

The contribution of the arrival of 5G in the consumption of mobile data

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Abstract— Mobile systems currently have several applications aimed at data transmission. Over the years, where several technologies have been developed - known as generations, that have enabled the traffic of information. Therefore, the objective of the work was to verify the contribution of the 5G system, in comparison to other generations, indicating its main benefits, in addition to the information about IoT. For this, the methodology used was a bibliographic review through an exploratory research based on information about the new 5G technology, in order to deepen the knowledge on the topic related to the other subjects included in this work. The results showed that telecommunications companies play an important role in the provision of 5G technology, since the availability of services depends on the investments that will be applied in the telecommunications sector. Among the services that 5G allows is support for Internet of Things applications (Internet of Things or IoT). Currently, IoT applications are operating on previous technologies, which are still in operation (2G, 3G and 4G), so 5G will make the internet of things much more efficient and effective. Each device and network created based on the IoT will use only what is necessary and when necessary. It is concluded that The 5G system and Internet of Things (IoT) will offer the ability to capture, store and move data from devices on a large scale and supply data-based decision making, the 5G and the Internet of Things (IoT) will offer the ability to capture, store and move data from devices on a large scale and power data-based decision making.

Keywords— Comparison, Generations, Benefits.

I. INTRODUCTION

The use of cell phones to access the internet has grown in Brazil. The devices are the main means of accessing the network in the country, used by almost all Brazilians. The information is from the National Continuous Household Sample Survey - Information and Communication Technology (PNAD Continuous TIC) 2018, released by the Brazilian Institute of Geography and Statistics (IBGE) [1].

Since the appearance of the cell phone, there has been a significant change in the way of communication. Mobile systems currently have several applications aimed at data transmission. Over the years, where several technologies have been developed - known as generations, that have enabled the traffic of information [2].

The implementation of 5G networks also has difficulties, such as the great growth of users by area,

problems in transmission by base station and cell coverage, lack of maintenance at stations causing problems in sending signals, in addition to bureaucratic difficulties for installation. new stations [3].

The 5G standard is a mix of network levels of different sizes, ensuring intelligent connection transmission, accessed by a large number of interconnected devices. It has a greater capacity, due to the improvement of architecture and the presence of advanced physical communication [3].

Anatel published three acts (3151, 3152 and 3153) that update the minimum technical requirements for the adoption, exploration and use of 5G technology in Brazil. In practice, this means that in order for cell phones and internet access stations, such as modems and equipment connected to the IoT, to be certified and marketed,

belonging to 5G, they must meet the established parameters [4].

Based on this information, the study aims to verify the contribution of the 5G system, compared to other generations, indicating its main benefits, in addition to the information on IoT.

II. MATERIALS AND METHODS

The methodology used was a bibliographic review through an exploratory research based on information about the new 5G technology, in order to deepen the knowledge on the topic related to the other subjects included in this study.

Data collection of this information took place from academic websites, scientific articles, bibliographic productions such as: dissertations and theses, and on government websites that discuss content about 5G technology and the benefits of IoT.

Criteria for the inclusion of texts published between 2000 and 2020 (preference of recent publications) were used, where only keywords were considered. Thus, 12 articles were analyzed and, by exclusion, reduced to 10. The exclusion criteria were given by duplicity, inaccessible editorials, where only 6 articles effectively corresponded to the proposed objective.

The results of the research will be presented qualitatively, from the collection of information from primary sources.

III. RESULTS AND DISCUSSION

5G technology for mobile systems is being increasingly discussed in Brazil. In some countries, this technology is already being implemented (USA, United Kingdom, South Korea, China, etc.), which causes great expectations in the consumer market regarding its effective operation in our country. The reasons for the long-awaited process are due to some characteristics of the system, when compared to the current 4G system: explained, in general terms, by data transmission 10 times faster, latency 10 times lower, 10 to 100 times more connected devices and lower battery consumption [5].

Telecommunications companies play an important role in the provision of 5G technology, since the availability of services depends on the investments that will be applied in the telecommunications sector. In Brazil, this is an aspect that must be evaluated from a deeper analysis, as it depends on several factors such as regulations, investments, scientific studies, etc. [15].

Among the services that 5G allows is support for Internet of Things applications (Internet of Things or IoT). Currently, IoT applications are operating on previous technologies, which are still in operation (2G, 3G and 4G) [5].

With the advent of the 5G network, it becomes possible to operate equipment and devices more efficiently, especially in certain cases where, some services could be affected [7].

The implementation of the 5G system provides numerous challenges, and for the objectives to be achieved, a drastic change in the design of the cellular telephone network architecture is necessary [8], since it is a systemic technology project capable of choosing the technological structure that best meets the requested request [9].

5G, unlike 4G and all other previous generations of cellular mobile communications systems, depends not only on large towers to cover a macro cell of tens of km² each, but also needs to have hundreds or thousands of small cells, available in city spaces [10].

5G technology is expected to increase internet data consumption on cell phones. According to the study [11], called "Mobility Report", which provides forecasts about the mobile connection. The average internet spend, on the smartphone, will be almost four times higher than the average of 2018, which should total 21 GB per month, in 2024.

Based on this information, it is observed that this technology will not only be a tool to transmit more data in less time, but will provide numerous benefits for the use and recognition of IoT, requiring the support of the interaction of millions of devices [12].

[12] further mentions that the main players describe that 5G is not only a necessity, but also a big bet for the future, and that in constant evolution, it is a pillar of transformation in the world, when it is known and used, given mainly for its capacity connection and congruence with the IoT concept, impacting different sectors [13].

[14] It indicates that the 5G system, fifth generation of mobile telephony, is a new technology of data transport in networks involving mobile devices.

Many characteristics will be observed when there is a standardization of the basic premises defined for the 5G (Table 1).

Table 1: Characteristics of the 5G Internet from the standardization of operating premises.

Characteristics	description
velocity	The 5G will achieve 100 times the speed available for LTE and 10 times the technology presented by LTE-Advanced.
Low latency	The decrease in latency in 5G will allow the entry of different services inherent to previous technologies.
High density	The 5G will have the capacity to support a large number of connected devices at the same time, even tolerating densities of up to 100 devices per m2.
Efficiency	This technology is expected to exceed the energy efficiency of 4G by 90%.

Source: Adapted [11].

In December 2017, the 3GPP (3rd Generation Partnership Project) approved the specifications of the 5G New Radio (NR), which deals with a 5G technology (the first officially approved standard), which cannot act autonomously, but which is supported higher than LTE, the current technology.

The connection made with 5G, still in 2020, by the companies: Vodafone and Huawei, from Barcelona to Madrid, was the first in the world to be carried out according to the NR standard [12] and also mentions that the main advances regarding the previous technologies are:

- A real-time operational: where to use 5G is to speak faster, especially with regard to response time, high availability, low latency and jitter. Latency and jitter, are two concepts that go together, since both refer to delays: the first is generalized to all networks, while the second is an effect of data networks not connection oriented and based on packet switching. The latency should be less than 150 milliseconds and the jitter should be below 100 milliseconds to suit the sensitivity of the human ear in real time communications (such as VoIP).
- Critical infrastructure: although up to the present moment, the dimensioning of 3G and 4G networks have been conditioned by problems in the transport network with 5G, this dimensioning will be a base of experience offered to the user with high reliability and coverage.

- Very high capacity networks: it will be worked with high quality coverage and the technology will support multispectral services for the maximum use of this capacity.
- Virtualized infrastructure: the networks will be defined by software (SDN) and functions (NFV), where the networks will be oriented in the cloud, which will allow the use of new and better scales, in addition to obtaining cost efficiency and flexibility, which were not yet feasible. .
- IoT and M2M: 5G will be able to support millions of connected devices by sending information periodically. The "all connected" can be a reality.

[15] The investments made by telecommunications operators, which were previously directed to people, may change by directly inferring new applications linked to the IoT.

[12] 5G will be easy to implement as opposed to 4G, described by features such as:

- The fifth generation technology will allow 90% energy savings per service provided.
- 5G will allow simultaneous connection on 100 billion devices.
- The frequencies used will be much higher, with the new technology being able to reach from 6GHz to 100GHz.

The 5G system will make the internet of things much more efficient and effective. Each device and network, created based on the IoT, will use only what is necessary and when necessary [15].

[16] suggests that in this technology there will not only be a big increase in connection speed, but it will also enable a significant increase in the number of simultaneous connections, the long-awaited decrease in data control latency, a reduction in power consumption and making the connection available in a much larger area, focusing on spaces where there is no mobile internet, even allowing the connection of 7 trillion devices.

[17] describes that 5G networks work through radio waves, as well as the mobile networks of previous generations. However, the spectrum covered by the fifth generation of mobile broadband is significantly higher than the previous ones, spreading between 600 and 700 MHz, 26 and 28 GHz and 38 and 42 GHz.

The 5G network antennas will be coupled to the existing antennas, which will be adapted to work in parallel with the new connection infrastructure. In

addition, smaller antennas with a range of a few meters, such as domestic ones, may be installed to repeat the signal from local devices, which will then be redirected to a central station. Whereas, replicating antennas, installed on poles or in tall buildings, will be able to cover distances up to 250 m [17].

The 5G network will allow service providers and operators to create new platforms to assist the operation of the next generation of applications, in addition to developing new business models. Video streaming and IoT-based applications are the current killer applications that, combined with the capabilities of virtual and augmented reality, will create opportunities in various sectors [8].

[8] Cites that most mobile operators worldwide indicate that enhanced mobile broadband (eMBB) will be the main proposition in the first 5G implementations, with massive, ultra-reliable low latency IoT communications gaining scale at a later stage .

Access through wireless technology has had major evolutions related to performance and efficiency, with the first generation (1G) fulfilling its function with the basic mobile voice service, while the second generation (2G) introduced greater service capacity and coverage , followed by the third generation (3G), which incorporated high-speed data search and the fourth generation (4G), which provides access to various telecommunications services combined with high mobility applications and data rates. Thus, it is clear that the fifth generation (5G) promises to be technologically more intelligent, interconnecting the whole world [18] (Table 2).

Table 2 Shows the comparison of generations.

Generations	Comparisons
1G	They brought mobility to analog voice services.
2G	Digital cellular voice services and basic data services (SMS, GPRS) - as well as roaming services on all networks
3 G	They brought a better mobile internet experience, however, with limited success to trigger the massive adoption of data services
4 G	IP-based services (Voice and Data), a fast broadband internet experience, with unified network protocols and architectures.

Source: Adapted [13].

The number of Internet of Things (IoT) connections will increase more than three times in the world, between

2017 and 2025, reaching 25 billion [15] and still presents that IoT can be considered as the future evaluation of the Internet that performs M2M learning (Machine to Machine), providing connectivity for everyone and everything.

IV. CONCLUSION

The 5G system and Internet of Things (IoT) will offer the ability to capture, store and move data from devices on a large scale and fuel data-based decision making.

Given this, 5G technology is a new standard for mobile devices that will bring both quantitative and qualitative changes in the way people use these devices, allowing for new features and a significant increase in the number and speed of connections.

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