

# A Review on HetNet in LTE-Advanced

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**ABSTRACT:** *Currently while using 4G network some issues were related to the network coverage, data speed and interference. So, to remove this problem there was needed for advancement in the network. By using a heterogeneous network, it can be solved. By heterogeneous network connection quality of service and data speed can be increased. It is flexible and the cost of deployment is also low so it can be used in LTE Advanced. There are some other advantages also of the heterogeneous network which are low latency, wider spectrum and high data rate. A heterogeneous network is a collection of different cells powers and using these different cell powers in a network causes interference in the network of cells. Therefore, there should be some techniques to be adopted for removing the interference between cells.*

**Keywords:** LTE, LTE-A, HETNET, QoS, RN, MB

## 1. INTRODUCTION

Day by day population is increasing rapidly. As the population increases the number of users of the mobile network is also increasing. Therefore, there is a need for lots of work to be done on the mobile network. As the load increases or in other words as the number of users increases in the mobile network, the services of the network is getting poor day by day. A user wants a network that has wide network coverage with a high-speed data rate. By observing this problem 3GPP Release 10 introduce Long Term Evaluation (LTE-A). Long Term Evolution is based on a network which is a heterogeneous Network. It helps the network to improve the efficiency of spectral in per unit area. Due to the increase of users on the network, it becomes hard to provide efficient spectral because it also has some limits. Therefore, there was the need to improve the spectral by increasing in nodes density.[1]

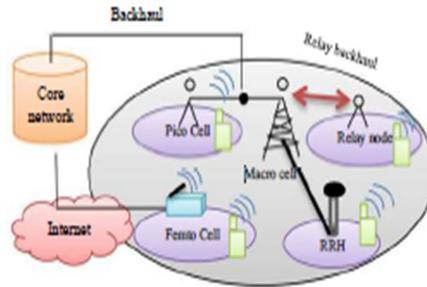
Before LTE-A all the Macro Base (MB) stations were used for the spectrum. This Macro Base station was used in such a way that they do not cause any interference between the cells. If some interferences occur in the network, then by using different techniques such as adjusting the bandwidth electronically. For installing Macro Base stations in the area lots of planning must be needed for a network and radiofrequency. But in urban dense areas, the Macro Base station was not able to fulfil the requirement of the user. And also, the signal was not able to reach properly in private premises. It can be solved by using more Macro Base Station in a Network, which is not possible. Because using more Micro Base stations in a network will increase intercell interference in the network and also not seems to be feasible [2]. Therefore, there was a need for different approaches to overcome this problem with low costing.

To overcome these problems low power base stations were used by which the problem of coverage area can be solved in the area of the high-power base station. The group of macro and low power Base stations is known as HetNet. HetNet consists of different Power Base stations with varying transmission power.

### 2.1 HetNet Introduction

A heterogeneous network is a network in which there is a group of different power stations with varying transmission power. In other words, it is a collection of different Power stations with varying transmission power. In other words, it is a collection of different small cells. Small cells are used to increase the coverage area of the Macro Base station. Small cells are power station that has transmission power between 10mW to 2 W. While on the

other hand, Microcell has transmission power between 5 to 20 W. there are different small cells like Pico, Femto and Relay Node.



**Fig. 1:** Architecture of HetNet

Small cells are used to overcome the problem of spectrum coverage area in urban areas. For increasing the strength of the signal in the basement or where the signal level is very low, Femto or Pico cells are installed to overcome this problem. Hence, small cells are very useful to increase the signal level or strength in an area where the Microcell fails.

Detail information about different Microcells is given below:

**Pico Node:** Pico Node is one of the small cells which is used for increasing the strength of the signal of a network. Pico Node is a small base station that can be used indoor or outdoor as per the requirement of the range coverage. It increases the strength of the signal in the small area where it is installed. Mostly it is used in the basement of offices, building, public places where the signal strength is very low [1].

**Femto Node:** It is also one of the main small cells which are mainly used indoors only. The main purpose of this small cell is to provide good signal strength in private property according to the demand of the consumer. This type of cell was used for consumer-oriented that why it is also called Home eNodeB [1]. It is not like Pico Node which provides indoor and outdoor services but it gave users free access without any charge. While Pico Node is not free for accessing or can be said that Pico Node is a closed subscriber group while Femto Node is an open subscriber group. The Transmission power of Femtocells is not more than 100mW [4].

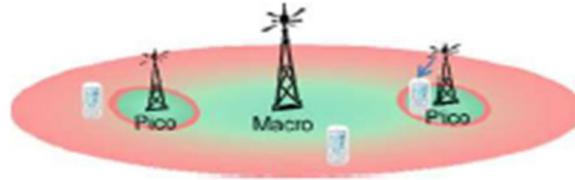
**Relay Node (RN):** Relay Node is a small cell that works between the user and the Microcell. It is connected with the Microcell which is used to transfer the information from the user to Microcell. There is a relay backhaul link is used between the Base station of the relay node and the Base station of the Micro node, which is used for transmission of the information using an air interface. It becomes important or useful where the wireline backhaul is not able to work. It is more flexible than the other backhaul [4].

**Features of HetNet:** After 3GPP Release 10 it was found that many features were adopted in the mobile network. There were a lot of problems in the network in which interference was one of them. And after Release 10 many new features were proposed so that network can overcome the interference between cells. ICIC technique is used to overcome the problem of interference. Interference occurs when the user Equipment was not able to decide to connect with which power station. This user cell equipment was at the edge of the cell so this feature helps to decrease the interference of any network.

By using small cells in the network signal strength was increased. Increasing the strength of the signal is also one of the main features of the heterogeneous network. Detail wise features are discussed in the sections given below.

**Cell Range Increment:** As discussed above small cells play important role in increasing the coverage area of any Macrocell. But using more small cells in an area can bring some problems in the network. One of the main problems

can be interference. When there is more small cell then each cell will try to connect the maximum number of cell phones or equipment. So, when the user equipment is between the range of more than one small cell and Macrocell, user equipment gets confused to connect with which cell. To solve this problem of network cell range increment is used [4].



**Fig. 2:** Interference due to strong Macro signal

Fig. 2 is used to explain how cells faced the problem of selecting a network when it comes between more than one cell coverage or range. As seen in fig. 2 a cell is between two Femtocells and Macrocell. Now the device has to decide to which cell is chosen to connect. To solve this type of problem Path Loss and SINR is checked. The cell with less Pathloss and SINR will be selected for resources. This technique is known as ICIC which is explained below:

## 2. Inter-cell Interference Coordination (ICIC)

In a heterogeneous network, this technique is used to overcome the Interference which comes when user equipment comes between Macro and Small cells. ICIC plays an important role in the heterogeneous network or in other words ICIC is one of the key features of a heterogeneous network. ICIC technique is required when the below condition comes in a network.

- Let a user device be connected with a Pico cell and there is high strength of DL signal of Macro Bs. Then there will be interference occurs between the Pico cell and the User device.
- Let a user device be connected with a Microcell and it is in the range of closed Femtocell. But user device is not allowed to connect with the Femtocells. In this case, interference will occur even in the DL of Femtocell is less as compared to the Macrocell.

As explained above two conditions some time Macro base station faced interference due to the Pico Base station. On the other hand, some time Pico base station faced interference due to the Macro base station. To solve this problem resource partitioning took place in the network through cell biasing [8]. Partitioning can be done in three different methods which can be time-based, frequency-based or spatial domain-based [8].

All the above are best for the partitioning of resources but mainly time domain is more used for partitioning of any resource. In time-domain radio, the frame is divided into 10 subframes. Mainly 10 ms radio frames are used for communication with the small cell. Some of the subframes are used for the channel control and left subframes were used for the Pico cell. While transferring subframes the cell is not able to deliver any data. It is used for controlling the channel which is also shown in the below **fig. 3** where some of the frames are used for data and others are used for only controlling the channel.

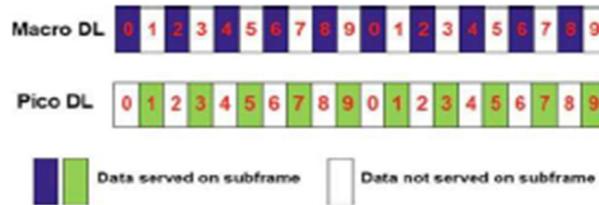


Fig 3. Partition of Macro and Pico Downlink

### 3. Advanced Interference cancellation Receiver:

For decreasing the interference in a network, user equipment checks the cell whether it is a weak or not. If it is found weak then measures the channel parameters. After all these, it sends feedback to the network core, which is responsible for proper handover. Interference faced by the user equipment is due to the channel acquisition and CRS Interference. If any user equipment faces the problem of interference in any cell, then it checks that the interference occurs due to which reason. If it occurs due to the cell then it will detect the desired cell. If it found the desired cell then it will report to the core of the network, if not then remove the acquisition of signal interference and again check for the interference occurring cell.

If the user equipment found the strong CRS interference, then it will decode the data channel. If it is not able to detect the strong CRS interference then it will remove CRS interference and again search for the strong CRS interference.

### 4. CONCLUSION

For improving the quality of service, data rate and connection between user and cell, HetNet is very necessary for any network. By using the HetNet data rate can be increased, services will be provided better and it will also ensure that every user will get proper connectivity with the network. With lots of advantages using HetNet also brings a disadvantage which is interference. This can be decreased by using different techniques used in HetNet which comes in Release 10 of 3GPP. Mainly ICIC is used for reducing the interference which occurs in a network.

There is much more work needed in this area. HetNet will be one of the most important and basic elements for building a 5G network.

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