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A APPROXIMATE GEOMETRY ANALYSIS OF DUAL CONNECTIVITY AND SPECTRUM SENSING IN HETEROGENEOUS WIRELESS NETWORKS

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Abstract:

The shared aid get entry to wi-fi communique device is regarded as an efficient paradigm that lets in the cellular network operators (MNOs) to have extended coverage and fulfill their subscribers' excessive capability demands at the same time as keeping the capital and operational expenditure in take a look at. On the alternative hand, twin connectivity (DC), a small cell enhancement function, permits the subscribers to have simultaneous connections increasing throughput and enhancing mobility robustness. The coordinated multipoint (CoMP) transmission/reception and consumer centric virtual cell (VC) improve the sign excellent and overall performance. For all of those mechanisms, the consumer desires to be beneath the coverage of more than one base stations (BSs) concurrently. Because of random nature of the wi-fi hyperlinks and distribution of BSs in a community, the practicability/operability of DC and CoMP/VC for an ordinary user below such random operating situations (each topological and wireless link randomness) desires to be thoroughly evaluated. In this mission, we take an intensive study this hassle exploiting tools from Poisson point manner principle and stochastic geometry and derive smooth-to-compare tractable indispensable expressions for crucial overall performance metrics along with DC and CoMP/VC insurance opportunity of a typical consumer in downlink cell. We verify the analytical analysis with simulation consequences.

Index Terms— ***Mobile Network operators, Dual connectivity, coordinated multipoint and virtual cell , poission point theory, stochastic geometry.***

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I. INTRODUCTION

To preserve up with the ever-growing facts desires and to supply clients with closing information revel in, the carrier providers or mobile community operators (MNOs) face intense challenges due to the constraints which include complicated creation requirements, scarcity and

really excessive price of the licensed frequency spectrum and unmarried possession of the community. Nowadays, work and observe aren't anymore constrained to an area, and the connections need to be operating efficaciously in urban regions in addition to in rural regions or in moderation populated regions. The fee of extending insurance to far off and sparsely populated areas might not substantiate the payoff for enriched offerings because of a small customer base.

Furthermore, in-site/constructing cell coverage is regularly referred as the fourth utility, and it is integral for a modern-day commercial web site and enterprise. The cost, as well as the call for of business and residential real estates, will increase after they have in-building cellular insurance and capacity. On the other hand, the operational, control, optimization and preservation efficiency of business web sites can be progressed with the help of wi-fi connectivity. The MNOs come upon important issue in getting access to the privately owned spaces, along with, port, mining web page, enterprise building, shopping mall, stadiums, and many others., which may additionally mandate single community deployment and do no longer allow multiple impartial networks operated by way of one-of-a-kind MNOs. The MNOs have confined pool of price range this is to be reserved for high-precedence clients. Note that the closing issue of an MNO is minimizing the capital expenditure and operational expenditure while they expand their insurance and provide excessive throughput to their subscribers.

Network Concept

In a cellular radio device, a land location to be provided with radio carrier is divided into cells in a sample depending on terrain and reception traits. These cellular styles more or less take the shape of normal shapes, including hexagons, squares, or circles even though hexagonal cells are traditional. Each of those cells is assigned with a couple of frequencies (f1 – f6) that have corresponding radio base stations. The group of frequencies can be reused in other cells, furnished that the equal frequencies are not reused in adjoining cells, which would motive co-channel interference.

The multiplied potential in a cellular network, in comparison with a community with a unmarried transmitter, comes from the cellular communique switching machine evolved by using Amos Joel of Bell Labs[4] that accredited multiple callers in a given location to use the identical frequency with the aid of switching calls to the closest to be had cellular tower having that frequency available. This strategy is possible because a given radio frequency may be reused in a distinctive location for an unrelated transmission. In assessment, a unmarried transmitter can handiest manage one transmission for a given frequency. Inevitably, there may be some degree of interference from the sign from the other cells which use the equal frequency. Consequently, there should be as a minimum one cell gap among cells which reuse the same frequency in a standard FDMA gadget.

Consider the case of a taxi company, wherein each radio has a operated by hand channel selector knob to track to one-of-a-kind frequencies. As drivers move round, they change from channel to channel. The drivers are aware of which frequency about covers some location. When they do not acquire a sign from the transmitter, they are attempting other channels until finding one that works. The taxi drivers only talk one by one when invited by the base station operator. This is a form of time-division more than one access (TDMA).

Cell Signal Encoding

To distinguish alerts from numerous extraordinary transmitters, time-department a couple of get admission to (TDMA), frequency-department multiple get right of entry to (FDMA), code-department a couple of get admission to (CDMA), and orthogonal frequency-division multiple get right of entry to (OFDMA) have been advanced.

With TDMA, the transmitting and receiving time slots used by distinct customers in every mobile are exclusive from every different. With FDMA, the transmitting and receiving frequencies utilized by exceptional users in each cell are distinctive from every other. In a simple taxi machine, the taxi motive force manually tuned to a frequency of a designated mobile to acquire a sturdy signal and to avoid interference from alerts from other cells.

The principle of CDMA is more complicated, however achieves the identical result; the dispensed transceivers can pick one cellular and concentrate to it. Other to be had methods of multiplexing together with polarization-division multiple get right of entry to (PDMA) cannot be used to separate signals from one cell to the subsequent since the results of both vary with position and this would make sign separation nearly impossible. TDMA is used in aggregate with either FDMA or CDMA in some of structures to give a couple of channels inside the insurance region of a unmarried cell.

Frequency Reuse

The key characteristic of a cellular network is the ability to re-use frequencies to increase both coverage and capacity. As described above, adjacent cells must use different frequencies; however, there is no problem with two cells sufficiently far apart operating on the same frequency, provided the masts and cellular network users' equipment do not transmit with too much power.

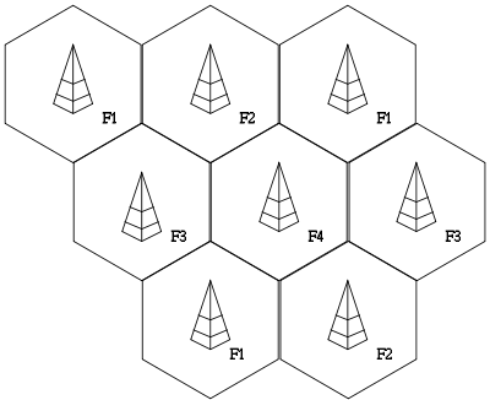


Fig. 1 Mobile Network

In case of N quarter antennas on the same base station site, every with one-of-a-kind course, the base station website online can serve N exceptional sectors. N is commonly three. A reuse sample of N/K denotes a in addition division in frequency among N sector antennas per website. Some contemporary and historical reuse patterns are three/7 (North American AMPS), 6/4 (Motorola NAMPS), and 3/4 (GSM). If the total to be had bandwidth is B, every mobile can best use a number of frequency channels similar to a bandwidth of B/K, and each region can use a bandwidth of B/NK.

Code-division multiple access-based structures use a much broader frequency band to obtain the equal charge of transmission as FDMA, however that is compensated for through the ability to apply a frequency reuse component of 1, as an instance using a reuse pattern of 1/1. In different phrases, adjoining base station sites use the same frequencies, and the distinct base stations and users

are separated with the aid of codes instead of frequencies. While N is proven as 1 in this case, that doesn't mean the CDMA cellular has best one region, but as an alternative that the whole mobile bandwidth is also to be had to each quarter in my opinion.

Depending on the dimensions of the metropolis, a taxi machine might not have any frequency-reuse in its very own metropolis, however surely, in other close by cities, the equal frequency may be used. In a massive town, then again, frequency-reuse ought to virtually be in use. Recently also orthogonal frequency-division more than one get entry to based structures inclusive of LTE are being deployed with a frequency reuse of 1. Since such systems do not unfold the sign across the frequency band, inter-cell radio useful resource control is critical to coordinate useful resource allocation among special mobile websites and to limit the inter-mobile interference. There are diverse way of Inter-Cell Interference Coordination (ICIC) already described in the popular. Coordinated scheduling, multi-web site MIMO or multi-web page beams forming are other examples for inter-cell radio resource control that is probably standardized in the destiny. The MNOs have customarily been unenthusiastic to proportion networks with other MNOs mainly due to uncertainties they apperceive regarding restrained network controllability, the chance of data leakage, marketing strategies, etc.,. Cooperation regarding sharing network resources takes location if widespread commercial advantages are predicted. Shared aid get entry to favours the MNOs to supply high capacity to their subscribers with extended insurance and provide get entry to to areas that mandate single network deployment at the same time as preserving the capital and operational spending contained. As a result, value-powerful deployment model is very pivotal for an MNO's potentiality to scale to satisfy the enormous capacity call for. Therefore, cooperative business fashions for shared aid get admission to communications empowering the MNOs with broader business gain while permitting them to compete with each other with personal advertising policy, are intensely fundamental.

II. RELATEDWORK

T. Bai, et.al,…[1] The existing research considered homogeneous and non-shared communication schemes, where the MNOs perform independently without sharing infrastructure and spectrum with different MNOs. On the other hand, although the machine taken into consideration as a heterogeneous network which include both macro cells and small cells, still operates independently. Consequently, the MNO have confined insurance or better overall fee of possession (TCO), and may not supply preferred capacity. In some cases, even though the spectrum to be had to the MNO isn't in use, it can not be utilized by different MNOs due to the non-sharing framework. For an MNO, insurance extension and building new mobile websites growth the TCO. However, with the shared resource access framework considered on this look at permits the MNOs to supply excessive capability wi-fi offerings with better usage of the available spectrum and lower TCO.

M.G. Kibria, et.al,…[2] In this paper, we conceive a sophisticated small cells wi-fi network deployment framework inside a controlled space beneath shared spectrum get right of entry to paradigm. We also conceive a complementary commercial enterprise model, known as neutral host micro operator (NH-µO), that leverages a single shared wi-fi infrastructure to jointly gain µO (a third birthday celebration service provider), the

owner of the distance/facility and cell network operators (MNOs). The model consists of a µO slice, which delivers a venue with custom designed wireless offerings tailored to the its nearby carrier requirements, and an MNO slice, which allows advanced wireless coverage to traffic/endusers with subscriptions to several distinct MNOs. The NHµO isn't always biased to desire any precise purchaser, which can be enforced through a concrete business settlement. A radio get entry to community cutting concept is exploited to aid and optimize both the slice instances (SIs) successfully in a shared way on a unmarried bodily community infrastructure. In addition, we devise an efficient architecture for the NH-µO small cell base station and dynamic spectrum undertaking manipulate unit, and their required functionalities assisting sustainable coexistence of various SIs in shared spectrum. We additionally devise each inter-SI and intra-SI dynamic spectrum allocation regulations thinking about time-various requirements of different SIs. These guidelines contend with utility stage priority by using presenting a right mixture of users with assured high-quality of service and first-rate-effort users, while making sure a wholesome SI opposition. The blessings of the proposed framework are -fold. It allows the venue owner to control its wireless networks and recollect its very unique requirements whilst capitalizing from the MNO slice. This, in turn, reduces the need for deployment of latest infrastructure at the same time as offering progressed wireless coverage and financial savings to MNOs. Finally, our proposed framework leverages green usage of spectrum, physical infrastructure and computational sources. The simulation consequences exhibit various crucial features of the proposed shared spectrum get right of entry to policies.

G. Femenias, et.al,…[3] The definition of the next generation of wireless communications, so-known as 5G networks, is currently underway. Among many technical selections, one this is particularly essential is the choice of the bodily layer modulation format and waveform, an issue for which numerous options had been proposed. Two of the maximum promising candidates are: (i) orthogonal frequency division more than one (OFDM), a conservative idea that builds upon the big legacy of 4G networks, and (ii) filterbank multicarrier/offset quadrature amplitude modulation (FBMC/OQAM), a revolutionary technique that during frequency selective channels sacrifices subcarrier orthogonality in lieu of an increased spectral efficiency. The comparative merits of OFDM and FBMC/OQAM had been nicely investigated over the previous couple of years but ordinarily, from a basically physical layer point of view and largely neglecting how the physical layer overall performance interprets into user-relevant metrics at the top-layers. This paper goals at providing a comprehensive assessment of both modulation formats in phrases of realistic network signs such as goodput, postpone, fairness and carrier insurance, and under operational conditions that may be envisaged to be realistic in 5G deployments. To this give up, a unifying move-layer framework is proposed that encompasses the downlink scheduling and resource allocation strategies and that builds upon a version of the queueing technique on the records-link manipulate layer and a physical layer abstraction that can be chosen to model either OFDM or FBMC/OQAM. Extensive numerical outcomes conclusively exhibit that maximum of the apriori advantages of FBMC/OQAM over OFDM do certainly translate into advanced network signs, this is, the increase in spectral efficiency done by using FBMC/OQAM

makes up for the distortion as a result of the loss of orthogonality

H.Q. Ngo, et.al,…[4] A Cell-Free Massive MIMO (more than one-input multiple-output) device incorporates a very huge range of allotted get right of entry to factors (Aps) which simultaneously serve a far smaller variety of customers over the identical time/frequency sources primarily based on immediately measured channel characteristics. The Aps and users have only one antenna every. The Aps acquire channel kingdom records via time-division duplex operation and the reception of uplink pilot alerts transmitted by way of the users. The Aps carry out multiplexing/de-multiplexing through conjugate beamforming on the downlink and paired filtering on the uplink. Closed-shape expressions for person person uplink and downlink throughputs lead to max-min electricity manage algorithms. Max-min power control guarantees uniformly good provider at some point of the vicinity of insurance. A pilot task set of rules allows to mitigate the consequences of pilot infection, but energy control is some distance greater essential in that regard. Cell-Free Massive MIMO has considerably stepped forward performance with admire to a traditional small-mobile scheme, wherein every user is served by way of a committed AP, in phrases of both ninety five%- in all likelihood consistent with-person throughput and immunity to shadow fading spatial correlation. Under uncorrelated shadow fading conditions, the mobile-free scheme affords almost five-fold improvement in ninety five%- in all likelihood consistent with-person throughput over the small-cell scheme, and 10-fold improvement whilst shadow fading is correlated.

M. Polese, et.al,…[5] The millimeter wave (mmWave) bands offer the possibility of orders of magnitude greater throughput for fifth generation (5G) mobile structures. However, due to the fact mmWave alerts are particularly prone to blockage, channel great on any person mmWave hyperlink may be extremely intermittent. This paper implements a singular dual connectivity protocol that enables cellular consumer system (UE) gadgets to preserve physical layer connections to 4G and 5G cells simultaneously. A novel uplink manipulate signaling device mixed with a nearby coordinator enables rapid direction switching in the event of screw ups on anybody hyperlink. This paper provides the primary comprehensive cease-to-stop evaluation of handover mechanisms in mmWave cell systems. The simulation framework consists of precise dimension-based totally channel fashions to realistically capture spatial dynamics of blocking activities, in addition to the full details of MAC, RLC and transport protocols. Compared to traditional handover mechanisms, the study well-knownshows widespread advantages of the proposed method below several metrics.

G.Femenias, et.al,…[6] Multiuser MIMO (MU-MIMO) in standard, and block diagonalization (BD) particularly, are playing a prominent role closer to the fulfillment of better spectral efficiencies in contemporary OFDMA-primarily based wi-fi networks. The usage of such strategies necessarily has implications in the scheduling and resource allocation methods looking after assigning subcarriers, electricity and transmission modes to the one of a kind users. In this paper, a framework for channel- and queue-conscious scheduling and aid allocation for BD-based totally MU-MIMO-OFDMA wi-fi networks is delivered. In precise, the usage of an SNR-

primarily based abstraction of the bodily layer, the proposed design is capable of cater for distinct BD-MU-MIMO processing schemes (coordinated Tx-Rx (CTR) or get hold of antenna choice (RAS)), uniform or adaptive electricity allocation (UPA/APA), continuous or discrete price allocation (CRA/DRA) and many exclusive scheduling regulations. Additionally, the distinct techniques are complemented through a new greedy user/move choice set of rules that is proven to perform very near the most suitable consumer/circulate choice policy at a far decrease complexity. Results the use of gadget parameters normally discovered in 4G networks monitor that, in most cases, low complexity answers (RAS-, UPA-based totally) attain a overall performance near the only attained through their extra complicated opposite numbers (CTR-, APA-based totally).

L. Tan, et.al,…[7] Conventional and high ability shared get admission to wi-fi networks deployment scenarios. The top mobile machine is the legacy cellular architecture wherein the MNOs have their single ownerships and function over own certified spectrums. The bottom cellular device is a high capacity wireless network structure wherein the MNOs have a commonplace RAN and function over a mixed spectrum.

L. Cano, et.al,…[8] One of the fundamental aspects of the shared access high capacity wireless network is the high data rates that are achievable. This is accomplished by combining the individual spectrums from both the MNOs, which is shown in the bottom cellular system in Fig. In our considered network sharing framework, the MNOs, to be enabled to deliver very high-speed connectivity and enhanced QoS, put together their individual owned licensed frequency resources.

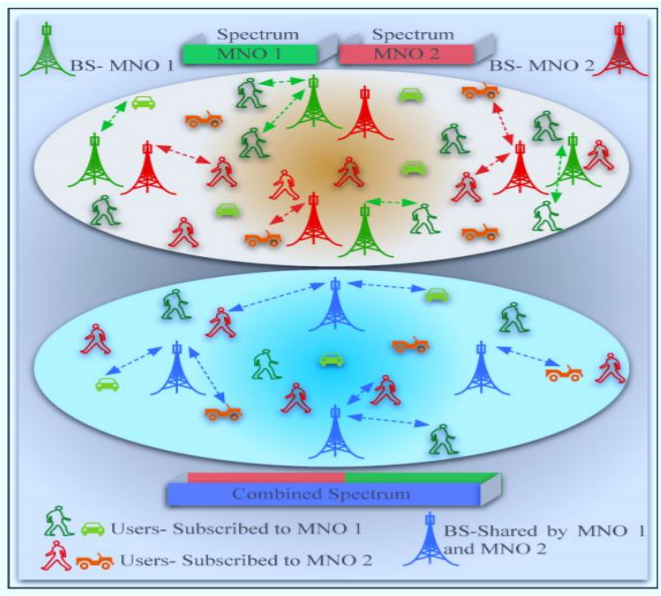
III. EXISTING METHODOLOGY

The existing studies considered homogeneous and non-shared communication schemes, where the MNOs operate independently without sharing infrastructure and spectrum with other MNOs. On the other hand, although the system considered as a heterogeneous network consisting of both macro cells and small cells, still operates independently. Consequently, the MNO have limited coverage or higher total cost of ownership (TCO), and may not deliver desired capacity.

In some cases, even if the spectrum available to the MNO is not in use, it cannot be utilized by other MNOs because of the non-sharing framework. For an MNO, coverage extension and building new cell sites increase the TCO. However, with the shared resource access framework considered in this study enables the MNOs to deliver high capacity wireless services with better utilization of the available spectrum and lower TCO.

To obtain substantial throughput enhancement a large number of cells in a given area is required. Small cell network is becoming integral parts of the 5th generation (5G) cellular networks, and 5G network architectures are sketched to deploy clusters of small cells, whose coverage overlaps with that of the macro cell. The small cell network is, in general, deployed on carrier frequencies higher than that of the macrocell network. The small cells boost the data/user plane capacity in hot spots and thus able to satisfy the ever-increasing traffic capacity and data rate demand. However, due to the limited coverage of small cells, the frequency of occurrences of mobility events, such as cell measurements, handovers, increases. The frequent mobility events lead to large signalling overhead to the radio access networks (RAN).

To deliver high capacity services and to meet the demand of the data-intensive applications, it is already established that the 5G system will utilize higher carrier frequencies to exploit the vast amount of spectrum in the millimeter wave (mmWave) bands as the bandwidth is proportional to the carrier frequency. The coverage/range is inversely proportional to the carrier frequency. The small cells evolve into high-capacity cells as they have access to vast bandwidth, especially in higher frequency bands (e.g., 3.5 GHz, 4.9 GHz, 28 GHz, 60 GHz) than the macrocells (e.g., 900 MHz, 1800 MHz). Note that the sub-3/sub-6 GHz spectrum is very suitable for providing the network coverage as both the path-loss and coherence time (linear and inversely proportional to the carrier frequency) are relatively much lower. On the contrary, the much broader bandwidths available in the mmWave bands can be used for data-intensive services, but only over smaller distances because of high noise power and very high path loss.



Existing Architecture

Conventional and high capacity shared access wireless networks deployment scenarios. The top cellular system is the legacy cellular architecture where the MNOs have their single ownerships and operate over own licensed spectrums. The bottom cellular system is a high capacity wireless network architecture where the MNOs have a common RAN and operate over a combined spectrum.

One of the fundamental aspects of the shared access high capacity wireless network is the high data rates that are achievable. This is accomplished by combining the individual spectrums from both the MNOs, which is shown in the bottom cellular system in Fig. In our considered network sharing framework, the MNOs, to be enabled to deliver very high-speed connectivity and enhanced QoS, put together their individual owned licensed frequency resources.

- Existing homogeneous network and nonshared communication schemes, where the MNOs operate independently without sharing infrastructure and spectrum with other MNOs.
- Heterogeneous network consisting of both macro cells and small cells, still operates independently.
- The spectrum available to the MNO is not in use, it cannot be utilized by other MNOs because of the non-sharing framework.

3.1 DISADVANTAGES

- A signal propagation-loss
- A fading averaged signal propagation loss process
- Limited network controllability, the risk of information leakage, marketing strategies

IV. PROPOSED METHODOLOGIES

In this proposed work, we consider a similar existing BS model based on fading-

averaged propagation loss process as considered. However, in DC coverage analysis in this project, the typical user is associated with only one BS in each tier rather than being simultaneously covered by multiple BSs from the same tier. On the other hand, for the CoMP/VC coverage analysis, althoughwe consider that BSs forming the CoMP set comes from a multi-tier network rather than from a single-tier system. Also considered multi-tier coverage, however, the user is connected to a subset of tiers where there is only one BS from each tier, which is not the case in this study. Unlike conventional, we assume a different BS association model and consider that the BSs forming the CoMP/VC set may come from only the MN-tier or only the SN-tier or from both of the tiers.

In this project, the shared resource access high capacity wireless cellular network under a stochastic geometry framework. The key contributions are as follows.A shared resource (both spectrum and infrastructure) access communications paradigm to deliver high-speed connectivity and enhanced QoS. Under this shared access model, the MNOs in spite of sharing the spectrum (they combine their spectrums and dynamically share it depending on traffic) and infrastructure, they still compete with each other with their distinct business models and marketing policies, i.e., products and pricing models. The inter-site CA or DC coverage probability under a stochastic geometry framework. We derive easy to-evaluate tractable integral expressions for the DC coverage probability of a typical user in downlink cellular. Unlike most of the existing works, the selection of the BS (the serving/strongest BS) is perturbed by the arbitrarily distributed shadowing, not by fading, i.e., we consider a fading-averaged signal propagation loss process.The CoMP/VC coverage probability, where a dynamic clustering strategy can be employed to form the CoMP/VC coordination set. All the BSs in the coordination set can operate (coherently) cooperatively to mitigate the interference and also can provide enhanced QoS and experience, especially for the cell-edge users. Resulting some system design issues by evaluating the CoMP/VC coverage probability as a function of BS Throughput, End-to-End delay, Packet Delivery Ratio, etc.,.The achievable throughput for a DC enabled user by identifying the distinct events that encompass all possible instances of the typical user in the shared access high capacity cellular network.

4.1 System Architecture

A downlink network comprising of two self-interested MNOs, all using both cmWave and mmWave bands. We consider a cooperatively shared resource access business model where the two self-interested MNOs take part in the collaborative effort. They engage themselves in a comprehensive and well-defined commercial cooperation agreement to build a shared (both infrastructure and spectrum) wireless network in a given area, for example. The agreement may also involve other parties such as the local authority, the owner of the private space, etc.

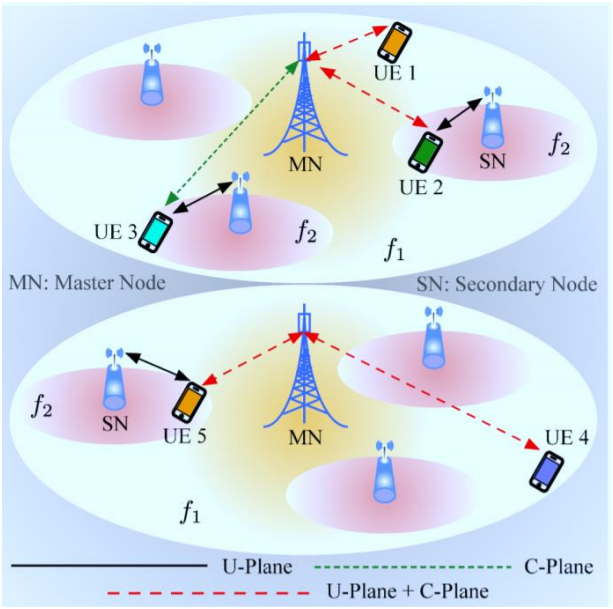


Fig. 2 Proposed Architecture for multi-carrier heterogeneous DC deployment

As mentioned earlier, the main reason for the MNOs to be reluctant to the shared access business model is the uncertainties and limitations they perceive regarding their marketing strategies. We consider that the implementation of the shared infrastructure is based on multi-operator core network fashion, where the MNOs can maintain their independent core networks. As a result, the MNOs are facilitated to still compete with each other with their business models, marketing policies, i.e., products and pricing models.

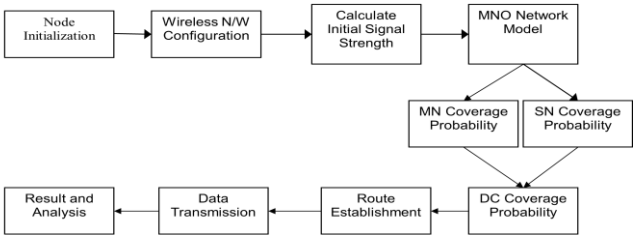


Fig: proposed block diagram

A typical DC deployment scenario is depicted in proposed figure. The macro BSs serving the primary/master cells are denoted as master nodes (MNs) while the small cell BSs serving the secondary cells, i.e., the small cells are denoted as secondary nodes (SNs). The MN-tier consists of all the MNs and the SN-tier consists of all the SNs. In general, these independent tiers operate over different frequencies. As seen in the figure, the MN always terminates the control-plane signals.

4.2 Dual Connectivity

In the legacy cellular architecture, cells are primarily designed to deliver both control-plane signalling and user-plane data. Furthermore, the amount of the available transmission spectrum is insufficient since the typical cellular frequency bands lay below 3 GHz. As a result, the legacy architecture has found to be ineffective when there are a large number of small cells deployed within the coverage of the macro cell. On the other hand, small cells are high-capacity cells as they have access to much broader spectrum in higher frequency bands, such as 3.5 GHz, 28 GHz, 30 GHz, etc. As the overlay small cell network becomes densely deployed, the UE is generally within the coverage of the one or many small cells no matter where it is within the macro cell. As a result, every time the UE moves, it inevitably experiences frequent handovers. If the small cell delivers the control-plane signalling, i.e., acts as mobility anchor towards the core network, there would be a drastic increase in control overhead, which in turn, deteriorates the transmission efficiency of the small cells.

4.3 Stochastic Model for DC Coverage Probability

We model the BS locations of each tier as mutually independent Poisson point processes, i.e., we consider two independent networks for the MN-tier and the SN-tier, respectively. Each tier may differ regarding transmitting power level, supported data rate, and BS density. The first tier, i.e., the MN-tier is a PPP Φ_m with density λ_m while the second tier, i.e., the SN-tier is also a PPP, Φ_s with density λ_s. The path-loss parameters for the MN-tier and SN-tier are given by η_m and η_s , respectively. Therefore, we consider a two-tier heterogeneous cellular network, consisting of independent and stationary point processes.

4.4 DC Coverage Probability

That the MN tier and the SN tier are independent, i.e., the BSs in MN tier and the BSs in SN tier are deployed independently. Consequently, the coverage area of the macro-tier and the coverage area of the small cell tier may

entirely/partially overlap or may not overlap. This can be the scenario where macro operator and small cell operator are operating independently. Finally, the DC coverage probability is obtained from the multiplication of the two independent delay coverage probabilities for two separate tiers.

4.5 Potential Throughput in DC

The DC feature can enhance the end-user experience by integrating data from multiple BSs and can satisfy the demand for high-capacity and data-intensive wireless services. In some cases, the BS in MN tier may act as an anchor, i.e., only the control-plane signalling is exchanged between the BS and the user. Therefore, the MN manages the mobility traffic while the high-capacity services are delivered via the ultra-wideband small cell BSs through user and control plane separation.

4.6 Coordinated Multipoint and User-Centric Virtual Cell Coverage Probability

CoMP enables dynamic coordination of transmission and reception over multiple BSs enhancing the overall QoS/QoE of the users, especially the cell-edge users as well the network utilization. It transforms the inter-cell interference into a useful signal by utilizing the interferences constructively. The CoMP technique requires close coordination among some spatially separated BSs to deliver joint scheduling as well as joint processing of the received signals. Therefore, in CoMP, a cell-edge user can be served by multiple BSs to improve signal transmission and reception and enhance the throughput. Also, the data can be routed through the BS which is the least loaded or has the best link quality, i.e., dynamic selection of the BSs can be performed. On the other hand, transmitting the same data from multiple BSs, the reliability of the communication can be improved. As such, for CoMP, the users need to under the coverage of multiple BSs simultaneously.

The traditional static network topologies have edges between cells, and from the coverage point of view and high data rate demand, these are not efficient, especially for cell-edge users. The LTE/LTE-A CoMP is primarily designed for regular hexagonal/circular tessellation of BS-centric cell. The user centric design is an emerging approach that facilitates a cost, spectrum and energy-efficient user mobility. One likely method may be the generation of the virtual cell. A set of cooperating BSs forms the user-centric VC, and it is continuously reformed in a way that the user is always at the centre of the cell. As a result, the actual size and the shape of the user-centric VC change continuously and is driven by the mobility of the user. User-centric VC enables the user to utilize resources from multiple BSs while residing in overlapping cells' coverage regions

4.7 SIMULATION SETUP

The proposed two-layer scheme and corresponding alternative route(s) are simulated in NS-2 discrete event simulator. The network consists of 40 nodes deployed in a 1500m × 1500m area. The use the *DsssRate* 10Kbps model from NS-2, which uses a data rate of 10Kbps per link. The packet size is 1000 bytes. The mobility model is set as "RandomWayPointMobilityModel" from NS-2 library. All the wireless nodes in the data plane are managed by a SDN controller.

Table: I SIMULATION PARAMETERS

PARAMETERS	VALUES
Tool	NS2
No. of Nodes	40
Area	150 X 1500
Routing Protocol	ZRP
Malicious Nodes	1, 2, 4
Traffic	CBR

Transport Layer	UDP
Mobility Type	Random Waypoint
Channel Type	Wireless Channel
MAC Type	IEEE 802.11
Antenna Type	Omni Directional Antenna
Queue Type	DropTail-PriQueue
Queue Length	1000
Simulation START/STOP Time	0.0/5.0 s

4.8 PERFORMANCE METRICS

Throughput:

It is the ratio of the total number of bits transmitted (B_{tx}) to the time required for this transmission, i.e. the difference of data transmission end time (t_{end}) and start time (t_{start}).

$$T = \frac{B_{tx}}{t_{end} - t_{start}}$$

End-End Delay

The end-end delay of a data packet is characterized as the data packet takes a point in time to travel from the source node to the destination node. D is computed as the ratio of the sum of individual delay of each received data packet to the total number of data packets received. By intentionally discarding, delaying or reordering packets, a node can increase the value of this metric; increase being caused by re-transmissions of such packets due to timeout at source. N_{rec}, No. of received packets.

$$D = \frac{\sum_{i=1}^{N_{rec}} D_i}{N_{rec}}$$

Packet Delivery Ratio

The packet delivery ratio (PDR) of a receiver is characterized as the proportion of the number of data packets actually delivered over the number of data packets transmitted by the source node.

$$PDR = \frac{no.\ of\ packets\ rec.\ in\ dest.}{no.\ of\ packets\ send\ by\ source}$$

Packet Drop Ratio

The packet drop ratio (*pdr*) is characterized as the difference between the generated data packets in source node and received data packets in receiver node.

$$PDR = no.\ of\ packets\ send - no.\ of\ packet\ received$$

V. RESULTS AND DISCUSSION

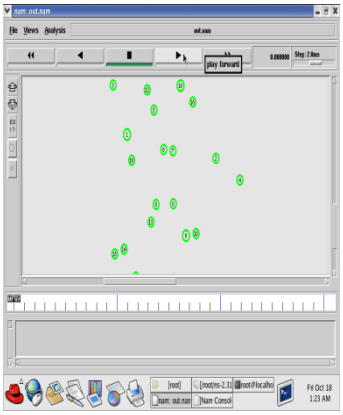


Fig1:Comp Implementation

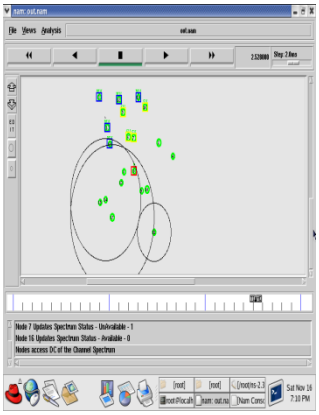


Fig2: Data Transmission

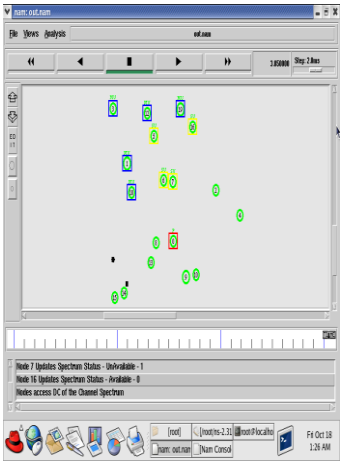


Fig3:Comp Dual Connectivity

Fig4:Numerical Values

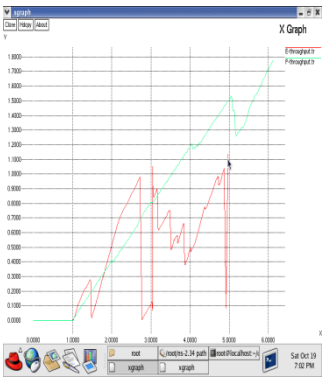


Fig 5: Throughput

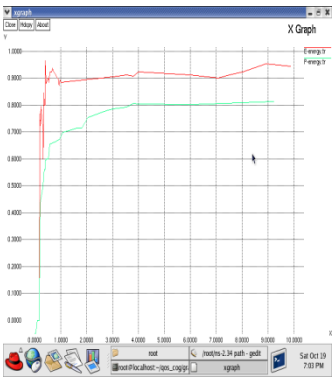


Fig 6: Energy

VI. CONCLUSION

Stochastic modelling of the DC and CoMP/VC for a regular person below random working conditions (each topological and wireless link randomness), coverage chance of a ordinary consumer in the downlink channel is done. We achieve explicit and simulated for the distribution of the put off and traffic throughput experienced by using the standard consumer from the most powerful BS (for DC). Unlike maximum of the prevailing works, the selection of the BS (the serving/strongest BS) is perturbed by the arbitrarily disbursed shadowing, no longer via fading, i.E., we recall a fading-averaged sign propagation loss technique. Also, we have obtained the closed-shape expression for the DC insurance chance for a specific fee of the course-loss exponent. For CoMP/VC, the coordinated set is fashioned by using locating more than one cooperating BSs, who can satisfy the given latency threshold necessities. The simulation outcomes verify the analytical outcomes, and we've got found an first rate matching among them. In the MU-mode, two D2D customers work as network MIMO to ahead the statistics to cellular customers and for this reason leverage the channel range. In the Sequential mode, the spatial distribution of D2D customers and cell customers is explored to improve the transmission charge. Based on those modes, D2D users proportion the downlink resources with two close by cellular users concurrently to achieve both proximity gain and reuse advantage.

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