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Big Data Network Architecture and Monitoring Use Wireless 5G Technology

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Abstract

Rapid development of Information and Communication Technology (ICT) in this era is very significant, increasing number of users accessing data keeps growing by the time. Data centre have to serve high volume transaction of data every day, thus a Big Data Centre is required to solve of insufficient of data storage in some of provider. High speed communication system is must to avoid latency in transfer of large data to users also for high speed communication especially in data rate. This paper discuss on the use of Fifth Generation (5G) of wireless technology to overcome the issue on data throughput and latency. High speed data rate standard decided on 5G technology communication system allow implementing in high data traffic as required in big data center. 5G technology wireless communication system used as alternative backbone of data centre and to serve users. New network architecture is proposed to support of wireless communication to big data for effective and efficient communication to each others in the network. Wireless communication system also used to monitor data traffic and data centre (database) environment status. Any faulty of abnormal condition will send a message or alert to the monitoring center.

Keywords: *Big Data, Network, 5G, Wireless.*

1 Introduction

Big Data in Information and Communication Technology (ICT) is data collection in large number and complex data transfer / transaction that need a good data management system or application to process of those data sets because current data management have difficulties to handle it. Some challengers for data collection such as data storage and need large database capacity, data capture and sharing that required high speed infrastructure system, data visual and analysis required good management system tools to do that. With high volume and numbers of data need to collect and large number data traffic, a new method of information system is required to process of that ability to enhancement decision and management system also optimization performance.

Billions number of data transaction and streams coming from devices worldwide, one of the challenges for the current data management to serve without any losses and low throughput also latency. Although, after enabling and integration of cloud management system still having difficulties to serve all the data streams and transaction. Cloud based Big Database and Data centre techniques offer some promise to overcome issues mentions above.

Mobile of people with carrying device such as smart phone or tablet is extending of Internet of Things (IoT), everyone has their own unique IP/IPs address with hold device. The future of IoT is to manage devices carrying by people around the world with unique IP as hub and interface to others devices. Billions number of devices with IoT has capability to sense, communicate and detect that allow efficient communication and data collection thru the device. Introduction of Internet Protocol version 6 (IPv6) and low power wireless network would able to do sensing and communication through devices. With the IPv6 has billions number of unique IPs for device and sensor that apply for house application such as monitoring of cameras, manage assets, house equipments controlling and security application.

Fifth Generation (5G) is promising technology to use for future development in telecommunication infrastructure. Currently, the use of radio frequency spectrum is in wide area, information system, industry, medical, education and so on than the spectrum a bit mess. By 2020 is estimate that 50 billion devices will be connected to the internet, so alternative of the use spectrum for connections of devices to internet need to be attention else system unable to serve of high demand. The large number of devices and machines connected to internet will be due to a boom inanimate object using the 5G network as known as the Internet of Things (IoT).

In this paper, discuss more on the use of 5G technology and wireless communication system to accommodate large number of devices and capacity for Big Data Centre (BDC). The promising technology to use 5G technology as alternative system in backbone and framework for Big Data infrastructure,

because of standard sets in 5G technology able to running in high speed Gigabits data connection. High speed data transfer and connection is required in Big Data Centre to serve large number of clients and high volume of data storage, else many issues facing up and also slow system will happen.

2 Literature Review

Increasing number of devices and user accessing internet gives impact to the numbers of data, whether stored into database or communication data between users. Thus, very high speed technology to serves those devices is a must else low speed of communication and delay occur. Several papers discussed on the use of wireless technology into data communication network and architecture scenarios.

Proposing of a comprehensive framework for empowering SONs to big data and address the requirements of 5G technology as discussed in [2], this framework characterize big data in the context of future mobile networks, identifying its sources and future utilities. Demonstrate of the spatial big data can play a key role in many emerging wireless networking applications discussed in [3] argue that spatial and spatiotemporal problems have their own very distinct role in the big data context compared to the commonly considered relational problems. Three major application scenarios for spatial big data, each imposing specific design and research challenges. Then present our work on developing highly scalable parallel processing frameworks for spatial data in the Hadoop framework using the Map Reduce computational model.

Traffic monitoring system and analysis for large-scale networks based on Hadoop as elaborated in [4, 5] an open-source distributed computing platform for big data processing on commodity hardware. The system has been deployed in the core network of a large cellular network. In [6] discusses the challenges and requirements in the design of 5G wireless networks for the big data center. Discussion on how cloud technologies and flexible functionality assignment in radio access networks enable network densification and centralized operation of the radio access network over heterogeneous backhaul networks. Article also describes the fundamental concepts, how to evolve the 3GPP LTE architecture, and outlines the expected benefits.

Proposing a solution to cope with the tremendous amount of data to analyze for security monitoring perspectives based on security of local enterprise networks and an overlay network construction scheme based on node location in physical network, a distributed task allocation scheme using overlay network technology also Empowered Self Organized Networks on Big Data as discussed in [7-9]. A case studies of real-world big data applications that are empowered by networking, highlighting interesting and promising future research directions including network highway and introduces a design methodology of an overlay-based parallel processing architecture based on integration of overlay and physical networks presented in [10, 11]. Review on application of Internet of Things (IoT)

into industrial and key enabling technologies, major IoT applications in industries, also identifies research trends and challenges. Trend on future of internet in supporting new applications, efficient resource utilization, and continuous evolvement discussed in [12, 13].

Propose a potential cellular architecture that separates indoor and outdoor scenarios, and discuss various promising technologies for 5G wireless communication systems, such as massive MIMO, energy-efficient communications, cognitive radio networks, and visible light communications [14]. Future challenges facing these potential technologies and identifies several emerging technologies which will change and define the future generations of telecommunication standards are discussed in [15, 16]. Fifth generation (5G) cellular networks describes five technologies that could lead to both architectural and component disruptive design changes, ideas for each technology are described, along with their potential impact on 5G and the research challenges in wireless for Big Data Network Architecture. Expected to achieve high speed 5G backbone and used of Node C as a new communication entity is defined to converge the existing ancestral base stations as discussed in [17, 18].

3 Big Data Era

Big data is being generated by everything around us at all times, any information comes with the information and must have number of data then need to keep or stored in database. Various types of data come from many source of information such as sensor, machine, social network, message or mail and voice or video. Those data can be text, voice or video type then in term of format can be structured, unstructured or semi structured. Big data is changing the way of people and organizations to think for future trend and technology also work together. Figure 1 show how a Big Data architecture framework illustrated, data sources comes from multi input and various types, then data stream analysis follow by data cluster and data search & query.

Definition of Big Data according the need of industry consists of several parameters such as;

- *Volume*, many numbers of factors that contribute to the increase in data volume. Everyday industry keep produce thousand even million numbers of transaction data then stored through the years. Increasing amounts of sensor in industry, additional member of social network and message or email transaction everyday collected huge number of data. Previously, excessive numbers of data in volume make issue on storage capacity. Emerging plan for the storage and decreasing technique for file including how to determine relevance and usable within large data volumes also how to use analytics technique to create value of data in relevant.
- *Velocity,* data stream is in unpredicted speed and need to monitor timely. For

example, RFID tags, sensors, and transducer are parameters of source of data have to communicate in real-time. Highly response of data and quick reaction to meet data velocity is challenging for Big Data backbone.

- *Variety*, nowadays sources of data comes in many types of format and structured of numeric data in conventional database. Unstructured format of data such as text, documents, audio, video, email and social media transaction. Technique to managing, governing and merging of different types of data is something needs to do a new technique to handle it.
- *Variability*, additional to the increasing velocities and varieties of big data, flows of data maybe highly inconsistent compare to period of peaks. This is happen in and something trending in social media network. Every day, seasonal and event-triggered peak data loads can be challenging to manage and even more so with unstructured data involved.
- *Complexity*, today's data comes from several of sources. Then still very hard to undertaking to the network link, need to match, transform data and cleanse form data across systems. However, it is very important to connect and linkage of data in quick response in correlate relationships, hierarchies and multiple data network.

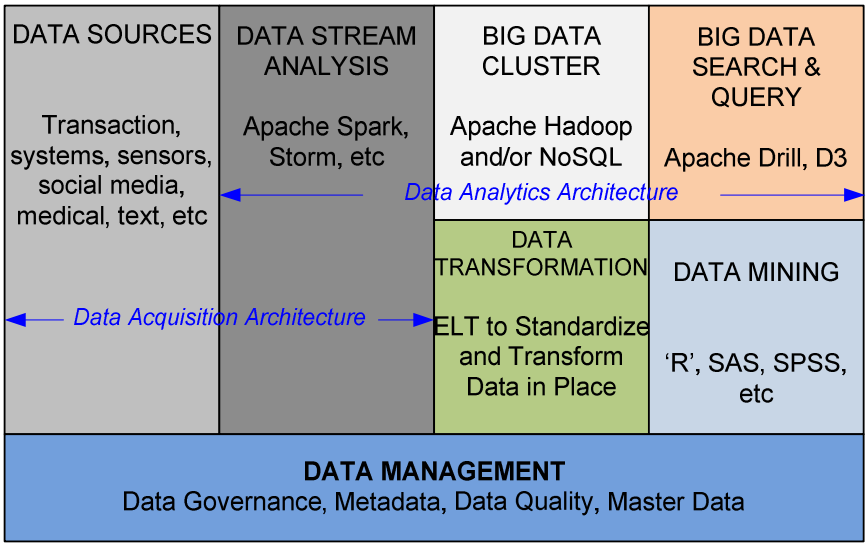

Fig. 1 Big Data Analytics Architecture Framework

Several sources of information as mention in above become raw data to data center and in huge numbers, all of data then will send to Big Data Staging for processing then only useful or valuable data that need by user will select and delivery to user. This process called Big Data Staging because in this stage big number of data classified based on the structured and types of data. Figure 2 shows a block diagram and process of Big Data Staging to classify of data. Staging process is required in order to improve efficiency and faster the process

else big number of data will effected to the processing time and accuracy.

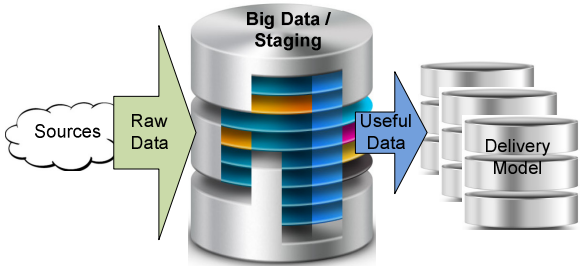

Fig. 2 Big Data Staging Process

4 Fifth Generation (5G) Technology

High speed data communication network normally build in wired architecture such as cable or fiber optic, wireless technology thru radio signal system is alternative network for data communication beside those wired system. Radio communication has evolution started from First Generation (1G) mobile / radio communication which analog system and continue for the Second and Third Generation (2G/3G). Then in year 2010 Fourth Generation (4G) of mobile communication introduced to make faster in term of speed and high capacity of data communication.

Fifth Generation (5G) wireless or mobile networks have a capability to support communication in high speed and capacity. The connections expected ability to support for at least 100Bn devices at a data rate of 10Gbps per user with low latency and faster response times. Implementation and deployment of 5G technology is expected in 2020 because currently in process of research and development also standardization. The use of 5G networks expected will rise between 2020 and 2030 once after deployment. Anyhow, 5G networks will be layered upon the existing wireless technologies such as Global System for Mobile Communication (GSM) and Wireless Fidelity (Wi-Fi) also radio access technologies. Figure 3 shows a mobile communication evolution started from 1G until now is 5G [15].

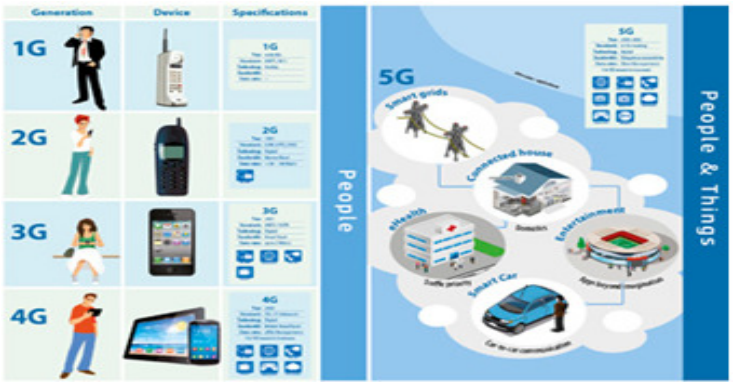

Fig. 3 Mobile Communication Evolution 1G to 5G [1]

5G wireless network is future technology that can implement in real for transformation of the world population into an end-to-end globally. Data analytics can be built on the cloud computing that drive business prospects and enrich user requirement. 5G technology would be challenging and crucial in realizing "zero distance" connectivity between users and devices across globally. With significant technological implemented and advance incorporate in telecom provider would give the customer requirement and need to a different level. 5G technology is able as role model for future of smart city planning and implementation for very high speed data network for million numbers of user and devices.

There are several advantages of implementing 5G for communication either voice and video or data, although 5G technology is expected to solve some issue that currently facing but there are some challenges need to be addressed in implementation also deployment this technology. Some factors involve such as the capability of the wireless networks infrastructure to support massive capacity and connectivity, support diverse set of services and efficiently of the use available spectrum need. More than that advanced breakthroughs in waveform related technologies have to be accomplished in order to develop 5G to perfection. Figure 4 shows 5G technology advantages in five categories**.**

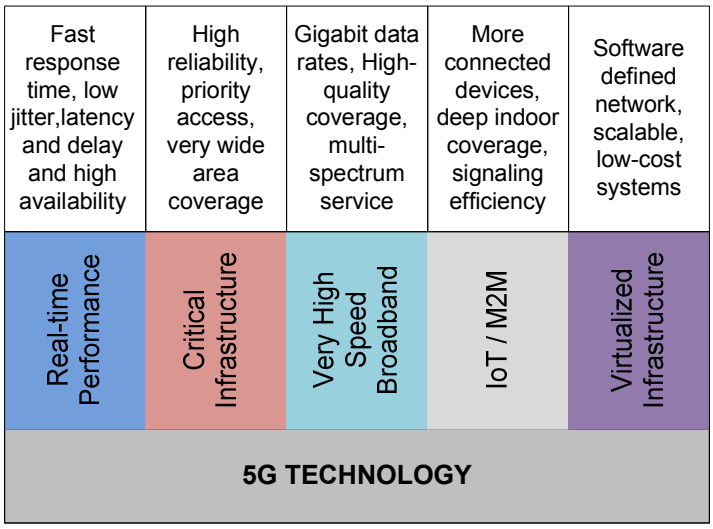

Fig. 4 Five Categories Advantages of 5G Technology

Fifth generation standard for communication especially for wireless network also involved in Wireless Fidelity (Wi-Fi), evolution of Wi-Fi technology started since year 1997, which standardize by IEEE 802.11 that ability for data rate maximum 2 Mbps, along the time improvement of speed continue and the latest standard is in Fourth Generation that set to maximum data rate up to 600 Mbps. Nowadays, preparation for Wi-Fi in 5G standard expected to achieve very high speed data

rate in Gigabits. With the capabilities 100 times faster and lesser latency also enhanced battery life compared to 4G, 5G is going to be the next promising technology.

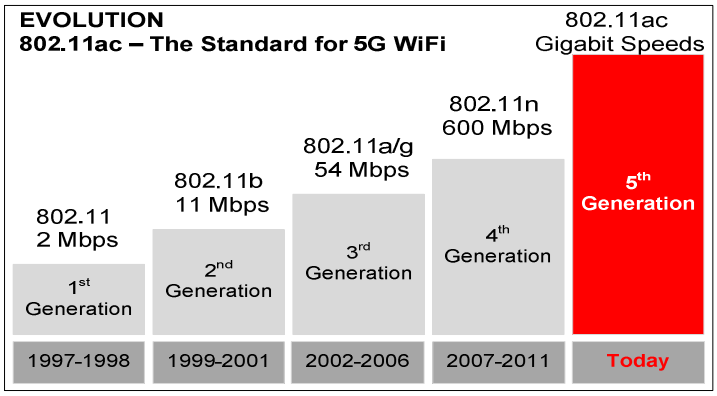

Fig. 5 Evolution of 5G Wi-Fi Standard

5 Big Data Network in 5G Technology

Today, with tremendous increasing number of devices such as sensor, smart phone, gadget, tablet and machines, all those devices has big size of message/data to be send or receive thus high capacity of network infrastructure is required to cover that transaction else traffic delay and latency occur. The enormous volume and number with complexity of data that is now being collected by sources to be send to the database or respective user. Investigation in a Big Data Network in order to optimize this network is urgently needed because by the time volume of traffic and transaction keep increasing. Conventional wired network like fiber optic and twisted cable as currently used for backbone to connect between server or data center is limited for some of application. For next decade by increasing huge number of devices need to connect to internet then current infrastructure predictive unable to serve its. Thus, alternatively technology or infrastructure to handle high volume of traffic is required; one of the technologies is 5G wireless communication. The other hand, use of wireless communication as backbone is related to the devices use by user is more on mobile that need wireless network. Figure 6 shows how illustrated of 5G wireless network infrastructure looks with high capacity of network link in Gigabits [1].

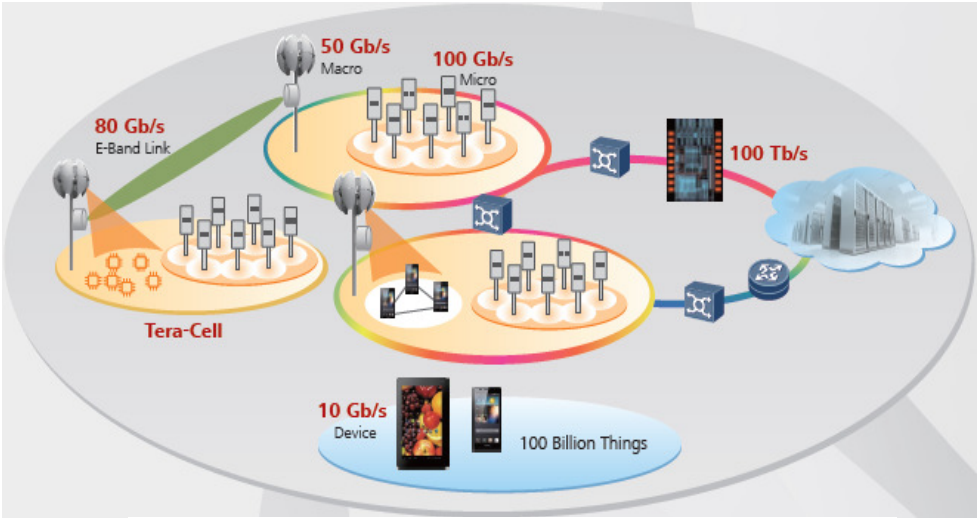

Fig. 6 Illustrated of 5G Wireless Infrastructure [1]

5G technology is considered as a key factor to the Internet of Things (IoT), the next era expected tying to connect to the internet of anything include peoples. Billions number of sensors will be built and connect into security systems, appliances, health monitors, door locks, cars and wearable's from smart watches. A survey and analyst from firm Gartner predicts the number of networked devices connected to the internet will rapid increasing from about 5 billion in year 2015 to 25 billion by year 2020 [19]. In 5G networks, the speed will be about 66 times more faster compare than 4G network. That speed opens up intriguing new capabilities for self-driving of cars can make time-critical decisions. Video conference will make us feel like meeting in the same room without any delay. Cities are able to monitor traffic congestion remotely, pollution levels, CCTV monitoring and parking information then feed all that information to your house or smart car on the road in real time. Furthermore, download speeds should increase from current 4G network with maximum peak is 150 Mbps to at least 10 Gbps in 5G network.

To deliver 5G network, a carriers will need to support network infrastructure capacity between mobile devices and the big antennas to get service (called base stations). Carriers will also push base stations installed more closely with in a few hundred meters to improve the services of mobile devices. Today's telecommunication provider operated to communicate at low frequency with 100 MHz to 3 GHz, for the next 5G network operated in higher frequency bands will be required. But radio waves at higher frequencies are quite harder to transmit over longer distances or if buildings and walls are blocking. Several new techniques to compensate, carriers will rely on advanced antenna technologies. These include of massive MIMO (multiple-input multiple-output) antennas, which send many radio signals in parallel, and beam forming, which focuses radio energy in a specific direction. Figure 7 shows how a wireless access is able to communicate inter-network for the wireless/access solutions [1].

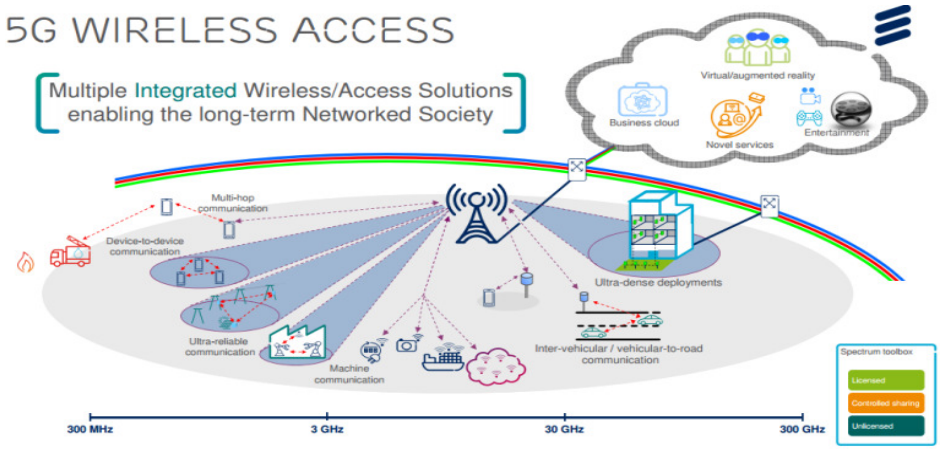

Fig. 7 Scenarios of 5G Wireless Access Network [1]

Currently, business models are influenced by the availability of internet and networking capabilities. Organizations or company are deploying more sophisticated networking equipment and technologies to enhance connectivity across the business spectrum. Connectivity is a key to quench demanding customer, there is huge market potential for technologies such as 5G that has connectivity powers several notches greater than the current existing network technologies. Figure 8 an example of scenario 5G technology in accessing network starting from user devices and send the data to a big data center.

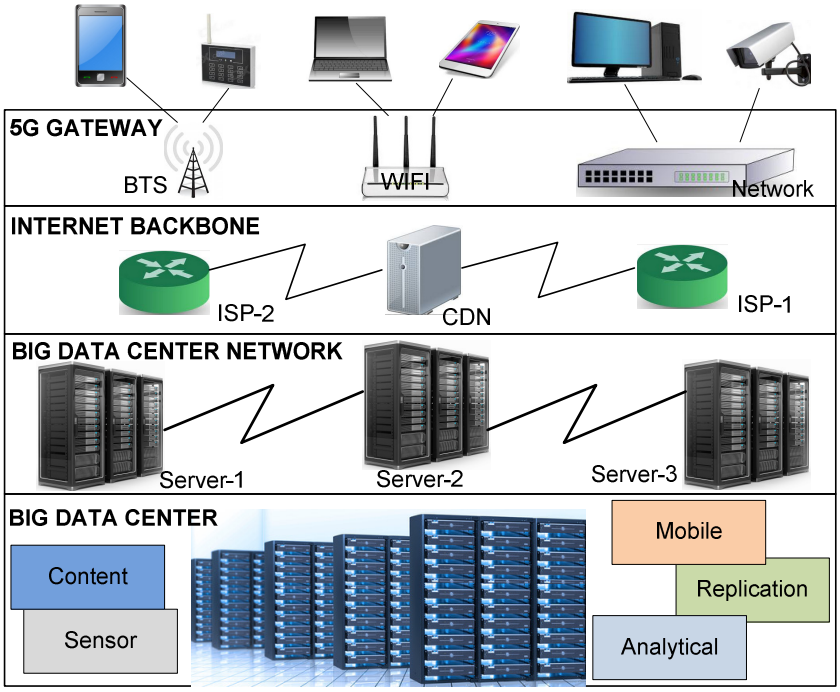

Fig. 8 Scenario of 5G Wireless Access Network

6 WIRELESS MONITORING FOR BIG DATA CENTRE

Data center is a key point in a company, institution or service provider, data center is to keep all the information or stored all transaction that some time need to query according to the need. Thus, system stability and maximum performance of a data center is a must to gives better service to client or company. Installation of a data center sometime is not in the area of company running, these can be running outside city or rural area, or even in others countries or continental, because of the distance then a monitoring system is required to monitor activities and gives alert if something is happen to the data center. Many parameters in a datacenter room need to continuously monitoring in order to prevent any incident happen, those parameters such as environment, room temperature, power line quality, smoke

detection, and others that related to the performance in data system. Figure 11 shows an illustrated how monitoring in a data center room, including asset monitoring to prevent stolen.

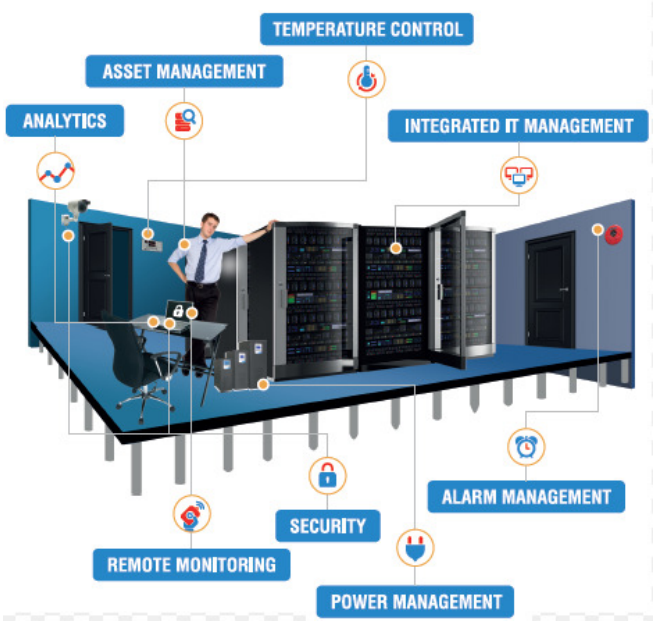

Fig. 11 Monitoring in a Data Center Room

Since wireless sensor technology has been deployed in a commercial application, implementation to monitor parameters remotely made efficiency either cost or technology used. Identification found efficiency measurement used to reduce the data center cooling load average by 48%, reducing from total data center power usage by 17% [20]. Wireless sensor network systems also eliminate some of the key logistical issues in installation of wiring to connect to every sensor in data center room. The used of wireless sensor network made easy in installation or maintenance also to expandable or relocation in future, because of this system provide flexibility then become growth in any application beside data center room. Another thing is by wireless monitoring made user friendly to do monitoring in almost any place and anytime without need to connect or come to the control station.

Besides monitoring of rooms environment and others physical status related to the database system in server, switch, router and backup power, wireless monitoring is required to check in software side. Software performance and load capacity is need to regular monitor in order to give good service and performance in a data center. Some parameters in software normally required to check regulatory such as:

- Database capacity
- System performance

- Traffic status
- Network status to other data center
- Network capacity
- Data rate to user
- Alarm indicator for hardware monitoring
- User status

Big data is a system build to handle high volume of data required to stored, a big database (data center) is part of big data system. With high traffic and huge number of data transaction everyday even some application serve thousands or millions of data then a data center have to ready in serving to data center. Thus, a good monitoring system is required to give alert if anything happens in order to solve within minimum of time. Wireless monitoring system as mention early is part of big data center to handle by remotely, especially for the long distance data center. In a big data system normally data storage setup in several places to handle the user according to the countries or region and also as backup data if any case happen in one of the data center, network and interconnection to those data center by wirelessly is need to manage of the data center.

7 CONCLUSION

The use of 5G technology application in Big Data Center network architecture as discussed give better efficiency and optimum performance to the devices. Data center as database for data stored and query for the user need perform in good network, increasing number of devices significantly every month or even every day, thus support for the infrastructure to gives high data rate and services is required else system performance and bad services happen. Data center monitoring is required in order to check status and monitor condition in a database system, some parameters normally monitored in data base such as environment, temperature, power supply, etc. Beside environment, software side also needs to monitor to check the performance and services capacity. Several monitoring technique can be used in data center, but nowadays most popular is wireless monitoring system because of the advantages this technology.

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