Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X
IMPACT FACTOR: 7.056

IJCSMC, Vol. 12, Issue. 2, February 2023, pg.1 – 12

An Effective Comparative Evaluation in 4G and 5G Generation of Wireless Mobile Network

Hiba Salah Mahdi
Assistant Teacher, MSc Computer Science / Baghdad University
General Directorate of Curriculum
Ministry of Education
Email: habawy20@yahoo.com

DOI: https://doi.org/10.47760/ijcsmc.2023.v12i03.001

Abstract:
Most business or government services are implemented in a web or cloud-based environment nowadays. For this purpose, websites, mobile applications, and cloud-based services are established in cyberspace so that services may be accessed at any time, from any location. India is one of the largest smartphone marketplaces and an attractive location for smartphone manufacturing multinational corporations. According to data and statistics from Statista.com, India is one of the leading nations with a substantial mobile user market. In 2017, over 134 million cellphones were sold in India, which is a significant number. According to a separate study, the number of people in India who use smartphones is expected to almost reach 450 million by the year 2022. There is a need to improve the performances of present 4G and upcoming 5G Net-work technologies so that a better level of performances may be obtained in the net-work environment in order to support the massive load of smartphone wireless networks. This book focuses on the presentation of the outcomes of advanced 4G and 5G wireless net-works simulated utilizing the advanced implementation tools of cupcarbon.

Keywords: Mobile Network, 4G & 5G Network, and Related Technologies An Analysis of the Performance of 4G & 5 Network, as well as Mobile Wireless Communications.

Introduction

There are already more than 20 mobile operating systems being used in smartphones, each with their own app stores and libraries [1, 2]. If a company wants to gain a competitive edge and improve its marketing, it will undoubtedly be eager to create mobile apps for all platforms in order to make its mobile-based services available and accessible on a variety of platforms and devices [3]. Dealing with compatibility concerns with large platforms and devices is one of the biggest obstacles in developing mobile apps [4, 5, 6].

It is necessary to have access to an environment that is integrity conscious in order to evaluate 4G and 5G based advanced net-works and achieve greater levels of speed and performances in wireless net-works [7, 8, 9, 10]. In doing so, the next technologies may be improved on a variety of factors.

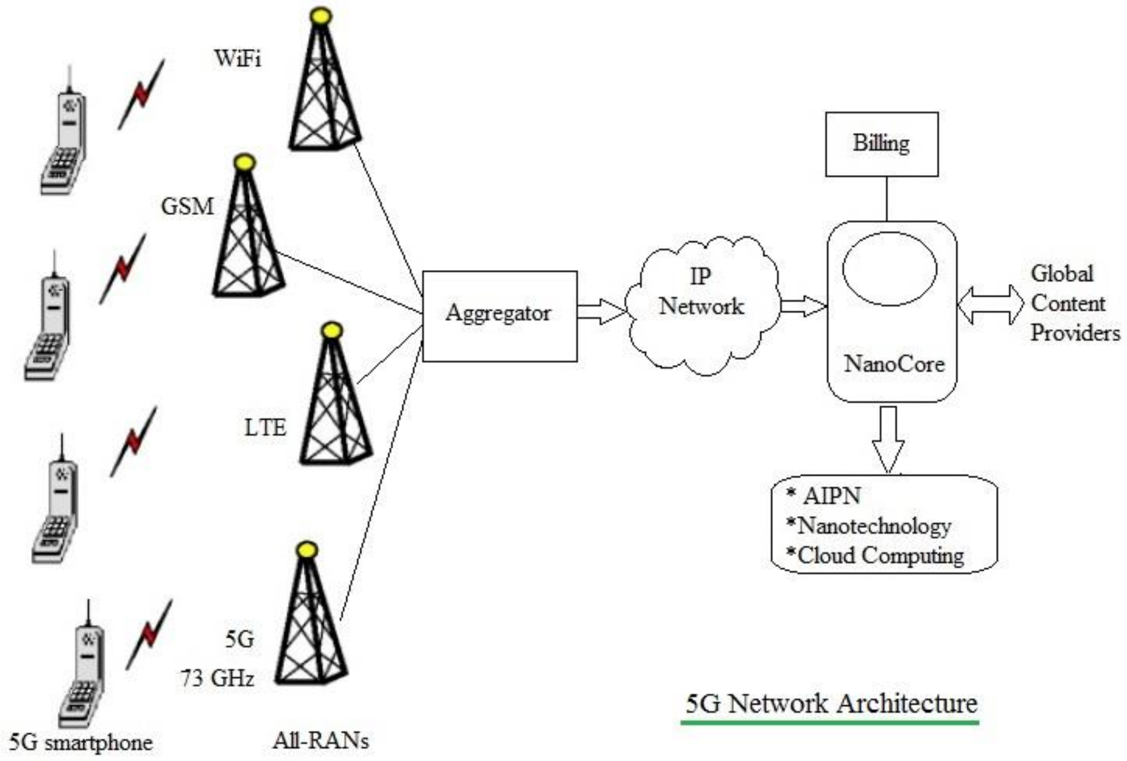

Figure 1: 5G Network Environment

As shown in the image, the 5G-based net-work environment has several modules, making it possible to access large modules that need performances [11, 12].

Table 1: Platforms for Mobile Wireless Applications Based on 4G and 5G [13,14, 15, 16]

Bada	Amazfit -os	Android
FunTouch	Firefox -os	Fire -os
Yun	Windows -Phone	Web OS
Cyanogen -os	Color - OS	BlackBerry
IOS	Fuschia	Flyme OS
Lune	Lite -OS	Kai OS
MeeGo	Maemo	MIUI
Pixel UI	Palm	Nokia Asha platform
Sailfish	QNX	Pure -OS
Ubuntu Touch	Tizen	Symbian Mobile

The three kinds of smartphone applications that may be used in environments with wireless net-works based on 4G and 5G are listed below [17].

- Native applications [18]
- Applications for Many Platforms [19]
- Hybrid applications [20]

4G and 5G Simulation Technologies for simulating

The simulating tools also technology utilized in order to represent the viewpoints and components of advanced wireless Net-work are included in the following list [21, 22]. The software and simulation’s packages that are discussed further down are often used while simulating 4G & 5G Net-work [23, 24]. The software suite are NCTUNS, WEBNMS, CORE, OpenIoT, MiniNet, PARSEC, IMUNES, GNS3, NETSIM, MIMIC, JSIM, GLOMOSIM, Ns3 mmWave, DSA, PSIM, Ns3, Zetta, NS2, Node-RED, VNX / VNUML, Shadow, CISCO Packet Tracer, Cloonix, IoTivity, SNMP, PHYSIM, QUALNET, OMNET++, PeerSim, JIST / SWANS, TRAFFIC, OPNET, NetKit, CNET, MOBIREAL.

Table 2: Major Differences Between 4G and 5G Technology [29, 30, 31]

Specifications	**4G Technologies**	**5G Technologies**
Bandwidths	2 Megabits per -2nd to 1Gb per -2nd	1Gb per -2nd and higher as per need
Data _Rate	1 Gb per -2nd	10 Gb per -2nd
Advent	2010	2015
Density	$1000/Km^2$	$1000000/Km^2$
Service Factors	HD Streaming	Wearable Technologies
Transmitting Time Interval	1 ms	100 µs (minimum.) to 4ms (Maxam.)
Latency	10 ms	<1 ms
Multiple Access	CDMA	CDMA,BDMA
Frequency Band	2-8 GigaHz	3-300 GigaHz
Spectral Efficiency	30 b/s/Hz	120 b/s/Hz
Mobility	350 Kmph	500 Kmph
Core net-work	All IP net-work	IP net-work with a flatter topology and 5G net-work connectivity (5G-NI)
Key standards	Convergence of all forms of access, include OFDMA, MC-CDMA, and net-work-LMPS	CDMA and BDMA

More points are shown below [32]. The mobile phone net-work utilizing 4G technology offers a wide range of services, include Internet TV, IP Telephony, HD Live Video Conferencing, Cloud Services, HD Live Gaming, 3D TV, and Multimedia Transmitting at a Speed of 100 mpbs [33, 34, 35]. The fundamental technology of the 5G cellular network is quite advanced, with a high level of precision and little latency. It is anticipated that 5G networks would operate with very little downtime and at astounding speeds of up to 10 Gbps. [36, 37]. Research and development activities have greatly expanded in order to implement 5G technology and reach a higher degree of accuracy. [38, 39, 40].

	4G-LTE	5G
Downlink real-world	42 Mb/s	100 Mb/s
Uplink real-world	25 Mb/s	50 Mb/s
Downlink Theoretical	1 GB/s	20 GB/s
Uplink Theoretical	500 MB/s	10 GB/s
Spectral Efficiency (Downlink)	15 bps / Hz	30 bps / Hz
Spectral Efficiency (Uplink)	6.75 bps / Hz	15 bps / Hz
Latency (Control plane)	100 ms	50 ms
Latency (User plane)	10 ms	1 ms
Frequency Bands	700-2100 MHz	28-40 GHz

Performance Assessment Using 4G and 5G Network Simulation

Using CupCarbon's sophisticated simulator, The capabilities of 4G and 5G networks, which have upgraded characteristics to the main points of modern wireless technologies, are evaluated in order to maximize connectivity and efficiency. [41, 42].

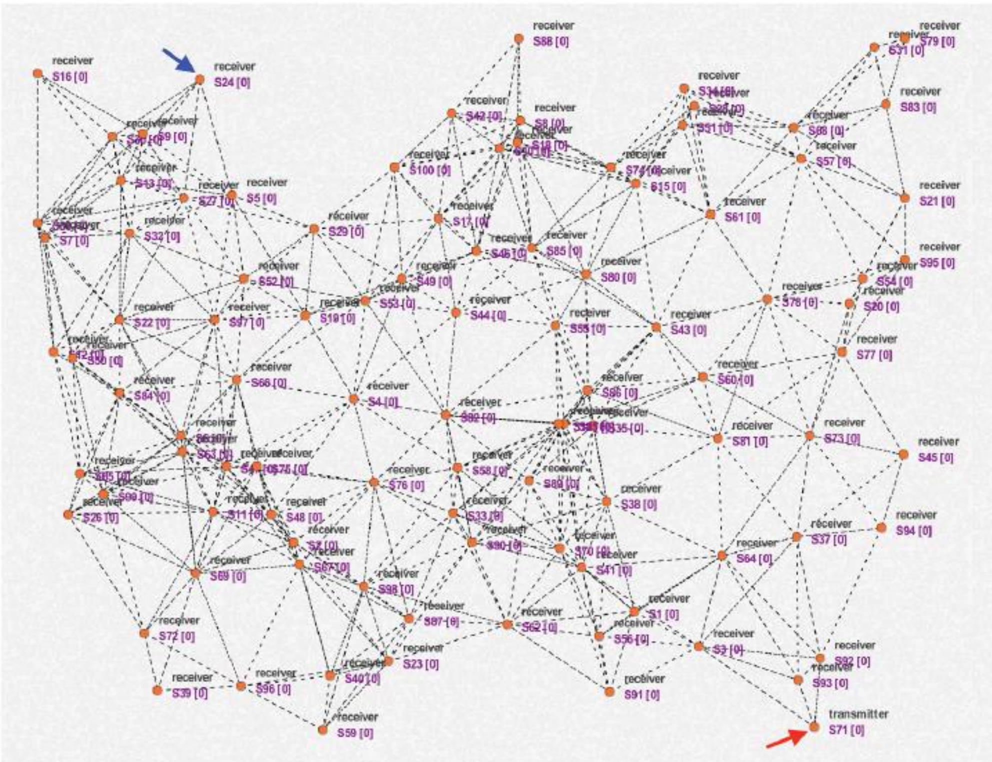

Figure 2: 5G Network Simulating

In order to thoroughly analyze the packets and logs, the graphic shows how connections and bandwidth characteristics are examined in various modules of the simulated 4G and 5G networks.

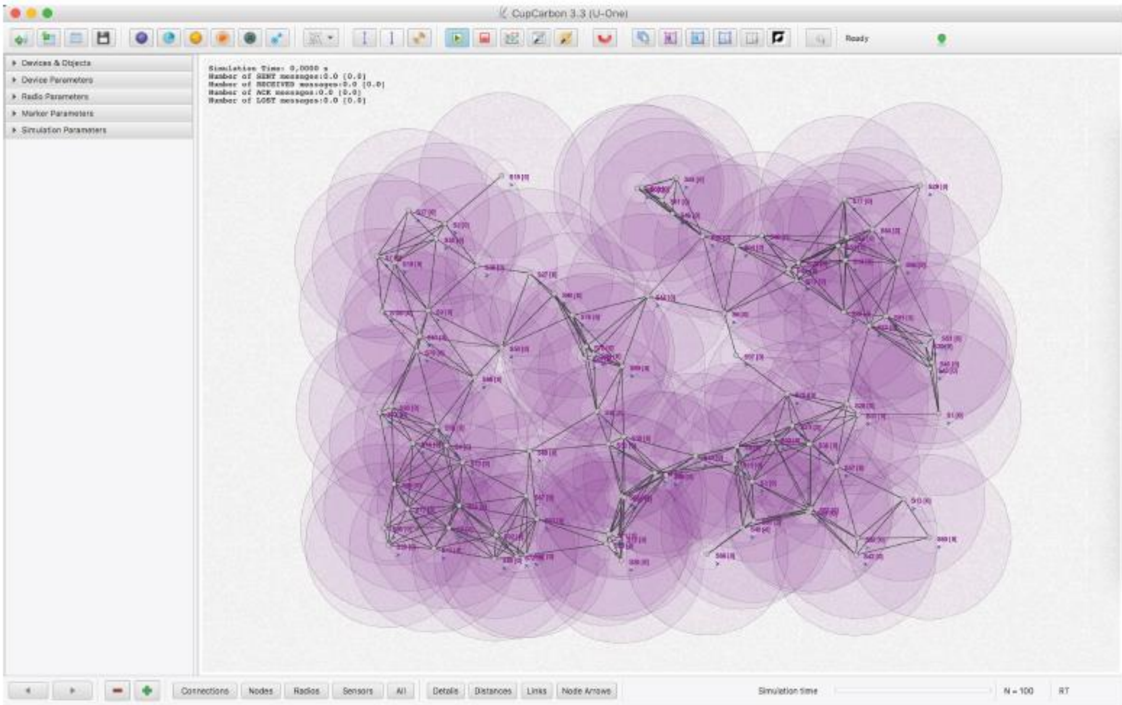

Figure 3: Network Connections and Associations

The following variables and parameters may be recorded in the results of the net-work simulation and implementation.

- Execution speed, complexity, and duration.
- Latency.
- Performance.

The results of the simulation demonstrate that a 5G-based network implementation has the least amount of latency and is extremely efficient overall.

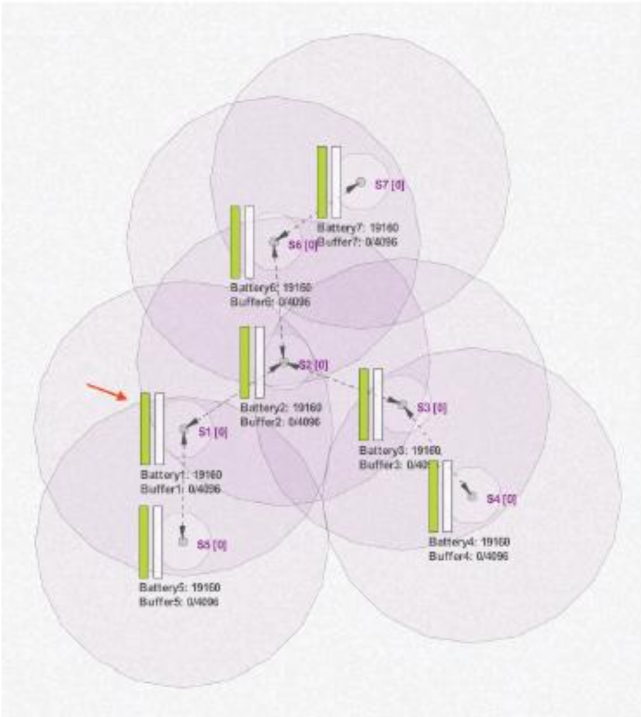

Figure 4: Elements of Performance in Advanced Network Scenarios

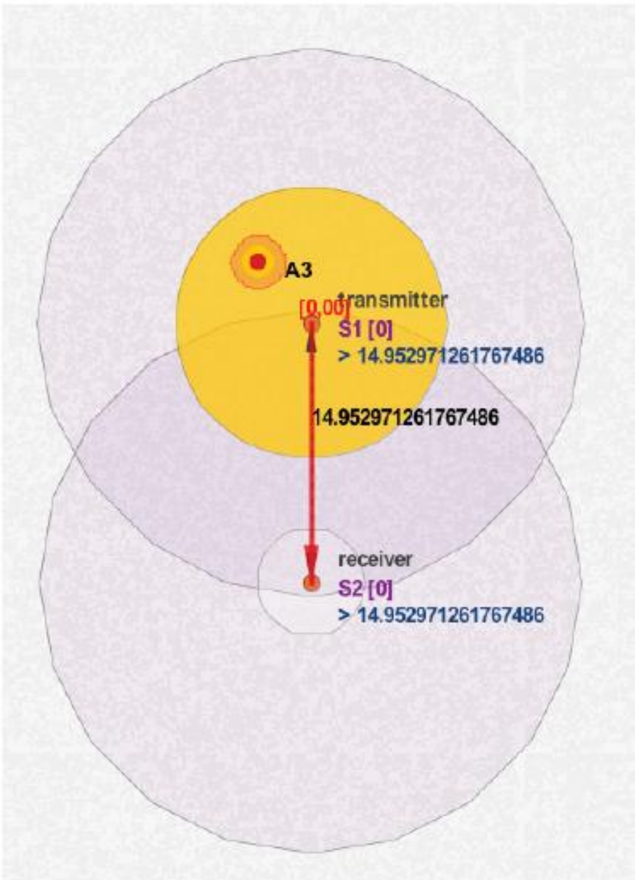

Figure 5: Logs Recording the Analysis

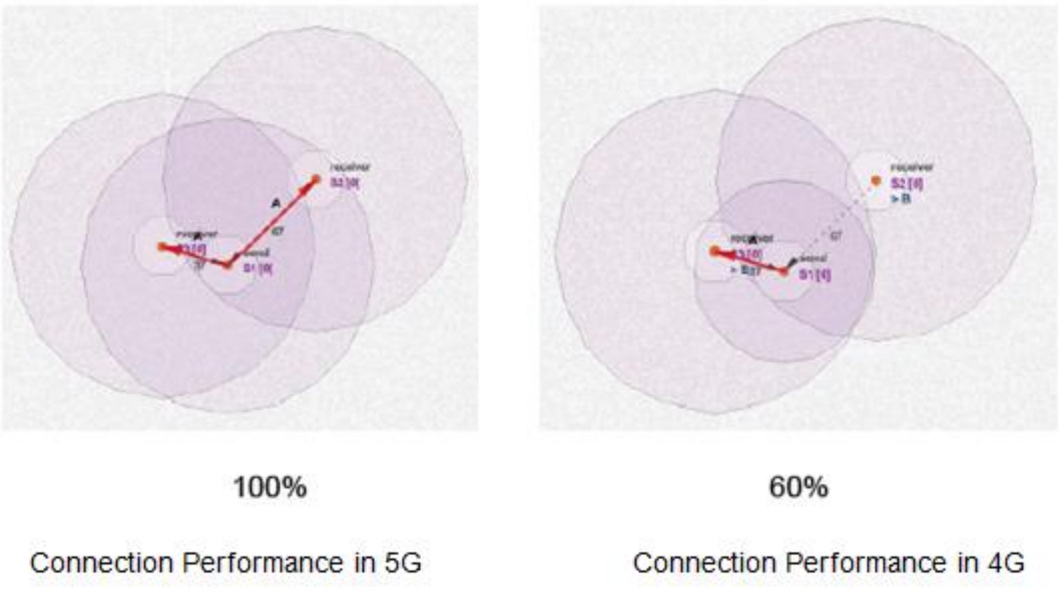

Figure 6: Performance Evaluation

Table 3: Evaluation of Parameters

Simulation Scenario	**Security (4G)**	**Security (5G)**	**Latency (4G)**	**Latency (5G)**
1	74	84	91	72
2	78	84	89	76
3	76	94	88	70
4	70	83	84	78
5	73	90	95	76
6	74	95	89	72
7	80	96	84	79
8	72	86	84	76
9	72	94	82	73
10	70	94	98	73

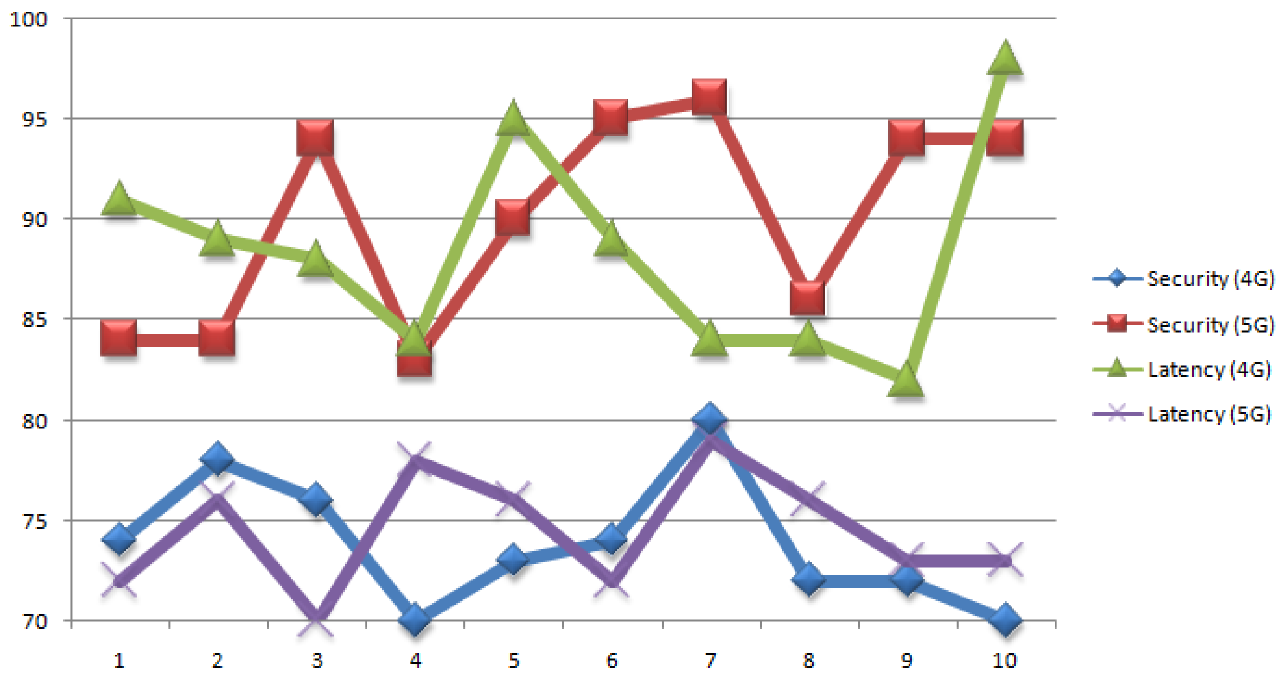

Figure 7: Parameter analysis

Table 4: Evaluation of Speed in Points

Execution Time (5G)	Execution Time (4G)
267.8571429	165.2892562
89.28571429	165.2892562
89.28571429	165.2892562
267.8571429	247.9338843
267.8571429	82.6446281
178.5714286	82.6446281
178.5714286	82.6446281
178.5714286	165.2892562
178.5714286	82.6446281
267.8571429	82.6446281

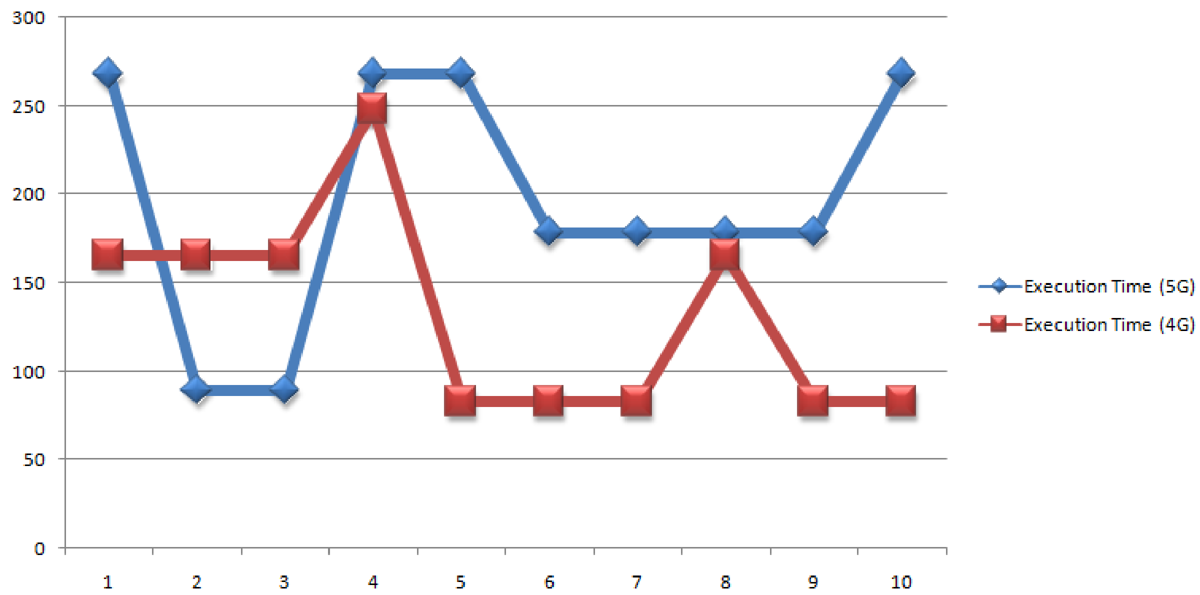

Figure 8: Analysis of Parameters

In the 5G-based net-work environment, the speed and other aspects have been shown to be better when compared to the 4G-based implementations. This conclusion was reached after the results on numerous metrics were analyzed.

Conclusion

The performances of mobile applications may be assessed utilizing several cross-platform frameworks for research and development. It is possible to create the same application utilizing the Cordova, Corona, as well as related frameworks. After development and deployment for certain devices and platforms, the capabilities of alternative development environments may be evaluated, enabling the selection of the best development framework for creating mobile applications to be found. In order to assess overall performances, the assessment of 4G and 5G is done in this article.

References

[1] Lusch, R. F., & Watts, J. K. (2018). Redefining the market: A treatise on exchange and shared understanding. Marketing Theory, 1470593118777904.
[2] Gündüç, S., & Eryiğit, R. (2018). Role of new ideas in the mobile phone market share. International Journal of Modeling, Simulation, and Scientific Computing, 9(02), 1850018.
[3] McGonigle, A., Wilkes, T., Pering, T., Willmott, J., Cook, J., Mims, F., & Parisi, A. (2018). Smartphone spectrometers. Sensors, 18(1), 223.
[4] Martins, J., Costa, C., Oliveira, T., Gonçalves, R., & Branco, F. (2019). How smartphone advertising influences consumers' purchase intention. Journal of Business Research, 94, 378-387.

[5] MacCrory, F., & Katsamakas, E. (2019, January). The Smartphone as the Incumbent "Thing" among the Internet of Things. In Proceedings of the 52nd Hawaii International Conference on System Sciences.
[6] Hernández, G. J. L. (2019). Wearable Technology: Shaping Market Opportunities Through Innovation, Learning, and Networking. In Reverse Entrepreneurship in Latin America (pp. 29-44). Palgrave Pivot, Cham.
[7] Jain, A., Lopez-Aguilera, E., & Demirkol, I. (2019). Evolutionary 4G/5G Network Architecture Assisted Efficient Handover Signaling. IEEE Access, 7, 256-283.
[8] Hussain, S. R., Echeverria, M., Chowdhury, O., Li, N., & Bertino, E. (2019). Privacy Attacks to the 4G and 5G Cellular Paging Protocols Using Side Channel Information.
[9] Ojaroudi Parchin, N., Jahanbakhsh Basherlou, H., Al-Yasir, Y. I., Ullah, A., Abd-Alhameed, R. A., & Noras, J. M. (2019). Multi-Band MIMO Antenna Design with User-Impact Investigation for 4G and 5G Mobile Terminals. Sensors, 19(3), 456.
[10] Oughton, E. J., Frias, Z., van der Gaast, S., & van der Berg, R. (2019). Assessing the capacity, coverage and cost of 5G infrastructure strategies: Analysis of The Netherlands. Telematics and Informatics.
[11] Panwar, S. (2020). Review Paper On: A Survey on 5g Technology.
[12] Islam, N., & Wahab, A. W. A. (2019). 5G Net-work: A Holistic View of Enabling Technologies and Research Challenges. In Enabling Technologies and Architectures for Next-Generation Networking Capabilities (pp. 37-70). IGI Global.
[13] Khune, A., & Pasricha, S. (2019). Mobile Network-Aware Middleware Framework for Cloud Offloading: Using Reinforcement Learning to Make Reward-Based Decisions in Smartphone Applications. IEEE Consumer Electronics Magazine, 8(1), 42-48.
[14] Al-Turjman, F. (2019). 5G-enabled devices and smart-spaces in social-IoT: an overview. Future Generation Computer Systems, 92, 732-744.
[15] Santa, J., Fernández, P. J., Ortiz, J., Sanchez-Iborra, R., & Skarmeta, A. F. (2019). SURROGATES: Virtual OBUs to Foster 5G Vehicular Services. Electronics, 8(2), 117.
[16] Kaur, M. J. (2019). A Comprehensive Survey on Architecture for Big Data Processing in Mobile Edge Computing Environments. In Edge Computing (pp. 33-49). Springer, Cham.
[17] Moghaddam, G. K., & Lowe, C. R. (2019). Mobile Healthcare. In Health and Wellness Measurement Approaches for Mobile Healthcare (pp. 1-11). Springer, Cham.
[18] Rodrigues, J. F. (2019). A Middleware for Mobile-Edge-Cloud Applications.
[19] Rieger, C., & Kuchen, H. (2019, January). A Model-Driven Cross-Platform App Development Process for Heterogeneous Device Classes. In Proceedings of the 52nd Hawaii International Conference on System Sciences.
[20] Kubben, P. (2019). Mobile Apps. In Fundamentals of Clinical Data Science (pp. 171-179). Springer, Cham.
[21] Mehrnezhad, M., & Toreini, E. (2019, March). What Is This Sensor and Does This App Need Access to It?. In Informatics (Vol. 6, No. 1, p. 7). Multidisciplinary Digital Publishing Institute.
[22] Hu, W. C., Kaabouch, N., & Yang, H. J. (2019). An Empirical Study of Mobile/Handheld App Development Using Android Platforms. In Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics (pp. 848-862). IGI Global.
[23] Xue, L., Qian, C., Zhou, H., Luo, X., Zhou, Y., Shao, Y., & Chan, A. T. (2019). NDroid: Toward Tracking Information Flows Across Multiple Android Contexts. IEEE Transactions on Information Forensics and Security, 14(3), 814-828.
[24] Amalfitano, D., Riccio, V., Amatucci, N., De Simone, V., & Fasolino, A. R. (2019). Combining Automated GUI Exploration of Android apps with Capture and Replay through Machine Learning. Information and Software Technology, 105, 95-116.
[25] Wang, Z., & Wu, T. H. K. (2019). U.S. Patent Application No. 10/169,203.
[26] Goodin, C., Carruth, D., Doude, M., Hudson, C., Dabbiru, L., & Sharma, S. (2019). Training of Neural Net-work with Automated Labeling of Simulated Sensor Data (No. 2019-01-0120). SAE Technical Paper.
[27] Iannacci, J. (2019). Compact modelling-based coupled simulation of RF-MEMS net-works for 5G and Internet of Things (IoT) applications. Microsystem Technologies, 25(1), 329-338.
[28] Nayyar, A., & Balas, V. E. (2019). Analysis of simulation tools for underwater sensor net-works (UWSNs). In International Conference on Innovative Computing and Communications (pp. 165-180). Springer, Singapore.
[29] Liu, A. (2019). The implementation of 5G V2X services in Finnish private and public parking.
[30] Schröder, F. (2019). 5G: New Opportunities?. In Future Telco (pp. 63-74). Springer, Cham.

[31] Lahby, M., Essouiri, A., & Sekkaki, A. (2019). An Improved Modeling for Network Selection Based on Graph Theory and Cost Function in Heterogeneous Wireless Systems. In Paving the Way for 5G Through the Convergence of Wireless Systems (pp. 285-304). IGI Global.
[32] Al-Yasir, Y. I., Ojaroudi Parchin, N., Abd-Alhameed, R. A., Abdulkhaleq, A. M., & Noras, J. M. (2019). Recent Progress in the Design of 4G/5G Reconfigurable Filters. Electronics, 8(1), 114.
[33] Demestichas, P., Georgakopoulos, A., Karvounas, D., Tsagkaris, K., Stavroulaki, V., Lu, J., ... & Yao, J. (2013). 5G on the horizon: Key challenges for the radio-access net-work. IEEE vehicular technology magazine, 8(3), 47-53.
[34] Santhi, K. R., Srivastava, V. K., SenthilKumaran, G., & Butare, A. (2003, October). Goals of true broad band's wireless next wave (4G-5G). In Vehicular Technology Conference, 2003. VTC 2003-Fall. 2003 IEEE 58th (Vol. 4, pp. 2317-2321). IEEE.
[35] Gohil, A., Modi, H., & Patel, S. K. (2013, March). 5G technology of mobile communication: A survey. In Intelligent Systems and Signal Processing (ISSP), 2013 International Conference on (pp. 288-292). IEEE.
[36] Bangerter, B., Talwar, S., Arefi, R., & Stewart, K. (2014). Net-work and devices for the 5G era. IEEE Communications Magazine, 52(2), 90-96.
[37] Mehdi, K., Lounis, M., Bounceur, A., & Kechadi, T. (2014, March). Cupcarbon: A multi-agent and discrete event wireless sensor net-work design and simulation tool. In 7th International ICST Conference on Simulation Tools and Techniques, Lisbon, Portugal, 17-19 March 2014 (pp. 126-131). Institute for Computer Science, Social Informatics and Telecommunications Engineering (ICST).
[38] Bounceur, A. (2016, March). CupCarbon: a new platform for designing and simulating smart-city and IoT wireless sensor net-works (SCI-WSN). In Proceedings of the International Conference on Internet of things and Cloud Computing (p. 1). ACM.
[39] Lounis, M., Mehdi, K., & Bounceur, A. (2014, March). A cupcarbon tool for simulating destructive insect movements. In 1st IEEE international conference on information and communication technologies for disaster management (ICT-DM'14), Algiers, Algeria.
[40] Noreen, U., Bounceur, A., Clavier, L., & Kacimi, R. (2016, May). Performance evaluation of IEEE 802.15. 4 phy with impulsive net-work interference in cupcarbon simulator. In Net-work, Computers and Communications (ISNCC), 2016 International Symposium on (pp. 1-6). IEEE.
[41] Lounis, M., Bounceur, A., Laga, A., & Pottier, B. (2015, June). GPU-based parallel computing of energy consumption in wireless sensor net-works. In Net-work and Communications (EuCNC), 2015 European Conference on (pp. 290-295). IEEE.
[42] Kasnesis, P., Toumanidis, L., Kogias, D., Patrikakis, C. Z., & Venieris, I. S. (2016, December). Assist: An agent-based siot simulator. In 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT) (pp. 353-358). IEEE.

