

RECOMMENDATION ITU-R SNG.1421*

COMMON OPERATING PARAMETERS TO ENSURE INTEROPERABILITY FOR TRANSMISSION OF DIGITAL TELEVISION SATELLITE NEWS GATHERING

(Question ITU-R 249/4)

(1999)

The ITU Radiocommunication Assembly,

considering

- a) that to facilitate the international coverage of news, it is necessary to adopt uniform operating parameters for digital satellite news gathering (SNG), to ensure interoperability between equipment from different manufacturers;
- b) that Recommendation ITU-R SNG.1007 gives uniform technical standard (digital) for SNG,

recommends

- 1 that the digital SNG equipment should comply with the uniform operating parameters described in Annex 1.

ANNEX 1

1 Scope

According to Recommendation ITU-R SNG.770, SNG is defined as “Temporary and occasional transmission with short notice of television or sound for broadcasting purposes, using highly portable or transportable uplink earth stations...”. The equipment should be capable of uplinking the video programme (or programmes) with its associated sound or sounds programme signals.

Limited receiving capability should be available in the uplink terminal to assist in pointing the antenna and to monitor the transmitted signal, where possible.

The equipment should be capable of providing two-way communication circuits and data transmission according to § 4.

Maximum commonality with Recommendation ITU-R BO.1211 is maintained, such as transport stream multiplexing, scrambling for energy dispersal, concatenated error protection strategy based on Reed-Solomon (RS) coding, convolutional interleaving and inner convolutional coding. The baseline system includes all the transmission formats included in Recommendation ITU-R BO.1211, based on quaternary phase shift keying (QPSK) modulation. Nevertheless it is possible to use more spectrum efficient modulation schemes like eight-phase shift keying (8-PSK) modulation and sixteen-quadrature amplitude modulation (16-QAM) for some specific applications.

The following warnings should be taken into account while using the high spectrum efficiency modes, 8-PSK and 16-QAM:

- they require higher transmitted e.i.r.p.s and/or receiving antenna diameters, because of their intrinsic sensitivity to noise and interferences;
- they are more sensitive to linear and non-linear distortions; in particular 16-QAM cannot be used on transponders driven near saturation;

* This Recommendation should be brought to the attention of Radiocommunication Study Group 11 and Working Party 2 of Telecommunication Standardization Study Group 9.

- they are more sensitive to phase noise, especially at low symbol rates; therefore high-quality frequency converters should be used;
- the system modulation/coding schemes are not rotationally-invariant, so that cycle-slips and phase snaps in the chain can produce service interruptions; therefore frequency conversions and demodulation carrier recovery systems should be designed to avoid cycle-slips and phase snaps.

The system is suitable for use on different satellite transponder bandwidths, either in single carrier per transponder or in multiple carriers per transponder (frequency division multiplex (FDM)) configuration. Appendix 1 gives examples of possible use of the system.

Satellite operators should also consider providing appropriate satellite capacity.

The use of conditional access systems and other service components, such as auxiliary data or vertical blanking interval data, are outside the scope of this Recommendation.

2 Source encoding, service information and multiplexing

2.1 Video encoding

Video encoding to MPEG-2 main profile at main level (MP@ML) is in accordance with existing standards (ITU-T Recommendation H.222). The use of MPEG-2 4:2:2P@ML may also be considered.

Video source, bit rate, (horizontal and vertical resolution) do not affect interoperability. These parameters are not specified in this Recommendation as integrated receiver decoders (IRD) should handle these automatically.

2.2 Audio encoding

Audio encoding to MPEG layer I or II is in accordance with existing standards (ITU-T Recommendation H.222).

Audio channel configuration, source and bit rate do not affect interoperability. These parameters are not specified in this Recommendation as IRD should handle these automatically.

2.3 Data encoding

Subject for further study.

2.4 Program Specific Information (PSI) and Service Information (SI)

2.4.1 General

PSI and SI should conform to all relevant requirements in accordance with applicable standards and guidelines.

The following tables are mandatory for MPEG-2 DVB-S compliance:

PAT:	Program Association Table
PMT:	Program Map Table
CAT:	Conditional Access Table
NIT:	Network Information Table, actual delivery system
SDT:	Service Description Table, (actual transport stream)
TDT:	Time and Date Table
EIT:	Event Information Table, present/following actual transport stream.

Some of these service information tables or their contents may not be relevant to digital SNG service, but they are still required.

This Recommendation does not specify values or syntax of the service information tables but recommends that wherever possible default values should be used by the equipment to facilitate simple and rapid deployment of digital SNG.

In digital SNG transmissions, editing of the SI tables in the field may be impossible due to operational problems. Therefore, only the following MPEG-2 defined SI tables PAT, PMT and SDT transport stream Service Description Table are mandatory.

2.4.2 First SDT descriptor

The first descriptor in the SDT descriptor loop contains the descriptor which identifies the transport stream as of type “CONA” (with reference to the CONtribution Application).

<i>Syntax</i>	<i>No. of bits</i>	<i>Identifier</i>
transport-stream-descriptor (){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++)symbol 123 \f “Symbol” \s 10		
byte	8	uimsbf
symbol 125 \f “Symbol” \s 10		
symbol 125 \f “Symbol” \s 10		

Semantics for the transport-stream-descriptor:

The descriptor_length field is set to the value 0x04.

byte: This is an 8-bit field. The four bytes shall contain the values 0x43, 0x4F, 0x4E, 0x41 (ASCII: “CONA”).

2.4.3 Second SDT descriptor

In digital SNG (DSNG) transmissions, the SDT descriptor loop also contains a second descriptor, the digital SNG descriptor, with the following syntax:

<i>Syntax</i>	<i>No. of bits</i>	<i>Identifier</i>
DSNG-descriptor (){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) symbol 123 \f “Symbol” \s 10		
station_identification_char	8	uimsbf
symbol 125 \f “Symbol” \s 10		
symbol 125 \f “Symbol” \s 10		

descriptor_tag: 0x68

Semantics for the DSNG-descriptor:

station_identification_char: Is a field containing a string used for fast identification of the uplink station transmitting the transport stream. The characters in the string are coded in ASCII.

2.4.4 Guidelines

2.4.4.1 Guidelines for the usage of the SDT (transport stream Service Description Table) within digital SNG streams

SDTs are repeated at least every 10 s.

The station_identification_char field contains the following items, comma-separated and in the following order:

- usual station code,
- SNG headquarter,
- SNG provider.

The usual station code is the code assigned to the station by the satellite operator with which the station is most frequently used.

The SNG headquarter (operating during the transmission period) is the control centre through which the station can uniquely be identified (by giving its usual station code) and quickly located. The SNG provider is the owner of the SNG station.

IRDs should be flexible enough to handle at least the mandatory service information table, and intelligent enough to ignore optional service information that they have not been designed to utilize.

Digital SNG IRDs shall be able to decode and interpret the SDT and the descriptors specified.

2.4.4.2 Guidelines to achieve compatibility with consumer IRDs

If compatibility with consumer IRDs is required, the SDT shall contain three descriptors:

- The first descriptor is a transport stream descriptor [0x67] containing the ASCII string “DVB”. The presence of this descriptor implies that all SI tables shall be present according to the DVB-SI specification.
- The second descriptor is the transport stream descriptor [0x67] containing the ASCII string “CONA”. The presence of this descriptor indicates that the transmission is of contribution nature.
- For digital SNG transmissions, the third descriptor is the digital SNG descriptor [0x68].

2.5 Multiplexing

The system input stream is organized in fixed length packets, following the MPEG-2 transport multiplexer MUX (see ITU-T Recommendation H.222). The total packet length of the MPEG-2 transport multiplex packet is 188 bytes.

3 Transmission system

The system is defined as the functional block of equipment performing the adaptation of the baseband TV signal, from the output of the MPEG-2 transport multiplexer (see ITU-T Recommendation H.222), to the satellite channel characteristics.

The system transmission frame is synchronous with the MPEG-2 multiplex transport packets (see ITU-T Recommendation H.222).

The system uses QPSK modulation, and optionally 8-PSK and 16-QAM modulations, and the concatenation of convolutional and RS codes. For 8-PSK and 16-QAM, pragmatic trellis coding apply, optimizing the error protection of the convolutional code defined in Recommendation ITU-R BO.1211. The convolutional code is able to be configured flexibly, allowing the optimization of the system performance for a given satellite transponder bandwidth.

Digital television transmissions via satellite can be affected by power limitations, therefore ruggedness against noise and interference has been one of the design objectives of the system. On the other hand, when larger power margins are available, spectrum efficiency can be increased to reduce the cost of the space segment. Therefore the system offers many transmission modes (inner coding and modulations), giving different trade-offs between power and spectrum efficiency. For some specific contribution applications, some modes – QPSK and 8-PSK – thanks to their quasi-constant envelope, are appropriate for operation with saturated satellite power amplifiers, in single carrier per transponder configuration. All the modes – including 16-QAM – are appropriate for operation in quasi-linear satellite channels, in multi-carrier FDM type applications.

The following processes are applied to the data stream (see Fig. 1):

- transport multiplex adaptation and randomization for energy dispersal (according to Recommendation ITU-R BO.1211);
- outer coding (i.e. RS) (according to Recommendation ITU-R BO.1211);
- convolutional interleaving (according to Recommendation ITU-R BO.1211);
- inner coding:
 - punctured convolutional coding (according to Recommendation ITU-R BO.1211);
 - pragmatic trellis coding associated with 8-PSK and 16-QAM (optional);
- bit mapping into constellations:
 - QPSK (according to Recommendation ITU-R BO.1211);
 - 8-PSK (optional);
 - 16-QAM (optional);
- squared-root raised-cosine baseband shaping:
 - roll-off factor $\alpha = 0.35$ according to Recommendation ITU-R BO.1211 for QPSK, 8-PSK and 16-QAM;
 - additional optional roll-off factor $\alpha = 0.25$ (for the optional modulations 8-PSK and 16-QAM);
- quadrature modulation (according to Recommendation ITU-R BO.1211).

If the received signal is above C/N and C/I threshold, the forward error correction technique adopted in the system is designed to provide a quasi-error-free (QEF) quality target. The QEF means less than one uncorrected error-event per transmission hour, corresponding to bit error ratio (BER) = 1×10^{-10} to 1×10^{-11} at the input of the MPEG-2 demultiplexer.

3.1 Adaptation to satellite transponder characteristics

The symbol rate is matched to given transponder characteristics, and, in the case of multiple carriers per transponder (FDM), to the adopted frequency plan. Examples of possible use of the system are given in Appendix 1.

3.2 Interfacing

The system is limited by the following interfaces given in Table 1.

TABLE 1
System interfaces

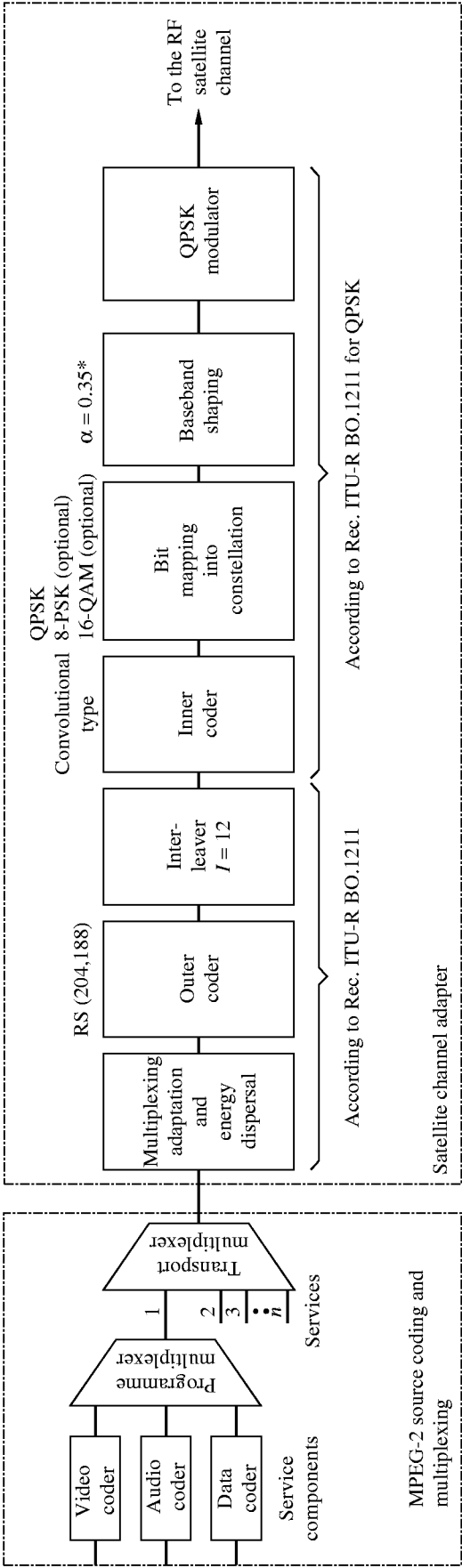
Location	Interface	Interface type	Connection
Transmit station	Input	MPEG-2 transport multiplex	From MPEG-2 multiplexer
	Output	70/140 MHz IF 1.5 GHz-band IF, RF	To RF devices
Receive station	Input	MPEG-2 transport multiplex	To MPEG-2 demultiplexer
	Output	70/140 MHz IF 1.5 GHz-band IF	From RF devices

3.3 Channel coding

3.3.1 Transport multiplex adaptation and randomization for energy dispersal

See Recommendation ITU-R BO.1211.

FIGURE 1
Functional block diagram of the system



* $\alpha = 0.25$ for 8-PSK and 16-QAM (additional and optional).

3.3.2 Outer coding (RS), interleaving and framing

See Recommendation ITU-R BO.1211.

3.3.3 Inner coding and bit mapping

As the spectrum may be inverted depending on the frequency converters chain, the demodulator needs to automatically adapt its configuration to comply with the actual situation.

3.3.3.1 Inner coding and bit mapping to QPSK mode (convolutional)

See Recommendation ITU-R BO.1211.

3.3.3.2 Inner coding and bit mapping for 8-PSK and 16-QAM modes (pragmatic trellis coding type)

The inner coding schemes produce pragmatic trellis coded modulations (TCM) which are an extension of the coding method adopted in Recommendation ITU-R BO.1211. The pragmatic TCMs are produced by the principle scheme shown in Fig. 2 and by Tables 2 and 3. The byte-parallel stream (P0 to P7 in Fig. 2) at the output of the convolutional interleaver are conveyed to a parallel-to-parallel converter (see Note 1), which split the input bits into two branches, depending on the selected modulation/inner coding mode.

NOTE 1 – The schemes of the parallel-to-parallel converters have been selected in order to reduce, on average, the byte error ratio at the input of the RS decoder (high concentration of bit errors in bytes). Therefore the BER after RS correction is reduced. Furthermore some MPEG sync-bytes are regularly convolutionally encoded.

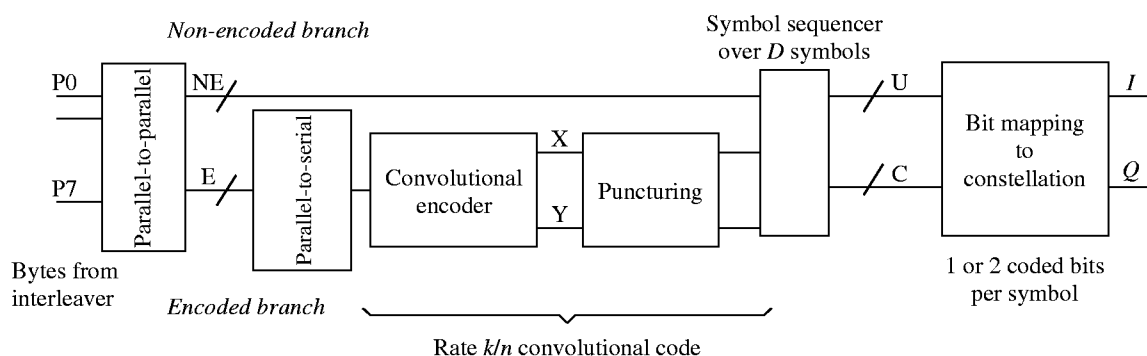
The parallel-to-parallel converter is synchronized in such a way that the MPEG sync-bytes, in the normal form (47_h) or bit-wise inverted form (B8_h), regularly appear in byte A (see Table 2). When an MPEG sync byte (47_h) is transmitted, the A byte shall be coded as follows: A = (A7, ..., A0) = 01000111.

The signal NE of the non-encoded branch generates, through the symbol sequencer, a sequence of signals U, each to be transmitted in a modulated symbol. These bits generate parallel transitions in the trellis code, and are only protected by a large Euclidean distance in the signal space (see bit mapping to constellation). The signal E in the encoded branch is processed by the punctured convolutional encoder according to Recommendation ITU-R BO.1211. These bits generate, through the symbol sequencer, a sequence of signals C, each to be transmitted in a modulated symbol. The specific coding scheme for each constellation and coding rate follows the specification given in § 3.3.3.2.1 to 3.3.3.2.3. A pragmatic trellis code characterized by c coded bits per symbol ($c = 1$ or 2) will be indicated in the following with the notation c CBPS (see Note 2).

NOTE 2 – The 1CBPS schemes require lower processing speed of the TCM decoder compared to 2CBPS schemes. The selections have been carried out on the basis of the best performance in the presence of additive white Gaussian noise (AWGN).

NOTE 3 – The QPSK modes described in § 3.3.3.1 can be generated by the TCM scheme of Fig. 2, without non-encoded bits.

FIGURE 2
Inner trellis coder principle



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