IEEE 802.21
Extension for supporting handovers with Downlink only technologies

Media Independent Radio Configuration

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Abstract

This document presents a solution to the lack of interface configuration primitives in the D01 version of the 802.21b specification.

# Background

Current IEEE 802.21 and the extensions provided to support handover in broadcast technologies provide very limited support for radio configuration. Current specification supports the following actions in an interface through the use of the MIH\_Link\_Actions primitive:

* LINK\_DISCONNECT
* LINK\_LOW\_POWER
* LINK\_POWER\_DOWN
* LINK\_POWER\_UP

Any other action such the configuration of parameters such as channel or transmission power, which are required for appropriate channel selection in .21b are completely missing from the specification.

# Proposed Solution

In the following we present the set of primitives to be included in the .21b draft. We divide the primitives per SAP were they should be included.

**Add in definition:**

**Network Interface:** The actual hardware transmission and reception entity serving as boundary across which two independent systems communicate with each other. Each Network Interface is associated with an endpoint and has a unique identifier.

**MIH\_SAP**

1. **MIH\_Radio\_Get\_Capabilities**

**General:**

This primitive allows the higher layer user to get detailed information regarding the configuration properties of the interface. Through the use of this primitive the higher layers can understand the different configuration choices and configure the interface accordingly.

**MIH\_Radio\_Get\_Capabilities.request**

**Function**

This primitive is invoked by the higher layer user to discover the different configuration options of the interface.

**Semantics of the service primitive**

MIH\_Radio\_Get\_Capabilties.request(

 DestinationIdentifier,

 InterfaceIdentifierList,

 CapabiltiesRequestList

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| InterfaceIdentifierList | LIST(LINK\_ID) | List of Interface IDs to be queried. If the list is empty, return the status of all available interfaces. |
| CapabilitiesRequestList | RADIO\_CAPABILITY\_REQ | Indicate which interface capabilities are being requested. |

**When generated**

This primitive is invoked by a MIH user when it wants to request the capabilities information of a set of local or remote interfaces

**Effect of receipt**

If the destination of the request is the local MIHF itself, the local MIHF gets the requested information on the capabilities of the specified local interfaces and responds with a MIH\_Radio\_Get\_Capabilities.confirm. If the destination of the request is a remote MIHF, the local MIHF generates and sends a MIH\_Radio\_Get\_Capabilities request message to the remote MIHF.

**MIH\_Radio\_Get\_Capabilities.confirm**

**Function**

This primitive is issued by a MIHF user to report the requested capabilities of a set of specific local or remote interfaces in response to a MIH\_Radio\_Get\_Capabilities request from a local or remote MIH user.

**Semantics of the service primitive**

MIH\_Radio\_Get\_Capabilties.confirm(

 DestinationIdentifier,

 Status,

 CapabilitiesResponseList

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| Status | STATUS | Status of the operation |
| CapabilitiesResponseList | LIST(SEQUENCE(LINK\_ID, RADIO\_CAPABILITY\_RSP) | List of Interface capability responses |

**When generated**

This primitive returns the results of an MIH\_Radios\_Get\_Capabilities request to the requesting MIH user.

**Effect of receipt**

Upon receipt of the interface capabilities information, the MIH user makes appropriate decisions and takes suitable actions. However, if Status does not indicate ““Success,”” the recipient performs appropriate error handling.

1. **MIH\_Radio\_Set\_Parameters**

**General:**

This primitive allows the higher layer user to set the appropriate configuration for a specific interface.

**MIH\_Radio\_Set\_Parameters.request**

**Function**

This primitive is invoked by the higher layer users to configure an interface.

**Semantics of the service primitive**

MIH\_Radio\_Set\_Parameters.request(

 DestinationIdentifier,

 InterfaceIdentifier,

 RadioConfiguration

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| InterfaceIdentifierList | LINK\_ID | Interface ID to be queried.  |
| RadioConfiguration | RADIO\_CONFIG\_PARAMETERS | Parameters to be configured |

**When generated**

This primitive is invoked by a MIH user when it wants to configure a local or remote interface.

**Effect of receipt**

If the destination of the request is the local MIHF itself, the local MIHF configures the interface following the information provided in the query and responds with a MIH\_Radio\_Set\_Parameters.confirm. If the destination of the request is a remote MIHF, the local MIHF generates and sends a MIH\_Radio\_Set\_Parameters.request message to the remote MIHF. Optionally in the case a remote MIHF receives a MIH\_Radio\_Set\_Parameters.request it can issue a MIH\_Radio\_Set\_Parameters.indication to higher layer users.

**MIH\_Radio\_Set\_Parameters.indication**

**Function**

This primitive is used by the MIHF to indicate MIH users that the interface configuration is going to change.

**Semantics of the service primitive**

MIH\_Radio\_Set\_Parameters.indication(

 SourceIdentifier,

 InterfaceIdentifier,

 RadioConfiguration

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| SourceIdentifier | MIHF\_ID | This identifies the remote MIHF that is the source of this request. |
| InterfaceIdentifierList | LINK\_ID | Interface ID to be queried.  |
| RadioConfiguration | RADIO\_CONFIG\_PARAMETERS | Parameters to be configured |

**When generated**

This primitive is invoked by the MIHF upon reception of a remote MIH\_Radio\_Set\_Parameters.request.

**Effect of receipt**

An MIH user receiving this indication is aware that the configuration of one of its interfaces has changed.

**MIH\_Radio\_Set\_Parameters.confirm**

**Function**

This primitive is issued by a MIHF user to confirm the correct configuration of an interface upon reception of a MIH\_Radio\_Set\_Parameters.request from a local or remote MIH user.

**Semantics of the service primitive**

MIH\_Radio\_Set\_Parameters.confirm(

 DestinationIdentifier,

 Status,

 InterfaceCurrentConfig

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| Status | STATUS | Status of the operation |
| InterfaceCurrentConfig | SEQUENCE(LINK\_ID, RADIO\_CONFIG\_PARAMETERS) | List of Interface configuration  |

**When generated**

This primitive returns the results of an MIH\_Radios\_Set\_Parameters.request to the requesting MIH user.

**Effect of receipt**

Upon receipt of the interface capabilities information, the MIH user makes appropriate decisions and takes suitable actions. However, if Status does not indicate ““Success,”” the recipient performs appropriate error handling.

1. **MIH\_Radio\_Get\_Parameters**

**General:**

This primitive allows the higher layer user to get the current configuration for a specific interface.

**MIH\_Radio\_Get\_Parameters.request**

**Function**

This primitive is invoked by the higher layer users to get the configuration of an interface.

**Semantics of the service primitive**

MIH\_Radio\_Get\_Parameters.request(

 DestinationIdentifier,

 InterfaceIdentifierList

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| InterfaceIdentifierList | LIST(LINK\_ID) | List of Interface IDs to be queried.  |

**When generated**

An MIH user invokes this primitive when it wants to obtain the configuration a local or remote interface.

**Effect of receipt**

If the destination of the request is the local MIHF itself, the local MIHF responds with a MIH\_Radio\_Get\_Parameters.confirm. If the destination of the request is a remote MIHF, the local MIHF generates and sends a MIH\_Radio\_Get\_Parameters.request message to the remote MIHF.

**MIH\_Radio\_Get\_Parameters.confirm**

**Function**

This primitive is issued by a MIHF user to provide the current configuration of an interface upon reception of a MIH\_Radio\_Get\_Parameters.request from a local or remote MIH user.

**Semantics of the service primitive**

MIH\_Radio\_Get\_Parameters.confirm(

 DestinationIdentifier,

 Status,

 InterfaceCurrentConfig

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| DestinationIdentifier | MIHF\_ID | This identifies the local MIHF or a remote MIHF that will be the destination of this request. |
| Status | STATUS | Status of the operation |
| InterfaceCurrentConfig | LIST(SEQUENCE(LINK\_ID, RADIO\_CONFIG\_PARAMETERS)) | List of Interface capability responses |

**When generated**

This primitive returns the results of an MIH\_Radios\_Get\_Capabilities request to the requesting MIH user.

**Effect of receipt**

Upon receipt of the interface capabilities information, the MIH user makes appropriate decisions and takes suitable actions. However, if Status does not indicate ““Success,”” the recipient performs appropriate error handling.

**MIH\_LINK\_SAP**

1. **Radio\_Get\_Capabilities**

**General:**

This primitive allows the MIHF to get detailed information regarding the configuration properties of a interface.

**Radio\_Get\_Capabilities.request**

**Function**

This primitive is invoked by the MIHF to discover the different configuration options of the interface.

**Semantics of the service primitive**

Radio\_Get\_Capabilties.request(

 CapabilitiesRequestList

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| CapabilitiesRequestList | RADIO\_CAPABILITY\_REQ | Indicate which interface capabilities are being requested. |

**When generated**

This primitive is invoked by a MIHF when it wants to request the capabilities information of a set of interfaces

**Effect of receipt**

The recipient link responds with a Radio\_Get\_Capabilities.confirm

**Radio\_Get\_Capabilities.confirm**

**Function**

This primitive is issued by a link to report its requested capabilities in response to a Radio\_Get\_Capabilities request.

**Semantics of the service primitive**

Radio\_Get\_Capabilties.confirm(

 Status,

 CapabiltiesResponseList

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| Status | STATUS | Status of the operation |
| CapabilitiesResponseList | RADIO\_CAPABILITY\_RSP | List of Interface capability responses |

**When generated**

This primitive returns the results of a Radios\_Get\_Capabilities.request to the requesting MIHF

**Effect of receipt**

The recipient passes the interface capabilities values received to the MIH users. However, if Status does not indicate “Success” the recipient performs appropriate error handling.

1. **Radio\_Set\_Parameters**

**General:**

This primitive allows the MIHF to set the appropriate configuration for a specific interface.

**Radio\_Set\_Parameters.request**

**Function**

This primitive is invoked by the MIHF to configure an interface.

**Semantics of the service primitive**

Radio\_Set\_Parameters.request(

 RadioConfiguration

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| RadioConfiguration | RADIO\_CONFIG\_PARAMETERS | Parameters to be configured |

**When generated**

This primitive is invoked by the MIHF when it wants to configure a local interface.

**Effect of receipt**

The recipient interface answers with a Radio\_Set\_Parameters.confirm

**Radio\_Set\_Parameters.confirm**

**Function**

This primitive is issued by the interface to confirm the correct configuration of an interface upon reception of a Radio\_Set\_Parameters.request from a local MIHF.

**Semantics of the service primitive**

Radio\_Set\_Parameters.confirm(

 Status,

 InterfaceCurrentConfig

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| Status | STATUS | Status of the operation |
| InterfaceCurrentConfig | RADIO\_CONFIG\_PARAMETERS | List of Interface configuration  |

**When generated**

This primitive returns the results of a configuration query.

**Effect of receipt**

Upon receipt of the interface configuration confirmation, the MIHF makes appropriate decisions and takes suitable actions. However, if Status does not indicate ““Success,”” the recipient performs appropriate error handling.

1. **Radio\_Get\_Parameters**

**General:**

This primitive allows the MIHF to get the current configuration for a specific interface.

**Radio\_Get\_Parameters.request**

**Function**

This primitive is invoked by the MIHF to get the configuration of an interface.

**Semantics of the service primitive**

Radio\_Get\_Parameters.request ()

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
|  |  |  |
|  |  |  |

**When generated**

An MIHF invokes this primitive when it wants to obtain the current configuration of a local interface.

**Effect of receipt**

Respond with a Radio\_Get\_Parameters.confirm

**Radio\_Get\_Parameters.confirm**

**Function**

This primitive is issued by an interface to provide its current configuration to the MIHF.

**Semantics of the service primitive**

MIH\_Radio\_Get\_Parameters.confirm(

 Status,

 InterfaceCurrentConfig

)

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Name** | **Data type** | **Description** |
| Status | STATUS | Status of the operation |
| InterfaceCurrentConfig | RADIO\_CONFIG\_PARAMETERS | List of Interface capability responses |

**When generated**

This primitive returns the results of an Radios\_Get\_Capabilities request to the requesting MIHF

**Effect of receipt**

Upon receipt of the interface capabilities information, the MIHF makes appropriate decisions and takes suitable actions. However, if Status does not indicate ““Success,”” the recipient performs appropriate error handling.

**MIH Protocol Messages**

**MIH\_Radio\_Get\_Capabilities.request**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| LinkIdentifierList (Link identifier list TLV) |
| CapabiltiesRequestList(Radio Capabilities Request TLV) |

**MIH\_Radio\_Get\_Capabilities.confirm**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| Status (Status TLV) |
| CapabilitiesResponseList (Radio Capabilities Response TLV) |

**MIH\_Radio\_Set\_Parameters.request**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| InterfaceIdentifier (Link identifier TLV) |
| RadioConfiguration (Radio Configuration Parameters TLV) |

**MIH\_Radio\_Set\_Parameters.indication**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| InterfaceIdentifier (Link identifier TLV) |
| RadioConfiguration (Radio Configuration Parameters TLV) |

**MIH\_Radio\_Set\_Parameters.confirm**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| Status (Status TLV) |
| InterfaceCurrentConfig (Current Interface Configuration TLV) |

**MIH\_Radio\_Get\_Parameters.request**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| LinkIdentifierList (Link identifier list TLV) |

**MIH\_Radio\_Get\_Parameters.confirm**

|  |
| --- |
| **MIH Header Fields (SID=TBD, Opcode=TBD, AID=TBD)** |
| **Source Identifier =** sending MIHF ID (Source MIHF ID TLV) |
| **Destination Identifier =** receiving MIHF ID (Destination MIHF ID TLV) |
| Status (Status TLV) |
| InterfaceCurrentConfig (Current Interface Configuration TLV) |

Include the following definitions in Annex F: Data type definition:

|  |  |  |  |
| --- | --- | --- | --- |
| **Data Type Name** | **Derived From** | **Definition** | **Valid Range** |
| RADIO\_CONFIG\_PARAMETERS | LIST (CHANNEL\_CONFIG\_SET) | List of channel parameters for radio configuration | N/A |
| CHANNEL\_CONFIG\_SET | SEQUENCE(CENTRAL\_CHANNEL\_FREQ, CENTRAL\_CHANNEL\_BW, CENTRAL\_CHANNEL\_PWR, N\_PLUS\_ONE\_CHANNEL\_FREQ, N\_PLUS\_ONE \_CHANNEL\_BW, N\_PLUS\_ONE \_CHANNEL\_PWR, N\_MINUS\_ONE\_CHANNEL\_FREQ, N\_MINUS\_ONE \_CHANNEL\_BW, N\_MINUS\_ONE \_CHANNEL\_PWR) |   | N/A |
| CENTRAL\_CHANNEL\_FREQ | FREQUENCY | Central channel frequency in KHz | 0..2^32 -1 |
| CENTRAL\_CHANNEL\_BW | BANDWIDTH | Central channel bandwidth in KHz | 0-255 |
| CENTRAL\_CHANNEL\_PWR | TX\_POWER | Central channel power in dBm |  |
| N\_PLUS\_ONE\_CHANNEL\_FREQ | FREQUENCY | Higher adjacent channel frequency in MHz | 0..2^32 -1 |
| N\_PLUS\_ONE \_CHANNEL\_BW | BANDWIDTH | Higher adjacent channel bandwidth in MHz | 0-255 |
| N\_PLUS\_ONE \_CHANNEL\_PWR | TX\_POWER | Higher adjacent channel transmit power in units of 1 dBm |  |
| N\_MINUS\_ONE\_CHANNEL\_FREQ | FREQUENCY | Lower adjacent channel frequency in MHz | 0..2^32 -1 |
| N\_ MINUS \_ONE \_CHANNEL\_BW | BANDWIDTH | Lower adjacent channel bandwidth in MHz | 0-255 |
| N\_ MINUS \_ONE \_CHANNEL\_PWR | TX\_POWER | Lower adjacent transmit power in units of 1 dBm |  |
| FREQUENCY | UNSIGNED\_INT(8) | Channel frequency |   |
| BANDWIDTH | UNSIGNED\_INT(4) | Channel bandwidth |   |
| TX\_POWER | EIRP |  TxPower in units of 1dBm |  |
| RADIO\_CAPABILITY\_REQ | LIST(RADIO\_CAPAB\_TYPE) | List of capabilities being query |  |
| RADIO\_CAPAB\_TYPE | UNSIGNED\_INT(1) | A type to represent the different capabilities which can be configured in the interface0: Frequency band1:Channel list2:Technology3:Tx Power range4:Modulation properties5:Antenna diversity6-255: To be defined |  |
| RADIO\_CAPABILITY\_RSP | SEQUENCE(RADIO\_CAPAB\_TYPE,RADIO\_CAPAB\_VAL) | Answer to a query for capabilities |  |
| RADIO\_CAPAB\_VAL | UNSIGNED\_INT(2) | The current value of the capability. The format of the media-dependent value is defined in the respective media specifi- cation standard and the equivalent number of bits (i.e., first bits) of this data type is used. In case that there are remaining unused bits in the data type, these are marked as all-zeros (‘‘0’’).Valid Range: 0..65535 |  |
| LINK\_ID | SEQUENCE(  LINK\_TYPE  LINK\_ADDR) | The identifier of a link that is not associ- ated with the peer node. The LINK\_ADDR contains the address of this link.When present not forming part of a LINK\_TUPLE\_ID, it may also be interpreted as an Network Interface identifier. |  |

Include the following in table in Annex L, Table L.2: Type values for TLV encoding

|  |  |  |
| --- | --- | --- |
| **TLV Type Name** | **TLV Type Value** | **Data Type** |
| Radio Configuration Parameters | (assigned by Editor) | RADIO\_CONFIG\_PARAMETERS |
|  Radio Capabilities Request | (assigned by Editor) | RADIO\_CAPABILITY\_REQ |
| Radio Capabilities Response | (assigned by Editor) | RADIO\_CAPABILITY\_RSP |
| Current Interface Configuration | (assigned by Editor) | SEQUENCE(LINK\_ID, RADIO\_CONFIG\_PARAMETERS) |