



**Recommendation ITU-R BT.1877-2**  
(12/2019)

**Error-correction, data framing, modulation  
and emission methods and selection  
guidance for second generation digital  
terrestrial television broadcasting systems**

**BT Series**  
**Broadcasting service**  
**(television)**



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### Series of ITU-R Recommendations

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| Series     | Title                                                                                |
|------------|--------------------------------------------------------------------------------------|
| <b>BO</b>  | Satellite delivery                                                                   |
| <b>BR</b>  | Recording for production, archival and play-out; film for television                 |
| <b>BS</b>  | Broadcasting service (sound)                                                         |
| <b>BT</b>  | <b>Broadcasting service (television)</b>                                             |
| <b>F</b>   | Fixed service                                                                        |
| <b>M</b>   | Mobile, radiodetermination, amateur and related satellite services                   |
| <b>P</b>   | Radiowave propagation                                                                |
| <b>RA</b>  | Radio astronomy                                                                      |
| <b>RS</b>  | Remote sensing systems                                                               |
| <b>S</b>   | Fixed-satellite service                                                              |
| <b>SA</b>  | Space applications and meteorology                                                   |
| <b>SF</b>  | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| <b>SM</b>  | Spectrum management                                                                  |
| <b>SNG</b> | Satellite news gathering                                                             |
| <b>TF</b>  | Time signals and frequency standards emissions                                       |
| <b>V</b>   | Vocabulary and related subjects                                                      |

**Note:** This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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## RECOMMENDATION ITU-R BT.1877-2

**Error-correction, data framing, modulation and emission methods and selection guidance for second generation digital terrestrial television broadcasting systems**

(Question ITU-R 132-5/6, 133-1/6)

(2010-2012-2019)

**Scope**

This Recommendation defines error-correction, data framing, modulation and emission methods for the second generation of digital terrestrial television broadcasting transmission systems<sup>1</sup> (referred to, outside ITU-R, as a DVB-T2, ATSC 3.0, or DTMB-A system, respectively). Some of these systems have been developed such that they are compatible with the provisions of the GE06 Agreement. This Recommendation is intended for the digital terrestrial broadcasting transmission system, when high flexibility in the system configuration and broadcasting interactivity is of importance allowing for a wide-ranging trade-off between operation under minimal  $C/N$  levels or maximum transmission capacity<sup>2</sup>.

The ITU Radiocommunication Assembly,

*considering*

- a) that the digital terrestrial television systems for use in broadcasting systems have been developed in Recommendation ITU-R BT.1306, which are referred to as the current systems;
- b) that digital terrestrial television broadcasting (DTTB) is being introduced in the VHF/UHF bands by some administrations from 1997 and second generation systems are currently being deployed by some administrations;
- c) that it may be desirable to support the simultaneous transmission of a hierarchy of nested quality levels (including low definition television (LDTV), high definition television (HDTV), ultra-high definition television (UHDTV), standard definition TV (SDTV), and supplementary data within a single channel;
- d) that many types of interference, including co-channel and adjacent channel, ignition noise, multipath and other signal distortions exist in the VHF/UHF bands;
- e) that it is necessary that the frame synchronization be capable of robustness in channels subject to transmission errors;
- f) that it is desirable that the frame structure be adapted to different bit rate channels;
- g) that recent developments in the field of channel coding and modulation have produced new techniques with performances approaching the Shannon limit;

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<sup>1</sup> The second generation of digital terrestrial television broadcasting transmission systems in this Recommendation is meant as systems offering higher bit rate capacity per Hz and better power efficiency in comparison to the systems described in Recommendation ITU-R BT.1306, and there is no general requirement for backward compatibility with first-generation systems.

<sup>2</sup> For the first-generation systems information on planning parameters, protection ratios, etc. is already contained in relevant ITU-R Recommendations. For the second-generation systems, there is a need to study and include such information in the relevant ITU-R Recommendations.

- h) that these new digital techniques would offer better spectrum and/or power efficiency, in comparison to the current systems, whilst maintaining the possibility to be flexibly configured to cope with the specific broadcasting bandwidth and power resources;
- i) that the recommended systems make use of such techniques and thus allow for a wide-ranging trade-off between operation under minimal  $C/N$  levels or maximum transmission capacity;
- j) that the recommended systems would be capable to handle the variety of advanced audiovisual formats currently available and under definition, including immersive audio and ultra-high definition transmissions;
- k) that the selection of a modulation option needs to be based on specific conditions such as spectrum resource, policy, coverage requirements, existing network structure, reception conditions, type of service required, cost to the consumer and broadcasters;
- l) that advances in digital television transmission techniques are required to support content delivery to mobile devices;
- m) that second generation systems may also support IMT-2020 data transport to supplement downlink capacity offload and provide flexibility and efficiencies for telecommunications platforms,

*recommends*

that administrations wishing to introduce the second generation DTTB systems may consider one of the families of error correction, framing, modulation and emission methods outlined within Annexes 1, 2 and 3, with the system selection guidelines provided in Annex 4, taking into account the *further recommends* below,

*further recommends*

that an evaluation of the recommended systems to facilitate system selection should be included in a future revision of this Recommendation, which should be based on criteria relevant to terrestrial digital broadcasting, and may consist of the following information:

- a) a list of requirements and their relevance to the system parameters and technical features;
- b) a list of system parameters of the recommended systems; and
- c) a list of technical features of the recommended systems that concern aspects relevant to implementation and deployment.

## Annex 1

### DVB-T2

Currently two variants of the system are considered (referred to, outside ITU-R, as a DVB-T2 system) – for fixed and mobile reception of SDTV and HDTV services (referred to as the T2-Base profile or simply DVB-T2) and for reception by very low capacity applications such as mobile broadcasting (referred to as the T2-Lite profile). T2-Lite signals may also be received by conventional stationary DVB-T2 receivers.

Table 1 provides general data about the second-generation multi-carrier system with multiple physical layer pipes (PLP) covering both profiles. Notes 9-13 to Table 1 contain information on restrictions with respect to the T2-Base and T2-Lite profiles. Specifications and implementation guidelines for both profiles of this system are found in Attachment 1 to Annex 1.

TABLE 1  
Parameters for the DVB-T2 DTTB transmission system  
Second-generation multi-carrier system with multiple physical layer pipes (PLP)<sup>(1)</sup>

| No. | Parameters                     | 1.7 MHz multi-carrier<br>(OFDM) <sup>(2)</sup>                            | 5 MHz multi-carrier<br>(OFDM) <sup>(2)</sup>                                                                                  | 6 MHz multi-carrier<br>(OFDM)                                                                                                 | 7 MHz multi-carrier<br>(OFDM)                                                                                                 | 8 MHz multi-carrier<br>(OFDM)                                                                                                 | 10 MHz multi-carrier<br>(OFDM) <sup>(2)</sup>                                                                                 |
|-----|--------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1   | Used bandwidth                 | 1.54 MHz<br>in normal mode                                                | 4.76 MHz<br>in normal mode<br>4.82 MHz<br>in extended mode<br>(8k mode)<br>4.86 MHz<br>in extended mode<br>(16k and 32k mode) | 5.71 MHz<br>in normal mode<br>5.79 MHz<br>in extended mode<br>(8k mode)<br>5.83 MHz<br>in extended mode<br>(16k and 32k mode) | 6.66 MHz<br>in normal mode<br>6.75 MHz<br>in extended mode<br>(8k mode)<br>6.80 MHz<br>in extended mode<br>(16k and 32k mode) | 7.61 MHz<br>in normal mode<br>7.72 MHz<br>in extended mode<br>(8k mode)<br>7.77 MHz<br>in extended mode<br>(16k and 32k mode) | 9.51 MHz<br>in normal mode<br>9.65 MHz<br>in extended mode<br>(8k mode)<br>9.71 MHz<br>in extended mode<br>(16k and 32k mode) |
| 2   | Number of<br>radiated carriers |                                                                           |                                                                                                                               |                                                                                                                               |                                                                                                                               |                                                                                                                               |                                                                                                                               |
|     | 1k mode <sup>(10)</sup>        | 853                                                                       | 853                                                                                                                           | 853                                                                                                                           | 853                                                                                                                           | 853                                                                                                                           | 853                                                                                                                           |
|     | 2k mode                        | 1 705                                                                     | 1 705                                                                                                                         | 1 705                                                                                                                         | 1 705                                                                                                                         | 1 705                                                                                                                         | 1 705                                                                                                                         |
|     | 4k mode                        | 3 409                                                                     | 3 409                                                                                                                         | 3 409                                                                                                                         | 3 409                                                                                                                         | 3 409                                                                                                                         | 3 409                                                                                                                         |
|     | 8k mode                        | 6 817 (8k mode)                                                           | 6 817 (8k mode)<br>6 913<br>(8k extended mode)                                                                                | 6 817<br>(normal mode)<br>6 913<br>(extended mode)                                                                            | 6 817<br>(normal mode)<br>6 913<br>(extended mode)                                                                            | 6 817<br>(normal mode)<br>6 913<br>(extended mode)                                                                            | 6 817 (8k mode)<br>6 913<br>(8k extended mode)                                                                                |
|     | 16k mode                       |                                                                           | 13 633 (16k mode)<br>13 921<br>(16k extended mode)                                                                            | 13 633<br>(normal mode)<br>13 921<br>(extended mode)                                                                          | 13 633<br>(normal mode)<br>13 921<br>(extended mode)                                                                          | 13 633<br>(normal mode)<br>13 921<br>(extended mode)                                                                          | 13 633 (16k mode)<br>13 921<br>(16k extended mode)                                                                            |
|     | 32k mode <sup>(10)</sup>       |                                                                           | 27 265 (32k mode)<br>27 841<br>(32k extended mode)                                                                            | 27 265<br>(normal mode)<br>27 841<br>(extended mode)                                                                          | 27 265<br>(normal mode)<br>27 841<br>(extended mode)                                                                          | 27 265<br>(normal mode)<br>27 841<br>(extended mode)                                                                          | 27 265 (32k mode)<br>27 841<br>(32k extended mode)                                                                            |
| 3   | Modulation<br>modes            | Constant coding and modulation (CCM)/variable coding and modulation (VCM) |                                                                                                                               |                                                                                                                               |                                                                                                                               |                                                                                                                               |                                                                                                                               |

TABLE 1 (continued)

| No. | Parameters               | 1.7 MHz multi-carrier<br>(OFDM) <sup>(2)</sup>                      | 5 MHz multi-carrier<br>(OFDM) <sup>(2)</sup> | 6 MHz multi-carrier<br>(OFDM) | 7 MHz multi-carrier<br>(OFDM) | 8 MHz multi-carrier<br>(OFDM) | 10 MHz multi-carrier<br>(OFDM) <sup>(2)</sup> |
|-----|--------------------------|---------------------------------------------------------------------|----------------------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------------------------|
| 4   | Modulation method        | QPSK, 16-QAM, 64-QAM, 256-QAM specific for each physical layer pipe |                                              |                               |                               |                               |                                               |
| 5   | Channel occupancy        | To be defined <sup>(2)</sup>                                        |                                              |                               | See Rec. ITU-R BT.1206        |                               | To be defined <sup>(2)</sup>                  |
| 6   | Active symbol duration   |                                                                     |                                              |                               |                               |                               |                                               |
|     | 1k mode <sup>(10)</sup>  | 554.99 µs                                                           | 179.2 µs                                     | 149.33 µs                     | 128 µs                        | 112 µs                        | 89.60 µs                                      |
|     | 2k mode                  | 1 109.98 µs                                                         | 358.4 µs                                     | 298.67 µs                     | 256 µs                        | 224 µs                        | 179.20 µs                                     |
|     | 4k mode                  | 2 219.97 µs                                                         | 716.8 µs                                     | 597.33 µs                     | 512 µs                        | 448 µs                        | 358.40 µs                                     |
|     | 8k mode                  | 4 439.94 µs                                                         | 1 433.6 µs                                   | 1 194.67 µs                   | 1 024 µs                      | 896 µs                        | 716.8 µs                                      |
|     | 16k mode                 |                                                                     | 2 867.2 µs                                   | 2 389.33 µs                   | 2 048 µs                      | 1 792 µs                      | 1 433.6 µs                                    |
|     | 32k mode <sup>(10)</sup> |                                                                     | 5 734.40 µs                                  | 4 778.67 µs                   | 4 096 µs                      | 3 584 µs                      | 2 867.2 µs                                    |
| 7   | Carrier spacing          |                                                                     |                                              |                               |                               |                               |                                               |
|     | 1k mode <sup>(10)</sup>  | 1 801.91 Hz                                                         | 5 580.63 Hz                                  | 6 696.75 Hz                   | 7 812.88 Hz                   | 8 929 Hz                      | 11 161.25 Hz                                  |
|     | 2k mode                  | 900.86 Hz                                                           | 2 790 Hz                                     | 3 348 Hz                      | 3 906 Hz                      | 4 464 Hz                      | 5 580.00 Hz                                   |
|     | 4k mode                  | 450.43 Hz                                                           | 1 395 Hz                                     | 1 674 Hz                      | 1 953 Hz                      | 2 232 Hz                      | 2 790.00 Hz                                   |
|     | 8k mode                  | 225.21 Hz                                                           | 697.50 Hz                                    | 837 Hz                        | 976 Hz                        | 1 116 Hz                      | 1 395.00 Hz                                   |
|     | 16k mode                 |                                                                     | 348.75 Hz                                    | 418.5 Hz                      | 488.25 Hz                     | 558 Hz                        | 697.50 Hz                                     |
|     | 32k mode <sup>(10)</sup> |                                                                     | 174.38 Hz                                    | 209.25 Hz                     | 244.125 Hz                    | 279 Hz                        | 348.75 Hz                                     |

TABLE 1 (continued)

| No. | Parameters                             | 1.7 MHz multi-carrier (OFDM) <sup>(2)</sup>                           | 5 MHz multi-carrier (OFDM) <sup>(2)</sup>                             | 6 MHz multi-carrier (OFDM)                                            | 7 MHz multi-carrier (OFDM)                                            | 8 MHz multi-carrier (OFDM)                                            | 10 MHz multi-carrier (OFDM) <sup>(2)</sup>                            |
|-----|----------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| 8   | Guard interval duration <sup>(3)</sup> | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration | 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4 of active symbol duration |
|     | 1k mode <sup>(10)</sup>                | 34.69, 69.37, 138.75 µs                                               | 11.2, 22.4, 44.8 µs                                                   | 9.3, 18.6, 37.3 µs                                                    | 8, 16, 32 µs                                                          | 7, 14, 28 µs                                                          | 5.6, 11.2, 22.4 µs                                                    |
|     | 2k mode                                | 34.69, 69.37, 138.75, 277.50 µs                                       | 11.2, 22.4, 44.8, 89.6 µs                                             | 9.3, 18.6, 37.3, 74.6 µs                                              | 8, 16, 32, 64 µs                                                      | 7, 14, 28, 56 µs                                                      | 5.6, 11.2, 22.4, 44.8 µs                                              |
|     | 4k mode                                | 69.37, 138.75, 277.50, 554.99 µs                                      | 22.4, 44.8, 89.6, 179.2 µs                                            | 18.6, 37.3, 74.6, 149.3 µs                                            | 16, 32, 64, 128 µs                                                    | 14, 28, 56, 112 µs                                                    | 11.2, 22.4, 44.8, 89.6 µs                                             |
|     | 8k mode                                | 34.69, 138.75, 277.50, 329.53, 554.99, 659.05, 1 109.98 µs            | 11.2, 44.8, 89.6, 106.4, 179.2, 212.8, 358.4 µs                       | 9.3, 37.3, 74.6, 88.6, 149.3, 177.3, 298.6 µs                         | 8, 32, 64, 75.9, 128, 152, 256 µs                                     | 7, 28, 56, 66.5, 112, 133, 224 µs                                     | 5.6, 22.4, 44.8, 53.2, 89.6, 106.4, 179.2 µs                          |
|     | 16k mode                               |                                                                       | 22.4, 89.6, 179.2, 212.8, 358.4, 425.6, 716.8 µs                      | 18.6, 74.6, 149.3, 177.3, 298.6, 354.6, 597.3 µs                      | 16, 64, 128, 152, 256, 304, 512 µs                                    | 14, 56, 112, 133, 224, 266, 448 µs                                    | 11.2, 44.8, 89.6, 106.4, 179.2, 212.8, 358.4 µs                       |
|     | 32k mode <sup>(10)</sup>               |                                                                       | 44.8, 179.2, 358.4, 425.6, 716.8, 851.2 µs                            | 37.33, 149.33, 298.67, 354.67, 597.33, 709.33 µs                      | 32, 128, 256, 304, 512, 608 µs                                        | 28, 112, 224, 266, 448, 532 µs                                        | 22.4, 89.6, 179.2, 212.8, 358.4, 425.6 µs                             |
| 9   | Overall symbol duration                |                                                                       |                                                                       |                                                                       |                                                                       |                                                                       |                                                                       |
|     | 1k mode <sup>(10)</sup>                | 589.68-4578.69 µs                                                     | 190.4, 201.6, 224 µs                                                  | 158.6, 168, 186.6 µs                                                  | 136, 144, 160 µs                                                      | 119, 126, 140 µs                                                      | 95.20-112.00 µs                                                       |
|     | 2k mode                                | 1 144.67-1 387.48 µs                                                  | 369.6, 381, 403, 448 µs                                               | 308, 317, 336, 373.3 µs                                               | 264, 272, 288, 320 µs                                                 | 231, 238, 252, 280 µs                                                 | 184.80-224.00 µs                                                      |
|     | 4k mode                                | 2 289.34-2 774.96 µs                                                  | 739, 762, 806, 896 µs                                                 | 616, 635, 672, 746.6 µs                                               | 527.9, 544, 576, 640 µs                                               | 462, 476, 504, 560 µs                                                 | 369.60-448.00 µs                                                      |
|     | 8k mode                                | 4 474.63-5 549.92 µs                                                  | 1 444.8, 1 478.4, 1 523.2, 1 540, 1 612.8, 1 646.4, 1 792 µs          | 1 204, 1 232, 1 269.3, 1 283.3, 1 344, 1 372, 1 493.3 µs              | 1 032, 1 056, 1 088, 1 100, 1 152, 1 176, 1 280 µs                    | 903, 924, 952, 962.5, 1 008, 1 29, 1 120 µs                           | 722.4, 739.2, 761.6, 770, 806.4, 823, 896 µs                          |
|     | 16k mode                               |                                                                       | 2 889, 2 956.8, 3 046.4, 3 080, 3 225.6, 3 292.8, 3 584 µs            | 2 408, 2 464, 2 538.6, 2 566.6, 2 686, 2 744, 2 986.6 µs              | 2 064, 2 112, 2 176, 2 200, 2 304, 2 352, 2 560 µs                    | 1 806, 1 848, 1 904, 1 925, 2 016, 2 058, 2 240 µs                    | 1 444.8, 1 478.4, 1 523.2, 1 540, 1 612.8, 1 646.4, 1 792 µs          |
|     | 32k mode <sup>(10)</sup>               |                                                                       | 5 779.20-6 585.60 µs                                                  | 4 816-5 488 µs                                                        | 4 128-4 704 µs                                                        | 3 612, 3 696, 3 808, 3 850, 4 032, 4 116 µs                           | 2 889.6, 2 956.8, 3 046.4, 3 080, 3 225.6, 3 292.8 µs                 |

TABLE 1 (continued)

| No. | Parameters                                 | 1.7 MHz multi-carrier (OFDM) <sup>(2)</sup>                                                                                                                                                                                                                      | 5 MHz multi-carrier (OFDM) <sup>(2)</sup> | 6 MHz multi-carrier (OFDM) | 7 MHz multi-carrier (OFDM) | 8 MHz multi-carrier (OFDM) | 10 MHz multi-carrier (OFDM) <sup>(2)</sup> |
|-----|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------|----------------------------|----------------------------|--------------------------------------------|
| 10  | Transmission frame duration <sup>(6)</sup> | Frame starts with preamble and has a configurable number of symbols, with maximum duration of 250 ms.<br>Minimum number of data symbols is 3 (32k mode) or 7 (other modes).<br>Super-frame length is configurable, maximum 256 frames, 64 s                      |                                           |                            |                            |                            |                                            |
| 11  | Input stream format <sup>(4)</sup>         | Either transport streams (TS) or generic streams (GS)                                                                                                                                                                                                            |                                           |                            |                            |                            |                                            |
| 12  | System stream format                       | BB format <sup>(5)</sup>                                                                                                                                                                                                                                         | BB format                                 |                            |                            |                            |                                            |
| 13  | Mode adaptation code                       | CRC-8                                                                                                                                                                                                                                                            |                                           |                            |                            |                            |                                            |
| 14  | Channel coding <sup>(9)</sup>              | LDPC/BCH code with block size of 64 800 (64 K) <sup>(10)</sup> or 16 200 (16 K) bits and code rates 1/3 <sup>(9)</sup> , 2/5 <sup>(9)</sup> , 4/9, 1/2, 3/5, 2/3, 11/15, 3/4 <sup>(10)</sup> , 4/5 <sup>(10)</sup> , 37/45 <sup>(10)</sup> , 5/6 <sup>(10)</sup> |                                           |                            |                            |                            |                                            |
| 15  | Interleaving                               | Bit, cell and time interleaving separately for each physical layer pipe. Common frequency interleaving <sup>(1)</sup>                                                                                                                                            |                                           |                            |                            |                            |                                            |
| 16  | Constellation rotation                     | None, 29 (QPSK), 16.8 (16-QAM), 8.6 (64-QAM) degrees or atn (1/16) (256-QAM) <sup>(10)</sup>                                                                                                                                                                     |                                           |                            |                            |                            |                                            |
| 17  | Physical layer pipes (PLP)                 | Mode A with single PLP and mode B with multiple PLPs.<br>Modulation, coding and time interleaving depth selectable separately for each PLP <sup>(1)</sup> <sup>(7)</sup>                                                                                         |                                           |                            |                            |                            |                                            |
| 18  | Data randomization/energy dispersal        | PRBS                                                                                                                                                                                                                                                             |                                           |                            |                            |                            |                                            |
|     | Initial scan                               | Fast scan process with special preamble symbol P1                                                                                                                                                                                                                |                                           |                            |                            |                            |                                            |
| 19  | Time/frequency synchronization             | Preamble symbols P1 and P2. Scattered pilot carriers with 8 different pilot patterns available <sup>(13)</sup> . Continual pilots                                                                                                                                |                                           |                            |                            |                            |                                            |
| 20  | MISO                                       | An optional 2 × 1 Multiple Input Single Output (MISO) with Alamouti coding                                                                                                                                                                                       |                                           |                            |                            |                            |                                            |
| 21  | Receiver power consumption reduction       | Physical layer pipes are organized as subslices in the frame.<br>When receiving a single PLP only the preamble and relevant subslices are received and processed                                                                                                 |                                           |                            |                            |                            |                                            |
| 22  | Layer 1 signalling                         | L1 signalling is carried by P2 symbols in the preamble. L1 pre-signalling is modulated with BPSK and coded with 1/4 16k LDPC. L1 post-signalling has configurable modulation and 1/2 16k LDPC coding. Option for in-band signalling within the PLP               |                                           |                            |                            |                            |                                            |
| 23  | Layer 1 signalling                         | Either within the data PLPs or with special common PLP at the beginning of the frame                                                                                                                                                                             |                                           |                            |                            |                            |                                            |

TABLE 1 (end)

| No. | Parameters                                | 1.7 MHz multi-carrier (OFDM) <sup>(2)</sup>                                                                     | 5 MHz multi-carrier (OFDM) <sup>(2)</sup>                                                                       | 6 MHz multi-carrier (OFDM)                                                                                     | 7 MHz multi-carrier (OFDM)                                                                                     | 8 MHz multi-carrier (OFDM)                                                                                     | 10 MHz multi-carrier (OFDM) <sup>(2)</sup>                                                                      |
|-----|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 24  | PAPR (Peak-to-Average Power Ratio)        | Active Constellation Extension (ACE) and Tone Reservation (TR) as options                                       |                                                                                                                 |                                                                                                                |                                                                                                                |                                                                                                                |                                                                                                                 |
| 25  | Future Extension Frames (FEF)             | A super frame can include one or several FEF-parts. These can be used for future extensions of the system       |                                                                                                                 |                                                                                                                |                                                                                                                |                                                                                                                |                                                                                                                 |
| 26  | Net data rate                             | 0.22-10.17 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR | 3.01-31.55 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR | 4.01-37.8 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR | 4.68-44.1 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR | 5.35-50.4 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR | 5.93-63.23 Mbit/s, depending on FFT-size, modulation, code rate, guard interval, pilot pattern, MISO, FEF, PAPR |
| 27  | Carrier-to-noise ratio in an AWGN channel | Depending on modulation and channel code. –1 to 22 dB <sup>(8)</sup>                                            |                                                                                                                 |                                                                                                                |                                                                                                                |                                                                                                                |                                                                                                                 |
| 28  | Time interleaving memory                  | $2^{19}+2^{15}$ cells <sup>(11)</sup> , $2^{18}$ cells <sup>(12)</sup>                                          |                                                                                                                 |                                                                                                                |                                                                                                                |                                                                                                                |                                                                                                                 |

BCH: Bose – Chandhuri – Hocquenghem multiple error correction binary block code.

LDPC: Low density parity check.

OFDM: Orthogonal frequency division multiplex.

PRBS: Pseudo-random binary sequence....0.

QAM: Quadrature amplitude modulation.

QPSK: Quaternary phase shift keying.