Power-On Procedure in 5G-Wireless Communication

Research Proposal Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy

In

Electronics and Communication Engineering

By

MD ASIF

Under the guidance of

Dr. R.K.Yadav

[1ˢᵗ Year & MD ASIF]

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Degree: **Doctor of Philosophy**

Title: **Power-On Procedure in 5G-Wireless Communication**

Doctoral Research Committee:

Supervisor   Dr. R.K.Yadav

Co-Supervisor/Supervisor

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Name of Supervisor	Dr. R.K.Yadav		
Department	Electronics and Communication Engineering		

Technical Field of Proposal

5G –Wireless Communication

Title of Proposal

Power-On Procedure in 5G-Wireless Communication

Abstract:

5G technologies will change the way most high-bandwidth users access their phones. With 5G pushed over a VOIP-enabled device, people will experience a level of call volume and data transmission never experienced before.4G technology is offering the services in Product Engineering, Documentation, supporting electronic transactions (e-Payments, e-transactions) etc. As the customer becomes more and more aware of the mobile phone technology, he or she will look for a decent package all together, including all the advanced features a cellular phone can have. Hence the search for new technology is always the main motive of the leading cell phone giants to out innovate their competitors. Recently apple has produced shivers all around the electronic world by launching its new handset, the I-phone. Features that are getting embedded in such a small piece of electronics are huge.

Objective - Project Significance / Relevance with ongoing academic activities

Power-On is a main concern for mobile network users, and there are many proposed enhancements for the protection of the long-term subscription identifier. Some enhancements require asymmetric key operations, which increase both processing requirements and protocol message sizes. To the best of our knowledge, there has been no practical implementation feasibility study of these enhancements using commodity mobile devices. Neither is it clear whether the enhancements are sufficient. My interest covers, Power-On procedure, where the long-term subscription identifier is used in Paging procedures, and proposes new ways to resolve these so as to removes another set of obstacles for realizing the protection in mobile network standards

Project Impact -Expected outcome

My research interest basically focuses on investigating Power-On procedure in upcoming 5G Wireless Communications Technology. This new technology is going to use full IP based transactions and there is a need to study the data flow in the 5G network. In this context there are unique challenges for designing, developing and deploying a simulation model of data flow in 5G using MATLAB/Octave software.

Literature survey on National &International scenario

There is no doubt that we are living in modern science where life without science is almost impossible to live in. Science had made our life easy to live and do our day to day jobs in any field without any big problem as it has to be in the past. This is because of the phenomenal changes in the telecommunications industry due to science and technology. We have different wireless communication system such as 3G and 4G which has innumerable benefits that makes many tasks easy to finish with in less time. Nowadays, researchers of many countries are exploring the most advance wireless communication technology, which could be 5G.

Researchers of China Mobile Research Institute (2014) says that in order to meet the requirement of the future in the field of Internet, technologists worldwide have started looking for next generation wireless solutions after the launch of 4G system. So, research on Fifth generation (5G) for wireless communication technology, which is a new and advanced technology in the field of communication, has slowly started to build from last year. In the past, 3G and 4G have been evolved mainly due to the demand of data services over the internet but in case of 5G, it could be more than just data. According to Thompson and his other six colleagues (2014) 5G technology is expected to be implemented around 2020 which is a single unified wireless technology with more advanced capacity network and is energy efficient than existing technology. Hossain (2013) predicts that it will definitely raise system space and nature within the limited available frequency spectrum, whose frequency band could be around 3 to 300 GHz and Data Bandwidth up to 1Gbps or higher.

There are not enough articles published related to emerging technology "5G Wireless Communication Systems. Some of them had forecasted how 5G can be achieved and illustrated the challenges associated with it to make 5G feasible where as some talked about the necessity of 5G and its benefits. This research will help to get in depth knowledge about 5G which might be beneficial for understanding random access channelling procedure (Power On procedure) and for future career endeavours in the field of Wireless Communication.

This review will focus mainly on the information provided by different previous researchers on 5G Wireless Communication Systems which is done either by analysing the literature published by them in different areas of 5G such as challenges or requirement to make 5G working and the benefits of 5G. It will also compare the sayings of different article and at the end the author will give his overall point of view.

There are many challenges that need to be overcome to make successful implementation of 5G. There are few articles published so far analysing the challenges related with 5G and some of them are analysed below. Analysts from China Mobile Research Institute (2014), Alcatel-Lucent Bell Labs (2013) and that of Intel labs (2014) mentioned that big multiple input multiple-output (MIMO) (also called Large-Scale Antenna Systems) technologies; device-to-device communications and high frequency wave bands are required for successful implementation of 5G. The main focus should be the design of energy efficient radio networks and cellular networks respectively in which base site is transferred to the Internet cloud which is called C-RAN approach. Similar things are mentioned by researchers from the United Kingdom and China (2014). They said that MIMO and spatial modulation is a way to increase the capacity of antenna array systems. They also discussed the use of cognitive radio effectively in future to produce greener communication technology since 5G is expected to be a greener that previous ones. Their article also reveals a cellular network planning to use a combination of macro cells for outdoor coverage and communication, and small cells for indoor.

A research that was supported by the European Commission (2014) mentioned five major characteristics that are required to carry out device to device communications and run internet successfully in 5G. First one is to construct cooperative frame structure for the real network to support high data rate and traffic. Second one is the development of non-rectangular waveforms to provide better performance. The third and fourth are the use of thin signal processing and robust wireless systems respectively. Finally the reduction of end to end delay of wireless connections is also required to fit the machine to machine communication.

Two of the Editors (Fettweis and Alamouti, 2014) discussed some major historical trends in wireless communications and looks forward to some of the major challenges that are required for new 5G standards. These include providing high bandwidth content with speeds in excess of 10 Gb/s. Furthermore, emerging monitoring and control applications should be integrated into 5G with very low wireless data rates and should be energy efficient. A third major trend is to develop new applications through the tactile wireless Internet, with total end-to- end delays of less than 1 ms.

Samsung Research America (2014) mentioned some very interesting information regarding the amount of money invested in the research of 5G and potential benefits of 5G. The European Commission announced to invest €50 million in 2013 for 5G research in multiple projects which is followed by the establishment of group led by Chinese authority and the commencement of the Korean government led forum. It also provides the initial field trial results of a practical 30 GHz antenna array system tested in Korea. 5G is expected to provide good cellular coverage with the increase in data service to fulfil rapidly increasing demand of the future and offer at least 1 Gb/s data rate with high mobility and consistent gigabits experience per second for users. Samsung Research America had done some initial feasibility study for data transmission and field trail using 30GHz antenna array system in Korea in both open and closed areas. Good cellular coverage was produced for both the scenarios; hence they came into conclusion for the use of millimetre-wave frequencies for 5G systems.

Shakil Akhtar (2009) had little bit different views regarding 5G as compared to one illustrated above. 4G system is about putting networks, applications and terminals all together to fulfil increasing user demands with speed of over 100Mbps in stationary mode whereas 5G is beyond 4G which is capable of supporting Worldwide wireless web (wwww) and produce a highly flexible system using future technologies such as a Dynamic Adhoc Wireless Network (DAWN). Intelligent antenna and flexible modulation are the key components to optimize the adhoc wireless networks. In different words, 5G systems should be a technology which is competent enough to interconnect the whole world web without any restrictions. A better example to clear this view could be a robot with built-in-wireless communication system with artificial intelligence.

Many countries are doing their research to discover 5G successfully to this world for better future. But as per ENP Newswire article (2013), Huawei, a leading communication technology

(ICT) solution provider, could be the first one to launch 5G to the world since currently it is providing assistance to Europe to develop 5G wireless future. There is no second thought to say that 5G wireless technology brings revolution in the field of communication technology since it can connect billions of things wirelessly with radio access capability, so it can help much new exciting business in many ways. Huawei are at the verge of technology development for 5G wireless and recently funded a project meeting in Munich consisting of 140 researchers to build the foundation that will enable 5G wireless to emerge. Dr. Wen Tong, Huawei Fellow and the head of Huawei Communications Technologies Lab believes that after 5G emerges, visual communication will become prominent and people all over the world will use wireless equipments to connect with other people living in different part of the country, as if they were meeting face to face.

5G have many reasons to be launched and have various benefits despite of the challenges mentioned above. Hossain, S. (2013) enlightened how 5G can provide more facilities for a common man to take maximum advantage of their occupation in any field and have enormous progress.

According to Hossain, S. (2013), some reasons for the need for 5G are less battery consumption and outage probability; high coverage and data rates available, possibly 1Gbps or higher data rate; higher security and system level spectral efficiency; very minimal or zero harm to human health as it focuses on greener environment; more applications combined with Artificial Intelligent (AI); a common platform for all the technologies; cheaper traffic fees due to the use of low infrastructure implementation cost and antenna systems; brings better revenue to existing global operators worldwide; improves data coding and modulation approach; numerous concurrent data transfer paths; world Wide Wireless Web (WWWW), wireless-based web operation that consist full multimedia capability beyond 4G speeds and beneficial use of low wave frequencies for wireless access and back haul.

Furthermore, Hossain, S. (2013) says 5G communication system is designed to fulfil the endless purpose up to the next two centuries. Some of them are downloading of files (even music videos) quickly; uploading of web page in the blink of eye; easy playing of online game; cheap 5G equipment's as compared to existing ones; even supportive to previous generation communication system; no limitation of user demands; upgradeable both hardware and software; fill user's demand at least up to 10 decades; facility of storing data in central data mines and high security.

Techno-Commercial Status / Outcome / IPR / Social Benefit /Other

The future mobile devices are going to have very high computing and memory capabilities and will support applications that will need high data rates. The current network architecture of 4G will not be able to support these high data rates required for high end applications and this a complete architectural change is necessary. This new architecture can be seen in the 5G wireless mobile network. The 5G mobile network offers very high data rates as compared to the current 4G. The 5G also offers low power consumption and also supports global computing where the user is connected to many access technologies simultaneously like Wi-Fi or 5G networks and the user can move from range of one access technology to another without loss of internet access. Thus as the 5G mobile network has several advantages over 4G mobile network. The current 4G network would soon be replaced by a more flexible 5G mobile network architecture having better features and capabilities than its current counterpart.

Technical Consultancy / Revenue generation

Prime Bit Solutions,Hyderabad/(DST/MIECT/AICTE etc.)

The work plan is as follows:

Step I:

Study the proposed IP based model designed for the wireless and mobile networks and feature of 5G Wireless Technology

Step II:

Analysis of data flow in 4G Wireless Technology as a base for 5G wireless Technology

Step III:

Develop Simulator for Data flow in 5G wireless Technology Using MATLAB/Octave.

Step IV:

Evaluation: Compare results in 4 G and 5G

Time & Activity chart

Activity	Months(add columns as required)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Receive Grant	███	███	███	███	███	███	███	███	███	███			
Purchase of equipment	███	███	███	███	███	███	███	███	███	███	███		

Facilities / Equipment available in the area of research proposed

Name of equipment	Make and model	Cost in Rs.	Year purchased
MATLAB Software	https://www.mathworks.com/solutions/wireless-communications	Rs.2,20,000/-	2016
OCTAVE Software	Open Source Software	NIL	2019

Budget Estimates – Non Recurring

Proposed equipment/s	Specifications	No of units	Cost in Rs.	Justification
NetSim	NetSim v11.1	01	Rs.1,50,000/-	For result simulation and comparision of data with 4G
Total(NR)			Rs.1,50,000/-	

Add rows as required

Budget Estimates –Recurring

	Estimate for Year 1	Estimate for Year 2	Estimate for Year 3
Service charges	Rs.22,000/-	Rs.25,000/-	35,000/-
Consumables & Contingencies	Rs.5000/-	Rs.5000/-	Rs.5000/-
Other	Rs.3000/-	Rs.3000/-	Rs.3000/-
Total	R1.30,000/-	R2=33,000/-	R3=43,000/-

Profile of Collaborating/Participating Industry/s or other organization(s), if any.

Name	Address	Website	Contact person , designation, email	Role$ in collaborating/ participating	Financial commitment# towards project in Rs.
Prime Bit Solutions	404/2A , Surekha Chambers , Opp: Vijay Textile ,Near Lal Bunglow, Ameerpet , Hyderabad, Phone:+91 8790059362,8639657452 Landline: 040-	https://www.primebitsolution.com/	Mr .Kumud Kumar (Kumud Kumar is registered with Ministry of Corporate Affairs (MCA). Their DIN is 02927691. Following is their current and past directorship holdings.)	Technical Support (service provider) Assistance	1,00,000/-

	40181104 Email: contactus @primebi tsolution. com				
				Total Rs.	1,00,000/-(financial commitment yet to receive)

$ prime bits.xml

Details of Research Scholar

Name	MD ASIF		
Date of Joining as Research Scholar at University	**12-02-2019**		
Department	**Electronics and Communication Engineering**		
Qualifications	UG: B.Tech	PG: M.Tech	
Experience in years	Teaching:07	Industry:00	Research:00
Students guided	UG:12	PG:02	
Publications	National:05	International:03	Books:00
Relevant experience	Teaching		
Other information	**nil**		
Cell number	**7780524761/9052701257**		
Email	asiff1988@gmail.com , asiff1988@kgr.ac.in		
Signature			

Details of Supervisor

Name	DR R K YADAV		
Date of Joining University			
Department	ECE		
Qualifications	UG:BE	PG:ME	PhD
Experience in years	Teaching:23	Industry	Research:5
Students guided	UG: 30	PG:8	PhD:2 +(04 ONGOING
Publications	National:30	International:37	Books
Relevant experience	TEACHING		
Other information			
Cell number	9810319261		
Email	ravipusad@gmail.com		
Signature			

5.1 **Introduction:**

Current cellular spectrum at below 3 GHz bands is experiencing severe shortage and cannot keep up with the dramatic proliferation of mobile traffic in the near future, requiring the search for innovative solutions to enable the 5G era. mmWave communications, with a possible gigabit-per-second data rate, have attracted great attention as a candidate for 5G broadband cellular communication networks. However, a complete characterization of mmWave links for 5G wireless networks still remains elusive and there are many challenges and research areas that need to be addressed. In this work we discuss several key elements to enable mmWave communications in 5G: · Channel characteristics regarding mmWave signal attenuation due to free space propagation, atmospheric gaseous and rain are explained. · The hybrid (digital plus analog) beam forming architecture in mmWave system is discussed. · The blockage effect in mmWave communications due to penetration loss and possible approaches are presented. · The application of mmWave transmission with narrow beams in non-orthogonal device-to-device communication is proposed. · mmWave transmission in the booster cell of heterogeneous anchor-booster networks.

5.2 **Research objectives and approach:**

My research interest basically focuses on investigating Power-On procedure in upcoming 5G Wireless Communications Technology. This new technology is going to use full IP based transactions and there is a need to study the data flow in the 5G network. In this context there are unique challenges for designing, developing and deploying a simulation model of data flow in 5G using MATLAB/Octave software.

The four step framework is as follows:
- **Step I.** User Background Analysis
5G User Device and Capability Analysis
User Task Analysis (Videos, Data upload /download etc)

- **Step II**. Data flow Design Conceptualization
User Interface Design for data transactions
Selection of data parameters based on user requirements

- **Step III**. Iterative Prototype Implementation
User Data flow step by step implementation
User upload and download of data requirements for an application

- **Step IV.** Usability Evaluation
Evaluation of Simulation model using MATLAB/Octave
Evaluation of Data flow needs and fulfilment.

Different case studies of Data flow such as simple, medium, huge data flow requirements can be studied. Step by step the data requirements can be simulated for complex needs like interactive and fast delivery of data for higher end applications like gaming and health industry.

5.3 **Review of Work already done on the subject**
There is no doubt that we are living in modern science where life without science is almost impossible to live in. Science had made our life easy to live and do our day to day jobs in any field without any big problem as it has to be in the past. This is because of the phenomenal changes in the telecommunications industry due to science and technology. We have different wireless communication system such as 3G and 4G which has innumerable benefits that makes many tasks easy to finish with in less time. Nowadays, researchers of many countries are exploring the most advance wireless communication technology, which could be 5G.
Researchers of China Mobile Research Institute (2014) says that in order to meet the requirement of the future in the field of Internet, technologists worldwide have started looking for next generation wireless solutions after the launch of 4G system. So, research on Fifth generation (5G) for wireless communication technology, which is a new and advanced technology in the field of communication, has slowly started to build from last year. In the past, 3G and 4G have been evolved mainly due to the demand of data services over the internet but in case of 5G, it could be more than just data. According to Thompson and his other six colleagues (2014) 5G technology is expected to be implemented around 2020 which is a single unified wireless

technology with more advanced capacity network and is energy efficient than existing technology. Hossain (2013) predicts that it will definitely raise system space and nature within the limited available frequency spectrum, whose frequency band could be around 3 to 300 GHz and Data Bandwidth up to 1Gbps or higher.

There are not enough articles published related to emerging technology "5G Wireless Communication Systems. Some of them had forecasted how 5G can be achieved and illustrated the challenges associated with it to make 5G feasible where as some talked about the necessity of 5G and its benefits. This research will help to get in depth knowledge about 5G which might be beneficial for understanding random access channelling procedure (Power On procedure) and for future career endeavours in the field of Wireless Communication.

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There are many challenges that need to be overcome to make successful implementation of 5G. There are few articles published so far analysing the challenges related with 5G and some of them are analysed below. Analysts from China Mobile Research Institute (2014), Alcatel-Lucent Bell Labs (2013) and that of Intel labs (2014) mentioned that big multiple input multiple-output (MIMO) (also called Large-Scale Antenna Systems) technologies; device-to-device communications and high frequency wave bands are required for successful implementation of 5G. The main focus should be the design of energy efficient radio networks and cellular networks respectively in which base site is transferred to the Internet cloud which is called C-RAN approach. Similar things are mentioned by researchers from the United Kingdom and China (2014). They said that MIMO and spatial modulation is a way to increase the capacity of antenna array systems. They also discussed the use of cognitive radio effectively in future to produce greener communication technology since 5G is expected to be a greener that previous ones. Their article also reveals a cellular network planning to use a combination of macro cells for outdoor coverage and communication, and small cells for indoor.

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develop new applications through the tactile wireless Internet, with total end-to- end delays of less than 1 ms.

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rate; higher security and system level spectral efficiency; very minimal or zero harm to human health as it focuses on greener environment; more applications combined with Artificial Intelligent (AI); a common platform for all the technologies; cheaper traffic fees due to the use of low infrastructure implementation cost and antenna systems; brings better revenue to existing global operators worldwide; improves data coding and modulation approach; numerous concurrent data transfer paths; world Wide Wireless Web (WWWW), wireless-based web operation that consist full multimedia capability beyond 4G speeds and beneficial use of low wave frequencies for wireless access and back haul.

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5.4 **Current work and preliminary results**

Power-On is a main concern for mobile network users, and there are many proposed enhancements for the protection of the long-term subscription identifier. Some enhancements require asymmetric key operations, which increase both processing requirements and protocol message sizes. To the best of our knowledge, there has been no practical implementation feasibility study of these enhancements using commodity mobile devices. Neither is it clear whether the enhancements are sufficient. My interest covers, Power-On procedure, where the long-term subscription identifier is used in Paging procedures, and proposes new ways to resolve these so as to removes another set of obstacles for realizing the protection in mobile network standards.

5.5 **Work plan and implications :**

The work plan is as follows:
Step I:
Study the proposed IP based model designed for the wireless and mobile networks and feature of
5G Wireless Technology
Step II:
Analysis of data flow in 4G Wireless Technology as a base for 5G wirelessTechnology
Step III:
Develop Simulator for Data flow in 5G wireless Technology Using MATLAB/Octave.
Step IV:
Evaluation: Compare results in 4 G and 5G

6. Need of the Proposed Research work:

Inspite of many challenges and requirements necessary for the successful implementation of 5G, revolutionary emerging technology 5G is required to be launched for the benefit of mankind. It seems to bring revolution in the field of communication system, since it can minimize problems in many ways in the field of computer system that previous technologies have, not just in terms of speed and security but also in terms of increase number of connected devices and high efficiency. It seems to be far better than the previous technologies in the field of communication systems with numerous benefits. The main reason of 5G could be to meet the market demands that 3G or 4G can't fulfil. It seems that there would be no looking back for decades in the field of internet after 5G is launched. However, still no international 5G development projects have officially launched which can make provide some hope of 5G coming in near future and can be termed as one of the best emerging technology. Since, 4G system is still seems to be in a research and development phase, even though it has been launched in some places, it may take more time than predicted by the analyst as mentioned for 5G to emerge. Also, very less or no evidence is published that and show the drawbacks of 5G since there could be some during the early stage of every technology.
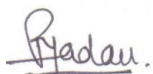
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Signature of the Candidates with date

Outline Approved

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04/07/2019

Name and Signature of supervisor with date & seal