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P5G New Radio Evaluation against IMT-2020 Key Performance Indicators

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ABSTRACT: This project work provides a detailed analysis and performance evaluation of 5G NewRadio (NR) against a set of Key Performance Indicators (KPI), as defined in the InternationalMobile Telecommunications 2020 (IMT-2020) guidelines, and provides an overview about thefulfillment of their associated requirements.This project gives the detailed explanation about two most significant Key Performance Indicators(KPI) is Spectral Efficiency(SE) and Energy Efficiency(EE) arecontributed by the Third Generation Partnership Project(3GPP).

KEYWORDS: Massive MIMO,zero forcing(ZF),Phased Zero Forcing(PZF),Maximum Ratio Combining(MRC)

I. INTRODUCTION

A 5G Technology is a new wireless standard cellular technology after 4 existing standards. Cellular communication is continuously enhancing to keep up with the rapidly increasing demand for wireless data services. 5G expands the mobile communications concept to new industry sectors. 5G aims at supporting three major service types with different kinds of requirements like enhanced mobile broadband, Ultra-reliable low latency communication and massive machine type communication. 5G is expected to satisfy a wide set of high-demanding requirements. 5G was specified for the first time in the third generation partnership project(3GPP) structured in three phases.5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines and objects. 5G opens up many possibilities like it allows more users to connect to one tower, avoiding network congestion during conventions and mass gatherings.5G is critical because it will enable unprecedented levels of connectivity, upgrading 4G networks with five key functional drivers like superfast broadband, ultra-reliable low latency communication, massive machine-type communication, high reliability and efficient energy usage. Commercial 5G networks have been deployed in 378 cities across 34 countries. 5G can be significantly faster than 4G, delivering up to 20 Gbps peak data rates. 5G has more capacity than 4G. 5G is designed to support a 100x increase in traffic capacity and network efficiency. 5G has lower latency than 4G.

II. METHODOLOGY

Zero Forcing(ZF)

It is a method of spatial signal processing by which a multiple antenna transmitter can nullify the multi-user interference in a multi-user MIMO wireless communication system.It is also called “null-steering”.It has a disadvantage called ‘noise-amplification’(Inverse filter may excessively amplify noise at frequencies where the folded channel spectrum has high attenuation).

Maximum Ratio Combining(MRC)

It is a method of diversity combining in which the signals from each channel are added together, the gain of each channel is made proportional to the RMS signal level and inversely proportional to the mean square noise level in that channel.It is also known as “ Ratio-Squared Combining and Pre-detection Combining”

Phased Zero Forcing(PZF)

The phased zero forcing is used to overcome the limitations of zero forcing,because in the zero forcing inverse filter is utilized .By using this filter complete noise amplification will be happen and it includes some attenuation in the signal or information.

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Massive MIMO(Multiple Input-Multiple Output)

massive MIMO is used to overcome the limitations of MIMO,the MIMO has finite number of transmitters and receivers but in the massive MIMO has infinite number of transmitters and receivers .And also massive MIMO is used

III . MODELIND AND ANALYSIS

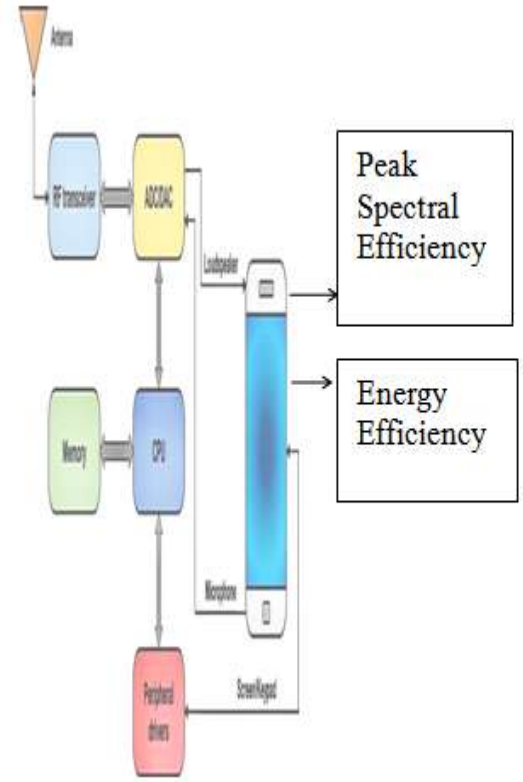

Figure 1 : schematic diagram of tx and rx of mobile

IV.PROBLEM IDENTIFICATION

As the demand for wireless technology increasing.Demand for base station services increases with the increasing users.Maximum amount of energy is consumed by service providers and consumers ,which leads to unefficient utilization of energy.Present 4G technology though it is promising, it may fail to provide services with this enormous demand for WC(Wireless Communication).

V . SOFTWARE DESCRIPTION

This project is completely software based and stimulated on Matlab

VI. RESULTS AND DISCUSSION

The graphical representation describes the characteristics of spectral efficiency which dependson the number of base stations.This can be analyzed by 4 cases.

Case 1

These case has mainly four figures and the figures names are figure 4,figure 5,figure 6,figure 14

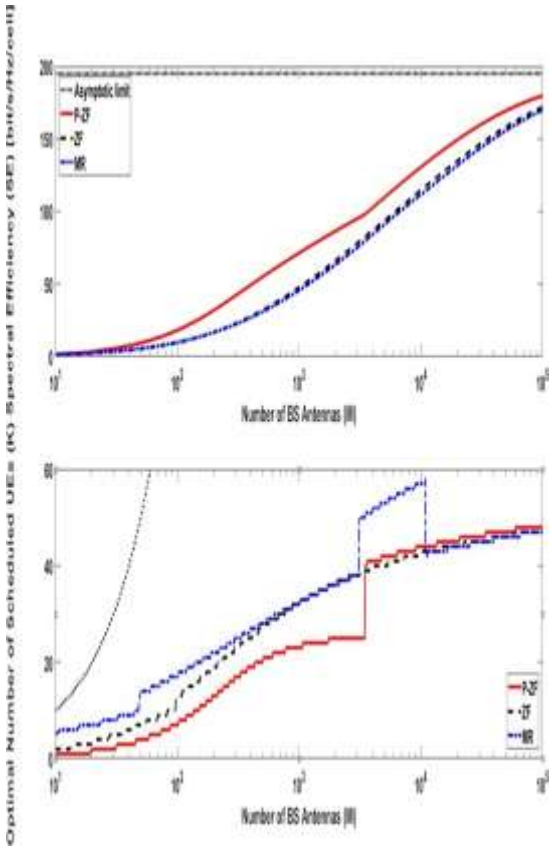

Figure 2: Characteristics of figure 4

Table 1 : Values of Figure 4

NO. BASE STATIONS	MRC	ZF	PZF
100	10	10	20
1000	40	40	60
10000	100	100	120
100000	150	150	170

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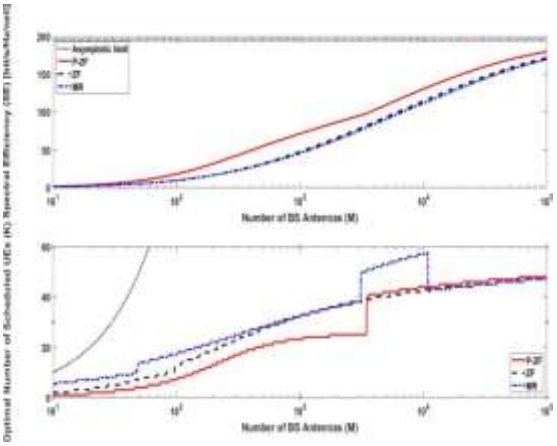

Figure 3 : Characteristics of figure 5

Table 2 : Values of Figure 5

NO. BASE STATIONS	MRC	ZF	PZF
100	10	10	20
1000	40	40	60
10000	100	100	120
100000	150	150	170

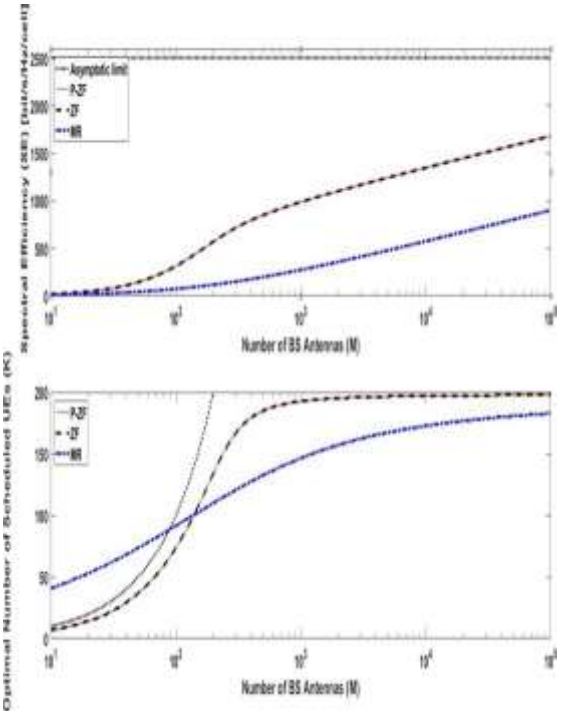

Figure 4 : Characteristics of figure 6

Table 3 : Values of Figure 6

NO. OF BASE STATIONS	MRC	ZF	PZF
100	50	350	350
1000	200	900	900
10000	500	1300	1300
100000	900	1700	1700

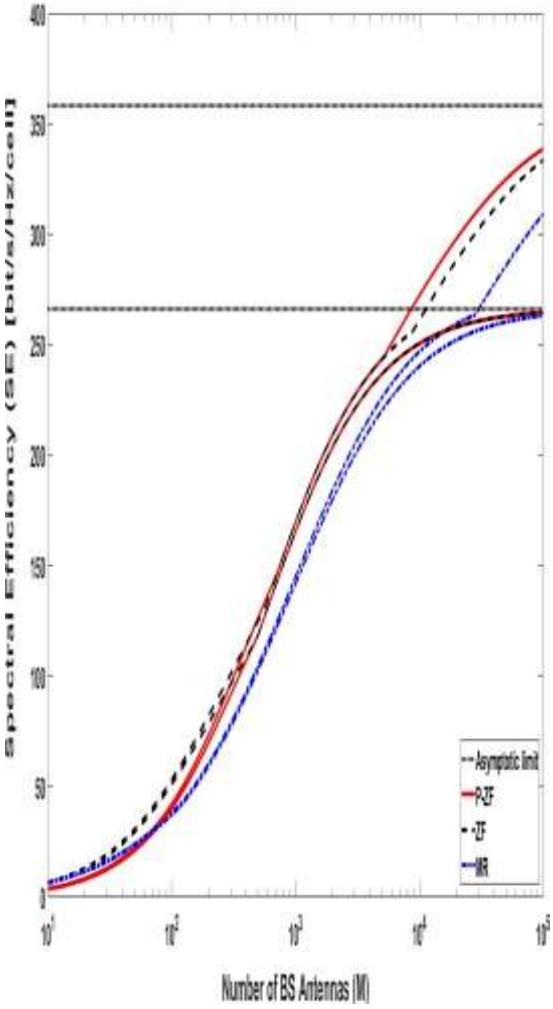

Figure 5 : Characteristics of figure 14

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Table 4 : Values of Figure 14

NO. OF BASE STATIONS	MRC	ZF	PZF
100	30	50	30
1000	100	150	150
10000	230	260	270
100000	260	320	330

Case 2

These case has mainly four figures and the figures names are figure 8,figure 9,figure 10,figure 11

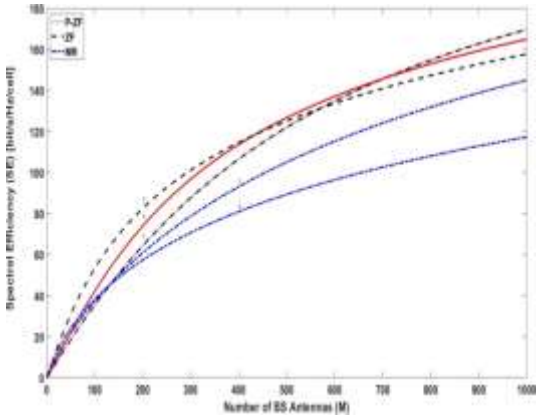

Figure 6 : Characteristics of figure 8

Table 5 : Values of Figure 8

NO. OF BASE STATIONS	MRC	ZF	PZF
100	38	40	40
500	70	110	110
1000	95	160	160

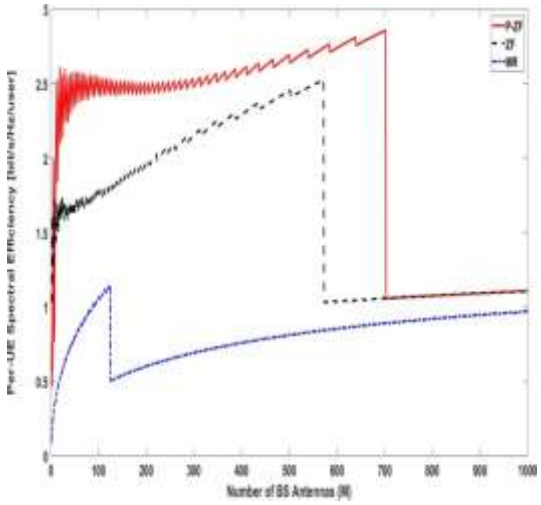

Figure 7 : Characteristics of figure 9

Table 6 : Values of Figure 9

NO. OF BASE STATIONS	MRC	ZF	PZF
100	2.5	3	6
500	3	9.8	10
1000	5.8	5.8	5.8

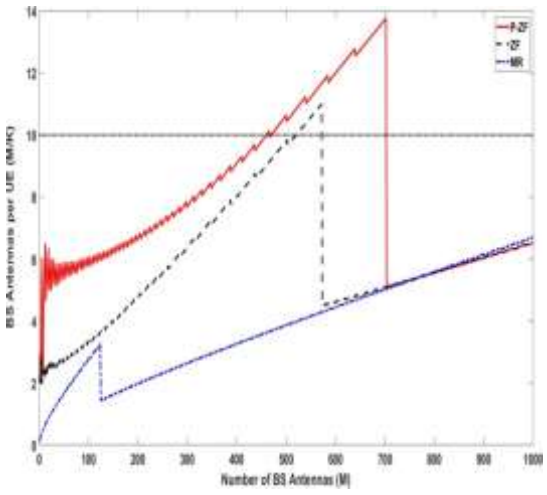

Figure 8 : Characteristics of figure 10

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Table 7 : Values of Figure 10

NO. OF BASE STATIONS	MRC	ZF	PZF
100	2.5	3	6
500	3	9.8	10
1000	5.8	5.8	5.8

Figure 9 : Characteristics of figure11

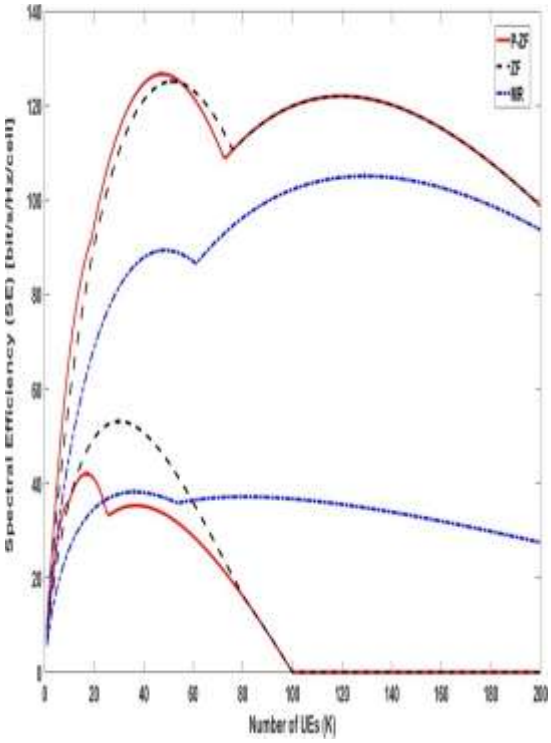

Table 8 : Values of Figure 11

NO. OF BASE STATIONS	MRC	ZF	PZF
100	30	50	30
500	-	-	-
1000	-	-	-

Case 3

These case has mainly two figures and the figures names are figure 12,figure 13.

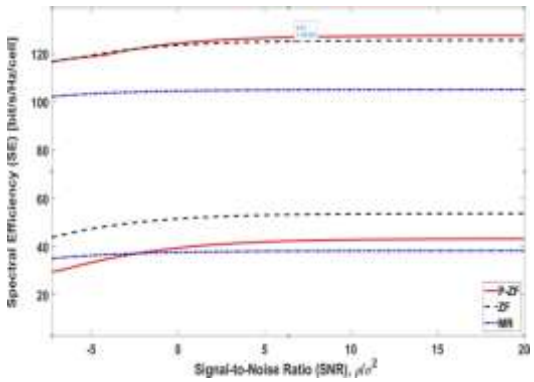

Figure 10 : Characteristics of figure 12

Table 9 : Values of Figure 12

SNR	MRC	ZF	PZF	MRC	ZF	PZF
-5	35	45	30	102	118	118
0	35	50	40	102	120	120
5	32	50	42	102	122	124
15	30	48	40	102	120	124

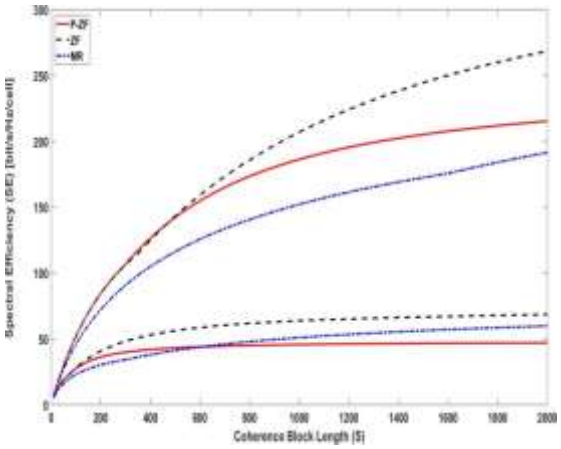

Figure 11 : Characteristics of figure 13

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Table 10 : Values of Figure 13

CBL	MRC	ZF	PZF	MRC	ZF	PZF
200	25	40	25	60	90	90
600	35	50	35	100	140	150
1000	45	50	40	130	200	170
2000	48	50	30	155	240	160

Case 4

These case has only one figure and the figure names are figure7.

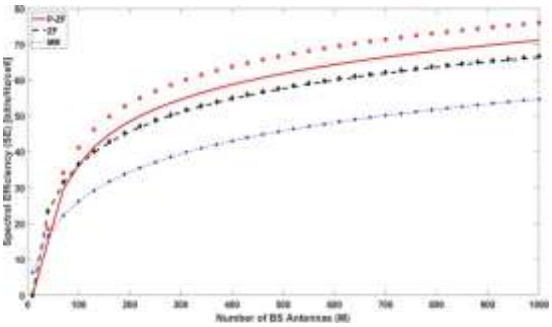
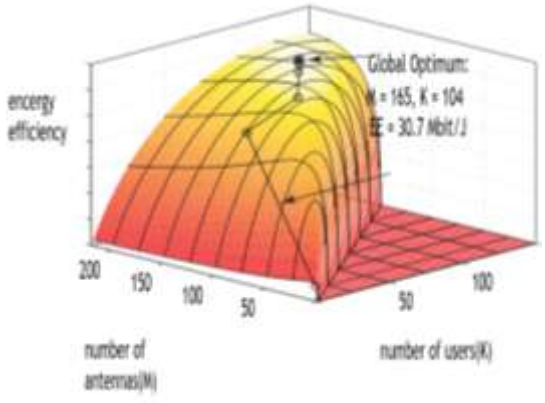


Figure 12 : Characteristics of figure 7

Table 11 : Values of Figure 7

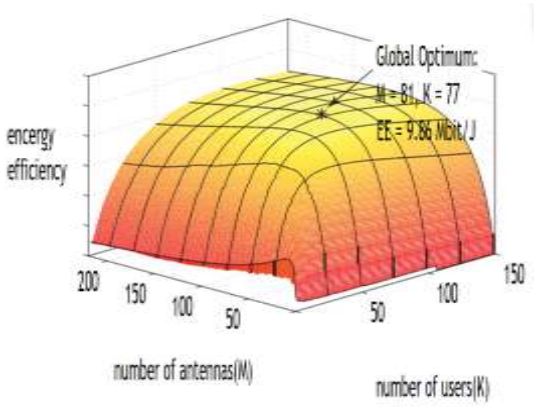
NO OF BASE STATIONS	MRC	ZF	PZF
100	25	30	30
200	30	40	45
300	35	45	50
400	38	50	52
500	40	52	53
600	42	54	55
700	44	56	56

The graphical representation describes the characteristics of Energy Efficiency by analysing 220 antennas

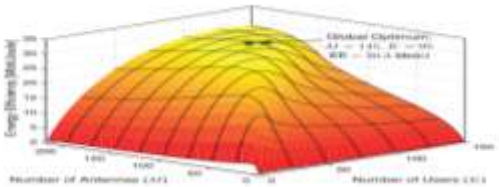


This is a 3D schematic diagram which shows the relationship between number of users,number of antennas, and energy efficiency. Energy efficiency (in Mbit/Joule) with ZF processing in the single-cell scenario.

The global optimum is star-marked and the surroundings are white. The convergence of the proposed alternating optimization algorithm is indicatedwith circles.



Energy efficiency (in Mbit/Joule) with MMSE processing in the single- cell scenario.The above picture shows how energy efficiency varies with respect to number of antennas(M) and number of users(K).



The above picture represents “Energy efficiency” (in Mbit/Joule) with MRT/MRC processing in the single-cell scenario.

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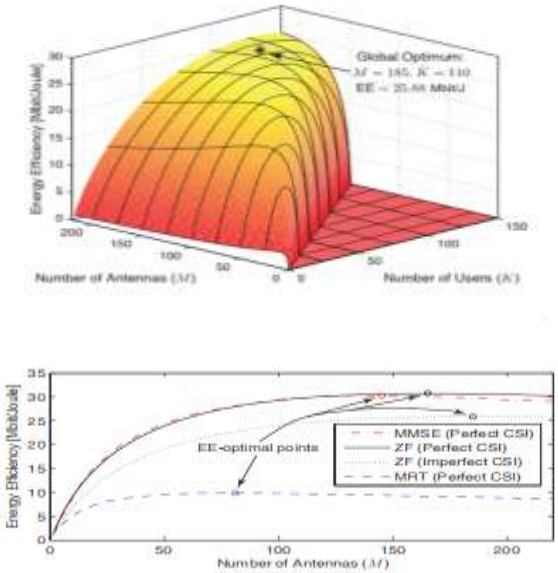
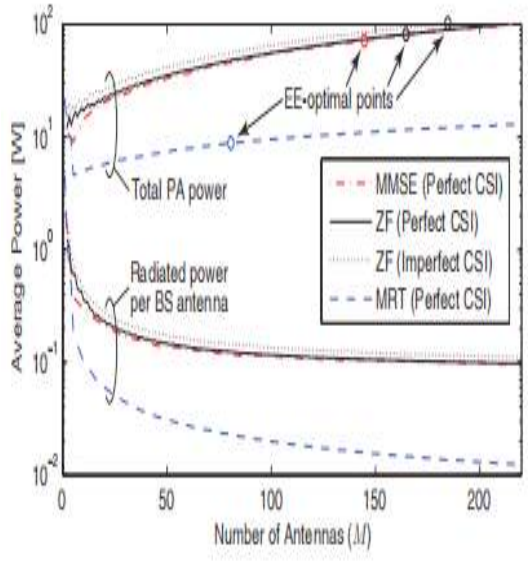
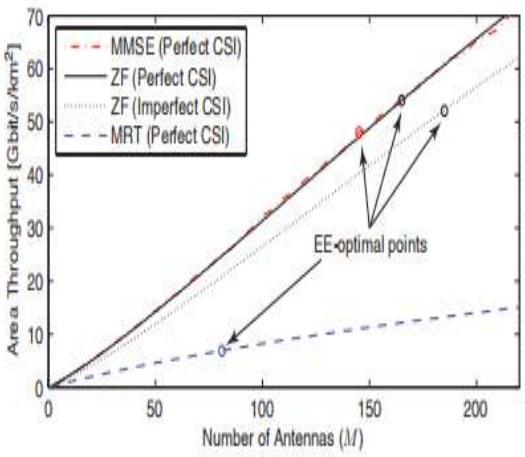


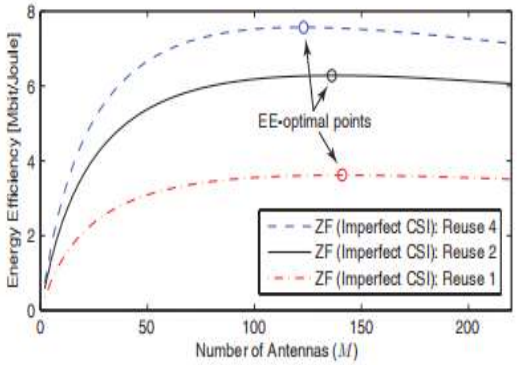
Maximal EE for different number of BS antennas and different processing schemes in the single-cell scenario.Above picture shows the maximum EE as a function of the number of BS antennas. Clearly, the similarity between MMSE and ZF shows an optimality of operating at high SNR (where these schemes are almost equal).



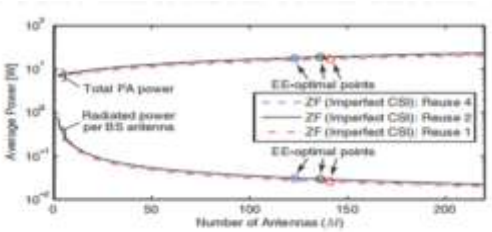
The aboce picture shows the Total PA(Average power power) at the EE-maximizing solution for different number of BS antennas in the single-cell scenario.It shows the total PA power that maximizes the EE for different M (using the corresponding optimal K).



It shows the "Area throughput" at the EE-maximizing solution for different number of BS antennas in the single-cell scenario.



Above picture shows about "Maximal EE" in the multi-
cell scenario for different number of BS antennas and different pilot reuse factors.



Above picture shows about the "Total PA power" at the EE-maximizing solution in the multi-cell scenario, for different number of BS antennas.

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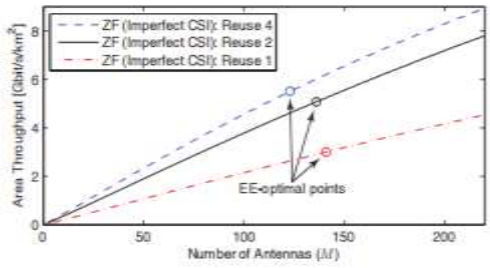
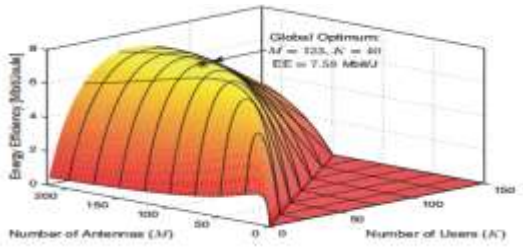


The above picture shows about the"Area throughput" at the EE-maximizing solution in the multi-cell scenario, for different number of BS antennas.



The above picture represents "Energy efficiency" (in Mbit/Joule) with ZF processing in the multi-cell scenario with pilot reuse 4.

VII . CONCLUSION

This work has evaluated the performance of 5G against relevant KPI as defined in the IMT-2020 guidelines . The project has studied whether the requirements specified in are met or not. The analysis has been done from an independent perspective, complementing the one provided by 3GPP and emphasizing the role of 5G NR towards the IMT-2020 landmark. In particular, two KPI has been addressed in this work.

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