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**Information technology — Sharable
Content Object Reference Model
(SCORM®) 2004 3rd Edition —**

**Part 3:
Run-Time Environment Version 1.1**

*Technologies de l'information — Modèle de référence d'objet de
contenu partageable (SCORM®) 2004 3e édition —*

Partie 3: Environnement du temps d'exécution Version 1.1

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ISO/IEC TR 29163 consists of the following parts, under the general title *Information technology — Sharable Content Object Reference Model (SCORM[®]) 2004 3rd Edition*:

- *Part 1: Overview Version 1.1*
- *Part 2: Content Aggregation Model Version 1.1*
- *Part 3: Run-Time Environment Version 1.1*
- *Part 4: Sequencing and Navigation Version 1.1*

Advanced Distributed Learning (ADL)

SCORM® 2004 3rd Edition Run-Time Environment (RTE) Version 1.1

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SECTION 1

The SCORM® Run-Time Environment (RTE)

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1.1. Introduction to the SCORM Run-Time Environment (RTE) Book

The Sharable Content Object Reference Model (SCORM®) is often described as a set of books on a bookshelf. The Run-Time Environment (RTE) book is one of a set of books (refer to Figure 1.1a: *The Run-Time Environment Book as Part of the SCORM Bookshelf*). More information on the other SCORM books and their relationships to one another can be found in the SCORM 2004 Overview. The SCORM RTE book describes the Learning Management System (LMS) requirements in managing the run-time environment (i.e., content launch process, standardized communication between content and LMSs and standardized data model elements used for passing information relevant to the learner's experience with the content). The RTE book also covers the requirements of Sharable Content Objects (SCOs) and their use of a common Application Programming Interface (API) and the SCORM Run-Time Environment Data Model.

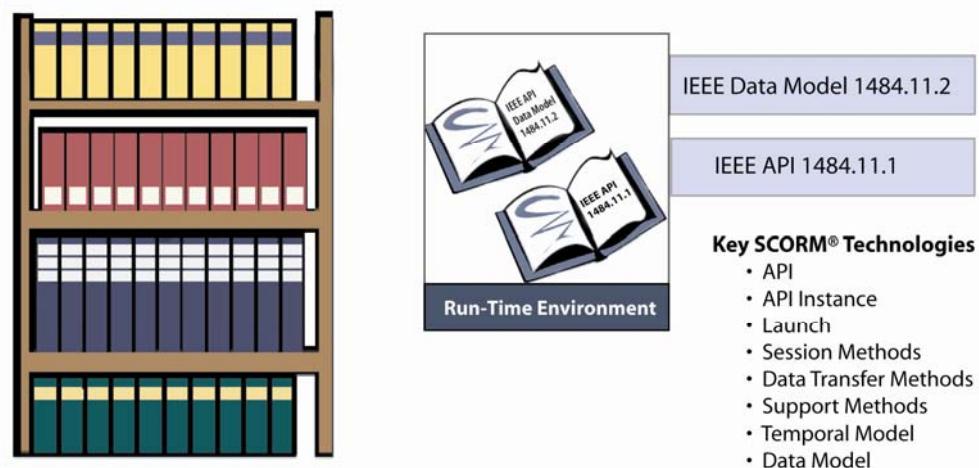


Figure 1.1a: *The SCORM Run-Time Environment Book as Part of the SCORM Bookshelf*

1.1.1. What is Covered in the SCORM RTE Book?

There are several key concepts that are introduced in the SCORM RTE book. The book covers the essential LMS responsibilities for sequencing content objects (SCOs or Assets) during run-time and allowing SCOs to indicate navigation requests. In addition, guidance is offered for providing navigation controls to learners. General subjects discussed include:

- RTE Management: Launching of content objects – SCOs and Assets, Management of communications with a SCO, Run-time environment data model management

- Application Programming Interface (API): LMS API requirements, SCORM communication requirements, communication error conditions
- SCORM Run-Time Environment Data Model: Data model management and behavior requirements, Data type requirements

1.1.2. Using the SCORM RTE Book

This book should prove useful to LMS, SCO and authoring tool vendors wishing to support SCORM in their products, and to anyone wishing to understand the communications relationship between content and LMSs, such as SCORM content developers.

Section 1: *The SCORM® Run-Time Environment (RTE)* and Section 2: *Managing the Run-Time Environment (RTE)* of this book cover general RTE-related concepts. These sections are recommended reading for those seeking an introduction to the concepts behind the SCORM RTE and who may not wish to delve into its technical details. Others who may find these sections useful include those wishing to learn about updates to the RTE. Section 2.1: *Run-Time Environment (RTE) Management*, for instance, discusses how the new Sequencing and Navigation book impacts the SCORM RTE.

Section 3: *Application Programming Interface (API)* is the first section providing technical details about the RTE. This section explains every SCORM API method and error message available to content developers, and even provides sample code as well as API Usage Requirements and Guidelines.

Section 4: *SCORM® Run-Time Environment Data Model* covers every SCORM data model element in detail, which includes a listing of specific LMS and SCO behavior requirements in relation to a given element.

1.1.3. Relationship with other SCORM Books

While the various SCORM books are intended to stand alone, there are areas of overlap or mutual coverage. For instance, while this book focuses primarily on communication between learning content and LMSs, it frequently refers to SCOs that conduct that communication. SCOs are discussed in some detail in the SCORM Content Aggregation Model (CAM) book.

Similarly, while the SCORM Sequencing and Navigation (SN) book covers the details of SCORM sequencing and navigation processes, including detailed coverage of how an LMS evaluates navigation requests and related activities, this book deals with content delivery, and as such, lightly touches on how an LMS determines which piece of content to deliver at any given time.

1.1.3.1 The SCORM Content Aggregation Model (CAM) Book

The SCORM CAM book [18] defines responsibilities and requirements for building content aggregations (i.e., the process of assembling, labeling and packaging content). The book contains information on creating content packages, applying metadata to the components in the content package and applying sequencing and navigation details in the context of a content package. Several dependencies span from the SCORM CAM book to the SCORM RTE book.

Metadata is “data about data”. Metadata can be used to describe the different components of the SCORM content model (Content Aggregations, Content Organizations, Activities, SCOs and Assets). Metadata, a form of labeling, enhances search and discovery of these components. At this time, there are no defined relationships between metadata and the SCORM Run-Time Environment Data Model. For these reasons, metadata is not discussed in detail in the SCORM RTE book. This relationship may change as SCORM evolves.

A *Content Package*, in a general sense, bundles content objects with a content structure that is described by a manifest. A SCORM Content Package may represent a SCORM course, lesson, module or may simply be a collection of related content objects that may be stored in a repository. The manifest, an essential part of all SCORM Content Packages, is contained in an Extensible Markup Language (XML)-based file named `imsmanifest.xml`. This file, similar in many ways to a “packaging slip”, describes the contents of the package and may include an optional description of the content structure.

SCORM Content Packages may include additional information that describes how an LMS is intended to process the Content Package and its contents. Some of these elements are utilized by the SCORM RTE model.

- Content object launch locations and launch parameters are also described as elements in a SCORM Content Package. These elements are essential to the launch and delivery of content objects. The SCORM RTE book details these elements and their effects on launching content objects.
- Several elements in a SCORM Content Package affect initialization and management of a content object’s run-time data model. The SCORM RTE book details these data model elements and the required LMS behaviors.
- Other elements in a SCORM Content Package describe initial values for specific elements of a content object’s run-time data model. The SCORM RTE book details these data model elements and their initialization behavior.
- When a SCORM Content Package includes a description of content structure, sequencing information elements may be added to define an intended approach to sequencing the package’s content objects. A SCORM Content Package may include User Interface (UI) elements that are intended to provide guidance to an LMS on how certain UI navigation controls are to present, enabled or hidden. When a content object is launched, as defined in this book, these elements may be used, in conjunction with sequencing information (refer to the SCORM SN book), to present the correct (at the time of rendering) UI navigation controls (e.g., “Continue” or “Previous” user interface controls).

For a better understanding of how all of the elements described above are specified in a SCORM Content Package, refer to the SCORM CAM book.

1.1.3.2 The SCORM Sequencing and Navigation (SN) Book

The SCORM SN book is based on the IMS Simple Sequencing (SS) Specification [17], which defines a method for representing the intended behavior of an authored learning experience such that any SCORM conformant LMS will sequence discrete learning activities consistently.

The SCORM SN model defines how the IMS SS specification is applied and it is extended in a SCORM environment. It defines the required behaviors and functionality that SCORM conformant LMSs must implement to process sequencing information at run-time. More specifically, it describes the branching and flow of learning activities in terms of an Activity Tree, based on the results of a learner's interactions with launched content objects and an authored sequencing strategy. An Activity Tree is a conceptual structure of learning activities managed by the LMS for each learner.

The SCORM SN book describes how learner- and system-initiated navigation events can be triggered and processed, resulting in the identification of learning activities for delivery. Each learning activity identified for delivery will have an associated content object. The SCORM RTE model describes how identified content objects are launched. The sequence of launched content objects, for a given learner and content structure, provides a learning experience (learner interaction with content objects); the SCORM RTE Model describes how the LMS manages the resulting learning experience and how that learning experience may affect the Activity Tree.

1.2. Run-Time Environment Overview

This book defines the SCORM RTE model, which details the requirements for launching content objects, establishing communication between LMSs and SCOs, and managing the tracking information that can be communicated between SCOs and LMSs. In the context of SCORM, content objects are either:

- SCOs, which communicate during run-time, or
- Assets, which do not communicate during run-time.

The SCORM RTE book describes a common content object launch mechanism, a common communication mechanism between content objects and LMSs, and a common data model for tracking a learner's experience with content objects. These aspects create an environment where several of the ADL “-ilities” are satisfied. For example, content objects that communicate through the standardized communication mechanism can be moved from LMS to LMS without modification to their communication attempts; this increases learning object portability and durability, thereby lowering the cost of development, installation and maintenance.

The SCORM RTE defines a model that picks up at the point when a specific content object has been identified for launch. The actual identification of the content object to be launched is out of scope of this book and can be found in the SCORM SN book [11].

This book only deals with the management of the run-time environment, which includes:

- The delivery of a content object to the learner's Web browser (i.e., launch);
- If necessary, how a content object communicates with the LMS; and
- What information is tracked for a content object and how the LMS manages that information.

The following sections explain the relationships between the SCORM RTE book and the remaining SCORM books. In addition, frequently used terminology will be introduced at a high level to eliminate the need for the reader to become an expert in the entire SCORM to understand this book. This, however, is not an effective method to learn and apply SCORM and its concepts as a whole. It is strongly recommended that each SCORM book be read to more fully understand the purpose, details, relationships and advantages of all of the SCORM concepts.

SCORM was developed to enable the development of content objects that are reusable and interoperable across multiple LMSs. For this to be possible, there must be a common way to launch and manage content objects, a common mechanism for content objects to communicate with an LMS and a predefined language or vocabulary forming the basis of the communication. As illustrated in Figure 1.2a, these three aspects of the RTE are Launch, API and Data Model.

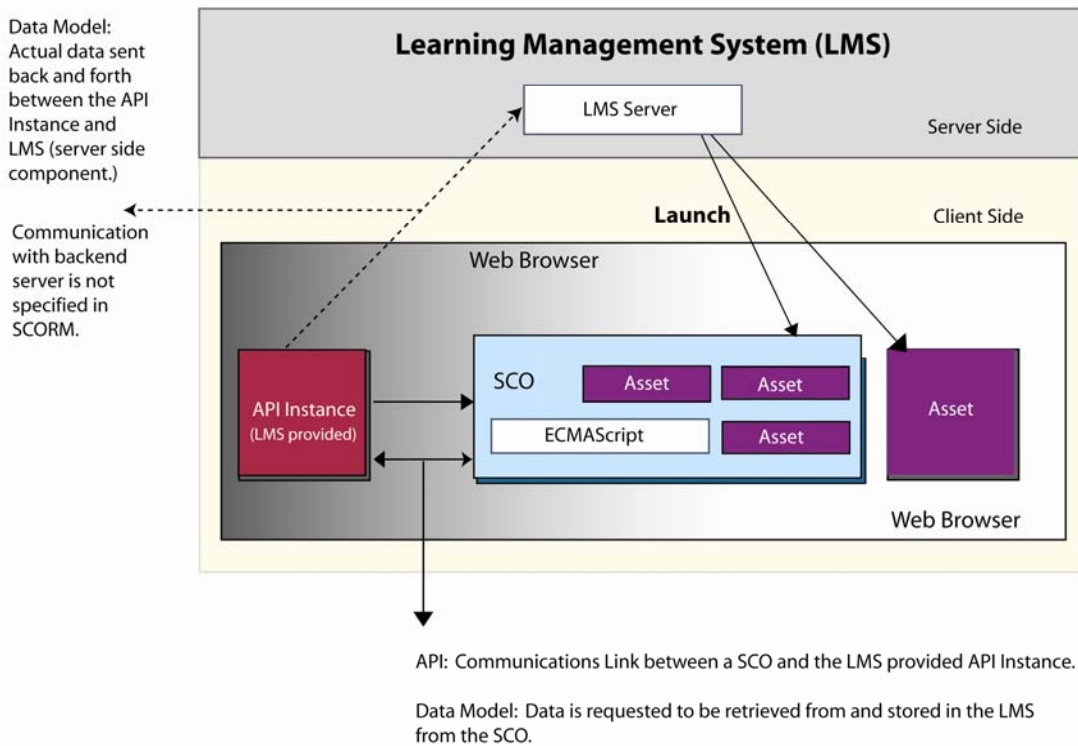


Figure 1.2a: SCORM Conceptual Run-Time Environment.

The *Launch* process defines a common way for LMSs to start Web-based content objects. The term “content object” is used generically here to describe any piece of content that can be launched for a learner. In SCORM, there are two types of content objects: SCOs and Assets. The launch process defines procedures and responsibilities for the establishment of communication between the launched content object and the LMS. The communication mechanism is standardized with a common API.

The *API* is the communication mechanism for informing the LMS of the conceptual communication state between a content object and an LMS (e.g., initialized, terminated and/or in an error condition), and is used for retrieving and storing data (e.g., score, time limits, etc.) between the LMS and the SCO.

A *Data Model* is a standard set of data model elements used to define the information being tracked for a SCO, such as the SCO’s completion status or a score from an assessment such as a quiz or a test. In its simplest form, the data model defines data model elements that both the LMS and SCO are expected to “know about.” The LMS must maintain the state of SCO’s data model elements across learner sessions, and the SCO must utilize only these predefined data model elements to ensure reuse across multiple systems.