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Amendment 2

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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Access networks – In premises networks

Unified high-speed wireline-based home networking
transceivers – Power spectral density specification

Amendment 2

Recommendation ITU-T G.9964 (2011) – Amendment 2



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Recommendation ITU-T G.9964

Unified high-speed wireline-based home networking transceivers – Power spectral density specification

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Summary

Recommendation ITU-T G.9964 specifies the control parameters that determine spectral content, power spectral density (PSD) mask requirements, a set of tools to support reduction of the transmit PSD, means to measure this PSD for transmission over telephone wiring, power line wiring and coaxial cable, as well as the allowable total transmit power into a specified termination impedance. It complements the system architecture and physical layer (PHY) specification in Recommendation ITU-T G.9960, and the data link layer (DLL) specification in Recommendation ITU-T G.9961, as well as the modifications and additions to these Recommendations specifying the multiple input/multiple output (MIMO) home networking transceiver in Recommendation ITU-T G.9963.

Amendment 1 adds support for a new profile for 200 MHz baseband coax.

Amendment 2 contains the specification of spectral content for 200 MHz bandplan for telephone lines.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.9964	2011-12-16	15	11.1002/1000/11406
1.1	ITU-T G.9964 (2011) Amd. 1	2016-02-26	15	11.1002/1000/12579
1.2	ITU-T G.9964 (2011) Amd. 2	2016-09-30	15	11.1002/1000/12843

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation ITU-T G.9964

Unified high-speed wireline-based home networking transceivers – Power spectral density specification

Amendment 2

Editorial note: This is a complete-text publication. Modifications introduced by this amendment are shown in revision marks relative to Recommendation ITU-T G.9964 (2011) plus its Amendment 1 (2016).

1 Scope

This Recommendation specifies the control parameters that determine spectral content, power spectral density (PSD) mask requirements, a set of tools to support reduction of the transmit PSD, means to measure this PSD for transmission over telephone wiring, power line wiring and coaxial cable, as well as the allowable total transmit power into a specified termination impedance. It complements the system architecture and physical layer (PHY) specification in [ITU-T G.9960], and the data link layer (DLL) specification in [ITU-T G.9961] as well as the modifications and additions to these Recommendations specifying the multiple input/multiple output (MIMO) home networking transceiver in [ITU-T G.9963].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T G.9960] Recommendation ITU-T G.9960 (2011), *Unified high-speed wireline-based home networking transceivers – System architecture and physical layer specification*.
- [ITU-T G.9961] Recommendation ITU-T G.9961 (2010), *Unified high-speed wireline-based home networking transceivers – Data link layer specification*.
- [ITU-T G.9963] Recommendation ITU-T G.9963 (2011), *Unified high-speed wireline-based home networking transceivers – Multiple input/multiple output specification*.

3 Definitions

This Recommendation defines the following terms:

3.1 bandplan: A specific range of the frequency spectrum that is associated with only one domain. Multiple bandplans may be used in the same domain provided that any bandplan is either a subset or a superset of all other bandplans in the same domain. The bandplan is defined by a lower frequency and upper frequency except for radio frequency (RF), which is defined by a bandwidth and centre frequency.

3.2 baseband: A frequency band defined by an up-convert frequency $F_{UC} = 0$ and an up-shift frequency $F_{US} = F_{SC} \times N/2$ (see Table 7-67 of [ITU-T G.9960]).

3.3 domain: A part of an ITU-T G.9960 home network comprising the domain master and all those nodes that are registered with the same domain master. In the context of this Recommendation, use of the term "domain" without a qualifier means "ITU-T G.9960 domain", and use of the term "alien domain" means "non-ITU-T G.9960 domain". Additional qualifiers (e.g., "power-line") may be added to either "domain" or "alien domain".

3.4 domain master (DM): A node supporting the domain master functionality that manages (coordinates) all other nodes of the same domain (i.e., assigns bandwidth resources and manages priorities). Only one active domain master is allowed in a domain, and all nodes within a domain are managed (coordinated) by a single domain master. If a domain master fails, another node of the same domain, capable of operating as a domain master, should pick up the function of the domain master.

3.5 home network: Two or more nodes that can communicate with each other either directly or through a relay node at the physical layer, or through an inter-domain bridge above the physical layer. A home network consists of one or more domains. In the context of this Recommendation, use of the term "home network" means "ITU-T G.9960 home network". Use of the term "alien home network" means "non-ITU-T G.9960 home network". Use of the term "network" without a qualifier means any combination of "ITU-T G.9960 home network", "non-ITU-T G.9960 home network" and "access network". Use of the term "alien network" means any combination of "non-ITU-T G.9960 home network" and "access network".

3.6 medium: A wire-line facility, of a single wire class, allowing physical connection between nodes. Nodes connected to the same medium may communicate on the physical layer, and may interfere with each other unless they use orthogonal signals (e.g., different frequency bands, different time periods).

3.7 node: Any network device that contains an ITU-T G.9960 transceiver. In the context of this Recommendation, use of the term "node" without a qualifier means "ITU-T G.9960 node", and use of the term "alien node" means "non-ITU-T G.9960 node". Additional qualifiers (e.g., "relay") may be added to either "node" or "alien node".

3.8 passband: A frequency band defined by an up-convert frequency $FUC = 0$ and an up-shift frequency $FUS \gg FSC \times N/2$ (see Table 7-67 of [ITU-T G.9960]).

3.9 radio frequency (RF): A frequency band defined by an up-convert frequency $FUC > 0$ and a centre frequency $FC = FUC + FUS \gg FSC \times N/2$ (see Tables 7-67 and 7-68 of [ITU-T G.9960]).

3.10 sub-carrier (OFDM sub-carrier): The centre frequency of each OFDM sub-channel onto which bits may be modulated for transmission over the sub-channel.

3.11 sub-channel (OFDM sub-channel): A fundamental element of OFDM modulation technology. The OFDM modulator partitions the channel bandwidth into a set of parallel sub channels.

3.12 wire class: One of the classes of wire, having the same general characteristics: coaxial cable, home electrical-power wire, phone-line wire and Category 5 cable.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BB	BaseBand
CB	Coax Baseband
CRF	Coax Radio Frequency
DM	Domain Master

LPM	Limit PSD Mask
OFDM	Orthogonal Frequency Division Multiplexing
PB	Power-line Baseband
PHY	Physical Layer
PSD	Power Spectral Density
PSDC	PSD Ceiling
PSM	PSD Shaping Mask
RF	Radio Frequency
RPM	Regional PSDM Mask
SM	Sub-carrier Mask

5 Transmit PSD mask

Transmit PSD mask (TxPSD) is determined by a sub-carrier mask (SM), a PSD shaping mask (PSM), a notching of international amateur radio bands defined in this clause, the limit PSD mask (LPM) defined for each particular medium, and a regional PSD mask (RPM) if specified in a regional annex (see [ITU-T G.9960]). The same TxPSD shall be applied to all nodes in the domain.

For an ITU-T G.9960 transceiver, the PSD of the transmit signal at any frequency shall never exceed the transmit PSD mask. For an ITU-T G.9963 transceiver, the sum of PSDs of the two transmit signals transmitted from the two Tx ports at any frequency shall never exceed the TxPSD. The PSD of the transmit signal may be further limited by a PSD ceiling (PSDC) that is applied to nodes involved in a particular connection (clause 5.4).

The LPM (see clauses 6.1.2, 6.2.2 and 6.3.2) specifies the absolute limit of the transmit PSD. However, if an RPM is specified for a particular region, the absolute limit shall be the minimum level between the LPM and RPM at any given frequency. The SM, PSDC, and PSM provide further reduction and shaping of the transmit PSD using three mechanisms: sub-carrier masking (notching), PSD ceiling (limit on PSD level), and PSD shaping.

ITU-T G.9960 and ITU-T G.9963 transceivers shall support sub-carrier masking, notching of international amateur radio bands, and PSD ceiling. Support of PSD shaping is optional.

The transmit PSD mask shall comply with national and regional regulatory requirements.

The LPM is defined based on the assumption that measurements are made using equipment conforming to [b-IEC CISPR 16-1] specifications using an RMS detector with a "maximum hold" function and using a resolution bandwidth of 9 kHz for frequencies below 30 MHz and 120 kHz for frequencies above 30 MHz. In order to conform to [b-IEC CISPR 22] and make reliable measurements, ITU-T G.9960 transceivers shall be active at least 10% of the time and sustain the transmit power level for a minimum of 250 ms.

NOTE – In addition to the mechanisms described in this clause that provide absolute limits to the transmit PSD (both in-band and out-of-band), this Recommendation defines a mechanism of PSD ceiling that allows dynamic reduction of the transmit power for each particular connection to the minimum value that is sufficient to achieve the given QoS targets.

5.1 Sub-carrier masking

Sub-carrier masking shall be used to eliminate transmission on one or more sub-carriers. Sub-carrier masking is defined by a sub-carrier mask (SM). The transmit power of sub-carriers specified in SM shall be set to zero (linear scale). The SM shall override all other instructions related to the transmit power of the sub-carrier.