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Methods of measurement for digital network – Performance characteristics of terrestrial digital multimedia transmission network

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The text of this standard is based on the following documents:

CDV	Report on voting
103/89/CDV	103/106/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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METHODS OF MEASUREMENT FOR DIGITAL NETWORK –

Performance characteristics of terrestrial digital multimedia transmission network

1 Scope

When a transmission network for digital terrestrial television broadcasting (DTTB) is being deployed, new networking technologies such as the Single Frequency Network (SFN) can be employed excelling the conventional analogue TV systems. However, new technical evaluation parameters are introduced for installing SFN systems. In addition new quality evaluation methods are also established in order to achieve stable and high-quality broadcasting services avoiding the cliff effect, which is one of the typical phenomena in the digital transmission that the signal quality is abruptly degraded when the received C/N becomes just lower than a specific value representing the system limit.

Given the background described above, this International Standard has the purposes of

- establishing measuring methods that enable the objective evaluation of the performance of transmission networks so as to make stable DTTB services a reality,
- establishing a technical baseline, such as a definition of technical terms, to standardize measuring methods.

The measurement methods described in this standard are intended for digital terrestrial television transmission network test and validation. The measurement methods for digital terrestrial transmitter are not included in this standard. These methods are described in IEC 62273-1.

This standard does not give any regulations and/or mandatory requirements. The specifications and requirements defined for each system have priority over this standard. However, there may be some cases where details are not specified in each individual specification or different systems should be evaluated under a common measurement method. The purpose of this standard is to provide a common technical baseline that makes measurement results comparable in all cases.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62273-1:2007, *Methods of measurement for radio transmitters – Performance characteristics of terrestrial digital televisiont transmitters*

ISO/IEC 13818-1:2007, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

Amendments 1 to 6

TR 101 190*, Digital video broadcasting (DVB); implementation guidelines for DVB Terrestrial services;Transmission aspects*

TS 101 191, *Digital video broadcasting (DVB); DVB mega-frame for Single Frequency Network (SFN) synchronization*

TR 102 377, *Digital Video Broadcasting (DVB); DVB-H Implementation Guidelines*

ARIB STD-B31, *Transmission system for digital terrestrial television broadcasting*

3 Terms and abbreviations

ADC	Analog to Digital Converter
ARIB	Association of Radio Industries and Businesses
ASI	Asynchronous Serial Interface
ATM	Asynchronous Transfer Mode
BER	Bit Error Ratio
C/N	Carrier to Noise rate
CPU	Central Processing Unit
DTTB	Digital Terrestrial Television Broadcasting
DVB	Digital Video Broadcasting
DVB-H	DVB Handheld
DVB-T	DVB Terrestrial
D/U	Desired to Undesired Signal Ratio
END	Equivalent Noise Degradation
ETSI	European Telecommunication Standards Institute
FFT	Fast Fourier Transform
GPS	Global Positioning System
IF	Intermediate Frequency
IFFT	Inverse Fast Fourier Transform
IIP	ISDB-T Information Packet
IP	Internet Protocol
ISDB-T	Integrated Services Digital Broadcasting – Terrestrial
ISI	Inter Symbol Interference
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JEITA	Japan Electronics and Information Technology Industries Association
MER	Modulation Error Ratio
MFN	Multi-Frequency Network
MIP	Mega-frame Initialization Packet
MMSE	Minimum Mean Square Error
MPEG	Moving Picture Experts Group
OFDM	Orthogonal Frequency Division Multiplex
PCR	Program Clock Reference
PCR_AC	PCR Accuracy
PCR_FO	PCR Offset
PCR_OJ	PCR Overall Jitter
PDH	Plesiochronous Digital Hierarchy

PRBS	Pseudo Random Binary Sequence
PID	Packet Identifier
PLL	Phased Locked Loop
PN	Pseudo Random Noise
QAM	Quadrature Amplitude Modulation
RBW	Resolution Bandwidth
RF	Radio Frequency
RS	Reed-Solomon
SDH	Synchronous Digital Hierarchy
SFN	Single Frequency Network
SP	Scattered Pilot signal
SPI	Synchronous Parallel Interface
STL	Studio to Transmitter Link
STS	Synchronization Time Stamp
TMCC	Transmission and Multiplex Configuration Control signal
TS	Transport Stream
TTL	Transmitter to Transmitter Link
TV	TeleVision
UHF	Ultra-High Frequency (300 MHz to 3 000 MHz)
UI	Unit Interval
VBW	Video Bandwidth
VHF	Very High Frequency (30 MHz to 300 MHz)
VLAN	Virtual Local Area Network

4 General conditions of measurement

4.1 Definitions and classifications of digital terrestrial TV transmission network

4.1.1 General

The digital terrestrial broadcasting transmission networks defined in this standard consist of two or more Digital Tv transmitters, relay lines (SDH or PDH contribution link: e.g. satellite, ATM radio, ATM optical fibre, IP Ethernet VLAN), broadcast-wave relay stations (called Gap-Filler or Transposer) through which the same broadcasting program is transmitted. Figure 1 shows an example of the transmission network.

The network is classified in 4.1.2 and 4.1.3 according to the following conditions

a) Assigned frequencies of each transmitter station which compose the network.

b) Signal transmission method between transmitter stations.

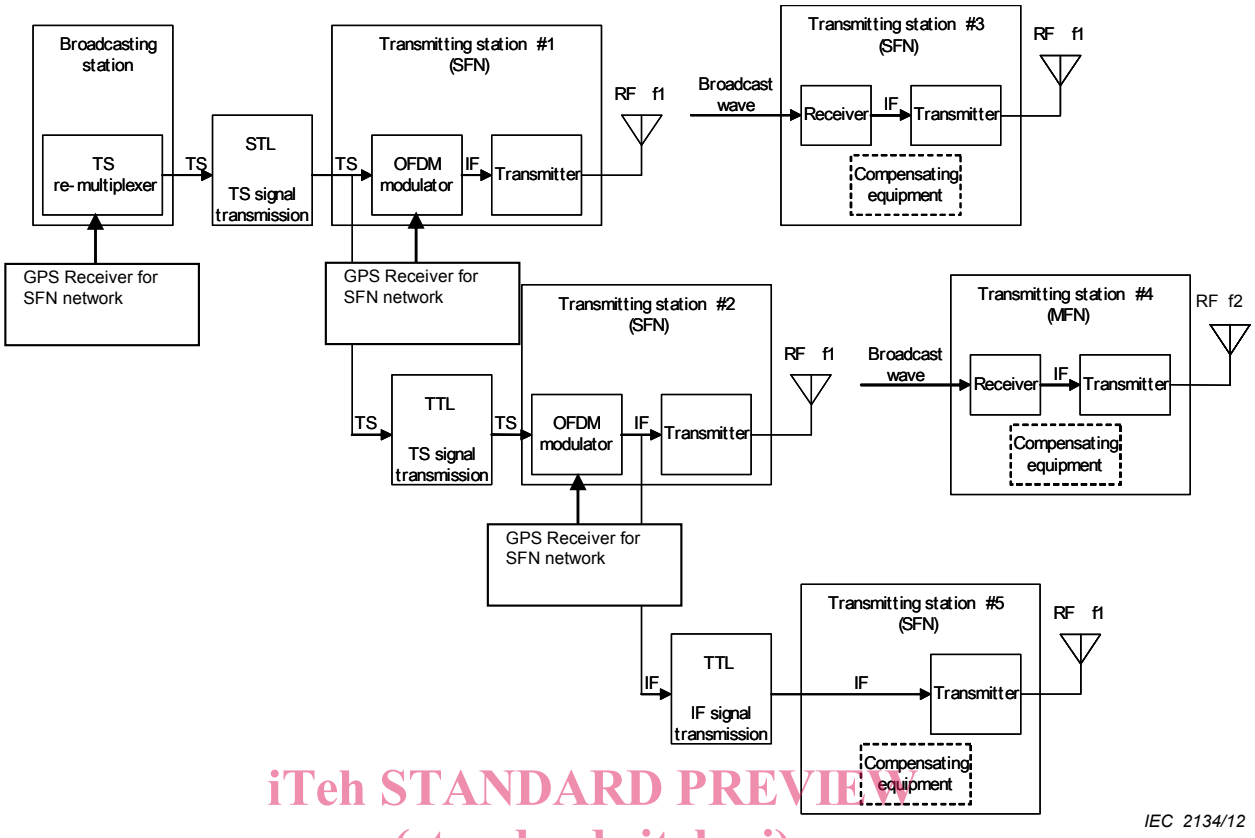

Figure 1 – Example of transmission network

4.1.2 Network classification for transmitting frequencies

SFN: Transmission network which is composed by plural transmitter stations whose assigned frequencies are the same. In Figure 1, transmitter stations, which are marked #1,#2,#3, and #5 and use the same transmitting frequency f1, compose the SFN.

MFN: transmission network which is composed by plural transmitter stations whose assigned frequencies are different. In Figure 1, #2 transmitter stations whose assigned frequency is f1 and #4 transmitter station whose assigned frequency is f2 compose the MFN.

In case of SFN, transmission parameters of each transmitter station should satisfy the following conditions:

a) The difference of transmitted frequency of each station should be within a specified range.

b) If necessary, the difference of sampling frequency of transmitted OFDM signals of each station should be within a specified range.

c) Waveform of transmitted signals means the channel modulation of each station should be the same. It means that the data contents of modulation of each station should be the same.

d) The difference of transmission timing of each transmitter station should be within a specified range.

e) The synchronized operation of each station shall be necessary. For synchronized operation, GPS time reference is used as a network reference signal or network should be locked to GPS time reference.

4.1.3 Network classification on useable contribution links for signal transport system between stations

Different contribution links for signal transport system between stations are investigated and mentioned in Table 1.

Table 1 – Classification of contribution link

Contribution link	Transmission system	Signal
STL(Studio to Transmitter Link)	Transport Stream transmission system	Digitalized Broadcast program and control information(note)
	IF transmission system	Modulated OFDM signal(note)
TTL(Transmitter to Transmitter Link)	Transport Stream transmission system	Digitalized Broadcast program and control information(note)
	IF transmission system	Modulated OFDM signal(note)
Broadcast wave relay	Broadcast wave relay system	Modulated OFDM signal(note)
NOTE Refer to 4.2.2 for signal form.		

4.2 Signal form

4.2.1 TS signal form

Signal form in which digitalized broadcast program contents and control information are multiplexed. For details of signal format, the following documents should be referred.

- DVB-T/H system: ETSI TR 101 190, ETSI TR 102 377
- ISDB-T system: ARIB STD-B31 Operational Guideline chapter 5.5

4.2.2 IF signal form

OFDM signal which is modulated by digitalized broadcast signal. For details of signal format, the following documents should be referred.

- DVB-T system: ETSI TR 101 190, ETSI TR 102 377
- ISDB-T system; ARIB STD-B31 Main body

4.3 Test signals and auxiliary signals for measurement

4.3.1 Test signals

As test signals for measurement, the following signals can be used. The broadcasting Transport Stream signal used for on-air services, or the equivalent broadcasting Transport Stream signal in it, or the OFDM signal used for on-air.

The specifications of the test signals should be specified for each system, but unless specified, for OFDM signal, the following transmission parameter set should apply, see Tables 2 and 3:

Table 2 – Parameter set of OFDM signal for test in ISDB-T system

Parameter	Value
Channel bandwidth	6 MHz
Number of carriers	8k
Guard interval ratio	1/8
Time interleave (see note)	I=2
Carrier modulation	64QAM
Coding rate of inner code	3/4 or 7/8
NOTE Apply for ISDB-T system.	

Table 3 – Parameter set of OFDM signal for test in DVB-T/H system

Parameter	Value
Channel bandwidth	6 MHz / 7 MHz / 8 MHz
Number of carriers	8k
Guard interval ratio	1/8
Time interleave(see note)	Native
Carrier modulation	64QAM
Coding rate of inner code	2/3
NOTE Apply for DVB-T/H system.	

4.3.2 Auxiliary signals for measurement

4.3.2.1 General

For measurement of signal delay, the auxiliary signals shown below are used.

4.3.2.2 Reference signal

a) 10 MHz signal; 10 MHz reference signal which is synchronized to GPS.

b) Sample clock pulse (see note); reference signal which is synchronized to Broadcast TS signal or sample clock signal of OFDM signal.

NOTE For 6 MHz ISDB-T system, its frequency is 512/63 MHz.

4.3.2.3 1 pps signal

Used for signal delay measurement within 1 s, unless specified, leading edge of 1 pps signal and up edge of 10 MHz sine wave signal should coincide.

1 pps signal and 10 MHz reference signal are obtained by making use of Reference signal generator with GPS synchronization.

4.3.2.4 Frame sync. Signal

Frame sync. Signal is extracted from frame synchronization information multiplexed in broadcast TS signal described in 4.2.1. In case of OFDM signal, frame sync. signal is regenerated from demodulator timing recovery circuit.

Frame sync. Signal may be used as a reference signal for signal delay measurement. The relationship between frame sync. Signal and sample clock should be specified for each system.

In addition, it is possible to widen the measurement range to more than 1 frame, by making use of the following information which is multiplexed in Transport stream.

- DVB-T system: mega-frame information, refer to ETSI TS 101 191.
- ISDB-T system: frame identification signal, refer to ARIB STD-B31.

5 Methods of measurement for signal delay time

5.1 Scope

Management of signal delay in transmission network is one important issue for SFN operation in Digital Terrestrial Broadcasting Network. In this clause, measurement methods for signal delay of transmission lines and equipments, and for relative delay time difference between different

transmission links are described. Signal delay of video and audio encoder/decoder is out of scope.

5.2 Definition of signal delay time

5.2.1 Delay time

As shown in Figure 2 a), delay time should be defined as the delay time between input signal and output signal of same transmission link.

Kinds of signal type of input/output are described in Table 4.

5.2.2 Relative delay time difference

As shown in Figure 2 b), relative delay time difference should be defined as the relative time difference between outputs of different transmission links.

Kinds of signal type of input/output are described in Table 4.

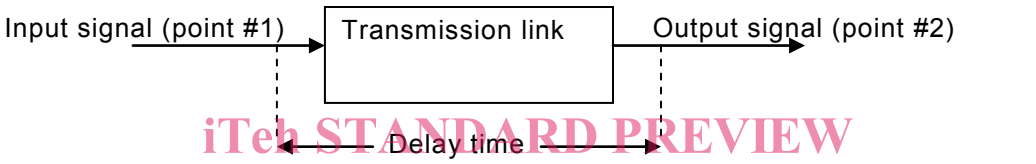

Figure 2 a) – Delay time definition

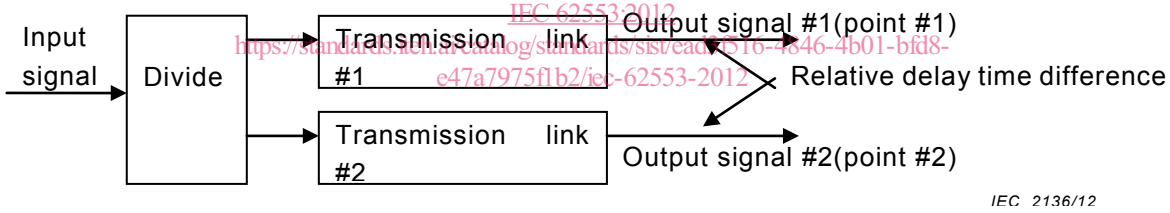

Figure 2 b) – Definition of relative delay time difference

Figure 2 – Delay time and relative delay time difference definitons

Table 4 – Combination of signal type

Measurement item	Measurement point #1	Measurement point #2
Delay time	Broadcast TS signal	Broadcast TS signal
	Broadcast TS signal	OFDM signal
	OFDM signal	OFDM signal
Relative delay time difference	Broadcast TS signal	Broadcast TS signal
	OFDM signal	OFDM signal

NOTE See details for signal type in Clause 4.

5.3 Direct/indirect measurement

5.3.1 General

As defined in 5.2, both signal delay and relative delay time difference are given as the time difference between measurement point #1 and #2.