

# Opportunities and Challenges for Deploying Relays in the Fifth Generation (5G) Network Wireless

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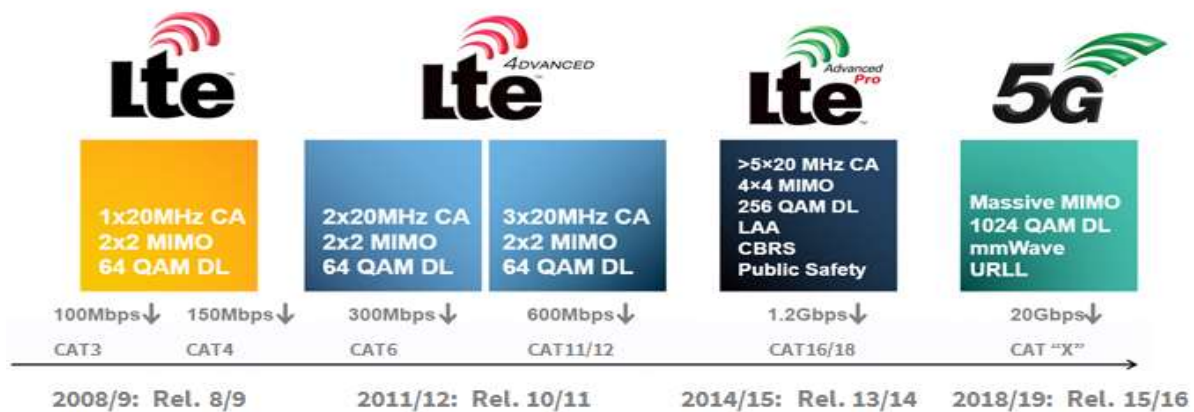
**Abstract** : 5G mobile communications is a paradigm shift in communication and internet technology. It aims to enable the networked society so that users, device, and machine can connect to high speed internet at anytime from anywhere. Nevertheless, the full description of the 5G is still emerging and issues related to the challenges that might face or confronting the 5G is still under research . Most of previous studies investigated the radio technology that makes the 5G a reality. However, few have focused on understanding the opportunities and challenges that can face deploying relays on the 5G network wireless. In this study, a review of existing literature is conducted to understand the opportunities and challenges that will face deploying relays on the 5G network wireless. The findings indicate that there are several challenges in achieving the maximum performance in the context of cooperative communication. These challenges are to find the optimal relay node (RN) from various prevailing RN. While there are also several opportunities and these include the enhancement in performance of the network and the reduction of the overhead triggered by RNs. This can be achieved by choosing from various communications metrics such as the signal to noise ratio (SNR), bit error rate (BER) and channel state information (CSI). and also include higher peak and user data rates,, enhanced coverage, improved energy efficiency.

**Keywords:** 5G, Challenges, latency, Self-organizing Network (SON)

## 1. INTRODUCTION

Since its initial release in 2008, LTE (Long Term Evolution) has evolved, and continues to evolve towards 5G. Typically, 3GPP releases a major update of the standard every three years, followed by a minor release. To differentiate between major LTE releases, 3GPP introduced marketing names such

as LTE-Advanced and LTE Advanced Pro. Release 13/14 were a key milestone for Gigabit LTE because the speed doubled to 1.2Gbps. Release 15/16 was released during 2018/2019 and it was the first standard defining the 5G. Figure 1 shows the evolution of the LTE advanced.



**Figure 1** : 3GPP Technology Evolution

The group of 3GPP data technologies enhance the capabilities support wide range of required applications. Clearly, the services are intended to provide users with better coverage and enhance high quality data throughput. A critical criteria which are not felt by users are the QoS control, spectral efficiency, and latency. When the spectral efficiency is enhanced, the average of throughputs and the coverage for active users increases as well as the responsiveness of the applications. Further discussion regarding the requirement and characteristic of the 3GPP are given in the following sections. Several release were given to enhance the coverage, speed, and the latency among others. In the release 9, HSPA and LTE enhancements which include HSPA double bearer downlink pastime in blend with MIMO, Multimedia Broadcast Multicast Services (MBMS), HSDPA double band hobby, HSPA double transporter uplink pastime,

EPC upgrades, femtocell aid, aid for administrative features, for example, emergency patron hardware situating and Commercial Mobile Alert System (CMAS), and advancement of IMS design. The release 10 develops LTE-Advanced that meets the requirements set by ITU's IMT-Advanced venture. Key highlights include bearer accumulation, multi-antenna twine upgrades, for example, improved downlink eight-branch MIMO and uplink MIMO, transfers advanced LTE Self-Organizing Network ability, Evolved Multimedia Broadcast Multicast Services (eMBMS), HetNet enhancements that contain eICIC, Local IP Packet Access, and new recurrence groups. For HSPA, includes quad-transporter activity and further MIMO choices. Likewise incorporates femtocell upgrades, enhancements for M2M interchanges, and nearby IP traffic offload. In release 11, LTE, specializes in Coordinated Multi Point (CoMP), provider aggregation

enhancements, gadgets with obstruction abrogation, advancement of the Enhanced Physical Downlink Control Channel (EPDCCH), and further advanced eICIC incorporating gadgets with CRS (Cell-explicit Reference Signal) impedance scratch-off. The discharge carries similarly DL and UL MIMO upgrades for LTE. For HSPA, gives eight-transporter at the downlink, uplink enhancements to enhance inactivity, double receiving wire beamforming and MIMO, CELL Forward Access Channel (FACH) state improvement for mobile phone type visitors, 4-department MIMO upgrades and transmissions for HSDPA, sixty four QAM inside the uplink, downlink multipoint transmission, and non-contiguous HSDPA bearer accumulation. Wi-Fi blend is superior thru S2a Mobility over GPRS Tunnelling Protocol (SaMOG). An more structural component called "Machine Type Communications Interworking Function" (MTC-IWF) will all the more deftly bolster system-to-system correspondences. The release 12 enhancements incorporate advanced little cells/HetNets for LTE, LTE multi-reception apparatus/internet site innovations (counting Active Antenna Systems), Dual Connectivity, 256 QAM law choice, further CoMP/MIMO enhancements, enhancements for interworking with Wi-Fi, improvements for MTC, SON, support for disaster and open security, Minimization of Drive Tests (MDT), propelled collectors, device to-machine correspondence (additionally alluded to as Proximity Services), bunch correspondence empowering retailers in LTE, choice of Web Real Time Communication (WebRTC) to IMS, vitality proficiency, progressively adaptable transporter accumulation, dynamic adjustment of uplink-downlink proportions in TDD mode, in addition enhancements for HSPA+, little cells/HetNets, Scalable-UMTS, and FDD-TDD bearer overall. Further enhancement has been done inside the release 13. LTE highlights incorporate Active Antenna Systems (AAS) with assist for upwards of 16 receiving cord components (full-dimension MIMO) and beamforming, Network-Assisted Interference Cancellation and Suppression (NAICS), radio-gate to arrange sharing, bearer accumulation assisting 32 component transporters, transporter conglomeration of as much as 4 transporters on the downlink and two bearers on the uplink, LAA for interest in unlicensed groups, LTE Wi-Fi Aggregation such as LWIP, RCLWI, detached pastime and strategic voice correspondences for open security, application-explicit clog the board, User-Plane Congestion

Management, improvement to WebRTC interoperability, layout improve for committed middle systems, improve to nearness based administrations, Mission-Critical Push-to-Talk, bunch interchanges, CoMP upgrades, little cell upgrades, gadget-kind interchanges enhancements which include NB-IoT and Extended Coverage GSM (ECGSM), VoLTE upgrades, SON upgrades, shared device enhancements, indoor situating dependent on WLAN passages, Bluetooth reference factors and barometric weight, and stepped forward circuit-exchanged fallback. HSPA+ highlights comprise assist for double band uplink transporter collection. This degree of general alludes to flagging abilities. The amount of bearers that may be joined in a real agency is littler and relies upon RAN conjunction examines. Allude to the reference section segment on "Bearer Aggregation" for added subtleties. Release 14 was released on June 2017. Thought approximately highlights comprise uplink hobby for LAA (advanced LAA), full-measurement MIMO upgraded with up to 32 reception apparatus components, double network of legal and unlicensed transporters throughout noncollimated hubs, car-to-automobile and vehicle-to-framework (V2X) interchanges based on Release 12 Proximity Services, shared LTE talk in which numerous administrators communicate a similar substance on a similar recurrence, non-IP interest for IoT, Downlink Multi-consumer Superposition Transmission (MUST), improved LWA, VoLTE enhancements, LWIP/LWA improvements, eMBMS upgrades, NB-IoT improvements, and LTE idleness decrease. Release 15 was launched on September 2018. Non-independent (using LTE middle gadget) alternative anticipated March 2018. Indicates degree 1 of 5G. NR radio, 4G-5G interworking, and MIMO/beamforming. Further LTE improvements comprise ultra-reliable low-inertness interchanges, NB-IoT upgrades, LAA improvements, V2X upgrades, DL 1024 QAM, CoMP enhancements, AAS improvements, and LTE/5G middle machine capacity. Lastly, the release sixteen is the most updated version and it was expected to be released at the stop of 2019. This release will decide stage 2 of 5G. Includes URLLC, variety sharing, unlicensed range activity and coordination, and several specific upgrades. Further LTE improvements. Figure 2 shows the chronological development of the 3GPP release features.

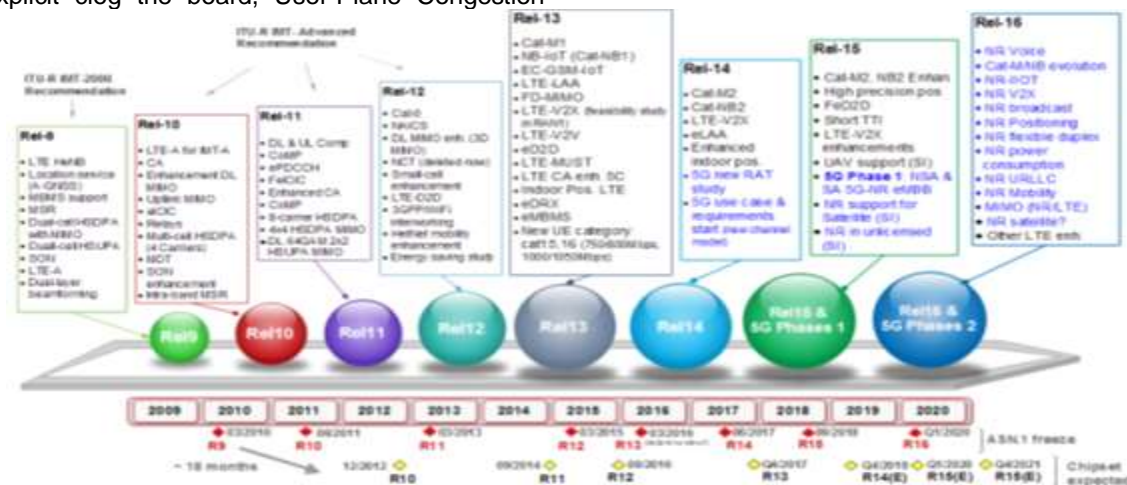


Figure 2. 3GPP Overall Release Features

In the five generation of wireless network and remote systems, cooperative correspondence is one of the favourable strategies through which spatial assorted variety could be accomplished by allowing the single reception apparatus to go about as virtual different information numerous yield (VMIMO). The major rule of agreeable correspondence was set up on various kinds of transferring conventions and execution of various handing-off conventions as indicated by the necessities of correspondence situations. The difficult assignment for accomplishing a superior in helpful correspondence is to discover the ideal transfer hub (RN) among various winning RNs..

## 2. LTE SYSTEM REQUIREMENTS

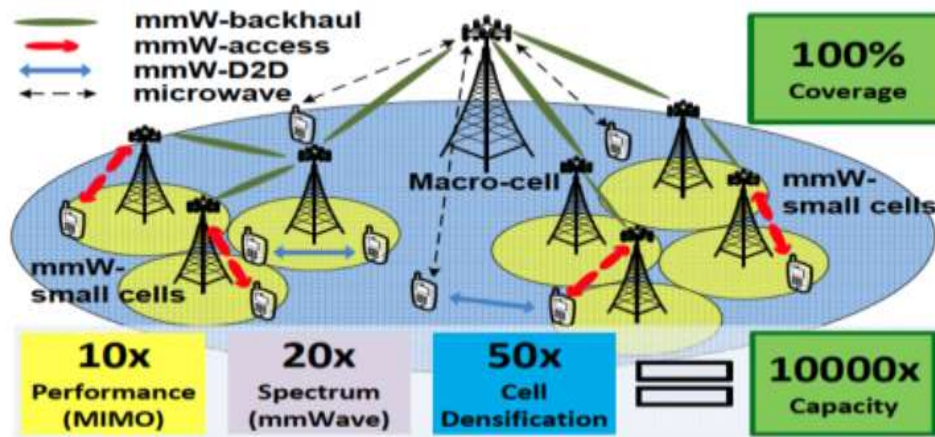
The exponential improvement of remote information administrations driven by portable Internet and keen gadgets has set off the examination of the 5G cell system. Around 2020, the brand new 5G versatile structures are relied upon to be conveyed. 5G systems need to bolster sight and sound packages with a huge collection of necessities, including higher top and client statistics rates, diminished dormancy, upgraded indoor inclusion, improved vitality proficiency, etc. The idea of LTE is a stage towards 4G correspondence innovations, guaranteeing the upper hand of 3G advancements for future. The LTE framework needs to give long haul effective arrangements nearly to its forerunners innovations, so as to empower improved system inclusion and limit. The LTE framework necessities are enrolled as follow [1]–[3] [4]–[8]:

- A. Peak data rates: The LTE framework expects to give prompt pinnacle information paces of 5 Mbps (with unearthly productivity of 2.5 bps/Hz) and 100 Mbps (with ghastly effectiveness of 5bps/Hz) in uplink (UL) and downlink (DL) separately, inside a 20 MHz range assignment.
- B. Latency: The decrease of the framework inertness (as far as control-plane and client plane latencies), is likewise remembered for LTE principle targets. The previous alludes to the time required for progress from non-dynamic states to dynamic state. The non-dynamic states contained stayed outdoors state and lethargic state and progress ought to be under 100 ms and 50 ms individually. The client plane inertness is characterized as the necessary single direction transmit time for Internet Protocol (IP) bundle from UE to Radio Access Network (RAN) edge hub or the other way around.
- C. Throughput: The LTE frameworks looks to empower a uniform client experience over the cell zone, by improving the cell edge execution. Similarly, it gives 2 to multiple times of HSDPA Release 6 cell-edge client throughput in DL while 2 to multiple times of HSUPA in UL. As far as arrived at the midpoint of client throughput, it is 3 to multiple times of HSDPA Release 6 in DL while 2 to multiple times of HSUPA in UL.
- D. Spectrum efficiency: In DL case, LTE means to accomplish 3 to multiple times the range effectiveness of

HSDPA Release 6, with 2 Tx and Rx reception apparatuses at the Node B and UE, individually. While for UL, it is 2 to multiple times of Release HSUPA 6. It can exist together with the previous 3GPP advancements.

- E. Mobility: The LTE permit the client portability across cell arrange. It needs to furnish best execution with great nature of administration at low speed (0-15 km/h) just as at fast (15 to 20 km/h) versatility.
- F. Coverage: The LTE framework ought to achieve the presentation focuses for 5 km of cell sweep as far as throughput, ghastly proficiency and versatility. Be that as it may, there may be a minor corruption in throughput and unearthly productivity for 30 km cell extend.
- G. Enhanced MBMS: The LTE framework ought to permit the concurrent provisioning of voice calls and Multimedia Broadcast/Multicast Services (MBMS). The MBMS empowers the multicast/communicate benefits in the portable cell systems.
- H. Spectrum allocation: The LTE framework support the between framework handover with the current sent GSM and UMTS arranges under the limitation of adequate effect on terminal multifaceted nature. In addition, it ought to work in both, combined and unpaired range, for example Recurrence Division Duplexing (FDD) and Time Division Duplexing (TDD). It additionally gives transfer speed adaptability to work at various recurrence data transmission for example 1.25, 1.6, 2.5, 5, 10, 15, 20 MHz
- I. Architecture: In spite of the fact that having all IP based engineering, LTE framework additionally needs to help realtime and conversational class traffic. Relatively, LTE diminishes the quantity of system interfaces leaving in different advances, for example, Evolved Node B (eNB) is the main radio interface between the UE and Core Network (CN), which goes about as base station lessening the system flagging and nerves.
- J. Cost: The Self-arranging Network (SON) highlights will empower the LTE frameworks of doing the self-design and self-improvement of its system which will diminish the system arranging and advancement cost [9], [10].

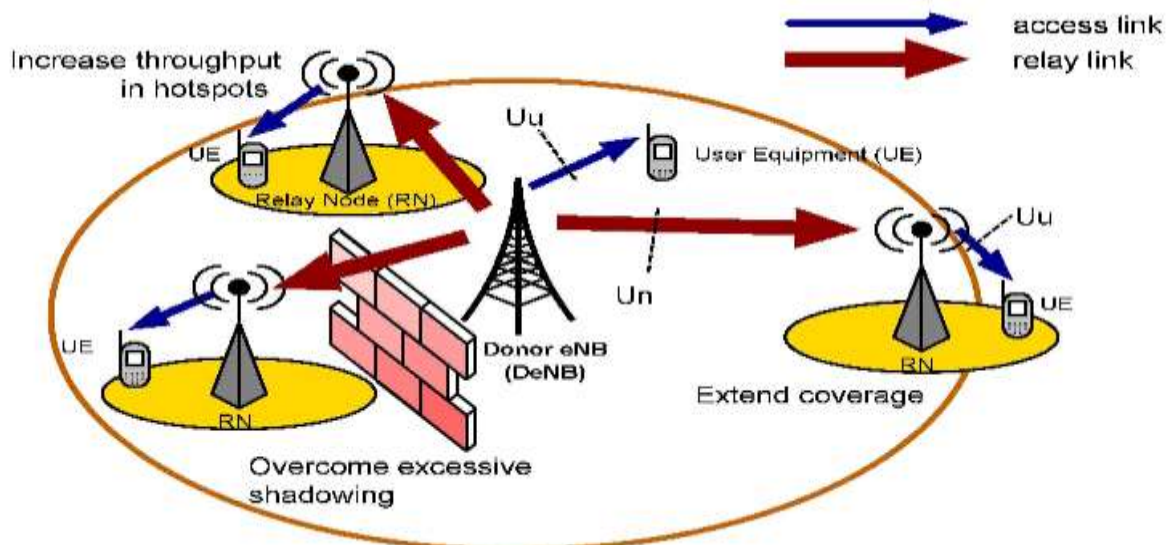
In the next-generation remote systems, cooperative communication is one of the promising procedures through which spatial assorted variety could be accomplished by allowing the single radio wire to go about as virtual numerous info different yield (VMIMO). The central guideline of helpful correspondence was set up on various sorts of transferring conventions and execution of various handing-off conventions as indicated by the prerequisites of correspondence situations. The difficult errand for accomplishing an elite in agreeable correspondence is to discover the ideal hand-off hub (RN) among various winning RNs. The fundamental reason for helpful correspondence is to boost the exhibition of the system and limit the overhead activated by RNs by thinking about various correspondence measurements, i.e., sign to clamour proportion (SNR), channel state data (CSI), and bit blunder rate (BER). Figure 3 shows the site and mechanism of the system.



**Figure 3:** Site and Mechanism of the system

As of late, the touchy development of versatile information traffic has prompted a regularly developing interest for a lot higher limit and lower idleness in remote systems. It has finished in the advancement of the fifth era (5G) remote correspondence frameworks, expected to be sent constantly 2020, with key objectives of information rates in the scope of Gbps, billions of associated gadgets, lower dormancy, improved inclusion and unwavering quality, and ease, vitality effective and condition well-disposed activity. At present, the arrangement of Long Term Evolution (LTE) frameworks has given a convenient limit lift to cell systems. Nonetheless, to satisfy the regularly expanding needs in remote rush hour gridlock which is anticipated to increment by around 1000 overlay constantly 2020, and remembering that the present remote range is nearly soaked, it is basic to move the worldview of cell range to another scope of frequencies. In such manner, Millimetre wave (mm Wave) groups with critical

measures of unused or softly utilized data transmissions give off an impression of being a practical method to push ahead. With groups of 20-100 GHz accessible for correspondence, mm Wave can be the foundation in the plan of 5G systems. Relay transmission can be viewed as a sort of cooperative interchanges, wherein a transfer station (RS) assists with sending client data from neighbouring client gear (UE)/versatile station (MS) to a nearby eNode-B (eNB)/base station (BS). In doing this, a RS can viably expand the sign and administration inclusion of an eNB and improve the general throughput execution of a remote correspondence framework. The exhibition of relay transmissions is incredibly influenced by the synergistic procedure, which incorporates the choice of hand-off sorts and transfer accomplices (i.e., to choose when, how, and with whom to team up), is shown in Figure 4.



**Figure 4:** cooperative Relays show coverage extension, increasing throughput and overcoming shadowing.

Relays that get and retransmit the signs between base stations and mobiles can be utilized to adequately build throughput expand inclusion of cell systems. Infrastructure transfers don't require wired association with organize subsequently offering reserve funds in administrators' backhaul costs. Versatile transfers can be utilized to fabricate

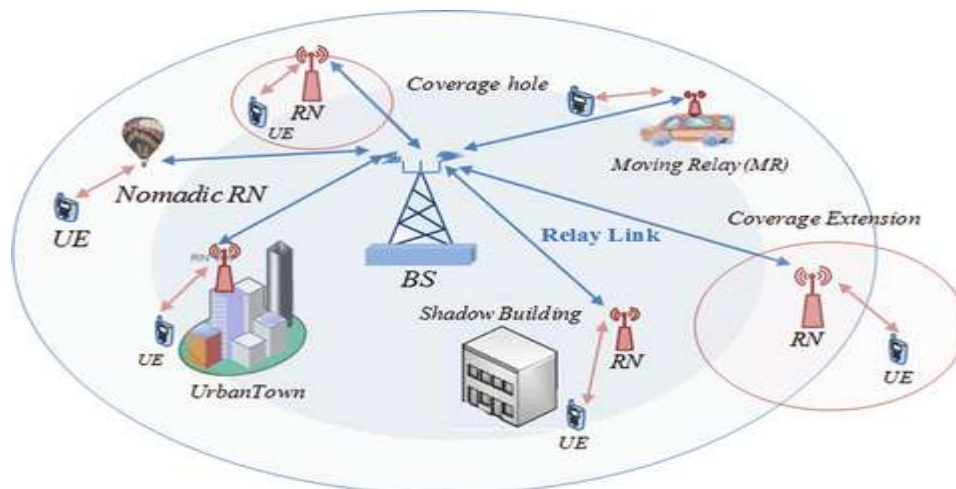
neighbourhood between portable clients under the umbrella of the wide territory cell systems. also show in figure 5 explain deploying Relays operation, depicting the most important use.

Also There are some of chances and advantages of deploying relay in the following:

- Expanded Coverage: With multi-bounce transfers the large scale cell inclusion can be extended to the spots where the base station cannot reach.
- Expanded Capacity: It makes hotspot arrangements with decreased obstruction to build the general limit of the framework .
- Lower CAPEX and OPEX: Relays expanding the inclusion wipes out the need of extra base stations and comparing backhaul lines sparing remote administrators sending costs and relating support costs. The transfers can be client possessed transfers gave by administrators and can be mounted on rooftop tops or inside.

- Better Broadband Experience: Higher information rates are subsequently now accessible as clients are near the smaller than expected RF passage
- Decreased Transmission power: With Relays sent there is an extensive decrease in transmission power diminishing co-channel impedance and expanded limit
- Quicker Network rollout: The arrangement of transfers is straightforward and enlivens the system rollout process with a more elevated level of outside to indoor help and prompting utilization of macro diversity expanding inclusion quality with lesser blurring and more grounded sign levels .

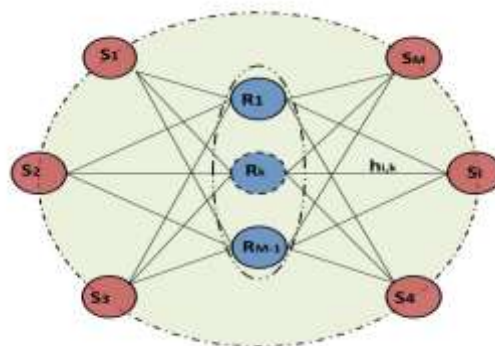
In Figure 5, deploying Relays operation, depicting the most important use : coverage extension, moving relay, shading building , urban town , and nomadic.



**Figure 5:** deploying Relays operation, depicting the most important use : coverage extension, moving relay , shading building , urban town , nomadic and etc.

As a hot research subject with incredible application potential, relays innovations have been correctly examined and considered inside the institutionalization manner of reducing edge portable correspondence frameworks, for instance, 3GPP LTE-Advanced as well as IEEE 802.16j (multihop transfers for WiMAX norms). Cooperative communication has activated gigantic research enthusiasm for understanding the presentation of various multi-way transfer channels (MWRCs). The MWRC can be seen as an augmentation of

the two-way hand-off channel (TWRC), where two clients trade their data by means of a transfer. In multi-way transfer situation, a few clients attempt to trade their data with one another with the assistance of transfers, where direct connections between the source hubs whether exist or are not considered either because of enormous scale way misfortune or shadowing impacts. Like two-way handing-off, self-obstruction can be evacuated by investigating the priori data at the source hubs see in figure 6 [11].



**Figure 6 :** Deploying Relay Communications

We study the multi-way transferring situation with M clients who need to trade their data with one another with the

assistance of N transfers (N M) among them. There are no immediate transmission channels between any two clients.

Especially, all clients transmit their signs to all transfers in the first schedule opening and  $M - 1$  transfers are chosen later to communicate their blend signals during the accompanying  $M - 1$  availabilities to all clients. Contrasted with the transmission with the assistance of a single transfer, the multi-way handing-off situation lessens the transmit time altogether from  $2M$  to  $M$  vacancies.

### 3. EXISTING CHALLENGES

The appearance of the original (1G) remote communication changed the world by interfacing individuals to individuals, as its ancestor innovation could just associate spots to places. Presently 5G expects to change the world by associating anything to anything. Additionally, in contrast to its antecedents, 5G should be considered as a lot of advancements that are proficient and practical regarding a variety of Key Performance Indicator (KPIs) that are important to all partners in an omnium-gatherum of utilizations [12], [13]. These KPIs, from an administrator's viewpoint, incorporate limit, nature of administration (QoS), capital consumption (CAPEX), and operational use (OPEX). From a client's viewpoint, the KPIs incorporate consistent network, spatiotemporal consistency of administration, impression of practically unending limit or zero inertness, and, to wrap things up, the expense of administration. Clearly, no innovation can offer interminable limit or zero inertness, however by keeping up an inactivity shorter than the human tactile and physiological deferral in the kind of utilization under use, a bogus view of unending limit or zero idleness can be given [14]. For, instance if the system can give an idleness underneath 100 ms, 10 ms, and 1 ms for sound, video, and material applications, individually, restricted by the inborn inertness of the appropriate human tangible organs and related neural hardware, the client will have a view of unbounded limit and zero inactivity [15]. Nonetheless, structuring the total 5G arrange, just for incredibly low inertness prerequisites may it be wasteful notwithstanding troublesome, if certainly feasible. The more sensible methodology is to structure 5G to be completely self-sorting out with start to finish arrange conduct insight, from the point of view of a self-arranging system (SON) motor, so it can misuse the perception of the setting of utilization just as that of the condition of the system to redirect and center the perfect measure of system assets when and where required to such an extent that clients will see consistent and boundless availability [16]–[18] [9], [10], [12], [13], [19]–[23]. 5G likewise needs to consider the ongoing marriage between Moore's law sponsored processing power and the remote innovation that has set off another period in mankind's history. In this new period the utilization of remote interchanges for novel applications is just bound by creative mind. There is not really a part of human life that won't profit by fast remote correspondence, including social insurance, portability, instruction, administration, producing, savvy matrices, amusement, sports, and significantly more. The "boundless" and "consistent" availability from anything to anything, from anyplace to anyplace, can open new skylines for unexpected advancements and bring another degree of administrations and way of life to society. Subsequently, no single application ought to be focused on while planning 5G. The quick development of portable Internet has impelled 1000-overlap information traffic increment by 2020 for 5G.

Thus, the ghostly effectiveness gets one of the key difficulties to deal with such dangerous information traffic. In addition, because of the fast advancement of the Internet of Things (IoT), 5G needs to help huge availability of clients or potentially gadgets to satisfy the need for low inertness, ease gadgets, and various assistance types. To fulfill these prerequisites, improved innovations are essential. Up until this point, some potential competitors have been proposed to address difficulties of 5G, for example, huge MIMO, millimeter wave correspondences, ultra-thick net-work, and non-symmetrical various access (NOMA) [24]. The essential test is the way by which to design another backhaul mastermind building and shows for ultra-thick cell association circumstances. As we discussed in the last segment, little cells and ultra-thick game plan will transform into the essential features in future 5G frameworks [7]. For this circumstance, the number of little cells will unmistakably augment in the unit zone. Therefore, the relating backhaul traffic will increase exponentially at the entryway if the common concentrated control model is grasped in the 5G backhaul framework designing. The colossal backhaul traffic makes a blockage just as breakdown the backhaul organize. It looks that the appropriated control model must be gotten in the 5G backhaul framework designing. In any case, it gets another test the instance of existing framework shows can support the massive backhaul traffic by remote associations. For quick customers, how to vanquish the effect of a significant part of the time handover in little cells is the consequent test. To clarify this test, the possibility of accommodating little cell pack is shown to help the quick customer handover among little cells. For this circumstance, various little cells ought to pleasantly transmit traffic to a quick customer. Right when the quick customer pulls back a little cell, other pleasant little cells despite everything spread its track and progressively transmit the high traffic to the quick customer. Plus, the new little cell is incorporated into the supportive little cell bundle subject to the quick customer track. In any case, there are various issues ought to have been appreciated for understanding this idea, for instance, how to mastermind a ground-breaking pleasing cell assembling and how to reduce the overhead of sharing data in the accommodating little cell gathering. In reality, even the huge remote backhaul traffic can be transmitted back profoundly interface with a foreordained QoS, it is a key test to pass on it in a high essentialness adequacy way. Existing exploration examines likewise show new issues that must be understood to fuse D2D correspondence in future 5G systems [25]. The arrangement of an enormous number of little cells presents new difficulties to vitality effectiveness, which has frequently been overlooked in fifth era (5G) cell systems. While monstrous various information numerous yields (MIMO) will decrease the transmission power to the detriment of higher computational cost, the inquiry stays concerning which calculation or transmission power is increasingly significant in the vitality effectiveness of 5G little cell systems. In this way, the fundamental target in this paper is to examine the calculation power dependent on the Landauer standard. Reenactment results uncover that over half of the vitality is devoured by the calculation power at 5G little cell base stations (BSs). Also, the calculation intensity of 5G little cell BS can move toward 800 watt when the enormous MIMO (e.g., 128 radio wires) is sent to transmit

high volume traffic. This plainly shows calculation power improvement can assume a significant job in the vitality proficiency of little cell systems [26]. The three primary vehicle challenges are distinguished: (i) tremendous amassed traffic volumes, (ii) on-request provisioning of high limit in explicit land areas, and (iii) requirement for quick reconfigurability of the vehicle assets [27] [28].

#### IV. CONCLUSION

So as to comprehend the 5G transport difficulties one must see how 5G may advance the radio access section. Among the different activities that are investigating 5G, the EU venture METIS characterizes 5G as far as situations which the cutting edge remote access systems should bolster. An aggregate of five future situations have been characterized, to be specific incredibly quick (clients need to appreciate immediate system network), extraordinary assistance in a group, universal things imparting (i.e., compelling help to Internet of Things), too constant and solid associations, and best experience tails you. Every one of these situations presents a test. Three of these difficulties (i.e., high information rate, exceptionally thick hordes of clients and versatility) are progressively customary as in they are identified with proceeded with upgrade of client experience and supporting expanding traffic volumes and portability. Two rising difficulties, low dormancy and low vitality, cost and enormous number of gadgets, are related with the utilization of remote interchanges to new zones. Future applications might be related with one or a few of these situations forcing various difficulties to the system. Cooperative communication or Device to device communication is the interest of fifth generation where the User Equipment (UEs) are capable to directly communicate with other device with partial involvement of base station (BS). However, devices that are not in proximity area, communicate with other devices (relay). This relay selection is done by Base Station (Network Assisted). Network assisted Multihop device to device (D2D) communication increase the energy and spectral by using proximity service, hop gain and reuse of frequency in cellular communication. In this paper, we propose a relay selection scheme for secure Multihop (MH) communication. The propose scheme has two phases. In first phases search trust node among the neighbor based on trust node matrix and in second phase, trust node matrix has updated. This relay selection scheme not only considers a single parameter (SNR), also consider several parameters: maximum trust factor, minimum Estimated Service Time (EST), and the minimum interference SINR which provides reliable and secure communication from the malicious node. This relay scheme not only increases spectral and energy efficiency also provides a secure communication during relay selection. It has been compared with the main relay selection scheme and observed that our scheme gives up to 30 % better result in each case.

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