

RECOMMENDATION ITU-R SA.1627

Telecommunication requirements and characteristics of EESS and MetSat service systems for data collection and platform location

(Question ITU-R 142/7)

(2003)

The ITU Radiocommunication Assembly,

considering

- a) that satellite data collection systems and (DCS) platform location of the Earth exploration- and meteorological-satellite (EESS and MetSat service) services have unique telecommunication requirements;
- b) that the allocation to the EESS in the band 401-403 MHz had been raised to primary status at WRC-97;
- c) that information concerning the characteristics of present and future DCS is useful for carrying out studies based on Recommendations ITU-R SA.1162, ITU-R SA.1163 and ITU-R SA.1164,

recommends

- 1 that the requirements and characteristics described in Annex 1 should be taken into account in planning satellite DCS and platform location of the EESS and MetSat service.

Annex 1**Telecommunication requirements and characteristics of EESS and MetSat service DCS and platform location****1 Principle and applications**

This Recommendation applies to EESS and MetSat service DCS and platform location. The purpose of a satellite DCS is to provide a telecommunication network for users needing information from a variety of sources, which may be located anywhere in the world, including oceans, deserts or other not easily accessible regions.

The concept of a satellite DCS is the following:

- automatic, autonomous platforms installed on land or mounted on a support (boat, aircraft, balloon, anchored or drifting buoy, land vehicle) for the transmission of meteorological (pressure, temperature, humidity, etc.) or geophysical (tsunami warnings, seismic, oceanographic and geodetic data, etc.) parameters. These platforms should, as far as possible, be light and compact, use little power and be inexpensive;

- the information compiled and transmitted by the platforms is received on board a satellite and forwarded through one or more data acquisition earth stations to a system management centre;
- once centralized, the information is carried to users by conventional means of telecommunication;
- if necessary, provision may also be made to distribute information from the management centre to the platforms through the same system.

Such a system differs from conventional telecommunications in that it cannot be conceived without the use of satellites and is intended for a special category of customers whose needs cannot be met by other means. In general, it favours one direction of transmission and essentially serves to centralize information. It may, however, be backed up by a facility for the distribution of information to the data collection platforms (DCPs). Finally, a requirement that is very important for many users is that the data collection function may easily be coupled with a location system which determines the coordinates of the transmitting platforms.

A DCS has many fields of application: meteorology, Earth resources, hydrography, seismic observation, vulcanology, geodesy and geodynamics, anchored or drifting oceanographic buoys, oil prospecting, wild animal tracking, etc.

2 Satellite system design

Two types of orbit may be used: the geostationary-satellite orbit (GSO) or low-Earth orbits (LEO).

2.1 LEO satellite systems

The LEO satellites are generally placed in circular orbits at altitudes of between 600 and 1 800 km, with a period of revolution of approximately 2 h. The whole of the Earth, including the poles, can be scanned with a single satellite, but the number of passes is relatively low (about three or four per day over the equator). It may be increased by using several satellites, e.g. a twelve passes per day over the equator may be obtained with three satellites. Passes are far more frequent near the poles.

A single equatorial satellite could cover the Earth tropical region with a dozen passes per day. A satellite constellation with low inclination could considerably extend the Earth covered area, as a complementary system to the polar one.

The platforms of the LEO satellite systems are generally simple due to the better radio link budget compared with the GSO satellites. The location function is easier to provide using the Doppler-Fizeau effect.

However they have a limited instantaneous coverage area; typically the geocentric half-angle of the field of view is of the order of 30°, and the duration of the mutual visibility between the satellite and a given beacon is limited to a range generally from 10 to 15 min. Furthermore, it is necessary to store information on board the satellite to provide the worldwide coverage.

A typical example of a LEO satellite system is the one of the National Oceanographic and Atmospheric Administration (NOAA) in the United States of America with two meteorological satellites in sun-synchronous orbits. The planes of the two circular orbits are orthogonal, the

inclination about 98° , the altitudes are 830 and 870 km and the orbital period about 102 min. Another example of a LEO satellite system is the Brazilian DCS based on low inclination orbit satellites (25°) and an altitude of 750 km, acting as a complementary system to the NOAA satellites.

The METOP series of satellites from EUMETSAT, the first launch of which is scheduled in 2003, constitute another example of a LEO satellite system. Those satellites are sun-synchronous having an altitude of 820 km.

2.2 GSO satellite systems

The geometric coverage area of a geostationary satellite is a spherical cap with a geocentric half-angle of approximately 81° .

The GSO satellite provides a permanent visibility over a vast area, quasi of the scale of an hemisphere. The information is transmitted continuously and reaches the user very rapidly. However, at least four satellites are required for world coverage, excluding the polar regions. The platforms must be equipped with directional antennas and/or higher powered transmitters than for the LEO case. Finally, the location function is difficult to provide.

A GSO satellite system is essential where instantaneous transmission is required either continuously or at set times. Because a large number of platforms are visible from a GSO satellite, the DCP transmissions must occupy up to several hundred channels in the band 401-403 MHz, the exact number being different for different systems.

3 Platform location

Mobile platforms (balloons, drifting buoys, wild animals, etc.) are used for a great many applications and their movements, which are unpredictable, need to be tracked in order to carry out the mission (wind determination, study of marine currents, study of migratory movements, etc.). In such cases, the location and collection functions are performed simultaneously.

Either the distance or the radial velocity (Doppler effect), or both, may be measured. A number of measurements are taken and processed in order to locate the transmitting platform with an accuracy ranging from a few metres to a few kilometres.

The Doppler method of location is not applicable to GSO satellites. Location from GSO satellites may be theoretically achieved by interferometry from a single satellite or by ranging within the overlap area of two satellites.

4 Platform modes of operation

4.1 Interrogated platforms

4.1.1 Interrogated platforms in GSO satellite systems

Each platform contains both a transmitter and a receiver. The system management centre transmits to the satellite a work programme containing the addresses of the platforms to be interrogated and the time at which this operation must be carried out. The platforms cannot transmit unless they are interrogated. However, they can be designed to request interrogation, e.g. geophysical warning.