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PERFORMANCE ANALYSIS FOR TCP PROTOCOLS OVER MM WAVE IN 5G CELLULAR NETWORKS

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ABSTRACT

5G technologies are expected to connect people, objects, data, applications, transport systems, and cities in intelligent networked communication environments. An enormous amount of data should move much faster, reliably deliver too many devices, and handle very large amounts of data with minimal delay. However, the performance will be required TCP protocols to effectively utilize the large air link capacity and provide the end-to-end performance required by future networks and mmWave (Millimeter Wave) technology. In this paper, the implemented framework of mmWave modeling has been analyzed using ns-3 simulator. The framework is demonstrated through several simulation scenarios to analyze the performance of TCP protocols over mmWave using three main performance measurements, which are Round Trip Time (RTT), Congestion Window size (CWnd) and Throughput. The achieved results show that it would provide internet connections 40 times faster. The coverage four times more worldwide than the current 4G.

INTRODUCTION

Recent years have witnessed exponential growth in mobile data and traffic due to, e.g., ever increasing use of smart phones, portable devices, and data-hungry multimedia applications. According to the UMTS traffic forecasts, 1000 fold increase in mobile data traffic is predicted by the year 2020 [1]. In another estimate, more than 50 billion devices may be connected wirelessly by 2020 which may cause a capacity crisis [2]. Limited available spectrum in microwave (µWave) bands does not seem to be capable of meeting this demand in the near future, motivating the move to new frequency bands. Therefore, the large available bandwidth at millimeter wave (mmWave) frequency bands, between 30 and 300 GHz, becomes a good candidate for the fifth generation (5G) cellular networks and has attracted considerable attention recently [3] – [8].

Despite the great potential of mmWave bands, they have been considered attrac- tive only for short range- indoor communication due to increase in free-space pathloss with increasing frequency, and poor penetration through solid materials such as concrete and brick. However, these high frequencies may also be used for outdoor communication over a transmission range of about 150-200 meters as demonstrated by recent channel measurements. Also, comparable coverage area and much higher data rates than µWave networks can be achieved provided that the base station density is sufficiently high and highly directional antennas are used [9]. Withthe employment of directional antennas, mmWave cellular networks can be considered as noise-limited rather than interference-limited.

LITERATURE REVIEW

The first wireless networks, by means of smoke signals, flashing mirrors, or semaphore flags, etc., were developed long before industrial revolution. More than one hundred and twenty years ago, Guglielmo Marconi demonstrated the first radio transmission, in mid 1890s, andera of radio communication started[21],[22]. Since then, wireless communications have evolved continually, and new methods and systems were introduced. A new era of wireless communication was born in the 1960s and 1970’s after the introduction of cellular concept, and advancement in radio frequency hardware [22].

Today, wireless communication is the fastest growing engineering field with its wide spread applications prevailed in all aspects of 21stcentury humankind life. According to T.S. Rappaport et al. in [4], since the new era and the beginning of 1980, every 10 years has witnessed a new generation of wireless communication systems with more advanced technology in terms of data rate, spectrum efficiency, coverage and applications.

Although early wireless Local Area Networks (LANs) could not compete with wired Ethernet technology, the most successful application of wireless communication has been the cellular systems [21].The 1stgeneration (1G) cellular was announced at the beginning of 1980’s, which was an analog system with a few kbps data ratesand a lot of disadvantages. In 1993, the 2ndgeneration (2G) was introduced, which is a digital technology mainly used for voice communication and new capabilities such as roaming and Short Message Service (SMS) and with a bit rate of upto64kbps.Global System for Mobile communications(GSM) and Code Division Multiple Access (CDMA) and IS-95, were the famous technologies of 2G [10].The data rate was improved by introducing upgrades into 2G, such as General Packet Radio Service (GPRS) and Enhanced Data Rate for GSM Evolution (EDGE) to 144kbps and 384kbps respectively[10].

The 3rdgeneration was introduced in 2000 with new technologies and features. The initial transmission rate was 2Mbps which was improved up to 30Mbps as the evolving technologies such as High-Speed Uplink/Downlink Packet Access (HSUPA/HSDP) were added to the network[10].The 3rdGeneration Project Partnership (3GPP) introduced Long Term Evolution (LTE) technology as the descendant of previous cellular generations which is considered as 4G and was followed by LTE-Advanced with even higher bit rate. The higher bit rate compared to 2G and 3G,and new applications such as Multimedia Messaging Service (MMS), Digital Video Broadcasting (DVB) and High Divination (HD) mobile TV are among the features 4G operators offer to the subscribers[10].

EXISTING SYSTEM

Energy Efficiency in Relay-Assisted Millimeter Wave Cellular Networks

In this chapter, energy efficiency of relay-assisted mmWave cellular networks with RTT distributed BSs and relay stations (RSs) is analyzed using tools from stochasticgeometry. The distinguishing features of mmWave communications such as directional beamforming and having different path loss laws for LOS and NLOS links are incorporated into the energy efficiency analysis. Following the description of the sys- tem model for mmWave cellular networks, coverage probabilities are computed for each link. Subsequently, average power consumption of BSs and RSs are modeledand energy efficiency is determined in terms of system parameters. Energy efficiencyin the presence of beamforming alignment errors is also investigated to get insight on the performance in practical scenarios. Finally, the impact of BS and RS densities,antenna gains, main lobe beam widths, LOS interference range, and alignment errors on the energy efficiency is analyzed via numerical results.

PROPOSED SYSTEM

Coverage in Millimeter Wave in 5GCellular Networks

In this chapter, we provide an analytical framework to analyze heterogeneous down-link mmWave cellular networks consisting of K tiers of randomly located BSs where each tier operates in a mmWave frequency band. Signal-to-interference-plus-noise ratio (SINR) coverage probability is derived for the entire network using tools from stochastic geometry. The distinguishing features of mmWave communications suchas directional beamforming and having different path loss laws for LOS and NLOS links are incorporated into the coverage analysis by assuming averaged biased-received power association and Nakagami fading. By using the noise-limited assumption for mmWave networks, a simpler expression requiring the computation of only one numerical integral for coverage probability is obtained. Also, effect of beamforming alignment errors on the coverage probability analysis is investigated to get insight onthe performance in practical scenarios. Downlink rate coverage probability is derivedas well to get more insights on the performance of the network. Moreover, effect of deploying low-power smaller cells and the impact of biasing factor on energy efficiencyis analyzed. Finally, a hybrid cellular network operating in both mmWave and µWavefrequency bands is addressed.

Several recent studies have also addressed heterogeneous mmWave cellular net- works. In [53], authors consider two different types of heterogeneity in mmWave cellular networks: spectrum heterogeneity and deployment heterogeneity. In spectrum heterogeneity, mmWave UEs may use higher frequencies for data communication while the lower frequencies are exploited for control message exchange. Regarding deployment heterogeneity, two deployment scenarios are introduced. In the stand- alone scenario, all tiers will be operating in mmWave frequency bands, while in the integrated scenario, µWave network coexists with mmWave networks. A similar hybrid cellular network scenario is considered in [10] for characterizing uplink-downlink coverage and rate distribution of self-backhauled mmWave cellular networks, and in [54] for the analysis of downlink-uplink decoupling. In both papers, mmWave small cells are opportunistically used and UEs are offloaded to the µWave network when itis not possible to establish a mmWave connection. In [55], a hybrid spectrum access scheme (where exclusive access is used at frequencies in the 20/30 GHz range whilespectrum sharing is used at frequencies around 70 GHz) is considered to harvest themaximum benefit from emerging mmWave technologies. A more general mathematical framework to analyze the multi-tier mmWave cellular networks is provided in [13]. In [56], benefits of BS cooperation in the downlink of a heterogeneous mmWavecellular system are analyzed. Contrary to the hybrid scenario, each tier is assumed tooperate in a mmWave frequency band in both [13] and [56]. Similarly, in this chapterwe consider a cellular network operating exclusively with mmWave cells, while, as wedemonstrate in Section 4.4.3, an extension to a hybrid scenario can be addressed anda similar analytical framework can be employed by eliminating the unique propertiesof mmWave transmissions in the analysis of the µWave tier.

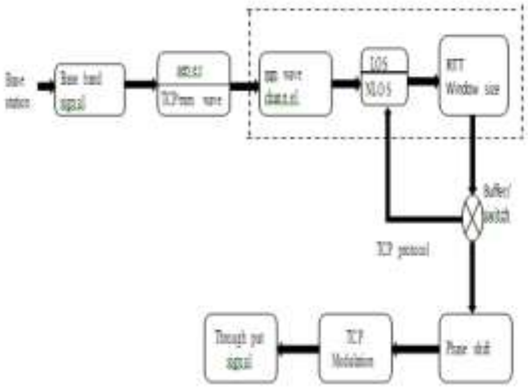

Fig.1: Block Diagram

Nowadays, the world has seen an accelerated race to develop (5G) networks, which will succeed the current (3G) and (4G) networks. The 5G is the latest cellular technology till date It is the set of modern technical rules that define how a cellular network works, including the frequencies used. The 5G Provides High speed data transfer, which ranges from 1-10Gbps.

The base station is responsible for maintaining communication between the network and the users, and also among users. and the signal here is either low frequency or high frequency signal so we define it is a baseband signal. Here the entire block diagram is categorised into two parts.where in the first case gets the performance output from the mm wave directly and in the second case analysing the performance for TCP protocol over mmwave through a feedback switch. The

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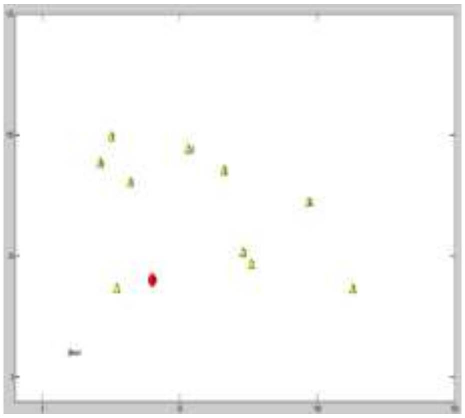
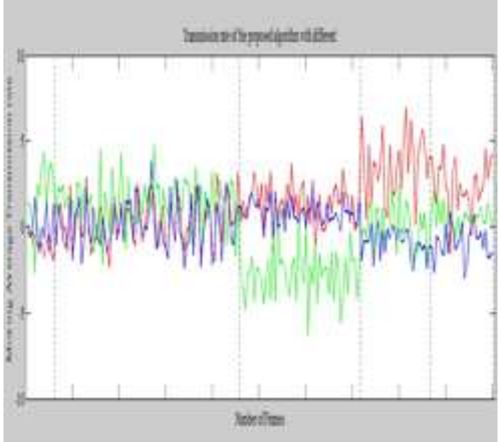
mmwave passes its signal through it’s channel.

Line of sight (LOS) is the imaginary line between basestation and the target (end user).The performance is basically analysed using three parameters RTT,CWND,Throughput. RTT(round trip time) basically defines the range in which the user is. CWND(congestion window size) says the number of active users in that particular range. Throughput refers to the rate at which data is successfully transmitted between the sender and receiver. To improve the performance we are using tcp protocol as a feedback switch via Non Line of sight(NLOS) .It propagates the information sharing directly between the users without the help of basestation.

SIMULATION RESULTS





CONCLUSION

In this paper, introduced the designing an end-to-end mmWave module to analyze the performance of TCP through increasing the data rate and decreasing latency not only inside the PHY and MAC layers but also in mmWave TCP protocols. To achieve the design end-to-end mmWave module, the simulation used LENA mmWave module for matlab. This module is the first open source framework that allows the simulate end-to-end performance of 5G mmWave networks. The structure of the classes is based on the ns-3 LTE module, which is implemented with an interface paradigm. Two scenarios 3and 6buildings are used in this paper, these scenarios have been applied to the analysis of the performance of TCP flows over a mmWave link even to get the same parameter measurements RTT, CWnd and throughput results for these scenarios.

FUTURE SCOPE

As an extension, our future work will investigate other mmWave propagation scenarios such as Outdoor-to-Indoor (O2I) and penetration into buildings which poses other challenges towards deployment of mmWave in the 5G and beyond wireless networks. Also, we will focus on the directional transmissions at mmWave frequencies employing massive antenna arrays, to study and propose efficient beamforming techniques mitigating directional propagation loss. This leads to consider time-efficient beam training techniques for estimation of channel state information at mmWaves with narrower beams and with high directionality as well. In this regard, our future work focus will be on consideration of innovative algorithms for channel estimation in designing hybrid beamforming as a promising architecture for future mmWave mobile communications.

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