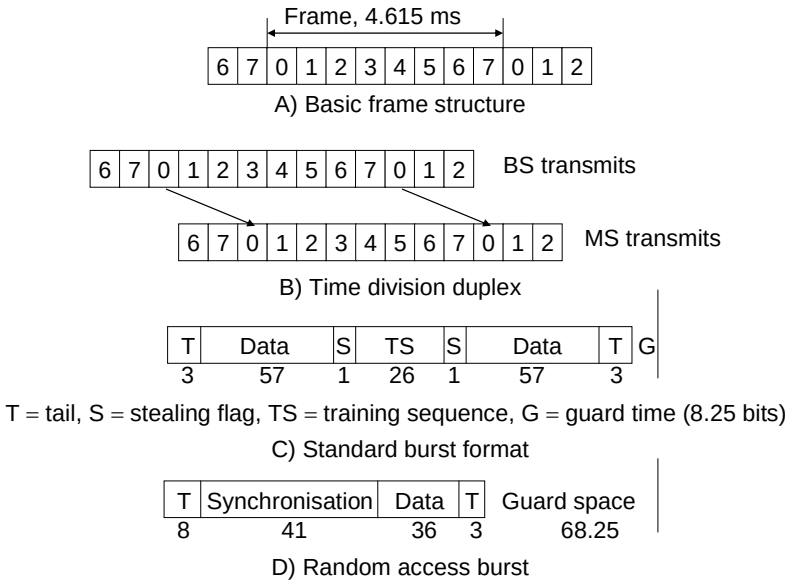
Exam in TTM4105 Access and transport networks – Autumn 2007 (English)

All problems count equally much in the evaluation.

Problem 1 Synchronization

a) Explain (by using sketches and text) how "timing advance" is implemented in GSM.

The following figure shows the burst configuration and the format of a standard burst and a random access burst.



b) Explain (using text and sketches) how we may synchronize a terminal that is connected on a fixed line to an exchange in the network (master-slave synchronization).

c) Show by using block diagrams how a phase-locked loop is constructed. Explain briefly how the loop works.

Problem 2 Satellite communication

a) Earth station: Explain briefly what is meant by "program tracking" and what is understood by "step tracking" of the antenna.

b) How can a satellite determine where the Earth is located and direct its antennas correctly toward the Earth? Use sketches and text to explain how this can be done.

c) Indicate approximately how large the distance is from the Equator to a low Earth orbit (LEO) satellite, a medium Earth orbit (MEO) satellite and a geostationary satellite (GEO). How many geostationary orbits are there and how big is the inclination of these orbits relative to the equatorial plane?

Problem 3 Multiplexing

a) Explain by use of text and sketches how frequency division multiplexing (FDM) works.

b) What is a statistical multiplexer? Show how signals from different sources are combined as one signal in a statistical multiplexer with constant envelope.

c) What does it mean that two signals are plesiochronous? How are plesiochronous signals multiplexed in a second order European time division multiplexer (TDM)? Explain this using text and sketches.

Problem 4 Multiple access

a) Explain how SFH-CDMA (slow frequency hopping code division multiple access) works. Explain what is understood by the terms “interferer diversity” and “frequency diversity”.

b) Explain why pure Aloha often is more efficient (that is, utilizes the channel more efficiently) than slotted Aloha in geostationary satellite systems. Derive a general condition that slotted Aloha is more efficient than pure Aloha.

c) Explain why power control is so important in DS-CDMA (direct sequence code division multiple access). What do we mean when we claim that DS-CDMA has a soft capacity limit? Is the capacity limit soft or hard in FDMA, TDMA and SFH-CDMA? Justify your answer.