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NEXT GENERATION 5G DEVICE-TO-DEVICE (D2D) WIRELESS COMMUNICATION SYSTEM

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ABSTRACT

Next Generation 5G Device-to-Device (D2D) Wireless Communication System the previous four generations of cellular technology have each been a major paradigm shift that has broken backward compatibility. So we expect that 5G will be a paradigm shift that includes very high carrier frequencies with massive bandwidths, In this thesis we discuss the new thoughts which would improve the efficiency like using mm-waves, small cell, and smart antenna. Then we discuss some of the emerging applications based on 5G Device-to-Device (D2D) Wireless Communication System. In addition, we mentioned some challenges and open issues related to the previous generations and infrastructure boundaries that we have to considerate during designing 5G Device-to-Device Communication System networks. Just a few years ago mm wave was not being put to use because few electronic components could receive millimeter waves.

Keywords:- Next Generation, 5G Device-to-Device, bandwidths, high-rate, high carrier.

1. INTRODUCTION

The cellular systems industry is envisioning an increase in network capacity by a factor of 1000 over the next decade to meet this traffic demand. In addition, with the emergence of Internet of Things (IoT), billions of devices will be connected and managed by wireless networks. Future networks must satisfy the above mentioned requirements with high energy efficiency and at low cost. Hence, the industry attention is[1] now shifting towards the next set of innovations in architecture and technologies that will address capacity and service demands envisioned for 2020, which cannot be met only with the evolution of 4G systems. These innovations are expected to form the so called fifth generation wireless communications systems, or 5G. Candidate 5G solutions include:

I. Higher densification of heterogeneous networks with massive deployment of small base stations supporting various Radio Access Technologies (RATs),
II. Use of very large Multiple Input Multiple Output (MIMO) arrays,
III. Use of millimeter Wave spectrum where larger wider frequency bands are available,
IV. Direct device to device (D2D) communication. Simultaneous transmission and [11] reception, among others.

In this thesis, we present the main 5G technologies. We have an Mm-waves new horizon in radio spectrum Capacity of wireless communication depends on many criterions spectral efficiency, bandwidth and cell size. Presently, almost all wireless communications use spectrum in 300 MHz to 3 GHz band because of its reliable propagation characteristics over several kilometers no matter what the radio environment is. Scientists don't expect from sub mm-wave band to suit and accommodate the exponential rising of mobile traffic and connectivity. The basic idea of the next generation 5G lies in exploring the unused high frequency mm-wave ranging from 3 ~ 300 GHz. [18] Even a small part of the available mm- wave spectrum can satisfy our needs and support hundreds of times of data rate over current cellular spectrum.

Small cells

As 5g technology needs to work with an enormous number of users, variety of devices and diverse services, the first priority is the integration of 5g BSs with the old generations (4G and 3G)which let us with two probabilities also discuss the network and device evolution towards 5G.

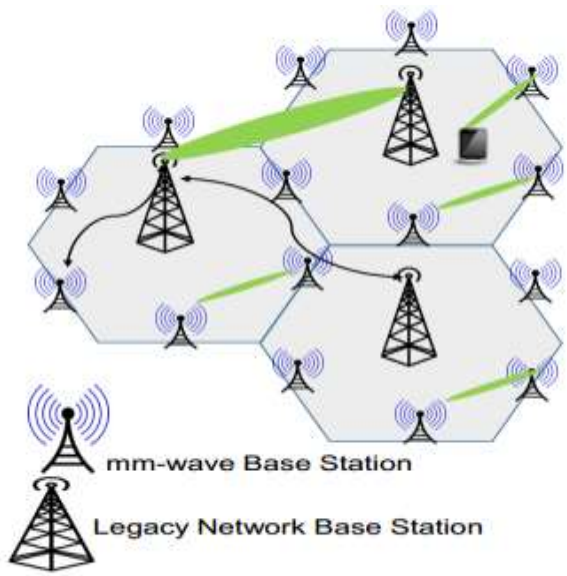

Fig.1: Dual-mode modem

Use a dual-mode modem, as shown in "Figure 1 dual-mode modem", to make user switch between the two networks (system of mm-wave (5g) and 4g network) or we could use mm-wave spectrum for data communications and use 4G network for transmitting control and system information.

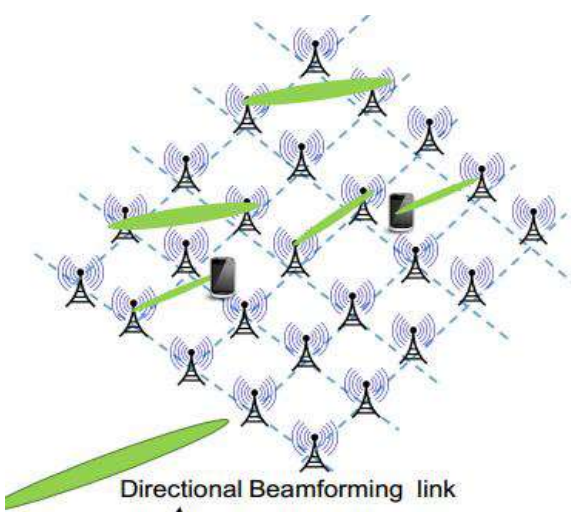

Fig.2: standalone 5g system

The other probability is to use standalone 5G systems with mm-waves for both control information and users' communications as show in" Figure1. 2 standalone 5g system", and this way is much better because using narrow beams allows to have more acceptable spectrum overlap and improves the connection quality between BS grids and users Using mm-wave demands small antenna sizes, scientists think that using directional array antennas help control phase and amplitude of signals, and enhance the signal waves in desired direction, while cancelling in other directions, [15] Which lead them to use adaptive beam forming techniques like SDMA (spatial division multiple access).SDMA improves frequency reuse for beam forming antennas at both transmitter and receiver.

2. SMART ANTENNA

Smart antennas are expected to reduce interference, get an optimal coverage area, lower the transmitted power, obtain location information on all subscribers, trace them automatically, and increase the capacity of the system.

The design of antenna used in 5G networks is essential, and scientists expect that effective antenna arrays is the most suitable design, because this design exploits the advantages of change [5] in air interface. These smart antennas -depending on SDMA capabilities- help in increasing the SNIR of the received signals so that the number of users can increase, and reducing the power dissipated by the BS and the most important thing that they help to mitigate the interference whereas smart antennas allow traditional channels, such as FDMA, TDMA, or CDMA channels, to be simultaneously shared by several users who are located at different spatial orientations. This technique is referred to as the Spatial Division Multi Access (SDMA) technique. Consequently, the system capacity increases greatly

D2D Communication

D2D communication in cellular networks is defined as direct communication between two mobile users without traversing the Base Station (BS) or core network. D2D communication is generally non-transparent to the cellular network and it can [21] occur on the cellular spectrum or unlicensed spectrum.

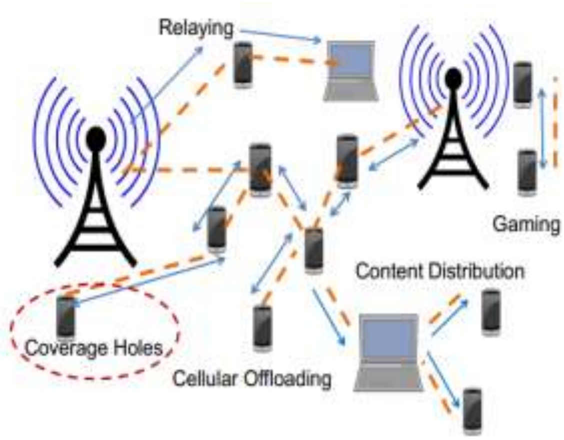

Fig.3: D2D communications

In a traditional cellular network, all communications must go through the BS even if both communicating parties are in range for D2D communication, whereas mobile users nowadays use high data rate services (video sharing, gaming, etc.). So D2D communications could be the best solution for such scenarios because they can highly increase the spectral efficiency of the network, in addition to improving throughput, energy efficiency, and delay.

D2D communication in cellular networks is defined as a method of creating direct communication link between two mobile users without traversing the Base Station (BS) or core network. It may appear invisible to cellular network. This communication can occur over licensed cellular spectrum or unlicensed spectrum depending upon demand and need. When it occurs over licensed cellular spectrum it is called in-band D2D and otherwise out-bands D2D. Today's cellular traffic is not just confined to voice and simple text; it includes sharing videos, online gaming, social networking, etc.

3. RESULTS

Signal-to-interference cumulative density function with respect to SINR threshold value. In our analysis we will range our SINR threshold value from20 dB to 15 dB. Here we have plotted the SINRCDF variation for two different values of D2D user density. Red line represents the SINRCDF when number of D2D users' density is equal to cellular users around a given BS. Blue line represents SINRCDF when D2D users' density is four times that of cellular user in that given BS area. The nature obtained here is monotonically increasing, but this increase is not uniform over the entire range. The lower portion of the curve, i.e. from -20 dB to -10 dB, increases at a lower rate while the middle section ranging from -10 dB to 10 dB increases with considerable rate.

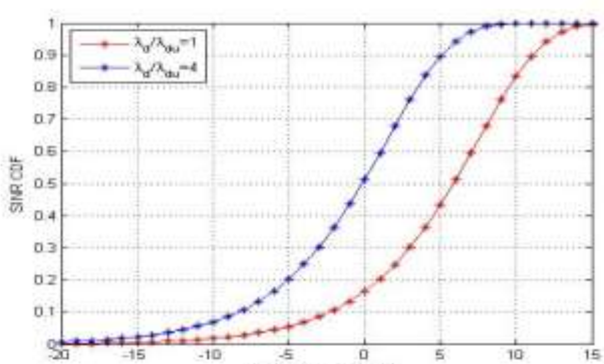

Fig.4: SINR CDF Versus SINR Threshold β

The reason for such behaviour lies in the fact that, when D2D users' density is equal to cellular users' density, distance between corresponding D2D transmitter and receiver is more which results in small amount of received signal strength at D2D receiver. Thus signal strength is less as compared to cumulative interference received at this receiver from all other D2D transmitters. When SINR threshold is increased from -20 dB to -10 dB, the SINR ratio will be very small. This ratio will increase as we increase the SINR threshold, and the SINR-CDF will increase at a greater rate.

The increase in SINR-CDF can be made more is we increase the D2D users' density. With increase in D2D users' density, distance between nearest D2D transmitter and its intendant receiver will decrease, which will eventually increase the strength of the received signal at receiver. The interference term will also increase, but its rate of increase will be less. Increase in SINR threshold will also favor the increase of SINR-CDF. Illustrates the variation of outage probability of D2D user against the SINR threshold. The nature of the variation is increasing, but this increase is not same over the entire SINR threshold range. Outage probability increases at a slow rate over -25 dB to -5 dB for D2D pair distance (d_0) of 5m, -25 dB to -10 dB for d_0=10m, and -25 dB to -15 dB for d_0=20m. Thereafter outage probability increases at a greater rate.

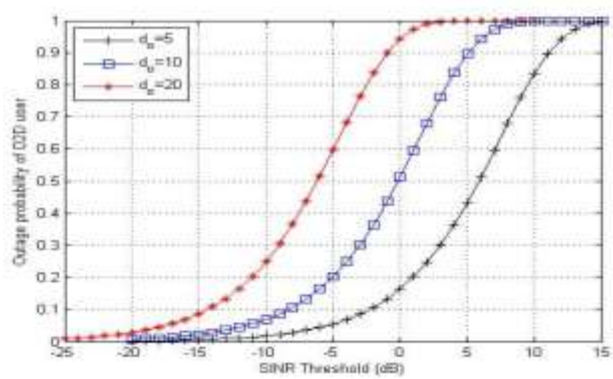

Fig.5: Outage probability of D2D user Versus SINR-Threshold β .

The reason for such nature is as follow. When D2D pair distance (d_0)=5m, the signal strength received at the D2D receiver is good enough, therefore the outage probability is small, but it increases when SINR threshold is increased. This increase of outage is due to reason that as SINR threshold is increased, more signal strength is required at receiver for successful decoding and estimation of signal, which eventually will result in lesser number of D2D pairs. But as we increase d0, signal strength received at D2D receiver will decrease, and outage probability increases. This increases is also favored by increase in SINR threshold, will results in increased outage probability.

4. CONCLUSION

Here we looked into the performance of a UAV that acts as a flying base station in an area in which users are capable of D2D communication. We have considered two types of users in the network: the downlink users served by the UAV and D2D users that communicate directly with one another. We have derived coverage probability, outage probability and system sum rate for D2D communication. Analyzing system sum rate was our sole purpose. The results have shown that SINRCDF and outage probability of D2D users increases with increase in SINR threshold. Outage probability increase even with $_{d}$= $_{du}$ ratio. Finally we have shown that our D2D system sum rate can be increased with SINR-threshold and D2D user density. This increase in D2D users system sum rate decreases if both SINR-threshold and $_{d}$ are in-creased beyond a range. Hence maximum value is attained over a small range of and $_{d}$ and this is where a tradeoff is made.

REFERENCES

[1] Cisco, Cisco Visual Networking Index: Global Mobile Data Tra c Forecast Update, 2015-2020, 2016.

[2] Huawei, The full spectrum of possibilities meeting future demand for commercial mobile broadband services in europe, 2013.

[3] [Online], "http://eng-cs.syr.edu/college-news/going direct communication in a device to device network," 2016.

[4] [Online], http://www.tsdsi.org/media/meeting/ 2015-07-22/d2d tsdsi f2f bangalore july 2015 v1 .pdf," 2016.

[5] J. G. Andrews, H. Claussen, M. Dohler, S. Rangan, and M. C. Reed, "Femtocells: Past, present, and future," IEEE Journal on Selected Areas in Communications, vol. 30,497–508, April 2012.

[6] C. h. Lee and M. Haenggi, "Interference and outage in poisson cognitive networks," IEEE Transactions on Wireless Communications, vol. 11, pp. 1392–1401, April 2012.

[7] G. Ding, J. Wang, Q. Wu, Y. D. Yao, F. Song, and T. A. Tsiftsis, "Cellular-base-station-assisted device-to-device communications in tv white space," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 107–121, Jan 2016.

[8] K. Doppler, M. Rinne, C. Wijting, C. B. Ribeiro, and K. Hugl, "Device-to-device communication as an underlay to lte-advanced networks," IEEE Communications Magazine, vol. 47, pp. 42–49, Dec 2009.

[9] J. Liu, N. Kato, J. Ma, and N. Kadowaki, "Device-to-device communication in lte-advanced networks: A survey," IEEE Communications Surveys Tutorials, vol. 17,1923–1940, Fourthquarter 2015.

[10] L. Wei, R. Q. Hu, Y. Qian, and G. Wu, "Energy efficiency and spectrum efficiency of multihop device-to-device communications underlaying cellular networks," IEEE Trans-actions on Vehicular Technology, vol. 65, pp. 367–380, Jan 2016.

[11] Z. Wu, V. D. Park, and J. Li, "Enabling device to device broadcast for lte cellular networks," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 58–70, Jan 2016.

[12] M. Sheng, Y. Li, X. Wang, J. Li, and Y. Shi, "Energy efficiency and delay tradeoff in device-to-device communications underlaying cellular networks," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 92–106, Jan 2016.

[13] X. Ma, J. Liu, and H. Jiang, "Resource allocation for heterogeneous applications with device-to-device communication underlaying cellular networks," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 15–26, Jan 2016.

[14] J. Jiang, S. Zhang, B. Li, and B. Li, "Maximized cellular traffic offloading via device-to-device content sharing," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 82–91, Jan 2016.

[15] E. Zihan, K. W. Choi, and D. I. Kim, "Distributed random access scheme for collision avoidance in cellular device-to-device communication," IEEE Transactions on Wireless Communications, vol. 14, pp. 3571–3585, July 2015.

[16] M. Ni, J. Pan, and L. Cai, "Geometrical-based throughput analysis of device-to-device communications in a sector-partitioned cell," IEEE Transactions on Wireless Communications, vol. 14, pp. 2232–2244, April 2015.

[17] M. Ni, J. Pan, and L. Cai, "Power emission density-based interference analysis for ran-dom wireless networks," in 2014 IEEE International Conference on Communications (ICC), pp. 440–445, June 2014.

[18] X. Xu, H. Wang, H. Feng, and C. Xing, "Analysis of device-to-device communications with exclusion regions underlaying 5g networks," Transactions on Emerging Telecommunications Technologies, vol. 26, no. 1, pp. 93–101, 2015.

[19] Y. Li, D. Jin, P. Hui, and Z. Han, "Optimal base station scheduling for device-to-device communication underlaying cellular networks,"

IEEE Journal on Selected Areas in Communications, vol. 34, pp. 27–40, Jan 2016.

[20] X. Y. Li, J. Li, W. Liu, Y. Zhang, and H. S. Shan, "Group-sparse-based joint power and resource block allocation design of hybrid device-to-device and lte-advanced networks,"IEEE Journal on Selected Areas in Communications, vol. 34, pp. 41–57, Jan 2016.

[21] W. Cheng, X. Zhang, and H. Zhang, "Optimal power allocation with statistical qos provisioning for d2d and cellular communications over underlaying wireless networks," IEEE Journal on Selected Areas in Communications, vol. 34, pp. 151–162, Jan 2016.