© https://fti-tn.net/publications Future Technologies and Innovations (FTI) Proceedings: 4th international conference on computer applications and information security (iccais'2021) / March 19 / 2021/ Tunisia: https://fti-tn.net/iccais-2021-list-of-papers

5G Towards A New Era of Smart Cities Application Clusters

Bader Alojaiman
Community College, Shaqra
Shaqra University
Shaqra, KSA
alojaiman@su.edu.sa

***Abstract*— The technological innovation in the software application space today is becoming the mantra, particularly with the introduction of 5G technology. A fresh generation of technical advancement will be assumed by the groundbreaking 5G technology, through self-driving vehicles through to smart cities. The various case applications for 5G are interesting, but it is also worth contemplating how 5G can transform the way people think about networking. Here is a glimpse at how 5G can change our perception of what it represents in the near future. Wireless cellular networks are evolving in an effort to achieve the advancement of the fifth generation (5G) network, which ensures that they can cover a wide scale. Today's wireless technology and the changing new 5G era are all deemed beneficial for the intelligent network. In essential and timely implementations, 5G networks offer relevant services for wider parts of the smart cities. In these works, the 5G Network as well as its strategy for the smart city application cluster are extensively evaluated and reviewed. Towards this end, intelligence services are analyzed and application clusters recognized; preferences, aspirations and insights of end users are observed. This study clearly demonstrates the present state of 5G networks in the smart city application clusters with efficiency review.**

Keywords- Smart cities; 5G mobile communication; innovation; Application clusters; decision making

I. INTRODUCTION

5G technology can improve cellular network performance, power and speed. This would trigger an improvement in IoT technology and contribute to a new age of technology. 4G undoubtedly performed a key role in the growth of app economies, but 5G is prepared to play a far more important role in promoting digital technology from interactive robotic implementation to the industrial internet of things (IIoT) [1]. Since target audience use ever greater volumes of data on a multitude of devices, the coverage and even capacities of 4G are limited. The feasibility of emerging innovations like automated vehicles which rely on all-round synchronization can also be affected by 4G's limitations to carry out edge computations in real time. 5G would, however, make such cases feasible whilst opening up expanded wireless communication potential at higher speeds. In the upcoming 5G Smart nodes which have to be linked regularly across large geographical areas.

We are now using systems which rely on wireless networks perhaps even more and more. Mobile phones and IoT devices developed rapidly, even faster than anyone predicted on 4G networks. It is no longer rare for anyone to have many gadgets, all of which require independent network service. To interact between these devices while retaining separate connections to the clouds, we would need a wireless high-speed network that supports all these connections simultaneously. It is anticipated that 5G networks will have a greater bandwidth performance that will allow today's linked environment.

Major developments by the world's smart city are close to the construction of power generation when energy first came into being. The network of utilities going further than a single organization, like energy, a generation ago, in the intelligent age. Added to this modern era is the well-developed Internet infrastructure which can run infinite numbers of apps, the proliferation of cloud power and memory capacities, resilient network virtualization and advanced data analysis, such as machine learning and artificial intelligence [2, 3, 4].

With 5G about to become the next telecommunications network its effect on the data and networking processing environment must be examined. In this article, we examine and evaluate our views on the potential research problems and possibilities of 5G, in both conventional and modern innovations [6]. While bandwidth and latency drop by 5-10x is estimated to grow by 10-100 times, 5G is estimated to be the largest enabler for smart cities, smart IoT, as well as efficient healthcare, whereby machine learning takes place on the verge.

Thousands of objects, systems as well as people are connected and interact in intelligent cities through wireless, IoT as well as 5G systems. A large number of mobile users have access to a vast amount of internet traffic which is often created by the items in WLANs and/or IoT (MUs). These all MUs compete for data, residential and infrastructure access to the 5G network. In fact, this will make the 5G network more costly.

The global market size of 5G technology is expected to hit USD 41.48 billion by 2020 and broaden at the Compound Annual Growth Rate (CAGR) of 43.9% between 2021 to 2027, as per a report released by Grand View Research [5]. Figure1 shows the graphical illustration of this report. 5G mobile broadband services are scheduled to market in 2020 and allow a truly mobile and wired world by providing clients with a wide

range of apps and financial performance. In addition, higher data velocities and incredibly low latency supported by 5G technology will improve the user involvement when using 5G services for a variety of uses, which including VR gaming, smooth video chatting and ultra-high definition (UHD) video. A expanding consumption is estimated to facilitate 5G service implementation over the forecast timeframe for the high-speed data communication for integrated internet of things (IoT) applications like smart domestically power management. In addition, the emphasis on building alliances with telecoms operators by 5G systems engineering providers is expected to expand by growing 5G service acceptance.

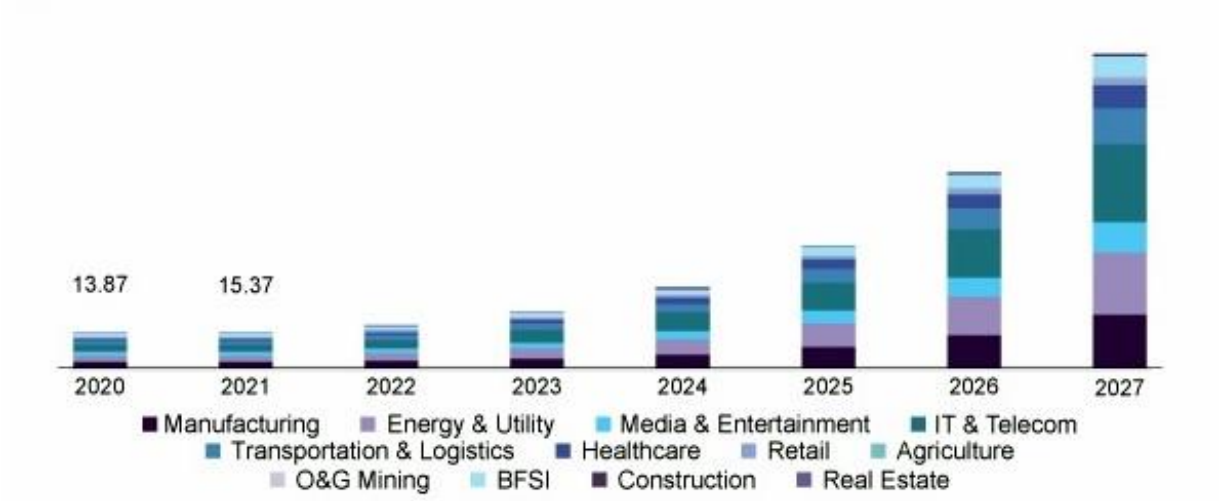

Figure 1U.S. 5G services market size in USD Billion, by vertical, 2020-2027 (Source: www.grandviewresearch.com)

II. LITRATURE REVIEW

Chatterjee et al. discussed various factors that significantly impact the function of network transmission lines on smart cities, without jeopardized security and privacy concerns, in addition to enhancing the overall performance of modern networking systems. It is important to clearly grasp the interconnections of these crucial success factors. They intended to identifying these essential areas and also attempts to detect the major driving forces between these key success factors and establish interrelationships between the CSFs. These aspects have been recognized with the support of three reliable instruments, that are questionnaire-based surveys, brainstorming and, ultimately consolidation by Principal Component Analysis (PCA) [8].

Vo et al. suggested an Optimization System (CSF) for the mutual caching and downlink exchange of resources in 5G technology, to help WMSNs effectively provide multimedia content. The CSF allows the MBSs to select efficiently how many multimedia information copies to cache with which feminine to base stations touch high multimedia information It also utilizes the optimum MUs who have obtained digital media and are ready to access their DownLink tools for downloading using device-to-device [9].

Líao & Wang's discussed the architecture and implementations for future optimized casinos and enterprise (5G ICEMO) 5G wireless micro operators in smart cities are presented. They suggested for the first time a model for the 5G ICEMO evaluation and growth of the business model with the Concentric Value Circles (CVC). The ICEMO framework is equipped for 5G Cloud-enabled with Wireless systems. The proposed 5G ICEMO design has been studied in three demonstrating cases of massive casino, anti-counterfeiting as well as automated transportation. The performance measurement between Las Vegas, Macao and Singapore were analyzed to verify how interconnected casinos as well as enjoyment in smart cities will take advantage of the suggested 5G operator framework [10].

Nassar & Yilmaz discussed the issue of network slicing of network edge restricted resources for vehicle and smart city clients with interdependent latency and complex computing requirements. In order to allow productive use of minimal services at the edge of networks. They have developed network cutting model which is centered on a fog node (FNs) co-ordinate with a finger controller (EC). The EC determines which FN to conduct the role for each service demand in a cluster, i.e. to work on the edge, or to deny the role and transfer it to the cloud. They also formulated the problem as a method of Markov decision (MDP) process on an infinite horizon. They suggested a solution that helps us to understand the optimum cutting strategy in an adaptable manner. By using other slicing methods in complex environments and for a variety of scenarios of design goals, the efficiency of the suggested DRL-based cutting system is tested. Simulation based findings indicate that the suggested DRL-based EC determines the optimum policy rapidly through environmental interaction, allowing for responsive and automated grid sliding in dynamic motor and smart city settings for efficient allocation of resources [11].

Loghin et al. analyzed how 5G can support federal learning grow. One other essential 5G feature is network slicing which allows multiple isolated networks to be run on the same physical infrastructure. In the sense of virtualization, multitenancy and high system density, however, protection remains the main

concern. 5G networks should be formally verified to identify problems with protection in large virtualized environments. In short, 5G will enhance the global connectivity and strengthen the connectivity. In 4G networking what we have seen is pale compared to the overwhelming number of possibilities that 5G provides [12].

Lytras et al. discussed about a variety of intelligent city facilities and also a variety of new resources augmented by ICT could be introduced in urban areas. In terms of methods, the issue is how these two can be related effectively. They aimed at dealing with the situation. For this reason, intelligent services are analyzed and system clusters recognized, preferences and perceptions of end users classified and evidence presented [13].

III. 5G TECHNOLOGIES

5G technology is the fifth generation of the third-generation partnership project (3GPP). 2G, 3G, and 4G and their related innovations are carried out, while major changes in efficiency are made. 5G wireless technology is intended to offer greater multi-Gbps data maximum rates, tremendously low latency, higher reliability, large network bandwidth, enhanced availability and a more reliable customer experience [7]. Greater productivity and performance allow new user experiences as well as connect new companies.

5G is planned to supply maximum data rates of up to 20 Gbps depending on specifications of IMT-2020. Qualcomm SnapdragonTM X55 and SnapdragonX60 Modem-RF Modules, the leading 5G solutions from Qualcomm Technologies are optimized to achieve high downlink speeds of up to 7.5 Gbps. However, 5G is much more than how easily it is. Besides significantly higher speeds, 5G provides even more internet bandwidth by extending to new spectrum, including mmWave.

Figure 2Overview of 5G technology

5G can also have a much lower computational complexity for an instant response and offer a more seamless end user experience and keep the data speeds continuously high even as users switch around. And a Gigabit LTE coverage foundation is enabled the new 5G NR cellular network, that can provide all-round communication of the gigabit class.

In general terms, 5G is being used throughout three primary types of network connections, namely improved mobile broadband, mission-critical and huge IOT telecommunications. A distinguishing characteristic of 5G is its potential flexibility – the ability to efficiently support future uncertain networks.

A. Improved mobile broadband

In addition to strengthening the gadgets, 5G digital technology promises quicker, more uniform information speeds, less lag and less expensive per-bit to introduce new interactive elements such as AR & VR.

B. Mission-critical communications

5G would deliver new products and services to improve businesses with highly efficient, accessible, low latency networks such as essential communications remote control, automobiles and medicine treatments.

C. Massive IoT

5G is intended to securely link a vast number of sensing devices in practically all by reducing data speeds, energy and versatility – offering highly sleek and accessible communication solutions.

IV. SMART CITIES APPLICATION CLUSTERS

In the 1990s, the phrase 'smart cities' was eventually adopted. In academic papers and global relations, the idea has become extremely prevalent. As per Albino et al. (2015) the California Institute for Smart Cities was one of the first organizations to concentrate on how to make cities smart and how to grow a city to incorporate information technology. In the past twenty years the idea of smart cities already has multiple meanings, with smart cities becoming the locations where data technology is integrated to solve social, environmental and social issues in services, engineering and everyday items [15].

Smart cities provide possibilities for several different kinds of applications and possible new business models as a field of rising concern for mobile networks. Smart cities still have wide concept; accessibility, protection, power, physical environmental management and transport/mobility are main technological implementations.

The key advantage of 5G is that it reduces prices, increases Quality of Service (QoS), improves reliability, and sets an industry standard. One of the primary reasons for this is to anticipate the use of established carrier infrastructures for smart cities projects to implement the planned innovative network instead of heavy Capex investments. A promised QoS could be given for application which are more important by using network trimming techniques.

With both the case of smart cities there are two significant points to remember. The reality is that the vast variety of use scenarios that can be considered in a smart city overall category involves applications that depend on the 5G capability of

Enhanced Mobile Broadband (eMBB) and Mission-Critical Services (MCS). Firstly, while they were included in the Massive Internet of Things section for the purpose of this report. For instance, dynamic traffic control is the smart city application, which would exploit many of the 5G MCS functionality (closely associated with transportation). Correspondingly, it will take the capabilities provided by the 5G EMBB to use both safety drones and mounted cameras as part of secure smart cities.

The next important point is that intelligent cities generally remain early in development even in 2035. IHS Markit therefore based its estimation of the economic effects on the fact that technologies for smart cities were commonly used, not omnipresent. Mobile technology and 5G can play an even more significant role as the industry reaches maturity beyond 2035 [14]. The IEEE Standards Association establishes standards and associated networking and connectivity operations that are essential for the design, generation, automation, service, transmission, delivery, distribution, support and link of power to cities, households and Networks, to serve the increasing energy needs of future generations. The Figure 3 shows the different IEEE standards to enable Smart City Technologies.

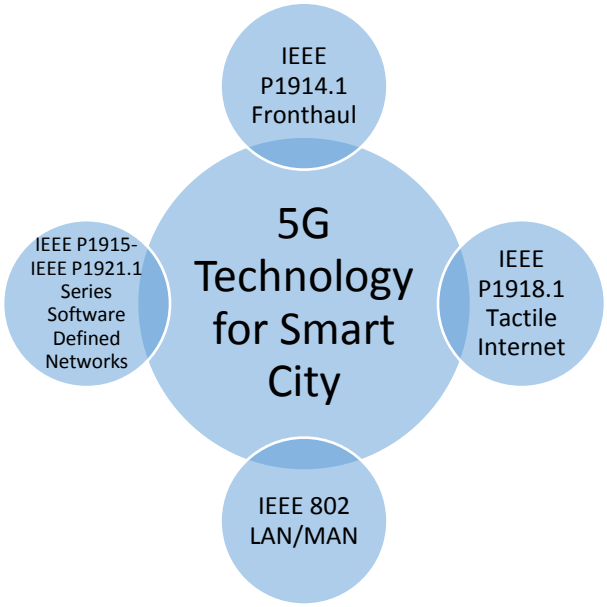

Figure 3IEEE Standards to enable Smart City Technologies

A changing environment is the technical setting. In a simple snapshot, it is difficult to evaluate it at a certain moment. Lytras etc. [13] arranged the main ICT innovation clusters, which make and endorse smart cities applications, in Figure 4 below, accordance with the context and comprehensive relevant literature. They assume this is a comprehensive summary that makes a dialog in modern day's vision of intelligent cities.

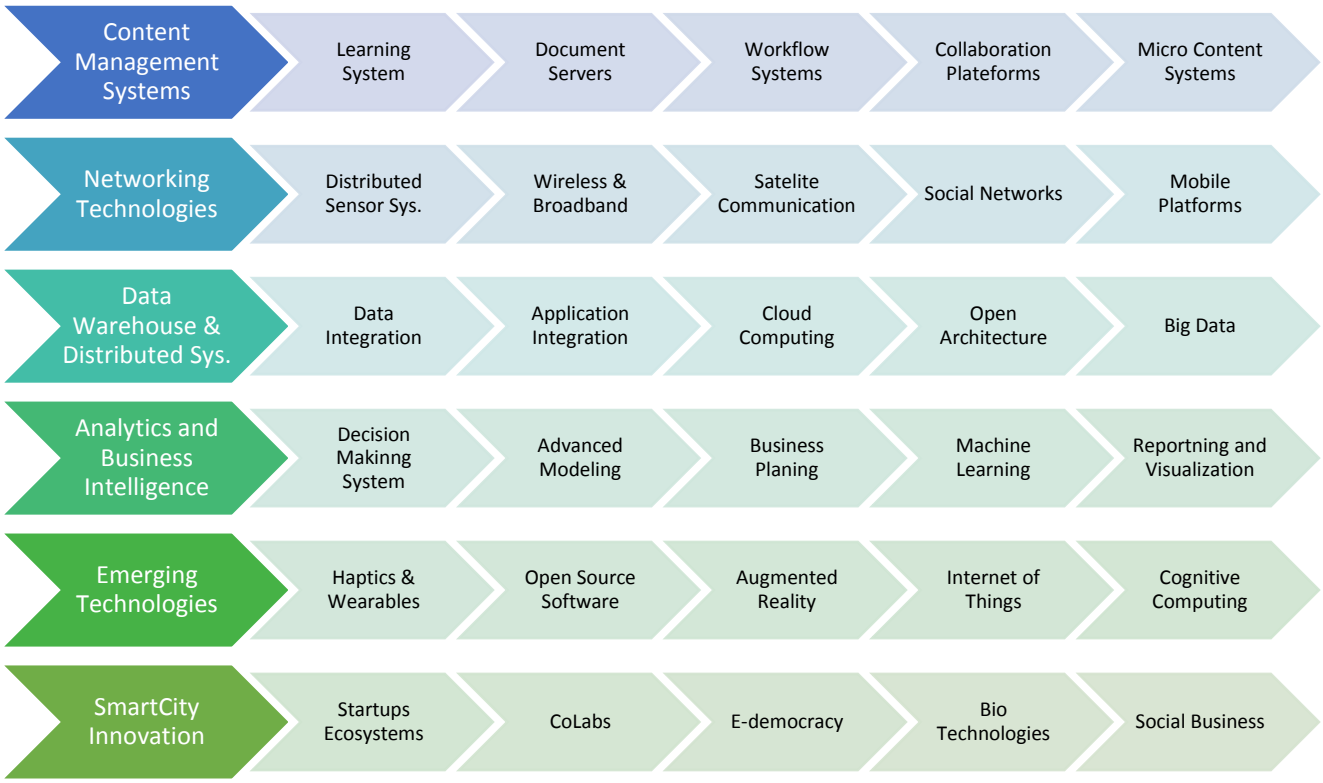

Figure 4Information and Communication Technology clusters for Sustainable Smart Cities applications

V. CONCLUSION

This study aimed at investigating the relation between end-users' views and experiences of smart city infrastructure and their sensitivity and their ability to adapt to the demands and expectations of people with the support of 5G technology. People demonstrate different views of various facilities. Many of them are ready to use smart city services to promote trusted local community news, access to education and experience, as well as creativity and business activities on a global scale.

It is evident that the global growth of towns and cities is causing new issues: public health issues, pollution and sewage operational issues, air pollution, absence of community inclusion, congestion in transport, etc. Smart city strategies with the support of 5G technology innovation will allow us to overcome these issues associated with ecological sustainability. Renewable and secure energy; quality of life, changing demographics and public welfare; weather, environment, resource consumption; security and stability. Smart, sustainable and automated transport providing included accessibility; At the very same time, it must be remembered that science and engineering can only take part in these obstacles.

ACKNOWLEDGMENT (HEADING 5)

.

REFERENCES

[1] Chettri, L., & Bera, R. (2019). A comprehensive survey on Internet of Things (IoT) toward 5G wireless systems. *IEEE Internet of Things Journal*, *7*(1), 16-32.

[2] Attaallah, A., Ahmad, M., Ansari, M. T. J., Pandey, A. K., Kumar, R., & Khan, R. A. Device Security Assessment of Internet of Healthcare Things.

[3] Ansari, M. T. J., Al-Zahrani, F. A., Pandey, D., & Agrawal, A. (2020). A fuzzy TOPSIS based analysis toward selection of effective security requirements engineering approach for trustworthy healthcare software development. *BMC Medical Informatics and Decision Making*, *20*(1), 1-13.

[4] Zarour, M., Ansari, M. T. J., Alenezi, M., Sarkar, A. K., Faizan, M., Agrawal, A., ... & Khan, R. A. (2020). Evaluating the impact of blockchain models for secure and trustworthy electronic healthcare records. *IEEE Access*, *8*, 157959-157973.

[5] Global 5G Services Market Size Report, 2021-2027. (2020, May). Retrieved February 02, 2021, from https://www.grandviewresearch.com/industry-analysis/5g-services-market

[6] Ansari, M. T. J., & Pandey, D. (2018). Risks, security, and privacy for HIV/AIDS data: big data perspective. In *Big Data Analytics in HIV/AIDS Research* (pp. 117-139). IGI Global.

[7] Ansari, M. T. J., Pandey, D., & Alenezi, M. (2018). STORE: security threat oriented requirements engineering methodology. *Journal of King Saud University-Computer and Information Sciences*.

[8] Chatterjee, S., Kar, A. K., & Gupta, M. P. (2017). Critical success factors to establish 5G network in smart cities: Inputs for security and privacy. *Journal of Global Information Management (JGIM)*, *25*(2), 15-37.

[9] Vo, N. S., Duong, T. Q., Guizani, M., & Kortun, A. (2018). 5G optimized caching and downlink resource sharing for smart cities. *IEEE Access*, *6*, 31457-31468.

[10] Liao, D. Y., & Wang, X. (2018). 5G Wireless micro operators for integrated casinos and entertainment in smart cities. In *Handbook of Smart Cities* (pp. 115-149). Springer, Cham.

[11] Nassar, A., & Yilmaz, Y. (2020). Deep Reinforcement Learning for Adaptive Network Slicing in 5G for Intelligent Vehicular Systems and Smart Cities. *arXiv preprint arXiv:2010.09916*.

[12] Loghin, D., Cai, S., Chen, G., Dinh, T. T. A., Fan, F., Lin, Q., ... & Zhang, Z. (2020). The disruptions of 5G on data-driven technologies and applications. *IEEE transactions on knowledge and data engineering*, *32*(6), 1179-1198.

[13] Lytras, M. D., Visvizi, A., & Sarirete, A. (2019). Clustering smart city services: Perceptions, expectations, responses. *Sustainability*, *11*(6), 1669.

[14] Campbell, K., Diffley, J., Flanagan, B., Morelli, B., O'Neil, B., & Sideco, F. (2017). The 5G economy: How 5G technology will contribute to the global economy. *IHS Economics and IHS Technology*, *4*, 16.