IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)—Federate Interface Specification

1516.1™

IEEE Computer Society

Sponsored by the
Simulation Interoperability Standards Organization/
Standards Activities Committee (SISO/SAC)

IEEE
3 Park Avenue
New York, NY 10016-5997, USA

18 August 2010

IEEE Std 1516.1™-2010
(Revision of
IEEE Std 1516.1-2000)

IEEE Std 1516.1™-2010
(Revision of
IEEE Std 1516.1-2000)

IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)— Federate Interface Specification

Sponsor

Simulation Interoperability Standards Organization/ Standards Activities Committee (SISO/SAC)
of the
IEEE Computer Society

Approved 25 March 2010

IEEE SA-Standards Board

Abstract: The High Level Architecture (HLA) has been developed to provide a common architecture for distributed modeling and simulation. The HLA defines an integrated approach that provides a common framework for the interconnection of interacting simulations. This document, the second in a family of three related HLA documents, defines the standard services of and interfaces to the HLA runtime infrastructure (RTI). These services are used by the interacting simulations to achieve a coordinated exchange of information when they participate in a distributed federation. The standards contained in this architecture are interrelated and need to be considered as a product set, when changes are made. They each have value independently.
Keywords: architecture, class attribute, data distribution management, federate, federation, federation execution, federation object model, HLA, instance attribute, instance attribute ownership, interaction class, object class, runtime infrastructure, simulation object model, time-constrained, time-regulating

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: ISBN 978-0-7381-6247-8 STD96059
Print: ISBN 978-0-7381-6248-5 STDPD96059

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information or soundness of any judgments contained in its standards.

Use of an IEEE Standard is wholly voluntary. The IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon this, or any other IEEE Standard document.

The IEEE does not warrant or represent the accuracy or content of the material contained herein, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained herein is free from patent infringement. IEEE Standards documents are supplied "**AS IS**."

The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation, or every ten years for stabilization. When a document is more than five years old and has not been reaffirmed, or more than ten years old and has not been stabilized, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

In publishing and making this document available, the IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity. Nor is the IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing this, and any other IEEE Standards document, should rely upon his or her independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration. A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal interpretation of the IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Recommendations to change the status of a stabilized standard should include a rationale as to why a revision or withdrawal is required. Comments and recommendations on standards, and requests for interpretations should be addressed to:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854
USA

Introduction

This introduction is not part of IEEE Std 1516.1-2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)—Federate Interface Specification.

This document has been developed to record an international standard for the High Level Architecture (HLA). It serves as one of three related standards for the HLA. It defines the services and interfaces to be used by federates when participating in a federation execution.

This new version of the IEEE 1516 HLA was produced in 2004 through 2007 by the HLA Evolved Product Development Group of the Simulation Interoperability Standards Organization (SISO). It incorporates a number of updates based on practical application of earlier versions of the standard. The purpose of the new version is to better support development, deployment, and net-centricity of distributed simulations.

Major new additions include support for Web Services communication, modular information models [federation object models (FOMs) and simulation object models (SOMs)], improved extensible markup language (XML) features (XML Schemata as well as extensibility), improved fault tolerance support, support for update rate reduction, and dynamic link compatibility between different implementations.

Notice to users

Laws and regulations

Users of these documents should consult all applicable laws and regulations. Compliance with the provisions of this standard does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

This document is copyrighted by the IEEE. It is made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

Updating of IEEE documents

Users of IEEE standards should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE Standards Association web site at http://ieeexplore.ieee.org/xpl/standards.jsp, or contact the IEEE at the address listed previously.

For more information about the IEEE Standards Association or the IEEE standards development process, visit the IEEE-SA web site at http://standards.ieee.org.

Errata

Errata, if any, for this and all other standards can be accessed at the following URL: http://standards.ieee.org/reading/ieee/updates/errata/index.html. Users are encouraged to check this URL for errata periodically.

Interpretations

Current interpretations can be accessed at the following URL: http://standards.ieee.org/reading/ieee/interp/index.html.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the HLA Evolved Working Group had the following membership:

Roy Scrudder, *Chair*
Randy Summers, *Vice Chair*
Björn Möller, *Vice Chair*
Katherine L. Morse, *Secretary*

Martin Adelantado
Bill Andrews
Fredrik Antelius
Joanne Atherton
Trevor Bakker
Shelby Barrett
Tolga Basturk
William Beavin
Emmet Baker
Alan Berry
Mark Bivens
David Brodoh
Jake Borah
Steve Boswell
Derrick Briscoe
Dominique Canazzi
Andy Ceranowicz
Tram Chase
Scott Clarke
David Coppler
Anthony Cramp
Dannie Cutts
Timothy Daigle
Bradford Dillman
Steven Dix
Hoang Doan
Uwe Dobrindt
David Drake
David Edmondson
Craig Eidman
Gary Eiserman
Gary England
Jason Esteve
James Evans
Robert Farraher
John Fay
Reginald Ford
Masakazu Furuichi
Michael Gagliano
Ralph Gibson
Edward Gordon
Len Granowetter
Jean-Baptiste Guillerit
Paul Gustavson
Per Gustavsson
Steve Hall
Fawzi Hassaine
Mark Hazen
William Helfinstine
Amy Henninger
Frank Hill
Jim Hollenbach
Torbjörn Hultén
Jean-Louis Igarza
Mark S. Johnson
Stephen Jones
Stephen Jones
Gunnar Karlsson
Mikael Karlsson
Rosemarie Keener
James Kogler
Jonathan Labin
Jennifer Lewis
Mike Lightner
Reed Little
Laurie Litwin
Staffan Löf
Björn Löfstrand
Paul Lowe

Franklin Lue
Robert Lutz
Farid Mamaghani
Lee Marden
Kim Marshall
Regis Mauget
James McCall
Michael McGarity
Sandy McPherson
Rob Minson
Mike Montgomery
Neil Morris
William Oates
Gunnar Ohlund
Mike Papay
Trevor Pearce
Mikel Petty
Tim Pokorny
Edward Powell
Laurent Prignac
Guillaume Radde
Peter Ross
Chris Rouget
Joseph Sardella
Geoff Sauerborn
John Schloman
Kevin Seavey
Graham Shanks
Petr Shlyaev
John Shockley
Pierre Siron
Keith Snively
Susan Solick
Joseph Steel
Steffen Strassburger
Marcy Stutzman
Jerry Szulinski
Martin Tapp
Gary Thomas
Andreas Tolk
Cam Tran
Ben Watrous
Marc Williams
Annette Wilson
Douglas Wood
Roger Wuerfel
Troy Yee
William Zimmerman

The working group acknowledges the following Interface Specification Drafting Group members who also contributed to the preparation of this standard:

Reed Little, *Editor*

Steve Boswell
Dannie Cutts
Len Granowetter
Mikael Karlsson
Jonathan Labin
Mike Lightner
Robert Lutz
Björn Möller
Katherine Morse
Trevor Pearce
Chris Rouget
Graham Shanks
Keith Snively
Ben Watrous
Annette Wilson
Douglas Wood
Roger Wuerfel

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

Ali Al Awazi
Bakul Banerjee
Steven Bezner
Jack Borah
Juan Carreon
Bertram Chase
Keith Chow
Tommy Cooper
Paul Croll
Dannie Cutts
Uwe Dobrindt
Sourav Dutta
Andre Fournier
Masakazu Furuichi
Len Granowetter
Randall Groves
Paul Gustavson
M. Hashmi
William Helfinstine
Roger A. Heunks
Frank Hill
Werner Hoelzl
James Ivers
Mikael Karlsson
Mark Knight
James E. Kogler
Jonathan Labin
Susan Land
Reed Little
Björn Löfstrand
William Lumpkins
G. Luri
Robert Lutz
Edward McCall
James McCall
Gary Michel
William Milam
Björn Möller
Katherine Morse
Thomas Mullins
Michael S. Newman
Miroslav Pavlovic
T. Pearce
Ulrich Pohl
Jonathan Prescott
Jose Puthenkulam
Robert Robinson
Michael Rush
Peter Ryan
Randall Safier
Geoffrey Sauerborn
Randy Saunders
Bartien Sayogo
John Schloman
Roy Scrudder
Keith Snively
Susan Solick
Joseph Stanco
Thomas Starai
Gerald Stueve
Marcy Stutzman
Thomas Tullia
Cam Van Tran
Annette Wilson
Douglas Wood
Paul Work
Roger Wuerfel
Oren Yuen
Janusz Zalewski

When the IEEE-SA Standards Board approved this standard on 25 March 2010, it had the following membership:

Robert M. Grow, *Chair*
Richard H. Hulett, *Vice Chair*
Steve M. Mills, *Past Chair*
Judith Gorman, *Secretary*

Karen Bartleson
Victor Berman
Ted Burse
Clint Chaplin
Andy Drozd
Alexander Gelman
Jim Hughes
Young Kyun Kim
Joseph L. Koepfinger*
John Kulick
David J. Law
Hung Ling
Oleg Logvinov
Ted Olsen
Ronald C. Petersen
Thomas Prevost
Jon Walter Rosdahl
Sam Sciacca
Mike Seavey
Curtis Siller
Don Wright

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Satish Aggarwal, *NRC Representative*
Richard DeBlasio, *DOE Representative*
Michael Janezic, *NIST Representative*

Lisa Perry
IEEE Standards Program Manager, Document Development

Michael D. Kipness
IEEE Standards Program Manager, Technical Program Development

Contents

[a] All RTI-initiated services are denoted with a † (printer's dagger) after the service name.

IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)—Federate Interface Specification

1. Overview

1.1 Scope

This document defines the interface between federates (simulations, supporting utilities, or interfaces to live systems) and the underlying software services that support interfederate communication in a distributed simulation domain.

1.2 Purpose

The High Level Architecture (HLA) has been developed to provide a common architecture for distributed modeling and simulation (M&S). To facilitate interfederate communications, HLA federates interact with an underlying software infrastructure. This specification defines the standard services and interfaces to be used by the federates to support efficient information exchange when participating in a distributed federation execution. (A federation execution occurs when sets of federates are brought together to support an objective.)