
Information technology — Learning, education and training — Learning environment components for automated contents adaptation

Technologies de l'information — Apprentissage, éducation et formation — Composantes d'un milieu propice à l'apprentissage pour l'adaptation des contenus automatisée



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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Mobile learning is a term used to describe education conducted via digital learning environments where mobile devices are used. It is an evolved form of education that exploits the functionality and convenience provided via computers and the Internet. Mobile learning allows students to participate in classes via various devices regardless of the student's location, free from traditional time constraints while engaged in daily life. Providing content optimized for the student is the most important element of mobile learning, however, there is an exponentially increasing amount of customized educational content, often with the same context available. This content is increasingly created and shared in mobile learning environments that need to support many different device types. Content providers should be aware of various characteristics of user devices and learning environments so that they can provide optimized content. In order to select content meeting the requirements of both the end users' devices and the learning environment, profile data and metadata that describes the characteristics of those devices and learning environments is used.

This document describes a learning environment profile to support the establishment of mobile learning environments and defines a standard set of terms used to express device information and learning environments for mobile learning. It aims to energize a mobile learning market that is tailored to meet individual student's needs by allowing them to receive recommendations on, and use suitable content for, both their devices and learning environments.

This document contains two methods:

- The profile expression method is a technical method of displaying device information language that includes definitions of schema and vocabulary.
- The profile grouping method is a technical method of grouping and displaying terminal information language that includes a group profile example.

The standards herein express basic information needed to function successfully across different devices and environments. These standards will help establish a foundation for successful delivery of mobile learning.

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Information technology — Learning, education and training — Learning environment components for automated contents adaptation

1 Scope

This document specifies two methods for adaptive content automation. Firstly, a learning environment profile for the expression of device and learning environment information required for mobile learning providers of both content and services, and for effective use of such services. Secondly, a grouping method is specified so that similar learning environment profiles can be bound into one and expressed collectively.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

attribute

item that describes data elements that a resource description framework (RDF) contains

Note 1 to entry: Each attribute is related to a value or resource.

3.2

component

element that classifies *CPI* (3.3) at a high level

EXAMPLE UAProf, HardwarePlatform, SoftwarePlatform, NetworkCharacteristics, WAPCharacteristics, and BrowserUA, CommonCharacteristics, HardwarePlatform, SoftwarePlatform, NetworkCharacteristics, UserAgent and UsageEnvironment.

3.3

CPI

capabilities and preference information

item that contains the function of device, operation and network environments, student information, etc.

3.4

profile

instance by *schema* (3.8) that has all *attributes* (3.1) of a device, network and learning environment

Note 1 to entry: This profile will have all vocabularies available in the *schema* (3.1).

3.5 profile repository

repository where the *profiles* ([3.4](#)) are collected and stored

Note 1 to entry: A profile is usually saved in a resource description framework (RDF) file.

3.6 property

characteristic expressing the capability of the resource

Note 1 to entry: Resources may have many properties.

3.7 resource

objective or element expressed in RDF format

Note 1 to entry: Resource description framework (RDF) resource is usually expressed in uniform resource identifier (URI).

3.8 schema

RDF format *vocabulary* ([3.11](#)) created to express the *resource* ([3.7](#))

Note 1 to entry: Schema contains only meaning (structural) information of REF data model, and does not have any values.

3.9 user

individual (student or teacher) or a group that acts as an individual

Note 1 to entry: A user will authenticate his or her identity in order to access resources or content from the server.

3.10 user agent

browser or program that operates in *users'* ([3.9](#)) devices

Note 1 to entry: In the mobile learning environment, user may express *CPI* ([3.3](#)) anywhere, anytime, by using various user agents.

3.11 vocabulary

set of terms used to express *CPI* ([3.3](#))

Note 1 to entry: Vocabulary is related to *schema* ([3.8](#)).

Note 2 to entry: Profile vocabulary for mobile learning devices include device functions and network characteristics.

4 Learning environment profile

4.1 Components

4.1.1 Common characteristics (CommonCharacteristics)

A set of common attributes related to users' devices. Each device has, common attributes (the attributes commonly needed to select a content), such as character set, language, local time, supported content type, etc.

4.1.2 Hardware platform (HardwarePlatform)

A set of hardware attributes related to the users' devices. Devices use various hardware and support various functions. To accommodate such variety, Hardware will describe functions that can be supported according to the characteristics of hardware unique to the device. Hardware platform includes type of device, kind of model, etc.

4.1.3 Software platform (SoftwarePlatform)

Software platform describes the software components supported by the device. Software platform includes functions the installed operating system supports and other characteristics such as supported video and audio formats, etc.

4.1.4 Network characteristics (NetworkCharacteristics)

A set of attributes related to network a user uses. A user using a device may use various networks, and depending on the characteristics of network, availability of functions may be limited. Network characteristics include mobile phone number, information on the network connected to and communication protocol.

4.1.5 User agent (UserAgent)

A set of attributes related to HTML (Hyper-Text Markup Language) browser application. There are many browsers, such as Internet Explorer, Firefox, Google Chrome, etc. Each browser may support different functions. User agent includes type of browser and whether ActiveX, Java applet and Java script are supported.

4.1.6 Usage environment (UsageEnvironment)

A set of attributes related to current circumstances of users. A user's circumstances may change at any time. Usage environment includes location, prior knowledge level, education target, schedule, etc. of a user.

4.2 Attribute

An attribute can be included in only one schema and will be defined using a format where a name is paired with a value. Description of RDF attribute will be unique to a meaning and a value, and will never be ambiguous.

Attribute description within RDF component description block will be a vocabulary or RDF resource included to express a value in advance. The RDF resource uses indirect remote reference or remote reference, such as URI.

In case of an attribute with complex or multiple values, attribute will be described by the RDF resource. For example, basic attribute points at attribute collection. Thus, it will be described as URI resource. Similarly, RDF container (Bag or Sequence) will be used to describe aligned or unaligned lists of values connected to a given attribute.

4.3 Resolution rule

An attribute value may have multiple descriptions. In such cases, the following applies:

- First, apply the attribute description associated with the default tag.
- Thereafter, apply any supplied attribute descriptions. The default attribute description will be overridden. However, where there are multiple attribute descriptions outside default description block, the following will apply: The final attribute value is determined by resolution rule of applicable attribute. There are three types of resolution rules – Append, Locked and Override:
 - Append: a list of all attributes forms the final value.

- Locked: the first attribute value determines the final value.
- Override: the final attribute value determines the final value.

4.4 Data type

Data type designates form of value that an attribute can take. The attribute may be one of the following: numeric value, binary value, literal string value or dimension value. The data type determines range and form that the attribute can have.

- 1) Number: numeric value. It means that the value can be in a positive integer, such as 1 or 28. The regular expression of a value that a number can take is as follows:

`[0-9]+`

- 2) Boolean: binary value. It has only two values, such as yes and no. The regular expression of a value that a Boolean can take is as follows:

`Yes|No`

- 3) Dimension: dimension value. It has dimension value that will be expressed in two or three dimensions. It means that the dimension may have a value, such as "960x640." The regular expression of value that dimension can take is as follows:

`[0-9]+x[0-9]+`

- 4) Literal: literal (character) string value. It has character string value composed of alphabets, numbers, "\", "-", and "_". It means that dimension value may have a value, such as "SamPle_2010". The regular expression of value that literal can take is as follows:

`[A-Za-z0-9/_-]+`

4.5 Learning environment profiles

4.5.1 Common characteristics

Attribute	Description	Resolution Rule	Data Type	Example
ApplicationProtocol	Application level protocol supported by user agent.	Append	Literal (Bag)	"HTTP", "FTP"
CharacterSet	Available character set.	Append	Literal (Bag)	"US-ASCII", "ISO 8859-1", "UTF-8", "Shift_JIS"
ContentType	MIME media type, sub-type and factors that can be replayed.	Append	Literal (Bag)	"image/gif", "text/xml", "video/mpeg"
InputModality	Method of supporting data entry.	Override	Literal (Bag)	"Camera", "Keyboard", "Microphone", "TactileDisplay"

Language	Language being used.	Override	Literal	"English", "Korean"
ModelName	Name of device model.	Locked	Literal	"iPhone3GS", "GalaxyS"
OutputModality	Method of supporting data output.	Override	Literal (Bag)	"3DDisplay", "CharacterDisplay", "Graphic Display", "Speaker", "TactileDisplay"
SoundMode	Method of device making a sound.	Override	Literal	"Earphone", "Speaker"
TimeZone	Local time.	Override	Literal	"Pacific Standard Time", "Korea Standard Time"
Vendor	Device manufacturer.	Locked	Literal	"Apple", "Samsung"

4.5.2 Hardware platform

Attribute	Description	Resolution Rule	Data Type	Example
activeBluetoothProfile	Currently used Bluetooth profile.	Override	Literal	"Head Set"
Battery	Percentage of available battery capacity.	Override	Literal	"5", "100"
BluetoothProfiles	Type of Bluetooth profile supported by the device.	Append	Literal (Bag)	"Head Set", "File Transfer", "Generic Object Exchange"
BluetoothVersion	Version of Bluetooth profile supported by the device.	Locked	Literal	"1.0", "2.0", "3.0"
Camera	Whether a camera is available.	Locked		"Yes", "No"
CPU	Name and model number of CPU.	Locked	Literal	"Pentium III", "PowerPC 750"
GyroSensor	Whether a gyro sensor that senses current direction, angle and movement of device is available.	Locked		"Yes", "No"
Keyboard	Type of keyboard.	Override	Literal	"Numeric", "Phone", "QWERTY"
LocationSensor	Type of location sensor.	Locked	Literal	"GPS", "RFID"
MemoryUnit	Type of memory device can use.	Append	Literal	"Built-in", "SDHC"
Microphone	Whether audio can be input (recorded).	Locked		"Yes", "No"
ScreenColor	Number of colors that can be displayed.	Override	Literal	"256", "1024"
ScreenSize	Information on the terminal's screen size in terms of pixels.	Locked	Dimension	"0x0", "160x160", "640x480"
SensorType	Type of sensors installed and whether they are operational.	Override	Literal (Bag)	"Gyro, Yes", "GPS, No"
Wireless	Wireless transmission and reception methods device adopts.	Locked	Literal	"Zigbee", "Wi-Fi"

4.5.3 Software platform

Attribute	Description	Resolution Rule	Data Type	Example
FaceRecognition	Whether face recognition software is supported.	Override		"Yes", "No"
Font	Currently used font.	Override	Literal	"Gulim"
FontSize	Size of currently used font.	Override	Literal	"10pt", "17px"
FontSupported	Types of font supported.	Append	Literal (Bag)	"Gulim", "Sans_serif"
JavaVersion	Information on version of installed Java.	Override	Literal (Bag)	"1.4", "1.5"
OS	Name and version of operating system installed in a terminal.	Override	Literal	"Mac OS",
Plugin	Type and version of plug-in installed.	Append	Literal (Bag)	"FlashPlayer9", "SilveLight7"
VoiceRecognition	Whether voice recognition software is supported.	Override		"Yes", "No"

4.5.4 Network characteristics

Attribute	Description	Resolution Rule	Data Type	Example
BandwidthSupport	Maximum bandwidth available in the network currently used.	Override	Literal	"10Mbps", "10Gbps"
NetworkBearer	Communication network supported.	Override	Literal	"CDMA", "GSM"
NetworkMode	Network mode currently used.	Override	Literal	"IEEE_802.11b"
NetworkModeSupport	Network mode supported.	Append	Literal (Bag)	"GSM", "IEEE_802.11b", "Wired"

4.5.5 User agent

Attribute	Description	Resolution Rule	Data Type	Example
ActiveXEnabled	Indication of whether ActiveX can be supported.	Locked		"Yes", "No"
BrowserInfo	Name of user agent or browser which is currently sending a request.	Override	Literal	"Nokia", "SEMC-Browser", "UP.Browser", "Mozilla", "MSIE", "WAP42"
BrowserVendor	Developer of browser	Locked		"Apple", "Google", "Microsoft"
JavaAppletEnabled	Indication of whether browser can support JavaApplet.	Locked		"Yes", "No"
JavaScriptEnabled	Indication of whether browser can support JavaScript.	Locked		"Yes", "No"
styleLanguages	Style language supported.	Override		"CSS_2"
Version	Browser version	Override		"6.31"

4.5.6 Environment of use

Attribute	Description	Resolution Rule	Data Type	Example.
AccessMode	Indicates accessibility of a student.	Override	Literal	"auditory", "tactile", "textual", "visual"
currentLocation	Current location of a user indicated under WGS84 standard in the order of: latitude, longitude, altitude, accuracy, altitude accuracy in meter unit, angle to due north and speed in meters per second unit.	Override	Literal (Sequence)	"51.49648, 7.11382, 51.489795, null, 180, 3"
lastLocation	Location of the last user indicated under the WGS84 standard in the order of: latitude, longitude, altitude, accuracy, altitude accuracy in meter unit, angle to due north and speed in meters per second unit.	Override	Literal (Sequence)	"51.49648, 7.11382, 51.489795, null, 180, 3"
Preferences	Indicated in the order of type and value to represent a students' preference.	Append	Literal (Bag)	"Audio, mp3", "Image, jpg", "PageMarkup, HTML3.2"

4.6 Schema definition rule

Layout of learning environment profile schema is identical to CC/PP schema. CC/PP schema definition will comply with the following rules:

- 1) A schema will be identical to a designated vocabulary. Appropriate RDF standard and unique XML name space [XML-NS] called "prf" will be used. This refers to "xmlns:", a prefix to XML name space, and it will provide an identifier that is accurate and unambiguous under all circumstances.
- 2) Other reserved u-Le environment profile list schema XML name space prefixes are: "rdf" and "rdfs". "ref" and "rdfs" are used only to identify RDF schema name space of each RDF.
- 3) Only XML name space declarations defined in mobile learning environment profile list schema will be used. The declaration will be made using the attributes of rdf:RDF root element. No alias of name space can be introduced or used within an overlapped XML element of mobile learning environment profile list schema.
- 4) Mobile learning environment profile list schema will be composed of one or more CC/PP component(s). Attribute or group of characteristics will be individually explained within one or more RDF description element(s).
- 5) All components will be RDF type class object that have a unique rdfs:label element within the group of components UAProf schema introduced.
- 6) All attribute values will have data type and be described in compliance with defined syntax. "Literal" type can be expressed in character string. When interpreting a literal type attribute, upper and lower case characters will be distinguished and spaces at the very first and last of character string will be ignored. The continuous space in the middle of a character string will be treated as prescribed by LWS Rule of HTTP/1.1(Hyper-Text Transfer Protocol). Syntax and value for data type of each attribute are described by mobile learning environment profile list schema.
- 7) By overwriting the default value, one can add additional description to the schema component. The final value of profile instance attribute is interpreted based on the interpretation rule applicable to such attribute.

5 Learning environment group profile

Devices have a variety of forms depending on their purpose and capacity. It is also possible that there may be many unique devices created by users, such as those assembled in various ways (e.g. do-it-yourself “DIY” kits) or remodelled ones. The group profile can be used to define such devices and various learning contexts may be stored in individual profiles defined in the above. A standard is required, so that various profiles can be expressed in one group by grouping them according to certain characteristics, from the perspective of profile management and content creation.

5.1 General concept

5.1.1 Group

Group is a set used to store profiles. Groups store profiles that meet certain criteria considered by the creator of the group into one set and provides an expression of that set. A group does not bind one or more profile information into a set to express such a set. Rather, group defines the range of characteristics and profiles applicable to a group. Group is composed of group name and 0 or more components. Each component contains one or more items. The number of actual values of an item is not limited. Thus, any item of component may have multiple value, regardless of the type of value. Range of group profile will be limited to characteristics defined in all items of the components for the group. Group has hierarchical structure because of such relation of inclusion. Each profile may belong to one or more group(s).

5.1.2 Group producer

Group producer creates the group to meet its intended purpose. A group can be created in various forms that serve the needs of organization or institution that uses the group. Thus, group producer will create the group that satisfies such needs. Group producer may have various forms. System administrator may directly create a group, terminal information administrator may take charge of a group and create one, and user may create a group when given various interfaces with which the user may directly enter the group. Who will be the group producer will be determined by system design for creation of group and purpose of group.

5.1.3 Group name

Group defines characteristics under the standard the applicable group intends to express. Group name is used to express such standard in a name can be understood. The group name will reflect the features of characteristics a group has and be created in a name that can be understood. Since group name can be defined from various perspectives, group creator may name a group depending on its perspective. However, groups with mutually different characteristics may not have the same name. The group name, as an identifier of group, will be unique. Also, the group will be expressed in an abstract name, since it is not a device that actually exists, but a virtual set.

Group has the following characteristics:

- Uniqueness: group name will be unique within the group management system.
- Representativeness: group name will have one or more word that represent(s) characteristics that the group expresses, in a way that can be understood.
- Abstractness: group name will be created in an abstract unit, not for a specific device.

5.2 Group component

Each component item will be identical to expressions of learning environment profile (see [4.1](#)).

5.3 Group attribute

5.3.1 Data type

Component item of a group has data type. Data type can be in dimension, integer, Boolean or literal, identically to the case when terminal information is expressed in the applicable item.

5.3.2 Value

Value of a group shows information about items that will be satisfied in order to meet the criteria to belong to a group. The value applied expresses characteristics of a device, not the actual device. All items will allow multiple values, because value will be able to describe groups of devices with multiple characteristics. Thus, while multiple values are allowed or not allowed according to items in case of existing device information, multiple values are allowed for all items in case of group.

While device information can include items without a value i.e. the device does not have the applicable characteristics, an item without value in case of group means that there is no limit to the value of applicable item. Thus, when comparing, an item without any value will be deemed that all values are allowed.

5.4 Profile and relationship

Group creates a set of devices by expressing a range of device characteristics. Thus, a device may be included in a group if it meets those characteristics. This section describes the relationship between device and group in order to describe how to determine whether a device does or does not belong to a group.

For a terminal to belong to a group, it will satisfy the following conditions:

- for all items with one or more value(s) in a group, a device will also have one or more value(s) of identical items; and
- all values that belong to each item of the device will exist in the values of applicable item of the group.

A device that satisfies the above conditions is deemed to “belong” to a group. Under the above conditions, one group may have various devices that satisfy the conditions, and one device may belong to many groups.

In a system that uses groups, there will be a group of which name is “Anything”, which basically has no limit to any characteristics, thus can include all devices and groups. All devices that do not belong to other groups belong to this group. Thus, all devices definitely belong to one or more group(s).

5.5 Relationship between profile groups

As defined in the above, group identifies set of related devices by limiting the characteristics of device information. Depending on the cases, one group may be completely included in the range of other groups according to the value of such characteristics range. When Group A completely includes Group B, Group A is referred to as the higher group of Group B, and Group B is referred to as the lower group of Group A.

For Group A to be the higher group of Group B, the following conditions will be satisfied:

- for all items with one or more value(s) in Group A, Group B will have matching items with one or more value(s); and
- all values of each item of Group B will exist in the values of applicable items of Group A.

All groups have hierarchical structure, as the higher and lower relationships are defined between groups under the above conditions. All groups form one hierarchical structure where anything is the highest group, since all groups other than anything has one or more higher group(s).

Group, in a system, can form a hierarchical structure with anything at the highest tier, and various application becomes possible through such structure. Basically because group limits range, when a group includes another group therein with the higher/lower group relationship, whether terminal is included or not can be retrieved more easily.

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