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DÜSSELDORF
21.5-1.6 1990
CCIR

XVIIth PLENARY ASSEMBLY
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INTERNATIONAL TELECOMMUNICATION UNION

REPORTS OF THE CCIR, 1990
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ANNEX TO VOLUME XII

TELEVISION AND SOUND TRANSMISSION (CMTT)

CCIR INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

Geneva, 1990

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92-61-04301-1

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INDEX OF TEXTS WHICH HAVE BEEN DELETED AT THE END OF THE STUDY PERIOD 1986-1990

(In order to facilitate the retrieval of a given text, the page No. of Volume XII of the XVIth Plenary Assembly, Dubrovnik 1986, is indicated.)

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(1) Recommendation 642, at present published in Volumes X-1 and XII, will not be published in the 1990 edition of Volume XII. Recommendation 642-1 will only be published in the 1990 edition of Volume X-1.

(2) Reports 817-2 and AA/CMTT have been deleted and replaced by Report 1241 (see Document CMTT/1021).

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TELEVISION AND SOUND TRANSMISSION (CMTT)

(CMTT)

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REPORT 965-1

TRANSMISSION PERFORMANCE OF TELEVISION CIRCUITS OVER SYSTEMS IN THE FIXED-SATELLITE SERVICE

(Question 13/CMTT and Study Programme 13A/CMTT)

(1982-1990)

1. Introduction

Since satellite circuits are designed and operated under limitations such as satellite equivalent isotropically radiated power (e.i.r.p.), occupied radio-frequency bandwidth, etc. it is necessary at this time to allocate values to some performance parameters that differ from the design objectives for the hypothetical reference circuit set out in Section D of Recommendation 567.

The values below are given as a reference for designers to assist them in determining the performance of chains which include circuits employing a satellite.

2. Maintenance values for the INTELSAT satellite system

Maintenance values for the INTELSAT satellite system are given in CCITT Recommendation N.62.

Additionally, the INTELSAT satellite system operations guide gives the following values for the signal-to-noise ratio (unified weighting):

525/60 Systems, full transponder: 53.3 dB

625/50 Systems, full transponder: 50.1 dB

525/60 Systems, half transponder: 48.7 dB

625/50 Systems, half transponder: 47.1 dB

3. Practical design values for a regional system

Practical design values for a European regional system are given in Table I.

In this table, column (a) gives values for the earth station/satellite/earth station segment. They have been justified by a series of tests with the European Space Agency (ESA) Orbital Test Satellite (OTS), which was launched in May, 1978 [EBU – Interim EUTELSAT, 1981].

Column (b) gives values for a terrestrial link connecting the earth station to a national technical control centre (CNCT) and which typically has a length of about 100 km. The values given are based largely on those in Recommendation 567 and would apply for lengths up to about one third of a hypothetical reference circuit.

Column (c) gives the resultant values for the whole chain from CNCT to CNCT, including terrestrial links, earth stations and the satellite. Wherever possible, the laws of addition specified in Recommendation 567 have been used.

TABLE I

§ of Part D of Rec. 567	Parameters	(a)	(b)	(c)
2.1	Nominal impedance	75 Ω		
2.2	Return loss	30 dB		
2.3	Non-useful d.c. component	0.5 V		
2.4	Nominal signal amplitude	1 V		
3.1	Insertion gain	0 ± 0.25 dB	0 ± 0.3 dB	0 ± 0.5 dB
3.1.1	Insertion gain variation (1 s)	± 0.1 dB	± 0.2 dB	± 0.3 dB
3.1.1	Insertion gain variation (1 h)	± 0.25 dB	± 0.3 dB	± 0.5 dB
3.2.1	Signal-to-continuous random noise	53 dB (1)	58 dB	51 dB
3.2.3	Signal-to-periodic noise (0-1 kHz)	50 dB	45 dB	39 dB
3.2.3	Signal-to-periodic noise (1 kHz - 6 MHz)	55 dB	60 dB	53 dB
3.2.4	Signal-to-impulsive noise	25 dB	25 dB (2)	25 dB (2)
3.3	Crosstalk between channels (undistorted)	58 dB	64 dB	56 dB
3.3	Crosstalk between channels (differentiated)	50 dB	56 dB	48 dB
3.4.1.1	Luminance non-linear distortion	10%	2%	12%
3.4.1.2	Chrominance non-linear distortion (amplitude)	3.5%	2%	5%
3.4.1.2	Chrominance non-linear distortion (phase)	4°	2°	6°
3.4.1.3	Differential gain (*x* or *y*)	10%	5%	13%
3.4.1.3	Differential phase (*x* or *y*)	3°	2°	6°
3.4.1.4	Chrominance-luminance intermodulation	± 4.5%	± 2%	± 5%
3.4.2.1	Steady-state sync pulse non-linear distortion	+ 5% − 10%	± 5%	+ 10-15%
3.4.2.2	Transient sync pulse non-linear distortion	20%		
3.5.1.2	Field-time waveform distortion	6%	2%	10%
3.5.1.3	Line-time waveform distortion	3%	2%	4%
3.5.1.4	Short-time waveform distortion (pulse/bar)	100 ± 12%	100 ± 6% (2)	100 ± 18% (2)
3.5.1.4	Short-time waveform distortion (pulse lobes)	3% (3)	1.5% (3)	4.5% (3)
3.5.3.1	Chrominance-luminance gain inequality	± 10%	± 6%	± 13%
3.5.3.2	Chrominance-luminance delay inequality	± 50 ns	± 60 ns	± 90 ns
3.5.4.1	Gain/frequency characteristic (0.15 - 6 MHz)	± 0.5 dB	± 0.5 dB (4)	± 1.0 dB (4)
3.5.4.2	Delay/frequency characteristic (0.15 - 6 MHz)	± 50 ns	± 50 ns (4)	± 105 ns (4)

(1) In cases where the receive earth-station is colocated with the broadcaster's premises, a relaxation of up to 3 dB in video signal-to-weighted-noise ratio may be permissible. In this context, the term "colocated" is intended to represent the situation where the noise contribution of the local connection is negligible.

(2) Law of addition not specified in Recommendation 567.

(3) The pulse lobes are contained within a mask of the type shown in Fig. 29a in Recommendation 567. The figure in column (a) is the amplitude of the mask in Fig. 29a for times $\leqslant -800$ ns and $\geqslant 800$ ns. The figures in columns (b) and (c) are corresponding amplitudes of scaled versions of the mask.

(4) Highest frequency: 5 MHz.

4. Measured values for a regional system

Measurements performed on the EBU leased network with the first generation of the EUTELSAT satellites (EUTELSAT I F2) and standard EUTELSAT earth stations (G/T = 39 dB) lead to the values presented in Table II for the whole transmission chain from CNCT to CNCT with single TV carrier per 72 MHz transponder.[CCIR, 1986-90a]

TABLE II

Parameters (defined in Recommendation 569)	Measurements from CNCT to CNCT*
- luminance bar amplitude error	± 7%
- base line distortion	± 3.5%
- 2T pulse/bar ratio error	± 8.5%
- peak differential gain	± 6.5%
- chrominance-luminance gain inequality	± 11.5%
- signal-to-weighted random noise ratio	55 dB

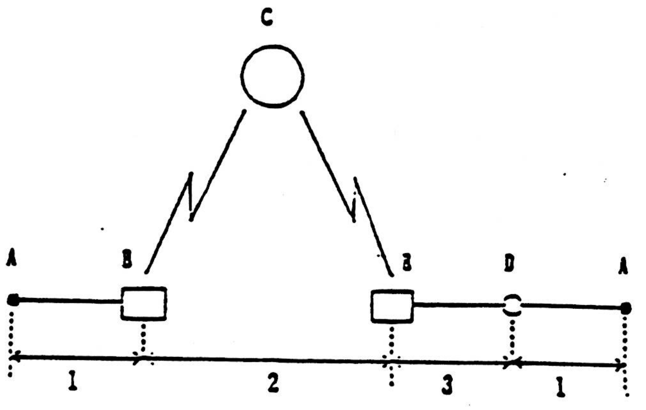
* 80% of the values (110) measured by the EBU are better than these given figures.

5. **Mixed terrestrial and satellite TV transmission circuits and their specified performance in Japan**

In Japan a new television transmission network is utilized in order to allow multi-destination transmission and to improve circuit flexibility. The 14/12 GHz band satellite communication system is being introduced systematically into the existing terrestrial television network [CCIR, 1986-90b].

A typical transmission circuit is shown in Figure 1 which consists of an earth station/satellite/earth station segment, a terrestrial circuit connecting the earth station to a terminal station and two local circuits.

The designed transmission performance for this circuit A to A in Figure 1 (see Table III) satisfies the performance objectives in Recommendation 567 [CCIR, 1986-90c]. In order to improve availability, two receiving earth stations with interconnecting terrestrial circuits and automatic selection are proposed.



1: Local television circuit
2: Satellite television circuit
3: Terrestrial television circuit (third of hypothetical reference circuit)

A: Program sending or receiving station
B: Earth station
C: Satellite space station
D: Terminal station

FIGURE 1

Typical mixed terrestrial and satellite TV transmission circuits

TABLE III

Performance of video circuit utilizing fixed satellite and terrestrial system

§ of Part D of Rec. 567	Parameters		(a) Design Objectives	(b) Measured Values
2.1	Nominal impedance		75/124Ω (UB/B)	75Ω (UB)
2.4	Nominal signal amplitude (V)		1.0	1.0
3.1	Insertion gain	(dB)	0±0.5	-0.36
3.1.1	Insertion gain variation (1 s)	(dB)	±0.3	0.05
3.1.1	Insertion gain variation (1 h)	(dB)	±0.5	0.11
3.2.1	Signal-to-continuous random noise	(dB)	53	59.6
3.4.1.1	Luminance non-linear distortion	(%)	5	1.0
3.4.1.2	Chrominance non-linear distortion (amplitude)	(%)	4	1.0
3.4.1.2	Chrominance non-linear distortion (phase)	(deg.)	4	1.0
3.4.1.3	Differential gain (x or y)	(%)	10	1.49
3.4.1.3	Differential gain (x or y)	(deg.)	5	0.38
3.4.1.4	Chrominance-luminance intermodulation	(%)	± 3	-0.4
3.4.2.1	Steady-state sync pulse non-linear distortion	(%)	± 10	-4.2
3.5.1.2	Field-time waveform distortion	(%)	± 6	-1.0
3.5.1.3	Line-time waveform distortion	(%)	± 3	-2.1
3.5.1.4	Short-time waveform distortion (pulse/bar)	(%)	100±12	104.2
3.5.1.4	Short-time waveform distortion (pulse lobes)	(%)	3	1.5
3.5.3.1	Chrominance-luminance gain inequality	(%)	± 10	0.9
3.5.3.2	Chrominance-luminance delay inequality	(ns)	±100	97
3.5.4.1	Gain/frequency characteristics (0.15-6MHz)	(dB)	± 1 (0.5-5MHz)	0.2 (0.5-5MHz)

Note - Columns (a) and (b) give the performance values for the entire circuit A to A (Figure 1).

REFERENCES

EBU – Interim EUTELSAT [1981] Analogue television transmission tests with OTS.

CCIR Documents

[1986-1990]: a. CMTT/9 (France); b. CMTT/42 (Japan); c. CMTT/233 (Japan).

REPORT 815-1

TRANSMISSION PERFORMANCE OF SATELLITE UP LINKS FOR TELEVISION BROADCASTING

(Question 13/CMTT and Study Programme 13A/CMTT)

(1978-1982)

The performance requirements for broadcast-satellite up links were examined by the CMTT at the Final Meeting as a result of a request from the Director, CCIR, in a letter RF(XIV)0-3 dated 21 February 1977.

Bearing in mind the possible interface conditions between the up link and the broadcast transmitter, which may not be at baseband, and the fact that the up link comprises only a part of a circuit in the fixed-satellite service, the CMTT wishes, as a possible aid to further studies regarding broadcast satellite up-link transmission performance, to comment as follows:

Recommendation 567 contains the definition of the hypothetical reference circuit for television transmission in the fixed-satellite service. In addition, Report 965 contains some transmission performance values for circuits over systems in the fixed-satellite service and some design values for a European regional system.

Since the hypothetical reference circuit for the fixed-satellite service contains only a single section it would be desirable that the up link of a broadcast satellite be considered as a fractional part of the hypothetical reference circuit for the fixed-satellite service. For practical purposes, an earth station-satellite-earth station loop can be considered equivalent to the hypothetical reference circuit, and the performance of the loop can be measured if the earth station is equipped with a suitable measuring receiver. In view of the probable configuration of the broadcast satellite, e.g. the method of interface between the up link and the broadcast transmitter, the up link can be considered, for most of the video transmission parameters, equivalent to half of a hypothetical reference circuit for the fixed-satellite service. On the basis of the list of characteristics given in Report 965, attention should be paid to Part E of Recommendation 567 which indicates the method to be applied to determine the transmission performance of circuits with fewer sections than the hypothetical reference circuit.

With regard to the noise performance of the up link, it is thought that the provision contained in the second paragraph of § 3.3 in Annex 8 to the Final Acts of the World Administrative Radio Conference on the broadcasting-satellite service (WARC-BS-77), should be taken into account for any signal-to-noise ratio requirement which may be derived for the up link on the basis of information in Recommendation 567. The provision of § 3.3 in Annex 8 to the Final Acts of WARC-BS-77 states that "the reduction in the quality in the down link* due to thermal noise in the up link is taken as equivalent to a degradation in the down-link carrier-to-noise ratio not exceeding 0.5 dB for 99% of the worst month".

At present a digital up link seems less likely than an analogue up-link for two reasons:

- for a current type of satellite transponder the broadcast signal would be modulated in the same way as the up-link signal;
- present technology is such that the decoder required to handle a low bit rate, high quality television signal from a broadcast satellite would be relatively expensive.

However, Report 952 indicates that very stringent protection ratios may be required in planning the up link (10 dB higher than the values for the down link). This in turn may necessitate different methods of transmission for the up link and for the down link, and therefore a need for demodulation and remodulation in the satellite. Two methods for transmission for the up link are envisaged:

- frequency modulation with a greater deviation;
- digital modulation.

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* Strictly speaking the broadcasting path.

In the future, digital satellite broadcasting may be possible if advancements in integrated circuit technology lead to low-cost decoders for television receivers. Digitally-coded broadcast signals are particularly attractive for such applications as subscription television, since encryption and other processes can be carried out more easily when the signals are in digital form.

REPORT 1090-1*

USE OF TRANSPORTABLE TRANSMITTING EARTH STATIONS FOR THE TRANSMISSION OF TELEVISION OUTSIDE BROADCASTS OVER SATELLITES

(Study Programme 13G/CMTT)

(1986-1990)

1. Introduction

The establishment of national and international contribution links for television outside broadcasts using terrestrial circuits often involves significant problems with regard to circuit access, circuit reconfiguration and alignment. In difficult cases, substantial equipment and human resources are required and the viability of an outside broadcast from a site which is remote from normal points of signal origination, is often determined by the time required to establish the circuit.

Many of these problems can often be overcome by using transportable transmitting earth stations which may be quickly transported to the outside broadcast site and set up in an up-link configuration to access an available satellite transponder which is used by a satellite receive earth station in the fixed-satellite service.

The use of this concept introduces a need for standards on transmission performance objectives and the determination of the requirements for operation and command.

2. Transportable transmitting earth station basic characteristics

The transportable transmitting earth station should be compact, robust and easily set up and to reduce set-up difficulties, the antenna diameter should ideally be 2 to 3 m. This size suggests the earth station should operate in the 10 to 15 GHz band which is particularly well suited for this function.

The station should be equipped to accept standard video and audio signals as described in the various texts of the CCIR.

3. Specific needs for operation and command

3.1 *Functions required*

The initial assumption is that the transportable earth station may be operated from any point of the satellite up-link coverage area.

The power applied to the earth-station antenna should be adjustable to take account of its geographical location, the constraints imposed by the space sector operating characteristics, and to compensate for degradation due to rain attenuation.

To provide operational flexibility, the earth station should be equipped to access any of the available satellite transponders.

Although the main purpose of the transmitting earth station will be to transmit television signals (video and sound) to the satellite, a receiving capability is also required in order to:

- facilitate satellite acquisition;
- check the up link and satellite circuit by establishing a loop back to the transmit earth station;
- communicate with the receive earth station with a dedicated circuit either by terrestrial means or by satellite.

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* This Report should be brought to the attention of Study Group 4.

3.2 *Operating requirements*

The station requires the following minimum measurement capabilities in order to verify:

- the frequency of transmission;
- the frequency deviation, including energy dispersal and modulation sense;
- the e.i.r.p.

To ensure correct operation, the station should have the capability of transmitting test signals (video and audio) to enable the receiving site to measure all necessary parameters (e.g. those described in Recommendation 567).

Deviation, frequency and antenna alignment should be adjustable as required by the satellite terminal control.

To maintain picture quality, the radiated power should be controllable by the satellite terminal control or the National Technical Control Centre (CNCT).

4. Overall performance objectives

As a result of the relative simplicity of satellite circuitry, overall performance for most parameters is dictated by the earth-station equipment. With the exception of the noise parameter, experience to date indicates that performance is as good as, or in some cases better than, that outlined in Recommendation 567 for the video component and the various Recommendations for the sound component. In these cases, the deviation of the carrier has a direct impact on the results.

Noise, however, depends upon both antenna size and e.i.r.p. Recommendation 567 provides an objective for the weighted video signal-to-noise (*S/N*) ratio of 53 dB for the hypothetical reference circuit in the fixed-satellite service. Report 965 indicates that the inclusion of terrestrial connections between the CNCT and earth stations reduces the *S/N* ratio to 51 dB. However, an *S/N* ratio of 51 dB is acceptable for the satellite circuit objective in the case of outside broadcast transmissions with a transportable transmitting earth station. This is based on the fact that the transmitting earth station will generally be located very close to the signal source and the performance of the receive end link to the CNCT will generally be much better than 53 dB.

4.1 Results obtained in France using a regional system (EUTELSAT I) with single TV carrier per 72 MHz transponder

Operations in France using satellites in the 10 to 15 GHz band, with a transmit antenna diameter size of 2.4 m, indicate that with clear sky conditions within an up-link coverage area as large as West Europe or Australia, the *S/N* ratio can be met with an e.i.r.p. of 73 dBW (see Table I). Further details can be found in [CCIR, 1982-86a and b].

This value of radiated power is typical for meeting a video *S/N* ratio of 51 dB. However, it may need to be modified depending on the noise contribution from the down link.

4.2 Performance expected on a regional system (EUTELSAT I) using two TV carriers per 72 MHz transponder

The EBU has carried out tests on the transmission of two TV programmes in a EUTELSAT I satellite repeater (72 MHz bandwidth) [CCIR, 1986-90a].

The signal quality obtained in these tests was considered by the EBU to be satisfactory and has prompted them to prepare for this type of operation.

In view of the constraints connected with multicarrier operation, in particular, adjacent channel interference, the transmitting earth stations (stations with G/T of 39 dB) have adopted an input backoff of 6 dB (i.e. a maximum e.i.r.p. of 76 dBW).

TABLE I - Video noise performance obtained over TV transmission circuits via satellite

Satellite e.i.r.p. (dBW)	Trans-mitted e.i.r.p. (dBW)	$(S/N)_w$ ratio (dB) received at large receiving antenna $(G/T = 39\ dB(K)^{-1})$		$(S/N)_w$ ratio (dB) received at small receiving antenna $(G/T = 27\ dB(K)^{-1})$	
		Earth station ↗ Satellite ↘ Earth station	Earth station ↗ Satellite ↘ Earth station → CNCT	Earth station ↗ Satellite ↘ Earth station	Earth station ↗ Satellite ↘ Earth station → CNCT
45 (EUTELSAT I satellite) (limited coverage)	69	53	52	48	48
	69.7	53	52		
	75.5	57	55		
39 (EUTELSAT I satellite) (global coverage)	76	55 to 58 (1)	54 to 57 (1)	49 to 50 (1)	49 to 50 (1)
39.4 (2) (INTELSAT V satellite) (West spot beam edge)	69.3	—	—	53 (3)	—

(1) Value obtained over a long period, using several receiving stations in Europe.

(2) Allotted to the 36 MHz RF bandwidth of a 72 MHz West Spot beam transponder on INTELSAT V satellite. The satellite e.i.r.p. toward the receiving earth station was estimated to be approximately 42 dBW.

(3) Value obtained by using vehicle-equipped transportable receiving earth station having a system G/T of 27.0 $dB(K)^{-1}$.