U.S. Department of Defense

High Level Architecture
Interface Specification (Portion Concerning DIF)

Version 1.3

2 April 1998
12. Federation execution data (FED)

12.1 FED data interchange format (FED DIF)

The high-level architecture FED data interchange format (DIF) is a standard file-exchange format that shall be used to store and transfer HLA FED files between multiple tools including object-model development tools (OMDTs) and RTIs.

12.1.1 BNF notation of the DIF

To ensure that there is no ambiguity in the definition of the DIF, the DIF is defined terms of Backus-Naur Form (BNF). BNF is a formal notation used to describe inductive specifications. Attributed to John Backus and Peter Naur, it was invented to describe the syntax of Algol 60 in an unambiguous manner. Since then it has become widely accepted and used by most authors of books on new programming languages to specify the syntax rules of the language.

Because no standard BNF notation exists, it is necessary to present the conventions for the notation used here. This document will use extended BNF (EBNF), which includes some additional constructs to handle iteration and alternation as described in the following sub-clauses.

12.1.1.1 BNF notation conventions

BNF has three major parts:
— Terminals, which require no further definition,
— Non-terminals, which are defined in terms of other non_terminals and terminals, and
— Productions which, for each non-terminal, precisely state how the non-terminal is constructed.

Certain symbols within the BNF shall have special meanings. These are be called meta-symbols, and they are used to structure the BNF. Double quotes, angle brackets, braces, etc., are meta-symbols within BNF, and their definition and use is given below.
— Words inside double quotes (“word”) shall represent literal words themselves (these shall be called terminals).
— Words contained within angle brackets ‘< >’ shall represent semantic categories (i.e. non-terminals) that shall be resolved by reading their definition elsewhere in the BNF. An example of a non-terminal is <NameCharacter>.
— A production (sometimes called a rule) shall be a statement of the definition of a non-terminal. It shall be designated by the production meta-symbol ´::=`’, which shall assign the definition to the right-hand side (RHS) of the production to the non-terminal on the left hand side (LHS) of the production symbol. The LHS shall always consist of a single non-terminal, while the RHS may consist of any combination of terminals and non-terminals. The symbol ´::=` shall be read as “…is defined to be…” or “…is composed of…”. An example of a production is:

```
<SpaceName> ::= <NameString>;
```

— Selection of one item for a given instance shall be designated by use of the vertical bar symbol ´|´. The symbol ´|´ shall be read as “…or…”.
— Each BNF statement shall be terminated by a semicolon (;).

12.1.1.2 EBNF notation conventions

— Terminals shall be represented using words inside double quotes. In addition, terminals shall be further highlighted using boldfaced text. An example of a terminal is “Federation”.

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The BNF used in this standard shall add a special case of non-terminal that shall be denoted by double brackets ‘<< >>’ rather than single angle brackets. A special case non-terminal shall be a reference to an item in the glossary found in clause 12.1.4, FED DIF glossary.

Optional Items shall be enclosed by square bracket meta-symbols ‘[ ’ and ‘ ]’. Square brackets shall indicate that the item exists either zero or one time; that is, it may or may not exist. An example of an optional item is [ <SpaceName> ], which indicates that the SpaceName item may or may not be present in the DIF.

Repetition (zero, one, or many) shall be performed by the curly brace meta-symbols ‘{ ’ and ‘ }’.

- Curly braces followed by a * character shall indicate that there are zero or more sequential instances of the item.
- Curly braces followed by a + character shall indicate that there shall be one or more sequential instances of the item.

The double period .. used within a literal shall be a shortcut notation for denoting the set of ASCII characters between the characters to either side of them. An example of this is “a..z”, which denotes the set of lowercase letters between ‘a’ and ‘z’ inclusive.

12.1.1.3 Basic BNF constructs

The following are a set of basic BNF constructs referenced in the main body of the DIF BNF definition. They are defined separately to make the main body more readable.

```
<NameString> ::= <Letter> {<NameCharacter>}*;
<NameCharacter> ::= <Letter> | <DecimalDigit> | "_" | "+" | "-" | "*" | "/" | "@" | "$" | "%" | "+" | "&" | "=" | "<" | ">" | "~" | "!" | ")";
<Letter> ::= "a..z" | "A..Z";
<DecimalDigit> ::= "0..9";
```

Figure 16—Basic BNF constructs

12.1.2 HLA FED DIF BNF definition

The following BNF productions shall define the HLA FED DIF.
<HLA-FED-DIF-v1.3> ::= "(FED " <Federation> <FEDversion> <Spaces> <ObjectClasses> <InteractionClasses> "")";

<Federation> ::= "(Federation " <<FEDname>> ")";
<FEDversion> ::= "(FEDversion " <<FEDDIFversionNumber>> ")";

<<FEDname>> ::= <NameString>;
<<FEDDIFversionNumber>> ::= "v1.3";

<Spaces> ::= "(spaces " {<Space>}* ")";
<Space> ::= "(space " <<SpaceName>> {<Dimension>}* ")";
<Dimension> ::= "(dimension " <<DimensionName>> ")";

<ObjectClasses> ::= "(objects "
   "(class ObjectRoot "
   "(attribute privilegeToDelete " <Transport> <Order> 
   [<<SpaceName>>] ")"
   "(class RTIprivate)"
   "(ObjectClass)* ")";
<ObjectClass> ::= "(class " <<ObjectClassName>> {<Attribute>}* {<ObjectClass>}* ")";

<Attribute> ::= "(attribute " <<AttributeName>> <Transport> <Order> 
   [<<SpaceName>>] ")";

<InteractionClasses> ::= "(interactions "
   "(class InteractionRoot " <Transport> <Order> [<<SpaceName>>]
   "(class RTIprivate)"
   "(InteractionClass)* ")";
<InteractionClass> ::= "(class " <<InteractionClassName>> <Transport> <Order> 
   [<<SpaceName>>] {<Parameter>}* {<InteractionClass>}* ")";

<Parameter> ::= "(parameter " "[ParameterName]"")";

<<SpaceName>> ::= <NameString>;
<<DimensionName>> ::= <NameString>;
<<ObjectClassName>> ::= <NameString>;
<<AttributeName>> ::= <NameString>;
<<InteractionClassName>> ::= <NameString>;
<<ParameterName>> ::= <NameString>;
<Transport> ::= <NameString>;
<Order> ::= <NameString>;

Figure 17—HLA FED DIF BNF definition
12.1.3 FED DIF meta-data consistency

The use of BNF cannot completely capture all of the rules that specify a complete and correct DIF file or object model. A FED DIF file shall comply with the following rules to be complete, consistent, and correct:

1. A comment shall be prefixed with two semicolons and terminated by \n (;; comment \n).
2. A comment may appear at the beginning of a line (on a line by itself).
3. A comment may appear at the end of a line following a FED element.
4. Wherever a literal space appears in the DIF definition, multiple spaces shall be valid.
5. One or more literal spaces shall be allowed between any parenthesis and the adjoining text.
6. Use of routing spaces shall optional.
7. Routing space names within a FED file shall be unique.
8. Dimension names within a single routing space shall be unique.
9. All names shall be case insensitive.
10. Object- and interaction-class names shall be unique where they share a common parent class. Class names may be reused across multiple branches or tiers of the class hierarchy, as long as no two sibling classes have the same name.
11. All MOM object and interaction classes along with their attributes and parameters shall be included in each FED DIF file.
12. All terminals in the BNF description and DIF files produced in accordance with this BNF description shall be considered to be case insensitive. For example, the literal “ObjectModel” and “OBJECTMODEL” shall be considered equivalent. Capitalization shall be used in the BNF strictly to enhance readability.

12.1.4 FED DIF glossary

This glossary shall define the terms used in the HLA FED DIF BNF definition to the corresponding concepts in the main body of the interface specification.

| AttributeName | The name of an object-class attribute. |
| DimensionName | The name of a routing-space dimension. |
| FEDDIFversionNumber | The identifier for a specific version of the FED DIF. |
| FEDname | The name of an HLA federation. |
| InteractionClassName | The name of an interaction class. |
| ObjectClassName | The name of an object class. |
| Order | The name of a type of message ordering. |
| ParameterName | The name of an interaction-class parameter. |
| SpaceName | The name of a routing space. |
| Transport | The name of a type of message transportation. |
12.2 Example FED file

Figure 18 depicts a complete FED file with particular emphasis on the MOM (MOM definitions are complete). Several liberties have been taken with the depiction:

— Aspects of the file that should be completed for a specific federation execution are in italics. This includes definition of space characteristics, specification of transportation and order type, and optionally space characteristic for each class attribute and interaction class. It also includes definition of extensions to the MOM object and interaction classes and specification of federation object and interaction classes.

— The x characters have been added to aid the user in associating subclasses with classes and attributes with classes.

Figure 18—FED file with MOM definitions

(FED
(Federation MOM)
(FEDversion v1.3)
(spaces
  Space definitions
 )
(objects
  x (class objectRoot
  x x (attribute privilegeToDelete transport order space)
  x x (class RTIprivate)
  x x (class Manager
  x x x (class Federate
  x x x (attribute FederateHandle transport order space)
  x x x (attribute FederateType transport order space)
  x x x (attribute FederateHost transport order space)
  x x x (attribute RTIversion transport order space)
  x x x (attribute FEDid transport order space)
  x x x (attribute TimeConstrained transport order space)
(attribute TimeRegulating  transport order space)

(attribute AsynchronousDelivery  transport order space)

(attribute FederateState  transport order space)

(attribute TimeManagerState  transport order space)

(attribute FederateTime  transport order space)

(attribute Lookahead  transport order space)

(attribute LBTS  transport order space)

(attribute MinNextEventTime  transport order space)

(attribute ROlength  transport order space)

(attribute TSOlength  transport order space)

(attribute ReflectionsReceived  transport order space)

(attribute UpdatesSent  transport order space)

(attribute InteractionsReceived  transport order space)

(attribute InteractionsSent  transport order space)

(attribute ObjectsOwned  transport order space)

(attribute ObjectsUpdated  transport order space)

(attribute ObjectsReflected  transport order space)

(class Federation

(attribute FederationName  transport order space)

(attribute FederatesInFederation  transport order space)

(attribute RTIversion  transport order space)

(attribute LastSaveName  transport order space)

(attribute LastSaveTime  transport order space)

(attribute NextSaveName  transport order space)

(attribute NextSaveTime  transport order space)

(MOM Object Class extension definitions)
(User Object Class definitions)

(interactions)

(class interactionRoot transport order space)

(class RTIprivate transport order space)

(class Manager transport order space)

(class Federate transport order space)

(parameter Federate)

(class Request transport order space)

(class RequestPublications transport order space)

(class RequestSubscriptions transport order space)

(class RequestObjectsOwned transport order space)

(class RequestObjectsUpdated transport order space)

(class RequestObjectsReflected transport order space)

(class RequestUpdatesSent transport order space)

(class RequestInteractionsSent transport order space)

(class RequestReflectionsReceived transport order space)

(class RequestInteractionsReceived transport order space)

(class RequestObjectInformation transport order space)

(parameter ObjectInstance)

(class Report transport order space)

(class ReportObjectPublication transport order space)

(parameter NumberOfClasses)
(parameter ObjectClass)

(class ReportInteractionPublication transport order space

(parameter InteractionClassList) )

(class ReportObjectSubscription transport order space

(parameter NumberOfClasses)

(parameter ObjectClass)

(parameter Active)

(parameter AttributeList) )

(class ReportInteractionSubscription transport order space

(parameter InteractionClassList) )

(class ReportObjectsOwned transport order space

(parameter ObjectCounts) )

(class ReportObjectsUpdated transport order space

(parameter ObjectCounts) )

(class ReportObjectsReflected transport order space

(parameter ObjectCounts) )

(class ReportUpdatesSent transport order space

(parameter TransportationType)

(parameter UpdateCounts) )

(class ReportReflectionsReceived transport order space

(parameter TransportationType)

(parameter ReflectCounts) )

(class ReportInteractionsSent transport order space

(parameter TransportationType)

(parameter InteractionCounts) )
(class ReportInteractionsReceived transport order space
  (parameter TransportationType)
  (parameter InteractionCounts) )
(class ReportObjectInformation transport order space
  (parameter ObjectInstance)
  (parameter OwnedAttributeList)
  (parameter RegisteredClass)
  (parameter KnownClass) )
(class Alert transport order space
  (parameter AlertSeverity)
  (parameter AlertDescription)
  (parameter AlertID) )
(class ReportServiceInvocation transport order space
  (parameter Service)
  (parameter Initiator)
  (parameter SuccessIndicator)
  (parameter SuppliedArgument1)
  (parameter SuppliedArgument2)
  (parameter SuppliedArgument3)
  (parameter SuppliedArgument4)
  (parameter SuppliedArgument5)
  (parameter ReturnedArgument)
  (parameter ExceptionDescription)
  (parameter ExceptionID) )
(class Adjust transport order space
(class SetTiming transport order space
  (parameter ReportPeriod) )

(class ModifyAttributeState transport order space
  (parameter ObjectInstance)
  (parameter Attribute)
  (parameter AttributeState) )

(class SetServiceReporting transport order space
  (parameter ReportingState) )

(class SetExceptionLogging transport order space
  (parameter LoggingState) )

(class Service transport order space
  (class ResignFederationExecution transport order space
    (parameter ResignAction) )
  (class SynchronizationPointAchieved transport order space
    (parameter Label) )
  (class FederateSaveBegun transport order space )
  (class FederateSaveComplete transport order space
    (parameter SuccessIndicator) )
  (class FederateRestoreComplete transport order space
    (parameter SuccessIndicator) )
  (class PublishObjectClass transport order space
    (parameter ObjectClass)
    (parameter AttributeList) )
  (class UnpublishObjectClass transport order space
    (parameter ObjectClass) )
)
x x x x (class PublishInteractionClass  transport order space
x x x x  (parameter InteractionClass) )

x x x x (class UnpublishInteractionClass  transport order space
x x x x  (parameter InteractionClass) )

x x x x (class SubscribeObjectClassAttributes  transport order space
x x x x  (parameter ObjectClass)

x x x x  (parameter AttributeList)

x x x x  (parameter Active) )

x x x x (class UnsubscribeObjectClass  transport order space
x x x x  (parameter ObjectClass) )

x x x x (class SubscribeInteractionClass  transport order space
x x x x  (parameter InteractionClass)

x x x x  (parameter Active) )

x x x x (class UnsubscribeInteractionClass  transport order space
x x x x  (parameter InteractionClass) )

x x x x (class DeleteObjectInstance  transport order space
x x x x  (parameter ObjectInstance)

x x x x  (parameter Tag)

x x x x  (parameter FederationTime) )

x x x x (class LocalDeleteObjectInstance  transport order space
x x x x  (parameter ObjectInstance) )

x x x x (class ChangeAttributeTransportationType  transport order space
x x x x  (parameter ObjectInstance)

x x x x  (parameter AttributeList)

x x x x  (parameter TransportationType) )

x x x x (class ChangeAttributeOrderType  transport order space
(parameter ObjectInstance)
(parameter AttributeList)
(parameter OrderingType)
(class ChangeInteractionTransportationType transport order space)
(parameter InteractionClass)
(parameter TransportationType)
(class ChangeInteractionOrderType transport order space)
(parameter InteractionClass)
(parameter OrderingType)
(class UnconditionalAttributeOwnershipDivestiture transport order space)
(parameter ObjectInstance)
(parameter AttributeList)
(class EnableTimeRegulation transport order space)
(parameter FederationTime)
(parameter Lookahead)
(class DisableTimeRegulation transport order space)
(class EnableTimeConstrained transport order space)
(class DisableTimeConstrained transport order space)
(class EnableAsynchronousDelivery transport order space)
(class DisableAsynchronousDelivery transport order space)
(class ModifyLookahead transport order space)
(parameter Lookahead)
(class TimeAdvanceRequest transport order space)
(parameter FederationTime)
(class TimeAdvanceRequestAvailable transport order space)
(parameter FederationTime)
x x x x x (class NextEventRequest transport order space
x x x x x (parameter FederationTime) )

x x x x x (class NextEventRequestAvailable transport order space
x x x x x (parameter FederationTime) )

x x x x x (class FlushQueueRequest transport order space
x x x x x (parameter FederationTime) )

x x x x )
x x x )
x x x ( MOM Interaction Class extension definitions )
x x )
( x ( User Interaction Class definitions )
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ANNEX E (informative)
Bibliography
