Technical Challenges Faced by wireless communication, They are as Follows:

- Multipath propagation
- Spectrum limitations
- Energy limitations
- User mobility
- Noise limited systems
- Interference limited systems

1. MULTIPATH PROPAGATION

For wireless communications, the transmission medium is the radio channel between transmitter TX and receiver RX. The signal can get from the TX to the RX via a number of different propagation paths. In some cases, a Line Of Sight (LOS) connection might exist between TX and RX, or the signal can get from the TX to the RX by being reflected at or diffracted by different Interacting Objects (IOs) in the environment. The number of these possible propagation paths is very large. Each of the paths has a distinct amplitude, delay (runtime of the signal), direction of departure from the TX, and direction of arrival;most importantly, the components have different phase shifts with respect to each other.

2. Spectrum Limitations

The spectrum available for wireless communications services is limited and regulated by international agreements. For this reason, the spectrum has to be used in a highly efficient manner. Two approaches are used: regulated spectrum usage, where a single network operator has control over the usage of the spectrum, and unregulated spectrum,where each user can transmit without additional control, as long as he complies with certain restrictions on the emission power and bandwidth.

3. Limited Energy

Truly wireless communications requires not only that the information is sent over the air (not via cables) but also that the MS is powered by one-way or rechargeable batteries. Otherwise, a MS would be tied to the “wire” of the power supply, batteries in turn impose restrictions on the power consumption of the devices. The requirement for small energy consumption results in several technical imperatives:

• The power amplifiers in the transmitter have high efficiency

• Signal processing must be done in an energy-saving manner.

• Maximum transmission power should be used only when required.

• For cellular phones, and even more so for sensor networks, an energy-efficient “standby” or “sleep” mode has to be defined.

4. User Mobility

Mobility is an inherent feature of most wireless systems has its important consequences for system design. Fading has already been discussed above. A second important effect is particular to mobile users in cellular systems: the system has to know at any time which cell a user is in:

• If there is an incoming call for a certain MS (user), the network has to know in which cell the user is located.

• If an MS moves across a cell boundary, a different BS becomes the serving BS in other words, the MS is handed over from one BS to another. Such a handover has to be performed without interrupting the call; as a matter of fact, it should not be noticeable at all to the user.

5. Noise-Limited Systems

Wireless systems are required to provide a certain minimum transmission quality.This transmission quality in turn requires a minimumSignal-to-Noise Ratio(SNR) at the receiver (RX). Consider now a situation where only a single BS transmits, and a Mobile Station (MS) receives; thus, the performance of the system is determined only by the strength of the (useful) signal and the noise. As the MS moves further away from the BS, the received signal power decreases, and at a certain distance, the SNR does not achieve the required threshold for reliable communications. Therefore, the range of the system is noise limited; equivalently, we can call it signal power limited. Depending on the interpretation, it is too much noise or too little signal power that leads to bad link quality.

6. Interference-Limited Systems

Consider now the case that the interference is so strong that it completely dominates the performance, so that the noise can be neglected. Let a BS cover an area (cell) that is approximately described by a circle with radius R and center at the location of the BS. Furthermore, there is an interfering TX at distance Dfrom the “desired” BS, which operates at the same frequency, and with the same transmit power. How large does D have to be in order to guarantee satisfactory transmission quality 90% of the time, assuming that the MS is at the cell boundary (worst case)? The computations follow the link budget computations of the previous section. As a first approximation, we treat the interference as Gaussian. This allows us to treat the interference as equivalent noise, and the minimum SIR, SIR min, takes on the same values as SNR min in the noise-limited case.