



INFORMATION SYSTEMS: A STUDY ON GROWTH OF MOBILE COMMUNICATION

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ABSTRACT

In the recent years Mobile communication in the world has been sought for its convenience. Today mobile communication is operated with the battery with the fastest growing segment throughout the world. This communication created a mile stone by the various users in using the initial arrival of 1G technology to 4 G technology and 5 G still in under research move. Hence there is a huge demand for this communication in the world wide with more standards and support a greater number of users.

The first commercial mobile phone was introduced in 1983 by Motorola, and moved from various generations through a long way. Moving technology, protocols, standards, services offered or speed are the various upgradation provided in the generations of mobile communication. This paper provides the details of growth of the mobile generations by differentiating it from the previous generations and a glimpse on the upcoming technology in future. . It also gives the benefits and limitations of the technology.

Keywords: *Mobile communication, Technology, Generations, Networks, Growth.*

INTRODUCTION

Mobile communication is one of the hottest areas with advanced techniques. It is developing extremely fast in present times and deals with all the fields of mobile and wireless communications. The use of this technology allowed us to communicate with various group of users in different locations without the use of any physical connection (wires or cables). The technology made our life easier, and it saved time and effort. Mobile communication has transfigured the way people use to communicate each other to exchange information. From the very first technology 1G in which information was exchanged in form of basic voice signals while the 2G came up with many add on features with new capacity and coverage capability. This followed by the 3G which was designed to achieve greater speeds with mobile broadband experience. 4G which is developed later which provide wide range of telecommunication services. Though the technology of communication has developed in

short period of time but it is not satisfactory for the customers growing population and mobile devices around the world using this communication facilities are expecting more speed and greater services than present technologies. This led to the development of new research of communication given name 5G which will come up with much greater speed, exceptional applications, Quality of Service (QoS).

A cellular network or mobile network is a radio network distributed over earth areas called cells. Each cell is served by at least 1 fixed-location transceiver and transceiver is known as a cell site or base station. In a mobile network, each cell uses a different set of frequencies from other neighbouring cells and avoids interference. The First Generation was referred as cellular and which was later abbreviated to "cell". Cell phone signals were analog in nature. 1G device was comparatively less heavy and expensive. Second Generation mobile phones used GSM technology. Global System for Mobile communications uses digital modulation and it improves voice quality with limited data service. The Third Generation allowed mobile telephone customers to use voice, graphics and video applications. Fourth Generation is for cell phones or/and hand-held devices. The fifth generation wireless 5G development is based upon 4G, which at present is struggling to meet its performance goals. Most important advantages of 5G network is providing myriads of services to end users.

Simply, the "G" stands for "GENERATION". While you connected to internet, the speed of your internet is depending upon the signal strength that has been shown in alphabets like 2G, 3G, 4G etc. right next to the signal bar on your home screen. Each Generation is defined as a set of telephone network standards, which detail the technological implementation of a particular mobile phone system. The speed increases and the technology used to achieve that speed also changes. For eg, 1G offers 2.4 kbps, 2G offers 64 Kbps and is based on GSM, 3G offers 144 kbps-2 mbps whereas 4G offers 100 Mbps - 1 Gbps and is based on LTE technology.

The aim of wireless communication is to provide high quality, reliable communication just like wired communication (optical fibre) and each new generation of services represents a big step (a leap rather) in that direction. This evolution journey was started in 1979 from 1G and it is still continuing to 5G. Each of the Generations has standards that must be met to officially use the G terminology. There are institutions in charge of standardizing each generation of mobile technology. Each generation has requirements that specify things like throughput, delay, etc. that need to be met to be considered part of that generation. Each generation built upon the research and development which happened since the last generation. 1G was not used to identify wireless technology until 2G, or the second generation, was released. That was a major jump in the technology when the wireless networks went from analog to digital.

1G - First Generation

This was the first generation of cell phone technology. The very first generation of commercial cellular network was introduced in the late 70's with fully implemented standards being established throughout the 80's. It was introduced in 1987 by Telecom (known today as Telstra), Australia received its first cellular mobile phone network utilising a 1G analog system. 1G is an analog technology and the phones generally had poor battery life and voice quality was large without much security, and would sometimes experience have dropped calls. These

are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital telecommunications. The maximum speed of 1G is 2.4 Kbps.

2G - Second Generation

Cell phones received their first major upgrade when they went from 1G to 2G. The main difference between the two mobile telephone systems (1G and 2G), is that the radio signals used by 1G network are analog, while 2G networks are digital. Main motive of this generation was to provide secure and reliable communication channel. It implemented the concept of CDMA and GSM. Provided small data service like SMS and MMS. Second generation 2G cellular telecom networks were commercially launched on the GSM standard in Finland by Radiolinja (now part of Elisa Oyj) in 1991. 2G capabilities are achieved by allowing multiple users on a single channel via multiplexing. During 2G Cellular phones are used for data also along with voice. The advance in technology from 1G to 2G introduced many of the fundamental services that we still use today, such as SMS, internal roaming, conference calls, call hold and billing based on services e.g., charges based on long distance calls and real time billing. The max speed of 2G with General Packet Radio Service (GPRS) is 50 Kbps or 1 Mbps with Enhanced Data Rates for GSM Evolution (EDGE). Before making the major leap from 2G to 3G wireless networks, the lesser-known 2.5G and 2.75G was an interim standard that bridged the gap.

3G - Third Generation

This generation set the standards for most of the wireless technology we have come to know and love. Web browsing, email, video downloading, picture sharing and other Smartphone technology were introduced in the third generation. Introduced commercially in 2001, the goals set out for third generation mobile communication were to facilitate greater voice and data capacity, support a wider range of applications, and increase data transmission at a lower cost .

The 3G standard utilises a new technology called UMTS as its core network architecture - Universal Mobile Telecommunications System. This network combines aspects of the 2G network with some new technology and protocols to deliver a significantly faster data rate. Based on a set of standards used for mobile devices and mobile telecommunications use services and networks that comply with the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. One of requirements set by IMT-2000 was that speed should be at least 200Kbps to call it as 3G service.

3G has Multimedia services support along with streaming are more popular. In 3G, Universal access and portability across different device types are made possible (Telephones, PDA's, etc.). 3G increased the efficiency of frequency spectrum by improving how audio is compressed during a call, so more simultaneous calls can happen in the same frequency range. The UN's International Telecommunications Union IMT-2000 standard requires stationary speeds of 2Mbps and mobile speeds of 384kbps for a "true" 3G. The theoretical max speed for HSPA+ is 21.6 Mbps.

Like 2G, 3G evolved into 3.5G and 3.75G as more features were introduced in order to bring about 4G. A 3G phone cannot communicate through a 4G network, but newer generations of phones are practically always designed to be backward compatible, so a 4G phone can communicate through a 3G or even 2G network.

4G - Fourth Generation

4G is a very different technology as compared to 3G and was made possible practically only because of the advancements in the technology in the last 10 years. Its purpose is to provide high speed, high quality and high capacity to users while improving security and lower the cost of voice and data services, multimedia and internet over IP. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

The key technologies that have made this possible are MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing). The two important 4G standards are WiMAX (has now fizzled out) and LTE (has seen widespread deployment). LTE (Long Term Evolution) is a series of upgrades to existing UMTS technology and will be rolled out on Telstra's existing 1800MHz frequency band. The max speed of a 4G network when the device is moving is 100 Mbps or 1 Gbps for low mobility communication like when stationary or walking, latency reduced from around 300ms to less than 100ms, and significantly lower congestion. When 4G first became available, it was simply a little faster than 3G. 4G is not the same as 4G LTE which is very close to meeting the criteria of the standards. To download a new game or stream a TV show in HD, you can do it without buffering.

Newer generations of phones are usually designed to be backward-compatible, so a 4G phone can communicate through a 3G or even 2G network. All carriers seem to agree that OFDM is one of the chief indicators that a service can be legitimately marketed as being 4G. OFDM is a type of digital modulation in which a signal is split into several narrowband channels at different frequencies. There is a significant amount of infrastructure changes needed to be implemented by service providers in order to supply because voice calls in GSM, UMTS and CDMA2000 are circuit switched, so with the adoption of LTE, carriers will have to re-engineer their voice call network. And again, we have the fractional parts: 4.5G and 4.9G marking the transition of LTE (in the stage called LTE-Advanced Pro) getting us more MIMO, more D2D on the way to IMT-2020 and the requirements of 5G.

5G - Fifth Generation

5G is a generation currently under development, that's intended to improve on 4G. 5G promises significantly faster data rates, higher connection density, much lower latency, among other improvements. Some of the plans for 5G include device-to-device communication, better battery consumption, and improved overall wireless coverage. The max speed of 5G is aimed at being as fast as 35.46 Gbps, which is over 35 times faster than 4G.

Key technologies to look out for: Massive MIMO, Millimetre Wave Mobile Communications etc. Massive MIMO, millimetre wave, small cells, Li-Fi all the new technologies from the previous decade could be used to

give 10Gb/s to a user, with an unseen low latency, and allow connections for at least 100 billion devices. Different estimations have been made for the date of commercial introduction of 5G networks. Next Generation Mobile Networks Alliance feel that 5G should be rolled out by 2020 to meet business and consumer demands.

Due to mobile phones nowadays, any information can be sent either orally and written, which was impossible in the old days. As there is no wire attached to mobile phones, it can be carried easily anywhere, and as its size is not too big, individuals can also keep it in their pockets.

A mobile phone is used to call or text someone and has multi-purposes like sending emails, taking pictures if someone doesn't have a camera or communicating with people online, and making new friends. Nowadays, everything is being done online, and by using a mobile phone, one can effortlessly do almost everything with a single touch. Online banking, access to modern services and apps, improved networking capabilities, and online shopping are major tasks that can be performed using mobile phones.

But on the other side, the disadvantages of mobile phones are also there. As mobile phones are a constant, real-time communication and always available avenue, the incoming calls, texts, social-media related notifications, or emails can get into someone's phone within seconds. It is convenient in some cases, but while in a meeting or attending a lecture, if the mobile phone starts to ring, it interrupts and disturbs everyone.

OBJECTIVES OF THE STUDY

- To understand the evolution of Mobile communication
- To compare the growth of Mobile generations differentiating from previous generations.
- To analyse the usage of mobile generations by the various users.
- To know the performance considerations from different perspectives.

RESEARCH METHODOLOGY

The research study is based on two types of data collection

1. **Primary data:** This data is based on stratified random sampling of 50 responses by self-administrated questionnaire sent to respondents on various age group users in one locality on which analysis carried on.
2. **Secondary data:** This data is based on certified books, websites, journals and articles on generations of mobile communication.

SCOPE OF THE STUDY

In future mobile communication interconnect heterogenous mobile communication with more updated technologies and get them to coordinate optimize services with operational protocols. Many significant numbers

of studies are being under research work both under evolutionary and revolutionary approaches taking a new shape towards the progress in the future mobile communication system and more efforts are still required to crystallize the future mobile communication system in the fields of

- Mobile communication leads to the new innovation including the emergence of new usage forms, the negotiation of norms, and symbolic representation by producers and users for more upgradation.
- The embeddedness of mobile communication within social networks shaping the technology and social structure for better quality accessibility.
- Mobile learning and education.
- Persuasion through mobile media in various domains
- History of mobile media
- Journalism and mobile media
- Specific technological methodologies address the various mobile features under the phenomenon ethnography, observation, network analysis, experience sampling, and other still emerging methods.

LITERATURE REVIEW

In the previous year's many scholars conducted the number of important studies and completed the research work in the field of growth of mobile communication.

- In 2016, Gopal and P. G [37], proposed the comparison between 4G and 5G wireless technology in relation to its speed, frequency band, switching design basis and forward error correction is studied.
- In 2017, Yadav, M., et al. [38], evaluated the mobile communication generation passed as so far till to the future for next generation by different mobile technologies.
- In 2018, Neumann, G., et. al. [41], introduced three strategies to combine 5G mobile networks and industrial Ethernet to a hybrid topology. This research introduced a brief knowledge about 5G wireless networks in the different technologies which can be applied to 5G Wireless such as IOT, MIMO, D2D and SDN, HetNet and IDS.
- In 2019, Rashid and Razak [43], discussed the challenges for big data analytics in 5G. The expected that 5G will deal with a billion of devices and thus the bandwidth consumption will increase the size of data.
- In 2020, AHMAD et al. [47], described the different mobile generations that are: 0G, 1G, 2G, 3G, 4G, and 5G. Also, the author made a comparison among the generations from 1st one to the 5th one in terms of different features.
- In 2021, 1Changchun University of Science and technology, Science Department, Jilin, China, 130012 conducted the research on the Development of the Fifth-Generation Technologies

LIMITATIONS OF THE STUDY

Mobile communication is facing number of challenges in incorporating the characteristics has a user friendly or eco-friendly technology like inherently poor, mobility implies address migration and location dependency, and

portability. In This paper the study limits to different age group users one locality in Bengaluru city who used the generations of mobile communication in the past and present period.

DATA ANALYSIS AND INTERPRETATION

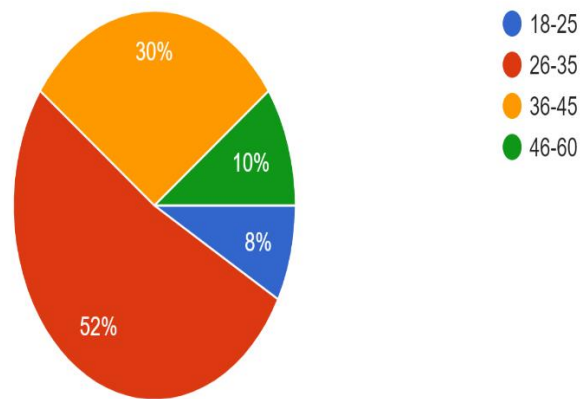
Objective 2:

The comparison of 1G, 2G, 3G, 4G, and 5G also makes it evident that 5G is going to be one of the most ambitious leaps in the history of cell network technologies.

COMPARISON	1 G	2G	3G	4G	5G
YEAR	1980s	1993	2001	2009	2018
TECHNOLOGY	TACS	GSM	WCDMA	LTE, WiMAX	MIMO, MM Waves
ACCESS SYSTEM	FDMA	TDMA, CDMA	CDMA	CDMA	OFDM, BDMA
INTERNET SERVICE	No Internet	Narrowband	Broadband	Ultra-Broadband	Wireless WWW
FREQUENCY	30 KHz	1.8 GHz	1.6-2GHz	2-8 GHz	3-30GHz
CORE NETWORK	PSTN	PSTN	Packet Network	Internet	Internet
BANDWIDTH	10 MHZ	25MHz	25MHz	100MHz	30GHz to 300GHz
ADVANTAGES	Simpler (less complex) network elements	Multimedia features (SMS, MMS), Internet access and SIM introduced	High security, international roaming	Speed, High speed handoffs, global mobility	Extremely high speed, low latency
APPLICATIONS	Voice calls in one country	Voice calls, short message	Video conferencing, mobile TV and GPS	High speed application, mobile TV, Wearable devices	High resolution video streaming, remote control of vehicles, robots and medical procedures

Age (in years)

50 responses



Interpretation

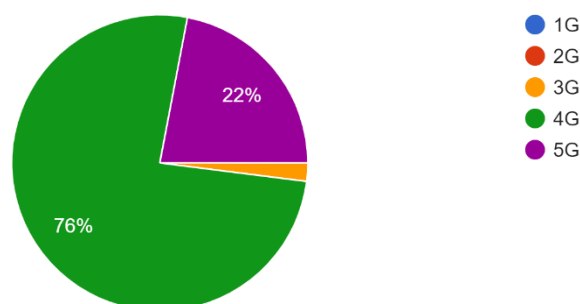
52% of the users of the age group 26- 35 years are having the knowledge on the mobile communication only 8% are in the age group of 46-60 years.

Objective 3

1.

Which generation Mobile communication is used in your device?

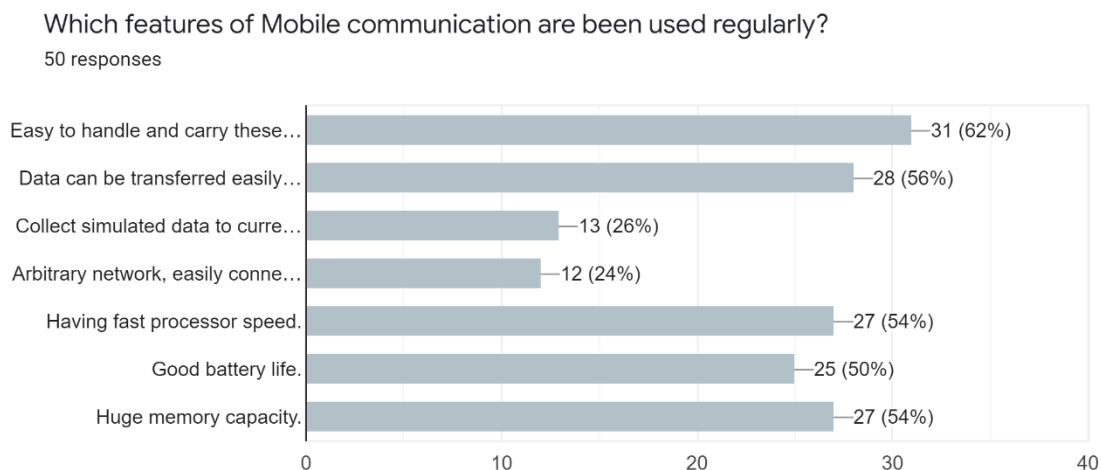
50 responses



Interpretation

76% of the users using 4G mobile generation, 22% are using the latest 5G generation and only 2% are using 3G mobile generation. Almost all the users are being updating themselves in using the upgraded version of mobile communication.

2.



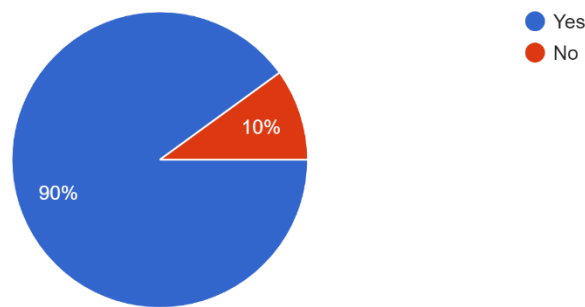
Interpretation

62% of the users are using the mobile communication for easy to handle and for the best communication globally and 26% users use this to collect simulated data to current access.

3.

Do you find the difference in using the generation of Mobile communication?(Like 1G is better than 2G)

50 responses



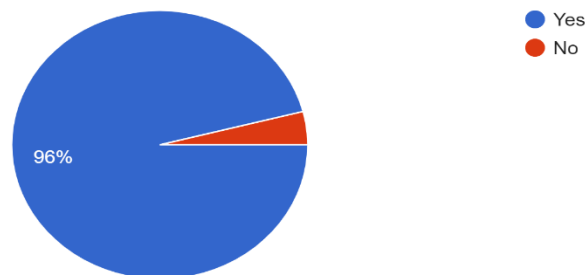
Interpretation

90% of the users find the difference in using the generation of mobile communication from the previous generation. 10% of the users doesn't find difference in the using the generation of mobile communication.

4.

Do you agree that the latest upgraded mobile communication is more beneficial?

50 responses



Interpretation

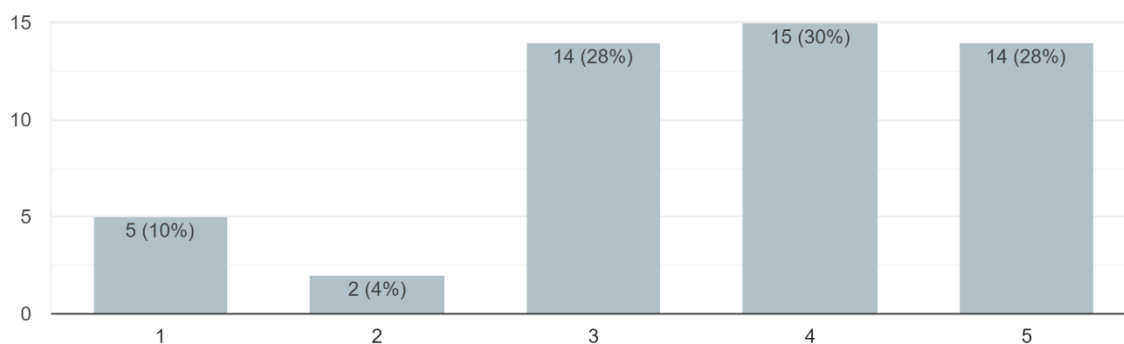
96% users agree that the latest upgraded mobile communication is more beneficial. Almost all the users globally accept the mobile communication is a means of communication with each other.

Objective 4

1.

We imply that 5G should not be considered as merely an evolutionary development of previous mobile communication. Do you agree the statement?

50 responses



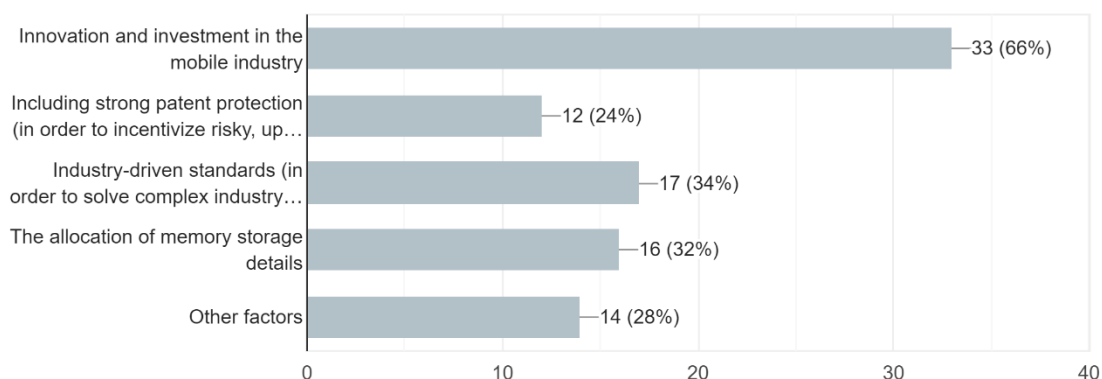
Interpretation

30% of the users have accepted 5G should not be considered as merely an evolutionary development of previous mobile communication. And only 2% haven't accepted the statement.

2.

What factors that are driving the evolution of mobile communication?

50 responses

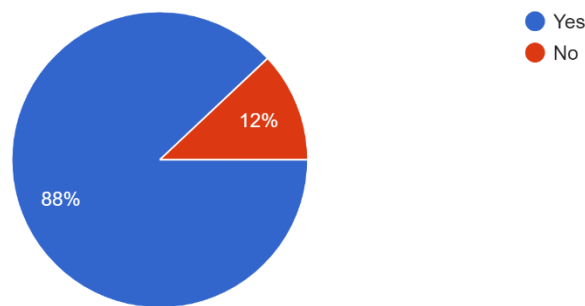


Interpretation

66% of the users accept that innovation and investment in the mobile industry are the major factor that are driving the evolution of mobile communication and only 24% users accept the evolution of the mobile communication are driving through strong patent protection.

3.

Usage of the upgraded technology in mobile communication has an impact on environment sustainability
50 responses



Interpretation

88% of the users agree that the usage of the upgraded technology in mobile communication has an impact on environment sustainability and all the natural resources in the surroundings.

FINDINGS OF THE STUDY

- The generations of mobile communications and its advanced growth had reduced the mechanical work.
- The focus must be on sustainable innovation and also develop new generations with a holistic need-based approach.
- Humans need to prioritize environment before any other necessity as the impact is going to be on the coming generations.
- Mobiles are not just means of communication in the recent years, they are versatile and are replacing many small manual gadgets.
- Difference in the generations of mobile has made its users more convenient to use and upgraded technology also made its users data handy along with various uses which is a very good development in the field of technology and communication

SUGGESTIONS

- Upgrade the technology without harming the Biotic and abiotic things around us.
- Reduce the strength of the signals emitting from the mobile towers.
- Mobile usage should be limited to certain actions considering the impact on our environment.
- Get rid of mobile towers and see if connectivity is possible through satellite
- Verifiable evidence must be published and shared with general public that 5G will not affect the environment significantly. The focus must be on sustainable innovation in developing future generations of Mobile communication.
- Depending the technology can far away the Relationship Between the Peoples So Communication through direct Will Stop Bond Reduces Healthy Environment not develops Which Leads to Mechanical Life style.

CONCLUSION

In the recent years Wireless communication as reached beyond the expectation of the users globally. The latest upgradation made the users more sophisticated and convenient life for communication worldwide. The generation of mobile communication had provided lots of benefits to communicate more efficiently and effectively with new introduction of advancement that is made in today's world. But the issues with security regarding access to the user's personal information or to the negative impact on society and on the environmental factors including both on the biotic and abiotic substances are creating the barrier towards the success of the wireless technology. To overcome the problems associated with the wireless communication, many research and experiments are under process, so that the problems relating to these can be reduced and make more significant part of the world. The technology will be more beneficial in the future which replaces all physical communication devices and will no longer in use.

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A STUDY ON GROWTH OF MOBILE COMMUNICATION

AN ANALYSIS OF THE GROWTH OF MOBILE COMMUNICATION IN INDIA
 FROM 2010 TO 2020. A STUDY ON THE GROWTH OF MOBILE COMMUNICATION
 IN INDIA. THE GROWTH OF MOBILE COMMUNICATION IN INDIA IS A
 SUBJECT OF RESEARCH.

Pages: 10
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Name of the Respondent *

Your answer: _____

Age (in years) *

☐ 18-25
☐ 26-35
☐ 36-45
☐ 46-60

Designation *

Your answer: _____

Are you aware of generation of Mobile communication ? *

☐ Yes
☐ No

Which generation Mobile communication is used in your device? *

☐ 1G

Which features of Mobile communication are been used regularly? *

☐ Easy to handle and carry these small devices.
☐ Data can be transferred easily between users.
☐ Collect simulated data to current zone or your time.
☐ Ad-hoc network, easily connect to other environment and transmit data.
☐ Having fast processor speed.
☐ Good battery life.
☐ Huge memory capacity.

Do you find the difference in using the generation of Mobile communication? Like 5G is better than 2G? *

☐ Yes
☐ No

We imply that 5G should not be considered as merely an evolutionary development of previous mobile communication. Do you agree the statement? *

1 2 3 4 5
 Disagree ☐ ☐ ☐ ☐ ☐ Agree

What factors that are driving the evolution of mobile communication? *

☐ Innovation and investment in the mobile industry
☐ Including strong patent protection (in order to incentivize risky, up-front investment in innovation).
☐ Industry-driven standards (in order to solve complex industry challenges)
☐ The allocation of memory storage details
☐ Other factors

Usage of the upgraded technology in mobile communication has an impact on environment sustainability? *

☐ Yes

Usage of the upgraded technology in mobile communication has an impact on environment sustainability? *

☐ Yes
☐ No

If you feel that there is an impact on the environment, then can you suggest an alternative? *

Your answer: _____

Any suggestion on the perspective of evolution of generations of Mobile communication? *

APPENDIX