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| Title | **Revised Text of “Media Independent Handover Service for Software-defined radio access network (SDRAN)” Section for IEEE 802.21.1 Draft Standard** |
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| Abstract | This document proposes the revised text of “Media Independent Service forSoftware-defined radio access network (SDRAN)” Section for IEEE 802.21.1 Draft Standard, according to the discussion on the contribution (DCN 21-15-44-03-SAUC) during the IEEE 802.21.1 TG teleconference at June 5, 2015. This document describes detailed use case and requirements on media independent service such as seamless handover and radio resource management in software-defined radio access networks (SDRANs). There were two comments at the IEEE 802.21.1 TG teleconference: one is the title and scope of backhaul and fronthaul in Fig.1 and the other is the table of primitive and message types. |
| Purpose | To be part of 802.21.1 draft standard document. |
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1. 7. Media Independent Service for Software-defined radio access networks (SDRANs)
      1. Introduction

In recent days, Software-defined networking (SDN)-like paradigm has been interested in wireless radio access networks (RANs). The SDN approach, characterized by a clear separation of the control and data planes, allows that operators can do quicker provisioning and configuration of network connections without requiring independently accessing and configuring each of the network’s hardware devices. A radio access network (RAN) is part of a mobile network that is implemented with a radio access technology. Conceptually, it resides between mobile devices such as a mobile phone and provides connection with its core network (CN). RAN can be divided into two parts: one is the fronthaul and the other is backhaul. The fronthaul is the connection between a baseband controller and remote standalone radio heads at cell sites. The backhaul is the connection between the baseband controller and the mobile network back to the wired CN.

Software-defined radio access network (SDRAN) is the RAN including fronthaul and backhaul, where the centralized controller enables both seamless handover and dynamic resource allocation in heterogeneous RAN environment. This trend also introduces new challenges in seamless mobility because RANs require the shared nature of radio spectrum for mobile users.

The SDRAN enables radio resource management (RRM) in a centralized controller in which RRM separates from the connection configuration of the conventional SDN control functions to evolve independently. RANs differ from CNs in that they mostly deal with L1/L2 functions, such as interference, cell ID, neighbor lists, and handover threshold. The SDRAN paradigm also improves adaptability to the diversity of scenarios that will arise from the deployment of a centralized controller in small-cell or multi-radio access technologies. In addition, the SDRN alleviates seamless mobility by leaving the non-latency-sensitive functions in a SDN controller and the latency-sensitive decisions by leaving the RRM functionality in RANs.

In this Section, we analyze the potential of applying the Media independent services (MIS) framework to SDRAN. First, we identify use cases for seamless handover where the MIS approach could bring additional benefits in SDRANs. Then, we drive the main characteristics of a RRM framework to support seamless handover. In the framework, we are paying attention to the MIS functions and interfaces. In order to illustrate the operation of the framework, we introduce the high-level interactions required between the defined MIS functions to support our use cases.

MIS framework of IEEE 802.21-2009 standard has been a common platform to support mobility management in heterogeneous networks. MIS framework can support seamless handover in heterogeneous RAN networks by using MIES (Media Independent Event Service), MICS (Media Independent Command Service), and MIIS (Media Independent Information Service). MIES primitives and messages help MN (Mobile Node) to monitor link status (e.g., signal strength and data rate), and MICS primitives and messages helps MN to control its link layers (physical layer and data link layer) for seamless handover in heterogeneous networks. The objective of MIIS is to gain knowledge about all heterogeneous networks in the area of interest of the terminal to facilitate handovers when roaming across these networks.

It is possible to expect that MIS Framework enables MN to monitor link, allocate resource, and enables seamless handover of MNs in SDRANs. The SDRAN can be characterized by a clear separation of the MIS control plane and SDN control plane. The SDRAN is the simplest solution for future wireless radio access networks integration where various applications connected through SDN networks conserve their independence. The major inconvenience of this approach is the long handover delay.

MIS primitives and messages can be used to transfer network configuration information for handover and mobility management via clear separated MIS control plane from the SDN control plane, and they can be used to provide seamless radio resource configuration for seamless handover while MN moving. Thus, MIS framework is appropriate for handover resource allocation and mobility management in SDRANs that use various heterogeneous switching provided by a clearly separating SDN control.

In SDRAN, MIS framework requires important modifications to the handover management protocols, the interfaces and the services of the access networks to provide good handover performance.

* + 1. Service scenarios and call flows
       1. Media Independent Service framework architecture

Our goal is to identify use cases for seamless handover in SDRANs, where an MIS approach could bring additional benefits of the RRM of the RANs separating from the SDN controller. In SDRAN, handover can occur when wireless link conditions change due to the users’ movement. In this case, service continuity should be maintained to minimize any perceptible interruption to the conversation. The media independent service (MIS) provides a framework and corresponding mechanisms by which an MISF entity can discover and obtain network information existing within SDRAN to facilitate the handovers. Then, we drive the main characteristics of a MIS framework for SDRANs. The proposed framework is assumed to be operated by a single operator or by cooperating service providers. It is based on the principal concepts of IEEE 802.21 for context information gathering and optimized handover decision making. Fig. 1 presents the MIS framework architecture for SDRAN, which includes the following network entities:

* Mobile Node (MN): This is a user device, such as a smart phone, which equips radio interfaces of multiple radio access technologies. MN exchanges message with more than one network entity. A set of handover-enabling functions within the protocol stacks of the network elements is called the MIS Function (MISF).
* MIS Point of Service (MIS PoS): This is an MIS network entity that exchanges MIS messages with the Mobile node.
* MIS Point of Attachment (PoA): This is the endpoint of a L2 link as it may exchange message with the Mobile Node. Traditionally, PoA has been treated as a base station in radio access network, base station in cellular networks, and access point in WLAN, that makes independent control plane decisions on the radio layer. MISF in PoA establishes link connection with the MN. It is responsible for medium access control that is expressed in terms of management information including the operating channel or the transmission power, the beacon interval or the contention parameters used by the medium access control.
* PoA Controller (MIS PoS): This is an MIS PoS that can manage both handover control and resource control of PoAs. PoA controller enables handover, cell association, and resource allocation at each PoA in concert with its neighbors to minimize the handover delay and maximize the network utilization. It is also responsible for decision of the data traffic flow about where traffic is sent to, from the underlying PoA that forwards traffic to the selected destination, in a way that is related to the controlling flow of new incoming MN.
* SDN Controller: A network entity that can manage resources of access switches. It is responsible for data forwarding where traffic is sent to/from the underlying PoA that forwards traffic to the selected destination, in a way that is related to the controlling flow.
* Information Server: A server that manages mobility information of MNs. This server has a real-time view of the MN and is capable of the access control and resource allocations of MNs in a media-independent way.

For handover execution phase, the crucial problem is the dependence on the media as well as the infrastructure network. For that reason, we designed a MIS framework for the handover execution phase to overcome the major issue of these dependencies in the SDARN. In the SDRAN, radio access networks (RANs) have the capability to operate in 3GPP LTE, WiMAX and Wi-Fi interfaces, and are equipped with MISF supporting handover management protocol depicted in Fig. 1. PoA Controller (PoS) will execute the MIS Functions to maintain service continuity, service adaptation to varying quality of service, battery life conservation, network discovery, and link selection. MIS users use MIS services such as a handover management and radio resource management via the PoA Controller. The PoA Controller (PoS) helps MIS users to implement effective handover procedures to support service continuity across heterogeneous network interfaces. The PoA Controller (PoS) facilitates seamless handover between heterogeneous PoAs. MIS users utilize MIS functions across different entities to query resources required for handover operation between heterogeneous networks. The radio resource information maintained in the PoA Controller (PoS) could help in the decision making of the handover as well as the radio resource optimization.

Separating MIS from the SDN controller enables network control functions to evolve independently. As a consequence, in SDRAN’s environment, vertical handover procedure becomes more challenging especially for SDRANs. It is clear that the coordination techniques between the PoA Controller (PoS) and SDN Controller should benefit of integration at multiple heterogeneous RANs. The coordination could be implemented by introducing a new API between the PoA Controller (PoS) and the SDN controller. We refer to this interface as the East/West interface of the SDN Controller.

The service framework architecture inherits some advantages as follows:

* The PoA Controller (PoS) could be implemented in the cloud for elastic, scalable and flexible deployment.
* Radio resource management and network control functions would be implemented as software, simplifying experimentation with and validation of new functions in the PoA Controller and the SDN Controller, respectively.
* Lower investments would be required, since intelligence would be taken from hardware to software.
* Consolidation around a central control structure would allow for greater automation, thereby reducing operational cost.



Figure 1—MIS framework architecture for SDRANs

In SDRAN, we assume that the PoA Controller (i.e., radio access point (RAP) Controller) is able to connect a variety of different PoAs, and PoA selection is derived from a mixture of user preferences, access network conditions and operator policies in a full SDN-based network. Radio access point acts as MIS PoA by achieving radio resource management on behalf of attached MNs.

Each PoA and its related MNs are co-located in a specific area or vehicle including a wireless RAN such as Wi-Fi network, WiMAX network or any other wireless network. So that, each end-user of MN can reach internet or communicate with a corresponding node via its PoA.

To prepare for handover, the MN may exchange link-layer PDUs with the target network PoA through a communication link that is established between an MN and the target PoA using the active network connection. During the handover, PoA Controller can control resources of PoAs that use various communication technologies (e.g., WLAN, Wi-Fi Direct, Bluetooth, and LTE) by using MIES message. PoA Controller directly configures radio resources (e.g., frequency, time, and power) at PoAs according to MICS message. The MICS message can be forwarded to SDN switches or indirectly forwarded by the SDN controller through the East/West interface.

SDN-based switch can also operate as a gateway between wireless RAN (or MNs) and a backhaul network. The latter is a cellular core network that may be connected to any other network. Fig. 1 shows the main functional entities in the RAN side and the architecture of the proposed handover management model. The Context aware Handover Controller at the MN side interacts with the Handover Manager of the PoA Controller and plans the execution of the handover management protocols. The MIS user at MN makes use of MIS signaling messages to achieve handover initiation and preparation. The context information module at the PoA Controller is able to extract relevant information from received triggers based on MIS signaling. Each mobile user has a local repository of its own context information. Then the PoA periodically queries the mobile users to establish its connectivity. The MIIS in our system can be incorporated with the information server. The information server at the core network sends handover policies to the PoA Controller and receives context information of each PoA controller and its attached users.

* + - 1. Media Independent Service reference model

A network reference model including MIS services is shown in Figure 2 to better illustrate the MIS reference points for SDRAN. Moving from left to right, the model includes an MIS-capable mobile node (MN) that supports multiple wired and wireless access technologies. An MN exchanges MIS information with its MIS point of service (PoS) within the PoA Controller. The MISF in any Network Entity becomes an MIS PoS when it communicates directly with an MN-based MISF. When an MISF in a PoA does not have a direct connection to the MN, it does not act as an MIS PoA for that particular MN.

The MN can use L2 transport for exchange MIS information with an MIS PoS that resides in its Network PoA. The MN can use L3 transport for exchanging MIS information with an MIS PoS that resides in its PoA Controller. This framework supports use of both L2 and L3 mechanisms for communication among MIS network entities.

Figure 2 shows the MISF communication model. The model shows MISFs in different roles and the communication relationships among them. It is important to note that each of the communication relationships in the communication model does not imply a particular transport mechanism. Rather, a communication relationship only intends to show that passing MIS-related information is possible between the two different Network Entities. Moreover, each communication relationship shown in the diagram encompasses different types of interfaces, different transport mechanisms used (e.g., L2, L3), and different service related content being passed (e.g., MIIS, MICS, or MIES).

This model assumes that the serving network either operates multiple link-layer technologies or allows its user to roam into other networks when a service level agreement (SLA) in support of inter-working has been established.

 Figure 2— MIS reference model for SDRAN 

The communication model assigns different roles to the MISF depending on its position in the system.

1. MISF on the MN
2. MIS PoS on the Network Entity that includes the serving PoA of the MN
3. MIS PoS on the Network Entity that includes a candidate PoA for the MN
4. MIS PoS on the Network Entity that includes the PoA Controller

The communication model also identifies the reference points between different instances of MISF.

* Reference point RP1: Reference point RP1 refers to MISF procedures between the MISF on the MN and the MIS PoS on the Network Entity of its serving PoA. RP1 encompasses communication interfaces over both L2 and L3 and above. MISF content passed over RP1 are related to MIIS, MIES, or MICS.
* Reference point RP2: Reference point RP2 refers to MISF procedures between the MISF on the MN and the MIS PoS on the Network Entity of a candidate PoA. RP2 encompasses communication interfaces over both L2 and L3 and above. MISF content passed over RP2 are related to MIIS, MIES, or MICS.
* Reference point RP3: Reference point RP3 refers to MISF procedures between the MISF on the MN and the MIS PoS on the PoA Controller. RP3 encompasses communication interfaces over L3 and above and possibly L2 transport protocols like Ethernet bridging, or multi-protocol label switching (MPLS). MISF content passed over RP3 are related to MIIS, MIES, or MICS.
* Reference point RP4: Reference point RP4 refers to MISF procedures between an MIS PoS in a Network Entity and an MIS PoS instance in PoA Controller. RP4 encompasses communication interfaces over L3 and above. MISF content passed over RP4 are related to MIIS, MIES, or MICS.
* Reference point RP5: Reference point RP5 refers to MISF procedures between an MIS PoS in a Network Entity and an MIS PoS instance in different Network Entities. RP5 encompasses communication interfaces over L3 and above. MISF content passed over RP5 are related to MIIS, MIES, or MICS.
* Reference point RP6 for East/West interface: Reference point RP6 for East/West interface refers to MISF procedures between PoA Controller and SDN Controller. RP5 encompasses East/West interfaces over SDN Controller. MISF content passed over RP5 are related to radio resource management and switch configuration.
  + - 1. MISF Services

The MISF provides the media independent event service (MIES), the media independent command service (MICS), and the media independent information service (MIIS) that facilitate handovers across heterogeneous RANs. Clause 5.7.3 provides a general description of these services. These services are managed and configured through service management primitives, as discussed in the following sub-Clause.

1. A media independent event service (MIES) that provides event classification, event filtering and event reporting corresponding to dynamic changes in link characteristics, link status, and link quality.
2. A media independent command service (MICS) that enables MIS users to manage and control link behavior relevant to handovers and mobility.
3. A media independent information service (MIIS) that provides details on the characteristics and services provided by the serving and neighboring networks. The information enables effective system access and effective handover decisions.
   * + 1. MISF SAPs

To prepare for handover, the MN may exchange link-layer PDUs with the target network PoA through a communication link that is established between an MN and the target PoA using the active network connection.

During the handover procedure, PoA Controller can control resources of PoAs that use various communication technologies (e.g., WLAN, Wi-Fi Direct, Bluetooth, and LTE) by using MIS message. PoAs directly configure radio resources (e.g., frequency, time, and power) according to MIS message. The MIS message can be forwarded to SDN switches or indirectly forwarded by the SDN controller through the East/West interface.

Figure 3 shows MISF in a protocol stack and the interaction of the MISF with other elements for handover control in SDRANs. All exchanges between the MISF and other functional entities occur through service primitives, grouped in service access points (SAPs). Each SAP consists of a set of service primitives that specify the interaction between the service user and provider.

The specification of the MISF includes the definition of SAPs that are media independent and recommendations to define or extend other SAPs that are media dependent. Media independent SAPs allow the MISF to provide services to the upper layers of the mobility-management protocol stack, the network management plane, and the data bearer plane. The MIS\_SAP and associated primitives provide the interface from MISF to the upper layers of the mobility-management protocol stack. Upper layers need to subscribe with the MISF as users to receive MISF generated events and also for link-layer events that originate at layers below the MISF but are passed on to MIS users through the MISF. MIS users directly send commands to the local MISF using the service primitives of the MIS\_SAP. Communication between two MISFs relies on MIS protocol messages.

Media dependent SAPs allow the MISF to use services from the lower layers of the mobility management protocol stack and their radio resource management planes. All inputs (including the events) from the lower layers of the mobility-management protocol stack into the MISF are provided through existing media-specific SAPs such as MAC SAPs, PHY SAPs, and logical link control (LLC) SAPs. Link Commands generated by the MISF to control the PHY and MAC layers during the handover are part of the media-specific MAC/PHY SAPs and are already defined elsewhere.

The MISF relevant SAPs include the following:

1. The MIS\_SAP specifies a media independent interface between the MISF and upper layers of the mobility management protocol stack. The upper layers need to subscribe with the MISF as users to receive MISF-generated events and also for link-layer events that originate at layers below the MISF but are passed on to MISF users through the MISF. MISF users directly send commands to the local MISF using the service primitives of the MIS\_SAP.
2. The MIS\_LINK\_SAP specifies an abstract media dependent interface between the MISF and lower layers media-specific protocol stacks of technologies such as IEEE 802.3, IEEE 802.11, IEEE 802.16, 3GPP, and 3GPP2. For different link-layer technologies, media-specific SAPs provide the functionality of MIS\_LINK\_SAP. Amendments are suggested to the respective media-specific SAPs to provide all the functionality as described by MIS\_LINK\_SAP.
3. The MIS\_NET\_SAP specifies an abstract media dependent interface of the MISF that provides transport services over the data plane on the local node, supporting the exchange of MIS information and messages with remote MISFs.



Figure 3— Relationship between different MISF SAPs

* + - 1. Stages for handover procedure

In SDRANs, handover refers to the ability of transferring an ongoing call or data session from one radio access technology to another, without any interruption, to the ongoing services. Radio resource allocation for Handover procedure comprises four stages as shown in Figure 4.

1. In the first stage, the MN may query the Information Server to discover candidate networks and their handover policies by starting handover initiation. This handover initiation enables the MN to determine whether or not there is a candidate target network available for handover. It consists of a set of steps of collection of information about neighboring networks, and exchange of information about QoS offered by these networks.
2. In the second stage, handover preparation starts from the link corruption detection until the request for preparation handover. The MN may query the PoA controller to discover candidate PoAs and their resource availability. Such information includes whether candidate networks and MN support radio resource management or not, and the availability of MIS service on the SDN Controller. The handover preparation consists of all steps of link measurements, collection of information about neighboring PoAs, and exchange of information about resource availabilities by these PoAs.
3. In the third stage, handover decision is the procedure to decide whether the connection to be switched to a new PoA based on parameters collected in the handover preparation phase. The evaluation can be made by the MN or the network based on parameters such as signal strength, target QoS, cost, resource availability, and operator policy. After then, radio resource allocation has been prepared by PoA Controller or via SDN Controller based on PoA’s link status or radio resource allocation of neighboring PoAs.
4. In the last stage, PoA’s radio resources (e.g., frequency, time, interface mode and power) are configured by PoA or PoA Controller. MN prepares to connect to radio access network with newly allocated radio resources as an action of Handover execution. After then, PoA reports its allocated radio resources to Information Server, PoA Controller (or SDN controller), and neighboring PoAs.

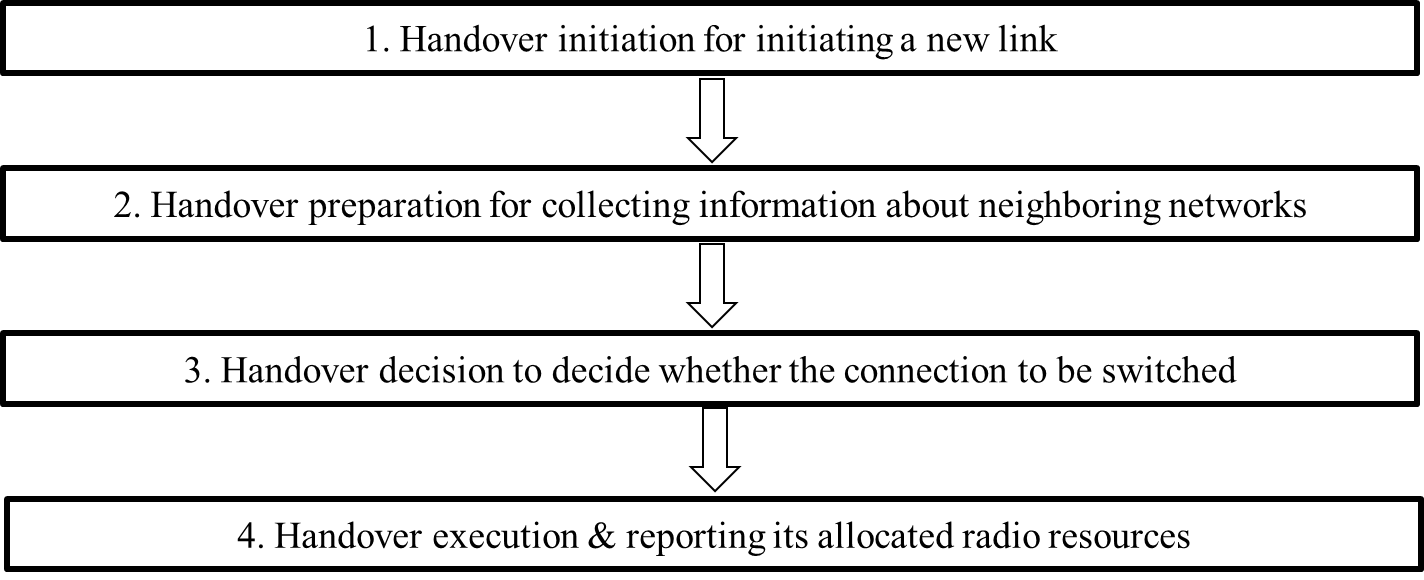
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Figure 4—Stages for seamless handover in SDRANs

* + - 1. Signal flows

Over the SDRANs, handover triggers generated by the link layer are exploited by the MISF incorporated in the PoAs to make easy vertical handover. This procedure has the four phases described in previous Session (Handover Initiation, Handover preparation, Handover decision and Handover execution).

* + - * 1. Stage 1: Handover Initiation

The handover initiation phase is start when the Mobile Node is connected to the serving network via the current PoA 1. The Mobile Node queries information about neighboring networks by sending an MIS\_Get\_Information request message to the Information Server. The Information Server responds with an MIS\_Get\_Information response message. This information is attempted as soon as the Mobile Node is first attached to the PoA 1 and it has access to the MIS Information Server. Figure 5 shows an example signal flow for handover initiation.



Figure 5—Signal flows for handover initiation procedure

* + - * 1. Stage 2: Handover Preparation

Figure 6 shows an example signal flow for handover preparation. When detecting MIS\_MN\_Link\_Detected\_indication, the Mobile Node triggers a mobile-initiated handover by sending an MIS\_MN\_HO\_Candidate\_Query request message to the PoA Controller. This request contains the information of potential candidate networks. The PoA Controller extracts context information of both attached users and neighboring radio access networks. The PoA Controller queries the availability of resources at the candidate PoAs by sending an MIS\_N2N\_HO\_Query\_Resources request message to one or multiple Candidate PoAs. The Candidate PoAs respond with an MIS\_N2N\_HO\_Query\_Resources response message and the PoA Controller notifies the Mobile Node of the resulting resource availability at the candidate PoAs through an MIS\_MN\_HO\_Candidate\_Query response message. Thus, RANs and MN have enough information about the neighboring networks to make a handover decision based on policies and multi-criteria of decision in either MN or network centric approach.



Figure 6—Signal flows for handover preparation procedure

* + - * 1. Stage 3: Handover Decision

After executing the selection mechanism and determining the preferred candidate target radio access network, the Mobile Node decides on the target of the handover, and notifies the PoA Controller of the decided target network information by sending the MIS\_MN\_HO\_Commit request message. The MIS\_MN\_HO\_Commit.request message includes information on MN’s newly allocated radio resources (e.g., frequency band and transmit power). The PoA Controller sends the MIS\_N2N\_HO\_Commit request message to the Target PoA to request resource preparation at the target network. The Target PoA responds with the result of the resource preparation by an MIS\_N2N\_HO\_Commit response message. The target PoA 2 can reply to the PoA Controller (MIS PoS) by sending MIS\_N2N\_HO\_Commit.response to prepare connection with newly allocated resources. The PoA Controller (MIS PoS) can respond to PoA 1 by sending MIS\_MN\_HO\_Commit.response message to prepare connection with newly allocated resources and PoA 1 itself can allocate its radio resources.



Figure 7—Signal flows for handover decision procedure

* + - * 1. Stage 4: Handover Execution

When the MN moves its attachment from a previous PoA (PoA 1) to a new PoA (PoA 2), certain handover execution procedure is carried out between the Mobile Node and the PoA Controller as follows: After radio link has been activated with the MIS\_Link\_Up.indication, the Mobile Node establishes the new layer 2 connection and sends an MIS\_MN\_HO\_Complete request message to the PoA Controller. The PoA Controller sends an MIS\_N2N\_HO\_Complete request message to the previous Serving PoA to release resource, which was allocated to the Mobile Node. After identifying that the resource is successfully released, the PoA Controller sends an MIS\_MN\_HO\_Complete response message to the Mobile Node to preserve connectivity to the correspondent (Figure 8 (m)) are exchanged between PoA 2 and the PoA Controller (MIS PoS), which are incorporated with PoA 1 (Figure 8 (n) and (o)). The handover procedure is completed when MN receives MIS\_MN\_HO\_Complete.response (Figure 8 (p)) from PoA 2.



Figure 8—Signal flows for handover execution procedure

* + 1. Service access point and primitives
       1. MIS\_SAP primitives
          1. MIS\_LINK\_SAP primitives

|  |  |  |
| --- | --- | --- |
| **Primitive** | **type** | **reference** |
| **MIS\_LINK\_SAP** | Link\_Detected.indication | 7.3.1 IEEE 802.21 XXXX |
| Link\_Up.indication | 7.3.2 IEEE 802.21 XXXX |
| Link\_Action.request | 7.3.14.1 IEEE 802.21 XXXX |
| Link\_Action.confirm | 7.3.14.2 IEEE 802.21 XXXX |

* + - 1. MIS\_SAP primitives

|  |  |  |
| --- | --- | --- |
| Primitive | **Type** | **reference** |
| **MIS \_SAP** | MIS\_Link\_Detected.indication | 7.4.6 IEEE 802.21 XXXX |
| MIS\_Link\_Up.indication | 7.4.7 IEEE 802.21 XXXX |
| MIS\_Get\_Information.request | 7.4.25.1 IEEE 802.21 XXXX |
| MIS\_Get\_Information.confirm | 7.4.25.4 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Candidate\_Query.request | 7.4.18.1 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Candidate\_Query.indication | 7.4.18.2 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Candidate\_Query.response | 7.4.18.3 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Candidate\_Query.confirm | 7.4.18.4 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources.request | 7.4.19.1 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources.indication | 7.4.19.2 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources.response | 7.4.19.3 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources.confirm | 7.4.19.4 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Commit.request | 7.4.20.1 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Commit.indication | 7.4.20.2 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Commit.response | 7.4.20.3 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Commit.confirm | 7.4.20.4 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Commit.request | 7.4.22.1 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Commit.indication | 7.4.22.2 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Commit.response | 7.4.22.3 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Commit.confirm | 7.4.22.4 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Complete.request | 7.4.23.1 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_ Complete.indication | 7.4.23.2 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_ Complete.response | 7.4.23.3 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_ Complete.confirm | 7.4.23.4 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Complete.request | 7.4.24.1 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_ Complete.indication | 7.4.24.2 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_ Complete.response | 7.4.24.3 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_ Complete.confirm | 7.4.24.4 IEEE 802.21 XXXX |
|  |

* + 1. MIS protocol message types
       1. MIS protocol messages
          1. —MIS message for command service

|  |  |  |
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| **Message** | **Type** | **reference** |
| **command service** | MIS\_MN\_HO\_Candidate\_Query request | 8.6.3.9 IEEE 802.21 XXXX |
| MIS\_MN\_HO\_Candidate\_Query response | 8.6.3.10 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources request | 8.6.3.11 IEEE 802.21 XXXX |
| MIS\_N2N\_HO\_Query\_Resources response | 8.6.3.12 IEEE 802.21 XXXX |
|  | MIS\_MN\_HO\_Commit request | 8.6.3.13 IEEE 802.21 XXXX |
|  | MIS\_MN\_HO\_Commit response | 8.6.3.14 IEEE 802.21 XXXX |
|  | MIS\_N2N\_HO\_Commit request | 8.6.3.17 IEEE 802.21 XXXX |
|  | MIS\_N2N\_HO\_Commit response | 8.6.3.18 IEEE 802.21 XXXX |
|  | MIS\_MN\_HO\_Complete request | 8.6.3.19 IEEE 802.21 XXXX |
|  | MIS\_MN\_HO\_Complete response | 8.6.3.20 IEEE 802.21 XXXX |
|  | MIS\_N2N\_HO\_Complete request | 8.6.3.21 IEEE 802.21 XXXX |
|  | MIS\_N2N\_HO\_Complete response | 8.6.3.22 IEEE 802.21 XXXX |

* + - * 1. —MIS message for information service

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| **Message** | **Type** | **reference** |
| **information service** | MIS\_Get\_Information request | 8.6.4.1 IEEE 802.21 XXXX |
|  | MIS\_Get\_Information response | * + - 1. IEEE 802.21 XXXX |