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VoLTE vs 4G: The Performance Comparison and Causes

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Abstract:- This research paper provides an insight into the performance comparison between VoLTE and 4G. According to 3GPP 4G was introduced to provide better QoS and provide efficient data transfer with high speed using low latency. The VoLTE was firstly launched by Reliance JIO in India in the year 2016. VoLTE had an add on feature over the conventional 4G which was Voice over LTE, which means that the voice would be broken into smaller pieces and will be packed and sent using packet switched services.

This paper focuses on the network they provide in urban areas and their performance. Various tests like SINR and CRT were performed on both the networks to find which one is better and which one needs to improve. As of now in India 4G is provided by many companies like Airtel, Vodafone, etc whereas VoLTE is provided by JIO only.

This paper first presents the challenges and benefits of both 4G and VoLTE and then explores more into their performance related information. The SINR and CRT test proves 4G to be better in most of the terms and it also displays the scope of improvement for VoLTE network.

Keywords:- *3GPP, LTE, QoS, SINR, VoLTE.*

I. INTRODUCTION

The mobile and wireless network technologies have been growing speedily day-by-day. Equipment continues to contract in size and rise in processing speed. The customer usually prefers more advanced and value for money equipment. Hence, capacity improvement is the supreme necessity in wireless communications. The development of mobile services begging from 1G to VoLTE begun as follows:

- **1G**: 1G stands for First Generation introduced in the early ’80s. It was a wireless network which comprised an analog cellular system adjacent with circuit switched network architecture.

It supported only the voice calls and was mainly confronted by low capacity and limited coverage. Due to this the telecommunications sector need an increase in the requirement for high-frequency ranges in order to develop the digital transmission technique from previously used analog transmission techniques.

- **2G**: 2G stands for Second Generation introduced in the early ’90s. This technology came into existence to cover up the capacity requirements by expanding the voice plus telephony, limited data services and text messaging. 2G used a digital transmission system which is capable of squeezing the signal more efficiently and effectively as compared to the earlier analog system and at the same time allows the transferring more packets in the same bandwidth with lesser power.

- **2.5G**: 2.5G was an improvement of the 2G with the added feature that includes GPRS, enhanced radio frequency channels and higher data speed, which is up to 384 kbps. It was named 2.5G as it came after 2G and prior to 3G and it made use of 2G infrastructure only.

- **3G**: 3G stands for the Third Generation introduced in 2000. 3G came after the 2.5G and before 4G. It had higher data speed than the previous 2.5G, it had higher network capacity and more enhanced multimedia access. Firstly launched by the NTT DoCoMo launched in Japan in Oct. 2001 and the first pre-commercial launched by FOMA, in Japan only.

- **4G**: 4G stands for Fourth Generation introduced in March 2008. It was an enhanced system from the 3G. 4G basically increase the download/upload speed, reduces the latency rate and also provides the crystal clear voice calls. 4G is way much faster than 3G. It is designed to provide from four to ten times higher than the original 3G.

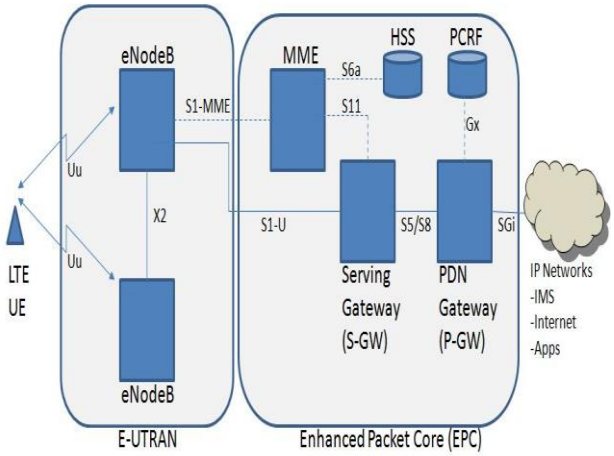

Fig 1:- Architecture of 4G/LTE

- **VoLTE**: VoLTE stands for Voice over LTE introduced in July 2016 in UAE. VoLTE had better call quality than the original LTE. It was a more revised version of LTE as it had an additional feature of Voice over which typically means that the calling would be done using the data pack, in which the voice would be broken up into tiny data packs which would then be transferred using the packet-switched network. Due to VoLTE the battery life of the phone also increased, as it does not have to shift from LTE to 2G or 3G.

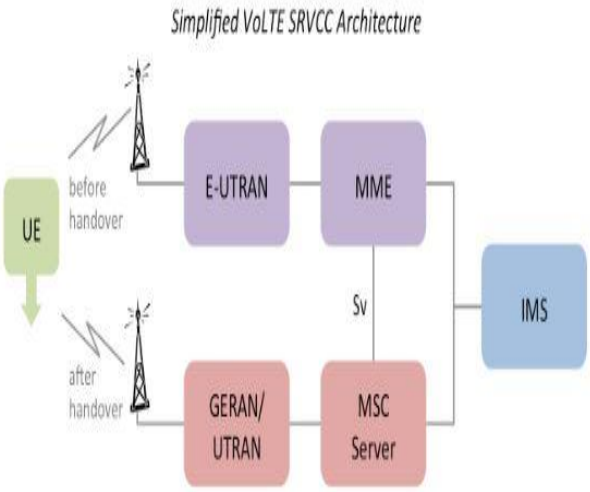

Fig 2:- Architecture of VoLTE

II. BENEFITS AND CHALLENGES OF LTE OR 4G

A. Benefits

- Coverage and Availability: 4G signals have more than 750MHz super frequency, which helps it to pierce to any extent to ensure wider coverage. If the service provider installs properly using advanced technologies it can be made available globally without any barrier to time, place and locations.
- Due to the increased bandwidth, more amount of data can be transmitted which would help to reduce the buffer time while watching any video online.
- With the help of increased download/upload speed, files can be downloaded quickly.

B. Challenges

- Quality of Service: In India, due to the huge population and their diversified needs it is difficult for service providers to provide better Quality of Service. The coverage of the network has a lot of inconsistency in the rural parts of the country.
- Widespread of LTE to rural: In order to increase the customer base of the company, the service providers should focus on increasing their coverage into the rural parts also.
- 4G has to shift to 2G or 3G in order to perform the calling service.
- 4G is not a battery efficient mode, as it needs to shift to 2G or 3G networks.

III. BENEFITS AND CHALLENGES OF VoLTE

A. Benefits

- VoLTE offered great calling quality which was even better than SKYPE4 for HD calling.
- It meets the demand for more reliable services.
- VoLTE can set up the call in very less time as compared to 4G.
- VoLTE does not need to shift to 2G or 3G for calling so it helps to reduce the battery usage.

B. Challenges

- A key challenge for VoLTE is to increase the coverage area in order to provide the services to more customers.
- To ensure proper feedback the quality should exceed the expectation.
- The calling would not be possible without the internet as it uses data pack to make calls.

IV. COMPARISON BETWEEN VoLTE AND LTE BASED UPON SIGNAL TO NOISE RATIO

Signal to Noise Ratio (SINR) is a very important metric when we measure the performance. Signal to noise ratio means that the ratio of the strength of any signal which is carrying information to that of unwanted disturbance.

The minimum SINR in poor quality is anything less than 7dB, Anything between 7dB to 10dB is considered fair, and if the SINR is between 10dB to 12.5dB then it is considered as good. In order to attain Excellency, the ratio should be greater than 12.5dB.

As we can observe in the fig. below the SINR for VoLTE is mostly below 10dB except for one time when it reaches 30dB. This test is conducted under various environments on the basis of time duration. The VoLTE's SINR graph suggests that the VoLTE is performing fair in accordance with the determined set of goals for SINR.

Fig 3

In Fig. below the LTE network performs mostly between 10dB to 20dB which shows that the performance of LTE is above the excellency level as anything above 12.5dB is considered as excellent. This test was conducted in accordance with the time and under various

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environments. To make the test effective we have used various different methods.

Fig 4

The fig. below shows the comparison between LTE vs VoLTE, which clearly shows the better QoS delivered by the LTE. The more the SINR, the better the QoS. The VoLTE perform fairly in this test whereas the LTE perform exceptionally good in this test.

LTE performs well in SINR test as it uses 4G for internet and 2G or 3G For calling whereas in VoLTE the data is only used for calling. As they have more network issues their signal connectivity is very low and due to which the SINR is very low for VoLTE. Whereas for 4G the SINR is high as they constantly shift upon various other networks like 2G or 3G in order to provide the customer with the better Signals. But this frequent conversion consumes the power of the equipment at a higher rate.

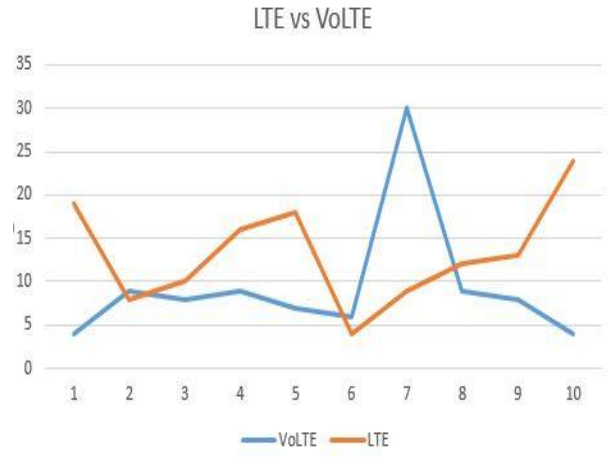

Fig 5

These tests were performed using Cellmapper application using android phone. Tests were performed in the same environment using same equipment's for both the networks. Cellmapper is an application found in play store and they also have a website for the same. Cellmapper records and monitors the cellular network information. It supports GSM, UMTS, CDMA, LTE and LTE-A.

V. COMPARISON BETWEEN VoLTE AND LTE BASED UPON CALL SETUP TIME AND RELIABILITY

In this test equal number of calls and the same route was taken for both the services.

The calling was done through the same mobile only which were mobile or stationary except for the railway test in which one mobile was on the train and the other one on the highway. The below figure shows the call setup time conducted in various environments.

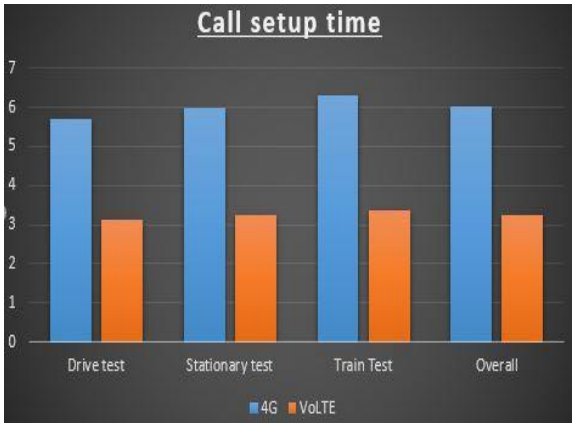

Fig 6:- Call setup time for mobility and stationary tests.

VoLTE is better in setting up the call then the conventional 4G network. The average setup time is 3.2 seconds, which is very much better than the conventional 4G network. The calls were considered as successful call if the call is successfully maintained for at least 2 minutes time during the test. This helped us to compare the reliability between VoLTE and 4G in both stationary and mobile cases. The result of the reliability is shown in the below figure.

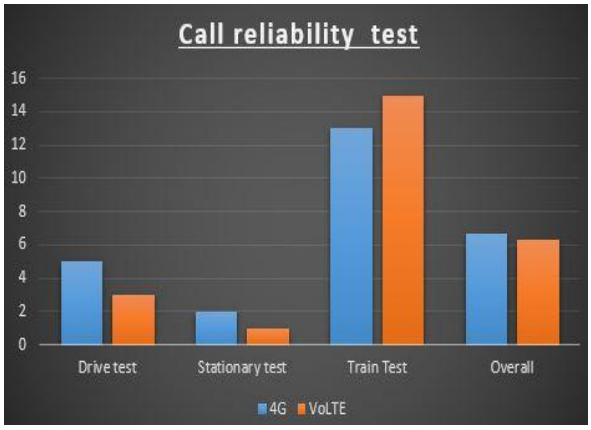

Fig 7:- Call reliability for mobility and stationary tests.

VoLTE showed better call setup time but the call drop or call failure rate was higher in the VoLTE network which is yet to be improvised by the service providers. Whereas the 4G took more time to set up as it had to shift to lower network but it had lesser call drops and call failure rate due to the better coverage area.

This tests were performed using the android phone. No special application was used to test the call setup or reliability test. Tests were performed in the same environment using the same equipment's for both the networks. This test show that currently the VoLTE is not as reliable as the 4G for calling services due to their network issues. But at the same time it proves that the call setup time for VoLTE is better than the 4G.

VI. CONCLUSION

In this paper, we presented a detailed study about 4G and VoLTE with focus on their benefits, challenges and performance analysis in real network deployment. We considered both mobility and stationary test measurement to gather real-time data from the network. The average SINR rate was 9.4dB for VoLTE whereas for the 4G it was 24dB. Finally, the call reliability and call setup time for VoLTE and LTE calls were analysed. Test results indicate clearly that VoLTE shows an improvement in call setup time while the number of call drops are higher than in 4G technologies. We also noticed that the call drops in the VoLTE were due to the lack of the coverage area that they cover. Whereas in the 4G if the network lag is observed then it quickly shifts to the 2G data making the call drops lesser in number in comparison to the VoLTE provider as they do not have any infrastructure of 2G or 3G network. As of now the 4G network can be considered best in the terms of calling whereas VoLTE is the best for streaming videos and surfing the internet. During these test we also analysed that the equipment having 4G as the network consumed more power than the equipment using VoLTE, as the 4G constantly keeps on switching to various other networks like 2G or 3G in order to provide the best signal to the customer. The 4G shifts to the best signal as per the customers' requirements.

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