
**Information technology —
Telecommunications and information
exchange between systems — MAC and
PHY for operation in TV white space**

*Technologies de l'information — Télécommunications et échange
d'information entre systèmes — MAC et PHY pour opération en espace
blanc TV*

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 16504 was prepared by Ecma International (as ECMA-392) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

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Introduction

Analogue broadcasting systems have been or are being upgraded to digital technology, which frees up channels in the TV frequency bands. This International Standard specifies a physical layer and a medium access sub-layer for wireless devices to operate in the TV frequency bands.

Applications include high speed video streaming and internet access on personal/portable electronics, home electronics equipment, and computers and peripherals.

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Information technology — Telecommunications and information exchange between systems — MAC and PHY for operation in TV white space

1 Scope

This International Standard specifies a medium access control (MAC) sub-layer and a physical (PHY) layer for personal/portable cognitive wireless networks operating in TV bands. This International Standard also specifies a MUX sublayer for higher layer protocols.

This International Standard specifies a number of incumbent protection mechanisms which may be used to meet regulatory requirements.

2 Conformance

Conforming devices implement the MUX sub-layer, MAC sub-layer and the PHY layer as specified herein and support at least one of the device types (master, peer, or slave) and at least one of bandwidths (6 MHz, 7 MHz, 8 MHz), and may support multiple antennae modes.

3 Normative references

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

ISO/IEC 10646:2003, *Information technology — Universal Multiple-Octet Coded Character Set (UCS)*

ISO/IEC 18033-3:2005, *Information technology — Security techniques — Encryption algorithms — Part 3: Block ciphers*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1

alien beacon group

group of devices for which the beacon period (BP) is not aligned with the BP of the current device

4.2

alien device

member of an alien beacon group

- 4.3**
Access Category
AC
common set of prioritized contention access (PCA) parameters to contend for the medium to transmit MAC protocol data units (MPDUs) with certain priorities
- 4.4**
beacon group
BG
set of devices that share the same beacon period start time (BPST)
- 4.5**
beacon period
BP
time during which a device sends or listens for beacons
- 4.6**
beacon period start time
BPST
start of the beacon period
- 4.7**
channel reservation protocol
CRP
protocol to support negotiation and maintenance of channel time reservations
- 4.8**
contention signalling window
time window for exchanging control or management information in the slotted aloha based manner
- 4.9**
data integrity
assurance that the data has not been modified from its original form
- 4.10**
data transfer period
DTP
time period within a superframe used mainly for data transfer via prioritized contention access (PCA) or in reservations established using the channel reservation protocol (CRP)
- 4.11**
device
entity conforming to this International Standard
- 4.12**
extended beacon group
union of a device's beacon group and the beacon groups of all devices in the device's beacon group
- 4.13**
incumbents
regulatory protected transmission systems operating in the TV bands
- 4.14**
incumbent protection mechanisms
mechanisms including DFS, TPC, geo-location/database access, and spectrum sensing
- 4.15**
MPDU
MAC PDU

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4.16**MSDU**

MAC SDU

4.17**master****master device**

device acting as a centralized coordinator of medium access on behalf of at least one slave device

4.18**master-slave group**

group of devices with a master device and its slave devices

4.19**message integrity code****MIC**

cryptographic checksum generated using a symmetric key

NOTE A MIC is typically appended to data for data integrity and source authentication similar to a digital signature.

4.20**neighbour**

member of a beacon group

4.21**network allocation vector****NAV**

remaining time a neighbour device has indicated it will access the medium

4.22**outband channel**

channel other than the one being used for data transmission

4.23**peer****peer device**

device coordinating medium access with other devices without a centralized coordinator

4.24**peer-to-peer group**

group of peer devices

4.25**prioritized contention access****PCA**

prioritized CSMA/CA access mechanism

4.26**proxy**

peer device that coordinates outband channel measurement

4.27**quiet period**

time period scheduled to detect incumbents

4.28**reservation**

one or more medium access slots (MASs) within a superframe during which a device has preferential access to the medium

4.29

reservation signalling window

time window used for exchanging control or management information in the reservation based manner

4.30

slave

slave device

device associated with and coordinated by a master device for medium access

4.31

stream

logical flow of MSDUs from one device to one or more other devices

4.32

superframe

periodic time interval to coordinate frame transmissions between devices

4.33

transmission opportunity

TXOP

time interval for prioritized contention access (PCA) to initiate transmissions

4.34

TXOP holder

device that has successfully contended for a TXOP

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5 Abbreviations and Acronyms (standards.iteh.ai)

AC	access category	ISO/IEC 16504:2011
ACK	acknowledgment	https://standards.iteh.ai/catalog/standards/sist/da193109-9778-4464-8bc7-8ab6893a98aa/iso-iec-16504-2011
A/D	analog-to-digital	
AES	advanced encryption standard	
AGC	automatic gain control	
AIFS	arbitration inter-frame space	
ASIE	application-specific information element	
AWGN	additive white Gaussian noise	
BPOIE	beacon period occupancy information element	
BPSK	binary phase-shift keying	
BcstAddr	broadcast device address	
BP	beacon period	
BPST	beacon period start time	
B-ACK	block acknowledgment	
BW	bandwidth	
CBC-MAC	cipher block chaining-message authentication code	
CCA	clear channel assessment	
CCM	counter mode encryption and cipher block chaining message authentication code	
CE	channel estimation	
CINR	carrier-to-interference and noise ratio	

CP	cyclic prefix
CRC	cyclic redundancy check
CRP	channel reservation protocol
CSMA/CA	carrier sense multiple access with collision avoidance
CTS	clear to send
D/A	digital-to-analog
DC	direct current
DestAddr	destination device address
DevAddr	device address
DME	device management entity
DTP	Data transfer period
EO	encryption offset
EUI	extended unique identifier
FCS	frame check sequence
FEC	forward error correction
FFT	fast Fourier transform
FITD	frequency interleaved transmit diversity
GF	Galos field
GTK	group temporal key
HDR	header
HEI	header error indicator
I	inphase
ICI	inter-carrier interference
ID	identifier
IE	information element
IFFT	inverse FFT
IFS	inter-frame space
Imm-ACK	immediate acknowledgment
ISI	inter-symbol interference
KCK	key confirmation key
LQE	link quality estimate
LSB	least significant bit
M2S	Master-to-Slave
MAC	medium access control
MAS	medium access slot
MCDU	MAC command data unit
McstAddr	multicast device address
MIB	management information base
MIC	message integrity code
MIFS	minimum inter-frame space

MKID	master key identifier
MLME	MAC sublayer management entity
MPDU	MAC protocol data unit
MSB	most significant bit
MSDU	MAC service data unit
NAV	network allocation vector
No-ACK	no acknowledgement
OFDM	orthogonal frequency division multiplexing
OUI	organizationally unique identifier
P2P	Peer-to-Peer
PCA	prioritized contention access
PER	packet error rate
PHY	physical layer
PLCP	physical layer convergence protocol
PLME	physical layer management entity
PMK	pair-wise master key
PPDU	PHY protocol data unit
ppm	parts per million
PRBS	pseudo-random binary sequence
PRF	pseudo-random function
PSDU	PHY service data unit
PTK	pair-wise temporal key
Q	quadrature
QAM	quadrature amplitude modulation
QP	quiet period
QPSK	quadrature phase-shift keying
RF	radio frequency
RMS	root mean square
RS	Reed-Solomon
RSSI	received signal strength indication
RTG	receive-to-transmit transition gap
RTS	request to send
SAP	service access point
SFC	secure frame counter
SFN	secure frame number
SIFS	short inter-frame space
SM	spatial multiplexing
SNR	signal-to-noise ratio
SrcAddr	source device address
STBC	space time block code

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TKID	temporal key identifier
TPC	transmit power control
TTG	transmit-to-receive transition gap
TV	television
TXOP	transmission opportunity
UCA	unused CRP reservation announcement
UCR	unused CRP reservation response
UHF	ultra high frequency
VHF	very high frequency
WM	wireless microphone

6 General description

6.1 Network components

A basic component of a network is a device. Two or more devices communicating on the same physical channel constitute a network. There are three types of devices, master device, slave device, and peer device. The device type of a device is preconfigured. The autonomous transition of device type is not supported in this International Standard, although the device type may be reconfigurable by DME which is out of scope of this International Standard.

6.2 Network formation

A basic network operates in one of two basic network formation modes: the master-slave mode or the peer-to-peer mode. Both are shown in Figure 1. In the master-slave mode, a device is designated as master and others are associated with the master as slaves. The master coordinates channel access in the master-slave mode. Communication is normally established between slave devices and the master device. A slave device may also directly communicate with another slave device under the coordination of the master.

A peer-to-peer network differs from a master-slave based network mainly in that devices can form a network in the peer-to-peer way and coordinate channel access with distributed beaconing and channel reservation. A peer-to-peer network comprises of peer devices. A peer device is able to access channel via distributed reservation and directly communicate with any other peer device as long as they are in range of one another. In other words, a peer-to-peer network can be ad hoc, self-organizing, and self-healing.

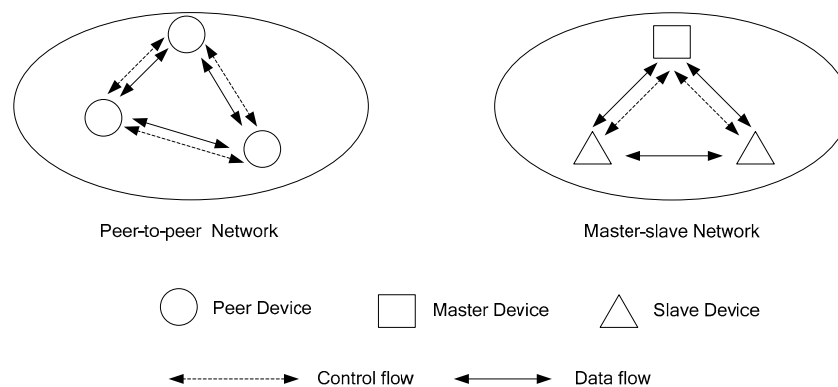


Figure 1 — Basic Network Formation