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| **Radiocommunication Study Groups** |  |
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| Annex 16 to Working Party 5A Chairman’s Report |
| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT REVISIONOF RECOMMENDATION ITU-R F.1763 |
| Radio interface standards for broadband wireless access systems in the fixed service operating below 66 GHz |

(Question ITU-R215-4/5)

(2006)

**Summary of revision**: TBD

*Editor’s Note: This working document towards a preliminary draft revision should be sent to BWA contacts of external organizations to invite their comments.]*

# **Scope**

This Recommendation identifies specific radio interface standards for broadband wireless access (BWA)[[1]](#footnote-1) systems in the fixed service operating below 66 GHz, addressing profiles for the recommended interoperability standards. It provides references to the standards for interoperability between BWA systems.

The interoperability standards referenced in this Recommendation include the following specifications:

– system profiles;

– physical layer parameters, i.e. channelization, modulation scheme, data rates;

– medium access control (MAC) layer messages and header fields;

– conformance testing methods.

This Recommendation is not intended to deal with the identification of suitable frequency bands for BWA systems, nor any regulatory issues.

# **References**

[Recommendation ITU-R F.1399](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-F.1399): Vocabulary of terms for wireless access.

[Recommendation ITU-R F.1401](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-F.1401): Considerations for the identification of possible frequency bands for fixed wireless access and related sharing studies.

[Recommendation ITU-R F.1499](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-F.1499): Radio transmission systems for fixed broadband wireless access based on cable modem standard.

[ITU-R Handbook on Fixed Wireless Access](http://www.itu.int/ITU-R/publications/publication.asp?product=hdb11&lang=e): (Volume 1 of the Land Mobile (including Wireless Access)).

[Recommendation ITU-R M.1450](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1450): Characteristics of broadband radio local area networks.

[Recommendation ITU-R M.1457](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1457): Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000).

[Recommendation ITU-R M.1801](http://www.itu.int/rec/R-REC-M.1801/recommendation.asp?lang=en&parent=R-REC-M.1801-2-201302-I): Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz.

[ [Recommendation ITU-T J.122](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=T-REC-J.122): Second-generation transmission systems for interactive cable television services – IP cable modems].

# **Acronyms and Abbreviations**

ATM Asynchronous transfer mode

ATS Abstract test suite

BRAN Broadband radio access network (ETSI)

BWA Broadband wireless access

CL Convergence layer

DLC Data link control

ETSI European Telecommunications Standards Institute

FDD Frequency division duplex

FEC Forward error correction

HA HiperACCESS (ETSI)

HiperACCESS High PERformance Radio ACCESS network

HiperMAN High PERformance Radio Metropolitan Area Network

HM HiperMAN (ETSI)

IEEE Institute of Electrical and Electronics Engineers

IP Internet Protocol

LAN Local area network

LoS Line of sight

MAC Medium access control (OSI layer)

MAN Metropolitan Area Network

MIB Management information base

MIMO Multiple input multiple output

NLoS Non‑line of sight

OFDM Orthogonal frequency-division multiplexing

OFDMA Orthogonal frequency-division multiple access

OSI Open systems interconnection

PHS Personal handyphone system

PHY PHYsical (OSI layer)

PICS Protocol implementation conformance statement

QoS Quality of service

RCT Radio conformance test

SC Single carrier

SDO Standards Development Organization

SME Small Medium Enterprise

SNMP Simple network management protocol

SOHO Small Office Home Office

TDD Time division duplex

TS Technical specification (ETSI)

TSS&TP Test suite structure and test purposes

WirelessMAN Wireless Metropolitan Area Network (IEEE)

XGP eXtended Global Platform

The ITU Radiocommunication Assembly,

considering

*a)* that it is useful to identify standards for broadband wireless access (BWA) systems in the fixed service for international use;

*b)* that the standards for BWA systems in the fixed services are developed by standardization development bodies with broad international participation;

*c)* that standards for systems operating in the mobile service can be utilized to provide fixed BWA;

*d)* that standards for BWA support a wide range of fixed and nomadic broadband applications, such as voice and videoconferencing, in urban, suburban, and rural areas,

noting

*a)* Recommendation ITU-R [F.1499](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-F.1499), which specifies radio transmission systems for fixed broadband wireless access (BWA) based on cable modem standards;

*b)* the Handbook on Fixed Wireless Access (Volume 1 of the Land Mobile (including Wireless Access)), which also includes a number of proprietary solutions for fixed BWA;

*c)* Recommendation ITU-R F.1401, which provides considerations for the identification of possible frequency bands for fixed wireless access and related sharing studies;

*d)* Recommendation ITU-R M.1450, which recommends broadband radio local area networks standards;

*e)* Recommendation ITU-R M.1457, which recommends IMT-2000 terrestrial radio interface standards, some of which may also be used to provide fixed BWA;

*f)* Recommendation ITU-R M.1801: Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz, some of which is also used to provide fixed BWA;

g) Recommendation ITU-R M.2012: Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced);

*[h)* Recommendation ITU-T J.122, which defines the second generation of radio-frequency interface for high-speed data-over-cable systems,]

recommends

1that administrations take into account the standards in *notings d)*, *e)*, *f)*, and *g)* which can be also utilized to provide fixed service operations;

2 that the specific radio interface standards in Annexes 1 to 3 may be used for BWA systems in the fixed service operating below 66 GHz.

**Annex 1

IEEE and ETSI Radio interface standards for BWA systems in the fixed service**

*[Editor’s note: This annex should be confirmed and revised by IEEE and ETSI, as appropriate.]*

# **1 Overview of the radio interface**

Depending on the frequency band and implementation details, an access system built in accordance with this standardized interoperable radio interface can support a wide range of applications, from enterprise applications to residential applications in urban, suburban and rural areas. This radio interface can also be applied to other applications, such as for backhaul network applications. The specification could easily support both generic Internet-type data and real-time data, including applications such as voice and videoconferencing.

This type of system is referred to as a wireless metropolitan area network (WirelessMAN in IEEE 802.16, HiperACCESS and HiperMAN in ETSI BRAN[[2]](#footnote-2)). The word “metropolitan” refers not to the application but to the scale. The architecture for this type of system is primarily point‑to‑multipoint (P-MP), with a base station serving subscribers in a cell that can range up to tens of kilometres. Fixed terminals are ideal for providing broadband wireless access to buildings, such as businesses, homes, Internet cafes, telephone shops (telecentres), etc. Also, typically in frequencies below 11 GHz, portable terminals such as laptop computers and bookshelf terminals support nomadic wireless access.

The radio interface includes support for a variety of data rates. At higher frequencies (e.g. above 10 GHz), supported data rates range over 100 Mbit/s per 25 MHz or 28 MHz channel, with many channels available under some administrations. At the lower frequencies (e.g. below 11 GHz), data rates range up to 70 Mbit/s per 20 MHz channel. The radio interface supports both TDD and FDD operation, along with operational use of various advanced antenna processing techniques, such as beamforming, precoding, space-time coding, MIMO, etc.

The radio interface includes a physical layer (PHY) as well as a medium-access control layer (MAC). The MAC is based on demand-assigned multiple access in which transmissions are scheduled according to priority and availability. This design is driven by the need to support carrier-class access to public networks, both Internet protocol (IP) and asynchronous transfer mode (ATM), with full quality of service (QoS) support.

The MAC supports several PHY specifications, depending on the frequency bands of interest and the operational requirements. In particular, the alternatives include, typically:

a) *Below 11 GHz*

– WirelessMAN-OFDM and HiperMAN: this specification, defined in IEEE Standard 802.16 and in ETSI TS 102 177, is based on OFDM.

– WirelessMAN-OFDMA: this specification, defined in IEEE Standard 802.16, is based on OFDMA.

– WirelessMAN-SCa: this specification, defined in IEEE Standard 802.16, uses single‑carrier transmission, based on TDD and FDD.

b) *Above 10 GHz*

– WirelessMAN-SC: this specification, defined in IEEE Standard 802.16, uses single-carrier transmission, based on TDD/FDD, time-division multiplexing (TDM)/time-division multiple access (TDMA).

– HiperACCESS: this specification, defined by ETSI BRAN for frequencies above 11 GHz, uses single-carrier TDM and TDMA transmission.

All the above PHYs use the same MAC, with the exception of HiperACCESS. The HiperACCESS standard defines an interoperable P-MP system for fixed BWA above 10 GHz, while using single-carrier TDM downlink and TDMA uplink transmissions for high spectral efficiency and flexibility.

Appendix 1 illustrates pictorially the equivalencies and differences between the IEEE and ETSI standards.

These IEEE and ETSI standards are radio interface interoperability standards. An interoperability standard is a document that establishes engineering and technical requirements that are necessary to be employed in the design of systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. Further relevant definitions describing other types of standards have been published by ISO/IEC[[3]](#footnote-3).

The SDOs, which have developed the above standards, define system profiles for the recommended interoperability parameters. IEEE 802.16 profiles are included in the main standards document. HiperMAN profiles are defined in ETSI TS 102 210, while HiperACCESS profiles are contained in ETSI TS 101 999 and TS 102 000. The profiles are necessary to facilitate interoperability. Further guidance, including references to conformance test specifications, are provided in Appendix 2.

# **2 Detailed specification of the radio interface**

The specifications contained in this section include the following standards for BWA in the fixed service:

## 2.1 IEEE Standard 802.16-2004

802.16-2004 IEEE Standard for local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems.

*Abstract:* This standard specifies the air interface of fixed BWA systems supporting multimedia services. The MAC layer supports a primarily point-to-multipoint architecture, with an optional mesh topology. The MAC is structured to support multiple PHY specifications, each suited to a particular operational environment. For operational frequencies from 10-66 GHz, the PHY is based on single-carrier modulation. For frequencies below 11 GHz, where propagation without a direct line of sight must be accommodated, three alternatives are provided, using OFDM, OFDMA, and single-carrier modulation. This standard revises and consolidates IEEE Standards 802.16-2001, 802.16a-2003, and 802.16c-2002.

*Standard:* The IEEE Standard is available in electronic form at the following address: <http://standards.ieee.org/getieee802/download/802.16-2004.pdf>

Subject to IEEE’s Corrigendum 1[[4]](#footnote-4)
<http://standards.ieee.org/getieee802/download/802.16e-2005.pdf>

## 2.2 ETSI Standards

The specifications contained in this section include the following standards for BWA in the fixed service:

a) Standards addressing fixed BWA below 11 GHz:

– ETSI TS 102 177 v1.2.1: Broadband Radio Access Networks (BRAN); HiperMAN; Physical (PHY) Layer.

– ETSI TS 102 178 v1.2.1: Broadband Radio Access Networks (BRAN); HiperMAN; Data Link Control (DLC) Layer.

– ETSI TS 102 210 v1.2.1: Broadband Radio Access Networks (BRAN); HiperMAN; System Profiles.

– ETSI TS 102 389 v1.1.1: Broadband Radio Access Networks (BRAN); HiperMAN; Simple Network Management Protocol (SNMP) Management Information Base (MIB).

 *Abstract:* The HiperMAN standards addresses interoperability for fixed BWA systems in 2‑11 GHz frequencies, while using OFDM downlink and OFDMA uplink, to provide high cell sizes in non‑line of sight (NLoS) operation. The standard provides for FDD and TDD support, high spectral efficiency and data rates, adaptive modulation, high cell radius, support for advanced antenna systems, high security encryption algorithms. Its profiles are targeting the 1.75 MHz, 3.5 MHz and 7 MHz channel spacing, suitable for the 3.5 GHz band.

b) Standards addressing fixed BWA above 10 GHz:

– ETSI TS 101 999 v1.1.1: Broadband Radio Access Networks (BRAN); HiperACCESS; Physical (PHY) Layer.

– ETSI TS 102 000 v1.4.1: Broadband Radio Access Networks (BRAN); HiperACCESS, Data Link Control (DLC) Layer.

– ETSI TS 102 115 v1.1.1: Broadband Radio Access Networks (BRAN); HiperACCESS; Cell-based Convergence Layer. Part 1: Common Part and Part 2: UNI Service Specific Convergence Sublayer (SSCS).

– ETSI TS 102 117 v1.1.1: Broadband Radio Access Networks (BRAN); HiperACCESS; Packet-based Convergence Layer. Part 1: Common Part and Part 2: Ethernet SSCS.

 *Abstract:* HiperACCESS specifies the air interface of fixed broadband wireless access systems with P-MP (point-to-multipoint) topology. The standard is optimized for packet- and cell-based core networks. The main applications are backhaul networks under line-of-sight (LoS) conditions, SME (small medium enterprise) and SOHO (small office home office). The HiperACCESS specification consists of several parts: physical layer based on single-carrier transmission, optimized for LoS links above 10 GHz, DLC (data link control layer) with a well-controlled set of optional features and hooks for future evolution, several convergence layers, a comprehensive set of test specifications to ensure interoperability between equipment from different manufacturers. The adaptive concept of HiperACCESS provides high throughput of more than 100 Mbit/s under normal propagation conditions, allows high frequency reuse factors, and guarantees minor and controllable interference to other systems and adjustable power flux-densities according to national regulatory conditions.

*Standards:* All the ETSI standards are available in electronic form at: [http://pda.etsi.org/pda/ queryform.asp](http://pda.etsi.org/pda/queryform.asp), by specifying in the search box the standard number.

Appendix 1
to Annex 1

Comparison and equivalency of the IEEE and ETSI standards

# 1 Introduction

This Appendix illustrates the equivalency between the IEEE and ETSI standards covered in this Recommendation. Since the specifications are different for the interoperability standards for systems intended to operate below 11 GHz or above 10 GHz, they are shown separately in Figs. 1 and 2.

It should be noted that there is a 1 GHz overlap between the applicability of the two sets of standards. This offers a choice of specifications in the 10-11 GHz range, and system designers will select the standards to use for this band, depending on whether they wish to achieve commonality with systems below 10 GHz or systems above 11 GHz.

# 2 Standards for bands below 11 GHz

Figure 1 shows the harmonized interoperability specifications of the IEEE WirelessMAN and the ETSI HiperMAN standards, for bands below 11 GHz, which include specifications for the OFDM physical layer, MAC, security, and the system profiles.

FIGURE 1

**BWA Standards harmonized for interoperability for frequencies below 11 GHz**

|

# 3 Standards for bands above 10 GHz

Figure 2 shows the similarities between the IEEE WirelessMAN and ETSI HiperACCESS standards for frequencies above 10 GHz. The specifications for systems above 10 GHz are different in HiperACCESS and WirelessMAN.

FIGURE 2

**BWA Standards common elements for frequencies above 10 GHz**



**Appendix 2
to Annex 1

Conformance testing specifications**

# 1 Introduction

The system profiles are sets of features to be used in typical implementation cases. Since the standards contain options to fulfill the needs in multiple environments, the first step towards ensuring interoperability is the definition of common system profiles. An exception is HiperAccess where system profiles are not needed since the base station has full control about the use of optional features on a per terminal basis.

Features specified in the standard as optional may be listed in a profile as “required” or “conditionally required”. Profiles do not change “mandatory” status if specified in the standard itself. Optional features shall be implemented as specified in the standard.

The next steps towards ensuring interoperability are conformance testing and interoperability testing.

– Conformance testing is the act of determining to what extent a single implementation conforms to the individual requirements of its base standard.

– Interoperability testing is the act of determining if end-to-end functionality between at least) two communicating systems is as required by those base systems’ standards.

The conformance testing specifications for WirelessMAN, HiperMAN and HiperACCESS are defined according to ISO/IEC 9646 “Information Technology – Open Systems Interconnection – Conformance testing methodology and framework”.

# 2 Conformance test specifications for IEEE 802.16-2004 WirelessMAN and ETSI HiperMAN for bands below 11 GHz

The following HiperMAN test specifications are applicable equally to both the HiperMAN DLC and WirelessMAN MAC standards, which demonstrate the equivalency of these standards.

**ETSI TS 102 385-1 V1.1.1 (2005-02)**

Broadband Radio Access Networks (BRAN); HiperMAN; Conformance testing for the Data Link Control Layer (DLC); Part 1: Procotol Implementation Conformance Statement (PICS) proforma.

**ETSI TS 102 385-2 V1.1.1 (2005-02)**

Broadband Radio Access Networks (BRAN); HiperMAN; Conformance testing for the Data Link Control Layer (DLC); Part 2: Test Suite Structure and Test Purposes (TSS&TP) specification.

# 3 Conformance test specifications for IEEE 802.16-2004 WirelessMAN and ETSI HiperACCESS for bands above 10 GHz

The testing specifications for systems above 10 GHz are different for WirelessMAN and HiperACCESS.

## 3.1 Conformance test specifications for IEEE 802.16-2004 WirelessMAN for 10-66 GHz

The conformance test specifications for IEEE 802.16-2004 WirelessMAN are in the following IEEE standards:

**IEEE Standard 802.16/Conformance01-2003**

IEEE Standard for Conformance to IEEE 802.16 – Part 1: Protocol Implementation Conformance Statements for 10-66 GHz WirelessMAN-SC Air Interface.

**IEEE Standard 802.16/Conformance02-2003**

IEEE Standard for Conformance to IEEE 802.16 – Part 2: Test Suite Structure and Test Purposes (TSS&TP) for 10-66 GHz WirelessMAN-SC.

**IEEE Standard 802.16/Conformance03-2004**

IEEE Standard for Conformance to IEEE 802.16 – Part 3: Radio Conformance Tests (RCT) for
10-66 GHz WirelessMAN-SC Air Interface 10-66 GHz WirelessMAN-SC Air Interface.

## 3.2 Conformance test specifications for ETSI HiperACCESS for bands above 10 GHz

Figure 3 shows the relation between base and test specifications for HiperACCESS.

FIGURE 3

**BRAN HiperACCESS standards and test specifications**



Annex 2

The “eXtended Global Platform: XGP” radio interface standards for
BWA systems in the fixed service

# 1 Overview of the radio interface

The “eXtended Global Platform: XGP” is one of modern BWA systems which was originally developed as a next-generation system of PHS. PHS had been designed and developed not only
as a mobile system but also as a fixed system called “Wireless local loop: WLL”. XGP is
an enhanced version of PHS, and therefore supports both mobile and fixed use as well.

XGP is a BWA system which utilizes OFDMA, SC-FDMA/TDMA-TDD, and some more advanced features described below:

– Realization of always-connected environment at IP level

 The always-connected session at IP level that enables users to start up high‑speed transmission immediately is essential, taking into account the convenience of always‑connected environment provided in wired broadband circumstance, etc.

– High transmission data rate

 It supports data rates over 100 Mbit/s per 20 MHz bandwidth.

– High efficiency in spectral utilization

 Highly efficient spectral utilization is necessary in order to avoid interruption of service applications by a shortage of frequency, due to a serious traffic congestion concentrated at a business district or downtown area.

In addition, it has the ability of highly efficient spectral utilization by adopting the latest technologies such as an adaptive array antenna technology, a space division multiple access technology and so on. These technologies also contribute to make cell-designing plans unnecessary. As a result, the cell radius less than 100 m can be realized.

Mobile/Fixed wireless systems, which are used for point-to-multipoint service, generally require a relatively high level of accuracy in terms of their installation position in order to avoid interferences to other cells. In the case of macro-cell networks, there would be a geographical offset of the base station from the intended position/building to its adjacent alternative position/building, for example due to unsuccessful negotiations with the building owners. The offset causes inter-cell interferences but they still lie within the range of tolerable error.

In the case of micro-cell networks, this offset, however, cannot be ignored since the offset is relatively large being compared to cell radius of micro-cell. Readjustments of the surrounding cell layout are needed to avoid coverage holes due to the offset, in some cases.

This issue has already been solved with XGP system, as it has an interference-robust structure and does not require strict accuracy for base station positions, resulting in less trouble in the construction of micro-cell networks.

XGP is a system, among BWA systems, which possesses a differentiating feature by flexibly utilizing micro- and macro-cells in its network in order to efficiently accommodate heavy traffic in densely-populated areas.

In addition to XGP original mode, the specification of XGP version 2 or later has the Global Mode that refers to 3GPP specification (LTE TDD) in order to attain the scale of merits provided by LTE. XGP, therefore, becomes substantially compatible with LTE TDD and can be regarded as a part of LTE community sharing a common eco-system.

The XGP specification also accommodates some specific requirements complying with regional or local regulations.

# 2 Detailed specification of the radio interface

Duplex method of XGP is TDD. TDD is not needed for paired spectrum channels, and allows to devote resources to uplink and downlink asymmetrically, freeing capacity for up/downlink data-intensive applications.

The operation channel bandwidths supported by XGP are 1.25 MHz, 2.5 MHz, 5 MHz, 10 MHz, 20 MHz, 22.5 MHz, 25 MHz, 30 MHz and its modulation scheme supports BPSK, QPSK, 16‑QAM, 64-QAM and 256-QAM. The subcarrier frequency spacing is 15 kHz and 37.5 kHz.
The time-frame has 4, 8, 10, 16, 20 slots of 2.5 ms, 5 ms, 10 ms. Each slot can be used separately, or continuously by a single user, and moreover continuously in an asymmetric frame structure.

The frame structure image of XGP is shown in Fig. A2-1.

FIGURE A2-1

The frame structure image of XGP



XGP achieves efficient spectral utilization mainly by the function of adaptive array antenna.

Adaptive array antenna is a technique to make adaptive beam forming from a BS/MS to an MS/BS by combining signals of respective antennas. The adaptive array antenna uses multiple antennas and combines their signals (1) to adaptively form a beam to desired directions in order to avoid harmful interference from interferers and (2) to send the most suitable radio waves/signals to a specific terminal by using the formed beam. In XGP system that employs OFDMA SC‑FDMA/TDMA‑TDD schemes, this antenna technology is well-suited and can be effectively applied to both transmitter and receiver. It has a potential to increase XGP’s spectrum efficiency and to make it possible to cover a wider area with lower cost.

System profiles, physical layer parameters, and also MAC layer messages of XGP system are described in following standards.

The “eXtended Global Platform” specifications of XGP Forum are available in an electronic form at its website:

 “A-GN4.00-02-TS: eXtended Global Platform Specifications” <http://www.xgpforum.com>.

The Association of Radio Industries and Businesses (ARIB) has also standardized “eXtended Global Platform” for Japanese domestic use.

The ARIB standard of “eXtended Global Platform” is also available at the ARIB website.

 “ARIB STD-T95: OFDMA/TDMA TDD Broadband Access System ARIB STANDARD” <http://www.arib.or.jp/english/index.html>.

The standard “ARIB STD-T95” includes Japanese regulation specifications as well as the system original specifications.

# 3 Conformance test specifications for XGP

The Conformance test specifications for “eXtended Global Platform” are available in an electronic form at the website below:

 “XXXXXXXX” http://www.xgpforum.com.

[*XGP Forum’s Note: Conformance test specification of XGP is underway in XGP Forum. The link of the website will be provided at Working Party 5A November meeting by the Forum.*]

Annex 3

Radio interface standards of Multiple Gigabit Wireless Systems for BWA systems in the fixed service

*[Editor’s note: This section will be provided by Wireless Gigabit Alliance as appropriate.]*

# 1 Overview of the radio interface

# 2 Detailed specification of the radio interface

# 3 Conformance test specifications for MGWS

1. “Wireless access” and “BWA” are defined in Recommendation ITU-R F.1399. [↑](#footnote-ref-1)
2. ETSI (European Telecommunications Standards Institute) and IEEE (Institute of Electrical and Electronics Engineers) are standards development organizations (SDOs) responsible for the radio interface standards considered in this Annex. [↑](#footnote-ref-2)
3. “Standardization and related activities – General vocabulary”, [ISO/IEC Guide 2](http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=39976&ICS1=1&ICS2=120&ICS3=), Eighth Edition. Geneva, Switzerland, International Organization for Standardization, 2004. [↑](#footnote-ref-3)
4. [↑](#footnote-ref-4)