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Methods of measurement for digital network – Performance characteristics of terrestrial digital multimedia transmission network  
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IEC 62553:2012

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## METHODS OF MEASUREMENT FOR DIGITAL NETWORK –

Performance characteristics of terrestrial digital  
multimedia transmission network

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

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

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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.

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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 television 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

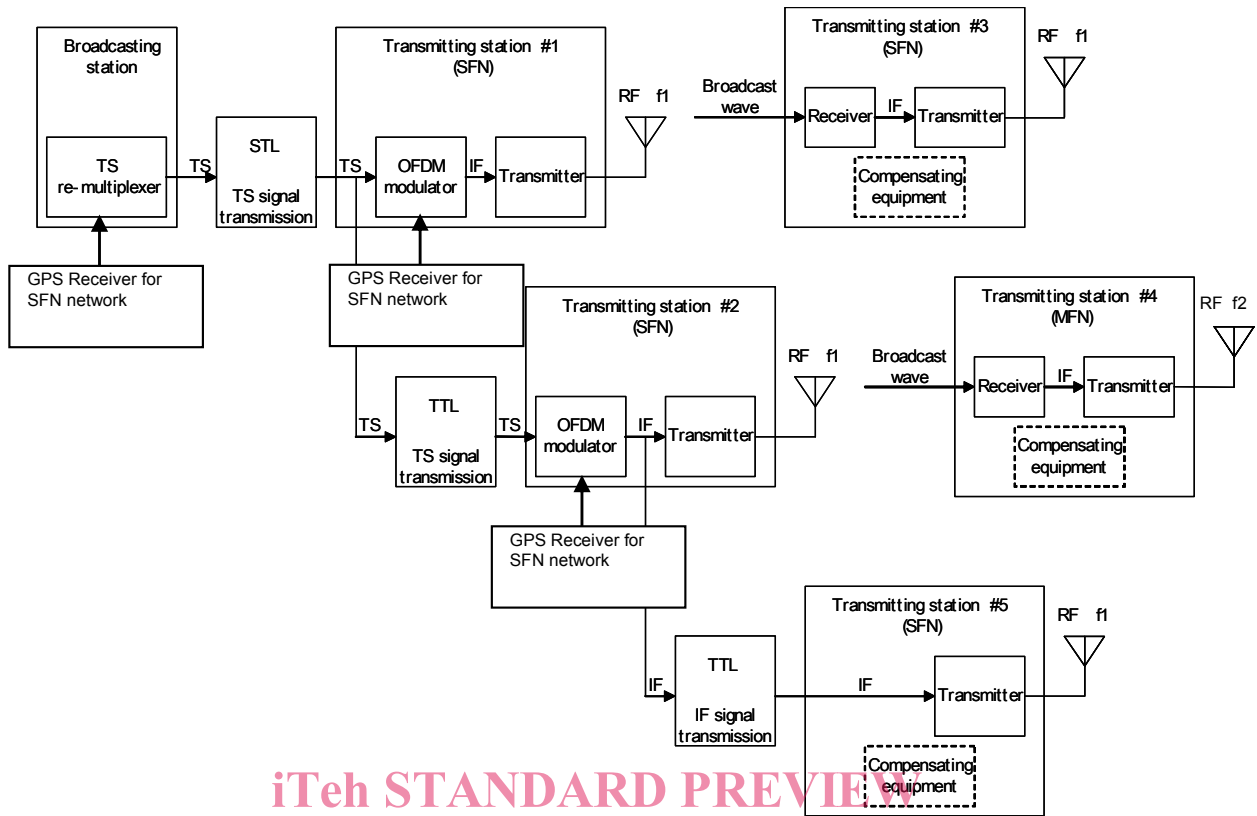
### 4.1 Definitions and classifications of digital terrestrial TV transmission network

#### 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

- Assigned frequencies of each transmitter station which compose the network.
- Signal transmission method between transmitter stations.



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Figure 1 – Example of transmission network

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#### 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  $f_1$ , 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  $f_1$  and #4 transmitter station whose assigned frequency is  $f_2$  compose the MFN.

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

- The difference of transmitted frequency of each station should be within a specified range.
- If necessary, the difference of sampling frequency of transmitted OFDM signals of each station should be within a specified range.
- 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.
- The difference of transmission timing of each transmitter station should be within a specified range.
- 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)    | 1=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.

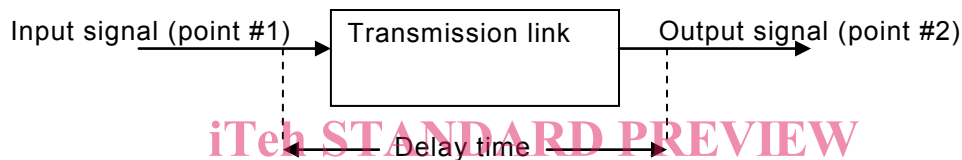


Figure 2 a) – Delay time definition

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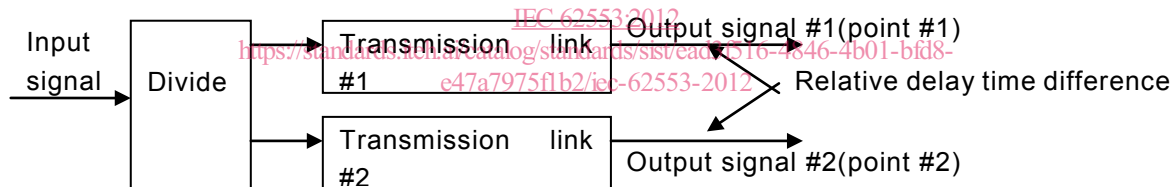


Figure 2 b) – Definition of relative delay time difference

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Figure 2 – Delay time and relative delay time difference definitions

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.