RECOMMENDATION ITU-R SA.1018

HYPOTHETICAL REFERENCE SYSTEM FOR SYSTEMS COMPRISING DATA RELAY SATELLITES IN THE GEOSTATIONARY ORBIT AND USER SPACECRAFT IN LOW-EARTH ORBITS

(Question ITU-R 117/7)

(1994)

The ITU-R Radiocommunication Assembly,

considering

a) that communications between the ground and low-orbiting spacecraft and launch vehicles used for space research, Earth exploration and other purposes is essential;

b) that such communications may be required to be continuous or near continuous;

c) that such communications may be required while the spacecraft are passing over specific points on the Earth's surface;

d) that a land-based station has only limited visibility of a low-orbiting spacecraft;

e) that available land-based stations are only able to cover limited portions of any low orbit;

f) that it is not economically or practically feasible to extend networks of land-based stations to provide full or more complete coverage;

g) that a data relay satellite (DRS) in geostationary orbit can provide communications between a single earth station and a low-orbiting spacecraft for more than one-half of its orbit;

h) that two such DRSs, suitably located in geostationary orbit, with a wide separation angle, can provide communications between two co-located earth stations and a low-orbiting spacecraft almost continuously, with the exception only of a zone of exclusion (ZOE), above the part of the Earth opposite to these earth stations;

j) that two such DRSs, suitably placed in geostationary orbit, can provide fully-continuous coverage between two separate earth stations and a low-orbiting spacecraft;

k) that a DRS system comprising two DRSs can serve several user spacecraft simultaneously, and many more user spacecraft by means of time-sharing;

l) that a DRS system can also serve additional earth stations, either both transmitting and receiving or only receiving signals from user spacecraft;

m) that a DRS must be capable of supporting at least four distinct links:

- an Earth-to-space link in the forward direction, from the earth station to the data relay satellite (known as the uplink or the forward feeder link);
- a space-to-space link in the forward direction, from the data relay satellite to the low orbit spacecraft (known as the forward inter-orbit link);
- a space-to-space link in the return direction, from the low orbit spacecraft to the data relay satellite (known as the return inter-orbit link); and
- a space-to-Earth link in the return direction, from the data relay satellite to the earth station (known as the downlink or the return feeder link);

n) that, for these four links, four separate frequency bands are required, with a guard band between the signals transmitted from and those received by the data relay satellite,

recommends

1. that a hypothetical reference system for data relay satellite systems (as shown in Fig. 1) should consist of:

1.1 an Earth-to-space link in the forward direction, from the earth station to the data relay satellite (the forward feeder link);

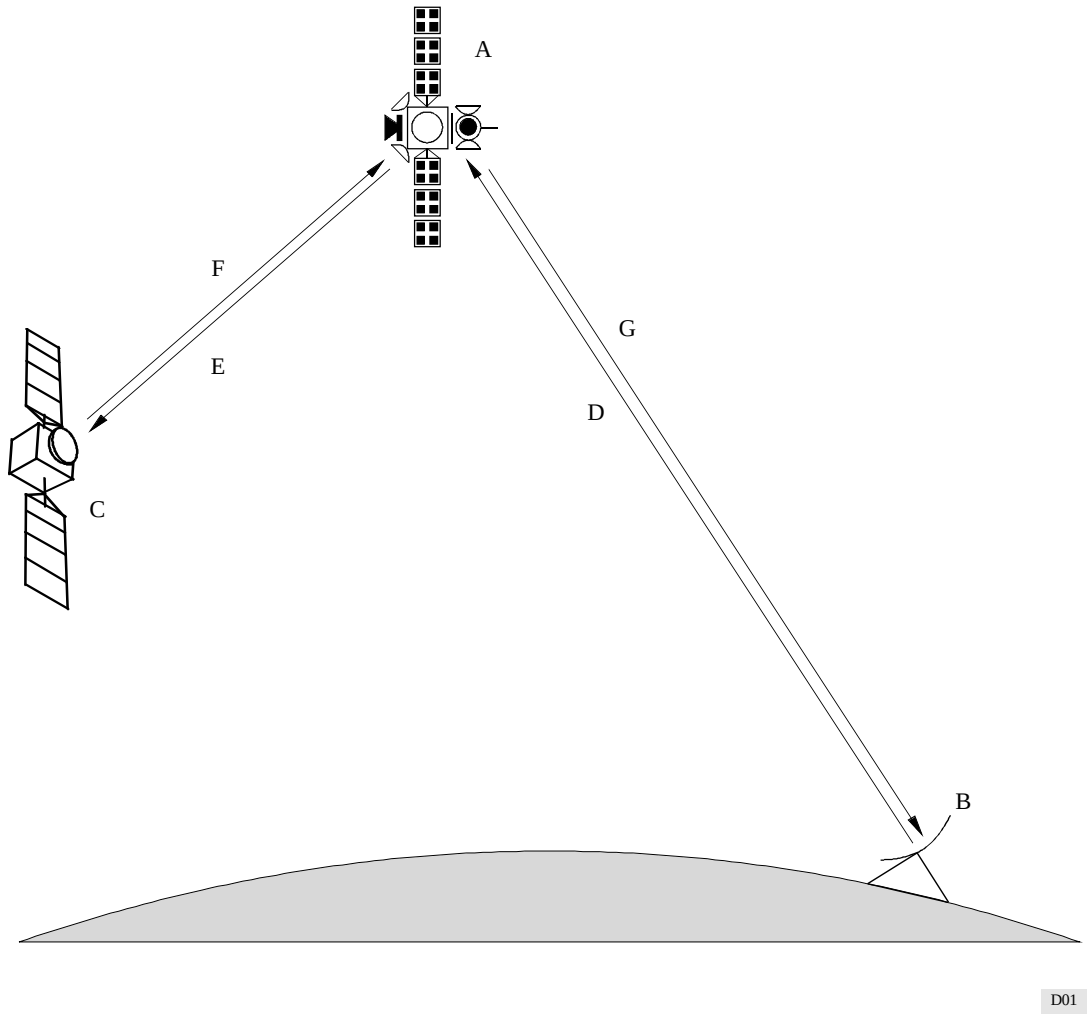
1.2 a space-to-space link in the forward direction, from the data relay satellite to the low-orbiting spacecraft (the forward inter-orbit link);

1.3 a space-to-space link in the return direction, from low-orbiting spacecraft to the data relay satellite (the return inter-orbit link); and

1.4 a space-to-Earth link in the return direction, from the data relay satellite to the earth station (the return feeder link);

FIGURE 1

Hypothetical reference system for data relay satellite systems



A: Data Relay Satellite (DRS)
B: DRS earth station
C: DRS user spacecraft
D: forward feeder link
E: forward inter-orbit link (IOL)
F: return inter-orbit link (IOL)
G: return feeder link

2. in the forward direction, the input to the circuit should correspond to the input of the earth station modulator carrying out the translation from the baseband to the radio frequency carrier and the output should:

2.1 for the case of a demodulating receiver on board the user spacecraft, correspond to the output of the demodulator on board the user satellite, or

2.2 for the case of a repeater on board the user spacecraft, correspond to the output of the earth station demodulator receiving the return feeder-link signal;

3. in the return direction, the input to the circuit should correspond to the input of the user spacecraft modulator carrying out the translation from the baseband to the radio-frequency carrier and the output should correspond to the output of the earth station demodulator carrying out the reverse operation;

4. that links between earth stations and the operations, data processing or other earth-based centres should not be included in this hypothetical reference system.