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Presented by

TBR TEAM

SYMBIOSIS
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The objective of Prayukti, SITM Student journal is to let students explore recent trends in Information Communication Technology domain via research. Every year students enthusiastically submit articles written on current ICT trends and the outstanding ones are published in this journal. The prime focus is helping students to stay updated with the current happenings in the ICT domain and also spread the word around helping others in the process. The process cultivates self-learning and sharing of knowledge, which will ensure students climb the ladder of success in a professional career as well. The institute prides itself in shaping its student through various co-curricular, extra-curricular and curricular activities with tireless support from faculty who contribute their expertise and experience with a twist of current happening in ICT. Prayukti is a crucial facilitator for enhancing the domain knowledge among students and teachers as well. Our faculty members also strive at improving the learning habitat through quality teaching, publications, seminars, conferences, etc.

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PREFACE

Symbiosis Institute of Telecom Management works towards an idea of creating techno-managers by inclining students towards changing technologies and thereby enabling them to help organizations in managing their technological fundamentals creating an edge over others. As a part of a techno-management business school that has remarkably evolved into a centre for learning and excellence in the Information and Communication Technology (ICT) domain, it gives us a great pleasure to release the second edition of Prayukti. The magazine's success is a collaborative effort of team members, students and faculties. It's a reflection of current ICT trends from business perspective presented in the form of papers written by students.

Prayukti was born as an initiative of Symbiosis Institute of Telecom Management. The word "Prayukti" is a Hindi word that spectrums the aim of this magazine, designed for motivation, application and result. Different trending domains of ICT are engaged through insightful papers driven by research and experience. The magazine comprises of 10 papers. The areas covered by the articles are Emerging Revenue Streams-N Sided Model, Telecom and IoT - Revenue Model and Challenges, Evolution from 4.5G to 5G, Heterogeneous Networks in LTE using Small Cells, Blockchain Technology in Roaming Fraud Scenario, Implications of Convergence in the ICT Industry, Blockchain Technology for Securing IoT Devices, Security-A Real Threat to VoLTE Success, Financial Technology in India, Impact of Convergence on Telecom. On behalf of the magazine members, we would like to express our gratitude to the professors for their guidance and support and to the students who have enthusiastically contributed to the magazine through interest and efforts. We would also be pleased to receive any suggestion that could assist us with the future editions.

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EMERGING REVENUE STREAMS-N-SIDED MODEL

Nakul Bhakri, Abhiruchi

Abstract

The telecom industry in India has seen wave after wave of innovation and strong development in network infrastructure. The main revenue streams were voice and messaging services in India which have evolved like never before. Data has become the king in the industry. The recent waves of disruption by new entrant Reliance Jio has posed a serious threat to revenue generation of the incumbent operators. The data revolution has brought in high competition among operators in India. Price and data war has become more significant and this has put a question on the strategies and business models of the telecom operators in India. We will dive in the ocean of opportunities using the 2- sided business model in our paper and the way operators in India are trying to explore and monetize them to gain revenue and market share.

Keywords

N Sided Model, Infrastructure Sharing, MVNO, Handset Bundling, Wi-Fi Hotspots, GSMA, CDMA, LTE, GST, SUC, PMRTS, GMPCS, UMS, IPLC, MNP

Introduction

India is currently the world's 2nd largest Telecommunications market and has seen a strong growth in the recent decade and half. The government has ensured an easy access to telecommunication equipment and a fair regulatory framework for this industry. The increase in competition among service providers has helped the Indian telecom industry largely. The current telephone (wireline + wireless) subscriber base stands at 1,210.84 million as of June-2017 with a tele density of 93.98% (TRAI, 2017). In terms of subscriber base the telecom sector in India has always seen a steady rise; the wireless subscriber base (GSM, CDMA, LTE) is 1,186.84 million as of June-2017 (TRAI, 2017). Government initiatives have also helped to bring fresh air in the telecom sector. The Modi government announced the "Digital India" program in the first 100 days of their office, which the telecom sector appreciated. The motive was to make a robust network throughout the country and enhance connectivity for all those citizens who are still deprived of mobile communication facility. Spectrum usage charge (SUC) has also been brought down to a flat 3% from 5% by the cabinet for the auction that was held in spetember-16, providing relief to the telecom industry. Smart cities initiative brings in new opportunities for the telecom industry, and will act as the digital highway leading to the digital dream that India has envisaged. The key to smart cities is connectivity and service providers have an important role to play with a robust telecom backbone. The Indian taxation system has seen a major indirect tax reform in the year 2016-17, with the cabinet approving the GST bill, it aims to remove any kind of tax barriers between states and create a single tax market. GST is a unified tax approach and will bring many changes in the way tax is collected in the telecommunication industry, as this industry cuts across all states and boundaries. GST compliance costs will be a matter of concern for service providers. The services providers will be levied with a tax rate of 18% as GST has been implemented against the current 15%, this will increase burden on the industry (SKPGroup, 2015). There are issues that will need to be taken care of once GST is implemented. The concept of "Necessity services" is very important in such a scenario, seeing the importance of telecom services the government should consider lowering tax rates for the telecom sector. Telecom companies have partners and distributors which are wide spread in the nation for the sale of SIM cards and recharge coupon vouchers, as per Notification No. 25/2012-Service Tax dated- 20th June, 2012, they were exempted from the service tax regime but with the new tax regime they will also be under the lens of tax. The FDI in the telecom sector is 100% i.e. 49% automatic and FIPB(Foreign investment promotion board) beyond 49% ,for All telecom services including Telecom Infrastructure Providers Category-I, viz. Basic, Cellular, Unified Access Services, Unified license(Access services),Unified License, National/ International Long Distance, Commercial V-Sat, Public Mobile Radio Trunked Services (PMRTS), Global Mobile Personal Communications Services (GMPCS), All types of ISP licences, Voice Mail, Audiotex, UMS, Resale of IPLC, MNP services, Infrastructure Provider Category – I (providing dark fibre, right of way, duct space, tower) except Other Service Providers (IBEF, 2017). The FDI equity inflow as of September-2016 stands at 111388.193 crores, the FDI inflow in telecom sector has seen growth seeing the huge potential in the Indian market. The global Telecom industry has experienced

waves of disruption, from the convergence of voice, video and data, to the explosion of digital media. In this environment, service providers are faced with a choice: they must either evolve into the role of innovation provider, or be content simply to provide a utility service. Many technological forces like the advent of 4G have contributed significantly towards a digital shift with high connectivity and speed availability. Total wireless subscribers (GSM, CDMA & LTE) increased from 1,180.82 million at the end of May-17 to 1,186.84 million at the end of Jun-17; thereby registering a monthly growth rate of 0.51% (TRAI, 2017).This has been achieved not only by a balanced regulatory framework but also by gradually making the network more robust. The Indian telecom market currently has 11 telecom service providers, with 90.92% market share with the private players and 9.08% market share with PSU as of June-2017(TRAI, 2017).

The year 2016 saw the arrival of Reliance-Jio, a new entrant to the telecom market in India. The name of Reliance Industries owned Infotel Broadband services was renamed as Reliance Jio Infocomm. Infotel broadband was the only company in India that had 20 MHz pan-India airwaves that it used for delivering VOLTE and 4G LTE services in all 22 circles across India. The commercial launch was on 5th spetember-2016. Within the first month of operations Jio had acquired 16 million subscribers and crossed 50 million subscribers in 83 days since its launch. Jio had crossed 100 million subscribers on 22nd Feb-2017. The company has a network of 25,000 km of optic fibre spread across the nation, over which it will partner with cable operators to get wider connectivity for its broadband services (Jio, 2017). Reliance-Jio has a multi-service operator (MSO) license through which it plans to become a TV channel distributor and offer television on demand on its network. The widespread network capability enabled Jio to target the Indian Telecom market like never before, with their predatory pricing strategy a new wave of disruption started. It is said that the effects of disruption appear only after it has settled; the Indian telecom industry trembled for the first time. The leading telecom operator in India saw a huge decline in Net income of 9,571 Million in December-2016; other telecom operators also saw a similar fall in revenue due to the new entrant in the market. This gave rise to a new revolution in India i.e. "Data revolution", a data war had begun among the service providers to retain their margins and position in the Indian telecom market. This data war saw the advent of new ways to attract and retain customer to increase their revenues.

N- sided Business Model

The legacy business model adopted by Telcos i.e. operators collect revenues from subscribers and further pay content provider and other stake holders which empower them. The 1-sided mobile platform approach is transforming to 2 or even n-sided model. The main source of revenue will still be the subscriber but the value network between operator's, subscribers and content providers will bring more opportunities. Telecom operators should focus on their core competencies and not just become pipes of connectivity.

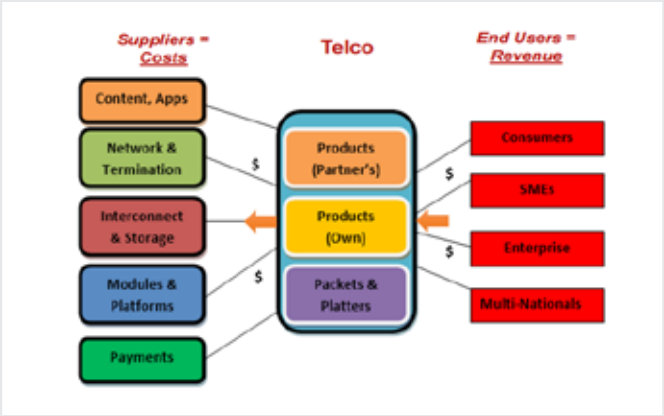

Figure 1. One-Sided Business Model

The current business model is 1 sided in which the end users pay the telecom operators the revenue and the operator's further pay to content providers for their services. Telecom operators should change the game and transform to a 2-sided model, in which customers are revenue side-1 and content owners, government, retailers, brand advertisers and developers are revenue side-2.

The main revenue source will be the subscriber, but a more complex network between subscribers, operators and content providers can bring in novel business opportunities. Telecom operators who have grown using the platform of voice and data services are realizing that the user consumption pattern is changing rapidly. Subsequently their old models are coming under high pressure and appear to be trembling now, some telco's have understood this and have started taking steps to reduce the pressure. The telecom operators should adopt the 2-sided or n-sided model to earn more revenues and reduce debt in their balance sheets.

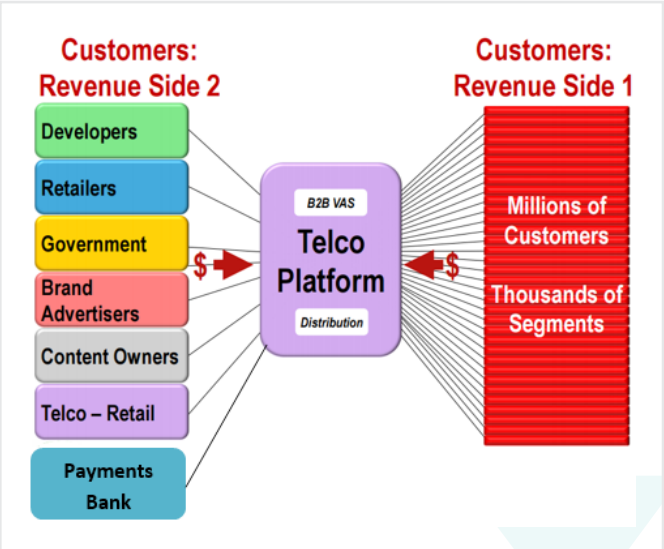

Figure 2. Two-sided Business Model

The 2-sided model helps the telecom industry not only to be an enabler but also helps them to monetize on their investments that they have made over the years. In this model, the service providers receive revenue form 2 sides which will help them to maintain the health of their network and the industry as a whole. Telecom operators today are looking into comprehensive offerings, they are trying to create a new ecosystem altogether. Service providers have evolved over the time from network guarantors and business enablers to experience creators. Telecom service providers have started exploring many new revenue generation methods due to market competition or otherwise.

Airtel the leading telecom operator in the country has 303.08 million subscribers in India which it aims to target for value added services like Airtel payments bank and Airtel Secure (Airtel, 2017). Airtel payments bank is leveraging on the ecosystem that they have, to bring banking services at the doorsteps of individuals. Airtel payments bank is open for non-Airtel customers as well; it will be a fully digital and paperless banking solution for its customers. It will provide cash deposit and withdrawal services and one can send money easily to anyone, anywhere in the country. An account can be opened by using the Aadhaar based e-KYC and no documents required at all only the Aadhaar number will do. A customer's mobile number will become his bank account number; Airtel payments bank will provide an interest rate of 7.25% p.a. the highest in India. Airtel's payment bank is also providing banking points from where an individual can withdraw cash and also a personal accidental insurance of INR 1 lac. Airtel's payment bank services will also provide 1 minute of talk time on every rupee deposited in an Airtel payment bank, making it a lucrative offer. Airtel has always been an innovator when it comes to opening new markets and services. Airtel recently launched "Airtel secure" in April-2017. Airtel secure is a service in which an individual can get handset damage protection, 2GB cloud backup, Spam block, Contacts backup and antivirus for their device for as low as INR49/month (Airtel Secure, 2017). This application has been launched to give a head on competition to the new market entrant Jiosecurity. Features offered by Airtel secure are more competitive than the Jiosecurity. Airtel partnered with OneAssist pvt. Ltd. To provide support for accidental damage happened to the handset. Besides this Airtel also provides features such as malware protection, theft, and web protection, they partnered with Norton Mobile Security application to make this happen. Telecom companies can also monetize their data by selling it to third parties. Service providers can anonymize the data and repackage it for 3rd party companies. To find the best nearby restaurant/ café telecom operators can study movement patterns and suggest their customers accordingly, they can also send promotional messages to a customer about an outlet who gets registered on such a platform with the service providers. Using data analytics comes with its challenges. The main challenge is to ensure customer privacy, because if a customer feels his privacy is being invaded, they will leave. Telecom operators can build customer loyalty and increases spending using real-time interactions with their customers, which will provide them an opportunity to up sell their services. For example, operators can advise that a service balance is about to expire and prompt a recharge or update about price change in new plans. This will add to personalized, differentiated and flexible services which will help to gain customer loyalty and lengthen customer's lifetime value.

Infrastructure Sharing

In Telecom industry, Infrastructure is the prime requirement to provide any level of service to the consumers. As per COAI's report Telecom service providers (TSPs) have invested about Rs 9, 27,000 crores in building world class Telecom infrastructure. The sector has installed additional 212,917 Base transceiver Stations across the country during the period from June 2016 to February 2017, taking the total number to 1.5 million. HSBC estimated that that 6,00,000-route km of fibre will need to be deployed in India at an average Rs 9 lakh per km to cater to the data surge propelled by the 4G boom over the next five years (Kalyan, 2017).

A possible solution to avoid such heavy expenditure is 'Infrastructure Sharing'.

Telecom operators can opt for below options to share Infrastructure:

- Passive Infrastructure sharing focuses on sharing the non-electronic infrastructure like shelter, Power supply, Generators
- Active Infrastructure sharing focuses on sharing electronic equipment's like Switches, Antenna, Transceivers and Microwave equipment.
- Backhaul Infrastructure Sharing refers to sharing the Core network.

Operators can opt for either of the two business models for sharing infrastructure

- Inter-operator tower sharing
- Third-party tower companies

MVNO market

With BSNL's decision to secure India's first MVNO partnership, new levels of opportunities have opened up for new entrants. BSNL has become the cellular partner for ADPAY, a Chennai-based mobile wallet company which runs an MVNO brand called Aerovoyce. Aerovoyce will have access to BSNL's spectrum but it will offer voice and data under its own brand umbrella ("BSNL Powers India's First MVNO, Aerovoyce", 2017). A MVNO establishes on the network capacity bought from other Network operators while offering all mobile subscriptions and value-added services under its own brand. With the growing debt, a stable Return on Investments has become a challenge for Telecom operators. To overcome the tight-rope walk of ROI, MNOs should consider MVNOs as a viable option. DOT also approved entry of MVNOs in India under Unified License in 2016 (C. Kudikala, 2017). Up till July 2017, 61 companies have acquired VNO License in India. Chennai-based Plintron tied up with BSNL to become a Virtual Network Enabler (VNE) in India. Partnerships like these will help Telco's monetize they're under serviced segments and underutilized assets. In the northern region of the country, Videocon has announced its plan to enter the MVNO market.

Wi-Fi Hotspots

As on August 2016,31,000 public Wi-Fi hotspots have been installed throughout India, the number is expected to grow beyond 2,02,000 by 2018.For India to match up to the global average, one public Wi-Fi hotspot will be needed for every 150 people (J. Kolla, 2016). To reach this number additional 8,00,000 hotspots need to be deployed. With BSNL and Bharti Airtel partnering in Facebook's 'Express Wi-Fi' program, the Telco's have already recognised Wi-Fi hotspots as an emerging venue stream. Facebook acquired state-owned telco's backhaul spectrum/bandwidth for running the project. Backhaul infrastructure sharing which wasn't prevalent until few years back seems to have taken up speed now. With the private telco, the plan is to launch 20,000 hotspots to increase connectivity even in the remotest areas in the country. While Facebook will handle the back-end technology, the Telco's will focus on the on-ground work. Unlike Free Basis, Express Wi-Fi will work on a paid model. Access will not be restricted to any particular website. Users can log on to Wi-Fi hotspots and buy various data packs.

Handset Bundling

Bundling refers to the process of assembling a range of products together into one integrated solution. In Telecom, bundling is done to appeal to potential customers and reduce advertising, marketing and other expenses associated with delivering multiple services. Another reason includes cutting down the number of bills the customer has to pay.

Bundled offers are a sustainable strategy. Both operator and the customer are benefited from bundled offer as long as they stick to the agreement. Operators usually introduce such schemes for richer than average customers, giving them an opportunity to scale up at a later point in time. While Airtel is bundling services like 10 GB per month for 12 months on iPhone7 and iPhone 7 plus (AirtelApple, 2017), Vodafone has announced free one-year Netflix subscription for Vodafone RED users (D. Moray. 2017). Offerings like these increase customer retention and devise a new direction for strategic partnership between Telco's and other industries.

Conclusion

India is on a digital journey which will empower it like never before. It is important that the ICT ecosystem be kept healthy so as to achieve the digital dream India has seen. Telecom service providers will play a very crucial role in the country in the coming decades. India has already started thinking on 5G which shows that it has the ability to keep up with the world in terms of technological advancements. In the September-2016 Indian Telecom industry saw the entry of a new Entrant, Reliance Jio Infocomm. Reliance Jio holds the maximum spectrum blocks in the Band-5 LTE FDD (850 MHz) for its VoLTE Services. The entry of Reliance Jio has disrupted the Indian telecom sector. Competition in the telecom sector is like never before. Service providers are finding new ways and bundling services to attract and retain customers. In July-17, Airtel launched "Project next", its digital innovation program. It plans to invest INR

2000 crore in the next three years. Service providers are head over heels and with the IMG (Inter Ministerial Group) considering extending spectrum payments for Indian Telco's, little relief might be around the corner. The regulators, government and stakeholders in the ICT industry should make sure that an optimum environment is made for this sector. The coming years will bring more advancements and changes to the face of this industry and networks will transform and perform like never before.

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TELECOM AND IoT: REVENUE MODEL & CHALLENGES

Kislay Bhardwaj, Dereddy Sabarinath Reddy

Abstract

The telecommunication industry is in the midst of immense competition and their existing revenue sources are just not enough for a sustainable business. The path of technological growth is moving towards pervasive connectivity and conversion of traditional devices into connected, data generating, Internet of Things (IoT) devices. Telcos have to harvest the power of IoT to give a push to their revenues. It has already been adopted by the Telcos in the developed countries. This study is an attempt to explain in brief how IoT can be leveraged by the Telecom operators in India to boost up their revenues and the challenges that Telcos will face in doing so.

Keywords

Internet of Things (IoT), Telcos, Revenue, Operating Model, Challenges

Introduction

The telecom operators today face intense competition not only from rivals in the industry but also from over-the-top (OTT) service providers. The revenue margins are shrinking and the subscriber churn rate is also growing in this consumer-focused business. Providing connectivity and security services is just not enough to ensure sustained relevance. Effective monetization of the business segment is the key in the industry today. As the telecom service providers try to leverage numerous disruptive technologies for redefining their business models, the Internet of Things (IoT) has emanated as a promising transformative enabler. If designed and executed correctly, IoT helps to deliver innovative products and services solutions that add value to the clients. This, in turn, can aid in the widening of revenue streams and enjoy greater customer loyalty.

IoT Operating Model for Telcos

Today's Telcos are technically no longer mere communication service providers. Convergence has always played a vital role in the telecom industry to remain innovative and competitive. Telcos too have come a long way from just providing communication means to network convergence to service convergence and device convergence. But now it is the time to adapt industry convergence at a new scale as shown in figure 1. This era needs to provide services belongs to various industries such that providing information technology, mobile/fixed telecom, multimedia content and application services all by one industry i.e. Telcos.

Figure 1. IoT Operating Model for Telcos

Elements for implementing IoT by Telcos -

- Nifty Devices – SIM, sensors, chips, apps, meters, cameras
- Communication Services – Network, coverage, capacity, connectivity, quality
- Content – Multimedia service, Applications
- IoT Platform – Combination of AI enabled cloud based storage, analytical process (predictive & prescriptive), device & network element management, and inter-system communication
- Customization – Integrators, responsible to work all the components in sync

It is almost impossible for one provider to provide end to end IoT solutions, so the only choice left is a partnership or horizontal & vertical integration.

Use Case Example

Vodafone's telematics solution for TMAX, Yamaha

Business Requirement -

TMAX, one of Europe's most popular scooters is produced by Yamaha which came up with the decision to equip the new model of TMAX with end-to-end telematics service and integrate it with an app that shares beneficial data on the road and remotely (Vodafone IoT

- Yamaha case study, 2017). Uninterrupted operations in each city and suburb across Europe ensuring that the TMAX 2017 model vehicles could not fail to connect was the key requirement for Yamaha.

Solution -

Vodafone came up with a telematics solution for Yamaha that includes connected vehicle service, hardware, connectivity and customer support. Vodafone Automotive designed and developed a telematics unit which was installed in the Yamaha line fitment. It ensures perfect integration into bike and warranty of the system for the TMAX SX and DX production models (Vodafone press release, 2016). The My TMAX Connect service can be activated through a dedicated customer portal and be operational within minutes after the purchase of the bike.

The TMAX customers can remotely locate their bike, monitor riding usage and map bike trips using the bike finder feature1. A geo fence and an alert, if the set maximum speed is exceeded, can also be set using the app. The TMAX SX and DX models are theft protected using Vodafone Automotive dedicated telematics infrastructure and service support organization. The app addresses the security issues for Yamaha and introduces a new gratifying customer experience. It is a trouble-free and trustworthy solution which is proving popular with Yamaha customers (Vodafone IoT - Yamaha case study, 2017).

Business Benefits -

- Vodafone Automotive delivers dependable, pan-European telematics service for Yamaha's new TMAX models.
- My TMAX Connect enables riders to observe usage, remotely access the vehicle and collect data on the usage of the bike.
- Stolen vehicles can be traced in real-time while Vodafone works with native police to secure retrieval (Vodafone press release, 2016).

Revenue Model for Indian Telcos to provide IoT services

Differentiation is all about to shine out from the crowd. This section demonstrates the overall potential of Telcos. This segment consists of three key elements which collectively create a unique value proposition and differentiate one from the competition. These elements are –

Licensing Service Area (LSA) –

This is the different market where Telcos are offering their services. In India, we can divide the market according to LSA, so there are 22 different markets to offer product or services.

Customer Segments –

In every LSA, customers can be divided into various segments according to their requirements, value (capacity to purchase), habits, migration pattern and life cycle value.

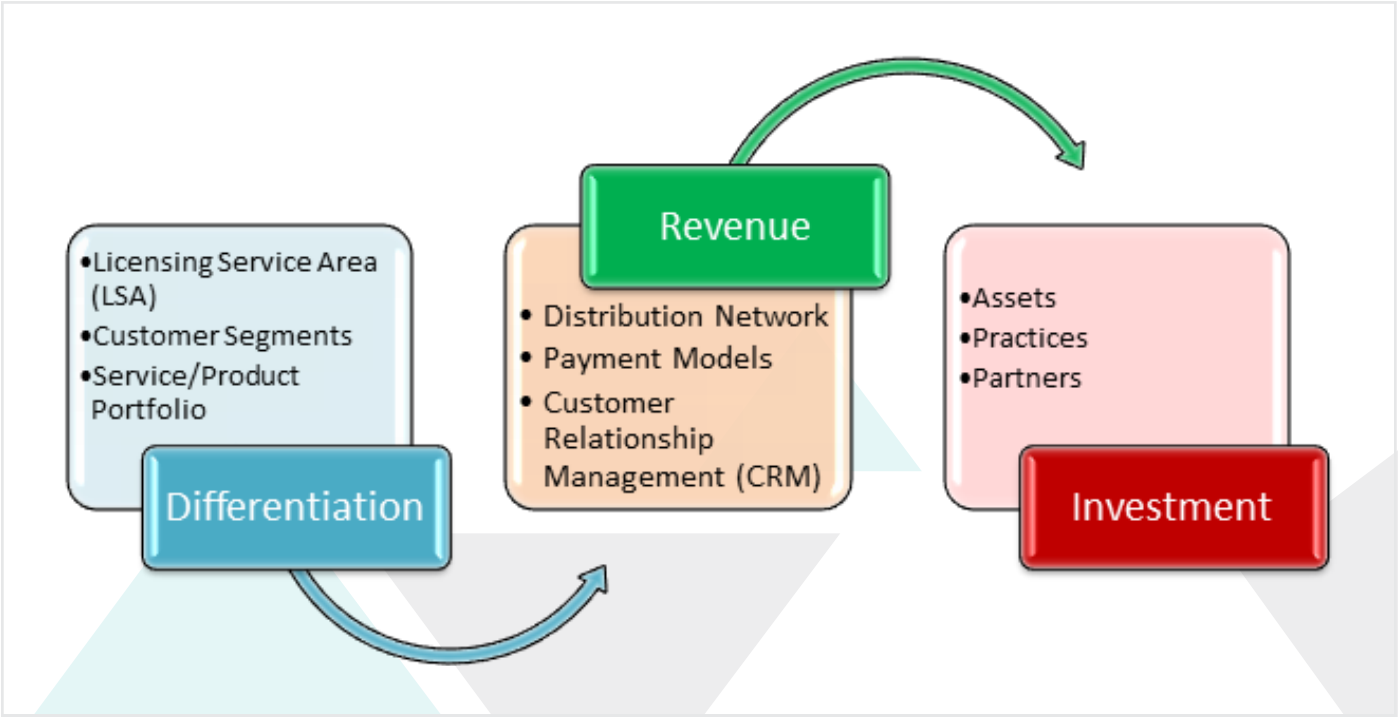

Figure 2. Revenue Model for Telcos in India to Provide IoT Services

Service/Product Portfolio –

Telcos should have a clear and predefined range of product/services accordingto already defined customer segments and their specific requirements.

Revenue entirely depends on how Telcos interact with customers and how effective is their distribution network to serve customers with their offerings. This segment also comprises of three key elements which collectively demonstrate cash inflow structure of the business. These elements are –

Distribution Network -

This element defines the distribution channel for Telcos through which they facilitate customers with their offerings. This channel must be agile and flexible.

Payment Models -

For Indian scenario, there should be Multimode payment options for customers and there should be an automatic reminder in billing system to send constant reminders to the customers as their due date of recharge is near. Telcos should work on the frequency of payments by consumers and accordingly plan products, so that appropriate Working Capital can be maintained in the business to achieve the desired Return on Investment (ROI).

Customer Relationship Management (CRM) -

This is the most important element because for Telcos to win customers trust and loyalty, special attention should be given to the intensity & the nature of the relationship with customers, frequency & types of moment of truth, and the content which exactly depicts the characteristics of the offered product to the customers. Device and network based customer services are required than the conventional product based.

Investment at the right time and at the right place is the key to convert a business into a success. Actions taken here will impact the outcome of the first two sections. This section tells that how Telcos get appropriate ROI and differentiates them from the competition by taking right investment decisions. This section also has three elements, which are –

Assets -

It can be divided into two parts: tangible and intangible. Must have assets to cater IoT services under tangible part are Optical Fiber Cable (OFC) connected to home, capable manpower to deal with automation & analytics, and huge customer base; whereas under intangible part Telcos should have enough Spectrum & Bandwidth, Licenses to provide services and contents approved by concern regulators.

Practices -

This element focuses on the special capabilities to produce services/products and finally to deliver them to the customers. Expertise in this area helps to build a brand image for the company which eventually brings value proposition.

Partners –

The role of partners is very important to deliver IoT services. Telcos are forced to provide all the services on their own (industry integration), but it will take some time to achieve such capabilities at once. So, it is necessary to decide the origin of every product/ services, whether Telcos are going to produce that on their own or will take that from partners. It is required to analyze complete financial aspects before choosing a partner, like the costs incurred in manufacturing by own than taking from partners or flexibility in service while providing on own or taking help from a partner or quality desired for particular products and actual quality offered by partner etc.

So, on summarizing followings need to take care by Telcos to cater IoT services –

- Emphasis on data management and analytics
- More focus on providing relevant, customized and superior content
- Provide superior network quality, so needs adequate infrastructure
- Synchronize all the stakeholders at one platform
- Adopt a new CRM strategy to monetize offerings in a much efficient way

Challenges ahead for Telcos

- Data integrity
- Data security and privacy
- Financial Stress on the Telcos
- Lack of awareness among the customers
- Lack of regulation – no clear guidelines to provide IoT on unlicensed bands
- Power – hungry protocols for IoT implementation (An IoT-Ignite White Paper, 2017)
- Technical nature of changing connectivity requirements (An IoT-Ignite White Paper, 2017)
- Uncertain Return on Investment (Mohit Agarwal, 2016)

Conclusion

In this paper, we have presented why and how Telcos should leverage on IoT to improve their revenues. We have also presented an operating model for Telcos to align their existing modus operandi with IoT using TMAX, Yamaha case from Europe. Indian Telcos are lagging in taking advantage of IoT due to the existing financial stress, unavailability of adequate infrastructure and lack of customer awareness about the IoT applications which are major challenges in implementing IoT solutions in India.

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THE ROAD OF EVOLUTION FROM 4.5G TO 5G

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Abstract

The technology with its significant rate of growth and its adaptability greatly depends on the ease of solving real life problems for its users. Considering the case of all the evolving technologies there is a significant change in the trend from human to machine interaction to machine to machine interaction. The success of machine to machine interaction and other business use cases will predominantly depend on the evolution of network framework. The demand for enhanced data rate and better connectivity has ensured the need to define new network architecture.

With the evolving technologies the crucial aspect of its application predominantly relies on the connectivity support the network provides. One of the distinguishing aspects across the evolution of 1G to 5G is enabling new use cases across different levels of new evolution. This paper primarily focuses on the evolution path from 4.5G to 5G in terms of its implementation and application aspect of 5G. This paper will also help readers to understand the challenges and business drivers of the future network technologies. It further illustrates the comparison between LTE, LTE-A and 5G.

Keywords

LTE-A Pro, 5G, Carrier Aggregation, MIMO, Relay Node, Small Cells, Millimetre (mm) waves, enabling technologies of 4.5G and 5G, Challenges of 4.5G to be overcome by 5G.

Introduction

4.5G or LTE Advanced Pro

Long term evolution (LTE) with its evolution from 3G technological architecture has given significant advantages by providing enhanced data rates and better connectivity. LTE with its adoption of complete packet switching network has given network operators a feasible evolution path to meet future surge in service demand. With implementation of all IP network architecture, reduced latency, high data rates and better Quality of Service (QOS) it marks a new beginning in Radio Access Technologies (RATs).The evolution of LTE further into LTE advanced and LTE Advanced Pro acts a parameter to enhance the network further in to 5G. LTE Rel-8 standard defined in March 2009 had the primary objective to allow evolutionary changes towards 4G as imposed by IMT Advanced. LTE-Advanced specified within the 3GPP Rel-10 [Javier Gozalvez,2016] was defined to meet IMT Advanced requirements and further with the release of LTE- Advanced Pro release 13 functionalities like LTE-WIFI Aggregation (LWA) , License assisted access (LAA) , Device to Device (D2D) direct communication etc. were defined enabling it to evolve closer towards the goals of 5G capabilities. With the downlink speed of 10,000 Mbps in 5G technology a huge generational shift of connected devices and application can be leveraged [Abdelfatteh Haidine, Sanae El Hassani, 2016].

Figure 1. Maximum Theoretical Downlink Speed by Technology Generation, in Mbps (Source: GSMA Intelligence)

The downlink speed across evolution of mobile generation technologies have evolved with the change in the adoption of technologies. The differences in the technological implications during its evolution from LTE to 5G are stated below.

LTE Advanced Pro (4.5G) enabling technologies

Carrier Aggregation (CA) -

To meet the demand of required bandwidths for high data rates, operators have come up with a scheme known as carrier aggregation, which allows them to utilize multiple channels in the same band or different areas of the spectrum. It is one of the most basic methods of increasing capacity. LTE-A can enjoy a maximum bandwidth of 100 MHz by aggregating up to 5 component carriers of different bandwidths. This

also makes LTE-A backward compatible with Release 8 and Release 9 mobiles. [Jialing Liu, Weimin Xiao, 2016]

Enhanced MIMO -

According to theory it is one of the simplest ways to increase the spectral efficiency. In enhanced MIMO, a ninth transmission mode to the downlink (8*8 MIMO) and a second transmission mode to uplink (4*4 MIMO) are added. [DavidMart´ın-Sacrist ´an at el., 2009]

Relay Nodes (RN) -

Relay nodes are necessary to provide an efficient homogenous network planning. A relay network can be created at Layer 1 i.e. by using repeaters to amplify the network. In Layer 2 relaying, the relay nodes have the capability to control some parts of the RRM functionality. Layer 3 relaying operates in similar manner to Layer 2 relaying with addition to having a unique Physical Cell ID which allows the relay node to mimic as a base station for the UE trying to connect to it. [Springer.com]

Coordinated Multipoint (CoMP) Transmission/ Reception -

These techniques with the help of multiple transmit and receive points provide coordinated transmission as well as reception. This process of transmission and reception is executed simultaneously and dynamically across multiple cell sites. The primary task of CoMP is to enhance the performance at cell edge [Jialing Liu, Weimin Xiao, 2016].

5G

5G Technology or 5th Generation Technology uses OFDM and millimetre waves that provides data rate of 20 mbps, having a frequency band of 2-8 GHz [Sapana Singh, Pratap Singh, 2012]. Since 5G is a packet based technology, capable of supporting World Wide Wireless Web (wwww) applications, new technological boundaries has to be broken for its commercialization [Sapana Singh, Pratap Singh, 2012].

To meet the high demand of wireless traffic in the next few decades and for the implementation of 5G mobile networks, millimetre wave technology is necessary as it can bridge the gap between 4G and 5G. This allows the utilization of a lot of frequency bandwidth [Sapana Singh, Pratap Singh, 2012]. Since, other modulation techniques are reaching its usage limits of frequency bandwidth; using Orbital Angular Momentum (OAM) Technology opens a new horizon for optical communication. Usage of OAM state for millimeter wave communication provides unlimited degree of freedom, compared to other degree of freedoms in time, space and frequency [Xiaohu Ge at el., 2016]. OAM technology for millimeter wave communication can provide better usage of higher bandwidth frequencies [A. Yao, M. J. Padgett, 2013]. Another possibility of mm-waves is adaptive beamforming. Mm-wave frequencies, due to its much smaller wavelength, may exploit new spatial processing technologies and polarization, such as massive MIMO and beamforming. This allows a significant jump in bandwidth allowing base station-to-mobile station links to handle much greater capacity [A. Yao, M. J. Padgett, 2013].

Technologies to be used in 5G

Millimeter Waves -

Millimeter-wave region lies in the extremely high frequency range having wavelength of 1 millimeter (0.04 inches) to 10 millimeter (0.4 inches) [S. Janakiraman, P. Marichamy, 2015]. These waves are larger than x-rays or infrared waves but shorter than micro waves or radio waves. These waves of the electromagnetic spectrum correspond to radio band frequencies of 30 GHz to 300 GHz. This wave is considered as one of the best constructive candidate for 5G implementation as it opens the horizon for 6 GHz bands, which is available and unlicensed in many countries [S. Janakiraman, P. Marichamy, 2015].

Mm-waves, in real-world application, is only used by operators of satellites and radar systems. Sending data between stationary points, such as two base stations, have started being implemented by some cellular providers as well as research centres [Engineering & Technology History Wiki, 2017]. But connecting a mobile user using mm-wave has many drawbacks. Mm-wave is easily absorbed by rain and plant. Moreover it cannot penetrate through buildings. To solve this problem researchers are looking at another technology called small cells.

Small Cells -

Small cells are portable base stations that operate on minimal power. These miniature base stations can be placed every 250 meters, preventing signal drops. Service providers can install thousands of small cells in a city to relay the entire network ecosystem. One advantage of small-cells is its size. Its smaller size allows network providers to install these miniature base stations atop buildings and light poles [Aderemi Atayero at el., 2016].

But there is also a drawback to small cells. The sheer number of these miniature cells required to create a 5G ecosystem means huge CAPEX in the initial phases. This will result in the creation of a dense network. A

technology to deploy femtocells and small cells at a satisfactory level of operation is required. In 5G, small cells have to be deployed at a frequent distant to create a relay network ecosystem, compare to 4.5G.

Massive MIMO -

5G base stations will also have more antennas to take advantage of another new technology known as massive MIMO. A typical 4G base station has 12 ports, 8 as transmitters and 4 as receivers. Whereas, a 5G base station will have 100 ports thus increasing the capacity of mobile networks by a factor of 22 or greater [F. Rusek at el., 2013].

To attain one of the aims of 5G i.e. spectrum efficiency, massive MIMO technology is being tested in various labs. Implementing massive MIMO allows users to transmit bits of data to a certain number of users per second at a phenomenal rate. But this technology also has a huge drawback of interference. Installing too many antennas to handle traffic will increase interference as well. To overcome this beamforming technology is necessary.

Beamforming -

This is traffic signalling system that identifies the most efficient route to deliver data to a user, thus reducing interference. Beamforming helps to ease one of the primary challenges of massive MIMO, i.e. to reduce interference while transmitting data.

Beamforming can also solve the problem of signal blockage of mm-waves by focusing a signal in a concentrated beam to a particular user's direction [Shuangfeng Han at el., 2015]. This approach can not only strengthen the signal's integrity but also reduce interference from other signals.

Full Duplex -

To achieve high throughput and low latency, many organizations are also testing a technology called full duplex. Till 4G base stations took turn to transmit or receive data over the same frequency, or use different frequencies if the user wants to transmit and receive at the same time. In 5G, researchers are trying to achieve data transmission and reception at the same time using the same frequency using the technology known as full duplex [S. Janakiraman, P. Marichamy, 2015].

To achieve full duplex in personal devices is hard. Recently, researchers have assembled a silicon transmitter that acts like a high-speed switch to control both the forward and backward radio wave travelling on the same frequency. But to overcome strong signal interference, through a pesky echo, researchers must design a circuit that can route incoming and outgoing signals at the same time along with echo-cancelling abilities.

Business Driver for 5G

5G came into importance for the fulfilment of certain real time business drivers that rely on better and faster data throughput. Some of these business drivers are mentioned below:

- The demand for large volume of data consumed by consumer due to video and business has given rise to exploration of the 5G ecosystem, providing enhanced mobile broadband solutions.

- IoT applications such as Massive machine-type communication (M-MTC) and Mission-critical applications [Zaher Dawy at el., 2017], such as machine-to-machine, which require low latency and high reliability is also another factor.

- Wireless transportation applications such as vehicle-to-vehicle (V2V), intelligent Transport System (ITS) and vehicle-to-infrastructure (V2I) [GSA Executive Report from Ericsson, Huawei and Qualcomm, 2015] also require low latency cellular network, much lower than currently provided by LTE.

- Industrial automation and robotics [GSA Executive Report from Ericsson, Huawei and Qualcomm, 2015] is also a very promising market. Wireless sensors needed for robotics require reliable and secure communication, but with low power requirements.

- With the new concept of telemedicine in the horizon of medicine and health practices, new and low-latency network is required for faster communication.

- With the hype for Virtual and Augmented reality, faster, secure and low-latency network is required for wirelessly and seamlessly connecting the gaming industry.

Applications of 5G

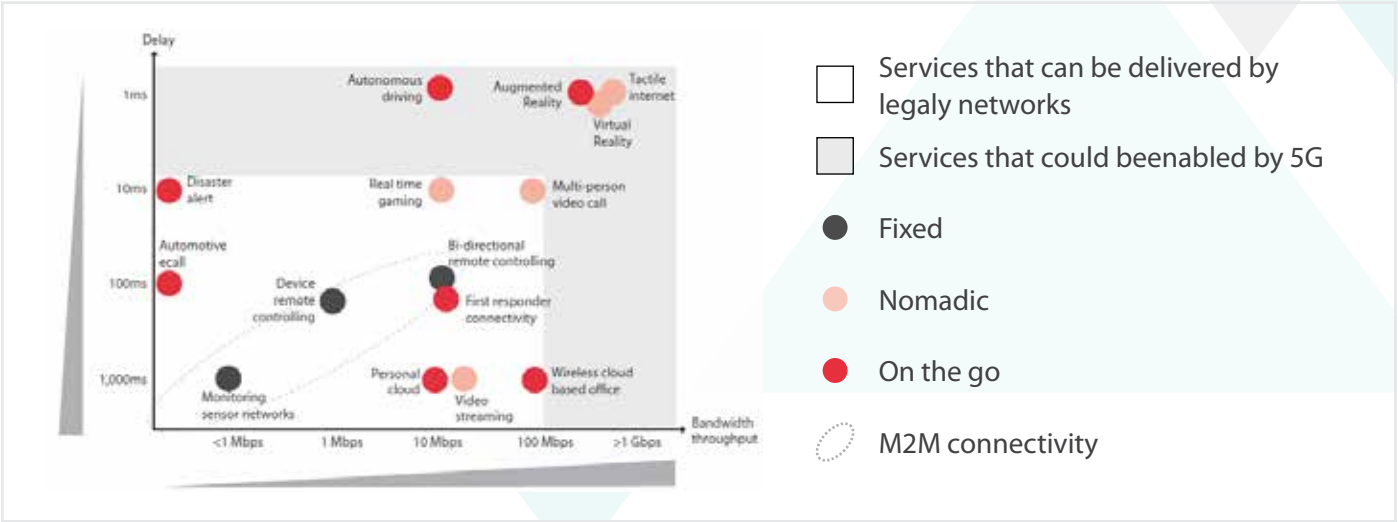

Figure 2. Bandwidth and Latency Requirements of Potential 5G Use Cases (Source: GSMA Intelligence)

The Primary goals in the evolution of 5G is to provide data rates of 10 Gb/s theoretically with high improvements in bandwidth utilization per unit area, capability to connect multiple devices to enable high usage of connected devices, reduction of 90% consumption of network electricity and capability of low latency rate of 1ms [GSMA Intelligence, 2014] enabling the 5G applications in diverse fields which requires high response rate. Some of the applications require instantaneous response time and high data rate as an essential factor for its functioning and applications.

Following are some of the services that can be leveraged by the applications of 5G:

Autonomous driving -

With the advancement in autonomous driving and driverless technologies command response time with very low latency rate which is essential for the overall safe operations and connectivity [GSMA Intelligence, 2017].

Internet of Things -

The capability to connect multiple devices and better communication bandwidth will open the possibilities of convergence between IOT and connected devices [GSMA Intelligence, 2017].

Massive Machine to Machine communications -

Currently machine to machine communications are deployed with existing 3G and 4G networks with its applications in connected homes, smart automation and wireless sensor networks. However the capabilities are confined with limited connections which can be overcome by deploying 5G having the capability of handling massive machine to machine communications with relatively efficient connectivity [Zaher Dawy at el., 2017].

Augmented and Virtual reality -

AR and VR with its necessity to be constantly connected to the network. 5G will play a critical role in providing huge amount of data with high reliabilities and low latency. This will prove to a critical factor of consideration as most of the applications will require real time efficient connectivity [GSMA Intelligence, 2014].

Challenges of 4.5G mitigated by 5G

In 4.5G, to increase the rate of data through-put, usage of relays introduces inter- as well as intra-cell interference, which degrades the performance capability of the system. Relays also introduce network complexity in processes such as handover, overlapping, and resource allocation for peer-to-peer communications compared to single hop [Abdelfatteh Haidine, Sanae El Hassani, 2017]. These issues can be resolved by introducing small cells and implementing beamforming technology to reduce inter-cell interference. Moreover, small cells such as pico cells can be used for better data through-put. 5G also increases the theoretical downlink peak data rate and reduces latency. This increases the possibility of seamless massive machine to machine communication which was not possible by 4.5G. Moreover, TSP's are reaching commercial limit of multiplexing on the same frequency band using various methods such as FDM, TDM etc. But 5G introduces a new multiplexing technique known as Orthogonal Angular Momentum (OAM).

Comparison between LTE-A; LTE-A Pro and 5G

Parameters	LTE	LTE-A Pro (4.5G)	5G
Downlink Peak data rate (theoretical)	100Mbits/sec	1Gbits/sec	10Gbits/sec
Uplink Peak data rate (theoretical)	50Mbits/sec	500Mbits/s	5Gbits/sec
Latency	Approx. 10ms	Less than 5ms	Less than 1ms
Multiplexing	OFDM	OFDM	OAM
Multiple Antenna Techniques	Up to 4*4 MIMO downlink	Higher order MIMO (8*8 MIMO downlink; 4*4 MIMO uplink)	Massive MIMO (order not defined for 5G)

Table (1) : Theoretical Specification of LTE, LTE-A Pro And 5G

Conclusion

The evolution in wireless network architecture has brought in its assistance by finding its use cases in various applications. The 5G network unlike previous architecture will assist in critical communications application and IoT applications. But like previous architecture it won't be confined to limited communication industry, 5G with its high data rate and reduced latency initiates the diversification of its application in myriad segments like automobile, connected homes, M2M communications and Augmented reality which was not possible in the 4G/ 4.5G architecture there by greatly changing the way telecom industry functions. The 5G network architecture thus has to have seamless connectivity transition as per the latency and availability requirements depending on the use cases. Thus, defining a highly flexible network will increase the service offering portfolio for MNO's. The MNO's can offer diverse range of communication services built on the existing , new and yet to be developed use cases thereby ensuring a constant stream of revenue generation. This in turn will greatly help the existing telecommunication industry where revenue is predominately depended on connectivity and capacity.

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HETEROGENEOUS NETWORKS IN LTE USING SMALL CELLS

Elizabeth Jacob

Abstract

With the exponential traffic growth and the ever increasing demand for bandwidth rich applications, leveraging technology is of paramount importance, so as to serve this widespread demand. Most of the operators are evaluating their options, and small cells deployment figures high in their priorities with 60% of operators considering them to be an important part of their 4G service. A holistic small cell strategy will address both the short term challenges like cost savings in providing service and the longer term challenges like improving customer loyalty and exploring new revenue streams. This report talks about the high demand of using Small Cells in heterogeneous LTE networks, which are being deployed in applications that require higher bandwidth demands and increased traffic. The paper also throws light on the topics like the major driving factors, features, types, pros and cons, market outlook and the current Indian scenario.

Keywords

Small cells, Heterogeneous network, LTE HetNet

Introduction

A well-defined network planning is critical to deal with the increasing number of mobile broadband data subscribers and bandwidth-intensive services which is competing for very limited radio resources. Operators are dealing with this challenge by increasing the existing capacity with a new radio spectrum, adding multi-antenna techniques and implementing even more efficient coding and modulation schemes. But at highly crowded environments and at cell edges where the performance can significantly degrade these measures alone are insufficient. Thus, in order to meet the rising demands of network subscribers and to handle the challenges of urbanizing environments in the network performance, a new approach must be taken. A completely wireless environment facilitating indoor and outdoor networks to perform perfectly anywhere and anytime to provide the best end user experience is made possible through a totally holistic view of the network and securing the performance across all radio network layers for multiple standards and bands. By making use of Small Cells alone or with Integrated Small Cells (macro and small cells combined) network performance can be improved by delivering high per-user capacity and rate coverage everywhere in the macro network by offloading traffic generated in hotspots. Operators now are making use of the small cells and tightly-integrating these with their macro networks so as to spread the traffic loads, improve performance and service quality while reusing the spectrum most efficiently. (Dr. Yan Q Bian & Deepak Rao, 2014)

The paper explains the major features of small cells, followed by the requirements for implementing the same. The later session on LTE HetNet features explains the various features incorporated in an LTE heterogeneous network. The further sessions discusses about the types and deployment scenarios, followed by the various noted features of the small cells. The advantages, disadvantages, current market outlook, the impeding prospects of 5G network, and the Indian scenario explained in the following sessions describes in detail about the heterogeneous network in LTE using small cells.

Small Cells and Heterogeneous Network

Small cells are primarily made use to fill the uncovered areas of the macro network, to increase the capacity in hot spots where the user demand is high and to improve network performance and service quality. The heterogeneous networks which consist of a combination of large macro-cells with small cells increased the bitrates per unit area. The growth in the mobile data is outpacing the associated revenue and making use of the Small Cells and Carrier Wi-Fi can help to meet operator's requirements for a high performance user experience and a cost-effective model based on both installed CapEx and ongoing OpEx. Moreover, making use of small cell architecture and unlicensed bands, like Wi-Fi, will become increasingly strategic components for the operator's 5G strategy. (Small Cell Forum, 2012). The major hurdle in restructuring and expanding the existing homogeneous network is to densify it by adding more number of sectors per eNB or by deploying more macro-eNBs. However, the reduction in site-to-site macro-network distance is limited because finding new macro-sites is expensive, especially in crowded places. An alternative to this is to

make use of small cells with the addition of low-power base stations (eNBs, HeNBs or Relay Nodes (RNs)) or Remote Radio Heads (RRH) to existing macro-eNBs. This method also helps to reduce the cost and effort in site acquisition. (Tech Mahindra, 2014).

The heterogeneous network planning in GSM technology separates the small and large cells using different frequencies. The same solution is possible in LTE networks also, where frequency reuse is done to maximize the utilization of licensed bandwidth.

Large Cell -
- High-power eNB
- macro-eNB site can be difficult to find

Small Cell -
- Low-power base stationor RRH
- hot-spot coverage
- coverage at cell edgeof large cell
- coverage in area notcovered by the macro-network
- indoor coverage
- off loadfor large cell
- small site size

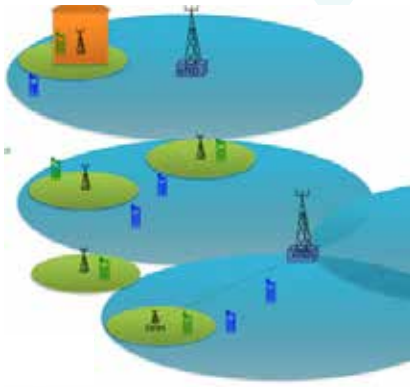

Figure 1. Illustration of a Heterogeneous Network with Large and Small Cells

Various features added to the 3GPP LTE specification can be used to mitigate interference problems in heterogeneous networks with small cells -

Inter-cell Interference Coordination (ICIC) –
By making use of 'Load Information' message, an eNB can inform its neighbouring eNBs about the UL interference level per Physical Resource Block (PRB) allocated to cell edge UEs.

Carrier Aggregation with cross-carrier scheduling –
Carrier Aggregation increases the total bandwidth available to UEs and maximum bitrates. And, cross-carrier scheduling maps the Physical DL control channels (PDCCH) on various CCs in large and small cells.

Coordinated Multi Point (CoMP) -
Using CoMP, multiple transmission/reception points may be coordinated to provide service to a UE. CoMP can be used both in DL and UL.

The trend on proliferation of mobile broadband data has been increased in the past decade and is likely to increase in the coming years. Presently, cellular networks are not well equipped to deal with this surge in demand. So, in order to satisfy the user demand and to maximize profits, a new paradigm is needed to operate networks. The need for the cellular telecommunications operators to be able to operate networks consisting of multiple radio access technologies, formats of cells and many other aspects, and combining them to operate in a seamless fashion has given rise to the concept of the Heterogeneous Network. A whole array of new technologies have been introduced such as dynamic switching of small cells, new carrier types with reduced control signalling, dynamic reconfiguration of TDD-LTE, joint configuration of TDD and FDD via carrier aggregation and lastly advanced MIMO signal processing with three dimensional beamforming. All these technologies will work in unison leading to efficient operations of small cells. Heterogeneous networks are now an established concept within LTE networks.

Requirements

For the implementation of a small cell network to be a financially sound investment for carriers and enterprises it must adhere to a few requirements.

Low cost –
Coverage is being provided to fewer subscribers, so costs must be kept down.

Easy to manage –
The huge number of small cells being deployed means consolidated management is necessary.

"Outdoor furniture" appearance and light - weight design –
Small cells are often mounted to street lights and signs, so there can be restrictive requirements laid out by landowners.

High weather reliability and safe-to-touch design –
Small cells provide street-level coverage and are in close proximity to human activity.

LTE HetNet Features

As mentioned in session 4, multiple features of LTE may be incorporated into an LTE heterogeneous, although they may conceivably be used with the other forms of wireless heterogeneous network.

Carrier aggregation -
With spectrum allocated for 4G networks, operators often find they have a variety of small bands that

they have to piece together to provide the required overall bandwidth needed for 4G LTE. Making these bands work seamlessly is a key element of the LTE heterogeneous network operation.

Coordinated multipoint -

In order to provide the proper coverage at the cell edges, signal from two or more base stations may be needed. Again, providing the same level of service regardless of network technology and areas within the cell can prove to be challenging. Adopting a heterogeneous network approach can assist in providing the same service quality regardless of the position within the cell, and the possibly differing cell and backhaul technologies used for the different base stations. Small Cells deliver cost-effective capacity and coverage, indoors and outdoors, and are key to network innovation. Small cells deployed in strategic areas are the perfect vehicles to bring network innovation such as value-adding applications, local contextual applications and IoT services. Small cells have defined purposes when it comes to providing end users an improved cellular experience in congested urban areas.

- Increasing capacity in areas with high user densities;
- Improving coverage and available data rates;
- Extending handset battery life by reduced power consumption.

These low-powered radio access nodes can work in either licensed or unlicensed spectrum, and have a range between 10 meters and two kilometres. The purpose of installing small cells is to increase range and capacity in densely populated urban areas that cannot be sustained by macro cells. (Ericsson review, 2011)

Types and Deployment Scenarios

The three types of small cells include:

1. Femtocells-

These are the shortest range of small-cell types, usually deployed at home or small businesses where the router-like devices installed can accommodate the coverage for just a few users at a time with a maximum range of less than 10 meters.

2. Pico cells-

These are usually installed in larger indoor areas like shopping malls, offices or train stations and can support up to 100 users at a time with a range of under 200 meters.

3. Microcells-

These are the largest and most powerful small cell that are usually installed outdoors by network operators on traffic lights or signs, and can be temporarily used for large events. Microcells have a range of fewer than 2 Kms, whereas macro cell towers can cover up to 20 miles.

Small Cell Features

Locked to a single mobile phone network -

Unlike Wi-Fi, these devices use licenced radio spectrum, so must be operated and controlled by a mobile phone company and thus encourages all users in a household or business enterprise to switch to the same network operator.

Low power but high quality -

Small cells operating at very low radio power levels substantially increases the battery life, both on standby and talk time. Since they are so much closer to the handset or mobile device, call quality is excellent and data devices can operate at full speed. The smallest femtocells can handle up to 4 simultaneous active calls from different users, with most indoor products having a standard capacity of 8. Larger small cell designs for business (enterprise) or public areas use can handle 16, 32 or more concurrent calls or data sessions. A few of the latest multi-mode 3G and LTE small cells can cope with up to 64 3G and 128 LTE concurrent active sessions. Some products can handle even more. These numbers are in addition to passive users not actively making or receiving voice or data calls.

Open or restricted access -

Restrictions can be applied on who can access a small cell. Many residential femtocells include a facility to restrict service to a whitelist of up to 30 specified telephone numbers. Enterprise use is more commonly open to all, including visitors, but may prioritise phones belonging to the business itself.

Secure and self-managing -

Small cells encrypt all voice and data sent and received, ensuring a high level of protection from sniffing or snooping. Unlike large outdoor mobile phone base stations, femtocells don't require specialist RF planning engineers to design, calibrate or configure themselves, thus minimising the ongoing cost of maintaining them. They do have remote management from the network operator, who can upgrade the configuration and software as required.

Doesn't require special phones -

They are compatible with existing standard 3G and 4G

mobile phones and are not restricted to any specific models. No additional software is required to enable the phone to work with a small cell.

Advantages

- A solution for improving coverage in small areas at low power outputs
- Reliable and effective coverage and capacity
- Very small footprint
- Lower comparative cost and higher flexibility than macro cells or distributed antenna systems

Disadvantages

- Lack of orchestration across different systems and groups
- Uncertain deployment time for small cells due to site acquisition and zoning
- Backhaul continues to be a costly and complex problem for carriers
- Power is required that is often not accessible at the point of installation

The major issue with the heterogeneous network planning is to ensure that these small cells serve sufficient users. This can be ensured by making use of a positive cell selection offset to the SSDL of small cell called Cell Range Extension (CRE).

Market Outlook

According to the surveys conducted by 'Informa Telecoms and Media', in the year 2013, almost 98% of mobile operators responded that they believe small cells would be "essential" for the future of their networks, but the deployment has been proven to be difficult over the years.

Intel's case study states that in London over a span of 10 years, so as to put the costs of backhauling into perspective, total OpEx and CapEx for small cell deployments is around $141 million and $1.42 billion, respectively.

Report by Senza Fili Consulting says that small cells prove to be a better cost-effective solution than installing a three-sector LTE macro cell, which has an overall cost of ownership of over a five-year span of $279,412, assuming an equal mix of wireless and fiber backhaul, which costs up to six times as much as 3G small cells.

The analyst firm Mobile Experts states that carrier small cell deployments grew 140% in 2015, including both the indoor and outdoor units; and that the growth rate "will be even bigger in 2016". They expect enterprise small cell shipments to multiply by twice in 2016 with a 270% spike in sales growth. They estimate the enterprise small cell shipments to be worth $4 billion annually by 2020, whereas, the Transparency Market Research predicts the global femtocell market to be worth $4.7 billion by 2019.

The Impeding Prospect of 5G Networks

The digitization and efficient management of small cell systems with the use of technologies like C-RAN will allow the budding technology to adapt to a new network standard. Hence many experts believe that small cells will have a brighter future than DAS when it comes to 5G compatibility. Huawei's president of small cells product line compared future of small cells favourably to that of the distributed antenna systems. Even though LTE HetNets are fast becoming a reality; it may be challenging to deal with the higher control traffic, backhaul issues and the interference between the macro and small cell networks which the small cell brings during deployment. Also, the HetNets are more complex than the traditional macro only networks, hence automating the conventional manual and network optimization processes will be highly essential.

Indian Scenario

According to the report by Deloitte, there lies a tremendous opportunity in India, as the nation is on the cusp of a data revolution and wireless towers in the region are primed for a transformative period. As more and more Indian consumers replace standard cell phones with smartphones, demands on the network are at an all-time high. This explosion of data demand and switch from pay-as-you-go voice phones to pay-as-you-go smartphones is what Deloitte predicts will transform India's tower industry over the next five years.

Regulatory capabilities of 3G band(s) -
2100 MHz; UMTS

Regulatory capabilities of 4G band(s) -
850 MHz, 1800 MHz, 2300 MHz; LTE

Small Cell Initiatives -

- Ericsson has developed and launched Pico cells, which support multiple wireless technologies and work in coordination with the macro network. (Ericsson Small Cells)

- Ericsson has also focused on deploying IBS (in-building solutions), such as small cells and Wi-Fi hotspots which

facilitate better indoor network capacity and coverage. (Ericsson Small Cells)

• Ericsson had won a contract from Ozone Networks for the deployment and management of 30,000 Wi-Fi hotspots across India. (Ericsson Small Cells)

• Ericsson and Ozone to provide Small Cell as a Service Wi-Fi network for Reliance Communications. (Ericsson Small Cells)

• Reliance Jio has outsourced a part of small cell deployments to local cable operators, since have access in residential areas, which can save manpower in field work. (TMT intelligence| informa, 2017)

• In addition to a ubiquitous cellular network, Jio plans to deploy 1,000,000 Wi-Fi hotspots across India in 2017. (TMT intelligence| informa, 2017)

• Airtel is installing over 8,000 small cells across the country by the launch of a massive network transformation program – "Project Leap" under the partnership of Nokia.

Conclusion

The required capacity and spectral efficiency for fulfilling the ever-increasing demands for data traffic over the cellular networks can be obtained by the topologies with heterogeneous network featuring small cells with the underlying traditional macro cells. By deploying small cells in real life, controlled field environment and low power consumption, organizations are able to deliver an optimized solution with a target to meet the data rate, performance and latency requirements of both LTE and legacy networks. By providing the necessary capacity uplift and improved user experience with a cluster of co-channel that are required to meet hot zone capacity needs, LTE small cell underlay with a macro overlay can simplify deployment and operational impacts, and determine the use cases in which outdoor Wi-Fi access provides capacity offload. The customers are thus able to receive an exceptional small cell user experience, enabling the highest performance as well as lowest cost and power consumption per bit of data communicated for small cell network deployments. With the digitization and efficient management of technologies, the impact of small cells is set to increase tremendously in the upcoming years.

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IMPLEMENTATION OF BLOCK CHAIN TECHNOLOGY IN ROAMING FRAUD SCENARIO

Devanshi Jhaveri, Nishant Tyagi

Abstract

Blockchain is the underlying technology behind cryptocurrencies like bitcoin. It is presently the most widely discussed and hyped technologies. The blockchain technology has been explored across many industries for purposes of time saving, cost saving and revenue enhancement. This article states how blockchain can be used in roaming fraud scenario to deliver efficient services and overcome the drawbacks of present underlying technology using blockchain.

Keywords

Blockchain technology, Revenue enhancement, Cost savings, Smart contracts, Miners, Ethereum, Distributed ledger, Roaming fraud

Introduction

Blockchain technology carries the potential to disrupt the market across various industries including telecom and can increase transparency and efficiency in the process. However, applications of blockchain are still evolving and a set of regulatory standards still seem to come after a few years. Nonetheless, organizations across the globe have started investigating in the technology to avoid missed opportunities in both core and adjacent operations and business functions. Early movers in deploying this technology will position them better to gain advantages in terms of revenue growth and cost reductions when the technology is mature and ready for wider adoption.

What is blockchain technology?

The blockchain is a secured protocol enabling peer-peer on a distributed network in a secured, public and a non-repudiable way. A blockchain is a public ledger of all transactions that have ever been executed in the network. A block is the "current" part of a blockchain which records some or all of the recent transactions, and once completed, goes into the blockchain as permanent database. Each time a block gets completed, a new block is generated. Blocks are linked to each other (like a chain) in proper linear, chronological order with every block containing a hash of the previous block. To use conventional banking as an analogy, the blockchain is like a full history of banking transactions. Bitcoin transactions are entered chronologically in a blockchain just the way bank transactions are. Meanwhile, blocks, are like individual bank statements. The full copy of the blockchain has records of every bitcoin transaction ever executed. It can thus provide insight about facts like how much value belonged to a particular address at any point in the past.

Let us understand Traditional transaction vs Blockchain based transaction

Historically, when it comes to transacting money or anything of value, people and businesses have relied heavily on intermediaries like banks and governments to ensure trust and certainty. Middlemen perform a range of important tasks that help build trust into the transactional process like authentication & record keeping. In today's scenario if one entity wants to send money to another entity then their banks act as intermediary to transact money by authenticating their identities, checks balance and finally do clearing for a successful transaction to happen. When we do a global transaction (between countries) it takes more time than a country based transaction. Also a fee will be taken by intermediary on successful transaction of money between two entities.

Figure 1.Traditional Transaction

In a blockchain based transaction, two entities can transfer different types of blockchain based cryptocurrencies between each other. Sending entity asks for a QR code or a payment address which is the public key of the receiving entity. Sending entity then puts public key of receiving entity in application along with other details encrypted with its own private key to release cryptocurrency. The application alerts the bitcoin miners around the world in its network of impending transaction and it is grouped together in a cryptographically protected block with other transactions that have occurred in the last 10 minutes and sent out to the entire network. Miners (members in the network with high levels of computing power) then compete to validate the transactions by solving complex coded problems. The first miner to solve the problems and validate the block receives a reward. (In the Bitcoin Blockchain network, for example, a miner would receive bitcoins). Hence the money is transferred in at-the-most 10 minutes between two entities.

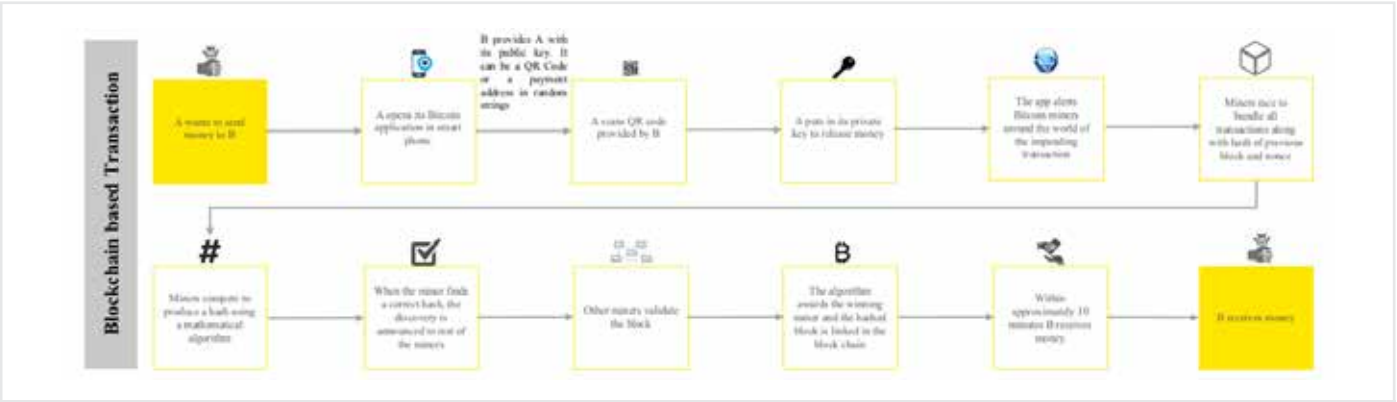

Figure 2. Blockchain Based Transaction

Key elements of Blockchain technology

The benefits of this type of multiple, distributed and decentralized storage are robustness and trust, at the cost of confidentiality and processing performance. All the nodes in the network verify the correctness of transactions. Network consensus methods and cryptographic technology are used to validate transactions. Hence, trust is established here continuously within the network not by any central intermediary or auditor. All the validated events in a blockchain are updated near-real time and are recorded in a sequential manner and time-stamped. Hence, tracing of any transaction becomes possible. Also, this decentralized storage is failure resistant. In case of failure of any node the blockchain remains available, eliminating single point of failure. Any information stored on blockchain is immutable. It prevents deletion or reversing of transactions once added to the blockchain as soon as further blocks are added. A smart contract, also known as a crypto contract, used in advanced blockchain like Ethereum is a computer program that directly controls the transfer of cryptocurrency between parties under certain conditions. Hence until and unless particular conditions are not fulfilled for an event to happen, a smart contract will not release any digital currency. It not only defines the rules and penalties around an agreement but also can automatically enforce those obligations.

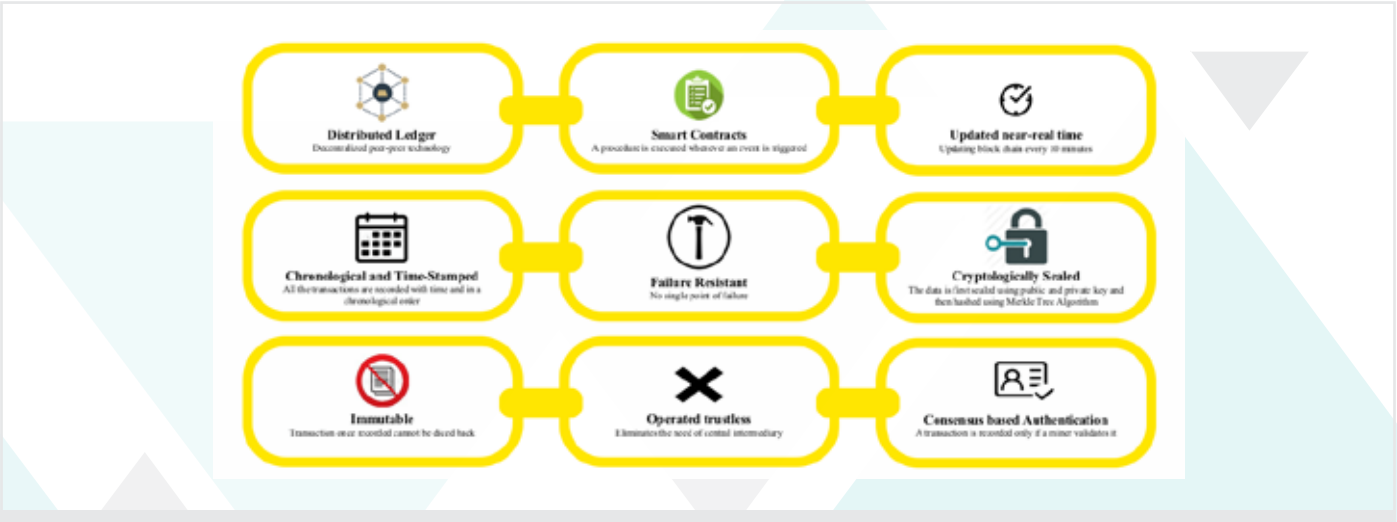

Figure 3. Key Elements of Blockchain Technology

Implementation of Blockchain technology in Roaming Fraud scenario:

A roaming fraud occurs when a user accesses the resources of the HPMN ("Home Public Mobile Network") via the VPMN ("Visitor Public Mobile Network") but the HPMN is not able to charge the user for the services provided, but is obliged to pay the VPMN for the roaming services. Some of the roaming fraud scenarios are interoperability faults, time delay in data exchange between network elements, network configuration flaws, internal management frauds, etc. Normally when a user places a call while in roaming, VPMN queries the HPMN about the services to which the roaming user has subscribed. The CDRs ("Call Detail Record") is sent to the billing system in their respective networks. The VPMN sends CDR information to HPMN as a TAP ("Transfer Account Procedure") file. Certain companies act as a DCH ("Data Clearing House") to process such files. Once the TAP files are received, HPMN settles accounts as per costs incurred with VPMN according to the roaming agreement.

Blockchain based solution

A blockchain can be implemented between every pair of operators (Communication Service Provider) which have a roaming agreement. Special nodes from both operators act as miners (special nodes in the network) to authenticate each transaction on the network. The roaming agreement is implemented between HPMN and VPMN as a smart contract that is triggered when a transaction containing the CDR data is broadcasted on the blockchain network. Every time a user triggers an event in a visiting network, the VPMN broadcasts the CDR information as a transaction to the HPMN. This data triggers the smart contract and the terms of the agreement are executed. The HPMN can thus automatically calculate the billing amount based on the services rendered and send this information back to the VPMN and also charge the user at the same time.

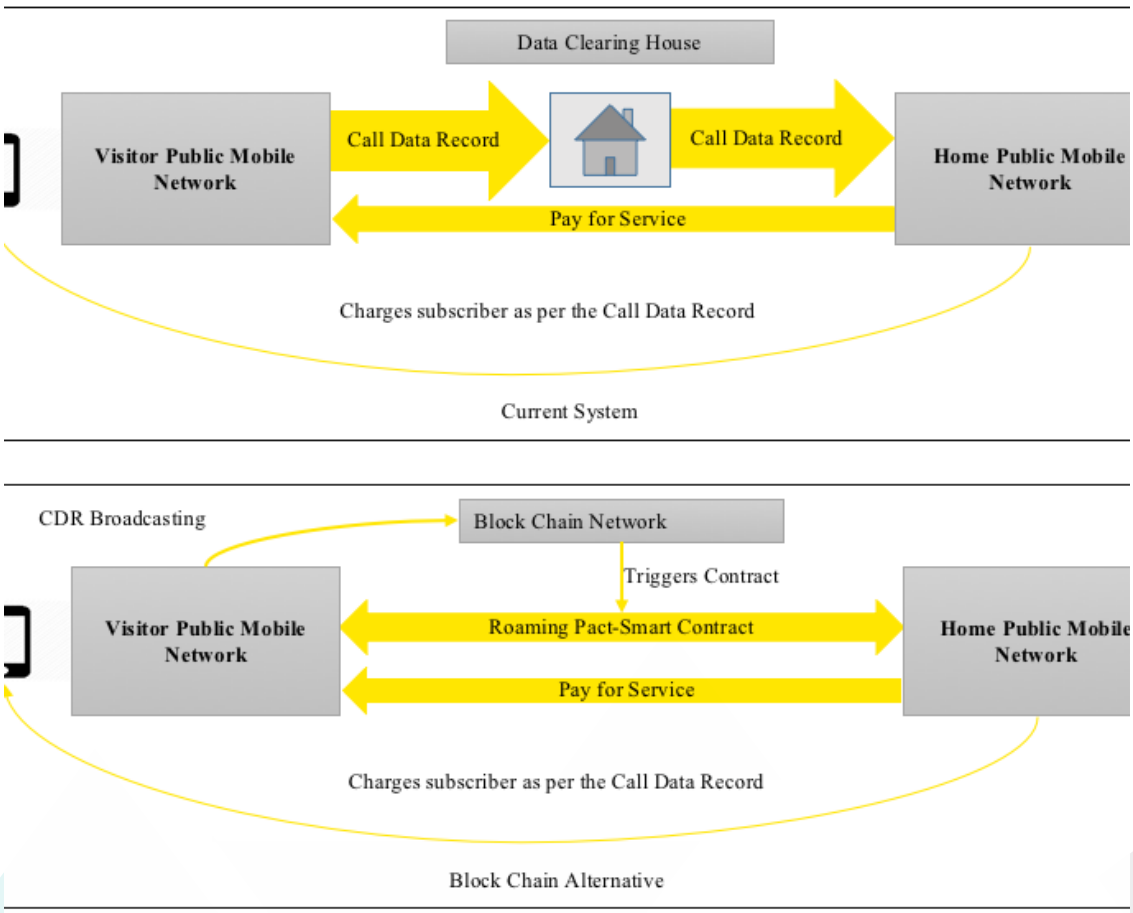

Figure 4. Roaming Fraud Scenario

Benefits of using blockchain based solution

- Reduction in cost due to elimination of Data clearing house
- Real time charging and roaming fraud minimization due to triggering of smart contract instantaneously
- Record of validated transactions between operators for quick dispute resolution

Challenges

Scaling -

For millions of calls happening across the nation in a single minute, authenticating those numbers of events and settling its bill will be a tough task to handle.

Irreversibilit -

All the events recorded in a block chain network are immutable. If one wants to reverse any of its transaction then it needs to marshal 51% of the processing power of the network to engage in a 'hard fork' of the network, where all the nodes agree to move simultaneously to an amended blockchain.

Security -

The security of a blockchain database is entirely reliant on the expenditure of processing power on verification of transactions and proof-of-work. Hence, a huge investment is needed to secure the blockchain network.

Conclusion

One thing is certain: Blockchain is here to stay. The opportunities with blockchain technology seem almost endless. Using such a distributed ledger between network elements can definitely lead to cost savings and assure revenue generation. To stay ahead of the competition and remain relevant to customers, businesses need to keep a close eye on blockchain and be prepared to adapt and transform accordingly.

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IMPLICATIONS OF CONVERGENCE IN THE ICT INDUSTRY

Paurush Verma, Sheetal Jain

Abstract

Growth in the ICT industry has been remarkable for more than 20 years. The reason behind such remarkable push has been the erosion of boundaries between the IT, Telecom and Media services. This has led to the phenomenon called as Convergence. Examples include internet television, M&A activities between Media and Telco companies. However, the convergence in the ICT brings along challenges on the policy and regulatory front. With Convergence in ICT, spanning on a global scale; the nature of the response to convergence may differ from country to country. Although, the countries whose regulatory frameworks are tailor made to local circumstances may reap maximum awards.

This paper explores in detail the implication of convergence on the ICT service industry to analyze the current market trends in convergence and identify the drivers, opportunities, and challenges that come along with it.

Keywords

Convergence, Telecommunication, ICT, Cloud Computing, Horizontal Convergence, Vertical Integration, Converging Regulators, Cyber Security

Introduction

Technology is one field which has seen a continuous and real-time drift in adoption and has been changing and upgrading ever since. This change is in the form of convergence of technologies, which has resulted in the convergence of businesses. To define technological convergence, it is a process by which Telecommunication, IT and Media sector, that earlier were operated independent of each other, are now growing together. It is a holistic convergence of SMAC (Social, Mobility, Analytics, and Cloud) that will provide organizations with the tools they need to run faster with more efficiency in order to connect with customers, partners, employees and rest of the world proactively. The paramount technological changes that have acted as a catalyst in convergence process are digitalization and computerization. Digitalization has given rise to the creation of new services within and beyond the realm of traditional communication sectors; whereas, Computerization has improved the data processing capabilities of businesses.

In the good early days, IT industry (Information Technology) and CT industry (Communication Technology) were two distinct fields, meaning telecommunications, Information Technology and Broadcasting operated independently with separate networks, content/ transmitted information, technology, licensing procedures, regulators under separate laws; but with the advent of rapid convergence; the boundaries between the two have started becoming increasingly indistinguishable. As a result of which, new industries have started emerging to deliver rich user experiences to its consumers.

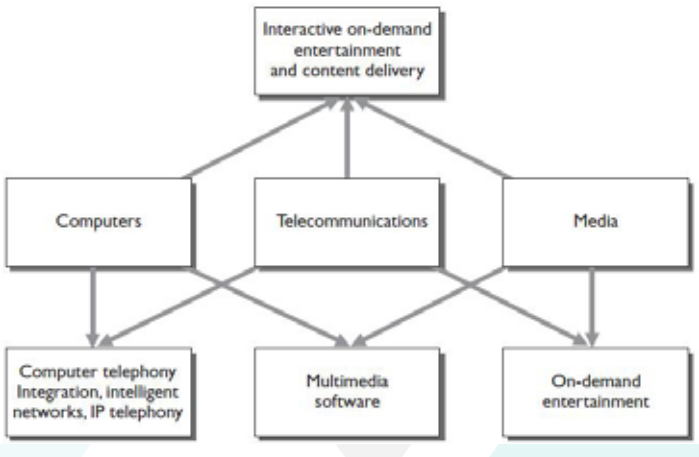

Figure 1.Examples of Convergence (Murillo, & MacInnes, 2002, p.58)

This fabrication of synergies, blurring of industry boundaries, integration and overlapping of industries and markets are all part of this term convergence.

In Cloud Computing, It's the Era of Convergence

The Cloud services have taken up space in the convergence of IT, Telecom and Broadcasting industries. The major challenges in integrating the three industries are the lack of common standards, interfaces and security specifications. The telcos have started moving their IT systems, VAS and Internet Data Centers into Cloud to serve different industries. The only roadblock that exists is the unification of standards which once applicable can drive down the cost of Cloud Services, facilitate interconnection and rapid development of next-generation technologies. Earlier, the telcos were more concerned with providing its subscribers an affordable mobile connectivity solution. With the transformation of CT into ICT, integration of multiple services on a single platform is widely available. Even, the meaning of pipes which were used in reference to bandwidth or throughput has evolved from a physical connectivity to an all-IP network. Similarly, IT industry has also been evolving post its transformation into ICT. In the past, traditional IT industry faced challenges in the form of inflexibility, low resource utilization, high energy consumption, high software, and hardware management cost and the inability of keeping up with the current fast paced industry markets. Post transformation, cloud computing has replaced traditional data centers (Huang, Guo, Xie & Wu, 2012).

Perception has changed in the ICT era in the following ways:

- Focus has shifted from data security to user privacy
- Focus has shifted from people adapting to new technologies to technologies being designed to cater human needs
- Focus has shifted from the use of only structured data to possible use of large amounts of semi-structured and unstructured data
- Focus has shifted from purchasing products to purchasing services

Cloud Computing has enabled rich user experience by adopting two key technologies- distribution and virtualization; this helped to unwind any service dependence on software, favoured resource sharing with data centers now on cloud and help accelerate deployment of services.

Different types of convergence

Network Level

Integration of different telecom, broadcasting and IT technologies within a single network. The use of multiple communication nodes on a single network offers flexibility, which was not possible with separate infrastructure

Functional Level

Technologies seem to offer more functions and services, when compared to its pre-converged form for different business needs and they help in fulfilling different technological needs of fast developing countries

Regulatory Level

Regulatory entities look to merge, in response to the consolidation of different industries and also identify the hurdles that can prevent countries from successfully adopting a common standard

Policy Level

Countries look at synergizing their ICT policies into convergence policies, in order to provide a common platform for different players and create common channel for delivering seamless and reliable content to end users

Market Level

Increase in the number of mergers, acquisitions and strategic alliances amongst ICT corporations, in order to drive maximum profit from the existing infrastructure

Convergence in Value Chain

The convergence in the value chain is depicted below in the figure, which talks about the technological drivers and barriers for the convergence process to take place in the different parts of the value chain. Each level mentioned in the figure relates to the technical dimensions of convergence:

- Convergence in content production is related to services convergence.
- Convergence in distribution is related to network convergence.
- Convergence in equipment production is related to terminal convergence.

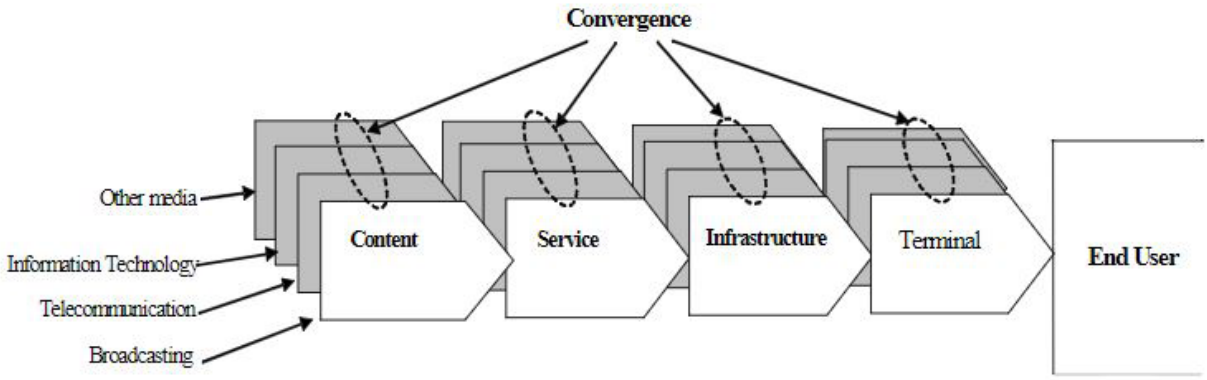

Figure 2. Convergence in the Value Chain (Henten, Samarajiva & Melody, 2003, p.5).

Market Trends

A company or a market/industry structure is designed mainly keeping financial considerations and corporate strategies in mind. Mergers and Acquisitions take place mostly between organizations within the same market/ industry. Still, cross-sectional and vertical M&A take place. Vertical Integration can mainly be seen between content production and distribution companies. Also, in the telecom sector, there has also been a disintegration of service provision and manufacturing sector, due to the separation of network provision and telecom service provision. Convergence in various verticals includes different sectors of the value chain. For example, convergence in distribution includes telecom and broadcasting sector, in production, includes all four sectors, while in equipment production includes IT and telecom sector.

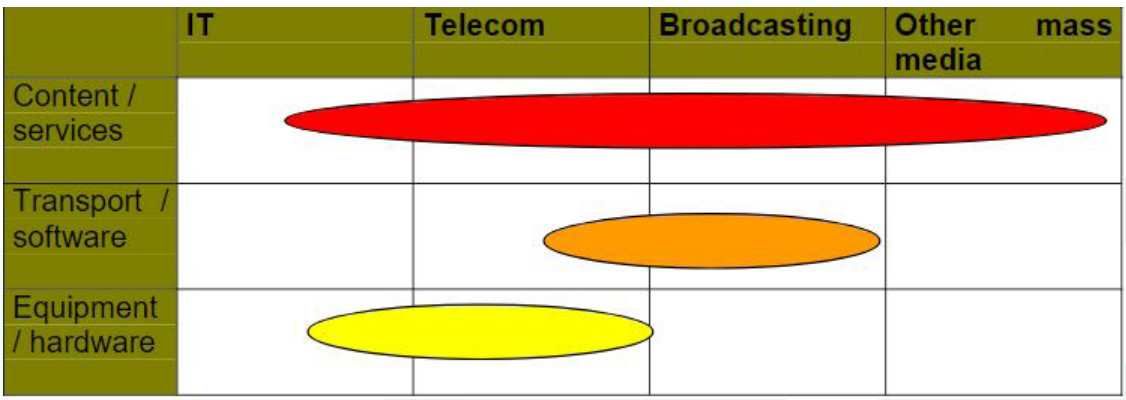

Figure 3. Trends in Convergence (Henten, Falch & Tadayoni, 2002, p.20).

Business Aspects of Technological Convergence

Technological Convergence between multi-delivery platforms and services results in increased competition and creativity among various industry sectors. Digitization and virtualization of technologies have cut-down on the latency issues, which existed previously in the legacy devices. The simplification of the complex telecom architectures with the implementation of Cloud Computing and all IP network has resulted in the reduced cost of telecommunication. Technological Convergence plays the role of a catalyst in promoting further development of efficient technologies and services.

Key Drivers

Digitization like IoT, 5G Mobility, and high-speed optical networking will be the key drivers for the growth across telecom and internet service providers. Technological advances in transmission techniques like 3G wireless cellular systems, emerging wireless sensors networks, ADSL/VDSL based digital subscriber lines are the few examples. Advancements in storage capacity, as majority of organizations, built storage systems comprised of Direct Attached Storage (DAS), Network Attached Storage (NAS) and Storage Area Network (SAN). Availability of wireless devices globally, as there were 16 billion wireless devices in 2014 and expected to reach to 40 billion by 2020 with net growth of 75%.The movement towards using IP in the transmission of all services and media using IP Multi-Media Subsystem that facilitates the use of IP for packet communication in all known forms over wireless or landline. Market Liberalization that drives strong economic performance and attracts large investors across the globe.

Opportunities

There are five areas in which operators must transform the convergence opportunities the way they do business in order to provide the best services to end users, they are availability of services for last mile connectivity, choice for flexible contract and payments terms, quality of services (both for voice and data end users), customization of services (also called as bundled services) in order to attract new customers and also help promote Interconnectivity across a wide range of media (Papadakis, 2007).

Challenges

Mergers and Acquisitions of large industry players converging with each other may reduce the choice for consumers and this may lead to monopoly with a high level of governed controls in the overall process. Also the unification of different regulatory organizations may result in more bureaucratic interventions, resulting in less scope of independent implementation of policies. One key aspect here is cyber security, which is meant to provide network/information/data security and integrity to end users (Papadakis, 2007).

Convergence of Competition: Example from Smart City Industry

Companies involved in developing smart cities will not just partner and converge among themselves to produce "smart" capabilities; but also, start converging with different participants in the ecosystem.

The global smart city project is proposed at a market value of $1.5 trillion by 2020. It is also proposed that there will be around 80 billion connected devices by the year 2020 and the internet economy will be valued at $14.7 trillion. It is estimated that the Big Data market will show a 40% growth in the year 2020, the 3D/4D printing and wearable devices market will grow up to be valued at $7.3 billion and $11 billion. With around $11 billion worth of bitcoins circulating in the market, the digital currency sector is supposed to grow. From personalized robots, to nanobots, to powered exoskeletons, to 4D printing, to augmented reality/ virtual world; these are the upcoming industry trends for the next 4-5 decades (James, Frost and Sullivan, p.23).

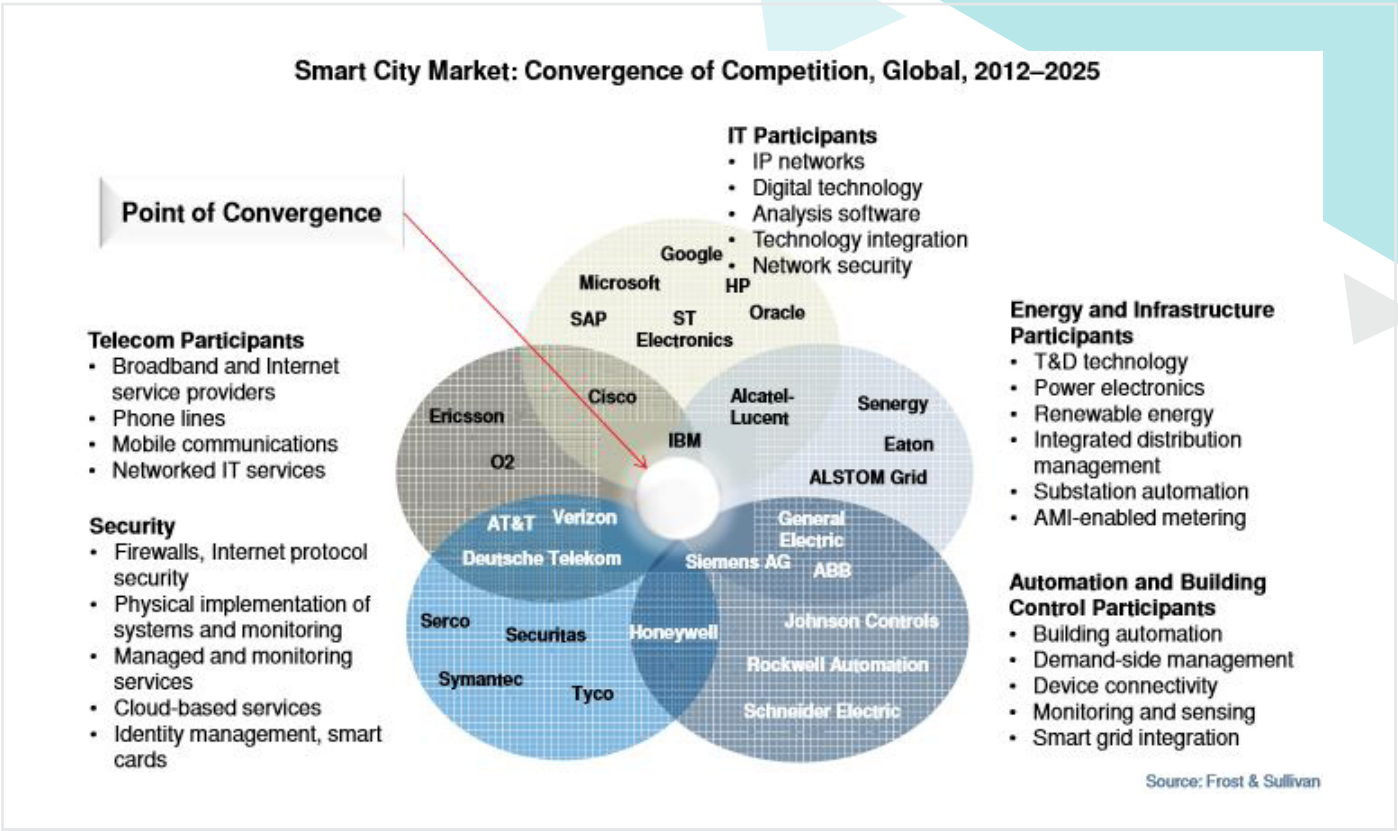

Figure 4. Convergence of Competition: Example from Smart City Industry (Frost & Sullivan, 2013, p.9).

Conclusion

Convergence does open up wide and diversified revenue opportunities, but with that, there also are financial, regulatory and competitive risks, most of which are not yet fully understood. The promising latest technologies can be taken over by cheaper solutions which would be more efficient and would be available sooner than expected. Innovations could increase companies' fighting over intellectual property rights and user data security could pose the biggest threat of all. However, for those companies that can get their convergence strategies right can reap the maximum rewards.

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LEVERAGING BLOCKCHAIN TECHNOLOGY FOR THE SECUTITY OF IoT DEVICES

Yash Nalawade

Abstract

It is estimated that by 2020, 50 billion machines/ devices will be connected to the internet and by 2030 each person shall have 15 devices serving him/ her which shall communicate with each other over the internet as compared to current number 2 billion [TEDx (2012)Dr. John Barrett][EY Cybersecurity and the Internet of Things (2015)]. To better serve the customer or to save on operational expenditure IoT is being embraced readily across industries. As per Gartner, there are 6.4 billion connected devices in the world, 30% hike as compared to 2015 [Gartner (2015)]. With IoT, organization can gain granular insights into their operations and services, as such never possible before.

As the number of devices connected to the network increases so does the risk to an organization. The organizations today, though are better equipped to handle cyber-attacks, are prone to increasingly malicious activities of cyber attackers. Hackers continue to develop new strategies and methods to search and exploit vulnerabilities in the IT infrastructure of an organization. Massive deployment of IoT devices in the field by a company is like creating more doors to enter a castle as each IoT device is like an access point to the network of an organization. Attacking the IT infrastructure of an enterprise requires certain level knowledge and expertise on part of the attacker but IoT devices which are meant to be low power consuming sensory apparatuses with limited computational power pose as a soft target for hackers to attack. As per an EY report, 70% of the most commonly utilized IoT devices pose some or the other vulnerabilities [EY Cybersecurity and the Internet of Things (2015)] In the case of a utility company using smart meters though damage to IT infrastructure may not be so significant it may lead to leakage of revenue to them. Today companies increasingly are shifting to smart meters for metering utilities like power, water, and gas. Despite the new sophisticated technology being employed the threat though reduced is ever present.

Introduction

Internet of Things

Just as humans use the internet to communicate with each other, the thought that machines communicating with each other is the fundamental idea of Internet of things. Although the primary concept laid emphasis on machine-to-machine communication, in the current scenario it has diversified [TEDx (2014) Benson Hougland]. Internet of things is not new; in 1982 students of computer science department of Carnegie-Melon University connected a coke vending machine to the internet. This enabled them to know the temperature of the machine, also if it had cola cans or not [Gary Smith (2015)]. The term 'Internet of Things' was coined by Kevin Ashton while making a presentation for Procter & Gamble in 1999 [Lopez Research (2013)].

Internet of Things: Basic Architecture

Architecture for IoT is relatively simple to design. But a standard architecture which can be used for varied heterogeneous applications is still absent. The IBM describes 5 layers commercial architecture for IoT architecture namely user layer, proximity network, public network, cloud and enterprise network [IBM () IBM cloud architecture]. A simpler architecture is mentioned in Internet of Things: a survey by Wu Hi and Shancang Li. It consists of just 4 layers; sensing, network, service, and interface [Wu and Shancang Li (2014)] shown as alongside. There are hundreds of Service oriented architectures available to refer; though they differ the core concept is same across all.

One of the most widely used Architecture for IoT device is called "Smart, connected Product" architecture observed to be used by many OEMs. It is both simple and proportionately elaborate considering IoT device. It has 4 layers Interface Layer: It services as an interface between the service and the user. It can be an app or a browser

Analytics Layer -

Hundreds of IoT devices send raw data to the service. To make sense of this data is the job of this layer

Network Layer -

it helps an IoT device communicate to the service

Layers	Description
Sensing	This layer contains various sensors and associated peripherals which are to be used as per the application. The sensor can be photodiode, ultrasonic etc.
Networking	This layer consists of the networking module while helps the device communicate with the network it can be LoRaWAN, Wi-Fi, Zigbee etc.
Service layer	This layer is responsible for managing the service being provided.
Interface Layer	This layer serves as a medium of interface between the user and the service.

Figure 1. Basic Architecture of IoT

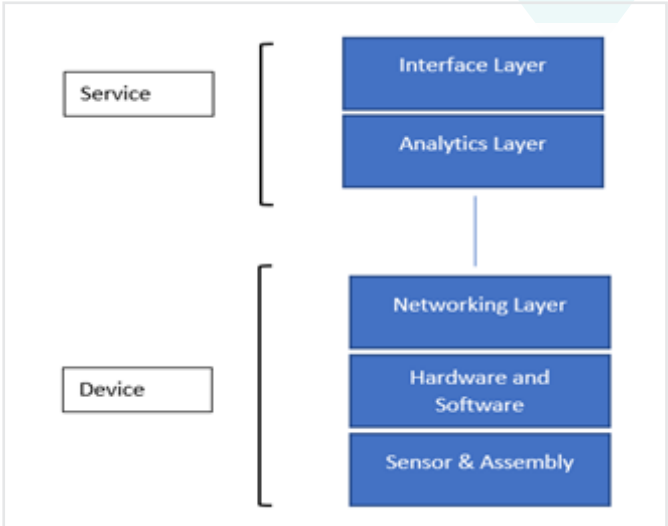

Figure 2. Smart, Connected Product Architecture

Hardware and Software -
it includes the microprocessor and its firmware

Interface Layer -
It services as an interface between the service and the user. It can be an app or a browser

Sensor & assembly -
This layer is associated with the sensors necessary for sensing and its driver assembly

Blockchain

The blockchain is a shared digital ledger in which every party in the network has access to view this ledger. It is a secure and reliable technology, operating on a peer-to-peer basis, used for recording data. Blockchain was first proposed by Satoshi Nakamoto, an anonymous Japanese person/group, in 2008. It is the foundation on which the popular crypto currency 'bitcoin' is built. In blockchain data is stored in the form of a block; each block is cryptographically linked to next block forming a chain. Hence the name 'blockchain'. The advantage of recording data in such way is that if the content of one block is modified it will be reflected in all the subsequent blocks. Thus, any modification to the original information can be easily identified, making it easier to trust the authenticity of the information recorded in it.

Working

A block is the constituent unit of the blockchain. Each block has fields such as block no. nonce, data etc. as shown in the figure above. Along with these fields, there is also a time stamp applied to each block. All this information is run through a hash generating algorithm like SHA 256. The output of the algorithm is a 256-bit hash. This hash is like the digital fingerprint of the block hashes are unique for every block, even a letter being changed in the data field of the block will cause the hash to change significantly. Unlike encryption data which can be decrypted to obtain original information, it is almost impossible to obtain original data from the hash.

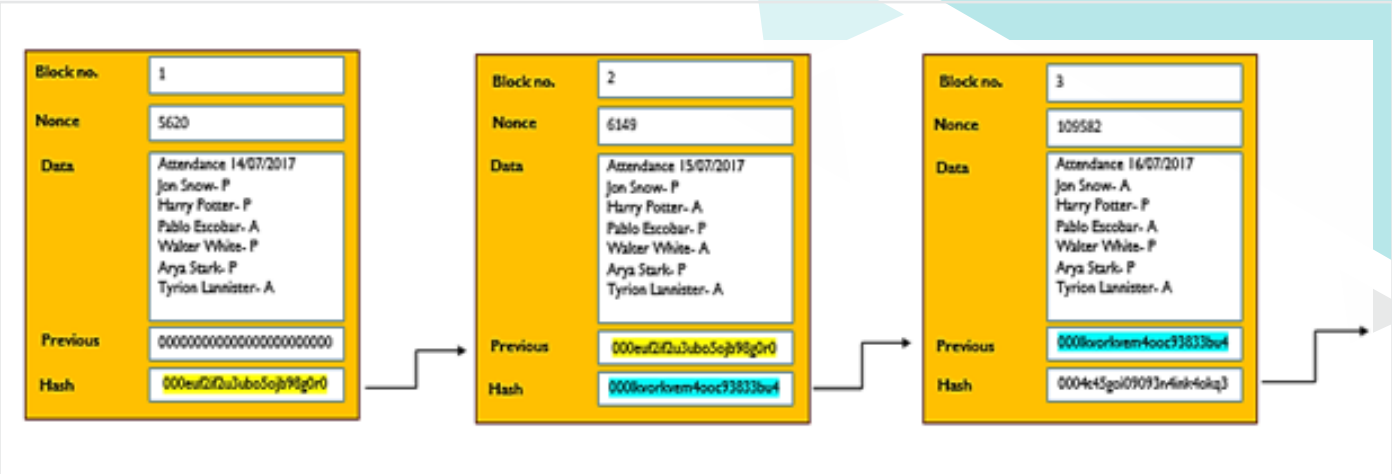

Figure 3. A Simple Blockchain

This hash of the current block is fed into the 'previous' field of next block. These hashes of the previous block along with the data in various fields of a current block form another hash, which in turn is used in the previous field of the following block. This is how the blocks are linked. Any change in a block will cause its hashes to change and hence will also cause hashes of subsequent blocks to change also, thus setting off a chain reaction. To ascertain if a block is genuine one must check the leading characters of its hash function. If they start from zeroes then the block is held to be genuine if not then otherwise. This is how the authenticity of records contained in each block is guaranteed.

Proof of work

This is a procedure by which a block is added to the blockchain. Each node in the system will validate the block, if all the nodes involved in validation reach a consensus then only the block is added to the blockchain. In simple words consider 5 people are asked to solve a math problem e.g. "A+A=6; AxA= 9, Find A" the solution to this problem is 3. But this will only be accepted as a solution if all the 5-people asked to solve the problem agree to it and this is done by each one validating the solution [IBM (2016)] [MANGEAT (2017)] [Dr. Arati Baliga (2017)] [https://anders.com/blockchain/] [Satoshi Nakamoto (2008)].

Proposition 1

Considering the scenario where multiple smart meters must send their sensory measurements to a central server. Smart electricity meter, they send the kW/h measurements to the central network. In this case, the central server or the power company isn't aware if their meter was physically tampered with or not. Power companies in developing countries like those in South East Asia and Africa physically send personnel once a month to each power meter at customer premises for taking the reading from it and verifying if it is still untampered. A significant amount of operational expenditure is associated with this activity.

Figure 4. Smart meter ecosystem

The solution Proposed is based on "Proof of Work" concept which is employed in blockchain for consensus building among various nodes involved in mining. The smart meter contains some sensory calibration parameters which are set as per standard by the power company. Owing to the digital built-up of meters today the meter and the source code/logic housed in it which is used for proper measurement of utility consumption is prone to tampering. To counter this each meter is required to generate a 'Hash' value. This hash value shall be generated by a combination of the source code, The Ideal sensory parameters defined by the Power Company and Nonce (Random Number). The Nonce shall be generated by a PN sequence algorithm in the meter. The hashes will be sent to the central server by each meter via a mediatory gateway between them. At the central server, there shall be a SIoT platform (social

networking platform for IoT) [Luigi Atzori, Antonio Iera and Giacomo Morabito (2014)]. At this stage, the Proof of work concept in blockchain technology comes into the picture. Based upon the source code, the standard sensory parameters and the nonce each meter will generate the same hash. At the central server hash of each meter shall be verified against its own by every meter to establish a consensus. Under ideal conditions if the source code and the sensory parameters are not tampered with and if the Nonce being generated by every meter are in sync then each meter will produce the same hash(unique meter ID is not used for generating hash, it is communicated separately). In this case, there will be a hundred percent consensus among the meters and thus a block of current meter readings will be created and linked to the earlier block.

In cases, if suppose a meter is tampered with and it sends a different hash to the central server then in the consensus stage that meter can be zeroed down as being rogue. On detection of such a meter, the central server can push the standard device configurations like the source code and the sensory parameters onto the meter. The central server can then instruct the meter to re-generate hash which shall be compared with hashes of the other meters. On consensus being achieved a block will be added to the blockchain as before.

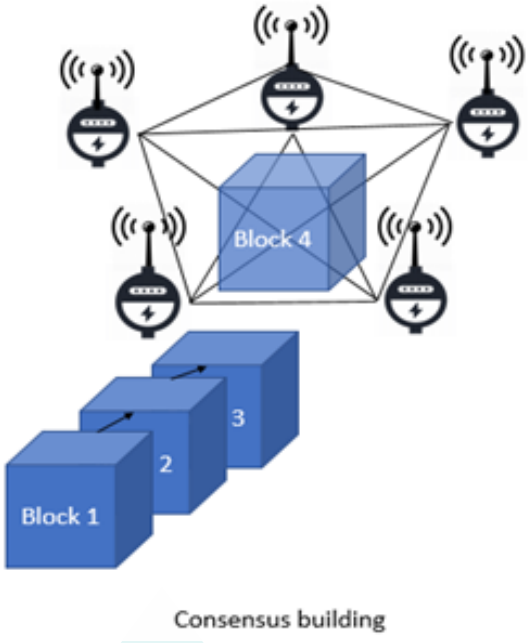

Figure 5. Consensus Building

Why is nonce included in generating hashes?

As most of the time, the hashes generated by the meters will be same as the source code and standard sensory parameters should ideally remain un-changed, the Nonce is added to prevent 'Man in the middle' attack. It is possible that a certain device is placed in between the gateway and the meter. This device captures the hash being sent by the meter to the gateway. The meter can then be tampered and same hash will be sent to the central server. Here even if the meter is tampered the central server will not come to know of the happening as hash received will be same. To counter this, Nonce is included while generating the hash along with the source code and standard sensory parameters and it will keep on changing. While installing of a new meter this Nonce can be mined until the current sequence is obtained to achieve consensus later.

Proposition 2

As cited before, by 2020 people would be having at least 6 devices associated with them, communicating

Figure 6. Consensus Building

over the internet. In such cases, blockchain technology can be used for securing personal information of the user as well as for the personal security of the user.

In an M2M environment where multiple devices communicate with one another to serve a single person the risk of private information of that person being stolen or he/she being spied upon is real. Hackers can program a device to send them sensitive data of a person's activities. Hackers can also insert a rogue device, which sends data to the hacker over the victim's Wi-Fi, to spy on that person. In this case here is how the proof of work and blockchain can provide security; every device serving the user will have the certain configuration which will be set by the user. The configuration might be IP address of the home server, its own IP address, WLAN settings and other security settings. Since these are fixed parameters, the hash is generated based on these. Every transaction/ communication a device does with other shall be recorded in a block along with the identifiers and hashes of every device. Whenever a block needs to be added to

the block chain the device in the ecosystem catering to the user shall scan the complete blockchain and verify the previous hashes of the transacting devices against the current hash. This will be done by every device in the ecosystem and only when a consensus is established, over SIoT platform, how would it be? Will a block be added to the blockchain? If for a known device, hashes do not match then it will be deemed as hostile and the user will be alerted, moreover, the system can also be a programmed to block that device. The outcome of this is the hostile device cannot communicate with other devices and thus is left out of the ecosystem and in the case of a new rogue device being planted in the ecosystem it will effectively be detected and blocked as well. Here onwards only those devices which pass the consensus test will be allowed to contribute to the blockchain.

In the case pertaining to the addition of a new device to the ecosystem the user will have to do it by manually

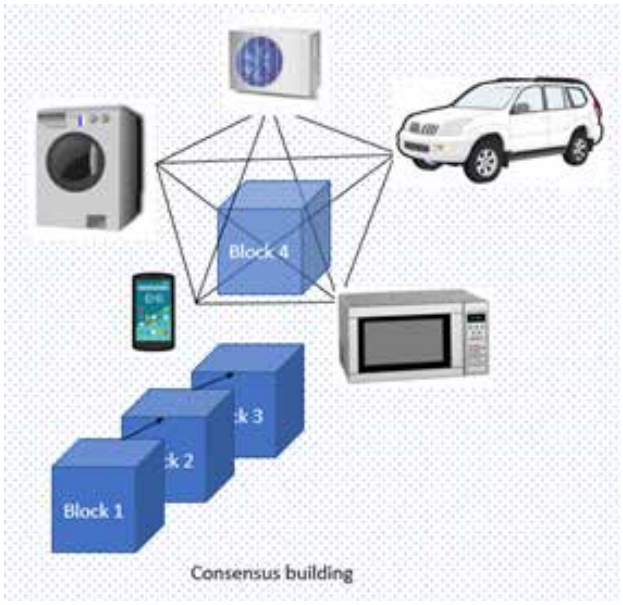

Figure 7. Consensus Building M2M

overriding the consensus procedure and adding the block to block chain, this means creating a brand new blockchain itself. It is likely that this provision can be exploited by the hackers but it must be remembered that the solution proposed for device security is contained within the M2M ecosystem serving the user, the security of which is completely different issue and in anyway can be implemented using contemporary cyber security solutions, tools, and practices. It is important to note that devices in an M2M ecosystem catering to the user may be smartphone, car, AC, microwave etc. none of these devices are bought on the frequent basis. Hence while configuring the system it is done for the significantly longer duration.

Conclusion

As more and more devices connected to the network increase, their security is going to be a major concern for organization, governments and users alike. This paper is an attempt to secure the IoT devices using the "proof of work" and the blockchain technology. The solution though does not provide complete security to the ecosystem as whole and as mentioned before the security of the IoT devices is contained within the security boundary of the ecosystem itself, which requires different cyber security protection. Though the solution proposed here needs to be elaborated on the granular level, as of on paper it is logical and a feasible one.

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SECURITY: A REAL THREAT TO VoLTE SUCCESS

Nagarjun, Kruthika More

Abstract

LTE has introduced new cost-saving and revenue-generating features where the profits of the Cellular Service providers across the worlds are increasing with increasing the life enhancement capabilities for the end users. But even it has much significant vulnerability which never existed in legacy networks. For example, the encryption in 3G traffic is encrypted at end user device and is terminated on network whereas LTE's network termination is on eNB.

In this Paper, we have discussed such vulnerabilities across different nodes and how they are being used to exploit information between users.

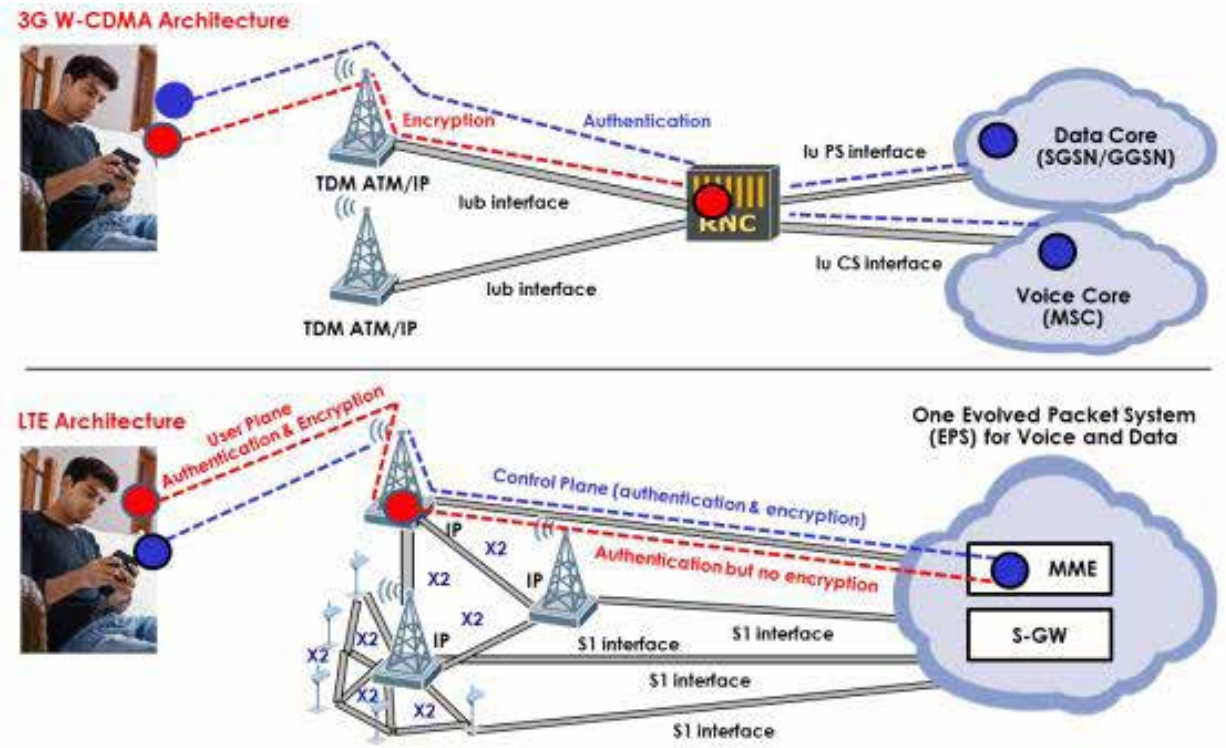

Figure 1.Comparison of Encryption in 3G and 4G

Keywords

VoLTE, HeNB, MitM, Dos, DDoS, eNB

Introduction

The evolution of wireless network has set the stage for the rise of 4G and then VoLTE which allows transmitting voice calls over data layers. This technology is associated with 3 planes viz. data, voice & control. Data plane is used for Internet, Voice plan for voice calls & control plane manages signaling for both the planes (Firdaus, H. (2016)). Most carriers and service providers are switching from circuit-switch to packet-switch, third-generation wireless (3G) technologies to fully Internet Protocol (IP)-enabled, fourth generation (4G), end-to-end technologies. The weakest link and vulnerable aspect of VoLTE are the devices. This is introduced through carrier infrastructure, greater bandwidth & connection to multiple devices (Firdaus, H. (2016))

W-CDMA networks have leapfrogged PSTN/twisted pair networks to service rural communities, especially in the Asia Pacific, Latin American, and African regions. Access points inside the home provide the local network interface, and LTE networks are being deployed to backhaul the data traffic.

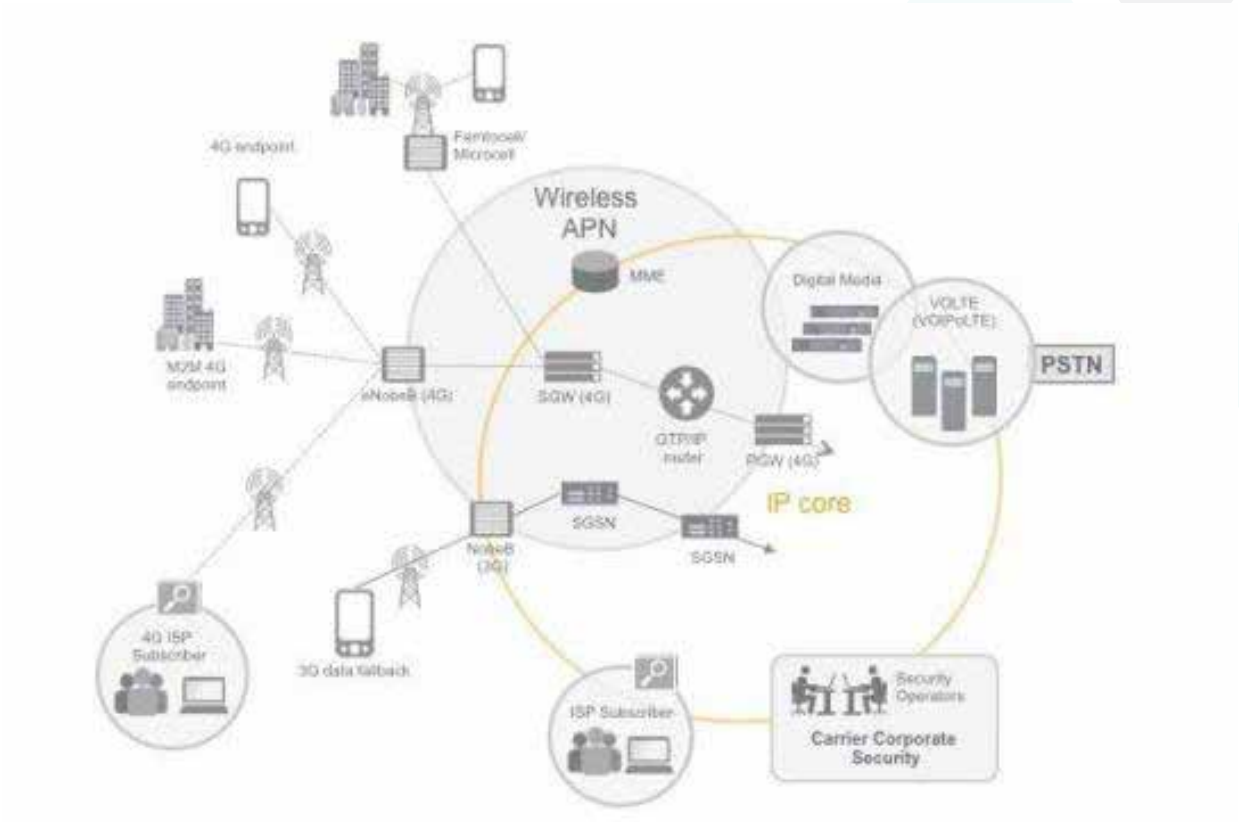

Figure 2. E2E Networking Connectivity

Threats

The aim of security measures is to prevent all the LTE interfaces and elements where the outsiders have the minimal opportunity for fraudulent activities. The first step of security planning is identifying the security threats (Tyson Macaulay. (2013)). Based on the security risk analysis the system is designed to counter-measure all the identified security risks. Next level of security is on the software level where securing the code would be the prime most tasks in security. (Chi-Yu Li, G.-H. T. (2015))

At the end of security process, comprehensive security testing has to be taken into account about imaginable attack times in the normal operation of network.

Some of the threats include -

- Cloning of HeNB credentials
- Physical attacks of HeNB, e.g. Tampering
- Configuration attacks on HeNB i.e. fraudulent software updates
- Protocol attacks on HeNB
- Attacks against Core network i.e. Denial of Service
- Attacks on user data & identity privacy by eavesdropping
- Attacks against Radio resources & management

Preparation of Attacks -

- Air link Security (U-plane & C-plane): Ciphering algorithm, definition & description of integrity protection algorithm (Hina, F. (2016)).
- Transport Security: Definition & Description of ciphering and integrity algorithms for transport network

Intra LTE & Inter System Mobility: Definition of security aspects in Handover processes.

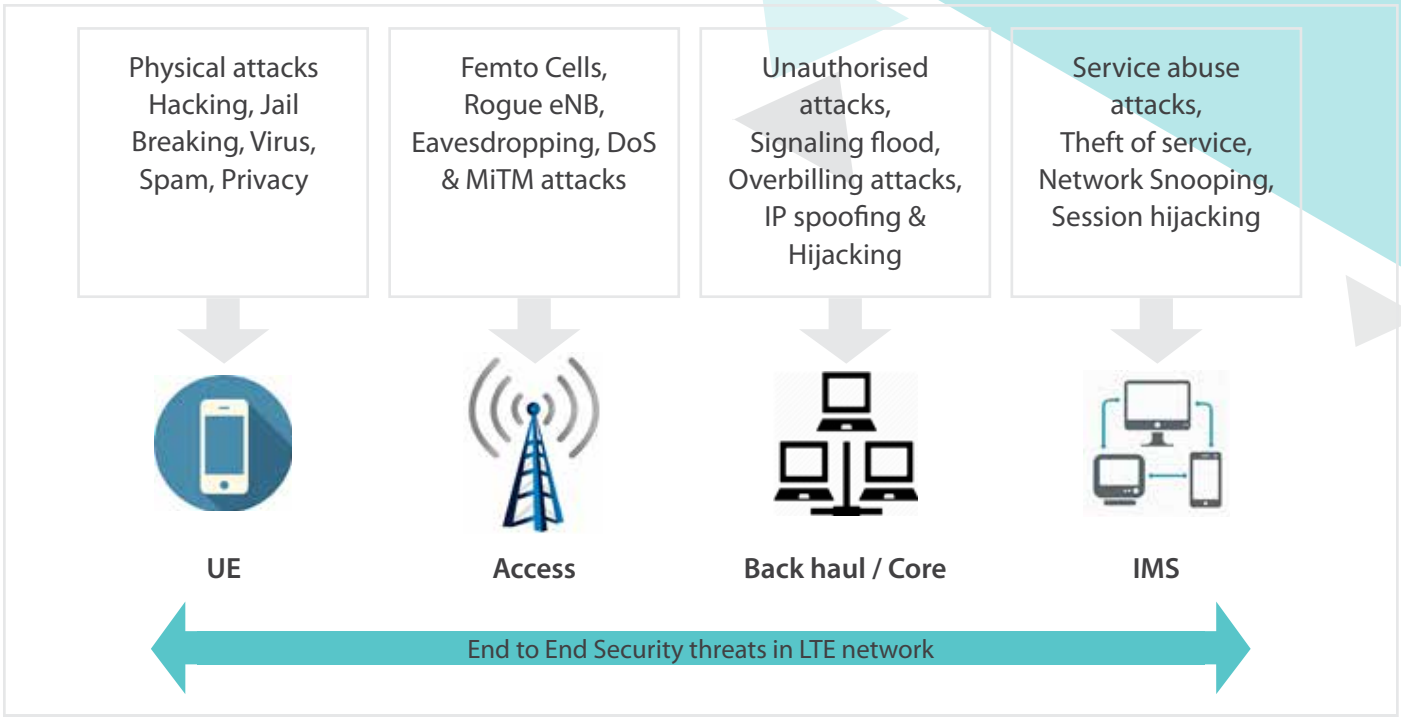

Figure 8. Node Wise Threats in VoLTE Architecture

Key Security threats/risks

Distributed network and open architecture -

• 4G LTE is an all IP based end to end deployment where seamless roaming with service continuity is offered to the end user

• Share security risks and threats as their respective infrastructures and services are now interconnected into one aggregated service providing network.

• Distributed network and open architecture leads to weak security configurations on one device or interface provide the entry point to attackers looking to compromise the LTE network. (Guan-Hua Tu, C.-Y. L. (2015))

Complex business models with infrastructure (IS) and service sharing -

• Cost benefits will lead MNOs into different models of active infrastructure sharing arrangements with new revenue sharing business models

• Multiple MNOs with varying security controls and standards interconnecting with shared pools of network elements pose a threat to security levels (Guan-Hua Tu, C.-Y. L. (2015))

Decentralized accountability -

• MNOs wanting worldwide presence, end to end security levels to subscribers will find it problematic that a single MNO does not have unilateral decision control over security parameters of the LTE networks and operations

• Decentralized accountability and lack of overall control on security of the LTE service experience will be worsened as hosted and cloud services penetrate the marketplace creating new and complex operating models.

Minimizing security spends -

• LTE operators should spend millions of dollars required for a full IPsec rollout alongside other security infrastructure deployments

• With LTE the interconnectedness of the network brings the security level to the level of the least common denominator, lowering security thresholds

User Equipment's security

Physical -

• Increased Intelligence & processing capabilities of LTE handsets parallely increases the sophistication of possible cyber-attacks on UE

Data loss & Privacy -

• Deloitte reports state "90% of user passwords on LTE devices are vulnerable to hacking in a matter of seconds"

• Due to more data rate capabilities & storage in LTE UE's, it tends to store more data which would become attractive to target from attackers

Security Standards -

• Many devices with disparate, open and proprietary operating systems (OS) and software

• Lack of Security Management tools and operators allowing unsecured devices to connect to their network

Application Vulnerabilities -

• As VoLTE is IP-based service they are more susceptible to IP based attacks

• The external applications are more prone to viruses, malware, spam, phishing and similar threats that compromise the integrity of the device, bandwidth usage on the MNO network (Bonmin Koo, S. K.)

• McAfee states "here was a 4000% increase in mobile malware year over year in to just under 37,000 variants."

Access

Physical attacks -

• Due to space constraints and increase in demand of LTE bandwidth introduction of Femtocells, smaller cell sites, installation of eNodeB's in public locations & installation of less expensive HeNBs (Pascal Bisson, J.-P. W. (2014))

• eNB are prone to Physical threats by unauthorized access to network

Eavesdropping, MitM (Man in Middle attack) attacks -

• Unencrypted data between UE & eNB is prone to attack during initial attach which allows eavesdropper to track the user cell-location or launch a man in the middle attack by user identifier (IMSI) impersonation (Pascal Bisson, J.-P. W. (2014))

Rogue eNodeBs -

• Introduction of Rogue eNB into the network can intercept voice and data transmission from the UE and redirect user traffic to a different network

Privacy -

• Attackers can utilize paging procedures to locate phones by injecting paging requests multiple times and correlating the gathered temporary identity (TMSI) of the phone with the paged permanent identity IMSI(Meena, U. S. (2016))

• Attackers can replay the intercepted authentication request and determine the location of the user.

EPC / Transport

Unauthorized access -

• During Roaming, operators should authenticate systems to allow subscribers to access the internet

• Untrusted roaming devices have to allowed interconnection to enable service continuity while roaming

DoS and DDoS attacks -

• Nokia states "The signaling requirements between the EUTRAN and the EPC in the 4G architecture is about 40% higher per LTE subscriber than 3G networks" (Humma Shoket, J. S. (2017))

• LTE architecture is flat, all the signaling traffic generated at the EUTRAN flows to the MME and if signaling load either benign or malicious exceeds the provisioned capacity of the MME, then service may be compromised

Overbilling attacks (IP address hijacking, IP spoofing)-

• VoLTE is IP-based service which can be easily prone to IP address hijacking, spoofing, packet injection in LTE networks

• When IP address is being returned to the IP pool hijacker can attack the IP address of subscriber and takes control over it & utilizes the LTE data services at the expense of the subscriber

• When IP is reassigned to another subscriber, overbilling also may occur

Service Networks

Unauthorized access -

• IMS is open and distributed architecture which may lead to multitude of distribution points that must be secured

• IMS makes the network semi-vulnerable during IP peering between service providers with diverse service offering and varying security standards

Service abuse attacks, Theft of service -

• Service abuse is when subscriber gains more privilege to services than those allocated to the user by accessing UE using compromised UE

• Theft of service is achieved is by the UE while not releasing the established media stream between a UE and IMS core after a Bye request has been sent to a call session control function (CSCF) which leads the CSCF to stop accounting for the session while the user or attacker continues to stay connected to the media stream (Peng C, L. C. (2012))

Network snoop, session hijacking -

• Attackers intercept the information flow between two users in a SIP session where SIP signaling can be captured using tools like Wireshark

• Session hijacking is when attacker inserting malicious packets, substituting traffic and breaching integrity, impacting QoS and service (Peng C, L. C. (2012))

Conclusion

As the wireless networks evolved from inception, the intelligence is diversified to all the nodes of the network but failed to implement enough security measures to protect the data. Here we have discussed some of the vital threats across different planes where the info can

be lost to intruders by implementing easiest methods where the security aspects of the nodes have to be upgraded as the VoLTE would be the dawn of wireless networks where there will be increased usage across the world.

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EVOLUTION AND GROWTH OF FINANCIAL TECHNOLOGY IN INDIA

Purvi Chugh, Sayli Rajapure

Abstract

India has a cautious regulatory system for various financial activities. The Financial Technology Industry is changing its policies to tap into its potential market space and at the same time is attempting to balance it with the right amount of oversight. This is necessary to facilitate new entrants and technology start-ups, greater availability of infrastructure, an opportunity to grow and most importantly better financial inclusion in the country. Optimistic strategies should be adopted with an effective regulatory system. The article includes the scenario of Financial Technology market in India along with the various strategies adopted, different innovations and role of government in encouraging Financial Technology.

Keywords

FinTech, Ecosystem, JAM strategy, Technology, Stages, incentives, regulatory aspects

Introduction

The world is witnessing a major shift in financial services. The primitive and conservative world is vanishing, in its place is emerging a new era whose base is science and technology. Technology is changing fast as to how we pay, lend, borrow, invest, insure and do a host of financial activities or transactions in our personal as well as business lives. Global financial services businesses or institutions which handle all these kind of activities had till now managed to sidestep the onslaught of technological "tsunami" unlike in most other industries.

FinTech basically refers to the technology-based businesses that compete against, enable and/or collaborate with financial institutions. FinTech start-up firms usually engage in various external partnerships with different financial institutions, large number of universities and research institutions, along with government agencies, industry consultants and diversified associations. Through these partnerships, they try to create a highly integrated ecosystem that is capable of bringing with it the expertise, experience, technology and facilities of all the entities together.
With a population of around 1.3 billion, India is a rapidly growing market for FinTech. A large percentage of unbanked or under banked population and the known fact that it is a young nation witnessing tremendous high growth in digital penetration, makes India an exciting global space for FinTech. With over half a billion dollars regularly flowing into start-ups, FinTech in India has grown at a very rapid pace in the last three years and the same segment is expected to grow further. Banks and financial institutions have taken note of this

Figure 1. Companies which Changed the Landscape

and hence are actively participating in the ecosystem. The government and the regulatory bodies take several initiatives to boost the FinTech ecosystem and provide start-ups with various new opportunities to launch a high amount of competitive products.

The FinTech companies have evolved the landscape with Kabbage, Nutmeg, TransferWise, Paytm, Lending Club and Bitcoin being the major ones. Kabbage has transformed SME lending by creatively assessing credit risk and providing loans in record time. TransferWise- Matches a remittance transaction to a reverse transaction on the same route and settles locally, avoiding international transfer charges.

Lending Club-
It has reduced intermediation of financial incumbents by opening direct channels between borrowers and investors.

Paytm -
Wallets have allowed consumers to consolidate multiple solutions into one.

Nutmeg -
it has recently acquired small investors by reducing the investment levels.

Bitcoin -
it uses shared technology that validates transactions network wide.

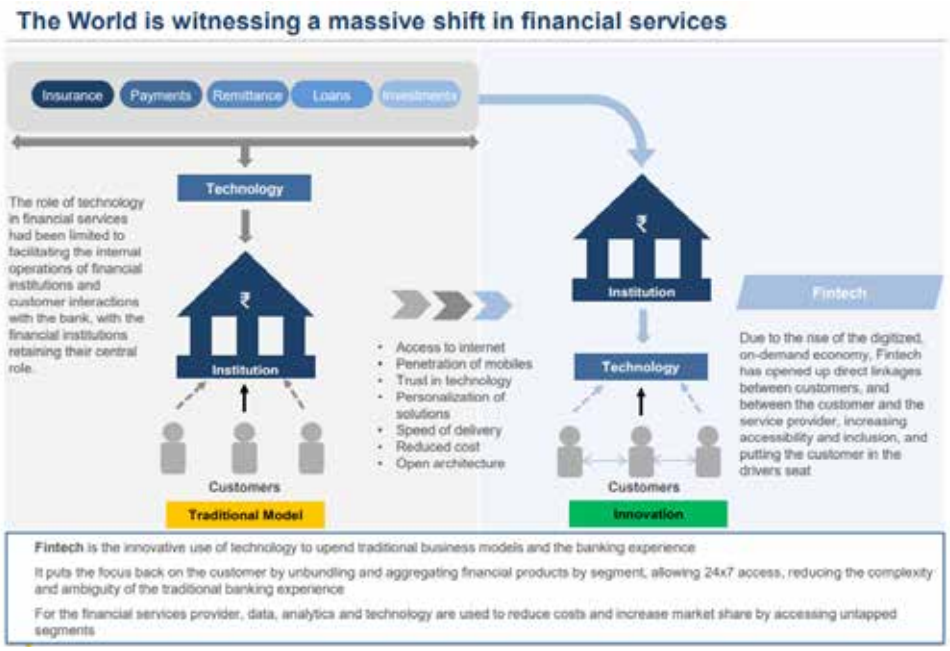

Figure 2. Shift in Financial Services

The role of technology is consistently increasing at a large pace, facilitating the internal operations of financial institutions and the increasing number of customer interactions with bank. Due to rise of the digitized on-demand economy, FinTech has opened up the direct linkages between customer and service provider, increasing accessibility and inclusion and has put the customer in the driver's seat. The particular shift has led to the wider access to internet, penetration of mobiles has increased and due to significant advances in the technology the speed of delivery has also increased.

Increasing use of FinTech in Telecom and Internet

The JAM strategy was a major step in favour of increasing the role of FinTech in the country. Increasing use of internet is a clear indicator that people are consuming more data than voice.
The widespread use of internet services even in rural areas is a clear indicator that the country is progressing at a vast pace and the smartphone subscription is increasing over the years, with the aim of connecting every single village across the country.

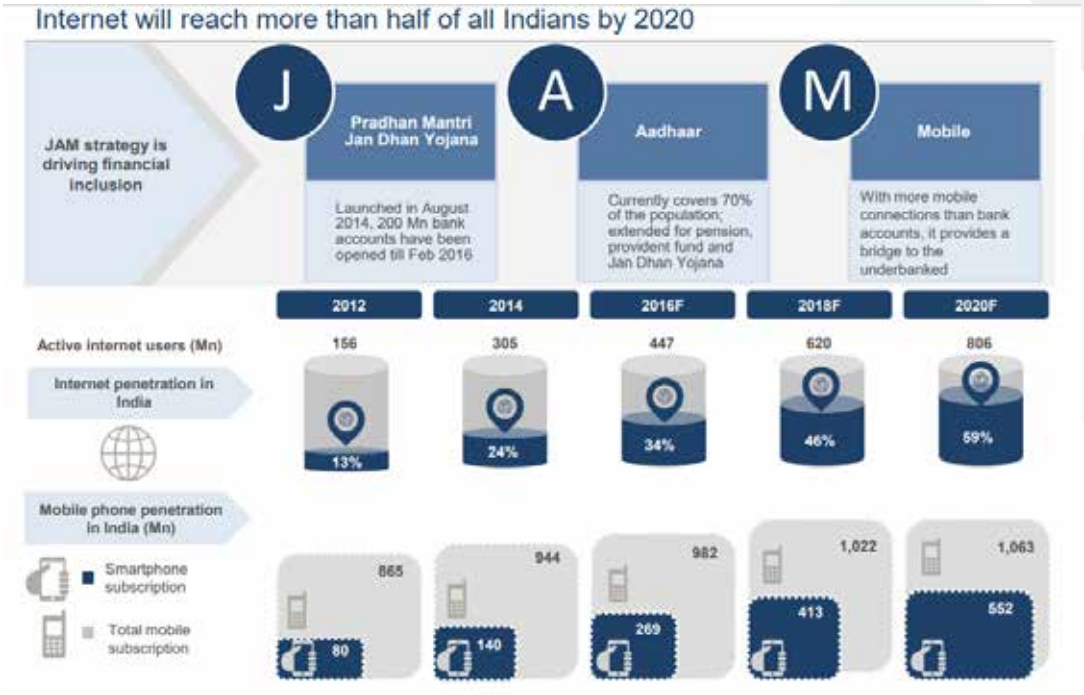

Figure 3. JAM Strategy

While some areas are in early stages of adoption, others have already gained wide acceptance

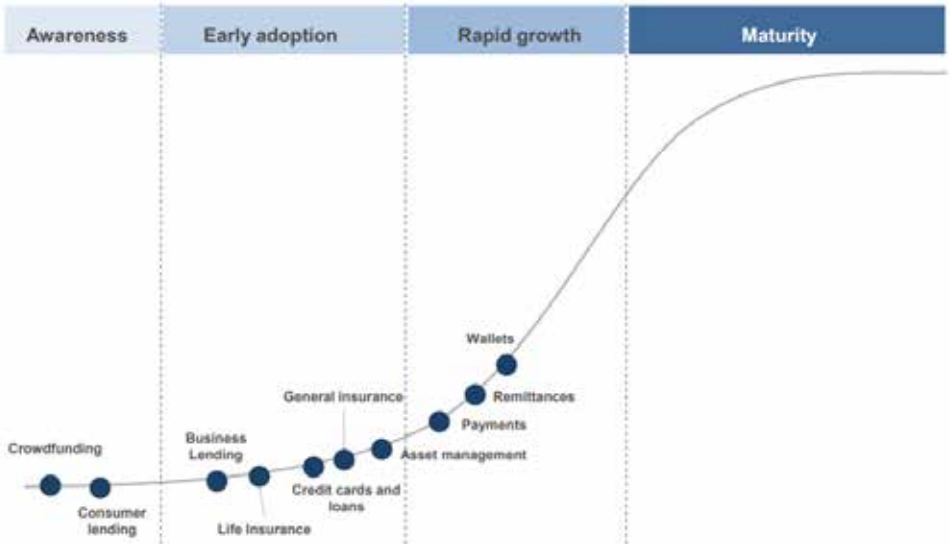

Figure 4. Adoption Stages in Different Sectors

The diagram shows different stages of the adoption of FinTech, some sectors are in the early stage of adoption while others have already reached the advanced stage. The crowd funding and customer lending sector are still in the awareness stage. Business lending and life insurance sector are in the early adoption stage while the payment banks and e- wallets have reached the advanced stage and are growing rapidly. Due to the demonetisation effect, the use of e-wallets increased at a larger pace. No particular sector has reached the maturity stage. This depicts the clear picture that the FinTech is advancing rapidly and will soon dominate the market.

Innovation in the Indian FinTech market

Two key innovation drivers, Aadhaar and UPI have a great potential to push the Indian FinTech ecosystem ahead. The first most innovative initiative to come out of India is Aadhaar, which acts as the core for India Stack initiative. 'India Stack' is a term which is used to explain a set of public APIs which are targeted at customer verification, along with digitizing identity, secure personal digital content and payments. It is led by iSPIRT, which is a non-profit industry body working with various volunteer 21 technology leaders, regulators and government agencies. The base of India

stack is Aadhaar – the national digital ID program. Aadhaar extends to a billion Indians, seems to be a powerful biometric database that can be accessed by any of the service providers. This is a huge milestone for India as until recently millions of Indians had no formal government identification. The data collected by Aadhaar forms the very basic foundation for electronic customer verification (eKYC), replacing the laborious physical verification used previously for financial transactions. This also reduces the time and cost of processing transactions by 50–80% depending on the product and service. Aadhaar is a gigantic step taking India ahead and changing the economics of providing financial services to masses. The reason for the success of Aadhaar has been the support that it has gathered over the years from various entities. Major Indian regulators like RBI, SEBI (securities), IRDA (insurance) and TRAI (telecom) have been using Aadhaar-based eKYC.

Government Encouragement of FinTech Sector

Facilitating Growth

- Start-up India initiative successfully launched by the Government of India in 2016 will provide efficient funding support through a $1.5 Bn
- SBI raised a Rs200 Crore fund for Fintech start-ups in a bid to collaborate and modernize its banking operations and workings.
- Start-ups will get proper support from the government for their patents filing, trademark and other creative design work
- Improved mobile connectivity through better infrastructure is expected to boost mobile usage to great levels and thus expand the user pool for technology start-ups as a whole, using Fintech as a major driver.

Financial Incentives

- New start-ups will be having a provision for 100% deduction of taxes on profit for three out of the first five years
- Long term capital gains (LTCG) tax for unlisted companies is now applicable for 24 months instead of 36 months
- Removal of LTCG tax on sale of residential properties when proceeds are invested in a specified start-up fund
- 80% of the rebate on the patent costs will incentivise innovation amongst start-ups
- Tax exemption for investment above the fair market value has been proposed to encourage seed investment which in return will give higher outputs
- Merchants who have more than half of their transactions done digitally could get tax rebate or 1-2% VAT reduction (now merged with GST)

Nascent Regulatory Acceptance

- The RBI has taken a very cautious stance on developing the FinTech space keeping in mind the legal and consumer protection issues
- Payments, lending and security have received the highest attention for regulatory enablement
- Unified Payment Interface has been introduced specially to provide a single architecture to integrate all the electronic payments, and should change the landscape and scale of the digital payments in India
- 11 licenses for all the payment banks have been granted in 2015,out of which 3 have been dropped out and only four have started operations and they should supposedly amplify the progress towards digital transaction
- RBI consultation paper on P2P lending has been proposed to formalize the space by defining P2P platforms as NBFC, while in return requiring improved assessment of both the lender and borrower
- Start-up India Action Plan provides for a proper self-certification to register as a start-up, which cuts the red-tape and compliance stringent regulatory charges
- Providing legal guidance in fast-tracking the process of patents will help start-ups in building IP-focused innovations
- MCA has took a step forward by rolling out a portal along with an app to reduce procedural load on the individual ventures which are usually stretched for resources

Future Growth

In the battle between Financial Technology and banking sector, Financial Technology has just scored twice whereas banks are still struggling to retrieve the ball that they scuffed into their own net. It's the beginning of what seems like a bruising battle for the traditional lenders.

India's banks, which still dominate the country's financial landscape at a higher pace, appear to have hardly a kick left in them. Assets without any loan-loss cover can now exceed $96 billion, declared by McKinsey &Co. recently. An overwhelming 91 percent, or $87 billion, of the same provisioning gap is at state-run lenders, whose net worth would be easily wiped out if they took the hit on their capital. It's an opportunity that a lethargic banking system, which is obsessed with the collateral, is lending against rather than for the business it's lending to, has handed inputs on a platter to data miners. This indicates that the resources required for FinTech need to be utilised more effectively to make FinTech a great success and it can only happen if proper rules are framed and the Government takes major steps for the growth of FinTech in the market.

Conclusion

India as such, provides a huge untapped opportunity for the growth of FinTech market. The use of mobile internet is growing rapidly. According to various stats and reports it has been found that the upcoming trend will be based on Technology linked with finance. The smartphone devices are equipped with powerful processors, substantial memory, along with high resolution cameras, barcode scanning, GPS geocoding, and NFC-based technologies. They now are the potent commerce-enablers taking this new feature of FinTech to great heights.

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IMPACT OF CONVERGENCE ON TELECOM REGULATIONS

Shraddha Bodhe

Abstract

The technology is changing with a tremendous speed. But, the rules and regulations are failing to catch up with that speed. The technology convergence is just another example. The more we delay in changing and mending our existing regulations with respect to the current technology trend, the less we pass on to our citizens as a country. This article presents the benefits of technology convergence and the need of change in the regulations. There have been two attempts to pass the Communication Convergence bill in the parliament but it could not materialize for some reasons. One of them being the tussle of power between the various stakeholders and the political parties present in India. Administering an appropriate Convergence Bill in India is a need of the time and India will face the hindrance in her way of success to become a superpower if we fail to deliver this challenge in time.

Keywords

Technological Convergence, Regulatory Framework, Policies

Introduction

The Simple meaning of convergence is a process of coming together of two or more things. Convergence in business refers to mergers and acquisitions. It can be viewed as an amalgamation of entertainment, information, and connectivity providing industries or technologies. Convergence combines the multiple communications services into a single network and creates bundled service offerings and generates fresh demand. Nowadays, the companies are looking forward to rising cross-selling opportunities by offerings quad play services – fixed line, broadband, television, and mobile. Convergence can help for an industry to become globally competitive. The level of convergence can be different for different countries. Few undeveloped and developing countries are struggling to provide basic connectivity because of limited resources to its people. The level of pitfalls and benefits gained by the different countries will also be different. Convergence along with new policies will allow the entry of new competent players. The incumbents sometimes fail to match the degree of cutting edge technology provided by these new entrants as the incumbents have more investments in legacy systems. Thus, convergence can break the monopoly.

There are different types of convergence-

1. Network convergence
2. Service Convergence
3. Device convergence
4. Industry convergence
5. Infrastructure convergence
6. Media convergence

There are reasons why any government should have regulations for convergence. Convergence regulations help to create a more competitive market. It helps to create a company which is competitive in a global market. It promotes deployment of next generation networks. It enables faster penetration of the internet throughout the country.

Indian Regulatory Scenario

Need for New Regulatory System for Convergence-

The establishment of regulatory systems fixed the uses of each medium. Regulatory systems are different for the television (one to many, non-interactive and synchronous), wired telephony (one to one, interactive and synchronous) etc. The internet blurs the line of difference between different media. Now the user may communicate with a single person or with a group of people, may switch back and forth among television and chatting application. One way or interactive applications, asynchronous and synchronous applications can be mixed in a single session. This compels to change the media policies. There are different laws and regulations for different industries. In India, different departments of the Government are regulating the Telecom, Broadcasting and IT sectors. Telecom services are regulated by the Union Government through the Ministry of Communications. separate and distinct licenses are required for Internet access services. The basic telephony and the cellular telephony come under the old Telegraph Act of 1885. Whereas, the ministry of Information and Broadcasting regulates radio and television broadcasting services under the Telegraph Act, 1885. With the convergence, there would have been a paradigm shift in the

regulatory framework. Thus, the efforts must be needed to change few of the existing laws and regulations to accommodate new changes in the technology and yet keep the industries separate. These new laws and regulations disturb the strategies and economics of the different sectors. There has to be an appropriate policy to ensure the equal access to information by rural area. Otherwise, this gap in accessibility may result in social instability. The need for a policy for convergence is also to protect social values. The easy access to information can also lead to fear of pornography and subversive information exchange.

Convergence benefits to India-

1. Taking the internet to the rural area and making it available universally
2. Learning, advertising, marketing, software development, exporting, rural health, education, agricultural extension and job creation in small towns and rural areas
3. Reduction in unequal access to information between urban and rural area

The Communication Convergence Bill 2001

The convergence bill was planned by the NDA government in 2000. The bill was designed to provide a regulatory framework that will facilitate the convergence of telecom, the internet and broadcasting service occurring worldwide. The bill was based on the amendments to the US Telecommunications Act of 1996 and Malaysia's 1998 multi media Act. The bill would have made India the second country after Malaysia to adopt convergence regulatory framework. The bill suggested creation of CCI (Communication Commission of India) and the consolidation of ministries of Information Technology, Communications and Information Broadcasting. The commission was proposed to establish the regulatory body for converged IT, communications and broadcasting industries and was expected to perform functions such as spectrum management, licensing allotting, deciding tariff rates and maintaining a competitive market. The bill had four goals (Ghosh, Pritam, The Communications Convergence Bill, 2001 - A Critical Study of Communications Convergence in India, December 5, 2012)-

1. Facilitating and enabling access to a national communication infrastructure
2. Providing wide choice of service to consumers
3.Forming a regulatory framework that can handle the convergence of technologies
4. Defining the role of single regulatory authority for all the three sectors viz. telecom, IT and broadcasting

The bill proposed five broad categories of licensing structure. The categories were-

1. To provide own network infrastructure facilities
2. To provide networking services
3. To provide networking application services
4. To provide content application services
5. To provide value added network application services.

These categories were defined to replace a number of licenses. However, there were few major flaws in the proposed bill. The bill did not define the word 'Convergence' in the first place. The Constitution of India follows a concept of separation of powers. The government is run by the three pillars of democracy, the executive, the judiciary and the legislature. The bill proposed establishment of a super regulator, CCI which will form the policies, regulate the policies, solve disputes. Thus, the newly proposed regulator was violating the principle of separation of powers. Eventually, the bill did not move forward due to differences between the involved bodies. There have been attempts to revive the policy again.

The Communication Convergence Bill 2014

The NDA government started working on the idea of forming a single regulatory framework to take care of IT and multimedia services in 2014. The government worked on a communication bill that was aimed to nullify all the four laws on which the telecom sector is based upon. These four laws are (CIRC RegTracker RT.2016, July -September 2014)–

1. The Indian Telegraph Act, 1885
2. The Indian Wireless Telegraphy Act, 1933
3. The Telegraph Wires Act, 1950
4. The Telecom Regulatory Authority of India Act of 1997.

The government was planning to modify the Cable TV Networks Regulation Act 1995 and Information Technology Act 2000. The new communication bill was similar to the Communication Convergence Bill 2001. The law was supposed to create a separate Communication commission replacing the existing Telecom Commission, which is the highest telecom policy decision-making body in the country, and a Communication Appellate Tribunal replacing the existing Telecom Disputes Settlement and Appellate Tribunal (TDSAT), which resolves disputes between telecom service providers and the consumers. But the benefits of the convergence policy were not clear. The current issues that were faced by the sector at that time were related to spectrum and interconnection. These issues were not addressed by the convergence policy.

Conclusion

The technology has evolved so much, but India still has Indian Telegraph Act of 1885, amended several times. India needs the Convergence Bill to revamp the existing regulatory system and catch up with the current technology trends. But the change is something that doesn't come up easily with the bureaucratic system in India. India needs to push harder for this change to come up so that we can realize the dream of Digital India successfully.

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Shrikant Bhujbal, Neel Chokshi, Ekta Mathur, Shriya Sontakke, Mohit Shelke,Khushboo Sachdev, Dipankar Talukdar,Vijayaroshan Bonigala (not in photo)

AD-HOC Junior Team (2017-19) names from Left to Right

Aishwarya Meshram, Bhavanashree Nandamuri, Shreya Singh, Shraddha Mishra, Padmanisha Subramanian, Arunav Agarwal, Tanish Khandelwal, Kratika Karamchandani, Rushal Arora

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