

## Survey of VoLTE Services: Jio versus Other Service Providers

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**Abstract:** 4G wireless standard, Long Term Evolution (LTE), promises to guarantee delivering of band-consuming applications. In this context data-based services as web browsing with equipped video and video streaming are the most requested services by end user. In order to be able to use all LTE innovative features, Mobile Network Operators (MNO) need to also guarantee both an opportune Quality of Service (QoS) both an acceptable Quality of Experience (QoE) perceived by end user. End-to-end approach for QoS is strongly recommended not only for data-based services but also for delay sensitive services as Voice over LTE (VoLTE). This paper first presents an overview on VoLTE, and then explores the comparison between Jio and other service providers.

**Keywords:** VoLTE, CSP, end-to-end QoS, LTE, UMTS, CSFB

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### I. INTRODUCTION

Telecommunication technologies are characterized by an impressive growth rate in the last years. Number of worldwide mobile subscriptions was 7,100 in 2014 and 7,400 in 2015. It is expected to be around 9,100 by 2021. [1] In particular LTE mobile subscriptions passed from 500 million (2014) to 1,000 million (2015) and it is expected to reach 4,100 million by 2021 with a 25% CAGR. From a traffic point of view, total monthly mobile data traffic was 3.2 EB/month in 2014, it reached 5.3 EB/month in 2015 and it is expected to be around 51 EB/month by 2021, with a 45% CAGR. From a traffic point of view, band-consuming applications as web browsing with equipped video and video streaming are the most requested services for end user. Long Term Evolution (LTE) technology for 4G wireless systems promises to satisfy this massive request for bandwidth and throughput. LTE is the first 3GPP cellular standard full IP-based. It is able to offer to end users a download data rate up to 100 Mbps and an upload data rate up to 50 Mbps [2].

VoLTE operators have the most competitive freedom with the lowest risk, as shown in Figure 1. They can deliver the new mobile voice, add video and messaging, and converge with the web through Web Real Time Communications (WebRTC). They can partner with application providers by delivering the best user experience at the lowest cost per bit, and they can mainstream application developers' innovation into communication services. They can experiment with new communication features that enliven adjacent markets, such as the web, or rapidly customize features for strategic industries such as mobile healthcare. Regardless of where technology, regulation and competition take the industry in the coming years, VoLTE operators' investment enables them to act decisively.



Figure (1) VoLTE - New mobile services

### II. VOICE over Long term evolution

#### 2.1 Overview

Voice over LTE or VoLTE is a GSMA profile of the standard definition of the delivery of services currently provided via Circuit Switch networks - mainly voice and SMS - over the Packet Switched only network of LTE, leveraging the core network IP Multimedia Sub-System (IMS). When mobile networks deploy LTE radio access technology, conforming to the VoLTE profile provides operators with the assurance of interworking between their LTE network and the devices that connect to it, as well as providing the expected user the experience of voice Multi-Media Telephony service and SMS.

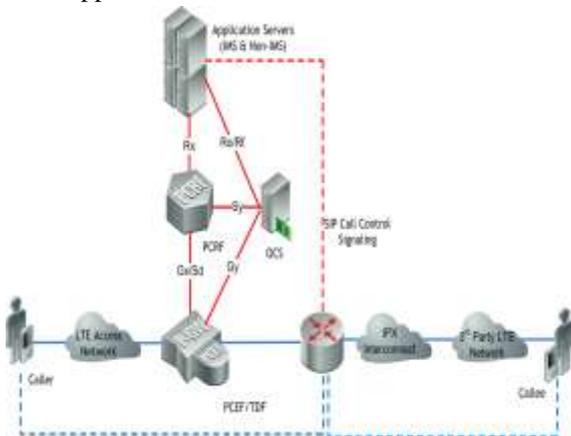
In combination with Policy Control, IMS provides the required QoS appropriate for voice service using LTE radio access technology, thereby providing the user experience of voice calls that the subscribers expect. Moreover, VoLTE is designed to fully integrate with the existing user experience that is currently implemented in circuit switched voice devices. Therefore, even the call is a circuit switched call or a VoLTE call, it is transparent for the end user.

The Policy and Charging Rules Function (PCRF) is the key network element that enables the transition to and reliable

operation of VoLTE services; to enable VoLTE the PCRF must include a number of conditions, and early generation PCRFs may fall short. For their part, CSPs are aware that additional investment may be necessary: Heavy Reading reports that more than 70 percent of service providers believe they will need to upgrade or replace their existing data PCRF to handle the rigors of VoLTE.

### 2.2 General architecture

In the VoLTE the most important part is the VoLTE UE, LTE component including E-UTRAN and EPC, the IMS part including CSCF: Call Session Control Function that have three entity P-CSCF ( P for Proxy), S-CSCF ( S for Servin) and the application server that include Telephony and SMS application server.

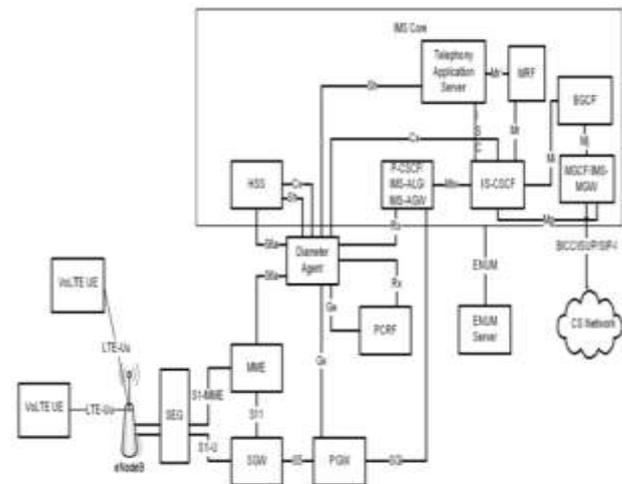


Figure(2) VoLTE architecture – two networks

### 2.3 Logical Architecture:

Since LTE is fully IP-based wireless standard, it only enables entire wireless transmission over Packet Switching (PS) paths using Internet Protocol (IP) protocol as network protocol. All applications delivered over LTE systems are IP-based, included voice applications as Voice Over LTE (VoLTE) [3],[4]. In case of VoLTE application (Fig. 2), the LTE system integrates IP Multimedia Subsystem (IMS) [5] [6]. It means Session Initiation Protocol (SIP) is used as VoLTE Signaling Protocol [7]. LTE logical architecture supporting VoLTE service is shown in Fig. 3. It is composed by four main sections: VoLTE User Equipment (UE), Evolved Universal Terrestrial Radio Access Network (EUTRAN), Evolved Packet Core (EPC) and IMS Core Network. UE is user's terminal, while E-UTRAN section includes eNodeB. EPC includes Serving Gateway (S-GW), Packet Data Network Gateway (PDN-GW), Mobility Management Entity (MME), Policy and Charging Rules Function (PCRF). IMS Core Network nodes are: Home Subscriber Server (HSS), Interrogating Call Session Control Function (I-CSCF), Serving Call Session Control Function (S-CSCF), Media Gateway Control Function (MGCF), IMS Media Gateway (IMS-MGW), Media Resource Function

(MRF), Telephony Application Server (TAS), Border Gateway Control Function (BGCF).



Figure(3) Logical Architecture for VoLTE Services[9]

### 2.4 Benefits of VoLTE

For both subscribers and network operators, VoLTE offers major benefits. An independent research study by Signals Research Group analyzed VoLTE performance in a commercially active VoLTE network with visibility of radio access, core and IMS, including the primary VoLTE functionality. The report evaluated call setup time, reliability, quality, the network resource requirements, and the impact on device battery life. The study produced the following insights:

- VoLTE call quality greatly exceeded that of 3G circuit-switched voice and was measurably higher than the HD voice service offered by Skype4.
- With network loading (i.e., lots of competing traffic), and in particular with background applications running on the mobile phone and transferring data with the network, the VoLTE results were considerably better than Skype.
- VoLTE call setup time was nearly twice as fast as 3G Circuit Switched Fallback (CSFB) call setup.
- VoLTE used substantially fewer network resources than Skype voice, which in turn resulted in longer estimated device battery life for the subscriber and a more efficient network for CSPs.
- When leaving LTE coverage, VoLTE calls were successfully handed over to 3G circuit-switched voice, ensuring calls continued without interruption.

Ultimately, then, subscribers benefit from a high quality of experience and improved device battery life, while operators enjoy greater delivery efficiency and happier subscribers.

### III. JIO v/s other service providers

With its next-generation 4G LTE and VoLTE services, the telecom operator aims to offer high speed internet and content services at affordable prices. Reliance Jio is grabbing all the headlines for its disruptive pricing of voice and data services. The company announced that all outgoing voice calls will be free for lifetime. And when it comes to data tariff, you get 1GB of data for Rs 50, which is the lowest in the world. Weeks before the official launch, incumbent network operators such as Airtel and Vodafone had already started feeling the heat and dropped their data prices by offering up to 67 percent more data. We compared the data tariff of Reliance Jio with Airtel and Vodafone in Mumbai, and here's how they fare.

#### 3.1 How Jio differs?

To understand how Jio 4G differs from other 4G, we need to understand a little about these companies.

Other companies that are currently venturing into the 4G space in India like Airtel, Vodafone, Idea etc are incumbent network operators. That means they already have 2G/3G networks in place and have been major telecom players in the market for quite some time. So for all of them 4G is a value addition to their existing telco networks and telco infra. They already have had the fibers, last mile connectivity and towers laid out. They only needed to upgrade their existing infra to support 4G eNodeBs and core network.

On the other hand Reliance Jio, is a greenfield player. It doesn't have any existing network infra to build its network upon, so it has to do everything from the ground up like setting up the fiber cables, the towers, the backend core network, etc. And since it has only decided to venture in 4G+ telecom technologies, it doesn't have the burden to support aging technologies like 2G/3G. Of course, this means that unless they launch PAN INDIA, initially they include might have to rely on some kind of agreement with other operator to provide roaming in the radio pockets.

So on first look it might look like the incumbent operator have an advantage over Reliance Jio due to their in place infra, but this is not true.. Now 4G, unlike aging 2G/3G technologies, is a IP only network, that means from your voice to video to data to everything else goes over IP. And on top of that this network type has set high data speeds requirement to be called as 4G. So one can just imagine how much bandwidth is actually needed to sustain a 4G network at full pace. Now incumbent players already have their fibers in place, true, but those fibers were laid out with keeping the 3G data requirements in mind which is like 10 - 20x slower than that of 4G data requirement. And on top of data, now 4G networks need to support Voice over IP for HD Voice too. This is where Reliance Jio has the major advantage, since its starting telecom technology is 4G, it

exactly knows how much bandwidth it should aim for its fiber backbone in order to support at least 1-2 future telecom network generations. That has lead to deployment of fibers with massive bandwidth (about 10 - 20x massive). Incumbent operators use cables with 12-24 fibers where as Jio is using cables with 288 fibers (96 fibers at few places with low requirement).

Not only this, they have made sure that they have the largest fiber backbone in India (2.7 lakh km compared to 2.01 lakh km for airtel, 1.9 lakh km for RCOM and 1 lakh km for Idea.

Now coming to the radio network, we know that 4G in india in going to be offered in 3 bands initially (850MHz, 1800MHz, and 2300MHz) and 700 MHz to follow in future and only RJIO has PAN india license in 2300MHz and from market experiences, regardless of what other operators are trying to convince subscribers, 2300MHz is the game changer in the 4G space and other network operators are just afraid of it. RJIO also has 1800MHz and 850MHz but they will be used only as backup when you fail to get a good 2300MHz signal. With the various studies it is concluded that 2300 MHz has poor penetration then 850/1800MHz due to being running on FDD will better penetration, but signal penetration is just one aspect of network. Second and the most important aspect of the network is the performance which depends on the bandwidth on the radio interface. Now here 2300MHz deal is advantage. It not only gives you a whooping 20MHz bandwidth, but also runs on TDD, that allows user to use the whole 20MHz of bandwidth for upload or download, whereas 850 offer 3.5MHz bandwidth and 1800MHz offers 5MHz bandwidth (4 - 8x smaller bandwidth), and runs on FDD, that means you have 5x2MHz for 1800 but will only be able to use 5MHz for either upload or download. Now that means you can get equal upload and download speeds and since 4G promises 40 Mbps DL speeds. So that Upload band for 5MHz in FDD will sit idle. Even if it is ignore, user just can't ignore the number, 20MHz will definitely support more (way more) users without a compromise to services. And when there is need of penetration in basement or lift, the FDD bands of RJIO will just suffice(Jio also has a mix of 1800/850 MHz PAN India).

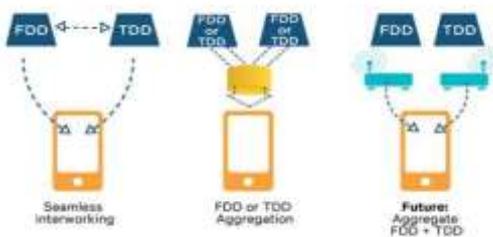
This was all about the backend technicality.

#### 3.2 Jio offered services: VoLTE

Since 4G is an all IP network, Jio will focus on VoLTE, the only operator in India to introduce HD Voice and Video and seamless transition between them. Try making a call on Airtel or Vodafone or Idea while downloading something, it will drop internet connection, as these operator drop 4G and fallback to 3G/2G to make the calls via a technique call CSFB(Circuit Switched Fall Back). It is just like what used

to happen with 2.5G(EDGE) , one can use either voice or data at once and not both. So although these operators say they are giving 4G, on a service level it is just analogous to a beefed up 2.5G. 3G was designed to overcome this very issue, to be able to use voice and data simultaneously, So why go back to old methods and wipe out everything that the technology in telecom sector has achieved till date. Even the telecom standards say that VoLTE is the only way to provide Voice services over LTE, and VoLTE must provide HD Voice. Only then a network can be called a “True 4G” network. Reliance Jio is doing exactly this, and will be the first and only “True 4G” network. Others, unless upgrade to VoLTE standards, are just fakes.

Since IP infrastructure cost way less than GSM/SS7 infra used in 2G/3G, it is vastly less expensive to maintain, so we can expect a drop in call prices since Jio doesn't have the burden to support aging inefficient technologies (Even 3G is a 15 years old technology). That directly means less network congestion, faster call connectivity, superior network performance.



Figure(4)TDD/FDD Ecosystem

Jio is also not back in the field of innovation, It has made sure that our existing non VoLTE 4G devices are able to work with Jio's network via an App called Jio Join that allows you to make calls from non native VoLTE phones(even from any wifi enabled phone connected to Jio Wifi device/Hotspot). Even if the phone support Voice over Wifi, Jio will allow the user that at predefined Jio public hotspots. This not only increases the network capacity but allows to extend Jio 4G to personal spaces using Wifi. Now people living in high rises, specially those living in upper floors (18+) really what a problem it it to receive the cell signals, rest alone 4G signals. Jio has as ingenious solution to this problem via using a technology called small cell towers. These are 1 - 2 ft wifi router like devices that extends the coverage of 2300/1800/850 MHz spectrum to a confined/secluded space, so one can have these devices in high rises' upper floor, or in the basement parking and enable full 4G signals even in those radio holes (Even in places where 850MHz will fail to penetrate). This greatly ensures that you get the most performing 2300MHz band at your disposal.

Jio also will provide a host of services on top of its 4G infrastructure, like cloud storage, IPTV, Video on Demand, Music streaming as it has the immense bandwidth to support the same. All this services will be developed and maintain by Jio so one can expect highest level of performance and service since no third party is involved Jio will also extend it Internet services via IP Phones and FTTx internet services.

In the years to come one can expect a lot more from Jio 4G as they don't think traditionally and for them mobile network is not only about voice calls. The areas they can expand are limitless, and they have the aptitude to do so.

#### IV. 4.CONCLUSION

This paper is not marketing the Jio services rather it is discussing how technically it is possible for Jio to provide the services that are offered using VoLTE. Reliance Jio's plans are to disrupt the market. It will be interesting to see how other operators react can bring competitive pricing to answer Jio.

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