ECEN 142 Networks and Communication
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Research and Report on 5G

Basic Capabilities - Connectivity Models

In a 5G network a device or UE (User Equipment) can relay a signal through another device to improve energy efficiency and signal range. The connecting device is called the remote UE and the relay device is considered an indirect network connection. Remote UEs communicate within a Personal Area Network which is defined as devices within a user's immediate area such as their headphones connected to their smartphone. To establish connectivity, the indirect network connection is configured through the available relay of devices that are in close proximity to the UE. This requires a selection procedure which finds these devices and determines availability. This can occur multiple times before the connection is secured as the indirect network may require multiple relay connections.

For the 5G system to begin supporting an indirect network connection it must first support network slices. This uses next generation radio access networks to connect different structured stream transports, which are transport control protocols using 3GPP cellular standards. Transport control protocols will provide applications with the ability to communicate with one another without affecting the internet protocol layer.

With this, a base station supports wireless coverage signals for the 5G network called a gNB and is the signals final destination after connecting through the relay devices. These base stations use fixed broadband technology to establish the internet protocol connection.

A 5G system may also have satellite access. With this the connection between the remote UEs and the relay UEs remains the same, but the network has the capacity to communicate with satellites from the base station and communicate information to exclusively terrestrial networks.

Performance Requirements - High Data Rate and Low Latency

Newer user equipment technologies, in the medical imaging industry and extended reality devices in the commercial industry, require high rates of data transfer with close to no time delay. The limits of this on a 5G network are pushed to meet audio-video synchronization in the range of 125ms to 5ms for audio delay and 45ms to 5ms for audio advanced. On top of this, extended reality devices require a low motion to photon latency which is the time from when the user moves their head to when the display reacts. A 5G system can support this at a range of 7ms to 15ms while supporting an 8K resolution.

While the device architecture can present a further limitation on the network's performance, designers have developed additional solutions for reducing latency. Rendering graphics on the client side is one solution whereby the 3D world is computed by processing systems within the headset, so that less data is required over the network; this technique is referred to as Edge Rendering. Similarly, tethering a headset to an external computer can improve network latency by performing computation on a stationary connected UE, as well as reducing the signal decoding functionality’s loss from a moving receiver.