IEEE P802.22
Wireless RANs

|  |
| --- |
| [802.22b General] |
| Date: 2013-05-23 |
| Author(s): |
| Name | Company | Address | Phone | email |
| Changwoo Pyo | NICT | 3-4, Hikarino-oka, Yokosuka, 239-0847, Japan |  | cwpyo@nict.go.jp |
| Zhang Xin | NICT | 20 Science Park Road, #01-09A/10 TeleTech Park, Singapore |  | amy.xinzhang@ieee.org |
| Chunyi Song | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | songe@ieee.org |
| Keiichi Mizutani  | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | mizk@nict.go.jp |
| Pin-Hsun Lin | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | pslin@nict.go.jp |
| Gabriel Porto Villardi | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | gpvillardi@nict.go.jp |
| Masayuki Oodo | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | moodo@nict.go.jp |
| Hiroshi Harada | NICT | 3-4 Hikarion-Oka, Yokosuka, Japan |  | harada@ieee.org |
|  |  |  |  |  |

Abstract

This document is a revision of initialization and network association (7.14) for 802.22b systems and provies definitions related with the revision.

**Notice:** This document has been prepared to assist IEEE 802.22. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

**Release:** The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE’s name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE’s sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.22.

**Patent Policy and Procedures:** The contributor is familiar with the IEEE 802 Patent Policy and Procedures

<[**http://standards.ieee.org/guides/bylaws/sb-bylaws.pdf**](http://standards.ieee.org/guides/bylaws/sb-bylaws.pdf)>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair Apurva Mody <apurva.mody@ieee.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.22 Working Group. **If you have questions, contact the IEEE Patent Committee Administrator at <****patcom@ieee.org****>**.

**7. MAC Common Part sublayer**

This clause describes the MAC layer used by the IEEE 802.22 WRAN point-to-multipoint medium access control standard. The MAC provides tools for protection of TV bands incumbent services as well as for coexistence. The MAC is　connection-oriented and provides flexibility in terms of QoS support. The MAC regulates downstream medium access by TDM, while the upstream is managed by using a DAMA/OFDMA system. In the MAC, the BS manages all the activities within its IEEE 802.22 cell and the associated CPEs are under the control of the BS.

This clause describes the MAC layer used by the IEEE 802.22 WRAN point-to-multipoint medium access control standard and the IEEE 802.22b WRAN multihop relay medium access control standard. The MAC provides tools for protection of TV bands incumbent services as well as for coexistence. The 802.22b MAC provides all functionalities of the 802.22 MAC, and additionally supports multihop relay operations, multiple channel operations, etc. The 802.22 MAC and 802.22b MAC areconnection-oriented and provide flexibility in terms of QoS support. The 802.22 MAC and the 802.22b MAC regulatedownstream medium access by TDM, while the upstream is managed by using a DAMA/OFDMA system. In the 802.22 MAC, the BS manages all the activities within its IEEE 802.22 cell and the associated CPEs are under the control of the BS. The 802.22b MAC provides point-to-multipoint connections and relay connections between the MR-BS and the CPEs as well as supports to configure a local cell consisting of a distributed scheduling R-CPE and S-CPEs. An R-CPE operates one of two modes of centralized scheduling and distributed scheduling depending on capability or network sistualtions. The R-CPE on the centralized scheduling mode (centralized scheduling R-CPE) provides relay connections for the subscribe CPEs (S-CPEs) under the management of the MR-BS. On the other hand, the R-CPE on the distributed scheduling mode (distributed scheduling R-CPE) configures a local cell within the 802.22b WRAN cell, and has the functionalitiy of MR-BS and manages S-CPEs within the local cell. The MR-BS manages the IEEE 802.22b WRAN cell containing CPEs and local cells.



**7.1 General**

In an IEEE 802.22 cell, multiple CPEs are managed by a single BS that controls the medium access. The downstream is TDM where the BS transmits and the CPE receives. The upstream transmissions, where the CPEs transmit and the BS receives, are shared by CPEs on a demand basis, according to a DAMA/OFDMA scheme. Depending on the class of service (CoS) utilized, a CPE may be issued continuing rights to transmit, or is dynamically allocated by the BS after receipt of a request from the CPE. The MAC supports unicast (addressed to a single CPE), multicast (addressed to a group of CPEs) and broadcast (addressed to all CPEs in a cell) services.

In an IEEE 802.22 cell, multiple CPEs are managed by a single BS that controls the medium access. The downstream is TDM where the BS transmits and the CPE receives. The upstream transmissions, where the CPEs transmit and the BS receives, are shared by CPEs on a demand basis, according to a DAMA/OFDMA scheme. Depending on the class of service (CoS) utilized, a CPE may be issued continuing rights to transmit, or is dynamically allocated by the BS after receipt of a request from the CPE. The MAC supports unicast (addressed to a single CPE), multicast (addressed to a group of CPEs) and broadcast (addressed to all CPEs in a cell) services.

In an IEEE 802.22b cell consisting of CPEs (R-CPEs and S-CPEs) and local cells, multiple CPEs are managed by a single MR-BS. The downstream is TDM where the MR-BS transmits and the CPEs receive. The upstream transmissions, where the CPEs transmit and the MR-BS receives, are shared by the CPEs on a demand basis, according to a DAMA/OFDMA scheme. In a local cell consisting of a distributed scheduling R-CPE and S-CPEs, multiple S-CPEs are managed by the distributed scheduling R-CPE. The downstream within a local cell is TDM where the distributed scheduling R-CPE transmits and the S-CPEs receive. The upstream transmissions within a local cell, where the S-CPEs transmit and the distributed scheduling R-CPE receives, are shared by the S-CPEs on a demand basis, according to a DAMA/OFDMA sheme.

The MAC implements a combination of access schemes that efficiently control contention between CPEs within a cell and overlapping cells sharing the same channel while at the same time attempting to meet the latency and bandwidth requirements of each user application. This is accomplished through four different types of upstream scheduling mechanisms that are implemented using: unsolicited bandwidth rants, polling, and two contention procedures (i.e., MAC header and CDMA based). The use of polling simplifies the access operation and attempts to allow applications to receive service on a deterministic basis if it is required.

The 802.22 MAC and 802.22b MAC implement a combination of access schemes that efficiently control contention between CPEs within a cell and overlapping cells sharing the same channel while at the same time attempting to meet the latency and bandwidth requirements of each user application. This is accomplished through four different types of upstream scheduling mechanisms that are implemented using: unsolicited bandwidth rants, polling, and two contention procedures (i.e., MAC header and CDMA based). The use of polling simplifies the access operation and attempts to allow applications to receive service on a deterministic basis if it is required.

The MAC is onnection-oriented, and as such, connections are a key component that require active maintenance and hence can be dynamically created, deleted, and changed as the need arises. A connection defines both the mapping between convergence processes at CPEs and BS and the related service flow (one connection per service flow). For the purposes of mapping to services on CPEs and associating varying levels of QoS, all data communications are instantiated in the context of a connection and this provides a mechanism for upstream and downstream QoS management. In particular, the QoS parameters are integral to the bandwidth allocation process as the CPE requests upstream bandwidth on a per connection basis (implicitly identifying the service flow). The BS, in turn, grants bandwidth to a CPE as an aggregate of grants in response to per-connection requests from the CPE.

The 802.22 MAC and 802.22b MAC are onnection-oriented, and as such, connections are a key component that require active maintenance and hence can be dynamically created, deleted, and changed as the need arises. A connection defines both the mapping between convergence processes at CPEs and BS or MR-BS and the related service flow (one connection per service flow). For the purposes of mapping to services on CPEs and associating varying levels of QoS, all data communications are instantiated in the context of a connection and this provides a mechanism for upstream and downstream QoS management. In particular, the QoS parameters are integral to the bandwidth allocation process as the CPE requests upstream bandwidth on a per connection basis (implicitly identifying the service flow). The BS, MR-BS or the distributed scheduling R-CPE, in turn, grants bandwidth to a CPE as an aggregate of grants in response to per-connection requests from the CPE.

**7.2 Addressing and connections**

Each IEEE 802.22 base station and CPE shall have a 48-bit universal MAC address, as defined in IEEE Std 802-2001. This address uniquely defines the base station and CPE from within the set of all possible vendors and equipment types. It is used as part of the authentication process by which the BS and CPE each verify the identity of the other at the time of network association. It is used as part of the authentication process by which the BS and CPE each verify the identity of the other at the time of network association. The BS MAC address is broadcast by the BS and is present in every CBP burst, being part of the Superframe Control header (SCH) data. Each WRAN device regularly broadcasts a CBP burst containing its Device ID and Serial Number. This is done as part of the device’s self-identification process that helps identify potential interference sources to incumbent services and for coexistence purposes.

Each IEEE 802.22 base station and CPE shall have a 48-bit universal MAC address, as defined in IEEE Std 802-2001. This address uniquely defines the base station and CPE from within the set of all possible vendors and equipment types. It is used as part of the authentication process by which the BS and CPE each verify the identity of the other at the time of network association. It is used as part of the authentication process by which the BS and CPE each verify the identity of the other at the time of network association. The BS MAC address is broadcast by the BS and is present in every CBP burst, being part of the Superframe Control header (SCH) data. Each WRAN device regularly broadcasts a CBP burst containing its Device ID and Serial Number. This is done as part of the device’s self-identification process that helps identify potential interference sources to incumbent services and for coexistence purposes.

Connections are identified by two items, a 9-bit station ID (SID) and a 3-bit flow ID (FID). The SID uniquely identifies a station that is under the control of the BS. A SID can be for a unicast station, when referencing a single CPE, or for a multicast station, when referencing a multicast group (of CPEs). A FID identifies a particular traffic flow assigned to a CPE. The tuple of SID and FID (SID | FID) forms a connection identifier (CID) that identifies a connection for the CPE. The SID is signaled in the DS/US- MAP allocation, and the FID is signaled in the generic MAC header (GMH) of a MAC PDU. This allows for a total of up to 512 stations, each with a maximum of eight flows that can be supported within each downstream and upstream channel.

Connections are identified by three items, a 8-bit local cell ID (LCID), a 13-bit station ID (SID) and a 8-bit flow ID (FID). The LCID uniquely identify a local cell that is under the distributed scheduling R-CPE. The SID uniquely identifies a station that is under the control of the BS, the MR-BS or the distributed scheduling R-CPE. A SID can be for a unicast station within a 802.22b WRAN cell or a local cell, when referencing a single CPE, or for a multicast station, when referencing a multicast group (of CPEs). A FID identifies a particular traffic flow assigned to a CPE. A 4bit LSB of FID defines downstream flow ID, while a 4bit MSB of FID defines upstream flow ID. The tuple of LCID, SID and FID (LCID|SID | FID) forms a connection identifier (CID) that identifies a connection for the CPE. The LCID and SID a signaled in the DS/US- MAP allocation, and the FID is signaled in the generic MAC header (GMH) of a MAC PDU. This allows for a total of up to 8192 stations in each local cell up to 255 , each with a maximum of sixteen flows that can be supported within each downstream and upstream channel. LCID with all zero shall be allocated for the 802.22b WRAN cell.

At CPE initialization, three flows shall be dedicated for management connections (see 12.2) for the purpose of carrying MAC management messages and data between a CPE and the BS. The three flows reflect the fact that there are inherently three different levels of QoS for traffic sent on management connections between a CPE and the BS. The basic flow is used by the BS MAC and CPE MAC to exchange short, time- urgent MAC management messages; whereas, the primary management flow is used by the BS MAC and CPE MAC to exchange longer, more delay-tolerant MAC management messages (Table 19 specifies which MAC management messages are transferred on which type of connections). Finally, the secondary management flow is used by the BS and CPE to transfer more delay tolerant, standards-based (e.g., DHCP, TFTP, and SNMP) messages that are carried in IP datagrams. The secondary management flow may be packed and/or fragmented, similarly to the primary management except that no ARQ should be used for the latter since it is more time critical.

At CPE initialization, three flows shall be dedicated for management connections (see 12.2) for the purpose of carrying MAC management messages and data between a CPE and the BS/MR-BS or the distributed scheduling R-CPE. The three flows reflect the fact that there are inherently three different levels of QoS for traffic sent on management connections between a CPE and the BS/MR-BS or the distributed scheduling R-CPE. The basic flow is used by the BS/MR-BS MAC or the distributed scheduling R-CPE MAC and CPE MAC to exchange short, time- urgent MAC management messages; whereas, the primary management flow is used by the BS/MR-BS MAC or the distributed scheduling R-CPE MAC and CPE MAC to exchange longer, more delay-tolerant MAC management messages (Table 19 specifies which MAC management messages are transferred on which type of connections). Finally, the secondary management flow is used by the BS/MR-BS MAC or the distributed scheduling R-CPE MAC and CPE to transfer more delay tolerant, standards-based (e.g., DHCP, TFTP, and SNMP) messages that are carried in IP datagrams. The secondary management flow may be packed and/or fragmented, similarly to the primary management except that no ARQ should be used for the latter since it is more time critical.

The FIDs for these connections shall be assigned according to the specification in 12.2. The same FID value is assigned to both upstream and downstream members of each connection.

The FIDs for these connections shall be assigned according to the specification in 12.2. A 4bit LSB of FID defines downstream flow ID, while a 4bit MSB of FID defines upstream flow ID.

The CID, which is a tuple of SID | FID, can be considered a connection identifier even for nominally connectionless traffic like IP, since it serves as a pointer to destination and context information.

The CID, which is a tuple of LCID|SID | FID, can be considered a connection identifier even for nominally connectionless traffic like IP, since it serves as a pointer to destination and context information.

Many higher-layer sessions may operate over the same wireless connection. For example, many users within a company may be communicating with Transmission Control Protocol (TCP)/IP to different destinations, but since they all operate within the same overall service parameters, all of their traffic is pooled for request/grant purposes. A service flow is a unidirectional flow of traffic (BS to CPE, or CPE to BS) that defines the mapping of higher-layer application service parameters (e.g., QoS) to a FID assigned to a particular CPE’s unicast SID or multicast group (multicast SID).

The type of service and other current parameters of an application service are implicit in the SFID. A service flow definition may be accessed reading the appropriate service flow MIB (see 13.1.3) indexed by the SFID of the service flow assigned to a particular CPE.

Service flow, once established, may require active maintenance. The maintenance requirements vary depending upon the type of service connected. Modifiable service flows may require maintenance due to stimulus from either the CPE or the network side of the connection.

Service flow may also be terminated. This generally occurs only when a subscriber’s service has changed or when the base station has not been able to communicate with the CPE. The BS or CPE can terminate a service flow.

Service Flow Management functions are supported through the use of static configuration and dynamic addition, modification, and deletion of service flow parameters and/or service flows themselves as described in 7.18.

Many higher-layer sessions may operate over the same wireless connection. For example, many users within a company may be communicating with Transmission Control Protocol (TCP)/IP to different destinations, but since they all operate within the same overall service parameters, all of their traffic is pooled for request/grant purposes. A service flow is a unidirectional flow of traffic (BS/MR-BS to CPE, CPE to BS/MR-BS, distributed scheduling R-CPE to CPE or CPE to distributed scheduling R-CPE) that defines the mapping of higher-layer application service parameters (e.g., QoS) to a LCID assigned to a particular local cell with a FID assigned to a particular CPE’s unicast SID or multicast group (multicast SID).

The type of service and other current parameters of an application service are implicit in the SFID. A service flow definition may be accessed reading the appropriate service flow MIB (see 13.1.3) indexed by the SFID of the service flow assigned to a particular CPE.

Service flow, once established, may require active maintenance. The maintenance requirements vary depending upon the type of service connected. Modifiable service flows may require maintenance due to stimulus from either the CPE or the network side of the connection.

Service flow may also be terminated. This generally occurs only when a subscriber’s service has changed or when the base station has not been able to communicate with the CPE. The BS/MR-BS or CPE can terminate a service flow.

Service Flow Management functions are supported through the use of static configuration and dynamic addition, modification, and deletion of service flow parameters and/or service flows themselves as described in 7.18.