IEEE P802.21/D01.09
Draft IEEE Standard for Local and Metropolitan Area Networks: Media Independent Handover Services

Normative Text Proposal for QoS

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Abstract

This document contains a normative text proposal in support of a Media Independent Handover Quality of Service model.

Proposed MIH QoS Model and normative text modifications to the IEEE 802.21 standard draft D01.09.

We propose to add to Section 3 on page 9 the following definitions:

Population of interest: the set of packets corresponding to a given source and destination over which the QoS parameters are computed.

We propose to replace section 5.1.3 on page 13 with the following text specified in blue:

5.1.3 Packet Transfer Quality Model

The quality of the service (QoS) experienced by an application depends on the *accuracy, speed and dependability* of information transfer of the communication channel. The IEEE 802.21 specifications provide support for fulfilling application QOS requirements in the presence of communication handover. The MIH QoS model defines parameters that may be used in specifying and assessing characteristics of packet transfers between a source and its destinations. The communication channel is considered to be composed of several connected segments, each under a possibly different but cooperative administrative authority. Examples for such channels, such as for IP traffic have been detailed in ITU normative Y.1540.

In the context of the 802.21 specification it is assumed that applications communicate via a packetized communication channel over which a transmitted packet can experience the following outcomes:

- Be received with no errors at its intended destination
- Be received with errors at its intended destination
- Not be received in which case it is said that the packet is lost.

The maximum attainable *speed* of information transfer over a given communication channel can be constant, as it is usually the case with network segments involving only wired links, or it can be time varying at different scales, at is the case for segments involving wireless links. This measure will be called channel capacity, for the purposes of this document.

The ability of the channel to provide *accurate* information transfer can be described via a statistical model characterized by the following parameters:

1. Minimum Packet Transfer Delay: is defined as the minimum delay over a population of interest
2. Average Packet Transfer Delay: is defined as the arithmetic mean of the delay over a population of interest
3. Maximum Packet Transfer Delay: is defined as the maximum delay over a population of interest
4. Jitter: is defined as the standard deviation of the delay over a population of interest
5. Packet loss rate: is defined as the ratio between the number of frames that are transmitted but not received and the total number of frames transmitted over a population of interest.
6. Packer error rate: is defined as the ratio between the number of packets that have been received with errors and the total number of packets present in a population of interest.

It is generally accepted that based on the required *accuracy* of information transfer applications can be grouped into a small number of behavioral sets [Y.1541] called Classes of Service (CoS). Support for differentiation via Classes of Service is pervasive in many of the IEEE 802 based standards [802.11, 802.1q, 802.16 etc.].

For a link that supports CoS differentiation, per CoS traffic *accuracy* parameters need to be maintained in order to provide insights on how individual traffic classes are faring.

In summary, the following set of parameters characterize the *speed and accuracy* of the information transfer a multi-CoS traffic link supports:

1. Link capacity, representing the maximum information transfer rate achievable. This value is determined by the physical characteristics of the link. While for wired links is it usually a constant, for wireless links it is time varying.
2. Link Packet Error Rate: representing the ratio between the number of frames received in error and the total number of frames transmitted in a link population of interest
3. Supported classes of service: represents the maximum number of differentiable classes of service supported by this link.
4. Class of Service Parameters List. For each of the supported classes of service the following parameters are defined:

1. Class Minimum Packet Transfer Delay: is defined as the minimum delay over a class population of interest
2. Class Average Packet Transfer Delay: is defined as the arithmetic mean of the delay over a class population of interest
3. Class Maximum Packet Transfer Delay: is defined as the maximum delay over a class population of interest
4. Class Packet Delay Jitter: is defiend as the standard deviation of the delay over a class population of interest
5. Class Packet loss rate: is defined as the ratio between the number of frames that are transmitted but not received and the total number of frames transmitted over a class population of interest.

The performance implications to consider from the MIH perspective include both the transient network performance achieved during a handover as well as the continuous monitoring of current network conditions.

The 802.21 specifications provide mechanisms to support seamless mobility as an enabler; however the MIHF alone cannot guarantee seamless mobility. Depending on the QOS requirements of the end-to-end application, seamless mobility implies minimizing the latency, and potential loss incurred during a handover so as to minimize the end-to-end delay and loss perceived by the application. Seamless mobility also implies the timely assessment of network conditions, such as the monitoring of the signal strength, packet loss, on the link, on both current and target networks in order to optimize the handover decision and its execution.

The MIH services defined by the IEEE 802.21, including event, command, and information service, need to consider network traffic performance objectives and their potential fulfilment as well as their relation to application traffic quality of service requirements.

In order to realize the QoS model described above, a number of primitives require modification to conform to the model. Modifications are applicable to all primitives that include the LINK_QoS_PARAMETER_LIST information element. Within the current draft, the LINK_Qos_PARAMETERS_LIST IE should be contained in the following messages:

- MIH_Configure.request
- MIH Get Status.confirm
- MIH_Link_Parameter_Report.indication

Therefore, the following section should be updated as follows:

Section 7.4.8.1.2 Semantics of Service Primitive

The primitive parameters are as follows:

MIH_Configure.request (
SourceIdentifier
DestinationIdentfier
LinkIdentifier
ConfigurationRequestSets
)

Table 19 details the set of parameters that can be configured:

Name	Type	Valid Range	Description
OPERATION_MODE	INTEGER	0x01 – Normal Mode 0x02 – Power Saving Mode 0x03 – Power Down	Change the device's power mode
DISABLE_TRANSMITTER	Boolean	N/A	Enable/disable the transmitter of the interface
LINK_ID	Link ID	N/A	Change to the specified link
CURRENT_ADDRESS	STRING	N/A	Change the current address to the value specified
SUSPEND_DRIVER	Boolean	N/A	Suspend or resume of the specified interface

LINK_QoS_PARAMETERS_LIST	LIST	N/A	A list of QoS Parameters and their corresponding values as specified in table XX

Insert the following table in section 7.4.8.1, after line 53

Table XX: LinkQoSParameterType values

Value	Name	Value Size (octets)	Valid Range	Description
0	Throughput	4	0-(232-1)	The maximum information transfer rate achievable. This value is determined by the physical characteristics of the link . It is measured in kbps
1	Link Packet Error Rate	2	0-65535	A value equal to integer part of the result of multiplying -100 times the log10 of the ratio between the number of packets received in error and the total number of packets transmitted in a link population of interest.
2	Supported number of COS	2	0-65535	The maximum number of differentiable classes of service supported by this link
3	CoS Minimum Packet Transfer Delay	4	0-2^32	This is an encoded value which contains the class of service identifier in the 2 most significant octets and the minimum packet transfer delay for the class in ms in the two least significant octets. Valid range for minimum packet transfer delay: [0..65535] ms
4	CoS Average Packet Transfer Delay	4	0-2^32	This is an encoded value which contains the class of service identifier in the 2 most significant octets and the average packet transfer delay for the class in ms in the two least significant octets. Valid range for average packet transfer delay: [0..65535] ms
5	CoS Maximum Packet Transfer Delay	4	0-2^32	This is an encoded value which contains the class of service identifier in the 2 most significant octets and the maximum packet transfer delay for the class in ms in the two least significant octets. Valid range for maximum packet transfer delay: [0..65535] ms
6	CoS Packet Transfer Delay Jitter	4	0-2^32	This is an encoded value which contains the class of service identifier in the 2 most significant octets and the packet transfer delay jitter for the class in ms in the two least significant octets. Valid range for packet transfer delay jitter: [0..65535] ms

7	CoS Packet Loss rate	4	0-2^32	This is an encoded value which contains the class of service identifier in the 2 most significant octets and a value equal to integer part of the result of multiplying - 100 times the log10 of the ratio between the number of packets lost and the total number of packets transmitted in the class population of interest
8-255	Reserved	N/A	N/A	Reserved for future use.

With regards to primitive “MIH_Get_Status.confirm”, made the following modification to the table contained in section 7.4.6.2.4 “Effect of receipt”

The following table details the set of parameters for which status can be provided

Name (Get Status Requests)	**Type**	**Valid Range**	**Description**
DEVICE_INFO	STRING	N/A	Information on manufacturer, model number, revision number of the software/firmware and serial num ber in displayable text are returned.
OPERATION_MODE	INTEGER	0x00 Normal Mode 0x01 Power Saving Mode 0x02 Power Down	Returns the link’s current power mode.
LINK_ID	Link ID	N/A	Return the ID of the link currently configured to communicate with.
CHANNEL_ID	INTEGER	N/A	The ID of the channel currently in use
~~CHANNEL_QUALITY~~	~~STRING~~	~~N/A~~	~~Current Connection Quality~~
~~LINK_SPEED~~		~~N/A~~	~~Bits per second~~
BATTERY_LEVEL	INTEGER	0-100; -1; unknown bat tery level	Battery level in percentage;
LINK_QoS_PARAMETER_LIST	LIST	N/A	A list of QoS Parameters and their corresponding values as specified in table XX

With regards to primitive “MIH_Link_Parameters_Report.indication”, made the following modification to the table contained in section 7.4.5.1.1 “Function”

Name	**Type**	**Valid Range**	**Description**
LINK_IDENTIFIER	Link ID	N/A	Identifier of the link associated with the event
~~NumLinkParameter~~	~~INTEGER~~	~~0-65535~~	~~Number of entries in LinkParameterList~~
LINK_Qos_PARAMETER_LIST	List	N/A	A list of QoS Parameters and their corresponding values as specified in table XX.

In page 157, add after line 60 the following table:

Annex A-5: QoS

802.21	802.11	802.16	3GPP	3GPP2
Max Bitrate	Peak Data Rate	Maximum Sustained Traffic Rate	Maximum Bitrate	Peak_Rate
Guaranteed (Min) Bitrate	Minimum Data Rate	Minimum Reserved Traffic Rate	Guaranteed Bitrate	
Packet Loss Rate Before Retransm.				Max_IP_Packet_Loss_Rate
Packet Error Rate		Packet Error Rate	SDU Error Ratio	
Max Packet Size	Maximum MSDU Size		Maximum SDU Size	Packet_Size
Delay	Delay Bound	Maximum Latency	Transfer Delay	Max_Latency
Jitter		Tolerated Jitter		Delay_Var_Sensitive

Table yy: An example of a QoS Parameter Mapping Table

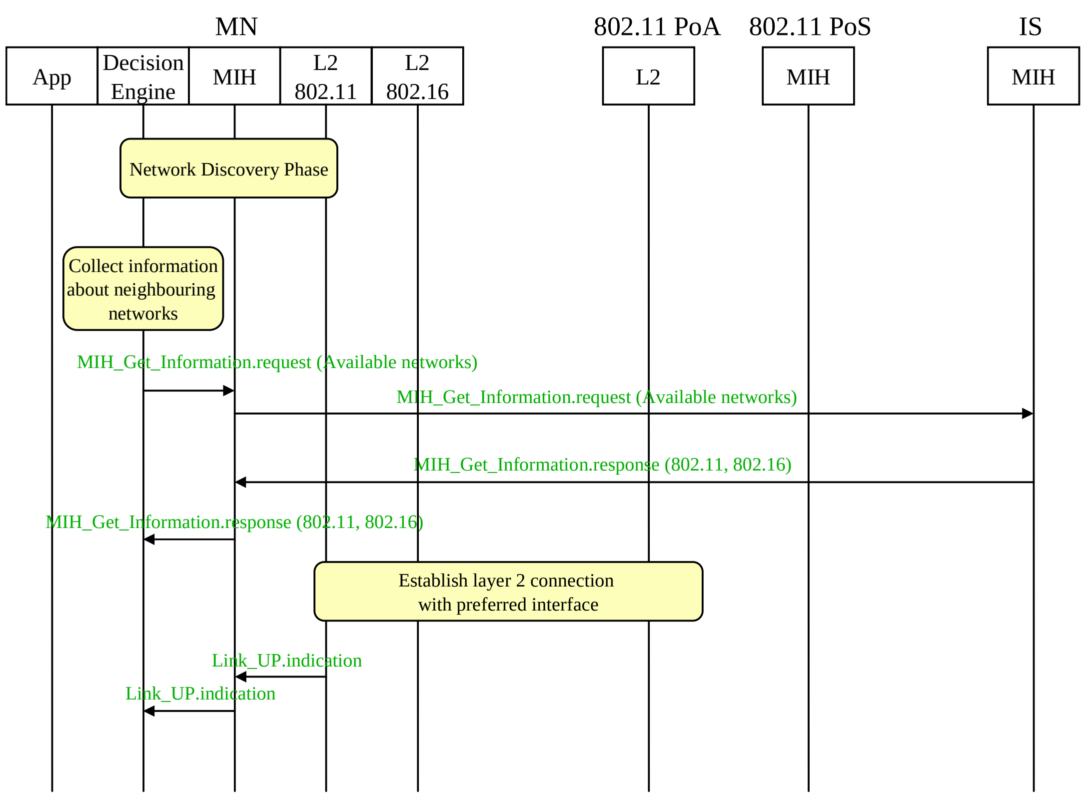

Figure 1: Event Flow Diagram: Initial Stage

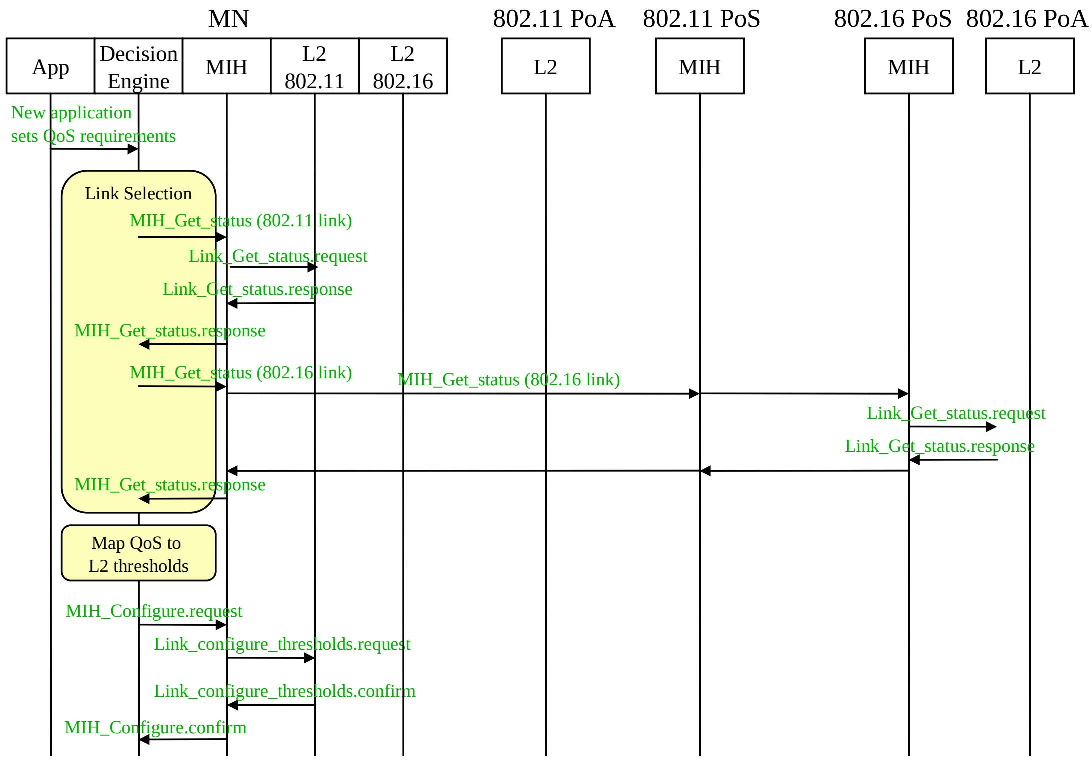

Figure 2: Event Flow Diagram: Link Selection

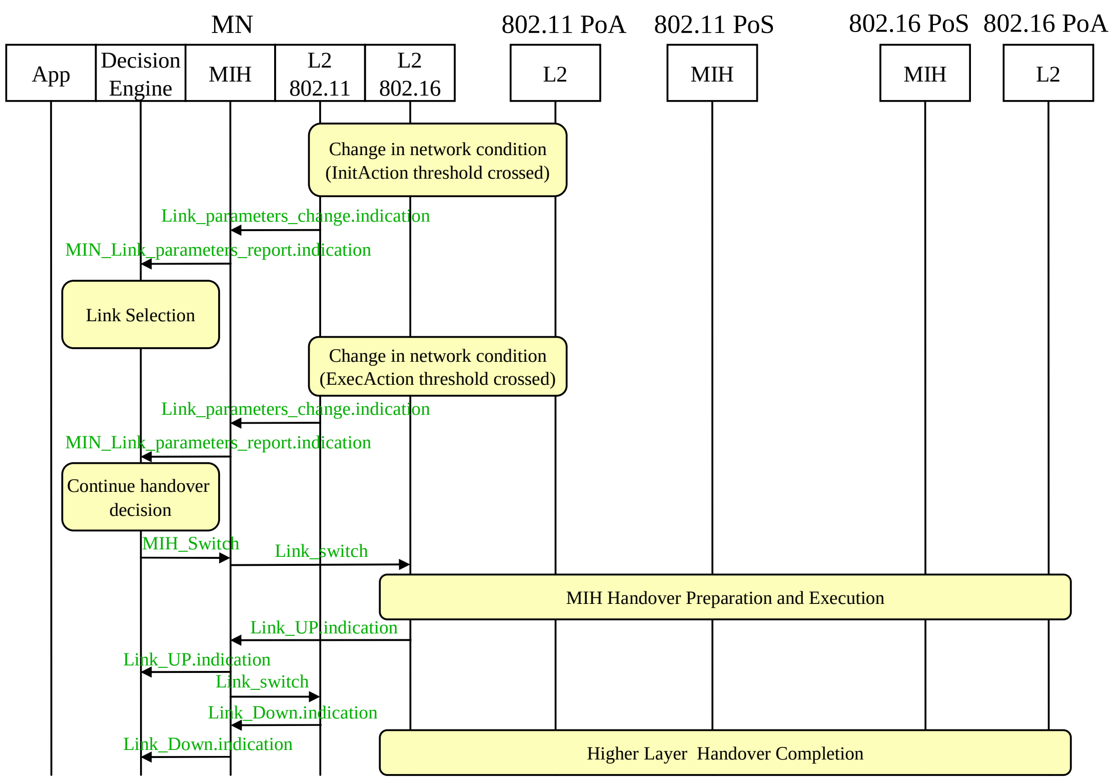

Figure 3: Event Flow Diagram: Handover