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Device-To-Device 5G Next Generation Wireless Communication System

Pradhyumna Verma[1] and Prof. Abhirup Sinha[2]
Department of Electronics & Communication, Radharaman Institute of Technology & Science, Bhopal (M.P.)[1,2]

Abstract: *Device-To-Device 5GNext Generation Wireless Communication System the network capacity for meeting the growing demands of the subscribers has led to the evolution of cellular communication networks from the first generation (1G) to the fifth generation (5G). There will be billions of connected devices in the near future. Such a large number of connections are expected to be heterogeneous in nature, demanding higher data rates, lesser delays, enhanced system capacity and superior throughput. The available spectrum resources are limited and need to be flexibly used by the mobile network with the rising demands. An emerging facilitator of the upcoming high data rate demanding next generation networks (NGNs) is device-to-device (D2D) communication. An extensive survey on device-to-device (D2D) communication has been presented in this paper, including the plus points it offers; the key open issues associated with it like peer discovery, resource allocation etc, demanding special attention of the research community; some of its integrant technologies like millimeter wave D2D (mmWave), ultra-dense networks (UDNs), cognitive D2D, handover procedure in D2D and its numerous use cases. Architecture is suggested aiming to fulfill all the subscriber demands in an optimal manner. The Appendix mentions some ongoing standardization activities and research projects of D2D communication.*

Keywords: *Mobile network discovery, ultra dense networks (UDNs), millimeter wave (mmWave), next generation networks (NGNs), device-to-device(D2D) communication.*

1. Introduction

Today the number of hand-held devices is drastically increasing, with a rising demand for higher data rate applications. In order to meet the needs of the next generation applications, the present data rates need a refinement. The fifth generation (5G) networks are expected and will have to fulfill these rising demands. A competent technology of the next generation networks (NGNs) is Deviceto-Device (D2D) Communication, which is expected to play an indispensable role in the approaching era of wireless communication. The use of D2D communication did not gain much importance in the previous generations of wireless communication, but in 5G networks, it is expected to be a vital part. The rising trends [1] pave way for this emerging technology. With the introduction of device-to-device (D2D) communication, direct transmission between devices is possible. This is expected to improve the reliability of the link Voice over IP (Voice over Internet Protocol or "VoIP") technology converts voice calls from analog to digital to be sent over digital data networks[1]. This allows the university to use its existing data network (which includes fiber and copper wiring between and within buildings, and Cisco routers and switches) to also transport telephone service throughout the campus. By offering Voice over IP (or VoIP), UofL is moving toward a "converged" network, where voice, data, and video all travel along the UofL gigabit network Voice over IP (VOIP), otherwise known as IP telephony, is the delivery of voice information over Internet Protocol (IP) packet switched networks. This means sending voice information in digital form in discrete[4] packets rather than in the traditional circuit-committed protocols of the public switched telephone network (PSTN). A major advantage of VOIP is that it can avoid the tolls charged by ordinary telephone service by utilising fixed charge IP network services such as broadband. Recent development with SIP (see below) technology and hardware supporting this standard has resulted in the production of a number of commercially marketed SIP handsets, both wired and wireless networks, removing the need for a PC or laptop running a software handset, or “soft phone”, to connect to VOIP services. A subscription to a local server from a SIP handset or soft phone provides you with all the normal telephony features including voice and fax, as well as text and even video services. VOIP networks are becoming an ever increasing part of the office and home network with many brands now producing reasonably priced VOIP equipment and phones. Software phones have also become much more flexible with support for the many codecs[6] (compressor/decompressors) available to perform video as well as voice data encoding compatible with standard computer equipment such as soundcards and webcams. With the recent spread of wireless network coverage across the country it is now possible to buy 802.11b wireless SIP phones, enabling users to roam freely within a wireless network such as within a company. Other mobile technologies such as Mobile-IPv6 have also been developed enabling user to roam different IPv6 supported networks whilst maintaining the same home location IP address.

2. Gateways and Telephone Numbers

In the literature available on D2D communication is presented as Inband D2D and Outband D2D. This survey, on the other hand, draws upon the growing need for switching towards the device-to-device (D2D) technology. Architecture for device to-device (D2D) communication has been proposed, which clearly depicts the scenario of the next generation networks (NGNs) and is the prime focus of this survey. It aims to aid the cellular networks in near future by allocating resources optimally to the D2D users in the network and the cellular users as well, with the use of sectored antennas at the base station (BS). Such architecture has the potential to efficiently serve the rising demands of the subscribers and meet the requirements of the network operators. Additionally, a mathematical analysis has been discussed, which is the basis of any resource allocation technique, for analyzing network throughput. Number of features can be integrated with D2D communication, to enhance its utility in existing cellular systems. These have been discussed in this survey. A number of challenges exist, pertaining to the implementation of device-to-device (D2D) communication. Few important algorithms in relation to these issues have been discussed. Thus, focus of this survey is to brief about different aspects of D2D communication. For many VoIP applications such as voice communications among the players of a computer game, there is no need for connections to the traditional telephone network. But VoIP applications that provide telephone service need the ability to connect to[8] the existing public switched telephone network (PSTN). The connecting points, which allow traffic to flow between the VoIP network and the PSTN, are called gateways. Gateways allow VoIP telephones to receive calls dialed to telephone numbers and permit VoIP telephones to place calls to traditional telephones. That is, a gateway permits a telephone number to be associated with a specific VoIP user. Gateway service is not a built-in element of Internet service.

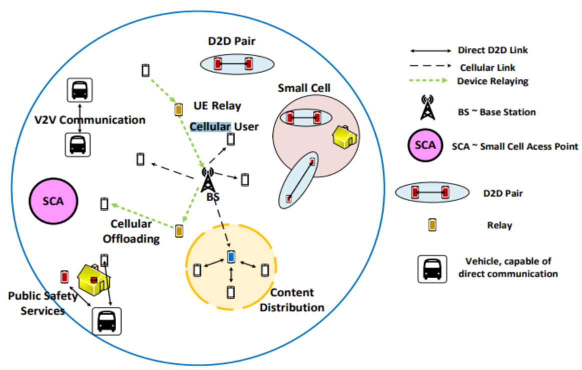

Fig.1 Basic Element of Satellite Communication

3. Benefits of VoIP

- The VoIP system offers UofL many benefits as a replacement for its current telephone technology: VoIP uses a single communications network for both telephones and computers instead of the separate phone and computer networks that are prevalent today.
- VoIP uses programmable sets that provide new features, applications and capabilities such as allowing the university to quickly relay alerts or messages to all locations.
- VoIP makes it easy to administer the system and individual features can be configured through a simple web interface.
- The IP phones can access the university phone directory, allowing users to find the most up-to-date telephone numbers right on their phones.

- Using VoIP positions the university for future technologies and future needs of students, faculty, and staff.

Users will be able to store a Personal Address Book and Fast Dial list, either using a Web interface or through manually entering information on the IP phone set. The speakerphones can be used in emergencies as a Public Address system. The 3rd Generation Partnership Project (3GPP) is a joint venture by a group of[10] telecommunication associations known as “Organizational Partners” which standardizes radio, core network and service architecture.

The structure of standards is organized in which[9] may incorporate hundreds of individual documents, the first specification of third generation of mobile network was maturation of Global System for Mobile communication (GSM) and development of new radio access network.[2] Later releases included technologies based on efficient transport of packet based information networks e.g. High Speed Packet Access (HSPA), however the emergence of new applications required access to multimedia services with high data rate such as games, voice, music and video in cellular networks. The performance [1]of technologies developed until Release 7 was inadequate for such applications. To fulfill the requirements of wireless data transmission, development of novel transmission system was expected. Therefore Long Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX) started to develop as 4th generation mobile technologies.[15] WiMAX specified as IEEE 802.16 standard which require completely new network setup to comply with existing mobile networks (e.g. GSM, UMTS).

The Long Term Evolution (LTE) specifications were first specified in Release 8. Both LTE and WiMAX are evolving technologies and have been considered as a part of 4th generation mobile networks. [3] According to 3GPP Release 8, the key features of LTE are to achieve 100Mbps downlink peak data rate and 50 Mbps in uplink with a 20 MHz bandwidth, support mobility up to 350 km/h. It is completely packet based system. Unlike WiMAX, LTE can have coexistence with previous technologies thus reduced complexity and cost.

4. Results

The variation of 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 value of D2D user density. Red line represents the SINRCDF when number of D2D users’ density are 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.The performance of the Proposed algorithm will be evaluated and compared with traditional scheduling algorithms Proportional Fair (PF), Round Robin (RR) and Best CQI (B-CQI) in both normal (no DRX) mode and power saving (DRX Light Sleep) mode. These schedulers are described in detail in. The evaluation and comparison is done in same simulation environment and parameter. For QoS satisfaction, criteria defined in LTE QCI for RT and NRT traffic must be fulfilled. Evaluation will be done on key performance evaluation parameters; System Throughput, Throughput Fairness Index, Packet Delay and Packet Loss Rate. Before presenting the results it is better to define these performance evaluation parameters.

System Throughput (Downlink): It is the accumulated data rates of all the users in bits/s. For this study work only downlink traffic is considered.

Throughput Fairness Index: Fairness can be defined in terms of resource allocation or throughput. One of the requirements for schedulers is to provide similar throughputs to all the users irrespective to their location and channel conditions. Jain’s equation is used to obtain throughput fairness index. It is defined as,

Packet Delay: It is difference in time when a packet is created and when user acknowledges that packet.

The random binary the varying data rate. Scatter plots of the received signal before and after equalization. From the plot of the equalized signal, you can tell which modulation type the system is currently using, because the plot resembles a signal constellation of 2, 4, 16, or 64 points. The power spectrum of the received signal before and after equalization, in dB. The dynamics of the signal's spectrum before equalization depend on the Fading mode parameter in the Multipath Channel block. The estimate of the SNR based on the error vector magnitude.

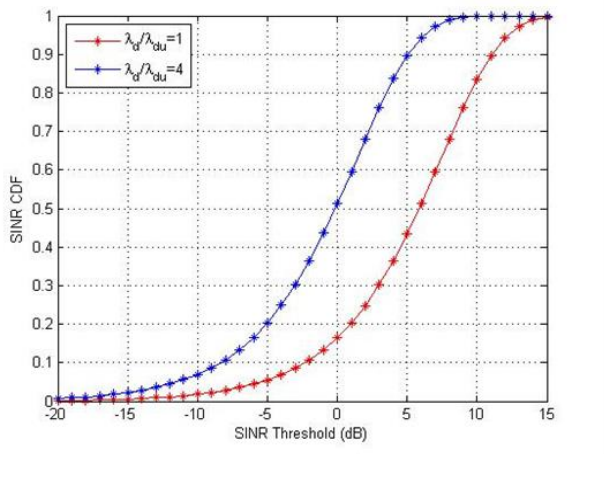

Fig.2 Results for SINR CDF Versus SINR Threshold β

The bit rate of the transmission, the bit error rate per packet, for most packets, the BER is zero. Because this plot uses a logarithmic scale for the vertical axis, BER values of zero do not appear in the plot. The following blocks display numerical results: The PER block shows the packet error rate as a percentage. The SNR block at the top level of the model shows an estimate of the SNR based on the error vector magnitude. The SNR block in the Multipath Channel subsystem shows the SNR based on the received signal power. The Bit Rate block shows which of the bit rates specified in the standard is currently in use.

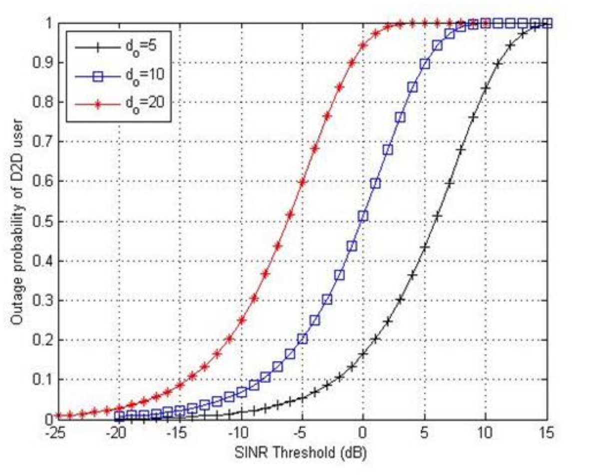

Fig.3 Outage probability

We evaluate the performances of STBC and SFBC with ML decoder at the speed of 30kmph in ITU vehicular B channel. As the solid lines in Figure show, being contrary to STBC that achieves satisfactory performance, SFBC suffers from severe ISI so that it's PER performance presents an error floor. In the channel with large delay spread, the performance degradation of SFBC mainly comes from the ISI due to the frequency selectivity of the channel in a code block. Again, the residual ISI of MMSE decoder results in nearly 32 dB performance degradation of STBC.

5. Conclusion and Future Work

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. Proposed Scheme with traditional schemes according to different QoS attributes through simulations. The Proposed Scheme is evaluated in normal operation mode and power saving mode and the impact of power saving on QoS is also examined

In normal operation mode, It is observable that B-CQI has higher system throughput in as compared to all other schedulers with cost of fairness among users, because it only serves those users which have good channel quality. PF scheduler performs second best in this regard, it tries to balance system throughput with fairness

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