Messaging LFB
Implementation Agreement

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Revision 1.1

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The words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", “MAY", and "OPTIONAL" in the remainder of this document are to be interpreted as described in the NPF Software API Conventions Implementation Agreement revision 1.0.

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1 Revision History

Revision	Date	Reason for Changes
1.0	04/14/2004	Created Rev 1.0 of the implementation agreement by taking the Messaging LFB draft (npf2003.504.07) and making minor editorial corrections.
1.1	12/16/2004	Updated to add LFB type code.

2 Introduction

A forwarding plane, as modeled within the NPF, is comprised of a series of Logical Function Blocks (LFBs), which may span multiple forwarding elements (FEs), to perform distinct packet processing activities. Within each FE, these LFBs are connected together, via the LFB Topology [LFB_TOPO], in order to carry out a consistent forwarding plane function for the FE. In order to carry out the forwarding plane function of the FE, or in order to provide forwarding functionality across FEs, it is often necessary for these LFBs to share metadata with each other, as a downstream LFB may rely on metadata from a previous LFB as part of its processing. When the passing of packet and metadata occurs between FEs that span a physical boundary, it is necessary to have common, well-defined interfaces for accepting and receiving packet and metadata at the edges of these FEs. The mechanism by which an FE passes packet and metadata, across a physical boundary, to another FE is the Messaging LFB. The following describes the Messaging LFB and how it is used.

The function of the Messaging LFB is to pass packet and metadata between FEs, across a physical boundary (e.g. LA-1, switch fabric, etc.), in a consistently packaged manner. This allows for interoperability of FEs, from a logical perspective, even if those FEs come from different vendors. The Messaging LFB uses the NPF Messaging Layer Implementation Agreement [NPF_MSG] as the basis for how it formats the metadata. The NPF Messaging IA defines a flexible grammar for metadata syntax. Figure 1 provides a conceptual picture of how the Messaging LFB functions within the Forwarding Plane.

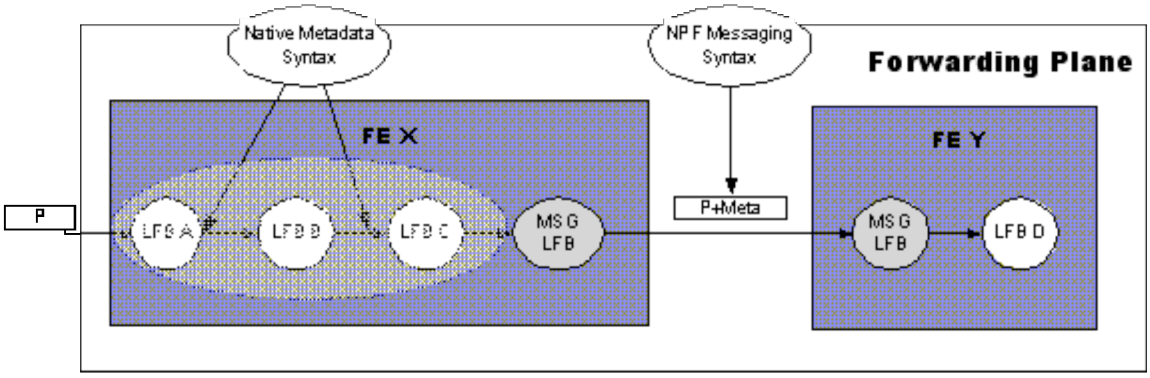


Figure 1 -- Conceptual model of Messaging LFB

2.1 Acronyms / Definitions

The following terms are used in this document:

Control Plane		The control plane maintains information for the purpose of effecting changes to the forwarding plane's behavior.
Data Plane		In this document a synonym for “forwarding plane”.
Forwarding Element	FE	An FE is modeled as a collection of logical function blocks (LFBs) whose relationship is expressed using a directed graph.
Logical Function Block	LFB	An abstraction of a defined packet-processing functionality standardized by the NPF. An NPF Functional API provides an LFBaware means of accessing (configuring, monitoring) the resources associated with the LFB.

Messaging		Communication between processors (i.e. Control Processor and Network Processor or between Network Processors) conveying a range of configuration, dynamic state and hardware status.
Network Processor	NP	A programmable or configurable semiconductor based device that is designed and optimized for the processing of network data (packets).
Packet		The SwAPI Lexicon [7] defines the term packet in general. In this document it is used to refer to an IP packet (inclusive of header and data).
SAE		System Architectural Entity. (Taken from [NPF_MSG]) An out-of-band configuration mechanism which gathers capabilities and requirements for the system and NPEs, and then, per-conveyance, configures the conveyance and application (i.e., service access point, or SAP) information in each NPE. Finally, the SAE determines and communicates message formats for each conveyance by mapping message fields into slots.

2.2 Assumptions

This document assumes the reader is familiar with the NPF Messaging IA [NPF_MSG] and understands how it is to be used in an NPF compliant forwarding element. Using the NPF Messaging IA terminology, the Messaging LFB exposes a control interface which allows the SAE to instantiate a specific application of the NPF Messaging specification.

2.3 Scope

The Messaging LFB describes the mechanisms by which metadata is formatted, for the purposes of transferring that metadata, along with the packet if required, between FEs that span a physical boundary. The format for metadata is based on the NPF Messaging IA [NPF_MSG]. The Messaging LFB does not define or create metadata. It only formats the metadata it receives to be compliant with the NPF Messaging IA or interprets an NPF Messaging compliant metadata stream.

2.4 External Requirements and Dependencies

The Messaging LFB describes the mechanisms by which metadata is packaged for the purposes of transferring the metadata between FEs that span a physical boundary. The packaging of metadata is based on the NPF Messaging IA [NPF_MSG]. The Messaging LFB constrains the format by which metadata is packaged to be compliant with this specification.

The FAPI Topology Discovery API [LFB_TOPO] defines the LFB ID type, `NPF_BlockId_t` which allows the Messaging LFB to be discovered by the Topology Discovery API.

Appendix A provides a header file which includes informative definitions of metadata elements. However, the normative definitions of metadata elements, as defined by the NPF, are contained in the LFB implementation agreements themselves. An implementation of the Messaging LFB will need to construct an appropriate header file based on NPF normative metadata definitions (i.e. the LFB implementation agreements that are to be used within an application). Appendix A is only provided as an example.

3 LFB Detailed Description

The Messaging LFB allows a system integrator to format packet and metadata (within the constraints of the underlying physical device) transferred between FEs to be compliant with the NPF Messaging IA [NPF_MSG]. The Messaging LFB, in and of itself, does not produce any metadata, nor does it perform any packet processing. The Messaging LFB is simply a formatting function that must perform two distinct operations: (1) take native packet and metadata syntax of a FE and convert it to an NPF Messaging compliant syntax and (2) translate a NPF Messaging packet / metadata stream into an FEs native syntax. Depending on the application, it may be desirable to restrict the amount of metadata that is transmitted from the Messaging LFB in order to conserve bandwidth. The Messaging LFB allows the SAE to select which metadata elements are actually placed on the "wire" by the Messaging LFB.

The Messaging LFB supports one input port and one output port on both "sides" (ingress and egress) of the Messaging LFB. This allows for an instance of the Messaging LFB to support the formatting of packet and metadata in a bi-directional manner, if so desired. Whether or not an instance of the Messaging LFB supports bi-directional formatting is up to the implementer.

The implementation of the formatting function is out of scope for the Messaging LFB, as it will vary from vendor to vendor. Implementers of the Messaging LFB will determine the most appropriate place/method to implement it. The operation of the Messaging LFB (which consists of converting native metadata syntax to NPF Messaging syntax, and vice-versa) could be expressed as a compile time or initialization option, a portion of microcode, or native to the device (e.g. an ASIC that has been hard wired to comply with the NPF Messaging specification). Additionally, the Messaging LFB provides an optional "set" API function for devices that support manipulation of metadata during runtime. The Messaging LFB also provides an optional "get" API function, which allows for the retrieval of metadata syntax currently being used by the Messaging LFB (see Section 5.2).

The operation of the Messaging LFB allows the SAE to instantiate an instance of the NPF Messaging specification that is specific to a particular application. The SAE is the one that determines what metadata requires a standard format (NPF Messaging format) for transport within an application. How the SAE goes about instantiating the operation of the Messaging LFB will vary from physical device to physical device. In some instances (i.e. for an ASIC) the instantiation of the Messaging LFB operation occurs when the SAE decides to purchase ASIC X that supports NPF Messaging format Y. In other cases (i.e. for a programmable NPU) the SAE may instantiate the Messaging LFB operation via the optional "set" function provided by the LFB or by setting a compile time option.

In simple terms, the system integrator should insert a Messaging LFB whenever a standard syntactic representation of metadata is required between two LFBs. This is typically observed when two functional LFBs span two physical entities (FEs). If there is no need for two LFBs to pass metadata, or if it's acceptable for two LFBs to exchange metadata in their native format, then the Messaging LFB does not need to be inserted at that point in the Topology.

It should be noted that the Messaging LFB can act as a sink or source type of LFB. In other words, the Messaging LFB may be seen in an LFB topology without inputs, or without outputs, when it's modeled at the ends of the topology. The Messaging LFB may also be used in conjunction with a sink/source type LFB other than the Messaging LFB.

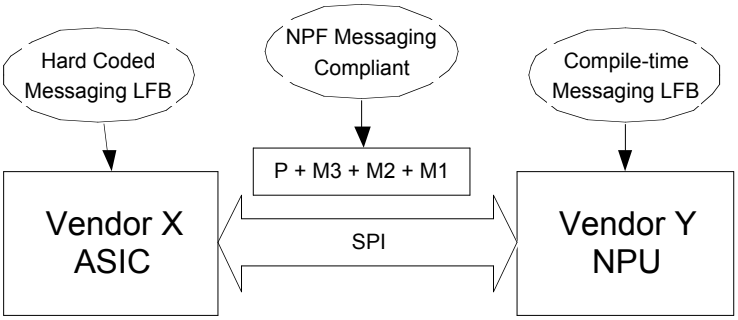


Figure 2 -- Two Messaging LFB examples

Figure 2 illustrates how two distinct vendors might go about implementing the Messaging LFB. Consider Vendor X to be an ASIC vendor who manually sorts through the NPF Messaging IA and determines how metadata produced by the ASIC should be formatted to comply with the specification. Once this determination has been made and burned into the ASIC, that ASIC will henceforth be NPF Messaging compliant. In order for Vendor Y's NPU to interoperate with the ASIC, the NPU code may need to be modified to expect the metadata syntax produced by the Vendor X ASIC. Alternatively, the NPU may support compile time options, and/or the Messaging LFBs "set" routine, which allow the system integrator to tell the NPU the metadata syntax to expect from the ASIC. Whatever the case, in this scenario the onus is on the NPU to adjust its syntactical representation of metadata to be able to interoperate with the hard-wired ASIC.

The Messaging LFB may optionally provide the capability of encoding/decoding different Messaging formats to frames sent and received by the LFB, based on a particular piece of metadata (e.g. apply Messaging format X for IPv4 packets and Messaging format Y for IPv6 packets). If the Messaging LFB supports encoding different Messaging formats to frames being sent out of the LFB, it must write the Messaging formats' profile ID into metadata sent with the frame. Similarly, a Messaging LFB that supports the ability to decode different Messaging formats, based on a piece of metadata, must be able to read a piece of metadata from the received frame and verify that the content matches the profile ID of one of it's configured Messaging formats. The ability to select which metadata element will be used in this process is a function of the LFBs API. The application, or SAE, will configure this functionality via the LFBs Set API function. If an instance of the Messaging LFB does not support these features, the relevant parameters of the API will be ignored.

The Messaging LFB supports the reception and transmission of any metadata elements specified by NPF LFB implementation agreements. Appendix A provides an sample header file which includes informative definitions of metadata elements. Normative definitions of metadata, however, are found among the various LFB implementation agreements defined by the NPF. Therefore, the implementer of the Messaging LFB will need to construct a header file that contains the appropriate list of normative metadata definitions, defined by NPF LFB implementation agreements, required by the application. The implementer may choose to use the header file in Appendix A as a basis for creating such a header file.

The following diagram provides a pictorial representation of the Messaging LFB.

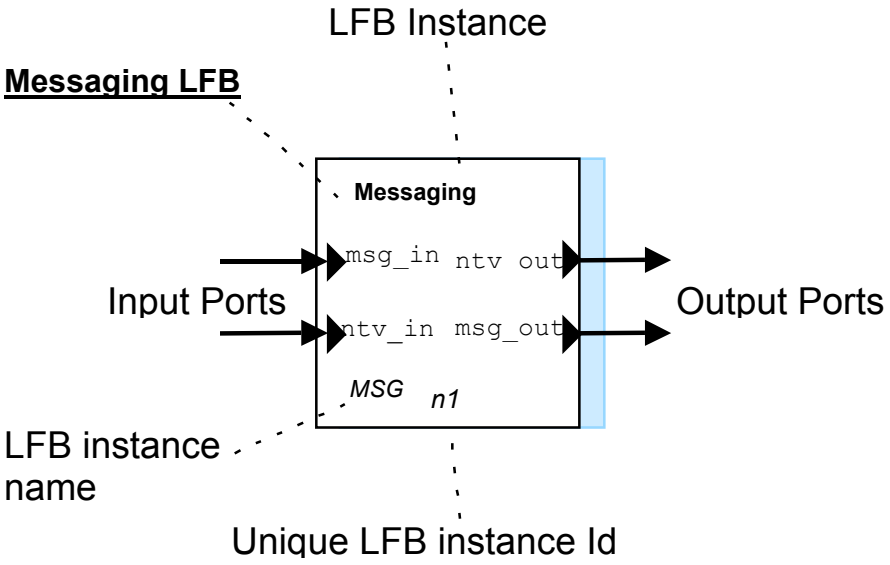


Figure 3 -- The Messaging LFB diagram

3.1 LFB Input Ports

The Messaging LFB supports two input ports which may be used to format received metadata from both sides (ingress and egress) of the LFB. One input port is used to receive a native metadata syntax which will be converted into an NPF Messaging compliant syntax. This input port is called `ntv_in`. The other input port is used to receive an NPF Messaging compliant metadata syntax that will be converted into a metadata syntax native to the underlying device. This input port is called `msg_in`.

3.1.1 Metadata Required

It is expected that the Messaging LFB will have access to all metadata generated, and not consumed, by the upstream LFBs that reside on the same physical entity (FE). However, it may not be necessary or expedient to transfer all metadata on the "wire". It should be noted that the user may prohibit the number of metadata elements that are transmitted on the "wire" via the use of the Messaging LFBs NPF_F_MSGSyntaxProfileSet API function. This function allows you to, essentially, construct the stream of metadata elements that will be transmitted out of the Messaging LFB. This capability allows for certain optimizations with respect to the amount of actual data transferred on the "wire".

If an instance of the Messaging LFB supports the ability to interpret different Messaging formats based on some piece of received metadata, it is expected that the application, or SAE, will be responsible for correlating which upstream metadata element will be used to select the Messaging format applied by the Messaging LFB. Once that determination is made, the application, or SAE, will communicate to the LFB which metadata element to look for via the LFBs API. The ability to interpret different Messaging formats only applies to frames coming into the "`msg_in`" port of the LFB.

3.2 LFB Output Ports

The Messaging LFB supports two output ports which may be used to output packet and metadata from both sides (ingress and egress) of the LFB. One output port is used to transmit a native metadata syntax that has been decoded from an NPF Messaging compliant syntax. This output port is called `ntv_out`. The other output port is used to transmit an NPF Messaging compliant metadata syntax that has been encoded from a metadata syntax native to the underlying device. This output port is called `msg_out`.

3.2.1 Metadata Produced

The Messaging LFB does not, in and of itself, create metadata. It simply passes through metadata it receives, altering only the syntactic representation of the metadata. The Messaging LFB does not alter the content of metadata that traverses through the LFB. The content of metadata passed in must be the same content passed out of the Messaging LFB. However, the Messaging LFB will alter the syntax of metadata so that it is NPF Messaging compliant. There are several syntactical elements that the Messaging LFB can alter.

- Location of a metadata element within the metadata stream
- Size of a metadata element

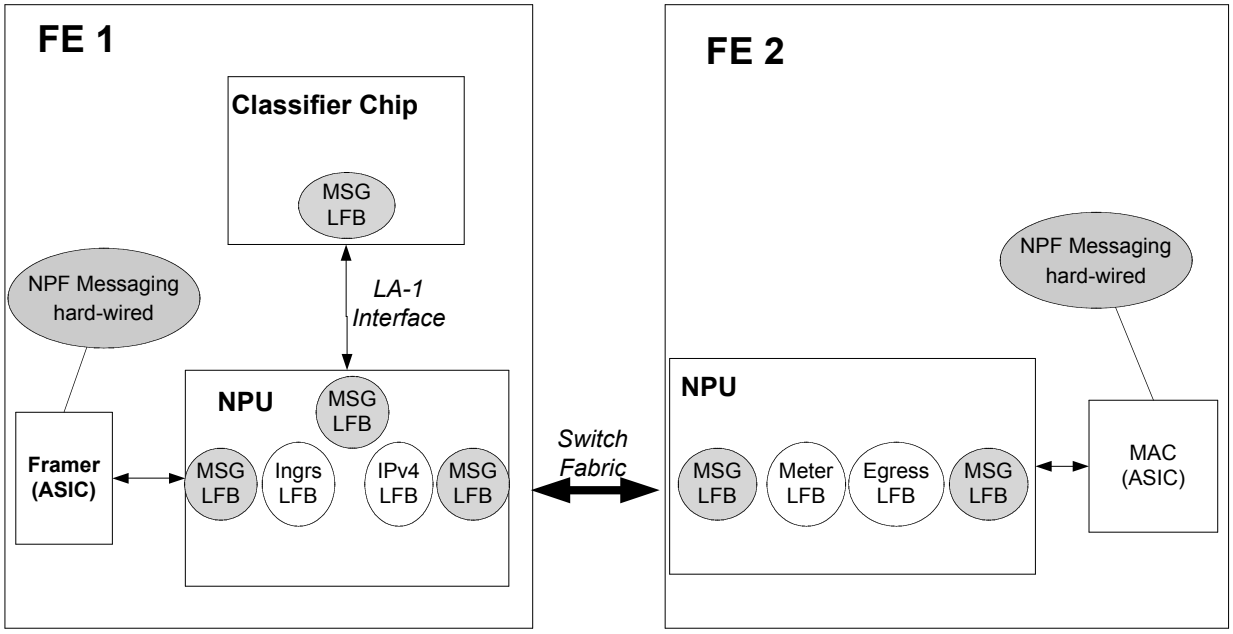
The Messaging LFB can modify these syntactic elements of metadata as long as those modifications do not change the content of the metadata (e.g. reduce the size of a metadata element to align with a byte granule without truncating any significant bits). In order to be compliant with NPF Messaging, the Messaging LFB must format all metadata elements, or at least verify compliance of all metadata elements.

If an instance of the Messaging LFB supports the ability to transmit frames using different Messaging formats, that instance must write a piece of metadata (configurable through the API) with the profile ID that is used to identify the Messaging format applied. Correlation of profile ID with Messaging format is a task for the application, and/or SAE. The ability to send frames of different Messaging formats only applies to frames being sent out on the "`msg_out`" port of the LFB.

It is important to note that the Messaging specification inherently contributes to the syntactic formatting of metadata. For instance, the Messaging specification defines a particular bit/byte order that should be adhered to. As such, not all syntactic attributes of metadata are controlled via the Messaging LFB. Only the attributes supported in the list above are controlled via the Messaging LFB.

3.3 Relationship with other LFBs

It is possible that the Messaging LFB will be seen in pairs in the forwarding plane. One Messaging LFB will be used for encoding metadata into the NPF Messaging format, while the other Messaging LFB will be used to decode the NPF Messaging compliant metadata. The Messaging LFB contains no intelligence with respect to the type of packet processing being done in the forwarding plane by other LFBs. The Messaging LFB is a transparent function, with respect to packet processing. Figure 4 presents a hypothetical example meant to illustrate various points in the forwarding plane where the Messaging LFB might be implemented.



**Assumption: ASICs in the diagram are NPF Messaging compliant*

Figure 4 -- How the Messaging LFB might be used

4 Data Types

The Messaging LFB exposes an optional API which requires a few specific data types, defined in the following sub-sections.

4.1 Common LFB Data Types

4.1.1 LFB Type Code

The LFB type code for the Messaging LFB shall be 14.

```
#define NPF_LFB_TYPE_MESSAGING                          14
```

4.1.2 Metadata enumeration

The implementation of the Messaging LFB will include a header file (.h file) which must include a typedef that is used to describe the metadata elements supported by the Messaging LFB instance. Appendix A provides an informative example of how the typedef might be specified. However, the normative definitions of metadata are contained in various NPF LFB implementation agreements. The Messaging LFB implementation must contain these normative definitions, and therefore the implementer must construct the metadata elements typedef out of the normative metadata definitions provided by the LFB implementation agreements. The typedef should be an enumeration of supported metadata elements by the Messaging LFB instance, and will be referenced by the metadata element structure defined in section 4.1.2.

```
typedef NPF_uint8_t NPF_F_Metadata_Id_t;
```

4.1.3 Metadata element structure

The metadata element structure defines the attributes of a metadata element relevant to the Messaging LFB. NOTE: The first element of this structure (meta_id) is of the type specified in Section 4.1.1, named here as NPF_F_Metadata_Id_t.

```
typedef struct {
    NPF_F_Metadata_Id_t meta_id;          /* Id of metadata */
    NPF_uint8_t meta_offset;              /* Location of metadata */
    NPF_uint8_t meta_size;                /* Size of metadata (bytes) */
    NPF_boolean_t meta_trailer;           /* Specifies whether the
                                           * metadata is contained in
                                           * the trailer part of the
                                           * PDU.  Otherwise, it is in
                                           * the header.
                                           */
} NPF_F_MetadataFormat_t;
```

4.1.4 Messaging Action

The Messaging action structure is used by the `NPF_F_MSGMetaSelectorSet` and `NPF_F_MSGMetaSelectorGet` functions. It specifies a read or write action.

```
typedef enum {
   NPF_MSG_READ = 0,
   NPF_MSG_WRITE = 1
} NPF_F_MSGAction_t;
```

4.1.5 Metadata Profile

The metadata profile structure is used to specify a list of metadata elements and the formatting of those elements. The structure also supports the optional feature of associating the Messaging format with a profile ID (`profile_id`). Instances of the Messaging LFB that support multiple Messaging formats will use the profile ID to distinguish between different Messaging formats configured in the LFB. The profile ID is also the value that a particular metadata must match in order for the Messaging format associated with the profile ID to be applied.

```
typedef struct {
    NPF_uint8_t             num_meta_elements;
    NPF_F_MetadataFormat_t  *meta_elements;
    NPF_uint8_t             profile_id;
} NPF_F_MSGMetaProfile_t;

typedef_struct {
    NPF_uint8_t               num_profiles;
    NPF_F_MSGMetaProfile_t    *profile;
} NPF_F_MSG_MetaProfileList_t;
```

4.2 Data Structures for Completion Callbacks

4.2.1 Asynchronous Response

```
typedef struct {
   NPF_F_MSGReturnCode_t            returnCode;
   union {
       NPF_F_MSGMetaProfile_t       metaProfile;
       NPF_F_Metadata_Id_t          meta_selector;
       NPF_F_MSG_MetaProfileList_t  profile_list;
   } u;
} NPF_F_MSGAsyncResponse_t;
```

4.2.2 Callback Type

The callback response will contain one of the following codes that indicates the function that triggered the callback.

```
typedef enum {
    NPF_F_MSG_SYNTAXPROFILE_SET = 1,
    NPF_F_MSG_SYNTAXPROFILE_GET = 2,
    NPF_F_MSG_SYNTAXALLPROFILES_GET = 3,
    NPF_F_MSG_METASELECTOR_SET = 4,
    NPF_F_MSG_METASELECTOR_GET = 5,
} NPF_F_MSGCallbackType_t;
```

Callback Type	Callback Data
NPF_F_MSG_SYNTAXPROFILE_SET	NPF_F_MSGMetaProfile_t
NPF_F_MSG_SYNTAXPROFILE_GET	NPF_F_MSGMetaProfile_t
NPF_F_MSG_METASELECTOR_SET	n/a
NPF_F_MSG_METASELECTOR_GET	NPF_F_Metadata_Id_t
NPF_F_MSG_SYNTAXALLPROFILES_GET	NPF_F_MSG_MetaProfileList_t

Figure 4 -- Mapping of Callback Type to Callback Data

4.2.3 Callback Data

```
typedef struct {
    NPF_F_MSGCallbackType_t         cbType;
    NPF_boolean_t                    allOk;
    NPF_uint32_t                     numResp;
    NPF_F_MSGAsyncResponse_t         *resp;
} NPF_F_MSGCallbackData_t;
```

4.3 Data Structures for Event Notifications

Not applicable.

4.4 Error Codes

A typedef is defined to capture error codes returned by Messaging LFB functions.

```
typedef NPF_uint32_t NPF_F_MSGReturnCode_t;
```

The following sub-sections provide a list of error codes that could be returned by the API.

4.4.1 Common NPF Error Codes

```
#define NPF_NO_ERROR
#define NPF_E_UNKNOWN
#define NPF_E_BAD_CALLBACK_HANDLE
#define NPF_E_BAD_CALLBACK_FUNCTION
#define NPF_E_CALLBACK_ALREADY_REGISTERED
```

4.4.2 Messaging LFB Specific Error Codes

```
#define NPF_MSG_ERR(n)      ((NPF_F_MSGReturnCode_t)NPF_MSG_ERR + (n))
#define NPF_E_MSG_META_NOT_SUPPORTED                NPF_MSG_ERR(0)
#define NPF_E_MSG_INVALID_META_ELEMENT              NPF_MSG_ERR(1)
#define NPF_E_MSG_BAD_FE_HANDLE                     NPF_MSG_ERR(2)
#define NPF_E_MSG_BAD_LFB_HANDLE                    NPF_MSG_ERR(3)
#define NPF_E_MSG_META_OVERWRITE                    NPF_MSG_ERR(4)
#define NPF_E_MSG_META_BAD_SIZE                     NPF_MSG_ERR(5)
#define NPF_E_MSG_META_ILLEGAL_OFFSET               NPF_MSG_ERR(6)
#define NPF_E_MSG_BAD_PROFILE_ID                     NPF_MSG_ERR(7)
#define NPF_E_MSG_NOT_SUPPORTED                      NPF_MSG_ERR(8)
#define NPF_E_MSG_INVALID_ACTION                     NPF_MSG_ERR(9)
#define NPF_E_MSG_NO_PROFILES_DEFINED                NPF_MSG_ERR(10)
```

5 Functional APIs (FAPIs)

5.1 Required APIs

The Messaging LFB does not define any required API functions.

5.2 Optional APIs

The Messaging LFB provides the following optional API functions:

- NPF_F_MSGRegister(): Allows the application to register a completion callback function with the Messaging FAPI implementation.
- NPF_F_MSGDeregister(): Allows the application to de-register the completion callback function with the Messaging FAPI implementation.
- NPF_F_MSGSyntaxProfileGet(): Returns a metadata syntax profile currently in use by the Messaging LFB.
- NPF_F_MSGSyntaxAllProfilesGet(): Returns all metadata syntax profiles currently configured in the Messaging LFB.
- NPF_F_MSGSyntaxProfileSet(): Allows for the configuration of a metadata syntax profile within the Messaging LFB.
- NPF_F_MSGMetaSelectorSet(): Used to tell the Messaging LFB which metadata element to read or write to determine how to encode or decode a Messaging format.
- NPF_F_MSGMetaSelectorGet(): Returns a numeric value that represents the metadata element the LFB is currently reading or writing.

5.2.1 Completion Callback Function

```
typedef void (*NPF_F_MSGCallBackFunc_t)(
                NPF_IN NPF_userContext_t userContext,
                NPF_IN NPF_correlator_t correlator,
                NPF_IN NPF_F_MSGCallbackData_t msgCallbackData);
```

5.2.1.1 Description

This callback function is used by the application to register an asynchronous response handling routine with the NPF Messaging Functional API implementation. This callback function is intended to be implemented by the application, and registered with the NPF Messaging Functional API implementation through the `NPF_F_MSGRegister( )` function.

5.2.1.2 Input Parameters

- userContext – The context item that was supplied by the application when the completion callback function was registered.
- correlator – The correlator item that was supplied by the application when the Messaging Functional API call was made. The correlator is used by the application mainly to distinguish between multiple invocations of the same function.
- msgCallbackData – Response information related to the Messaging functional API function call. This structure contains the syntactic details of the metadata used by the Messaging LFB. See Section 4.2 for more details.

5.2.1.3 Output Parameters

None.

5.2.1.4 Immediate Return Codes

None.

5.2.1.5 Callback Response

Not applicable.

5.2.1.6 Notes

None.

5.2.2 NPF_F_MSGRegister ()

```
NPF_error_t NPF_F_MSGRegister(
            NPF_IN NPF_userContext_t userContext,
            NPF_IN NPF_F_MSGCallBackFunc_t msgCallbackFunc,
            NPF_OUT NPF_callbackHandle_t *msgCallbackHandle);
```

5.2.2.1 Description

This function is used by an application to register its completion callback function for receiving asynchronous responses related to NPF Messaging FAPI function calls. The application may register multiple callback functions using this function. The callback function is identified by the pair of userContext and msgCallbackFunc, and for each individual pair, a unique msgCallbackHandle will be assigned for future reference. Since the callback function is identified by both userContext and msgCallbackFunc, duplicate registration of same callback function with different userContext is allowed. Also, the same userContext can be shared among different callback functions. Duplicate registration of the same userContext and msgCallbackFunc pair has no effect, and will output a handle that is already assigned to the pair, and will return `NPF_F_MSG_E_ALREADY_REGISTERED`.

Note : `NPF_F_MSGRegister( )` is a synchronous function and has no completion callback associated with it.

5.2.2.2 Input Parameters

- userContext – A context item used for uniquely identifying the context of the application registering the completion callback function. The exact value will be provided back to the registered completion callback function as its 1st parameter when it is called. The application can assign any value to the userContext and the value is completely opaque to the NPF Messaging functional API implementation.
- msgCallbackFunc – The pointer to the completion callback function to be registered.

5.2.2.3 Output Parameters

- msgCallbackHandle – A unique identifier assigned for the registered userContext and msgCallbackFunc pair. This handle will be used by the application to specify which callback function to be called when invoking asynchronous NPF Messaging FAPI functions. It will also be used when de-registering the userContext and msgCallbackFunc pair.

5.2.2.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_BAD_CALLBACK_FUNCTION:** msgCallbackFunc is NULL.

- **NPF_E_CALLBACK_ALREADY_REGISTERED:** No new registration was made since the userContext and msgCallbackFunc pair were already registered. Note: Whether this should be treated as an error or not is dependent on the application.

5.2.2.5 Callback Response

Not applicable.

5.2.2.6 Notes

None.

5.2.3 NPF_F_MSGDeregister()

```
NPF_error_t NPF_F_MSGDeregister(
            NPF_IN NPF_callbackHandle_t msgCallbackHandle);
```

5.2.3.1 Description

This function is used by an application to de-register a pair of user context and callback function.

Note: If there are any outstanding calls related to the de-registered callback function, the callback function may be called for those outstanding calls even after de-registration.

Note: `NPF_F_MSGDeregister( )` is a synchronous function and has no completion callback associated with it.

5.2.3.2 Input Parameters

- msgCallbackHandle – The unique identifier representing the pair of user context and callback function to be de-registered.

5.2.3.3 Output Parameters

None.

5.2.3.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_BAD_CALLBACK_HANDLE:** The API implementation does not recognize the callback handle. There is no effect to the registered callback functions.

5.2.3.5 Callback Response

Not applicable.

5.2.3.6 Notes

None.

5.2.4 NPF_F_MSGSyntaxProfileSet()

```
NPF_error_t NPF_F_MSGSyntaxProfileSet(
            NPF_IN NPF_callbackHandle_t         callbackHandle,
            NPF_IN NPF_correlator_t             correlator,
            NPF_IN NPF_errorReporting_t         errorReporting,
```

```
NPF_IN NPF_FEHandle_t                feHandle,
NPF_IN NPF_LFB_ID_t                  lfbId,
NPF_IN NPF_F_MSGMetaProfile_t        *metaProfile);
```

5.2.4.1 Description

This routine allows for the configuration of a metadata syntax profile of the Messaging LFB. The application passes in a list of metadata characteristics (passed in via `*metaProfile`) that should be used to alter the syntax of the current metadata stream produced / consumed by the Messaging LFB. The routine will return, via the completion callback function, a list of metadata characteristics which reflects what the implementation actually set.

By virtue of the metadata elements passed in via the `metaList` parameter, this function can restrict the number of metadata elements that are sent out on the "wire" by this LFB. If the user does not want a particular metadata element to be sent out, then that metadata element should not be specified in the `metaProfile` parameter.

If the application is using an instance of the Messaging LFB that supports multiple metadata syntax profiles, then a profile ID must be associated with the list of metadata elements. Both the profile ID and the metadata elements are contained within the metaProfile parameter. To change a profile that has already been configured, the user should call this function using the profile ID of the profile that is to be changed. Otherwise, if the profile ID does not match any of the profile IDs of the profiles that have already been configured, a new profile will be created.

5.2.4.2 Input Parameters

- **callbackHandle:** The unique identifier provided to the application when the completion callback routine was registered.
- **correlator:** A unique application invocation value that will be supplied to the asynchronous completion callback routine.
- **errorReporting:** An indication of whether the application desires to receive an asynchronous completion callback for this API function call.
- **feHandle:** The handle of the forwarding element in which the Messaging LFB is located.
- **lfbId:** The ID of the Messaging LFB.
- **metaProfile:** A pointer to the `NPF_F_MSGMetaProfile_t` structure which contains a profile Id, a list of metadata elements and their configurable attributes.

5.2.4.3 Output Parameters

None.

5.2.4.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_MSG_BAD_FE_HANDLE:** Returned if an invalid FE handle is passed into the routine.
- **NPF_E_MSG_BAD_LFB_HANDLE:** Returned if an invalid LFB handle is passed into the routine.

5.2.4.5 Callback Response

The callback response for this function will provide to the application the list of metadata elements (via the `NPF_F_MSGCallbackData_t` structure) that were successfully configured as specified, along with one of the return codes specified below. The application may use the returned structure to determine, in the event that the function failed, which metadata element(s) caused the problem.

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_MSG_META_NOT_SUPPORTED:** Returned if the underlying implementation does not support one, or more, of the metadata elements specified in `*metaList`.
- **NPF_E_MSG_INVALID_META_ELEMENT:** Returned if one of the attributes of a metadata element is can not be specified for that metadata.
- **NPF_E_MSG_META_OVERWRITE:** Returned if more then one metadata element has been specified to reside in the same offset location.
- **NPF_E_MSG_META_BAD_SIZE:** Returned if a particular metadata element can not be configured to be of the size specified.
- **NPF_E_MSG_META_ILLEGAL_OFFSET:** Returned if a particular metadata element can not be placed in the offset specified.
- **NPF_E_MSG_BAD_PROFILE_ID:** Returned if the profile ID passed in is invalid.

5.2.4.6 Notes

None.

5.2.5 NPF_F_MSGSyntaxProfileGet()

```
NPF_error_t NPF_F_MSGSyntaxProfileGet(
            NPF_IN NPF_callbackHandle_t    callbackHandle,
            NPF_IN NPF_correlator_t        correlator,
            NPF_IN NPF_errorReporting_t    errorReporting,
            NPF_IN NPF_FEHandle_t          feHandle,
            NPF_IN NPF_LFB_ID_t            lfbId,
            NPF_IN NPF_uint8_t            profileId);
```

5.2.5.1 Description

This routine returns, via a completion callback function, a metadata syntax profile currently accessible by the Messaging LFB. For instances of the Messaging LFB that do not support multiple Messaging syntax profiles, the `profileId` parameter is effectively ignored by the implementation of this function.

5.2.5.2 Input Parameters

- **callbackHandle:** The unique identifier provided to the application when the completion callback routine was registered.
- **correlator:** A unique application invocation value that will be supplied to the asynchronous completion callback routine.
- **errorReporting:** An indication of whether the application desires to receive an asynchronous completion callback for this API function call.
- **feHandle:** The handle of the forwarding element in which the Messaging LFB is located.
- **lfbId:** The ID of the Messaging LFB.
- **profileId:** The ID of the metadata syntax profile to be retrieved.

5.2.5.3 Output Parameters

None.

5.2.5.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.

- **NPF_E_MSG_BAD_FE_HANDLE:** Returned if an invalid FE handle is passed into the routine.
- **NPF_E_MSG_BAD_LFB_HANDLE:** Returned if an invalid LFB handle is passed into the routine.

5.2.5.5 Callback Response

The callback response for this function will provide to the application the list of metadata elements (via the `NPF_F_MSGCallbackData_t` structure) assigned to the specified profile ID. The return code field of the `NPF_F_MSGCallbackData_t` structure may contain one of two return codes:

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_MSG_BAD_PROFILE_ID:** Returned if the profile ID passed in does not match any of the currently configured profile IDs.
- **NPF_E_MSG_NO_PROFILES_DEFINED:** Returned if there are currently no metadata syntax profiles configured in the Messaging LFB.

5.2.5.6 Notes

None.

5.2.6 NPF_F_MSGSyntaxAllProfilesGet()

```
NPF_error_t NPF_F_MSGSyntaxAllProfilesGet(
            NPF_IN NPF_callbackHandle_t   callbackHandle,
            NPF_IN NPF_correlator_t       correlator,
            NPF_IN NPF_errorReporting_t   errorReporting,
            NPF_IN NPF_FEHandle_t         feHandle,
            NPF_IN NPF_LFB_ID_t           lfbId);
```

5.2.6.1 Description

This routine returns, via a completion callback function, all metadata syntax profiles currently configured in the Messaging LFB. For instances of the Messaging LFB that do not support multiple Messaging syntax profiles, this function will return a single profile (if configured).

5.2.6.2 Input Parameters

- **callbackHandle:** The unique identifier provided to the application when the completion callback routine was registered.
- **correlator:** A unique application invocation value that will be supplied to the asynchronous completion callback routine.
- **errorReporting:** An indication of whether the application desires to receive an asynchronous completion callback for this API function call.
- **feHandle:** The handle of the forwarding element in which the Messaging LFB is located.
- **lfbId:** The ID of the Messaging LFB.

5.2.6.3 Output Parameters

None.

5.2.6.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.

- **NPF_E_MSG_BAD_FE_HANDLE:** Returned if an invalid FE handle is passed into the routine.
- **NPF_E_MSG_BAD_LFB_HANDLE:** Returned if an invalid LFB handle is passed into the routine.

5.2.6.5 Callback Response

The callback response for this function will provide to the application the list of metadata elements (via the `NPF_F_MSGCallbackData_t` structure) assigned to the specified profile ID. The return code field of the `NPF_F_MSGCallbackData_t` structure may contain one of two return codes:

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_MSG_NO_PROFILES_DEFINED:** Returned if there are currently no metadata syntax profiles configured in the Messaging LFB.

5.2.6.6 Notes

None.

5.2.7 NPF_F_MSGMetaSelectorSet ()

```
NPF_error_t NPF_F_MSGMetaSelectorSet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_F_Metadata_Id_t       meta_selector,
            NPF_IN NPF_F_MSGAction_t         meta_action);
```

5.2.7.1 Description

This routine is used to tell the Messaging LFB which metadata element to read or write, in order to determine how to encode or decode a Messaging format. If the `meta_action` field is set for reading, this function will tell the LFB which metadata to read, on the "`msg_in`" port, in order to determine the Messaging format to apply to the incoming frame. If the `meta_action` field is set for writing, this function will tell the LFB which metadata to write, on the "`msg_out`" port, the profile ID of the Messaging format being applied to outgoing frames.

Note that the purpose of the metadata selector is to specify which metadata element the LFB should be looking for as a message (an NPF Messaging compliant frame, which contains packet and embedded metadata) comes into the LFB. The LFB will in turn read the contents of that piece of metadata and try to match it against one of the profile IDs configured in the LFB. If it finds a match, it applies the formatting of that profile to the message.

5.2.7.2 Input Parameters

- **callbackHandle:** The unique identifier provided to the application when the completion callback routine was registered.
- **correlator:** A unique application invocation value that will be supplied to the asynchronous completion callback routine.
- **errorReporting:** An indication of whether the application desires to receive an asynchronous completion callback for this API function call.
- **feHandle:** The handle of the forwarding element in which the Messaging LFB is located.
- **lfbId:** The ID of the Messaging LFB.

- **meta_selector:** A numeric value that represents the metadata element that the Messaging LFB needs to read or write.
- **meta_action:** Specifies whether the metadata selection applies to the reading of frames (frames coming in on port `MSG_IN`) or the writing of frames (frames going out on port `MSG_OUT`).

5.2.7.3 Output Parameters

None.

5.2.7.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_MSG_BAD_FE_HANDLE:** Returned if an invalid FE handle is passed into the routine.
- **NPF_E_MSG_BAD_LFB_HANDLE:** Returned if an invalid LFB handle is passed into the routine.
- **NPF_E_MSG_NOT_SUPPORTED:** Returned if the instance of the LFB does not support multiple Messaging formats.
- **NPF_E_MSG_INVALID_ACTION:** Returned if the action specified is invalid.

5.2.7.5 Callback Response

None.

5.2.7.6 Notes

This function is only used for instances of the Messaging LFB that support multiple Messaging formats.

5.2.8 NPF_F_MSGMetaSelectorGet ()

```
NPF_error_t NPF_F_MSGMetaSelectorGet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_F_MSGAction_t         meta_action);
```

5.2.8.1 Description

This routine returns a numeric value that represents the metadata element the LFB is currently reading or writing. If the `meta_action` field is set for reading, this function will return the metadata element that the LFB reads to determine the Messaging format to apply on incoming frames. If the `meta_action` field is set for writing, this function will return the metadata element that the LFB writes the profile ID to, for frames going out of port `MSG_OUT`.

Note that the purpose of the metadata selector is to specify which metadata element the LFB should be looking for as a message (an NPF Messaging compliant frame, which contains packet and embedded metadata) comes into the LFB. The LFB will in turn read the contents of that piece of metadata and try to match it against one of the profile IDs configured in the LFB. If it finds a match, it applies the formatting of that profile to the message.

5.2.8.2 Input Parameters

- **callbackHandle:** The unique identifier provided to the application when the completion callback routine was registered.
- **Correlator:** A unique application invocation value that will be supplied to the asynchronous completion callback routine.
- **errorReporting:** An indication of whether the application desires to receive an asynchronous completion callback for this API function call.
- **feHandle:** The handle of the forwarding element in which the Messaging LFB is located.
- **lfbId:** The ID of the Messaging LFB.
- **meta_action:** Specifies whether to return the metadata selector for the reading of frames (frames coming in on port `MSG_IN`) or the writing of frames (frames going out on port `MSG_OUT`).

5.2.8.3 Output Parameters

None.

5.2.8.4 Immediate Return Codes

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.
- **NPF_E_MSG_BAD_FE_HANDLE:** Returned if an invalid FE handle is passed into the routine.
- **NPF_E_MSG_BAD_LFB_HANDLE:** Returned if an invalid LFB handle is passed into the routine.
- **NPF_E_MSG_NOT_SUPPORTED:** Returned if the instance of the LFB does not support multiple Messaging formats.
- **NPF_E_MSG_INVALID_ACTION:** Returned if the action specified is invalid.

5.2.8.5 Callback Response

The callback response for this function will provide to the application the current metadata selector. The return code field of the `NPF_F_MSGCallbackData_t` structure may contain one of two return codes:

- **NPF_NO_ERROR:** Returned if no errors encountered by the function.
- **NPF_E_UNKNOWN:** Returned if the function encounters an error of unknown type.

5.2.8.6 Notes

This function is only used for instances of the Messaging LFB that support multiple Messaging formats.

6 References

[FORCESREQ] ”Requirements for Separation of IP Control and Forwarding”, H. Khosravi, T. Anderson et al, November 2003 (http://www.ietf.org/rfc/rfc3654.txt).

[SWAPICON] “Software API Conventions Revision 2” , Network Processing Forum SWAPI Foundations TG, September 2003 (http://www.npforum.org/techinfo/APIConventions2_IA.pdf).

[NPF_MSG] “NPF Messaging Layer Implementation Agreement”, Network Processing Forum Hardware TG, October, 2003 (http://www.npforum.org/techinfo/Messaging_IA.pdf).

[

APPENDIX A NPF_F_MSG.H

```
/*
 * This header file defines typedefs, constants, and structures
 * for the NP Forum Messaging Functional API
 */
#ifndef __NPF_F_MSG_H__
#define __NPF_F_MSG_H__

#ifdef __cplusplus
extern "C" {
#endif

/*
 * LFB Type code for the Messaging LFB
 */
#define NPF_LFB_TYPE_MESSAGING                                    14

/*
 *  Messaging LFB Error Codes
 */
typedef NPF_uint32_t NPF_F_MSGReturnCode_t;

#define NPF_MSG_ERR(n)      ((NPF_F_MSGReturnCode_t)NPF_MSG_ERR + (n))
#define NPF_E_MSG_META_NOT_SUPPORTED                NPF_MSG_ERR(0)
#define NPF_E_MSG_INVALID_META_ELEMENT              NPF_MSG_ERR(1)
#define NPF_E_MSG_BAD_FE_HANDLE                     NPF_MSG_ERR(2)
#define NPF_E_MSG_BAD_LFB_HANDLE                    NPF_MSG_ERR(3)
#define NPF_E_MSG_META_OVERWRITE                    NPF_MSG_ERR(4)
#define NPF_E_MSG_META_BAD_SIZE                     NPF_MSG_ERR(5)
#define NPF_E_MSG_META_ILLEGAL_OFFSET               NPF_MSG_ERR(6)
#define NPF_E_MSG_BAD_PROFILE_ID                     NPF_MSG_ERR(7)
#define NPF_E_MSG_NOT_SUPPORTED                      NPF_MSG_ERR(8)
#define NPF_E_MSG_INVALID_ACTION                     NPF_MSG_ERR(9)
#define NPF_E_MSG_NO_PROFILES_DEFINED                NPF_MSG_ERR(10)



/*
 * Messaging LFB Supported Metadata
 *
 * NOTE:  The enumeration below is an *informative* list of
 * metadata elements and is provided here for reference only.
 * Messaging LFB implementations should modify or replace this
 * typedef to reflect the normative metadata element definitions
 * found in NPF LFB implementation agreements.
 */
typedef enum {
    NPF_META_HEADER_TYPE = 0,           /* Type of header (i.e. IPv4,
                                         * IPv6, etc.)
                                         */
    NPF_META_TIMESTAMP = 1,             /* Specifies a system tick from
                                          * the transmitting NPE at
                                          * the time the packet was queued
                                          * for transmission.
                                         */
    NPF_META_SAP_ID = 2,                /* Specifies the application
                                         * endpoint of the message.
```

```
                                    */
NPF_META_CONTEXT_ID = 3,           /* Specifies the application-
                                    * endpoint-specific state of
                                    * the message.
                                    */
NPF_META_FORMAT_ID = 4,             /* Specifies which format to use
                                    * to parse the remaining
                                    * metadata string
                                    */
NPF_META_OFFSET = 5,               /* Specifies an offset, in bytes,
                                    * into the message payload.
                                    */
NPF_META_CRC_32 = 6,               /* Determines the integrity of all
                                    * bytes in the message up to the
                                    * integrity field, consistent
                                    * with ISO 3309.
                                    */
NPF_META_CKSUM_16 = 7,              /* Determines the integrity of all
                                    * bytes in the message up to the
                                    * integrity field, consistent
                                    * with RFC1071 and RFC1141.
                                    */
NPF_META_RX_STAT = 8,               /* Receive status flag (Unicast,
                                    * Broadcast, Multicast, etc.)
                                    */
NPF_META_PACKET_SIZE = 9,           /* Total packet size */
NPF_META_OUTPUT_PORT = 10,          /* Egress output port */
NPF_META_INPUT_PORT = 11,           /* Ingress input port */
NPF_META_FABRIC_PORT = 12,          /* Output port for fabric
                                     * indicating the blade ID
                                    */
NPF_META_FLOW_ID = 13,              /* QOS flow id or MPLS label/flow
                                     * id
                                     */
NPF_META_FLOW_QOS = 14,            /* Specifies the quality of
                                     * service associated with the
                                     * flow, as defined by the
                                     * application.
                                    */
NPF_META_FLOW_STATE = 15,          /* Determined by interoperating
                                     * vendors to meet the
                                     * requirements of the system
                                     * architecture
                                    */
NPF_META_NEXTHOP_ID = 16,           /* Next hop IP ID */
NPF_META_CLASS_ID = 17,             /* Class ID */
NPF_META_COLOR = 18,               /* Color */
NPF_META_NPE_TABLE = 19,           /* Specifies the "table" within
                                    * the NPE that the npe-operation
                                    * is targeting.
                                    */
NPF_META_NPE_REGISTER = 20,        /* Specifies the "register" within
                                    * the NPE that the npe-operation
                                    * is targeting.
                                    */
NPF_META_NPE_RECORD = 21,          /* Specifies the "record" within
                                    * an npe-table that the
                                     * npe-operation is targeting.
                                    */
```

```
    NPF_META_NPE_OPERATION = 22,        /* Specifies a common set of
                                         * operations that an NPE can
                                         * perform.
                                         */
    NPF_META_SEND_SEQUENCE = 23,        /* Specifies an incrementing
                                         * number of messages (starting
                                         * from 0), relative to the flow,
                                         * that has been generated
                                        * by the sending NPE.
                                        */
    NPF_META_ACK_SEQUENCE = 24,         /* Specifies the last Sequence
                                         * Number processed by the
                                         * receiving NPE relative to the
                                         * flow.
                                        */
    NPF_META_USER_ATTRIBUTE = 25,       /* Determined by interoperating
                                         * vendors to meet the
                                         * requirements of the system
                                         * architecture.
                                        */
    NPF_META_CHANNEL_ID = 26,           /* Channel ID */
    NPF_META_INGRESS_CHANNEL = 27,      /* Ingress Channel number */
    NPF_META_EGRESS_CHANNEL = 28,       /* Egress Channel number */
    NPF_META_END_META_LIST = 29         /* Always the last element of this
                                         * enumeration
                                         */

} NPF_F_Metadata_Id_t;

/* Messaging Callback Response Types */
typedef enum {
    NPF_F_MSG_SYNTAXPROFILE_SET = 1,
    NPF_F_MSG_SYNTAXPROFILE_GET = 2,
    NPF_F_MSG_SYNTAXALLPROFILES_GET = 3,
    NPF_F_MSG_METASELECTOR_SET = 4,
    NPF_F_MSG_METASELECTOR_GET = 5,
} NPF_F_MSGCallbackType_t;

/* Metadata element structure */
typedef struct {
   NPF_F_Metadata_Id_t meta_id;          /* Id of metadata */
   NPF_uint8_t meta_offset;              /* Location of metadata */
   NPF_uint8_t meta_size;                /* Size of metadata (bytes) */
   NPF_boolean_t meta_trailer;           /* Specifies whether the
                                          * metadata is contained in
                                          * the trailer part of the
                                          * PDU. Otherwise, it is
                                          * in the header.
                                          */
} NPF_F_MetadataFormat_t;

/* Messaging Action structure */
   typedef enum {
      NPF_MSG_READ = 0,
      NPF_MSG_WRITE = 1
} NPF_F_MSGAction_t;

/* Metadata Profile Sturcture */
typedef struct {
```

```
    NPF_uint8_t                    num_meta_elements;
    NPF_F_MetadataFormat_t        *meta_elements;
    NPF_uint8_t                    profile_id;
} NPF_F_MSGMetaProfile_t;

   /* Metadata profile list */
   typedef struct {
       NPF_uint8_t               num_profiles;
       NPF_F_MSGMetaProfile_t    *profile;
   } NPF_F_MSG_MetaProfileList_t;

/* Asynchronous Response */
typedef struct {
   NPF_F_MSGReturnCode_t             returnCode;
    union {
       NPF_F_MSGMetaProfile_t        metaProfile;
       NPF_F_Metadata_Id_t           meta_selector;
       NPF_F_MSG_MetaProfileList_t   profile_list;
    } u;
} NPF_F_MSGAsyncResponse_t;

/* Callback Data */
typedef struct {
    NPF_F_MSGCallbackType_t           cbType;
    NPF_boolean_t                     allOk;
    NPF_uint32_t                      numResp;
    NPF_F_MSGAsyncResponse_t          *resp;
} NPF_F_MSGCallbackData_t;


/* Function Prototypes */

/*
 *  Completion Callback Function
 */
typedef void (*NPF_F_MSGCallBackFunc_t)(
              NPF_IN NPF_userContext_t         userContext,
              NPF_IN NPF_correlator_t          correlator,
              NPF_IN NPF_F_MSGCallbackData_t   msgCallbackData);

/*
 *  Callback Registration Function
 */
NPF_error_t NPF_F_MSGRegister(
            NPF_IN NPF_userContext_t        userContext,
            NPF_IN NPF_F_MSGCallBackFunc_t  msgCallbackFunc,
            NPF_OUT NPF_callbackHandle_t    *msgCallbackHandle);

/*
 * Callback De-Registration Function
 */
NPF_error_t NPF_F_MSGDeregister(
            NPF_IN NPF_callbackHandle_t msgCallbackHandle);

/*
 * Messaging Syntax Set Function
 */
NPF_error_t NPF_F_MSGSyntaxProfileSet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
```

```
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_F_MSGMetaProfile_t    *metaProfile);

/*
 * Messging Syntax Get Function
 */
NPF_error_t NPF_F_MSGSyntaxProfileGet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_uint8_t               profileId);

/*
 *  Messaging Syntax Get All Function
 */
NPF_error_t NPF_F_MSGSyntaxAllProfilesGet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId);

/*
 *  Messaging Metadata Selector Set Function
 */
NPF_error_t NPF_F_MSGMetaSelectorSet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_F_Metadata_Id_t       meta_selector,
            NPF_IN NPF_F_MSGAction_t         meta_action);

/*
 *  Messaging Metadata Selector Get Function
 */
NPF_error_t NPF_F_MSGMetaSelectorGet(
            NPF_IN NPF_callbackHandle_t      callbackHandle,
            NPF_IN NPF_correlator_t          correlator,
            NPF_IN NPF_errorReporting_t      errorReporting,
            NPF_IN NPF_FEHandle_t            feHandle,
            NPF_IN NPF_LFB_ID_t              lfbId,
            NPF_IN NPF_F_MSGAction_t         meta_action);


#ifdef __cplusplus
}
#endif

#endif   /* __NPF_F_MSG_H__ */
```

APPENDIX B LIST OF COMPANIES BELONGING TO NPF DURING APPROVAL PROCESS

Agere Systems
Altera
AMCC
Analog Devices
Avici Systems
Cypress Semiconductor
Ericsson
Erlang Technologies
ETRI
EZChip
Flextronics
FutureSoft
HCL Technologies
Hifn
IBM
IDT
Intel
IP Fabrics
IP Infusion
ISIC Corporation
Kawasaki LSI
Motorola
NetLogic
Nokia
Nortel Networks
PMC Sierra
Silicon & Software Systems
Sun Microsystems
Teja Technologies
TranSwitch
U4EA Group
Xelerated
Xilinx
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