1.3 History and Background - Wireless Satellite Networks

The first satellite communication took place in 1962 using a GEO satellite (NASA). Since then satellites have been used to provide communication over long distances (very popular before the advent of fiber!) and over wide coverage areas (primarily for broadcasting services).

- **LOS**
  Satellites require line of sight (LOS) communication (signals too weak to penetrate buildings). If the service is to be used indoors, some other form of communication must be used to relay the signal from the LOS antenna.

- **Relay stations -> switching nodes**
  Although initially used only as relay stations, satellites now can include intelligent switching capabilities.

- **LANs: high bit rates, short distances. Satellites: low bit rates large distances.**
  As opposed to wireless LANs that offer high bit rates over limited geographic distances, satellite networks provide wide coverage areas with low bit rates. The coverage area is dependent upon the satellite orbit: GEO (35,800km) can cover up to 1/3 of the globe, MEO (10,000km) an area the size of a country (or state in US) and LEO (500 - 2000) an area the size of a county.

- **Long delays**
  The trade-off with larger area coverage is round trip delays. The higher the satellite the longer the delay (512ms round trip for GEO). This is a problem with interactive and real time services and some current data protocols such as TCP and HDLC, they have to be modified to operate in such an environment (timer values and window sizes).
● **Orbits and stationarity**

The GEO satellites are stationary with respect to earth whereas the MEO and LEO satellites move with time (varying geographic location). Therefore systems based on MEOs and LEOs must have several satellites in orbit, as one moves out of a coverage area, the next one moves in. This requires handoff procedures between satellites to maintain the communication link. The advantage of MEOs and LEOs over GEOs is lower power requirements, and smaller path loss resulting in smaller and lighter antennas.

● **Examples of Systems:**

- **Inmarsat** was formed in 1973 and uses GEO satellites to provide global communications. Initially conceived to provide maritime communications now air, land and sea systems can use it. Motorola’s **Iridium** is a global cellular system based on 66 LEOs satellites in a 778km orbit. It provides voice and data communication services. It is more expensive than current cellular systems. It is used as a backup in areas where cellular services exist and is used as the main service where no such infrastructure exists.

Loral and Qualcomm are planning a LEOs system called **GlobalStar**. TRW is planning one called **Odyssey** (MEOs) and Inmarsat has plans for **ICO**. In addition Hughes has filed with the FCC for a system called **SPACEWAY** and Teledisc Corporation for one called **Teledisc**. The latter two in particular are targeting higher speed data access (>2.4Kbps) in addition to voice services.