Title: The Intelligent Six Generation Networks for Green Communication Environment

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Abstract

Today human life without telecommunication is beyond belief. Green communications is the practice of selecting energy-efficient communications and networking technologies and products, and minimizing resource use whenever possible in all branches of communications. Green technology has drawn a huge amount of attention with the development of the modern world. Similarly with the development in communication technology the industries and researchers are focusing to make this communication as green as possible. In cellular technology the evolution of 5G is the next step to fulfill the user demands and it will be available to the users in 2020. This will increase the energy consumption by which will result in excess emission of co2.Future wireless networks (B5G/6G cellular networks) and Internet of Intelligence (IoI) are assumed to be the key enabler and infrastructure provider in the global ICT industry, by offering a variety of cutting-edge services with diverse requirements. The standardization of 5G mobile cellular networks is being expedited around the world, which also implies more of the breakthrough candidate technologies will be considered beyond 5G. Therefore, it is worthwhile to provide insight into the emerging paradigm-shifting techniques as a whole and examine the disruptive design philosophy behind them. In regard to B5G/6G, it is meaningful to highlight one of the most fundamental features among the revolutionary techniques in the B5G and 6G eras, i.e., there emerges ubiquitous intelligence in nearly every important aspect of mobile cellular networks, IoT (Internet of Things) and IoI (Internet of Intelligence), including radio network accessing, radio resource management, mobility management, service provisioning management (e.g. service function chains), networking (e.g., network slicing, mobile edge and fog computing, SDN/NFV, cloud, CogMesh, etc.), human behavior recognition, and so on. However, faced with the ever-increasingly complicated configuration issues and the blossoming new service requirements, it is totally insufficient for B5G/6G cellular networks if it lacks strong complete/sufficient AI (Artificial Intelligence) functionalities.

Keywords: B5G/6G, Green Communication, Artificial Intelligence, IoT, Green industry

1. Introduction

Several authors have pointed towards an increased integration of satellite communications to enhance bandwidth and also the spatial acuity of the 6G system. Indeed it would seem that going forward it will become critical to measure success in terms of the ability to deliver bits per second per m^3 rather than simply bits per second. Of course 5G is already all over the spatial multiplexing angle (if you will pardon the pun) of the problem with massive MIMO technology allowing directing of beams with high

accuracy to individual users. But the industry has yet to properly come to grips with how to measure the true benefit of this technology, in our humble opinion, which of course is measured in dollars not dB, leaving many great technologies circling around waiting to be properly motivated for productization. Presumably 6G will arrive with this all sorted out and there will be a new push for technologies that enhance the spatial density of b/s as well as a new appreciation for its value. Indeed there are some efforts to enhance massive MIMO beyond the current state of the art with 6G as their target. Anyway, we predict that there is much left to be done in spatial bandwidth enhancement beyond the current MIMO offerings, which are, they, still struggling to really make an impact[1].

Our mobile potential is enormous: Smart cities, connected infrastructure, wearable computers, autonomous driving, seamless virtual and augmented reality, artificial intelligence, Internet of Machines and Things, and much more are still very much untapped. Only by looking ahead to 6G and 7G (*take a breath*) with space roaming do we get a glimpse of what may be possible in the next 10 to 20 years. Also, while 5G has yet to grace us with its presence, Google Trends rates the term "6G" as the 17th most searched word in the search engines (as of the time of this writing). So, what's in 6G that isn't in 5G? Short answer: A lot of the things that just miss the 5G boat, plus a boatload of potential applications that sound like they come straight out of a sci-fi novel. We are talking home-based ATM machines, sea-to-space communication for world defense, and even mind-to-mind communication. Yes telepathy. It's a thing, and a thing that will soon be based on telephony[2]. Two key characteristics of wireless communications that greatly impact system design and performance are 1) the randomly-varying channel conditions and 2) limited energy resources. In wireless systems, the power of the received signal fluctuates randomly over time and distance due to multipath fading, mobility, and changing environment.

Green communication networks, with a focus on energy efficiency, is an emerging technological trend of great significance. Green communications, with a focus on energy efficiency, is a hot topic in both academic and industry communities since they can significantly enhance sustainability with regard to power resources and environmental conditions. Recently, with much effort in this area, several green communication approaches are entering into a more mature phase, with exciting applications in various networks. For instance, a simple and effective green communication solution is to place a device in sleep mode, which was incorporated by various MAC protocols with broad applications in wireless networks. However, it is essential to investigate the trade-off between the energy efficiency for green communications, and the network requirements. Moreover, it is crucial to evaluate the performance concerning the energy consumption, the throughput, and the response time, regarding green communications under different wireless network conditions (e.g., different traffic, different channels)[3].

In generations beyond 5G, network operators will be connected to one single core a nanocore. Combined with artificial intelligence, this nanocore will transform the mobile and wireless service that we know today. Already, 7G has lofty goals, such as space roaming (with support from the global navigation satellite system, the telecommunication satellite system, the earth-image satellite system, and

the 6G cellular system). The telecommunication satellite will be used for voice and multimedia communications; the navigational satellite will obviously be used for global positioning systems (GPS); and the earth-image satellites will provide us with closely up-to-the-minute weather updates and help with things like natural disaster preparedness. Needless to say, 7G should have absolutely no issue with data capacity coverage or bandwidth (no matter what tasks one throws at it). When can we expect this awesomeness to happen? Analysts conservatively estimate the following timeframes: 2020 for 5G; 2030 for 6G; and 2040 for 7G. Of course, the optimists and the Ray Kurzweil followers among us know all about the "law of accelerating returns," whereby human progress moves faster and faster as time goes on so perhaps 6G and 7G will appear sooner than we think[4].

The development of smart Mobile Applications holds the promise of creation of intelligent and globally connected ecosystems. These may act as catalysts to produce a new generation of innovative technologies, which will drive the creation of new industries. Application programming interface (API) is considered as a new world connector and a gateway to automated, efficient, flexible and personalized user and business experience. However, a lot of work is still needed to develop and grow this ecosystem. We have hardly started to address the design and development issues of APIs, which are intricately entwined with the security and privacy challenges that impinge on the business and standardization domains[5].

This cross-disciplinary, expert panel composed of individuals from industry and academia will provide comprehensive assessment of Mobile Applications, specifically mission critical applications, related APIs, their problematic details, and a potential roadmap for moving forward. The panel will examine new and innovative smart applications that are enabled by the latest research and business trends. Various challenges related to security and privacy will be discussed, and controversial issues in services and applications will be addressed. Ubiquitous computing, context awareness and mobility are the core requirement for all mission critical applications. The discussion will touch on all of these from the perspective of design, computation, service, privacy and security[6].

2. Conceptual Study

2.1. Green Communication and Wireless Network Generation

With the data traffic expected to grow nearly exponentially, concerns regarding excessive energy consumption in wireless networks have been also raised for home and enterprise environments. These two types of networks are discussed here jointly due to many similarities they exhibit, namely, similar propagation environments (dominantly indoor scenarios, high diversity of building structures with many obstacles, both due to wall construction and due to the used equipment), similar basis of a network structure, i.e., usually consisting of an Ethernet-based backbone and a wireless last hop where many different wireless technologies emerged. To complete the overview also the most important differences and future perspectives for both networks are pointed out. Then, the "green context" of the discussed environments is brought up[7].

The 5G wireless cellular networks are evolving, to meet the drastic subscriber demands in near future. This is accompanied with a rise in the energy

consumption in cellular networks. Higher energy consumption result in a rise in the carbon dioxide emissions into the environment, and exposure to greater amount of harmful radiations. To indemnify the ecological and health concerns associated with the rise in CO_2 levels, an important technology is green communication.

Nowadays, the whole world of telecommunications and information communities is facing a more and more serious challenge (from **2G/3G/LTE** to **5G/6G)**, namely on one side the transmitted multimedia-rich data are exploding at an astonishing speed and on the other side the total energy consumption by the communication and networking devices and the relevant global *CO_2 emission are increasing terribly. It has been pointed out that "*currently 3% of the world-wide energy is consumed by the ICT (Information & Communications Technology) infrastructure that causes about 2% of the world-wide CO_2 emissions, which is comparable to the world-wide CO_2 emissions by airplanes or one quarter of the world-wide CO_2 emissions by cars*"*. According to the recent research report of Ericsson, energy costs account for as much as half of a mobile operator's operating expenses. Therefore, telecommunications applications can have a direct, tangible impact on lowering greenhouse gas emissions, power consumption, and achieve efficient recycling of equipment waste. Moreover, to find radio networking solutions that can greatly improve energy-efficiency as well as resource-efficiency (Green Communications**)** is not only benefit for the global environment but also makes commercial sense for telecommunication operators supporting sustainable and profitable business. Within the framework of "5G/6G Green Communications", a number of paradigm-shifting technical approaches can be expected, including but not limited to energy-efficient network architecture & protocols, energy-efficient wireless transmission techniques (e.g., reduced transmission power & reduced radiation), cross-layer optimization methods, and opportunistic spectrum sharing without causing harmful interference pollution (i.e. Green Spectrum). Energy crisis and rising concerns on Greenhouse Gas (GHG) emissions have always been crucial issues faced by the development of wireless communication techniques. As more energy-efficient network architecture, green communications and networks (GCN) have recently attracted significant attention from academia and industry. In particular, the newly designed GCN not only can alleviate the greenhouse effect and decrease the operational expenditure but also can attain sustainable development due to the descending independence on fossil fuel and the exploitation of renewable energy resources. In order to enable the technical and economical GCNs, several emerging techniques have been proposed including energy-efficient and energy harvesting techniques. Although these emerging techniques have drawn considerable attention and have been studied recently, there are still many open theoretical and practical problems to be addressed. Specifically, most of the existing works have focused on optimizing a single objective of GCNs, such as energy efficiency. Since there are multiple conflicting objectives in GCNs, e.g., spectral efficiency and energy efficiency, multiobjective strategies are required to be in order to achieve a good tradeoff among the conflicting objectives. Moreover, since considered no orthogonal multiple access techniques have advantages in energy efficiency and massive connectivity, how to apply no orthogonal multiple access techniques into GCNs needs to be further investigated. Furthermore, the

conventional linear energy harvesting model is ideal in practice[8].

3. Report on the Finding

The technology development has an exponential growth that proportionally increases with the rate of the telecommunication usage over the recent years and will keep growing to connect all individual entities either through a wired (wireless) media. ICT is helping society become more energy efficient: think of the positive impact on CO2 emissions of telecommuting and ecommerce for example, Computers are helping us design more energy efficient products. But there is little doubt that, while other industries strive to become more energy efficient, computers and networks themselves risk becoming the "energy hogs" of the future, unless something is done[9].

It is envisioned that 5G networks will mostly be deployed for data-centric applications. Therefore, one of the main considerations that operators are facing today is how to migrate existing backhaul/fronthaul infrastructure toward Internet Protocol (IP)-based solutions for hyper dense small-cell deployment. Moreover, the data rates of 5G networks will demand an optical backhaul/fronthaul such as fiber. However, it's unlikely that fiber will be economical for all installation sites[10]. Operators will also face deployment restrictions for laying the fiber in many developed areas. Millimeter-wave backhaul/fronthaul is an attractive option, but technological and regulatory challenges are yet to be addressed. Another possible emergent solution is to exploit the interworking and joint design of open-access and backhaul/fronthaul network architecture for hyper dense small-cells based on cloud networks. This requires adaptive and smart backhauling/front hauling solutions that optimize their operations jointly with the access network optimization. The availability, convergence, and economics of smart backhauling/front hauling systems are the most important factors in selecting the appropriate backhaul/fronthaul technologies. Hence, it is imperative to analyze the variety of end-to-end backhaul and fronthaul solutions for 5G and Beyond 5G (B5G) networks. The Best Readings list is expected to provide several archival papers and special issues on the backhaul/fronthaul and related networking, communication, and signal processing issues that are currently available[11].

Green communication networks, with a focus on energy efficiency, is an emerging technological trend of great significance. These networks can significantly enhance sustainability for 5G and beyond networks with regard to power resources and environmental conditions. However, the high-density deployment of base stations and the exponentially increasing use of sensors and actuators in 5G and beyond networks, will lead to significant energy consumption. Thus, reducing carbon footprint in green communication networks is a key challenge facing researchers in academia and industry[12].

Due to the growing use of artificial intelligence (AI) in this area, several green communication approaches are entering a more mature phase, with exciting applications in various networks. Moreover, the information sharing and intelligent decision-making capabilities help recent green communication networks play an important role in improving not only energy efficiency but also network performance. For instance, a simple and effective green communication solution is to place a device in intelligent sleep mode; this is achieved with the help

of various MAC protocols with broad applications in wireless networks. However, it is essential to investigate the trade-off between the energy efficiency for green communication networks, and the network requirements. Moreover, it is crucial to evaluate the performance concerning the energy consumption, the throughput, and the response time, regarding 5G and beyond networks[13].

4. Discussion on the Finding

With the advancement of technology, there is a considerable increase in the usage of mobile phonesandothertelecommunicationdevices.Todaywea reinthedevelopmentphaseofbuildingaSmartCity.Infor mation and Communication Technology (ICT) sector has experienced a prodigious growth in the number of mobile subscriptions over the last decade. Recent studies have shown that the number of global mobile subscriptions has increased exponentially from 500 million subscriptions in 2000 to 5 billion subscriptions in 2012. Furthermore, the total number of mobile subscriptions is expected to grow to about 6 billion in 2014 and tend to reach global penetration of 100 percent after 2020[13].

Antenna technology is seeing a lot of activity right now and there is a strong expectation that antennas in the mW and above will be embedded on chip in handsets and then later in small cell solutions. This made no sense when you have just a few antennas but as we move towards 100s it starts to make a lot of sense. Companies like Metawave are productizing new materials to replace traditional antennas and give them properties that traditional antennas cannot achieve. Interesting work is also being done on using meta-materials to cloak antennas from each other in certain frequency bands, allowing them to be packed more tightly than would be traditionally possible. Of course AI is predicted to play a big part in any new standard and one way may be that it allows us to specify even less of what is happening, and just let individual intelligent machines fill in the gaps in our standard. The idea of auto tuning the modem in the field is a new one that may well play a role in 6G. Generally people are betting on smart city and factory 4.0 to drive the bandwidth density. It is possible that 6G will be the first standard of cellular designed primarily for machine to machine communication and this will have a dramatic impact on the requirements for QoS and roaming. Other general application classes we have talked about in previous articles include the Tactile Internet, the Internet of Skills and autonomous vehicles. All of these classes may become first class citizens of the requirement process in 6G in a way that was never true for 5G. It is expected that Virtual Reality will become a must support application by the time 6G begins standardization and this will drive the higher individual data rates more than any other application we know of so far[14].

Future wireless networks (B5G/6G cellular networks) and Internet of Intelligence (IoI) are assumed to be the key enabler and infrastructure provider in the global ICT industry, by offering a variety of cutting-edge services with diverse requirements. The standardization of 5G mobile cellular networks is being expedited around the world, which also implies more of the breakthrough candidate technologies will be considered beyond 5G. Therefore, it is worthwhile to provide insight into the emerging paradigm-shifting techniques as a whole and examine the disruptive design philosophy behind them. In regard to B5G/6G, it is meaningful to highlight one of the most fundamental features among the revolutionary techniques in the

B5G and 6G eras, i.e., there emerges ubiquitous intelligence in nearly every important aspect of mobile cellular networks, IoT (Internet of Things) and IoI (Internet of Intelligence), including radio network accessing (e.g., ORAN - Open RAN, cloud RAN, etc.), radio resource management, mobility management, service provisioning management (e.g. service function chains), networking (e.g., network slicing, mobile edge and fog computing, SDN/NFV, cloud, CogMesh, etc.), human behavior recognition, and so on. However, faced with the ever-increasingly complicated configuration issues and the blossoming new service requirements, it is totally insufficient for B5G/6G cellular networks if it lacks strong complete/sufficient AI (Artificial Intelligence) functionalities[15].

5. Conclusion

In the recent scenario, the communication network becomes the backbone of every business. The energy consumption is very challenging task for the design the new generation network. The concept of green information and communications technologies (ICT) is relevant to both environmental sustainability and ICT. Green ICT is an interdisciplinary field relevant to a number of areas and topics, such as information systems, computer science and technologies, communications and networking, power and energy systems, electronics, environmental and civil engineering, industrial engineering and project management, social sciences, and so on[6].

Green Communications and Networking introduces novel solutions that can bring about significant reductions in energy consumption in the information and communication technology (ICT) industry as well as other industries, including electric power. Containing the contributions of leading experts in the field, it examines the latest research advances in green communications and networking for next-generation wired, wireless, and smart-grid networks[16].

It seems clear that 6G is more than just a cocktail party topic now, with some universities finding funding to start to take on the challenge. Of course it looks a lot like an extension of 5G right now. But as new technologies continue to emerge, especially in AI, materials and antenna integration there is room for fundamental improvements that will have an impact on the radio and the network. IoT continues to build and put pressure on the network that may force it beyond 5G. So when will that all happen? Well conventional wisdom says by 2030 but maybe before. Also do not forget the old urban legend that all odd numbered Gs are not so good and need replacing by superior even numbered Gs. In that case 6G may be arriving even sooner!!

Hence, we feel necessary to introduce the fundamental concepts, approaches and strengths in Artificial Intelligence and discuss the relationship between AI and the potential techniques in B5G, future 6G cellular networks as well as Internet of Things. Specifically, we highlight the great opportunities and challenges to exploit AI (e.g., deep learning, reinforcement learning, transfer learning, imitation learning, representation learning, dictionary learning, collaborative learning, federated learning, swarm intelligence, collective intelligence, and other statistical machine learning) to achieve intelligent B5G/6G networks, and demonstrate the tremendous effectiveness of AI to orchestrate and optimize cellular networks and Internet of Things. We believe that AI-empowered B5G/6G cellular networks will

make the acclaimed dreaming ICT enabler a reality[17].

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