

Lecture 11



PRINCIPLES OF SATELLITE COMMUNICATION

Multiple Access System



- Applications employ multiple-access systems to allow two or more Earth stations to simultaneously share the resources of the same transponder or frequency channel.
- These include the three familiar methods:
 - FDMA,
 - TDMA, and
 - CDMA.
- Another multiple access system called space division multiple access (SDMA) has been suggested in the past. In practice, SDMA is not really a multiple access method but rather a technique to reuse frequency spectrum through multiple spot beams on the satellite.
- Because every satellite provides some form of frequency reuse (cross-polarization being included), SDMA is an inherent feature in all applications.

Single Channel Per Carrier (SCPC) system



- Small earth station
- Few channels
- Independently modulates its own carrier
- Transmitted to the transponder
- Inexpensive multiplexing and demultiplexing equipments
- Cost of earth station is considerably reduced
- Link is active

Multiple Access System



- TDMA and FDMA require a degree of coordination among users:
 - FDMA users cannot transmit on the same frequency and
 - TDMA users can transmit on the same frequency but not at the same time.
- Capacity in either case can be calculated based on the total bandwidth and power available within the transponder or slice of a transponder.
- CDMA is unique in that multiple users transmit on the same frequency at the same time (and in the same beam or polarization).
- This is allowed because the transmissions use a different code either in terms of high-speed spreading sequence or frequency hopping sequence.

Multiple Access System



- The capacity of a CDMA network is not unlimited, however, because at some point the channel becomes overloaded by self-interference from the multiple users who occupy it.
- Furthermore, power level control is critical because a given CDMA carrier that is elevated in power will raise the noise level for all other carriers by a like amount.

Multiple Access System



- Multiple access is always required in networks that involve two-way communications among multiple Earth stations.
- The selection of the particular method depends heavily on the specific communication requirements, the types of Earth stations employed, and the experience base of the provider of the technology.
- All three methods are now used for digital communications because this is the basis of a majority of satellite networks.

Multiple Access System



- The digital form of a signal is easier to transmit and is less susceptible to the degrading effects of the noise, distortion from amplifiers and filters, and interference.
- Once in digital form, the information can be compressed to reduce the bit rate, and FEC is usually provided to reduce the required carrier power even further.
- The specific details of multiple access, modulation, and coding are often preselected as part of the application system and the equipment available on a commercial off-the-shelf (COTS) basis.

Multiple Access System



- The only significant analog application at this time is the transmission of cable TV and broadcast TV.
- These networks are undergoing a slow conversion to digital as well, which may in fact be complete within a few years.