MIF
Internet Draft
Intended status: Informational
Expires: May 28, 2016

Hongke Zhang
Boxin Du
Mi Zhang
Fei Song
Beijing Jiaotong University

November 30, 2015

**MIF API extension for combining IEEE 802.21**
**draft-zhang-mif-api-extension-802-21-03.txt**

Abstract

The Application Program Interface (API) of MIF, specified in the MIF API consideration, must rely on lower layer functionalities when handover between homogeneous or heterogeneous networks is necessary. To improve the connectivity performance,the existing MIF API needs to be extended. IEEE is also aimed at the similar issue from different way. A kind of logical entities over the link layer protocol for handling the seamless handover has been defined in IEEE 802.21. This document proposes a mechanism via conbining the MIF API and IEEE 802.21 to support application service better.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on May 28, 2016.

Copyright Notice

Table of Contents

1. Introduction ..... 4
2. Terminology ..... 4
3. The Relationship between IEEE MIHF and MIF API ..... 4
4. The Extension of MIF API for Handover: A Case Study..... 8
4.1. The MN-initiated Handover ..... 8
4.1.1. Get Information ..... 8
4.1.2. Information Post ..... 9
4.1.3. Parameter Report ..... 9
4.1.4. Check Resources MN ..... 9
4.1.5. Resource Availability ..... 9
4.1.6. Connect to Interface ..... 9
4.1.7. Resource Preparation Messages ..... 10
4.1.8. Establish Link Messages ..... 10
4.1.9. Link Up ..... 10
4.1.10. Handover Completed ..... 10
4.1.11. Handover Completion Confirmation ..... 10
4.2. The Network-initiated Handover ..... 10
4.2.1. Candidate Query Notification ..... 11
4.2.2. Candidate Query Result ..... 11
4.2.3. Check Resources Net ..... 11
4.2.4. Confirm Chosen Target ..... 12
4.2.5. Establish Link Messages ..... 12
4.2.6. Link Up ..... 12
4.2.7. Handover Completed ..... 12
4.2.8. Handover Completion Confirmation ..... 12
5. Discussions for New Messages from MIF Perspective ..... 12
5.1. Get Information..... 12
5.2. Release the Ongoing Connection ..... 13
5.3. Establish New L2 Connection ..... 13
6. Discussions for New Messages from IEEE Perspective ..... 13
7. Security Considerations ..... 16
8. IANA Considerations ..... 16
9. References ..... 16
9.1. Normative References ..... 16
9.2. Informative References ..... 16
10. Acknowledgments ..... 17

## 1. Introduction

In MIF context, improved connectivity experiences SHOULD be created. Enhancing the performance of horizontal and vertical switches between networks is one of the main targets. Such situation is quite similar with Media Independent Handover (MIH) described in [IEEE 802.21]. The MIF Application Program Interface (API) specified in the MIF API consideration [I-D.ietf-mif-api-extension] describes a set of message calls to implement higher level APIs that solve the problems in multiple interface scenarios. However, this draft only provides a minimal set of message calls REQUIRED to implement the API. New functions could be added.

According to [IEEE 802.21], the Media Independent Handover Function (MIHF) is a logical entity that facilitates MIH make decisions based on the inputs from the MIHF. It provides abstracted services to higher layers. Communications with the lower layer of the mobility-management protocol stack can be achieved through technology-specific interfaces in MIHF.

Although two mechanisms, MIF API and MIHF,work in different layers and are defined by different organizations, the requirements of compatibility are clear. Some of the functions of MIF API SHOULD be supported by a connection manager (i.e. the MIHF), and vice versa. Owing to the advantages of both MIHF and its Service Access Points (SAPs), the functions of MIHF could be utilized in MIF API for handover issues. This document extends message calls of MIF API to support the MIH. Like [I-D.ietf-mif-api-extension], no bindings for programming languages are provided because they are left up to the implementation. This document only describes the messages sent and received,which can be read as a checklist for operating system vendors.

## 2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119 [RFC2119].

## 3. The Relationship between IEEE MIHF and MIF API

The purpose of IEEE 802.21 is to improve the user experience of mobile devices by facilitating handover among all IEEE 802 networks regardless of whether they are of different media types or not, including both wired and wireless. It also aims at making it possible for mobile devices to perform seamless handover between IEEE 802 and non IEEE networks. This standard defines:

1) A framework that enables service continuity while a Mobile Node (MN) transitions between heterogeneous link-layer technologies.

2) MIHF.

3) MIH_SAP and associated primitives for users to get services of MIHF.

4) The definitions of new link-layer SAPs and associated primitives for each link-layer technology. They help MIHF to collect link information and control link behaviors during handovers.

The concept of MIHF is a functional entity to realize the high-performance handovers. The primary advantage of MIHF is that it provides media-independent services to higher layers without considering the media-specific technology of lower layer being used, such as IEEE Std.802.3, IEEE Std.802.11, IEEE Std.802.16, 3GPP and 3GPP2. It also defines three kinds of SAPs (will be detailed later) of MIHF and their primitives that interact between different layers. The MIHF can also act as a filter: the messages received from link layer SHOULD be processed and submitted to higher layer for meeting the subscribers' need. Therefore, MIHF should work under MIF API. In fact, MIF API SHOULD be served as a user of MIHF, which is shown in Figure 1. The subscribers can then only interact with the MIHF via one kind of SAPs (i.e. MIH_SAP) without knowing lower level information. The MIH protocol is not in the scope of this document.

Three kinds of MIHF services are defined in the standard, including Media Independent Event Service (MIES), Media Independent Command Service (MICS) and Media Independent Information Service (MIIS).

MIES provides event classification, event filtering and event reporting corresponding to dynamic changes in link characteristics, link status and link quality. It originates from lower layers and can be passed to MIHF or upper users for the detection of handover requirement. MICS enables MIH users to manage and control link behavior relevant to handover and mobility. It is invoked by users or MIHF and makes effect on MIHF or lower layers.

For example, in MN-initiated handover scenario, MICS is adopted for MN switching between different links. MIIS allows MN and network entities to discover information that influences the selection of appropriate networks during handovers. Figure 2 [IEEE 802.21] shows MIH services as well as their initiation.

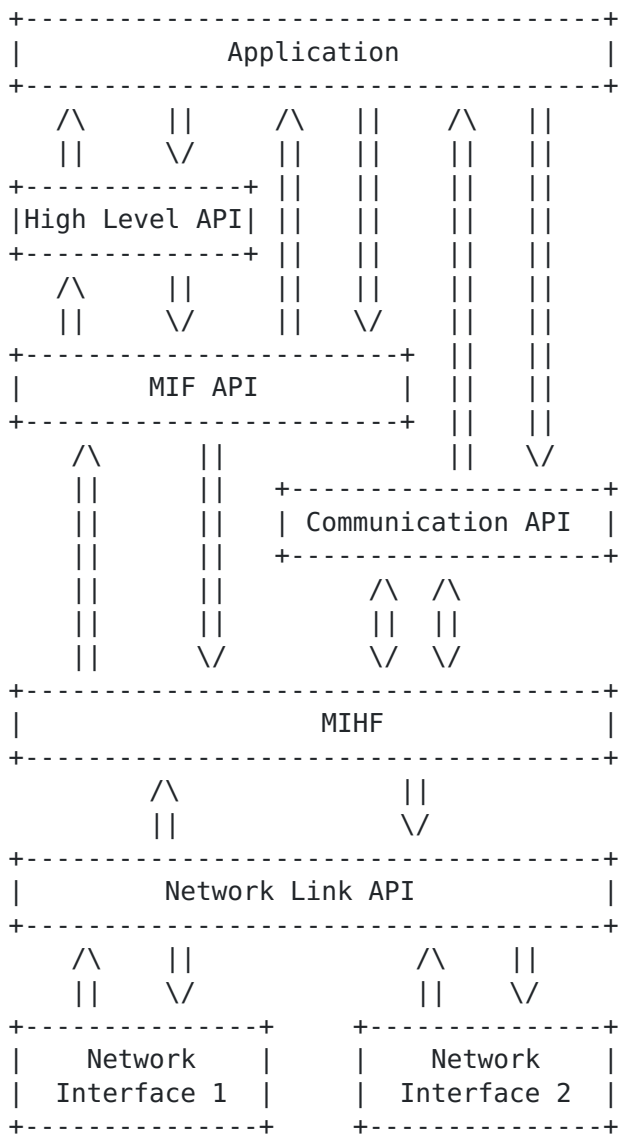


Figure 1 The relationship of MIHF & MIF API

The letters a, b, c in Figure 2 respectively represent:

a. MIH_SAP

b. MIH_LINK_SAP

c. LLC_SAP

The SAPs are divided into two categories:

1) Media dependent SAP (including MIH_LINK_SAP and LLC_SAP).

2) Media independent SAP (MIH_SAP).

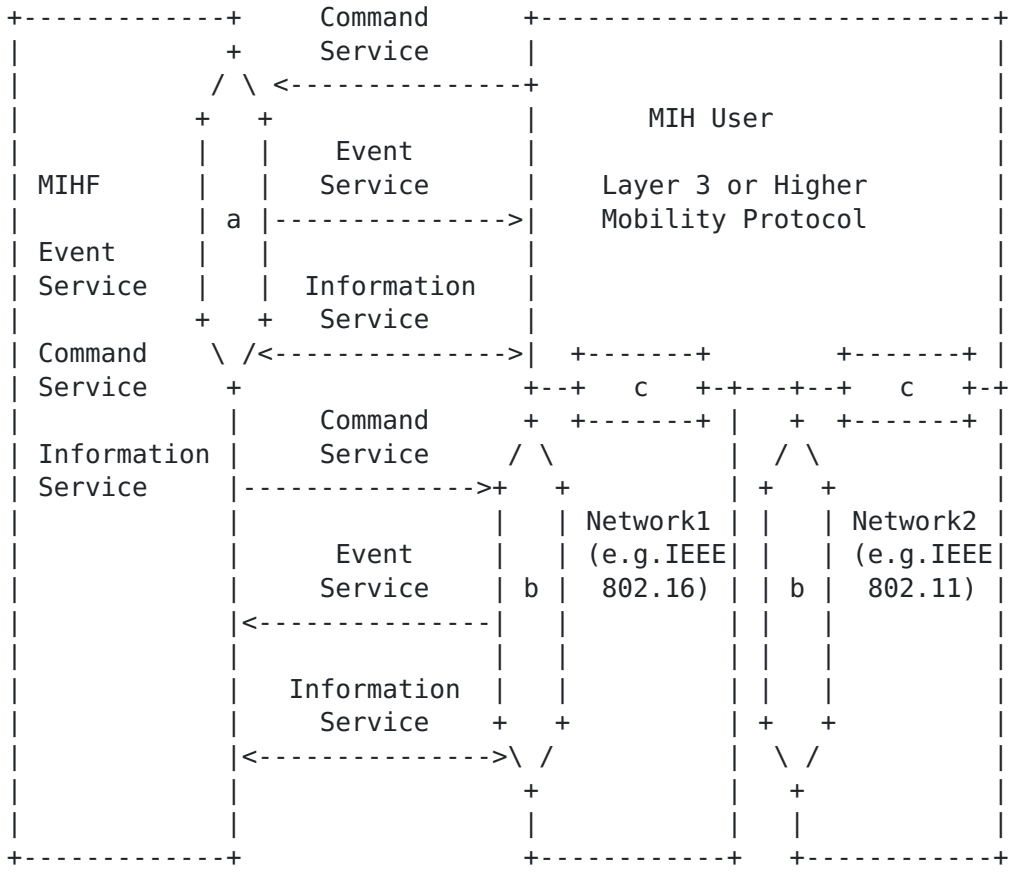


Figure 2 MIH services and their initiation

SAP of the MIHF (i.e. MIH_SAP) is media independent. The MIH_SAP defines the users' interface between the MIHF and MIH such as an upper layer mobility protocol or a handover function (e.g., MIF API) that might reside at higher layer transport entity as well. MIH_SAP allows the MIHF to provide services to the upper layers, the network management plane and the data bearer plane. Upper layers need to subscribe with the MIHFto receive MIHF events. In MIF case, the MIF API can directly send commands to the local MIHF via messages which use the service primitives of the MIH_SAP.

All the messages REQUIRED for communicating successfully in MIF environment that described in the [I-D.ietf-mif-api-extension] MUST also be used here. These messages define the way that MIF API interacts with the higher layers or applications. New messages need

to be added into this set for handover process. These new messages SHOULD be exchanged between MIHF and MIF API. Some of them may use the services of MIHF.

## 4. The Extension of MIF API in Handover: A Case Study

This section introduces the extension of message calls of MIF API in two parts based on the classification of handovers (MN-initiated handover and the network-initiated handover). To handle these two kinds of handovers successfully, MIF API SHOULD be extended respectively based on the characteristics of process.

### 4.1. The MN-initiated Handover

The MN-initated handover includes the following steps:

1) Information query. The MN collects network information from the MIIS server which the MN is connected to.

2) Resource availability check. The MIF API sends request to find candidates and then receives a list of candidate networks in response message.

3) Resource preparation. The MN SHOULD determine which target network is suitable and request it for resource preparation.

4) Establish new L2 connection. The MIF API initiates a new link connection.

5) Link up indication. The MIHF of MN notifies the MIF API that the link is up.

6) Higher layer handover execution.

7) Resource release. The original serving network resources must be released in the end.

The following messages, which are only the interactions between a MIHF and MIF APIs, need to be added.

#### 4.1.1. Get Information

This message is sent by the MIF API for the inquiry of the neighboring networks information. In MIH, we can use the MIH_Get_Information.request to realize the same purpose. After receiving this message, the MIHF inquires the MIIS server for the

information, which will return a list of network information needed for MIF API.

#### 4.1.2. Information Post

This message is sent to the MIF API by the MIIS server as a response to the Get Information message. MIH_Get_Information.confirm can be used to convey such information.

#### 4.1.3. Parameter Report

When attached to a specific network, the MIF API needs to receive the link status from the lower layers in order to better control the whole connection. The MIHF can receive reports from the link layers and submit them to the higher layers. If the link goesdown, the MIF API must notify its subscribers by "Interface is going away" message. The application or higher API could try to establish new connections by sending "Wants to connect" to MIHF and the connection process will restart from step 2 (i.e. Resource availability check).

Another situation is that once the MIF API receives a "Wants to connect" message from its subscriber, the MIF API SHOULD accordingly trigger a whole connection process to a new network. This can also begin from step 2.

#### 4.1.4. Check Resources MN

Before the start of connection, the MN SHOULD check the resource availability at the candidate networks. This message is sent to the MIHF by the MIF API. The serving network SHOULD request each candidate. The final result SHOULD be returned to the higher layer. The MIH_MN_HO_Candidate_Query.request can be used in the MIH case.

#### 4.1.5. Resource Availability

When receiving the resource availability of the candidates from the serving network, the MIHF SHOULD submit them to the MIF API. The MIH_MN_HO_Candidate_Query.confirm can be used in the MIH case.

#### 4.1.6. Connect to Interface

This message is sent to the MIF API by the upper applications. When the MIF API receives the Resource Availability, it could post the message to the higher layer. The upper application can use "Connect to Interface" to choose a better network interface. More about the choosing methods need further discussion.

#### 4.1.7. Resource Preparation Messages

The MIF API can use the MIH_MN_HO_Commit. request, which includs the target network information, to request the network chose for resource preparation. When the preparation is done, the MIHF receives the response from the target network. It sends a MIH_MN_HO_Commit. confirm message to the MIF API to inform the status of the previously issued target notification request.

#### 4.1.8. Establish Link Messages

MIF API can use the MIH_Link_Action. request to solve the problem in connection establishment. This message primitively in the [IEEE 802.21] is to control the local or remote lower link layers. It includes a MIHF ID and a Link Actions List, which can realize many controlling functions. After the action has been executed, the MIF API should receive a MIH_Link_Action. confirm to indicate the result.

#### 4.1.9. Link Up

After the new link is established, the MAC layers MUST deliver a Link_Up.indication to the MIHF. The MIHF then passes the MIH_Link_Up. indication message to the MIF API. The MIF API can notify the upper applications bythe "Link is going up" message. Then the higher layer handover execution might be triggered and the traffic flow can be re-established.

#### 4.1.10. Handover Completed

This message is sent to the local MIHF by the MIH API to release the resources of the previous serving network which was originally allocated to the MN. After identifying that the release is done, the target network Point of Service (PoS) sends the confirm message to the MIHF and the MIHF SHOULD also reply the MIF API with the same information.

#### 4.1.11. Handover Completion Confirmation

This message is sent to the MIF API by the MIHF indicating that the resource of the previous network is successfully released.

### 4.2. The Network-initiated Handover

There are also seven steps in an intact network-initiated handover, like the MN-initiated handover:

1) Information query.

2) Resource availability check.

3) Resource preparation.

4) Establish a L2 connection using MIH_Link_Action.request.

5) Sent link indications to the MIF API.

6) Higher layer handover execution.

7) Resource release.

The differences between Network-initiated case and MN-initiated case are in step 1 and step 2: the Get Information request and Information Query are respectively initiated by the MIH user of the serving network. When such MIH user obtains the information from the MIIS server, it sends requests to the MN for a response message containing the MN's handover acknowledgement, MN's preferred link and PoS lists.

In step 3, the commitment of target network is also initiated by the MIH user of a serving network. After the resource is prepared, the PoS of serving network SHOULD notify the MN for the establishment of L2 connection in step 4.

The following messages should be added in MIF API:

### 4.2.1. Candidate Query Notification

This message is sent to MN's MIHF from the PoS of the serving network with a list of PoAs of each candidate network link. Such message suggests the MN SHOULD consider new access network. This message can use the MIH_Net_HO_Candidate_Query. indication.

### 4.2.2. Candidate Query Result

This message is sent to the local serving network's MIHF from MN's MIF API, specifying whether the request of handover is permitted or not. MIH_Net_HO_Candidate_Query.response can be used here. If the handover is permitted, a new access network SHOULD be considered at the handover initiation stage.

### 4.2.3. Check Resources Net

This message is sent to the MN's MIF API by the PoS of serving network with a list of target network information and a set of resource parameters assigned to the MN for handover operations. MIH_Net_HO_Commit.indication can be used here. Then the MIF API can

trigger the establishment of L2 connection by using Link_Action.request. After the link connection is done, MIF API needs to inform the serving network. Link_Action. request might also have a list of actions for handover control during the link connection period.

#### 4.2.4. Confirm Chosen Target

This message is sent by the MN's MIF API as a response to the MIH_HO_Commit.indication, revealing that the indication is received. MIH_Net_HO_Commit.response can be used here. Also such message might include a list of the results of previous actions.

#### 4.2.5. Establish Link Messages

This message is exactly the same as that of the MN-initiated process, for establishing a new L2 link connection.

#### 4.2.6. Link Up

This message is exactly the same as that of the MN-initiated process, for informing the MIF API that the L2 link is completed.

#### 4.2.7. Handover Completed

This message is exactly the same as that of the MN-initiated process, for releasing the resources that have already attained by the MN.

#### 4.2.8. Handover Completion Confirmation

This message is exactly the same as that of the MN-initiated process, for confirming that the resources of the previous network are successfully released.

## 5. Discussions for New Messages from MIF Perspective

New messages described in this document are critical for information exchanging and function achievement between MIHF and MIF API. Since both "upper layer requirements gathering" and "lower layer command delivering" (or reverse) can be achieved via messages, the logical relationship should be discussed in-depth. The messages below are only the examples. Further updating is needed.

### 5.1. Get Information

According to [IEEE 802.21], this information query is related to a specific interface. It has the flexibility to query either a specific

data within a network interface or an extended schema of a given network. As an advanced application or upper APIs send "Announce Interface", "Announce PVD" and "Announce IE (Information Elements)", the MIF API could obtain the information by using the MIH_Get_information. request.

### 5.2. Release the Ongoing Connection

The [I-D.ietf-mif-api-extension] defines a message "Connection can be broken", which means that the MN can tolerate the connection being broken, e.g. for power conservation. When the subscribers of MIF API delivers this message, the MIF API SHOULD send "Release the ongoing connection" to the MIHF so that directly releasing the current resources of network to cut off this connection. This action will not weaken the function of the application.

### 5.3. Establish New L2 Connection

According to [IEEE 802.21], the MIH_Link_Actions can trigger a L2 link connection. When MN wants to build a TCP connection with an IP host, the MIF API will receive "Connect to Address" or "Connect to Address from Address" messages. Then the MIF API can use the MIH_Link_Actions.request to ask MIHF for a new L2 link connection.

## 6. Discussions for New Messages from IEEE Perspective

Table1, 2, 3 and 4, are from the [IEEE 802.21]. These messages might be used in the MIF API because they are exchanged between the MIHF and its MIH users. Some of them have been discussed above, but the specific usage of the rest is not represented. This section presents only a direct list of all these messages, their category and brief descriptions. Further discussion is still needed.

| Messages (Information) | Description |
|---|---|
| MIH_Get_Information | Request to get information from repository |
| MIH_Push_Information | Notify the MN of operator policies or other information |

Table 1 Information Messages of MIHF

| Messages (Event) | Description |
|---|---|
| MIH_Link_Detected | Link of a new access network has been detected. This event is typically on the MN when the first PoA of an access network is detected |
| Track_timeout | This event is not generated when subsequent PoAs of the same access network are discovered |
| MIH_Link_Up | L2 connection is established and link is available for use |
| MIH_Link_Down | L2 connection is broken and link is not available for use |
| MIH_Link_Paremeters _Report | Link parameters have crossed a specified threshold and need to be reported |
| MIH_Link_Going_Down | Link conditions are degrading and connection loss is imminent |
| MIH_Link_Handover _Imminent | L2 handover is imminent based on either the changes in the link conditions or additional information available in the network |
| MIH_Link_Handover _Complete | L2 handover to a new PoA has been completed |
| MIH_Link_PDU _Transmit_Status | Indicate transmission status of a PDU |

Table 2 Event Messages of MIHF

| Messages (Command) | Description |
|---|---|
| MIH_Link_Get _Parameters | Get the status of a link |
| MIH_Net_HO _Candidate _Query | Network initiates handover and sends a list of suggested networks and associated points of attachment |
| MIH_Link_Configure Thresholds | Configure link parameter thresholds |
| MIH_Link_Actions | Control the behavior of a set of links |
| MIH_MN_HO_Candidate _Query | Command used by MN to query and obtain handover related information about possible candidate networks |
| MIH_N2N_HO_Query _Resources | command sent by the serving MIHF entity to the target MIHF entity for resource query |
| MIH_MN_HO_Commit | Command used by MN to notify the serving network of the decided target network information |
| MIH_Net_HO_Commit | Command used by the network to notify the MN of the decided target network information |
| MIH_N2N_HO_Commit | Command used by a serving network to inform a target network that an MN is about to move toward that network, initiate context transfer and perform handover preparation |
| MIH_MN_HO_Complete | Notification from MIHF of the MN to the target or source MIHF indicating the status of handover completion |
| MIH_N2N_HO_Complete | Notification from MIHF of the MN to the target or source MIHF indicating the status of handover completion |
| MIH_N2N_HO_Complete | Notification from either source or target MIHF to the peer MIHF indicating the status of the handover completion |

Table 3 Command Messages of MIHF

| Messages (Service management) | Description |
|---|---|
| MIH_Capability _Discover | Discover list of Events and Commands supported by MIHF |
| MIH_Register | Register with a remote MIHF |
| MIH_DeRegister | Deregister with a remote MIHF |
| MIH_Event_Subscribe | Subscribe for MIH event notification |
| MIH_Event_Unsubscibe | Unsubscribe from MIH event notification |

Table 4 Service Management of MIHF

## 7. Security Considerations

This document does not contain any security considerations.

## 8. IANA Considerations

There are presently no IANA considerations with this document.

## 9. References

### 9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

### 9.2. Informative References

[IEEE 802.21] IEEE, "IEEE Standard for Local and Metropolitan Area Networks Part 21: Media Independent Handover Services", IEEE LAN/MAN Std 802.21-2008, January 2009. <http://www.ieee802.org/21/private/Published%20Spec/802.21-2008.pdf>.

[I-D.ietf-mif-api-extension] Liu, D., Lemon, T., Ismailov, Y., and Z. Cao, "MIF API consideration", draft-ietf-mif-api-extension-05 (work in progress), Feb. 2014.

## 10. Acknowledgments

This document was prepared using 2-Word-v2.0.template.dot.

Authors' Addresses

Hongke Zhang
Beijing Jiaotong University (BJTU)
Beijing, 100044, P.R.China

Email: hkzhang@bjtu.edu.cn

Boxin Du
Beijing Jiaotong University (BJTU)
Beijing, 100044, P.R.China

Email: 10291070@bjtu.edu.cn

Mi Zhang
Beijing Jiaotong University (BJTU)
Beijing, 100044, P.R.China

Email: 13120174@bjtu.edu.cn

Fei Song
Beijing Jiaotong University (BJTU)
Beijing, 100044, P.R.China

Email: fsong@bjtu.edu.cn