The University of New Mexico

School of Engineering

Electrical and Computer Engineering Department

ECE 535 Satellite Communications

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14.1 Explain what is meant by a single access in relation to a satellite communications network. Give an example of the type of traffic route where single access would be used.

Single Access is when a transponder channel aboard a satellite may be fully loaded by a single transmission from an earth station.

Single access operation is used on heavy traffic routes, and requires large earth station antennas such as the class A antenna. An example would be the Telesat Canada. The system provides heavy traffic route message facilities, with each transponder channel being capable of carrying 960 one-way voice circuits on an FDM/FM carrier.

14.2 Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network.

Pre-assigned

Circuits which are allocated on a fixed or partially fixed basis to certain users. The circuits are not available for general use and is simple to implement but is efficient for circuits with continuous heavy traffic.

Demand-assigned

Demand-assigned multiple access (DAMA) requires all circuits available to all users and are assigned according to the demand. DAMA is more efficient overall with the use of the circuits but is more costly and complicated to implement.

14.3 Explain what is meant by FDMA, and show how this differs from FDM.

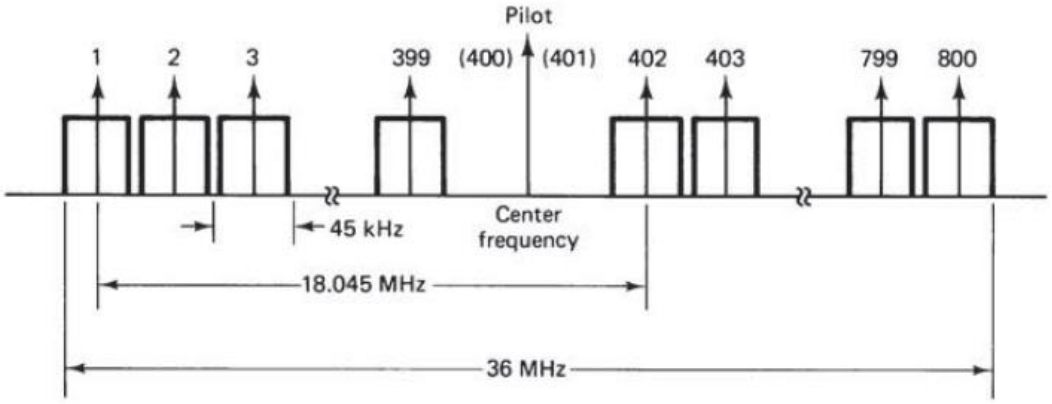
Frequency Division Multiplexing is one of the two most used methods of multiple access. Multiple users share the same communication channel by dividing the available frequency spectrum into distinct frequency channels. Each user is allocated a specific frequency channel for transmission.

Frequency Division Multiplexing (FDM) uses multiple signals transmitted simultaneously over the same communication channel by dividing the available frequency spectrum into non-overlapping frequency bands or channels.

FDMA and FDM differ as FDM can transmit multiple continuous signals while FDMA can transmit to multiple users.

14.4 Explain what the abbreviation SCPC stands for. Explain in detail the operation of a preassigned SCPC network.

The SCPC abbreviation stands for “single channel per carrier”. It refers to a single voice (or data) channel per carrier, not transponder channel, which may in fact carry some hundreds of voice channels by this method.



Preassigned SCPC systems are used for user and frequency allocation. In the preassigned SCPC network, carrier frequencies are allocated to dedicated channels. Each carrier can be modulated for a specific use such as voice/data/video. Separating the channels eliminates the interference and does not overlap.

14.6 Briefly describe the ways in which demand assignment may be carried out in an FDMA network.

Demand assignments within an FDMA network divides the transponder frequency bandwidth into subdivided channels. Channels are assigned to each carrier in use in a SPCP mode. FDMA can also use a polling method, with a mster eart station continuously polling all earth stations in sequency. If a call request is encountered, frequency slots are assigned from the pool of available frequencies. However, the polling delay with such a system can become excessive as the number of participating earth stations increases.

Earth stations may also request calls through the master earth station. This is defined as “centrally controlled random access”. Requests go over digital orderwire, which is a naroowband digital radio link or circuit through a satellite transponder reserved for this purpose. Frequencies can be assigned if available in the pool and the master station will block requests or place them in a queue.

Distributed control random access can also occur in demand assignment FDMA networks. DCRA can manage multiple users or terminals in a shared common frequency band. Users are not assigned a fixed frequency and are only designated a frequency band when making a request.

14.7 Explain in detail the operation of the Spade system of demand assignment. What is the function of the common signaling channel?

The Spade system of demand assignment is an acronym for SCPC pulse-code-modulated multiple-access demand-assignment equipment. It is used with on-demand requests so users can share bandwidth efficiently.

Spade systems have a ring topology network and use a common signal channel (CSC). This CSC servers as a control and coordination mechanism for the system assigning signal allocation, resource assignment (frequency/bandwidth/time slots) and destination terminal. The CSC can also assign connection establishments and terminate channels when communication ends.

14.8 Explain what is meant by power-limited and bandwidth-limited operation as applied to an FDMA network. In an FDMA scheme the carriers utilize equal powers and equal bandwidths, the bandwidth in each case being 5 MHz. The transponder bandwidth is 36 MHz. The saturation EIRP for the downlink is 34 dBW, and an output backoff of 6 dB is employed. The downlink losses are 201 dB, and the destination earth station has a G/T ratio of 35 dBK^{-1}. Determine the [C/N] value assuming this is set by single carrier operation. Determine also the number of carriers which can access the system, and state, with reasons, whether the system is power limited or bandwidth limited.

Power-limited systems are limited by the available power in the transponder or earth station available for communications. The number of users can be limited by the amount of power available from the transponder, and thus frequency allocation must be scrutinized.

Bandwidth limited operation is an imposed limitation on the number of carriers that can access the transponder. Any increase in the transponder EIRP cannot improve the bandwidth allocation.

Quantity	Decilogs
BW	5MHz
BTR	36MHz
EIRP	34dBW
BO	6dB
LOSS	-201dB
G/T	35dBK
k	228.6

Single Carrier

$$\frac{C}{N} = [EIRP] + \left[\frac{G}{T}\right] - [LOSSES] - [k] - [BTR]$$

$$\frac{C}{N} = [34] + [35\} - [201] - [-228.6] - [10\log(36MHz)] = 21.04\text{dB}$$

Total number of Carrier which can access the system:

$$[K] = [\alpha] + [B_{TR}] - [B] \xrightarrow{yields} = [-6] + [75.56] - [66.99] = 2.01dB$$

$$K = 10^{2.01/10} = 1\ (rounded\ down)$$

$$\frac{B_{TR} - K}{B} = \frac{36 - 1}{5} = 7\ carriers$$