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Application Of 5G Mobile Communication Technology In Specific Environment Of Power & Comparison

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Abstract : This paper aims at comparison between different technologies ranging from 4G to 7G. 5G communication is under the effect of beam forming technology, which enables mobile terminals to send corresponding signals accurately, directionally and at high speed in a very small range, so as to prevent them from being interfered by redundant radio waves and improve the quality of communication environment. 5G is likely to reach speeds that are 20 times faster than 4G LTE. It precedes 4G LTE technology and follows same 3GPP roadmap.4G LTE has a peak speed of 1GB per second. Both 5G and 6G take advantage of higher frequencies on the wireless spectrum to transmit more data, faster. 6G will operate at 95 GHz to 3 terahertz (THz). At those wavelengths, 6G will deliver speeds 1,000 times faster than 5G (which is only four to five times faster than 4G). It can be applied to distribution automation stations and substation communication. 5G communication will be applied to all kinds of equipment under the effect of power automation. For example, substations and distribution stations can take advantage of 5G wireless communication to smoothly access inspection robots and further improve the level of intelligence.

There is still a large gap between supply and demand in the short term. Competition will be gradually introduced from the field of generation to the field of distribution, resources will be more effective and reasonable allocation and utilization, and the industry is also developing towards the trend of interconnection.

In mobile technology, each generation has been designed from 1G to 6G to meet the needs of network and end users operators. The 6G mobile communications system would also include new services with new technologies.

***IndexTerms* – 5G, 6G, range, communication technology component**

I. Introduction

The Fifth Generation (5G) Wireless networks were planned to be free from the limitations of previous generations. It has become necessary for society to move beyond 5G and design a new architecture that can incorporate the technological needs of both the individual and society. Therefore, if Sixth Generation (6G) mobile communications are to be developed, many aspects must be improved, the most evident being: latency, higher data rate, quality of service (QoS) and system capacity. When looking at the previously mentioned aspiration and requirements of future networks, the need for the development of 6G networks becomes clear. Nevertheless, many challenges which society must overcome for such networks to be implemented exist. The cost of solving such problems pales in comparison to the potential benefits of 6G networks. The physical layer of a radio access system has a key role in defining the resulting capacity and becomes a focal point when comparing different systems for expected performance. A competitive system requires an efficient protocol layer to ensure good performance through both the application layer and the end user. This also enables the dynamic nature of the radio interface because all radio resource control is located close to the radio in the base station site. The 3rd Generation Partnership Project (3GPP) term for the base station used is eNodeB (different to the Wideband Code Division Multiple Access (WCDMA)BTS term, which is NodeB; e stands for evolved). Therefore this paper initial covers the channel structures and then introduces the channel codingand procedures.

In mobile technology, each generation has been designed from 1G to 6G to meet the needs of network and end users operators. The 6G mobile communications system would also include new services with new technologies. As we enter a new era of next-generation wireless systems represented by FifthGeneration (5G) New Radio (NR) technology, it is essential to grasp the recent progress in their standardization and development. A survey of the 5G NR system design that aims at introducing its features according to the relevant Third Generation Partnership (3GPP) specifications. Our focus is set on the flexibility of 5G NR, which refers to its capability to support novel services and technologies, such as enhanced Mobile Broadband (eMBB) and Internet of Things (IoT) for massive Machine Type Communications (mMTC) while satisfying the underlying quality requirements.

There is still a large gap between power supply and demand in the short term. Power market competition will be gradually introduced from the field of power generation to the field of power transmission and distribution, resources will be more effective and reasonable allocation and utilization, and the power industry is also developing towards the trend of grid interconnection. Furthermore, the impact of scalable numerology on system performance is discussed. Finally, we also consider open challenges andfuture research directions.

II. SYSTEM MODEL

2.1 .Selecting average transmit power:

Literature survey of the following papers were done in order to understand anddevelop the problem statement. A thorough literature review from various reputed journals were studied in detail before proceeding to the design of the project. Some of the key points are highlighted below as follows:-

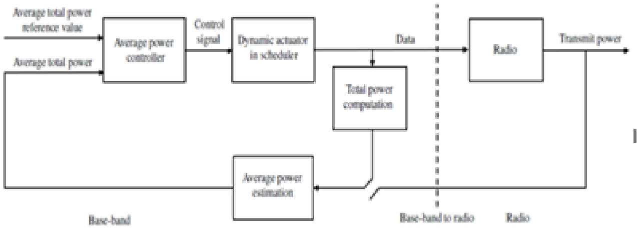


Figure 1: Block Diagram Of The Average Power Feedback Control Loop For The Alternatives With Computed And Measured Momentary Power.

The task to maintain the average transmit power of a single radio base station below a selected threshold associated with the exclusion zone can be formulated as a feedback control problem, as depicted in Fig. 2. This selected threshold is denoted ε below, and it is expressed as a fraction of the maximum power of the regulated radio system. The selected average power threshold associated with the exclusion zone is used to compute the average total power reference value of the control loop[6]. The average power controller then forms the difference (the control error) between the reference value and the estimated average power. Based on this information a control signal is computed.
This control signal commands a rate of change to a dynamic actuator operating in the scheduler. The actuator consists of a momentary resource limitation operating on the resource grid of the OFDMA air interface [3], [4]. The scheduler then creates the data stream that is further processed in the radio to generate the transmit power. In the feedback path, two architectural alternatives are shown. The first one is the one described in the paper. This alternative performs a computation of the momentary total transmit power of the cell in base-band, after scheduling[5]. The advantage to the alternative using the measurement of the total momentary power in the radio, is that the complete solution is in the base-band without radio impact, a fact that significantly simplifies testing. Later, measured power in the radio can be integrated directly if needed, but the rest of the feedback control loop is identical for both alternatives. Finally, the latest momentary power sample is stored in a sliding window of duration T , and the oldest momentary power sample in the sliding window is shifted out[7]. The average power is then computed for each sampling time instance of the feedback loop.

2.2 Maintaining the Integrity of the Specifications:

The motivation behind the self-study is to understand the deeper concepts behind the implementation of 5g and 6G and compare. Thecommunication standards of 4G are higher than its predecessors but it becomesreally important to understand the limitations and to keep pace with evolving new technologies like 5G and 6G.

2.3. Power

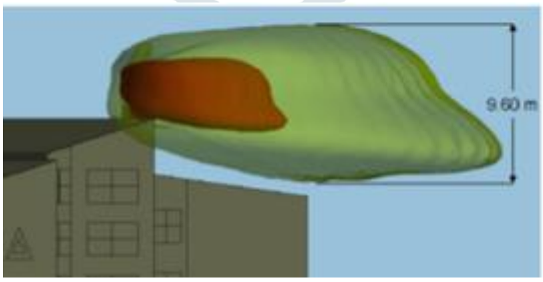


Figure 2: ICINRP based exclusion zone for 5g at 3.5GHz

From [4], Time Averaged Power Control of a 4G or a 5G Radio Base Station for RF EMF Compliance When determining the RF EMF exclusion zones for deployments of multi-input-multi-output (MIMO) transmitting 4G or 5G radios with advanced antenna systems (AASs) capable of active beam steering [2], it is important to observe that the maximum beamforming gain and equivalent isotropic radiated power (EIRP) may be significantly increased as compared to traditional antennas [3]–[6], since traditional antennas do not possess the active steering enabled by the arrays of AASs. However, the time averaged gain and EIRP are similar since these antennas steer the beams in different directions to serve different users. This means that the traditionally used methods for calculating RF EMF exclusion zones based on maximum EIRP generate overly conservative results if used for AASs [7]–[9].

2.4 The main objectives:

- To design and develop a comparison between 4G to 6G mobile communication using MATLAB and algorithms.
- To evaluate different technologies and their capabilities
- To analyze the diagram of 5G implemented power systems and arrive at appropriate conclusions.

III. SIMULATED RESULTS

* Number of RBs allocated to CSI-RS resource(s) (1...275)
* Starting RB index of CSI-RS resource(s) allocation relative to the carrier resource grid (0...2169)
* OFDM symbol locations of CSI-RS resource(s) within a slot

Allocated slots (0-based) of CSI-RS resource(s) within a period. Thi sparameter can be a vector or a cell array of vectors. In the latter case, each cell corresponds to an individual CSI-RS resource. In case of a vector, the same set of slots is used for all CSI-RS resources
* Periodicity of CSI-RS resource(s) allocation in slots. If this is empty it indicates no repetition. This parameter can be a scalar or a cell array. In the latter case, each cell corresponds to an individual CSI-RS resource. In case of a scalar, the same period is used for all CSI-RS resources
* Scrambling identity corresponds to CSI-RS resource(s) for pseudo-random sequence generation (0...1023)

3.1 Comparison with code of Existing 4G Model:

This proposition could be inserted either after the guard interval stage to ensure having a free of ISI channel or before it to offer a perfect circular convolution. Therefore, the insertion choice will be optimized to fit the cost and complexity equation criteria.

```
% Apply frequency estimation and correction for the purposes of performing
% timing synchronization
foffset_est = lteFrequencyOffset(rmc,rxWaveform);
rxWaveformFreqCorrected = lteFrequencyCorrect(rmc,rxWaveform,foffset_est);

% Synchronize to received waveform
offset = lteDLFrameOffset(rmc,rxWaveformFreqCorrected,'TestEVM');
rxWaveform = rxWaveform(1+offset:end,:);

% Use 'TestEVM' pilot averaging
cec.PilotAverage = 'TestEVM';
```

```
bw = "10MHz"; % Channel bandwidth
scs = "30kHz"; % Subcarrier spacing
dm = "FDD"; % Duplexing mode
```

```
tmwavegen = hNRReferenceWaveformGenerator(rc,bw,scs,dm);
[txWaveform,tmwaveinfo,resourcesinfo] = generateWaveform(tmwavegen,tmwavegen.Config.NumSubframes);
```

Figure 3 :Creating the waveform generator parameters

There is a need for supporting the needed data rates. For this purpose, a benchmark based on Multi-Antenna Multiband Orthogonal Frequency Division Multiplexing has been proposed to compatible with Ultra-Wideband systems such as the fifth generation based technologies. In order to enhance the system quality of service, the structure of the ultra-wideband system's main stage; namely Orthogonal Frequency Division Multiplexing has been modified by imposing a low complexity designed Haar-wavelets stage instead of the fast Fourier transform stage. This is in addition to reallocate the transmitted power in order to reduce the effect of one of the main drawbacks that is found in the Orthogonal Frequency Division Multiplexing[3]-[6]; namely the peak-to-average power ratio problem.

3.2 Algorithm:

Attach a zero sample to lead the OFDM symbol as a distinguishing one. Therefore, the start point of each symbol will be known.Enhance the conversin accuracy by increasing the number of samples between the adjacent OFDM samples;

$$TR_p^w(i) = \begin{cases} T_p^w(i) = T_p^w(1,(i-1)), then(i) = 0 \\ T_p^w(i) < T_p^w(2,(i-1)), then(i) = -slope \\ T_p^w(i) > T_p^w(3,(i-1)), then(i) = +slope \end{cases} \quad (1)$$

Based on the mean power algorithm, average the power over small number of samples leads to the optimum position for the sampling process.

```
csirs(2).Enable = 0;
csirs(2).BWP = 2;
csirs(2).Power = 3; % in dB
csirs(2).CSIRSType = {'nzp','nzp'};
csirs(2).RowNumber = [1 1];
csirs(2).Density = {'three','three'};
csirs(2).SubcarrierLocations = {0,0};
csirs(2).NumRB = 50;
csirs(2).RBOffset = 50;
csirs(2).SymbolLocations = {6,10};
csirs(2).AllocatedSlots = {[0,1],[0,1]};
csirs(2).AllocatedPeriod = {10,10};
csirs(2).NID = 0;
```

3.3 Comparison with 5G outputs:

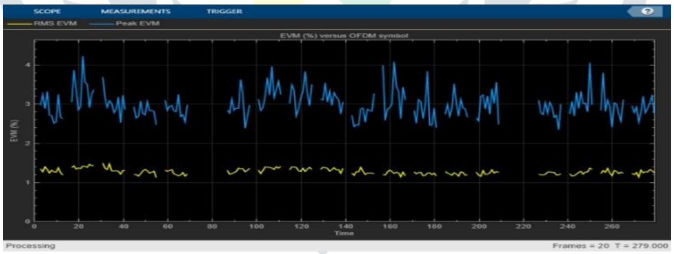
```
Command Window
Information associated to BWP 1:
            SamplingRate: 61440000
                    Nfft: 4096
               Windowing: 10
     CyclicPrefixLengths: [1×14 double]
           SymbolLengths: [1×14 double]
            NSubcarriers: 2592
       SubcarrierSpacing: 15
          SymbolsPerSlot: 14
       SlotsPerSubframe: 1
      SymbolsPerSubframe: 14
      SamplesPerSubframe: 61440
          SubframePeriod: 1.0000e-03
               Midpoints: [1×141 double]
           WindowOverlap: [1×14 double]
                      k0: 0

fx >> |
```

Figure 4: Code comparison with the mentioned technologies

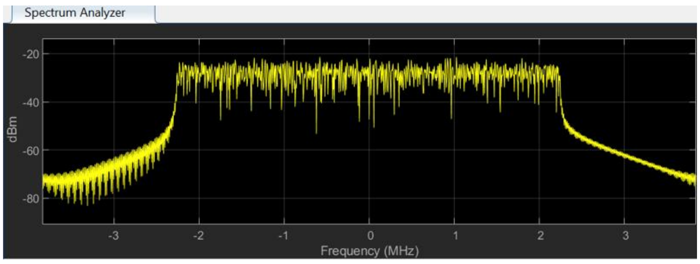
IV. RESULTS AND DISCUSSION

4.1 Performance:

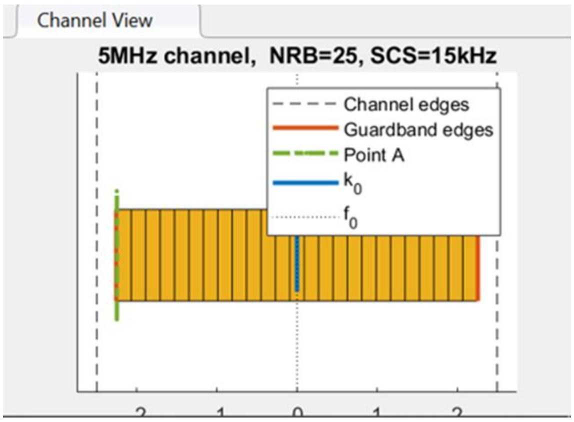
In order to check the system's performance based on both of the AMI parameter and the energy efficiency factor, Figure 13[3] depicts both values in term of the modified SNR that includes the processing needed energy; the relationship between the data rates have been included. Furthermore, a limit of 45 dB is used in order to be adequate to the new generation of the wireless systems. From the depicted results in Figure 3, the hybrid work gives the best results compared either to the proposed work individually or to the conventional OFDM. Focusing on a 30 dB threshold, the hybrid proposition gives extra 15% enhancement over the conventional work.



3a)4G EVM vs OFDM symbol



3b)5G spectrum analysis



3c)5G channel edges and guard bands

4.2 Comparison with 6G Results:

Based on the mean power algorithm, average the power over small number of samples leads to the optimum position for the sampling process[3].

The output from the preprocessing stage is ready to be processed in the transforming stage, which is depicted in Figure 8. This proposition could be inserted either after the guard interval stage to ensure having a free of ISI channel or before it to offer a perfect circular convolution.

Therefore, the insertion choice will be optimized to fit the cost and complexity equation criteria. In the transforming stage, three main processing levels will be fulfilled; calculating the slope between any two points, systems performance has been checked from both of the FER and EVM

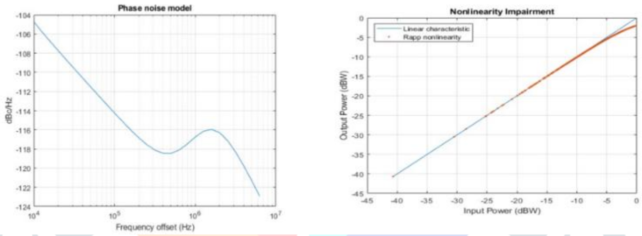


Figure 3d) 6G Phase noise model decreasing wrt frequency and power measurements

4.3 Technical features introduced in 6G:

Following are the key technical features introduced in 6G wireless.

- New Spectrum : Due to increase in traffic demand and scarcity of spectrum resources THz (Terahertz) and Visible light bands have been introduced for communication in 6G mobile communication system.
- New channel coding has been introduced based on Turbo, LDPC, Polar, etc.
- Sparse theory (compressed sensing)
- Very large scale antenna processing for THz
- Advanced signal processing
- Flexible spectrum (Full (free) spectrum, Spectrum sharing)
- AI based wireless communication
- Space-Air-Ground-Sea integrated communication
- Wireless Tactile Network

In power systems,6g can be used compared to 5g to connect electricity grid with communication networks and automation and to define novel mechanisms for energy market systems and structures. A 6g solution which is powered by renewable energy sources(RES) and provides the backbone for communications and computing for information exchange required for maintaining such power grids.

V. FUTURE SCOPE

From the proposed work, following are points that may lead to some better results.

- The study can be extended in to reduce overhead with increase in Antennas.
- Haar structure to enhance the transceiver’s structure

VI. ACKNOWLEDGMENT

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REFERENCES

[1] S. Peifeng et al., "Research on distributed FA adaptive technology for abnormal 4G wireless communication," 2021 China International Conference on Electricity Distribution (CICED), 2021, pp. 446-449, doi: 10.1109/CICED50259.2021.9556840. 2021

[2] S. Peifeng et al., "Research on distributed FA adaptive technology for abnormal 4G wireless communication," 2021 China International Conference on Electricity Distribution (CICED), 2021, pp. 446-449, doi: 10.1109/CICED50259.2021.9556840, 2021

[3] O. Daoud, "Power reallocation and complexity enhancement for beyond 4G systems," in China Communications, vol. 16, no. 6, pp. 114-128, June 2019, doi: 10.23919/JCC.2019.06.010, 2021

[4] C. Törnevik, T. Wigren, S. Guo and K. Huisman, "Time Averaged Power Control of a 4G or a 5G Radio Base Station for RF EMF Compliance," in IEEE Access, vol. 8, pp. 211937-211950, 2020, doi: 10.1109/ACCESS.2020.3039365 , 2020

[5]E. Dahlman, G. Mildh, S. Parkvall, J. Peisa, J. Sachs, Y. Selén, and J. Sköld, ''5G wireless access: Requirements and realization,'' IEEE Commun., vol. 52, no. 12, pp. 42–47, Dec. 2014.

[6] T. S. Rappaport, S. Sun, R. Mayzus, H. Zhao, Y. Azar, K. Wang, G. N. Wong, J. K. Schulz, M. Samimi, and F. Gutierrez, ''Millimeter wave mobile communication for 5G cellular: It will work!'' IEEE Access, vol. 1, pp. 335–349, 2013.

[7] T. Wigren, D. Colombi, B. Thors, and J.-E. Berg, ''Implication of RF EMF exposure limitations on 5G data rates above 6 GHz,'' in Proc. IEEE 82nd Veh. Technol. Conf. (VTC-Fall), Boston, MA, USA, Sep. 2015, pp. 1–5. [6] M. Wenhua, M. Huaxing, and G. Peng, ''The EMF radiation calculation and measurement for smart antenna,'' in Proc. 6th Int. Wireless Commun. Mobile Comput. Conf. ZZZ (IWCMC), 2010, pp. 119–123.

[8] Product Standard to Demonstrate the Compliance of Radio Base Stations and Fixed Terminal Stations for Wireless Telecommunication Systems (110 MHz-40 GHz), Standard CENELEC Standard EN 50385, 2017.

[9] [Determination of RF Field Strength and SAR in the Vicinity of Radio Communication Base Stations for the Purpose of Evaluating Human Exposure, IEC Standard IEC 62232:2017, 2017, 2017.