

RECOMMENDATION ITU-R F.1499

**RADIO TRANSMISSION SYSTEMS FOR FIXED
BROADBAND WIRELESS ACCESS BASED
ON CABLE MODEM STANDARDS***

(Questions ITU-R 215/8 and ITU-R 140/9)

(2000)

CONTENTS

	<i>Page</i>
Introduction.....	3
Scope	3
References	3
Definitions and abbreviations	6
Conventions	11
Considerations.....	11
Recommendation.....	11
1 General system requirements	11
1.1 Service goals	11
1.2 Reference architecture	12
1.3 Categories of interface specification.....	12
1.3.1 Phase 1.....	12
1.3.2 Phase 2.....	12
1.3.3 Phase 3.....	12
1.3.4 Phase 4.....	12
1.4 Server location.....	14
2 Functional assumptions.....	14
2.1 BWA network	14
2.2 Equipment assumptions	14
2.2.1 Frequency plan	14
2.2.2 Compatibility with other services.....	14
2.2.3 Fault isolation impact on other users	14
2.3 RF channel assumptions.....	14
2.3.1 Transmission upstream and downstream.....	15
2.4 Transmission levels	15
2.5 Power control requirements.....	15
2.6 BER vs. <i>S/N</i> specifications.....	15
2.7 Frequency inversion.....	15
3 Communication protocols	17
3.1 Protocol stack	17
3.1.1 BWA CPE and BWA BTS modems as hosts	17
3.1.2 Data forwarding through the BWA CPE and BTS modems	18

* This Recommendation is intended only for fixed BWA systems based on ITU-T Recommendation J.112, Annex B – Data over cable radio frequency interface. The Recommendation is complementary to ITU-T Recommendation J.116. This Recommendation and ITU-T Recommendation J.116 should be considered in their totality when implementing BWA systems.

3.2	The MAC forwarder	21
3.2.1	Example rules for data-link-layer forwarding	22
3.3	Network layer	22
3.4	Above the network layer	22
3.5	Data link layer	23
3.5.1	LLC sublayer	23
3.5.2	Link-layer security sublayer	23
3.5.3	MAC sublayer	23
3.6	PHY layer	24
3.6.1	Downstream transmission convergence sublayer	24
3.6.2	PMD sublayer	24
4	PMD sublayer specification	24
4.1	Scope	24
4.2	Upstream	25
4.2.1	Overview	25
4.2.2	Modulation formats	26
4.2.3	FEC encode	29
4.2.4	Scrambler (randomizer)	29
4.2.5	Preamble prepend	29
4.2.6	Burst profiles	29
4.2.7	Burst timing convention	32
4.2.8	Transmit power requirements	32
4.2.9	Fidelity requirements	34
4.2.10	Frame structure	36
4.2.11	Signal processing requirements	37
4.2.12	Upstream receiver input power characteristics	37
4.2.13	Upstream electrical output from the BWA CPE modem	38
4.3	Downstream	39
4.3.1	Downstream protocol	39
4.3.2	Scalable interleaving to support low latency	39
4.3.3	Downstream frequency plan	39
4.3.4	BWA BTS output electrical	39
4.3.5	Downstream RF input to BWA CPE	40
4.3.6	BWA CPE modem BER performance	40
5	Downstream transmission convergence sublayer	41
5.1	Introduction	41
5.2	MPEG packet format	42
5.3	MPEG header for BWA data-over-the-air	42
5.4	MPEG payload for BWA data-over-the-air	43
5.5	Interaction with the MAC sublayer	43
5.6	Interaction with the PHY layer	44
5.7	MPEG header synchronization and recovery	44
6	MAC specification	45
	Annex 1 – Data-over-BWA interface documents	45

Introduction

Local access and other high density radio-relay service planning and system deployments have rapidly accelerated in the last few years in many countries. This acceleration is due in large part to the trend towards increased demand and competition in the provision of high bit-rate local telecommunications and video distribution services. Because of cost and speed of deployment considerations, these developments are placing a major new focus on the provision of services directly to end users via fixed wireless access systems (FWA).

Current broadband wireless access (BWA) data rates over individual circuit paths range from about 1.5 Mbit/s to about 45 Mbit/s, and are expected to reach at least 310 Mbit/s within the next few years, as radios utilizing higher order modulation schemes become available (see Recommendation ITU-R F.758).

The variety of possible broadband FWA network configurations includes: conventional point-to-point (P-P), conventional point-to-multipoint (P-MP), and combinations thereof, e.g. P-P systems deployed in multi-sectored P-MP configurations. High density deployment of independent P-P links similarly results in clusters that assume the essential characteristics of P-MP deployment. An emerging system architecture is that of multipoint-to-multipoint (MP-MP), similar to mesh systems.

These broadband FWA systems are predominantly deployed in dense urban, suburban, and campus environments where transmission path elevation angles may reach up to about 40° to 60°. Links are regularly deployed on an on-demand basis to meet specific end-user requirements as they develop.

This Recommendation addresses fixed BWA systems, and this is based on ITU-T Recommendation J.112, Annex B – Data over cable radio frequency interface. A number of frequency bands in the range 2.5-66 GHz can be appropriate for these systems. This and other systems, which may be addressed in other recommendations, belong to the category of multimedia wireless systems (MWS). MWS are wireless systems which support information exchange of more than one type, such as text, graphics, voice, sound, image, data and video.

This Recommendation is complementary to ITU-T Recommendation J.116. This Recommendation and ITU-T Recommendation J.116 should be considered in their totality when implementing BWA systems.

Scope

This Recommendation is based on the standards approved and published by ITU-T for cable modems (specifically ITU-T Recommendation J.112, Annex B), but adapts the technical parameters for use in the wireless access environment, that is for BWA customer premises equipment (CPE) modems. The commonality is maximized to achieve economies of scale.

This Recommendation is complementary to ITU-T Recommendation J.116. This Recommendation and ITU-T Recommendation J.116 should be considered in their totality when implementing BWA systems.

References

The following ITU 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; all 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. Lists of the currently valid ITU Recommendations are regularly published.

Recommendation ITU-R F.755:	Point-to-multipoint systems used in the fixed service
Recommendation ITU-R F.1402:	Frequency sharing criteria between a land mobile wireless access system and a fixed wireless access system using the same equipment type as the mobile wireless access system
Recommendation ITU-R F.1400:	Performance and availability requirements and objectives for fixed wireless access to public switched telephone network
Recommendation ITU-R F.1399:	Vocabulary of terms for wireless access

Recommendation ITU-R F.1401:	Frequency bands for fixed wireless access systems and the identification methodology
ITU-T Recommendation H.222.0:	ISO/IEC 13818-1: 1996, Information technology – Generic coding of moving pictures and associated audio information: Systems
ITU-T Recommendation I.361:	B-ISDN ATM layer specification
ITU-T Recommendation I.363:	B-ISDN ATM adaptation layer (AAL) specification
ITU-T Recommendation J.83:	Digital multi-programme systems for television, sound and data services for cable distribution
ITU-T Recommendation J.110:	Basic principles for a worldwide common family of systems for the provision of interactive television services
ITU-T Recommendation J.111:	Network independent protocols for interactive systems
ITU-T Recommendation J.112:	Transmission systems for interactive cable television services
ITU-T Recommendation J.116:	Interaction channel for local multipoint distribution systems
ITU-T Recommendation V.21:	300 bits per second duplex modem standardized for use in the general switched telephone network
ITU-T Recommendation V.22:	1 200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits
ITU-T Recommendation V.22bis:	2 400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits
ITU-T Recommendation V.23:	600/1 200-baud modem standardized for use in the general switched telephone network
ITU-T Recommendation V.25:	Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls
ITU-T Recommendation V.32:	A family of 2-wire, duplex modems operating at data signalling rates of up to 9 600 bit/s for use on the general switched telephone network and on leased telephone-type circuits
ITU-T Recommendation V.32bis:	A duplex modem operating at data signalling rates of up to 14 400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits
ITU-T Recommendation V.34:	A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits
ITU-T Recommendation V.42:	Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion
ITU-T Recommendation X.25:	Interface between Data Terminal Equipment and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit
ITU-T Recommendation Z.100:	CCITT Specification and Description Language (SDL)

ISO/IEC:

- ISO 8025: Information processing systems – Open Systems Interconnection – Specification of the Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) (December, 1987)
- ISO/IEC 8802-2: Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control, 1994 (IEEE Std 802.2: 1994)
- ISO/IEC 8802-3: Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical sublayer specifications, 1996 (IEEE Std 802.3: 1996)
- ISO/IEC 10038: Information technology – Telecommunications and information exchange between systems – Local area networks – Media access control (MAC) bridges, 1993 (ANSI/IEEE Std 802.1D: 1993)
- ISO/IEC 10039: Information technology – Open Systems Interconnection – Local area networks – Medium Access Control (MAC) service definition, 1991
- ISO/IEC 15802-1: Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common specifications – Part 1: Medium Access Control (MAC) service definition, 1995

IETF:

- RFC-791: POSTEL, J. [September, 1981] Internet Protocol (MIL STD 1777). Internet Engineering Task Force (IETF).
- RFC-826: PLUMMER, D. [November, 1982] Ethernet Address Resolution Protocol: Or converting network protocol addresses to 48-bit Ethernet address for transmission on Ethernet hardware.
- RFC-868: HARRENTIEN, K. and POSTEL, J. [May, 1983] Time Protocol. IETF.
- RFC-1042: POSTEL, J. and REYNOLDS, J. [February, 1988] A Standard for the Transmission of IP Datagrams over IEEE 802 Networks. IETF.
- RFC-1058: HEDRICK, C. [June, 1988] Routing Information Protocol. IETF.
- RFC-1157: SCHOFFSTALL, M., FEDOR, M., DAVIN, J. and CASE, J. [May, 1990] A Simple Management Protocol (SNMP). IETF.
- RFC-1350: SOLLINGS, K. [July, 1992] The TFTP Protocol (Revision 2). IETF.
- RFC-1533: ALEXANDER, S. and DROMS, R. [October, 1993] DHCP Options and BOOTP Vendor Extensions. IETF.
- RFC-1541: DROMS, R. [October, 1993] Dynamic Host Configuration Protocol. IETF.
- RFC-1633: BRADEN, R., CLARK, D. and SHENKER, S. [June, 1994] Integrated Services in the Internet Architecture: An Overview. IETF.
- RFC-1812: BAKER, F. [June, 1995] Requirements for IP Version 4 Routers. IETF.
- RFC-2104: KRAWCZYK, H., BELLARE, M. and CANETTI, R. [February, 1997] HMAC: Keyed-Hashing for Message Authentication. IETF.

Definitions and abbreviations

Address resolution protocol (ARP): A protocol of the IETF for converting network addresses to 48-bit Ethernet addresses.

Asynchronous transfer mode (ATM): A protocol for the transmission of a variety of digital signals using uniform 53-byte cells.

Availability: Is the long-term ratio of the actual RF channel operation time to scheduled RF channel operation time (expressed as a per cent value) and is based on a bit error rate (BER) assumption.

Bridge Protocol Data Unit (BPDU): Spanning tree protocol messages as defined in ISO/IEC10038.

Broadcast addresses: A predefined destination address that denotes the set of all data network service access points.

Burst error second: Any errored second containing at least 100 errors.

BWA BTS modem: Broadband wireless access base transceiver station modem. One or more downstream demodulators and their corresponding upstream modulators.

BWA CPE modem: Broadband wireless access customer premises equipment modem.

Carrier hum modulation: The peak-to-peak magnitude of the amplitude distortion relative to the RF carrier signal level due to the fundamental and low-order harmonics of the power-supply frequency.

Carrier-to-noise ratio (C/N): The square of the ratio of the root mean square (r.m.s.) of the voltage of the digitally-modulated RF carrier to the r.m.s. of the continuous random noise voltage in the defined measurement bandwidth. (If not specified explicitly, the measurement bandwidth is the symbol rate of the digital modulation.)

Cross-modulation: A form of television signal distortion where modulation from one or more television channels is imposed on another channel or channels.

Customer: See end user.

Customer premises equipment (CPE): Equipment at the end user's premises; may be provided by the end user or the service provider.

Data link layer: Layer 2 in the open system interconnection (OSI) architecture; the layer that provides services to transfer data over the transmission link between open systems.

Downstream: The direction of transmission from the BTS to the subscriber.

Dynamic host configuration protocol (DHCP): An Internet protocol used for assigning network-layer (IP) addresses.

Dynamic range: The ratio between the greatest signal power that can be transmitted over a multichannel analogue transmission system without exceeding distortion or other performance limits, and the least signal power that can be utilized without exceeding noise, error rate or other performance limits.

End user: A human being, organization, or telecommunications system that accesses the network in order to communicate via the services provided by the network.

Errored second: Any one second interval containing at least one bit error.

Fibre distributed data interface (FDDI): A fibre-based LAN standard.

Fibre node: A point of interface between a fibre trunk and the coaxial distribution.

Forward channel: The direction of RF signal flow away from the BTS toward the end user; synonymous to downstream.

Group delay: The difference in transmission time between the highest and lowest of several frequencies through a device, circuit or system.

Guard time: Minimum time allocated between bursts in the upstream, referenced from the symbol centre of the last symbol of a burst to the symbol centre of the first symbol of the following burst.

Headend: The central location on the BWA network that is responsible for injecting broadcast video and other signals in the downstream direction. See also master headend, distribution hub.

Header: Protocol control information located at the beginning of a protocol data unit.

Impulse noise: Noise characterized by non-overlapping transient disturbances.

Interleave: An error correction method that enables the correction of burst noise induced errors.

Internet control message protocol (ICMP): An Internet network-layer protocol.

Internet protocol (IP): An Internet network-layer protocol, defined by the IETF.

Latency: The time, expressed in quantity of symbols, taken for a signal element to pass through a device.

Layer: A subdivision of the open system interconnection (OSI) architecture, constituted by subsystems of the same rank.

Local area network (LAN): A non-public data network in which serial transmission is used for direct data communication among data stations located on the user's premises.

Logical link control (LLC) procedure: In a LAN or a metropolitan area network (MAN), that part of the protocol that governs the assembling of data link layer frames and their exchange between data stations, independent of how the transmission medium is shared.

MAC service access point: is an attachment to a MAC-sublayer domain.

Mean time to repair (MTTR): the MTTR is the average elapsed time from the moment a loss of RF channel operation is detected up to the moment the RF channel operation is fully restored.

Media access control (MAC) address: The built-in hardware address of a device connected to a shared medium.

Media access control (MAC) procedure: In a subnetwork, that part of the protocol that governs access to the transmission medium independent of the physical characteristics of the medium, but taking into account the topological aspects of the subnetworks, in order to enable the exchange of data between nodes. MAC procedures include framing, error protection, and acquiring the right to use the underlying transmission medium.

Media access control (MAC) sublayer: The part of the data link layer that supports topology dependent functions and uses the services of the physical layer to provide services to the logical link control (LLC) sublayer.

Mini-slot: A mini-slot is an integer multiple of 6.25- μ s increments. The relationship between mini-slots, bytes and time ticks is described in Section 6.

Multipoint Access: User access in which more than one terminal equipment is supported by a single network termination.

Multipoint connection: A connection among more than two data network terminations.

Network layer: Layer 3 in the OSI architecture; the layer that provides services to establish a path between open systems.

Network management: The functions related to the management of data link layer and physical layer resources and their stations across the data network supported by the hybrid fibre/coax system.

Open systems interconnection (OSI): A framework of ISO standards for communication between different systems made by different vendors, in which the communications process is organized into seven different categories that are placed in a layered sequence based on their relationship to the user. Each layer uses the layer immediately below it and provides a service to the layer above. Layers 7 through 4 deal with end-to-end communication between the message source and destination, and layers 3 through 1 deal with network functions.

Organizationally unique identifier (OUI): A three octet IEEE assigned identifier that OUI can be used to generate universal LAN MAC addresses and protocol identifiers per ANSI/IEEE Std 802 for use in local and metropolitan area network applications.

Packet identifier (PID): A unique integer value used to identify elementary streams of a program in a single- or multi-program MPEG-2 stream.

Physical (PHY) layer: Layer 1 in the OSI architecture; the layer that provides services to transmit bits or groups of bits over a transmission link between open systems and which entails electrical, mechanical and handshaking procedures.

Physical media dependent (PMD) sublayer: A sublayer of the physical layer which is concerned with transmitting bits or groups of bits over particular types of transmission link between open systems and which entails electrical, mechanical and handshaking procedures.

Program specific information (PSI): In MPEG-2, normative data necessary for the demultiplexing of transport streams and the successful regeneration of programs.

Program stream: In MPEG-2, a multiplex of variable-length digital video and audio packets from one or more program sources having a common time-base.

Protocol: A set of rules and formats that determines the communication behaviour of layer entities in the performance of the layer functions.

Quadrature amplitude modulation (QAM): A method of modulating digital signals onto a radio-frequency carrier signal involving both amplitude and phase coding.

Quaternary phase-shift keying (QPSK): A method of modulating digital signals onto a radio-frequency carrier signal using four phase states to code two digital bits.

Radio frequency (RF): Refers to electromagnetic signals typically in the range 5 to 40 000 MHz.

Reed-Solomon code: A forward error correction code located before interleaving that enables correction of errors induced by burst noise.

Return loss: The parameter describing the attenuation of a guided wave signal (e.g. via a coaxial cable) returned to a source by a device or medium resulting from reflections of the signal generated by the source.

Reverse channel: The direction of signal flow towards the BTS, away from the subscriber; equivalent to upstream.

Roll off: A coefficient of cosine roll off function that determines the frequency characteristics of the filter.

Routing information protocol (RIP): A protocol of the IETF for exchanging routing information about IP networks and subnets.

Service access point (SAP): The point at which services are provided by one layer, or sublayer, to the layer immediately above it.

Service data unit (SDU): Information that is delivered as a unit between peer service access points.

Simple network management protocol (SNMP): A network management protocol of the IETF.

Sublayer: A subdivision of a layer in the OSI reference model.

Subnetwork: Subnetworks are physically formed by connecting adjacent nodes with transmission links.

Subnetwork access protocol (SNAP): An extension of the LLC header to accommodate the use of IEEE 802 type networks as IP networks.

Subscriber: See end user.

Subsystem: An element in a hierarchical division of an open system that interacts directly with elements in the next higher division or the next lower division of that open system.

Systems management: Functions in the application layer related to the management of various OSI resources and their status across all layers of the OSI architecture.

Transit delay: The time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission control protocol (TCP): A transport-layer Internet protocol which ensures successful end-to-end delivery of data packets without error, as defined by the IETF.

Transmission convergence sublayer: A sublayer of the physical layer that provides an interface between the data link layer and the PMD sublayer.

Transmission link: The physical unit of a subnetwork that provides the transmission connection between adjacent nodes.

Transmission medium: The material on which information signals may be carried; e.g. wireless, optical fibre, coaxial cable, and twisted wire pairs.

Transmission system: The interface and transmission medium through which peer physical layer entities transfer bits.

Transmit on/off ratio: In multiple-access systems, the ratio between the signal powers sent to line when transmitting and when not transmitting.

Transport stream: In MPEG-2, a packet-based method of multiplexing one or more digital video and audio streams having one or more independent time bases into a single stream.

Trivial file transfer protocol (TFTP): An Internet protocol for transferring files without the requirement for user names and passwords that is typically used for automatic downloads of data and software.

Type/length/value (TLV): An encoding of three fields, in which the first field indicates the type of element, the second the length of the element, and the third field the value.

Upstream: The direction from the subscriber location toward the BTS.

BC:	Broadcast channel.
BRA:	Basic rate access.
BTS:	Base transceiver station. A BTS could contain multiple BTS modems.
BWA:	Broadband wireless access.
CATV:	Community antenna television (system).
CRC:	Cyclic redundancy check, a method of error detection using cyclic code.
DA:	Destination address.
DAVIC:	Digital Audio-Visual Council.
DCE:	Data communication equipment.
DOBSS:	Data over BWA security system.
DTE:	Data termination equipment.
DTMF:	Dual tone multifrequency (dialling mode).
DVB:	Digital video broadcasting.
EH or EHDR:	Extended header.
FC:	Frame control.
FDM:	Frequency division multiplex.
FDMA:	Frequency division multiple access.
FEC:	Forward error correction.
FWA:	Fixed wireless access.
GSTN:	General switched telephone network.
GT:	Global time.
HCS:	Header check sequence.
HFC:	Hybrid fibre/coax (HFC) system.
IC:	Interaction channel.
IE:	Information element.
IEC:	International Electrotechnical Commission.
IEEE:	Institute of Electrical and Electronic Engineers.
IETF:	Internet Engineering Task Force.
INA:	Interactive network adapter.
IQ:	In-phase and quadrature components.
IRD:	Integrated receiver decoder.
ISDN:	Integrated services digital network.
ISO:	International Organization for Standardization.

LEN:	Length (in bytes unless otherwise stated).
LFSR:	Linear feedback shift register.
LMCS:	Local multipoint communication system.
LMDS:	Local multipoint distribution system.
LSB:	Least significant bit.
LT:	Local time.
MAC:	See media access control (MAC) procedure.
MCNS:	Multimedia cable network system.
MMDS:	Multi-channel multi-point distribution systems.
MPEG:	Moving picture experts group.
MSAP:	MAC service access point.
MSB:	Most significant bit.
NIU:	Network interface unit.
NSAP:	Network service access point.
OoB:	Out-of-band.
PM:	Pulse modulation.
PSTN:	Public switched telephone network.
QoS:	Quality of service.
REQ:	Request indicator.
RNG:	Ranging.
RTD:	Round trip delay.
SID:	Service identifier.
SMATV:	Satellite master antenna television.
SMS:	Spectrum management system.
SNMP:	Simple network management protocol.
STB:	Set-top box.
STU:	Set-top unit.
SYNC:	Synchronization.
TC:	Transmission convergence sublayer.
TDMA:	Time division multiple access.
Tick:	Time intervals that are the reference for upstream mini-slot definition and upstream transmission times.
TS:	Transport stream.
UCC:	Upstream channel change.
UCD:	Upstream channel descriptor.

Conventions

Throughout this Recommendation, the words that are used to define the significance of particular requirements are capitalized. These words are:

MUST	This word or the adjective REQUIRED means that the item is an absolute requirement of this specification.
MUST NOT	This phrase means that the item is an absolute prohibition of this specification.
SHOULD	This word or the adjective RECOMMENDED means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
SHOULD NOT	This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
MAY	This word or the adjective OPTIONAL means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

Other text is descriptive or explanatory.

Considerations

ITU-T has developed Recommendations for cable modems, which can be used as the basis for wireless access systems in order to achieve economies of scale. In particular, Annex B of ITU-T Recommendation J.112 and ITU-T Recommendation J.83 – Digital multi-programme systems for television, sound and data services for cable distribution, are particularly applicable. The technical parameters can be adapted to the wireless environment rather than for a cable environment in order to support bidirectional data over BWA systems for interactive services.

Recommendation

The Radiocommunication Assembly recommends that the following requirements be used with radio transmission systems for fixed BWA based on cable modem standards (Annex B of ITU-T Recommendation J.112).

This Recommendation is complementary to ITU-T Recommendation J.116. This Recommendation and ITU-T Recommendation J.116 should be considered in their totality when implementing BWA systems.

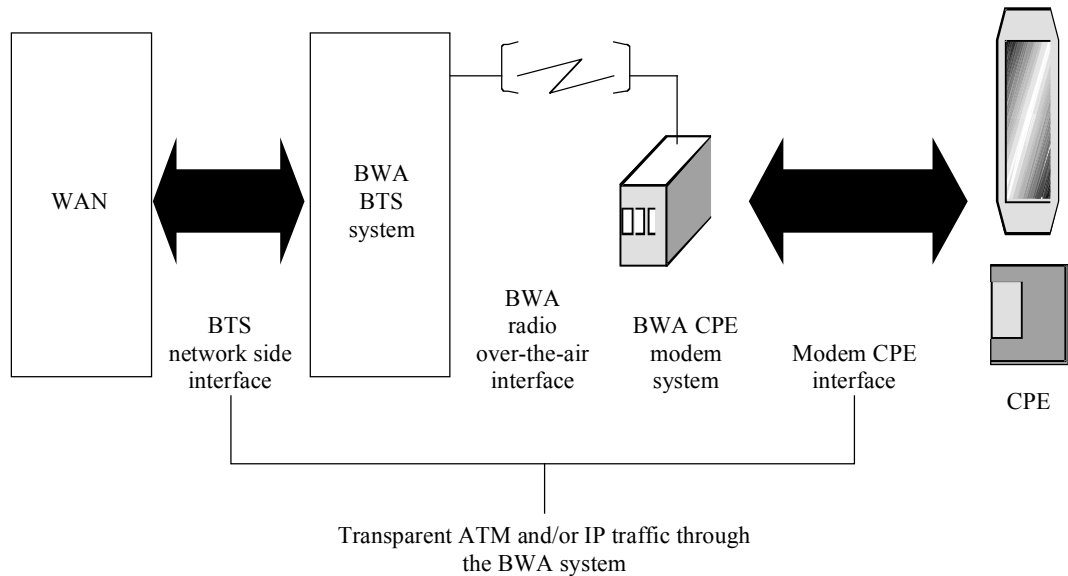
1 General system requirements

1.1 Service goals

The intended service will allow transparent bidirectional transfer of ATM and/or IP traffic, between the BWA BTS and customer locations, over a BWA network. This is shown in simplified form in Fig. 1.

The transmission path over the BWA system is realized at the fixed network side by a BWA BTS, and at each customer location by a BWA CPE modem. At the fixed network side, the interface to the BWA BTS system is called the BWA BTS – network-side interface (BTS-NSI) and is specified in MCNS3 (see Annex 1). At the customer locations, the interface is called the CPE-modem-to-customer-premises-equipment interface (CMCI) and is specified in MCNS4 (see Annex 1). The intent is for the BWA operators to transparently transfer ATM and IP traffic between these interfaces, including but not limited to datagrams, DHCP, ICMP and IP group addressing (broadcast and multicast).

FIGURE 1
Transparent ATM and/or IP traffic through the BWA system



1499-01

1.2 Reference architecture

The reference architecture for the data-over-BWA services and interfaces is shown in Fig. 2.

1.3 Categories of interface specification

The basic reference architecture of Fig. 2 involves four categories of interface. These are being developed in phases:

1.3.1 Phase 1

Data interfaces – These are the CMCI (MCNS4 (see Annex 1)) and BTS-NSI (MCNS3 (see Annex 1)), corresponding respectively to the CPE-modem-to-CPE interface (for example, between the customer's computer and the BWA CPE modem), and the BWA BTS modem system network-side interface between the BWA BTS modem and the data network.

1.3.2 Phase 2

Operations support systems interfaces – These are network element management layer interfaces between the network elements and the high-level operations support systems (OSSs) which support the basic business processes, and are documented in MCNS5 (see Annex 1).

1.3.3 Phase 3

IF interfaces – The IF interfaces defined in this Recommendation are the following:

- between the BWA CPE modem and the CPE IF module;
- between the BTS modem and the BTS IF module.

1.3.4 Phase 4

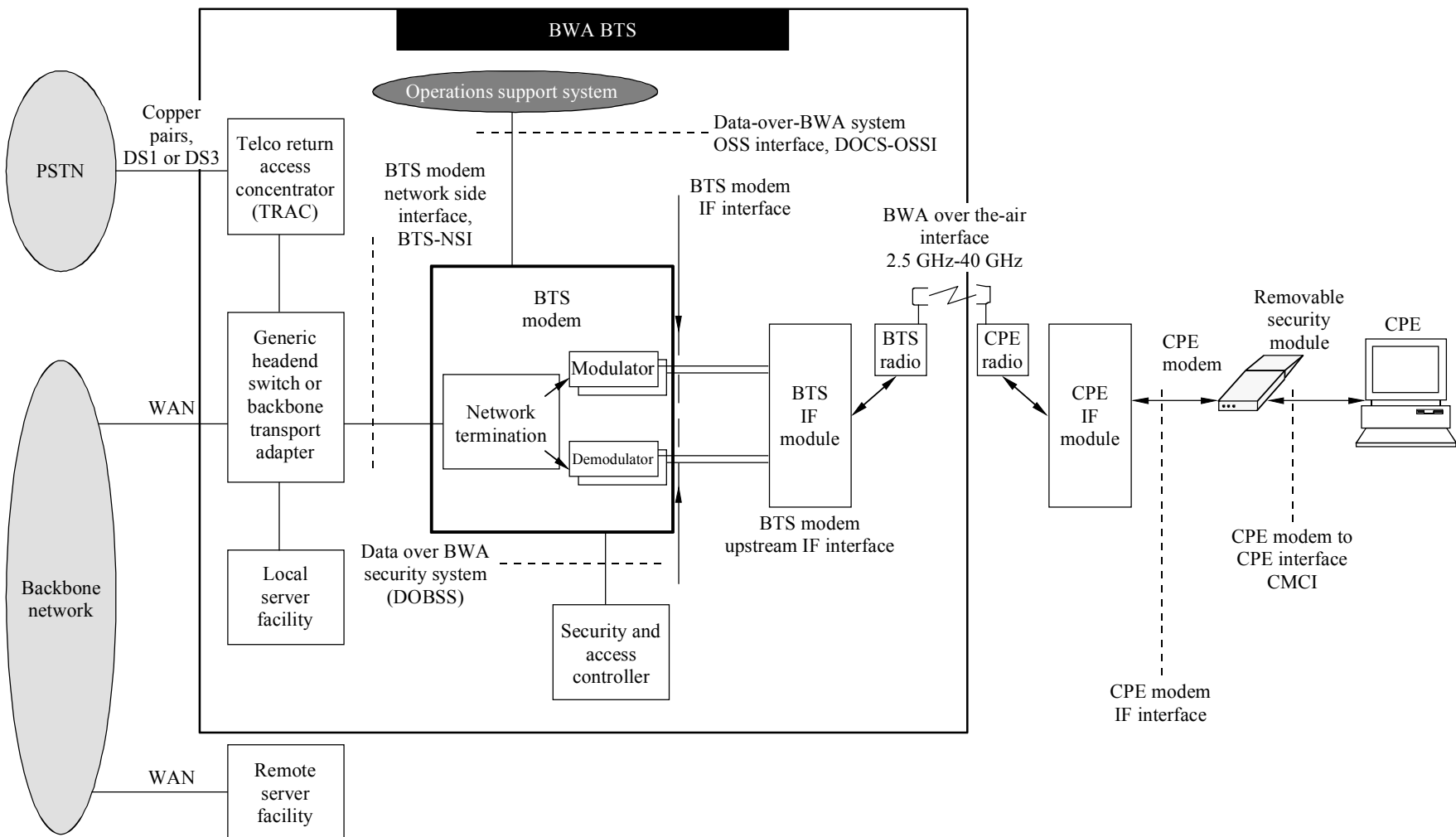
Over the-air interface – The RF interfaces defined in this Recommendation are the following:

- between the BTS radio and the CPE radio in the downstream direction;
- between the BTS radio and the CPE radio in the upstream direction.

Security requirements

- The Data-over-BWA security system (DOBSS) is defined in MCNS2 (see Annex 1).
- The CPE removable security module (RSM) is defined in MCNS7 (see Annex 1).
- Baseline data-over-BWA security is defined in MCNS8 (see Annex 1).

FIGURE 2
Data-over-BWA reference architecture



1499-02

1.4 Server location

This Recommendation refers to several servers which are central to the system operation (e.g. provision and security servers).

The message sequence charts used as examples within this Recommendation show sample message exchanges in which access to the servers is via the BTS modem.

2 Functional assumptions

This section describes the characteristics of a BWA network for the purposes of operation of the data-over-BWA system. The data-over-BWA system **MUST** operate satisfactorily in the environment described in this section.

2.1 BWA network

The BWA system uses TDMA. The key functional characteristics are the following:

- one- and two-way wireless transmission;
- downstream uses TDM;
- upstream uses TDMA;
- frequency bands between 2.5 to 66 GHz will be used;
- a BTS service area is called a cell, with a cell radius typically <15 km, depending on rain regions and the availability requirement;
- a cell may be divided into multiple sectors;
- the system must be able to combat rain fades of 30 dB and a fade rate of 5 dB/s.

2.2 Equipment assumptions

2.2.1 Frequency plan

Frequency bands between 2.5 GHz and 66 GHz (e.g. LMDS, LMCS and MMDS frequency bands) throughout the world are ideal for BWA applications. These types of systems form part of what is known as MWS. Considering the various RF bands to be used for BWA applications, it is desirable to define the IF for the interface between the modem units and the RF units, however the specific implementation of the IF is left to vendors.

2.2.2 Compatibility with other services

Some of the BWA frequency bands may be shared with satellite applications. In these cases, the mutual interference should be considered and engineered so that both systems will work with minimal performance degradation.

2.2.3 Fault isolation impact on other users

As the data-over-BWA system is a shared-media, point-to-multipoint (P-MP) system, fault-isolation procedures **MUST** take into account the potential harmful impact of faults and fault-isolation procedures on numerous users of the data-over-BWA and other services.

2.3 RF channel assumptions

The data-over-BWA system, configured with at least one set of defined physical-layer parameters (e.g. modulation, FEC, symbol rate, etc.) from the range of configuration settings described in this specification, must be capable of operating with a 1 500-byte packet loss rate of less than one per cent while forwarding at least 100 packets/s on BWA networks having characteristics defined in § 2.3.