

## RECOMMENDATION ITU-R SA.1030

TELECOMMUNICATION REQUIREMENTS OF SATELLITE  
SYSTEMS FOR GEODESY AND GEODYNAMICS

(Question ITU-R 143/7)

(1994)

The ITU Radiocommunication Assembly,

*considering*

- a) that satellite systems for geodesy and geodynamics have unique telecommunication requirements;
- b) that these requirements affect assignments and other regulatory matters,

*recommends*

1. that the requirements and characteristics described in Annex 1 should to be taken into account in connection with frequency assignments and other regulatory matters concerning satellites systems for geodesy and geodynamics, and their interaction with services other than the Earth exploration-satellite service or the space research service.

## ANNEX 1

Telecommunication requirements and characteristics  
of satellite systems for geodesy and geodynamics

## 1. Introduction

This Recommendation applies to satellite systems in which one or more satellites are linked to earth stations and/or to each other by means of high-precision range and range-rate measurements, using radio waves.

There are other satellite systems which contribute to the advancement of geodesy and geodynamics:

- range measurements by pulsed laser;
- VLBI measurements on deep-space probes and celestial sources (see Recommendations on deep-space research);
- ocean altimetry using satellite-borne radar (see Recommendations on spaceborne active remote sensing);
- microwave radiometry for determining the composition of the troposphere and so correcting propagation effects on other measurements (see Recommendations on spaceborne passive remote sensing).

These various techniques are often jointly operated, with different equipments on board the same spacecraft and with earth stations colocated, that is to say close to each other and close to a geodetic fiducial point.



## 2. Telecommunication requirements for range and range-rate measurements

### 2.1 General

Space telecommunication systems for geodesy and geodynamics are generally required to perform three functions:

- high-precision orbit determination,
- high-precision positioning of points on the Earth's surface, and
- rapid data distribution (preferably, this function is performed by the system itself).

The first and second functions are closely linked. In order to position points in a geocentric reference system, it must be possible to predict or restore the satellite orbit in that reference system with a degree of accuracy comparable to that required for the positioning. Consequently, the orbit determination system used for the tracking of geodetic satellites must have better accuracy than that which is generally required for application satellites. Such an orbit determination system typically uses a fairly large number of earth stations (e.g. 10-50) distributed geographically so as to ensure continuous tracking of the satellite(s) which should always be visible from two or more stations. This network may be used also for geodetic applications, i.e. to determine parameters relating to the Earth's rotation, the geocentric coordinates of stations and the base lines linking pairs of stations.

The second function (precise absolute and relative point positioning) is generally performed with transportable ground stations or networks to be established temporarily in areas of geographical interest, sometimes in clusters of more than 20 stations within a limited region.

With respect to the third function, certain geodetic and satellite orbital parameters must be covered within a relatively short time (approximately one day). It may also be necessary to distribute *in situ* data gathered locally and orbit prediction data generated at a central facility.

### 2.2 Measurement telecommunications

Determination of the relative positions of earth stations and satellites or of their variation in relation to the movement of the spacecraft can be based on the measurement of:

- range,
- range rate,
- range difference (e.g. from two satellites to one earth station),
- range difference rate,
- double differential range (e.g. from each of two satellites to each of two earth stations),
- double differential range rate.

Classifying of measurement telecommunications may also be based on the number and direction of the links:

- one-way space-to-Earth,
- one-way Earth-to-space,
- one-way space-to-space (satellite-to-satellite tracking),
- two-way between earth stations and satellites,
- two-way between satellites.