

# 5G Propelled AI, IoT and Blockchain

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**Abstract—** Network infrastructure is the backbone for all wired or wireless communication. Today, network technology is relied by organizations such as financial services, healthcare, agriculture, government and customer services just to mention a few. Every, other organization investing in fifth generation (5G) network infrastructure will take advantage of high-speed internet with all business transactions delivered at real-time. Today almost every organizations require real time communication in one form or another. Across the industry, there's a global demand for network professionals. With 5G in place, block-chain and its BYOE (Bring Your Own Encryption) concept will be reshaping the distributed ledger landscape and Machine learning over the 5G provisioning faster learning times. In understanding 5G network infrastructure is the underlying backbone infrastructure that will bring disruptive changes. Almost every other human facets depends on network or target to rely on network communication today or in future years. In this paper we are giving flavor of the potentialities realized at the advent of 5G technology and how it will change the aspects of Block chain, Artificial intelligence (AI) and Internet of Things (IoT) while discussing standard definitions, challenges, and benefits of this emerging infrastructure, as well as some interesting players in this space.

*Index Terms— AI, IoT, Blockchain*

## I. INTRODUCTION

The world businesses order is changing at a fast pace, it has leaped from an era propelled by 1G, 2G, 3G, and 4G global wireless networks standards to an upcoming 5G new era of network that is designed to connect virtually everyone and everything together including machines, objects, and devices (Kumar & Kumar, 2013). The essential concept about having a high speed connection will redefine the telecommunication industry on who controls the internetwork communication. More so, with ever increasing space of emerging technologies in cyber space realm. Soon, the competitiveness on how businesses are connected is going to depend on the type of connection. Organizations will be gaining a differentiating factor from each other depending on how they invest on the network technology.

The fifth generation 5G of wireless network communications technologies supporting cellular data networks is poised to deliver higher multi-Gbps peak data speeds, ultra-low latency, more reliability, massive network capacity, increased availability, and a user experience that is more uniform to a larger population (Rahman, 2017). Business are going benefit from one or multiple dimensions

of uRLLC: Ultra Reliable Low Latency Communication, mMTC: Massive Machine Type Communication (IoT), eMBB and Enhanced Mobile Broadband. The large scale integration of 5G technology into existing 4G already began in 2019 and almost every telecom provider is rushing towards upgrading its infrastructure to offer 5G functionality. It will leverage its benefits to BYOD ecosystem mostly handheld devices taking more advantage.

The utilization of high speed internet is more resounding not only in mobile broadband but also in mission-critical communications, and the massive IoT (Ijaz et al, 2016). The most prevalent advantage is its ability to be forward compatible and flexibly support future service. Mostly, it is reshaping a fully edge computing era. According to Ericsson Inc., by 2023, 5G will make up around one-fifth of all mobile data traffic, where 25% of the use-cases will depend on edge computing capabilities. With this developments, every player in the industry are shifting to distributed cloud computing paving the way for the future of network communications.

The technology working principle presents service area covered by providers in the digital cellular networks. The cells are divided into small geographical regions (Roh et al, 2014). Once an Analog signal either in form of sounds or images is received by a telephone, it passes through an A to D converter and results into a digital signal and available as stream of bits. The available handheld devices found in a cell area communicate to each other using radio waves (Evans, 2014). The waves move from a local antenna and automated transceiver within the cell area defined by assigned transceiver frequency channels. The connection of antennas is through a telephone network via high bandwidth optical fibre or wireless backhaul connection (Qiao, 2015). The frequency channels are reusable within cell area and can be reusable in other cells. There's seamless handing offer of mobile devices traversing from one cell to another

## II. BYOE, AI & IOT

BYOE is the working principle behind cryptocurrency such as blockchain. The cryptography behind this technology Increments a list of records and links them using a mathematical encryption scheme to form chain of blocks. Each block contains a cryptographic hash of the previous block, a timestamp, and a transaction (Isirova & Potii, 2018). With 5G in place, it will be a new addition to cyberspace landscape brought by blockchain, AI and IOT. Today, extensive research is done on how blockchain propelled by

5G can be integrated to services powered by the high speed internet.

With the uptake and growth of distributed ledger, brings the concept of decentralized applications (Dapps) which is leading innovation powering applications over the 5G network (Dai et al, 2019). It becomes integral part for better customer service and experience. With its core aspects of facilitating robust workflow among participant through data security with chaining mechanism, ensures tamper proof records that are not susceptible to infinite reproducibility.

Artificial intelligence is the ability of devices to mimic human characterization (Jackson, 2019). In AI intelligent agents which are devices programmed with knowledge are able to understand their surrounding and take actions to maximize chances to achieve specified goals. With artificial intelligence it requires large amounts of data which is sublimated by high speed network. 5G will be the driving factor in provision of ultra-reliable and high bandwidth network.

AI devices learn new heuristics through algorithms and sometimes write their own. Some of the ways through which AI can learn include Bayesian theorem, decision trees, and nearest neighbour (Zhongzhi, 2019). Through the acquired knowledge they map hypothesis for possible solutions. The high speed connection is going to make a revolution in delivering faster learning thus faster route knowledge.

Technology such as Internet of Things (IoTs) have quietly but steadily evolved over the past few years, reshaping the Internet as we know it. Globalization is no longer a buzz-word – we now toy with ushering in the 4th industrial revolution. The fast amounts of data from IoT based devices, and which today with 5G delivered on real time with enormous amounts of data. This data goes ahead in improving decisions making, enhance performance and generally bring about competitive advantage.

Its primetime for IoT with 5G technology as it integrates itself to diverse markets shifting the paradigm to operational technology and key business process offering while seeking solutions that bring about disruptive business outcomes. Not long, it will be supporting bigger number of static and mobile IoT devices. As 5G is expanding more customers are able to realise its flexibility and impact as it powers up many enterprises.

#### *A. Blockchain in 5G*

The high-speed network infrastructure (HSN) is poised to provide an integrated distributed accounting system with seamless 5G access, which includes a complete distributed deployment architecture, smart contract system, security system, and layered consensus mechanism. The system can meet the needs of high-throughput and complex, decentralized, high-performance 5G application scenarios and promote the 5G blockchain business ecosystem.

Through adopting a layered consensus mechanism consisting of Miner Nodes (PBFT-DPoS consensus

mechanism) and Edge Nodes, which not only guarantees the safe operation of the whole 5G ecosystem, but also promotes the flourishing ecology of edge computing and IoT terminals. This ensure interconnectivity of various devices and edge of computing applications.

In order to meet the demand for high concurrency and network storage in the 5G environment, HSN chose Interplanetary File System (IPFS) as its storage infrastructure. The IPFS network provides support for dynamic, precise, and distributed network storage and can better meet the requirements of 5G content distribution networks (CDNs). Large HSN files are divided into small encrypted blocks, which can be downloaded from multiple servers at the same time. In the object and file layers, most data objects exist in a Merkle DAG structure, and double hashing is used for deduplication, thus realizing flexible support of content addressing and storage deduplication.

On this basis, the HSN network provides a series of application frameworks such as distributed data exchange protocol and distributed process management protocol. Using general API, SDK, and various functional components of applications, HSN can realize convenient development and deployment and support agile development of Internet products.

The highly encapsulated HSN distributed accounting architecture and fast storage structure supporting a large number of concurrent processes allow HSN to meet the needs of complex 5G application scenarios. Within the block-chain infrastructure Miner Nodes are responsible for executing smart contracts and producing blocks. Edge Nodes are responsible for distributed computing and storage platforms involving smart terminals; they provide big computing and mass storage. The distributed ledger is responsible for core processing, on and off the blockchain.

#### *B. Challenges of 5G Based Blockchain*

With the continuous growth of transaction amount, the Block-chain size increases and any nodes in the network needs significant storage resources to store data. Due to the Block-chain size growth, the validation time increases and that needs more computational power to verify the activities over the network. The processing power and time needed to achieve encryption for all the objects included in a blockchain system proves a challenge. .

Blockchain itself is vulnerable to new security attacks, such as majority attacks, double-spend attacks, race attack. The Finney attack, Denial of Service (DoS), Man in the Middle (MitM) or Sybil can obstruct the network operation The Blockchain transparency compromises data privacy even though there is no direct relationship between transactions and individuals.

#### *C. Artificial Intelligence in 5G era*

5G will also provision necessary disruptions to AI and data analytics. It will be able to ensure network availability and

also reduce service failures. Because of the speed that it promises to deliver coupled with bandwidth, millisecond latencies and reliable connection AI will bring about faster processing. Because of AI ability to mimic human character it will be more elaborative with introduction of high speed connectivity. The core objectives achieved with AI such as optimization, clustering, data fitting, reasoning and online simulation analysis will be performed at the speed of light.

The speed of light, coming in 5G is a paradigm introduction of fast analysis of data accordingly to needs of different users. It is changing the way application services are received by users. The processing of services that traditionally being delivered through the cloud would be similar to localised services.

In reality, 5G will take some time to have significant impact on AI processing. In the meantime, as AI applications are being integrated into devices, rather than waiting for 5G to be deployed, there seems to be a safe strategy to rely on device-based processing of AI. However, one thing is for sure: the push is to have 5G and AI integration happen on the same chips on your mobile smartphones, making those phones more intelligent as well.

In the 5G AI based integration there's much expectation for devices that will possess AI capabilities that means one thing for sure that sooner handheld devices that can reason because of AI intelligence realized on the chips. This integration will bring about more significant impact to AI-5G processing.

Some of leading innovations that are architecting services with 5G are Equinix, an American multinational company for Internet connection and data centres. Using Radio Access Network (RAN), it seeks to provide services almost at instant in collaboration with NSPs (Network Service Providers). Via, Equinix Cloud Exchange Fabric, customers manage and scale applications in real time. The IT industry is looking forward to a future where consumers are attracted to speed of market services and any organizations must provision high speed connection to survive digital disruptions.

#### D. High speed AI challenges

Although widely agreed AI might not in future get to an extent of being emotional or developing inherent human nature. It will be an issue in the cyber space propelled by 5G considering the following scenarios;

*When AI is programmed incorrectly* – it can bring about a devastating scenario for example in autonomous weapon that are designed for mass destruction. This weapons can bring about casualties especially in its design to be secure from being thwarted by criminal agents. Also another incoming challenge in the High speed propelled AI is turning around of AI to other AI intelligent system resulting into an AI war.

*When AI develops destructive methods to achieve its goals* – this a scenario where AI can do tasks within a shorter span of time has required but later devices methods for shorter means or ways to achieve similar tasks. This results into damaging of surrounding environments.

#### E. IOT with 5G

The promising speeds leveraged with 5G infrastructure is poised to make disruptions from all business dimensions for example in healthcare, intelligent transport and manufacturing. IoT will be the technology basis bringing about uniform technical framework thereby realizing differentiated applications that can propel an entire organization. Especially, edge computing with IoT is bringing more significance when huge volumes of data are processed close to the data source.

In a more elaborate sense IoT will be able to provision services to customers seamlessly thereby reducing the need for cloud on demand services. Looking into the future IoT will influence how new drugs are developed, how we track pandemics such as COVID-19 and how to manage resources. According to Gartner, the number of IoT devices is projected to increase to 50 billion by 2020. The data obtained by these devices will also increase exponentially. The continued rise in the need for edge computing with vast amounts of data generated by IoT devices will be driving the demand for higher data speeds.

In addition, also year 2020 going forward it is expected to usher-in 5G infrastructure with blockchain technology into the IoT equation, thus helping business over high speed connection to overcome data trust challenges that previously hindered its adoption. Since blockchain offers a secure exchange of value between entities in a distributed network, a new class of IoT applications will arise. For example, automakers may use blockchain to authenticate the interactions between connected vehicles and roadside infrastructure (Rabah, 2017), or supply chain can trace and authenticate the source of goods with technology's tamper-proof transaction records (Rabah, 2017a).

#### F. Drawbacks of IOT

IoT systems have different types of devices which have very different computing capabilities, and not all of them will be able to run the same encryption algorithms at the required speed (Hossain, 2015). Such issues such as data leakage as a result of fast amounts of data leads to exposure of confidential information meaning that the cyber space might not be that safe enough for seamless sharing of data.

*Single loophole failure* were a particular security flow could mean extensive destruction to an entire IoT infrastructure. The multiplier effect is fuelled by the chance of taking advantage of poor landscape and exasperating attacks to other devices at a massive scale.

Negative effect of *dependability* there's an aspect of human beings relying on IoT for their lives. It can bring a negative impact in case there's a system failure. It could be quiet expensive to roll back and work without IoT devices. Also, a negative effect of control, especially when integrated with AI, it can be more disastrous in case of technology failure or unavailability.

### III. HEALTHCARE TRANSFORMATION IN 5G

Sensing and taking patient data using devices has always increased interest in healthcare. Already there a number of technological advances such as, smart biosensors, light weight and miniature IoT based devices. Through the network they communicate with computers conventionally, although the Wireless Body Area Network (WBAN) with 5G is bringing a new experience, it is going to enable devices fitted with body based sensors to quickly detect and prevent diseases. It becomes a major leap in healthcare has biosensors can work on real-time at a speed of light.

A rapid advancement of 5G is already transforming healthcare. The realization of high-speed connections delivers virtual reality (VS) and augmented reality (AR), for non-invasive medicine. Some challenges that are addressed by high speed internet are not limited to providing a holistic data-driven healthcare practice model, offering individualized diagnosis and treatment model, balance in medical resources, reduce movement issues and costs of patients to health facilities especially in developing world, reducing inconvenience to patents seeking urgent medical intervention, and eliminating cumbersome registration process whilst having an horizontal Medicare system.

With an extensive (home-based) continuous patient monitoring. 5G is providing a new way of interacting patients and healthcare workers. The innovative way of delivering Gigabyte imaging files rendered into diagnostic animations provided to mobile devices over a 5G network, utilizing millimetre wave spectrum provisions timely review of patient records. Also, healthcare workers work at freedom within a 5G spectrum without losing data quality and visuals. Because of low latency and ultra-reliable communication in 5G, medical records of higher granularity.

While digitization of records having been performed by a number of health care providers, the most profound advantage in 5G, is the ability to utilize edge computing capability and put a balance between local processing and storage while, ensuring data is transmitted at real-time on cellular network. This real-time aspects is particularly important when healthcare providers and AI use shorter intervals of measurement to show trajectories that took long time to be detected and make remedial interventions to improve outcomes.

### IV. 5G AND ITS APPLICATION FOR INDUSTRY

The utilization of 5G has is already on the fly, Rush an hospital in the US with support from AT&T are working on an Multi-Access Edge computing (MEC) to manage cellular network. It is going to enable the company improve patient experience and manage data across its use cases. Aside with its fast adoption and quick focus by many companies, a number of organizations are also coming to take advantage of 5G. According to Accenture, US wireless industry estimated to invest \$275 billion over the next few years to deploy 5G networks. To make 5G coverage widely available, telecom

companies will have to lay fibre, and place tens of thousands of small cells and distributed antenna systems (DAS) on utility poles and other urban infrastructure.

With an endeavour to take extended capabilities of spatial computing and non-invasive medicine AT&T has also collaborated with VITAS Healthcare providers introducing non-invasive treatment. They are working on calming and distracting content using AR and VR for terminally ill patients. On the other hand, full advantage of 5G and IoT has already began taking shape in china, Huawei has partnered with three major telecom providers and the China Association of Medical Equipment, realizing the first 5G based standard for hospitals. 30 hospitals are already connected to functional high speed connection capable of quickly transmitting scans, blood pressure cuffs, staff tracking, inventory management and general patient monitoring using IoT.

The much predicted 5G has not left behind companies almost all around the globe. There’s a forward action by companies such as BT, a UK based company already having launched its services on EE’s network connecting six cities in the UK. The most obvious attribute driving the move is speeds of up to 20 times faster than 4G. Aside, it takes approximately 3.6 seconds to download a 2 hour movie. In addition to other uses it is poised to be beneficial to cellular companies. The mobile network capacity is increasing by a factor of 100. It is going to connect more people because of increasing network densification. Degradation of service is going to be eliminated has customers simultaneously consume immense amounts of bandwidth.

In the US C spire, a telecom, is using 5G to enable people in remote areas of Mississippi to connect to Fixed Wireless Access (FWA) or “air fiber”. It is able to reach locations were actual fiber connection is too difficult to deploy on premises. For example in a 5MM wave service customers can be connected to download speeds of up to 750 Megabits per second (Mbps), upload speeds of up to 600 Mbps and latency as low as 8 milliseconds.

Across the industry, there’s a constant up rise for 5G that is unstoppable has companies heavily invest to bring the experience to customer edge. By 2033 it is expected that cross-organizational global investment into 5G will surpass \$88 billion dollar, according to Heavy Reading’s Mobile operator high speed 5G, Capex. The table below illustrates forecast of 5G annual global spending Capex.

Capex (Billions)	Years
\$0.6	2018
\$8.6	2019
\$16.0	2020
\$34.2	2021
\$58.5	2022
\$87.9`	2023

Source: Heavy Reading

## V. APPLICATION IN GAMING AND VEHICULAR COMMUNICATIONS

The biggest advantage of internet at so called real-time, is reengineering the game dynamics. Parties can be able to engage online at real time. This is possible because of EMBB and FWA that are promising interactive gaming. Not far with 5G catalyst, cloud based games is going to be the mainstream in the gaming market. This means people in remote locations with slow internet are going to compete at highest levels with their counterparts elsewhere.

The autonomous car industry is also going to receive a shakeup with 5G. Sooner, driverless cars is reshaped to a reality. They are proving to promise a safer means of transport because of ability to see, interpret and make judgements of surrounding environments. The cognitive ability is dependent on multiple devices including cameras and sensors used in the vehicular communication. It is able to sense buildings, streets and their outside surrounding at real-time, thus avoiding unnecessary collision. The "Vehicle to Everything" (V2X) concept redefining the extent to which vehicle enabled with sensors, is able to read its surrounding whilst getting communication on the fly. This is due to the 5G powered real-time communication that is able to collect, collate, process, analyze and securely store vehicular data.

## VI. 5G AND QUANTUM COMPUTING

The ever increasing new developments in the quantum world projects a period of quantum internet. The promising quantum mechanics technology is none the less yet to be realized. But theoretically quantum computing is poised to process at very high speeds, it can bring about computations of largest prime numbers and their factors at near real-time shaking the entire foundation of data encryption (Rabah, 2006). With 5G becoming a realty quantum internet and quantum technology is yet to function because of quantum computer challenges requiring cooling of up to -273 degree Celsius, approximately 10 Millikelvin. The foreseeable solution could be adding more qubits which also raises challenges of sensitivity and instability. If comes around to full operation it will supercharge AI and other technologies.

## VII. CONSTRAINTS OF 5G

The potential problem is on how to address small cell deployments and implementation of backhaul fibre connection. The infrastructural challenge is going to determine the demand and supply factors of 5G. However, owing to opportunities presented by its potential utilization, it lead to continuous rise in market demand. Especially, in its use for monitoring and tracking, automation, smart surveillances, VR and AR, enhanced video services and other application areas including potential investment in smart cities.

Onset there is also a simmering problem of spectrum space. Conventionally, previous 4G operated on established frequency bands below 6GHz. On the other hand, 5G requires spectrums of up to 300GHz. With the spectrum

challenge telecoms have to bid for higher spectrums to build and roll out 5G.

Being a new technology, it contributes to cyber space reality of 5G ecosystem. There's a potential challenge on security and privacy which obviously potent any data driven technology. Although like any other system that is stablishing trust between networks it falls under Authentication and Key Agreement (AKA). Despite the many expectations of higher speeds, also the connectivity will increase thus having a multiplier effect on attack surface. There's a possibility that attackers can now eavesdrop on live phone calls and track nearby handheld devices.

## VIII. CONCLUSION

Network technology is the backbone for all communication. 5G network proliferation is going to redesign every facet of life - 5G use cases will not be limited to a particular area: consumers, businesses, industries, and cities. The 5G range of applications that currently are hampered by slow speeds being spiced up by fixed wireless access (FWA) providing ultra-fast Internet for consumers and businesses.

It is going to shake up how business is done especially in data intensive applications that require high bandwidth. The high speed angry applications like real-time streaming will leverage 360 degree video of high quality and immersive experience. The viewers are accorded a chance to control image angle, enabling people doing gaming with racing cars to look behind and see whose next or behind you.

Organizations are accorded a chance to have more information on the cloud, and can also access required information over fast, low-latency 5G as if it were stored locally. This in effect allow business to leverage on cost reduction that goes into acquisition of expensive on premise servers. The 5G infrastructure brings a new form of connection reducing wiring and the related installation costs has customer connects directly with a cellular and it works.

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