RECOMMENDATION  ITU-R  S.521-3

# HYPOTHETICAL REFERENCE DIGITAL PATHS FOR SYSTEMS USING DIGITAL TRANSMISSION IN THE FIXED-SATELLITE SERVICE

(1978-1982-1986-1997)

The ITU Radiocommunication Assembly,

*considering*

a)    that it is desirable to establish hypothetical reference digital paths (HRDPs) for active fixed-satellite systems to afford guidance to designers of equipment and systems for use in networks employing digital transmission techniques;

b)    that satellite-to-satellite links may be used in the fixed-satellite service (FSS);

c)    that both geostationary and non-geostationary satellite systems will be part of the FSS;

d)    that some satellite systems include:

–    on-board processing with regeneration,

–    on-board processing with regeneration and switching on the satellite;

e)    that the transmission delay variation introduced by satellite movement is of significance in some applications but the buildout of such delay variations to their worst case to provide constant delay is outwith the scope of this Recommendation;

f)    that a FSS HRDP may form part of a hypothetical reference connection (HRX) as defined by ITU-T Recommendation G.801, Fig. 1;

g)    that satellite links may appear in the local, national, or international portion and combinations of two or more contiguous portions of a HRX;

h)    that inter-satellite links among geostationary satellites and non-geostationary satellites may be part of a single HRX;

j)    that a HRDP may include one or more intermediate space-to-Earth and Earth-to-space segments;

k)    that a HRDP may be independent of connections to the terrestrial network,

*recommends*

**1**    that the example HRDPs shown in Figs. 1-4 can be used to describe satellite connections. These figures show more than one satellite but in each case, there may be only one satellite;

**2**    that links between the earth stations and their associated terrestrial digital switching centres should be considered as part of the terrestrial network and should not be included in these HRDPs;

**3**    that for site diversity earth stations, the HRDP should also include the terrestrial links and any associated equipment necessary for connecting the diversity earth stations to the diversity switching point;

**4**    that the HRDPs include RF/IF, demodulation/modulation, error correction, buffer, processing, and multiplex equipment at the customer terminal or earth station;

**5**    that the terrestrial network may interface a HRDP at any bit rate depending on the application.

NOTE 1 – For satellite networks where earth station processing is integrated with dynamic allocation and rearrangement of capacity across the satellite link, the equipment to perform that processing should be regarded as part of the satellite HRDP. This processing may also include functions for:

–    efficient use of satellite bandwidth,

–    performance improvement,

–    service capabilities peculiar to the satellite system.

NOTE 2 – Customer terminal equipment which would be required to support the particular service(s) being offered regardless of the transmission medium it is connected to is assumed to be outside the satellite HRDP.

NOTE 3 – The HRDPs considered in this Recommendation apply to public networks only. Network operators may use these HRDPs for their private networks.

NOTE 4 – The HRDPs in this Recommendation are not limited to point-to-point services but may be used for multipoint and asymmetric services.

NOTE 5 – The need for additional HRDPs to encompass the range of new digital satellite systems is for further study.

NOTE 6 – This Recommendation does not address allocation of performance objectives to the HRDPs. It is recognized however that the same HRDP may be used to represent different satellite system configurations (e.g. on-board processing, earth station processing, non-processing transponder, inter-satellite link (ISL)) which may require different performance allocations.

ANNEX 1

Figure 1 describes a HRDP which may be in the national or international portion of a HRX, with connections to the terrestrial network at both ends.
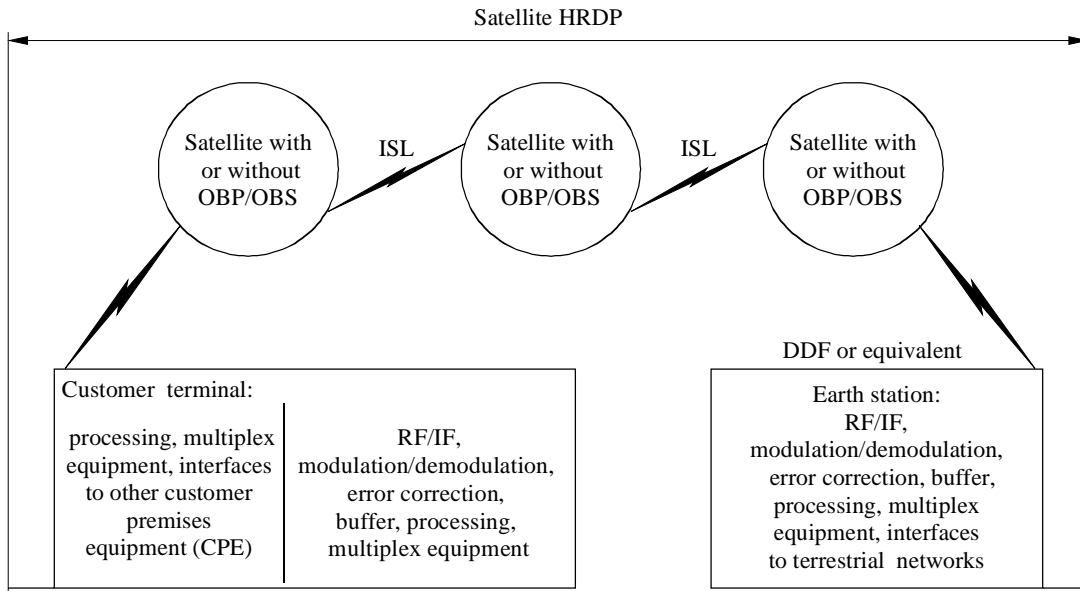
FIGURE 1
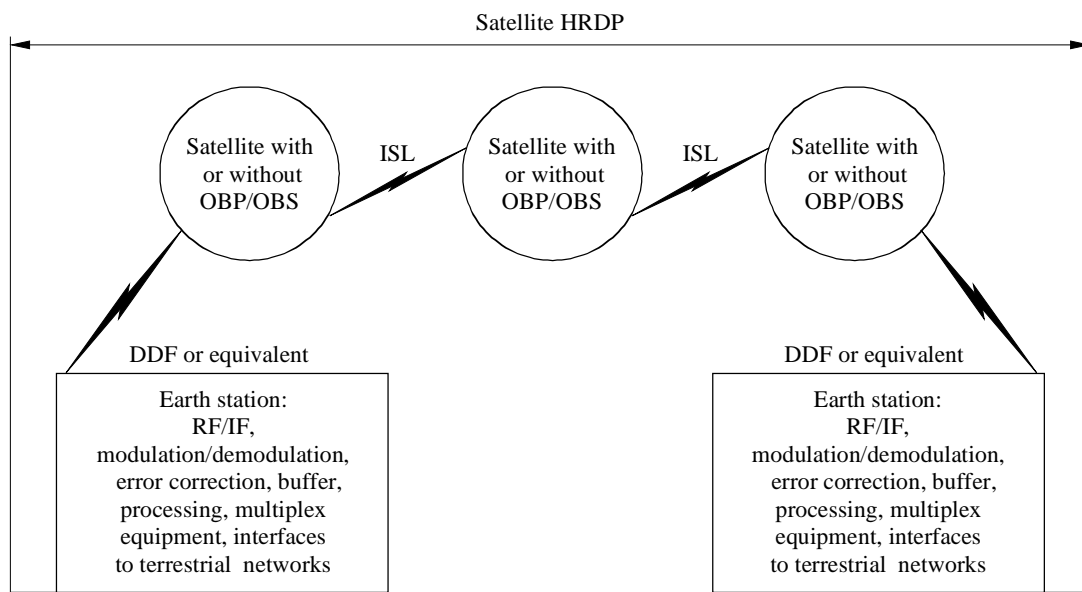


DDF: digital distribution frame
OBP: on-board processing
OBS: on-board switching

0521-01

Figure 2 describes a HRDP which forms part of a HRX, with connection to the terrestrial network. It includes a local portion to the customer terminal. The HRDP may be in the domestic or international portion.
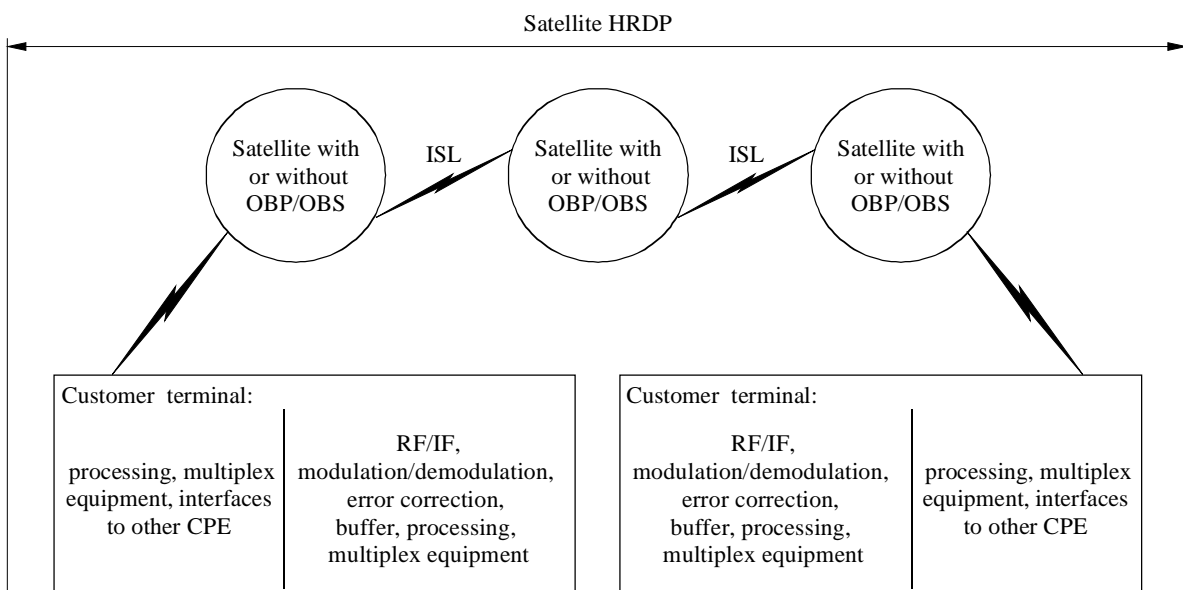
FIGURE 2

Satellite HRDP



Satellite with or without OBP/OBS

ISL

Satellite with or without OBP/OBS

ISL

Satellite with or without OBP/OBS

DDF or equivalent

Customer terminal:

processing, multiplex equipment, interfaces to other customer premises equipment (CPE)

RF/IF, modulation/demodulation, error correction, buffer, processing, multiplex equipment

Earth station: RF/IF, modulation/demodulation, error correction, buffer, processing, multiplex equipment, interfaces to terrestrial networks

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Figure 3 describes a HRDP which does not connect to the terrestrial network.

FIGURE 3

Satellite HRDP



Satellite with or without OBP/OBS

ISL

Satellite with or without OBP/OBS

ISL

Satellite with or without OBP/OBS

Customer terminal:

processing, multiplex equipment, interfaces to other CPE

RF/IF, modulation/demodulation, error correction, buffer, processing, multiplex equipment

Customer terminal:

RF/IF, modulation/demodulation, error correction, buffer, processing, multiplex equipment

processing, multiplex equipment, interfaces to other CPE

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Figure 4 describes a HRDP which includes a space-to-Earth and an Earth-to-space link to an intermediate earth station for further processing, but the HRDP does not connect to the terrestrial network.

FIGURE 4

Satellite HRDP



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