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| Re: | IEEE 802.21 Session #46 in Atlanta 2011 | |
| Abstract | This document provides an update on the media dependent mapping of IEEE 802.21 to LTE | |
| Purpose | To be included in next IEEE 802.21 release | |
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* 1. Mapping of MIH primitives to EPS/LTE protocols
     + 1. Introduction

The Evolved Packet System (EPS) is the next step of network system following the UMTS (commonly known as 3G) which brings strong enhancement and improved performance to mobile communications. In the EPS, the control part of the system is simpler and more efficient. The figure below shows the control plane protocol stacks linking the Mobile Terminal (MT, or User Equipment, UE), to its eNodeB acting as the Point of Attachment (PoA) and the associated MME, acting as an Access Router or PoS (Point of Service). This control plane provides functions for the network access connection, disconnection, address activation, mobility and user plane resource allocation.

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Figure 1: EPS Control Plane for Access Network interfaces (from [1])

Since the 3GPP system is not easily accessible, the exchange of 802.21 primitives should be performed at Layer 3 level, e.g. mapping on the NAS protocol. This is what is proposed in the section 1.1.1.2.1. However, since there are some implementation allowing the direct interaction through the Radio Resource Control Protocol (operating at L2), a direct mapping is also provided in section 1.1.1.2.2.

Figure 2 illustrates how the MIH reference model could be applied to the EPS system.

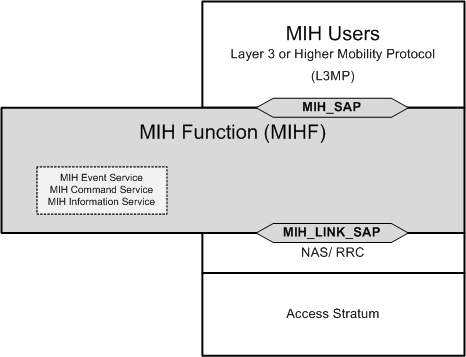


Figure 2: MIH reference model for EPS systems

* + - 1. Mapping
         1. Mapping with NAS protocol

The table below shows the proposed mapping and its rationales. It is followed by a very short summary of each of the 3GPP procedures and primitives used.

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| **Primitives** | **3GPP** | **NAS protocol** |
| Link\_Detected | N/A | Attach  MT Signal Quality\* |
| Link\_Up | ~~SMSM-ACTIVE~~  RABMSM-ACTIVATE | Attach  Activate Default EPS bearer context  Modify EPS bearer context |
| Link\_Down | ~~SMSM-DEACTIVEATE~~  ~~SMSM-STATUS~~  RABMSM-DEACTIVATE  RABMSM-STATUS  RABMAS-RAB-RELEASE | Detach  Deactivate EPS bearer context  ESM Status |
| Link\_Parameters\_Report | ~~SMSM-MODIFY~~  RABMSM-MODIFY | Tracking Area Update |
| Link\_Going\_Down | N/A | N/A |
| Link\_Handover\_Imminent | N/A | N/A |
| Link\_Handover\_Complete | RABMAS-RAB-ESTABLISH  RABMSM-MODIFY | Tracking Area Update  Activate Default EPS bearer context  Activate Dedicated EPS bearer context |
| Link\_PDU\_Transmit\_Status | N/A | N/A |
| Link\_Capability\_Discover | N/A | N/A |
| Link\_Event\_Subscribe | N/A | Packet Domain Event reporting\* |
| Link\_Event\_Unsubscribe | N/A | Packet Domain Event reporting\* |
| Link\_Get\_Parameters | N/A | EPS QoS Dynamic parameters\*  MT Signal Quality\* |
| Link\_Configure\_Thresholds | SMREG-PDP-MODIFY | Modify EPS bearer context |
| Link\_Action / Disconnect | N/A | Detach  Deactivate EPS bearer context |
| Link\_Action / Low Power | N/A | MT Set Functionality\* |
| Link\_Action / Power Down | N/A | Detach |
| Link\_Action / Power Up | N/A | Attach |

Table 1: Proposed mappings with NAS protocol

**Rationales**

This mapping is based on 3GPP service procedures and commands.

When the 802.21 primitive involves some interaction between the mobile terminal and the network, this mapping refers to NAS (Non Access Stratum) procedures. The NAS protocol [2] has been selected because it is the Evolved Packet System (EPS) equivalent of the Layer 3 protocols (SMREG, RABMSM, RABMAS) that were used for the MIH\_3GLINK\_SAP mapping. The NAS procedures are used by the protocols for mobility management and session management between the UE (or MT) and Mobility Management Entity (MME) in the EPS. When relevant, an equivalent signalling is defined between the eNodeB or point of Access and the MME, as part of the S1-AP protocol [3].

The mapping table lists NAS procedures rather than primitives to remain generic and compatible with both sides: MT and network nodes. From a general point of view, the end of the NAS procedure should trigger MIH events, and NAS procedures should be triggered by the reception of MIH commands.

When the 802.21 primitive implies a local action only, the corresponding local AT command defined for the operations inside the MT, as specified in [4], is used (AT means ATtention; this two character abbreviation is always used to start a command). These commands are marked with a (\*) in the mapping table. This mapping would have to be extrapolated for network nodes, since equivalent commands are usually implementation dependant in the network equipment, and thus not specified.

Same as in the 3GPP mapping proposed by the 802.21 specification, a NAS procedure or AT command can be mapped to more than MIH primitive.

**Summary of the NAS procedures used (from [2])**

Attach: The attach procedure is used to attach to an Evolved Packet Core Network (EPC) for packet services in EPS.

Detach: The detach procedure is used by the UE to detach from EPS services, by the network to inform the UE that it is detached or by the network to inform the UE to re-attach to the network and re-establish all connections.

Activate Default EPS bearer context: The purpose of the default bearer context activation procedure is to establish a default EPS bearer context between the UE and the EPC. The default bearer context activation procedure can be part of the attach procedure. The default EPS bearer context does not have any Traffic Flow Template (TFT) assigned during the activation procedure. This corresponds to using a match-all packet filter. The network may at anytime after the establishment of this bearer assign a TFT to the default EPS bearer and may subsequently modify the TFT or the packet filters of this default bearer.

Activate Dedicated EPS bearer context: The purpose of the dedicated EPS bearer context activation procedure is to establish an EPS bearer context with specific QoS and TFT between the UE and the EPC.

Modify EPS bearer context: The purpose of the EPS bearer context modification procedure is to modify an EPS bearer context with a specific QoS and TFT.

Deactivate EPS bearer context: The purpose of the EPS bearer context deactivation procedure is to deactivate an EPS bearer context or disconnect from a Packet Data Network (PDN) by deactivating all EPS bearer contexts to the PDN.

ESM Status: The purpose of the sending of the EMM STATUS message is to report at any time certain error conditions detected upon receipt of EMM protocol data. The EMM STATUS message can be sent by both the MME and the UE

Tracking Area Update: The MME knows the location of the UE with the granularity of a few cells, called the Tracking Area (TA). The tracking area update procedure is always initiated by the UE and is used for purposes such as updating the registration of the actual tracking area of a UE in the network, updating certain UE specific parameters in the network, recovering from certain error cases

**Summary of the AT commands used (from [4])**

Packet Domain Event reporting: This command enables or disables sending of unsolicited result codes, such as network detach, context activation, modification or deactivation.

EPS QoS Dynamic parameters: The execution of this command returns the Quality of Service parameters (QCI, DL\_GBR, UL\_GBR, DL\_MBR, UL\_MBR) of an established PDP Context \*

MT Signal Quality: The execution of this command returns the received signal quality parameters: RSSI, BER (channel bit error rate), RSCP, Ec/No (energy per chip divided by the noise power), RSRQ, RSRP

MT Set Functionality: This command allows to select the level of functionality in the MT. Level "full functionality" is where the highest level of power is drawn. "Minimum functionality" is where minimum power is drawn.

* + - * 1. Mapping with the RRC protocol

When RRC [5] is reachable (e.g. in the OpenAirInterface platform), it is also interesting to establish a direct mapping between the 802.21 primitives and the RRC (Radio resource Control) protocol.

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| **Primitives** | **LTE/RRC procedure** |
| Link\_Detected | System Information |
| Link\_Up | RRC Connection establishment  RRC Connection re-establishment  RRC Connection reconfiguration |
| Link\_Down | RRC Connection reconfiguration  RRC Connection Release |
| Link\_Parameters\_Report | Measurement report |
| Link\_Going\_Down | N/A |
| Link\_Handover\_Imminent | N/A |
| Link\_Handover\_Complete | RRC Connection reconfiguration |
| Link\_PDU\_Transmit\_Status | N/A |
| Link\_Capability\_Discover | N/A |
| Link\_Event\_Subscribe | Measurement configuration |
| Link\_Event\_Unsubscribe | Measurement configuration |
| Link\_Get\_Parameters | Measurement configuration |
| Link\_Configure\_Thresholds | Measurement configuration |
| Link\_Action / Disconnect | RRC Connection Release |
| Link\_Action / Low Power | N/A |
| Link\_Action / Power Down | RRC Connection Release |
| Link\_Action / Power Up | RRC Connection establishment |

Table 2: Proposed mappings with RRC protocol

**Summary of the RRC procedures used (from [5])**

System Information: Broadcast at the cell level of system information, including NAS common information, cell parameters, neighbouring cell information or common channel configuration, ...

RRC Connection establishment: The purpose of this procedure is to set-up the connection of the radio interface. This procedure is also used to transfer the initial NAS dedicated information/ message from the UE to the eNodeB.

RRC Connection re-establishment: The purpose of this procedure is to re-establish the RRC connection when a valid UE context is known in the network.

RRC Connection reconfiguration: The purpose of this procedure is to modify an RRC connection, e.g. to establish/ modify/ release radio channels, to perform handover, to setup/ modify/ release measurements.

RRC Connection Release: The purpose of this procedure is to release the RRC connection, which includes the release of the established radio bearers as well as all radio resources.

Measurement configuration: In the RRC procedures, measurements performed by the UE are reported to the network. The UE reports the measurement information in accordance with the measurement configuration as provided by the eNodeB. The eNodeB provides this configuration, applicable for a connected UE, using the RRCConnectionReconfiguration message. In the OpenAirInterface platform, some measurements can also be configured for local reporting to the upper layers.

Measurement report: The purpose of this RRC procedure is to transfer measurement results from the UE to E-UTRAN. In the OpenAirInterface platform, the reporting can also be performed locally towards the upper layers.

References

1. 3GPP TS 23.401; "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access"
2. 3GPP TS 24.301; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3"
3. 3GPP TS 36.300; "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2"
4. 3GPP TS 27.007; "AT command set for User Equipment (UE)"
5. 3GPP TS 36.331; "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification"