A Roadmap of ICT Standardization and Interoperability For Learning, Education, and Training

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Overview

• Standards and specifications development
  – an ongoing process for many years in the ICT
    (information and communication technologies) field
• Variety of ICT infrastructure standards from
  – accredited standards development organizations
    • e.g., ISO, IEC, ITU, and national standards committees
  – specification development organizations
    • consortia, fora, and other organizations, e.g., IETF, W3C, OMG
• **Interoperability and integration are critical issues**
Overview

• For learning, education, and training, formal standards activity began:
  – In 1996 with the formation of IEEE Learning Technology Standards Committee (LTSC)
  – Other organizations (e.g., CEN/ISSS/WS-LT, DCMI, ADL, ALIC, AICC, EdNA, eduSource, IMS, NATO ITD) have been involved in varying capacities (e.g., specification development, testing, technical contribution, etc.).
Overview

• Why use frameworks?
  – Can help explain
  – Some frameworks can be helpful,
    • e.g., ISO OSI -> HL7
    • application, middleware, bitways
  – Can identify interoperability/integration issues

• This presentation uses the IEEE 1484.1 Learning Technology Systems Architecture (LTSA) to frame the ICT interoperability and integration issues
What Is Information Technology for Learning, Education, and Training?

• What kind of technologies do we worry about?
• Learners
  – Related roles
    • Teacher, collaborator, mentor, administrator
  – Related technologies
    • Learner information
    • Management systems
    • Learning content
    • Terminology, vocabulary
    • Architecture
    • Quality
Building Standards In Several Steps

The “Standard”

Consensus Building

Development

Review

Maintenance

EXTENSIONS

User/Vendor/Institutional/Industry “Extensions”

Industry-Relevant, Widely-Adopted “Extensions”

“Extensions” Become Input To Next Revision Of Standard

Amendments: 2-3 years
Revisions: 4-5 years
The Learner, Learner Entity, And Environment

• Learner entity composed of learners
• Supports internal/external collaboration
Two Brief Introductions to LTSA

• LTSA:
  – LTSA is a systems-based component architecture
  – Interoperability and integration are critical for users, systems, institutions, etc.
    • For this presentation, LTSA is used to expose/reveal/analyze interoperability and integration issues
    • In general, LTSA can be helpful for identifying interoperability/integration issues of major components
  – Several ways to “motivate” the LTSA framework
    • Two introductions follow
Constructing LTSA System Components (One Strategy)

• #1: Start with human sensory input: multimedia delivery to learner (similar to entertainment)
• #2: Add coaching/feedback loop for human “variabilities”
• #3: Add learner records for varying teachers, infer intelligently about learner capability
• #4: Add rich learning resources, search, and lookup to support diversity of humans
• #5: Add negotiated learning parameters for direct communication with learner
Step #1: Transferring Information

- Transfer information to Learner Entity
- Sensory input/interactions for humans
- Delivery of Multimedia: same as entertainment
Step #2: Coaching/Feedback Loop [1/2]

- Feedback necessary
- Current “state” (i.e., the “sensor”) of the feedback loop:
  - Behavior
  - Evaluation
  - Assessment
Step #2: Coaching/Feedback Loop [2/2]

- Coach:
  - Determines corrective/suggestive/supportive actions
- Locator:
  - Examples: next lesson (Learning Content) towards objective; web URL
  - Directs Delivery of Multimedia to Learner
- Loop recovers from errors, focuses on target
Step #3: Learner Records

- Learner information
  - helps infer corrective/suggestive/supportive actions over long periods of time
  - nomadic learners: allows learner migration (handoff) to different teachers (e.g., grade promotion) and different institutions
- Learner Records: Learner’s history and objectives
Step #4: Learning Resources

- Diverse learning resources necessary to match human diversity
- Coach:
  - directs different Learning Parameters and strategies
  - based on Learner's history/objectives and Assessment
  - supported via queries to Learning Resources for appropriate Learning Content
Step #5: Advice from the Learner

- Humans are self-aware: can give advice on Learner Parameters
- Learning Parameters:
  - interaction between Learner and learning technology system(s) to negotiate optimal parameters
  - negotiation might actually be assertion: Learner may assert (e.g., experimentation), or coach may assert (e.g., primary school might dictate Learning Parameters)
A Second Illustration: “Learner-Directed” Approach

- Learner is self-directed
- Learner makes decisions about learner’s direction and learning experiences
- Representative of independent, self-taught learning scenarios
- Focus on humans as “directors of their experience”
- Compatible with “traditional approach” when viewed via LTSA system components
Step #1: Choosing His/Her Direction

- “Individual Learner” has some goal
- “Individual Learner”
  - is the Learner Entity
  - is aware of his/her Learning Parameters
  - chooses his/her learning direction — “Individual Learner” also serves as role of Coach
Step #2: Locating Learning Resources

- “Individual Learner”
  – searches (Query) the Learning Resources
  – locates learning resources described by Catalog Info
Step #3: Using Learning Resources

- “Individual Learner”
  - uses Learning Resources
  - “initiates” Delivery of Multimedia
Step #4: Learner Self-Evaluates/Directs

- “Individual Learner”
  - self-evaluation
  - learner chooses next/new/other learning experiences
Step #5: Records Are Kept

- “Individual Learner”
  - may use records to track progress
  - records may be used to improve self-directed “learner quality”
Several “Motivations” Are Possible

- Several possible “stories” motivate the need to address:
  - Learner-centric perspective
  - Traditional classroom/training scenarios
  - Self-directed learning
  - Pervasive design issues caused by humans

- Other stories are possible
  - Only two stories were illustrated
LTSA: Applicability, Conformance, Utility

• Wide applicability to learning technology systems
  – i.e., virtually all learning technology systems “conform” to LTSA

• No particular generation of technology implied:
  – LTSA applies to current and future systems (say, 10 years from now)
  – LTSA applies to “learning technology” 10, 30, and 100 years ago (e.g., Amish “low-tech” classroom)
LTSA: Applicability, Conformance, Utility

• Not all components need to be supplied to conform:
  – a Pro Forma Implementation Conformance Statement is used
  – the user/implementor declares which components are provided and how they map to/from LTSA

• For more info:
  http://ltsc.ieee.org/wg1 (IEEE LTSC 1484.1 Working Group)
Example LTSA Mapping #1: Web-Based Learning
 Demonstrates Tightly Integrated Components

* Note: Other mappings may co-exist.
Example LTSA Mapping #2: Demonstrates Parallel Sessions for Same Learner

- **Primary design issues**: multiple, simultaneous learning experiences; multiple flows of behavior, learning parameters, multimedia
- **Secondary design issues**: multiple evaluation, coach, and delivery processes
- **Example**: flight simulator -- simultaneous training of flying skills, navigation skills, communication skills, cockpit resource management
Example LTSA Mapping #3: Non-Electronic/Traditional Classroom

Limiting Case: No Technology Involved

* Note: Other mappings may co-exist.
Using LTSA To Identify Standards And Specification Activities

- LTSA is used to highlight the approximate technical boundaries of existing standards and specifications
- The following diagrams highlight the standardization areas

**Note: Non-exhaustive list of activities!!!**
A Brief Summary of Current Standardization/Specification Activities

- Learner Entity
- Evaluation, Behavior, Interaction Context, Assessment, Learner Information
- Learner Information, Learner Records
- Coach and Related Components
- Catalog Information
- Learning Resources, Learning Content, Locators
- Delivery
- Multimedia
- General/Generic Topics

*Note: Non-exhaustive list of topics!!!
Learner Entity

[Note: Distinguish Between Learner and Learner Entity]

- Standards/Specification Activity:
  - ISO/IEC JTC1 SC36 WG2 collaborative technology (several standards)
  - ISO/IEC JTC1 SC36 CLFA culture language function accommodation
  - ISO/IEC JTC1 SC32 locale identifier
  - ISO/IEC JTC1 SC35 user interfaces
  - INCITS/V2 accessibility
  - CEN/ISSS/DfA (design for all)
Evaluation, Behavior, Interaction Context, Assessment

- Standards/Specification Activity:
  - IMS QTI (question-test interoperability) for question banks
  - CEN/ISSS/WS-LT description of language capabilities
• Standards/Specification Activity:
  – ISO/IEC JTC1 SC36 WG3 participant information:
    • participant identifiers
    • accommodation information
    • performance information
  – ISO/IEC JTC1 SC32 WG2 metadata:
    • contact, relations, and security information
    • 20944 metadata interoperability and bindings (codings, APIs, protocols)
  – IMS learner information profile (LIP)
Coach and Related Components

- Standards/Specification Activity:
  - IEEE LTSC 1484.11.* computer managed instruction (CMI)
  - AICC CMI
  - ADL SCORM
  - ISO/IEC JTC1 SC36 WG4 management and delivery
  - CEN/ISSS/WS-LT educational modeling language (EML)
Catalog Info
(also known as “Learning Object Metadata” and “Metadata for Learning Resources”)

- Standards/Specification Activity:
  - IEEE LTSC 1484.12.* learning object metadata (LOM)
  - DCMI education metadata
  - EdNA metadata
  - ISO/IEC JTC1 SC36 WG4 metadata for learning resources
  - ISO TC46 bibliographic standards
• Standards/Specification Activity:
  – IMS content packaging
  – CEN/ISSS/WS-LT educational modeling language (EML)
  – W3C XML
  – IMS and ADL simple sequencing
  – ISO/IEC JTC1 SC29 MPEG-21
  – IDOI digital object identifier

Learning Resources, Learning Content, Locators
• Standards/Specification Activity:
  – ISO/IEC JTC1 SC36 WG4 management and delivery
  – W3C web protocols and services
• Standards/Specification Activity:
  – ISO/IEC JTC1 SC29 MPEG, JPEG
  – ISO/IEC JTC1 SC24 computer graphics
  – ISO/IEC JTC1 SC2 character sets
  – IEC TC 100
  – various ITU-T standards
  – various IETF specifications
General/Generic Topics

- Standards/Specification Activity:
  - ISO/IEC JTC1 SC36 WG1 vocabulary
  - ISO/IEC JTC1 SC36 WG1 registry
  - ISO/IEC JTC1 SC36 WG5 descriptive frameworks
  - IEEE LTSC 1484.1 learning technology systems architecture (LTSA)
  - IMS learning design
Current Activities of ISO/IEC JTC1 SC36

Working Groups

- WG1: Vocabulary (Ukraine)
- WG2: Collaborative Technology (Japan)
- WG3: Participant Information (UK)
- WG4: Management and Delivery (US)
- WG5: QA and Descriptive Frameworks (Germany)

Rapporteur Groups

- RG1: Marketing Rapporteur Group (Australia)
- RG2: International Standardized Profiles (China)
- RG3: Culture, Language, Function Accommodation (Norway)

Website http://jtc1sc36.org
SC36/WG1: Vocabulary

- Develops terminology
- Uses ISO/IEC 11179-3 metadata registry for multilingual terminology
- Uses ISO 5964 (multilingual thesauri) as guideline
- Use TC37, TC46 standards
- Supports local/regional terminology
SC36/WG2: Collaborative Technology

- Collaborative Workplace
  - Specification of collaborative learning environment
  - Coordinated with other SC36 standards activities

- Learner to Learner Interaction Scheme
  - Codings for interactions

- Agent to Agent Communication
  - Agent interaction within other agents/systems
SC36/WG3: Participant Information

• Participant Identifiers
  – Formerly called “student identifiers”, etc.

• Accommodation Information
  – Preferences

• Performance Information
  – Grades, certifications, future objectives, etc.

• Linguistic Preferences
  – Contributed via CEN/ISSS/WS-LT CWA
  – SC36 CLFA Resource Metadata
SC36/WG4: Management and Delivery

• Framework
  – Next generation learning management systems

• Metadata for Learning Resources
  – Harmonization with IEEE LOM work
  – Internationalization
SC36/WG5: Quality Assurance And Descriptive Frameworks

• Quality Management, Assurance and Metrics
  – Framework for quality metrics

• Several potential projects
  – Holistic Architecture
  – ERILE
  – LTSA
Marketing Rapporteur Group

• Marketing Plan Published and in action
• ISO Bulletin article on SC36 published in May
• Support Initiatives 2003 Conference
International Standardized Profiles (ISP)

- Developing application profiles of other standards and specifications
- Important for procurement/purchase
Culture, Language, and Function Accommodation (CLFA)

- Review and framework for supporting accommodation/adaptation of culture, language, and function (disabilities)
- CLFA serves as advisor/monitor for SC36
SC36 Participation: 22 National Bodies
Conclusions

• The requirements for standardization and the relevant standards can be determined in many cases by applying tools, such as LTSA, to frame the nature of the interoperability and integration
Conclusions

• Example #1 (above): Multiple LTSA Components Tightly Integrated
  – A particular web-based application was diagrammed using the LTSA notation
  – The components that cross the boundary of the system are the critical interoperability points (e.g., Behavior, Multimedia, Learner Information, Learner Parameters, Query, Catalog Information, Learning Content)
  – But the components internal to the boundary of the system (e.g., assessment, interaction context, the locator from coach to delivery) are merely internal implementation issues where standards may be desirable, but are not a requirement
Conclusions

• Example #2 (above): Parallel Sessions For The Same Learner
  – Indicates several “instances” of LTSA may be in effect at the same time
  – Each instance may require its own independent integration and interoperability analysis

• Example #3 (above): Non-Electronic/Traditional Classroom
  – Shows how LTSA analysis can be applied to low-tech or no-tech scenarios
  – LTSA analysis is still important in low/no-tech: LTSA can identify/illustration a long-term technology growth path
Conclusions

• In all cases:
  – Once the critical interoperability points have been determined,
    • the list of existing standards and specification development activities may be consulted to assess the risks associated with system/technical integration and interoperability
    • i.e., how standards/specifications may be applied
Thank You!

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