from IBM. It is IBM that gave birth to Quantum Computing.

4.3 Mathematical Model of Quantum Computing:

The proof of computing through quantum theory presents the following model from mathematics in following figure fig.4[5].

$$\phi = \frac{1}{\sqrt{2}} \begin{pmatrix} \phi^1 + i\phi^2 \\ \phi^0 + i\phi^3 \end{pmatrix},$$

$$\mathcal{L}_H = \left| \left(\partial_\mu - igW_\mu^a \tau^a - i\frac{g'}{2} B_\mu \right) \phi \right|^2 + \mu^2 \phi^\dagger \phi - \lambda (\phi^\dagger \phi)^2,$$

$$M_W = \frac{v|g|}{2},$$

$$M_Z = \frac{v\sqrt{g^2 + g'^2}}{2},$$

$$\cos\theta_W = \frac{M_W}{M_Z} = \frac{|g|}{\sqrt{g^2 + g'^2}},$$

$$\begin{aligned} \mathcal{L}_Y = & -\lambda_u^{ij} \frac{\phi^0 - i\phi^3}{\sqrt{2}} \overline{u}_L^i u_R^j + \lambda_u^{ij} \frac{\phi^1 - i\phi^2}{\sqrt{2}} \overline{d}_L^i u_R^j \\ & - \lambda_d^{ij} \frac{\phi^0 + i\phi^3}{\sqrt{2}} \overline{d}_L^i d_R^j - \lambda_d^{ij} \frac{\phi^1 + i\phi^2}{\sqrt{2}} \overline{u}_L^i d_R^j \\ & - \lambda_e^{ij} \frac{\phi^0 + i\phi^3}{\sqrt{2}} \overline{e}_L^i e_R^j - \lambda_e^{ij} \frac{\phi^1 + i\phi^2}{\sqrt{2}} \overline{\nu}_L^i e_R^j + \text{h.c.}, \end{aligned}$$

$$\mathcal{L}_m = -m_u^i \overline{u}_L^i u_R^i - m_d^i \overline{d}_L^i d_R^i - m_e^i \overline{e}_L^i e_R^i + \text{h.c.},$$

Fig.4 Mathematical model of quantum computing

And By the Way, here is a wonderful Quantum Computing Quote,

"The nineteenth century was known as the machine age, the twentieth century will go down in history as the information age. I believe the twenty-first century will be the quantum age." – Paul Davies[4].

5. Related Work:

To make the satellite communications better, a lot of work has been done by other peoples too. Like to make GEO Satellite Communications faster, they've made LEO and MEO Satellites, but there are also drawbacks in this idea. Yes, the speed has increased for sure, but the thing is, the cost of these satellites like fuel cost, maintenance cost, satellite purchasing cost and other costs like delay due to orbital dynamics and connection handovers as well. So, in the end, they are pretty expensive.

In [2], total delay of GEO verses LEO with 5 satellites and LEO with 10 satellites are compared. These are 250 to 500, 60 to 420, and 77 to 924 respectively. Which shows that LEO is very expensive.

To make computer fast, they're using a lot of computers rather than one powerful computer which also takes a lot of power which is kind a hard to

provide on satellites and other costs as well. So, with quantum computing, they can reduce as well.

This is what other people have done yet.

6. Proposed Idea

The proposed idea is already discussed in introduction as there are mainly two types of delays in GEO satellite communication; the communication latency and processing and queuing delay. The communication delay will be minimized by using Higgs Boson instead of light but its speed is not yet confirmed by scientists and expected in mid 2013[4] but still not defined. The processing and queuing delay will be eliminated by using Quantum computers instead of classical semi conductor computers. And the next era is of Quantum computers.

7. Conclusion

Now, here we are at the end of this document. The propagation delay and buffering delay have too much impact on overall delay. We've discussed Quantum Computing to minimize buffering delay, Higgs Boson to minimize propagation delay and all about Satellite Communications weather present or future for next era enhancements. Due to limitation of time further research could not be continued although Higgs and Englert won Nobel Prize for discovery of Boson particle on Oct. 8th 2013[9]. Unfortunately the speed of this particle not yet discovered. So we still unable to calculate delay because of less time and lack of advanced research.

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