ISO/IEC JTC 1 VR AR for Education

January 21-24, 2019

SC24 WG9 & Web3D Meetings, Seoul, Korea

Myeong Won Lee (U. of Suwon)

Requirements

- Learning and teaching
  - Basic components for a virtual learning system
  - Basic components for a virtual teaching system
  - SC36 components
- Data
  - Basic components for data
  - How to organize and manage all types of data for virtual education and training systems
- Device and sensor
  - Sensor information
  - Sensor data interface
  - Device types

Use cases

- Applications or examples
- Functional overview of virtual education and training systems
- Users
  - Learner
  - Teacher
  - System designer and developer
- System components
- Use case diagram (UML)

Scope

- VR AR MR terms and concepts
- VR AR MR education and training terms and concepts
- Software technology for virtual education and training systems
- Application development technology for virtual education and training systems
- VR AR MR information generation, transfer, and exchange
- Information model and architecture for virtual education and training systems
- Standards based application development technology for virtual education and training systems
- Software interfaces between computers and devices are included
- Examples for standards based virtual education and training systems
- Exclusions
  - Device hardware technology for virtual education and training systems are excluded

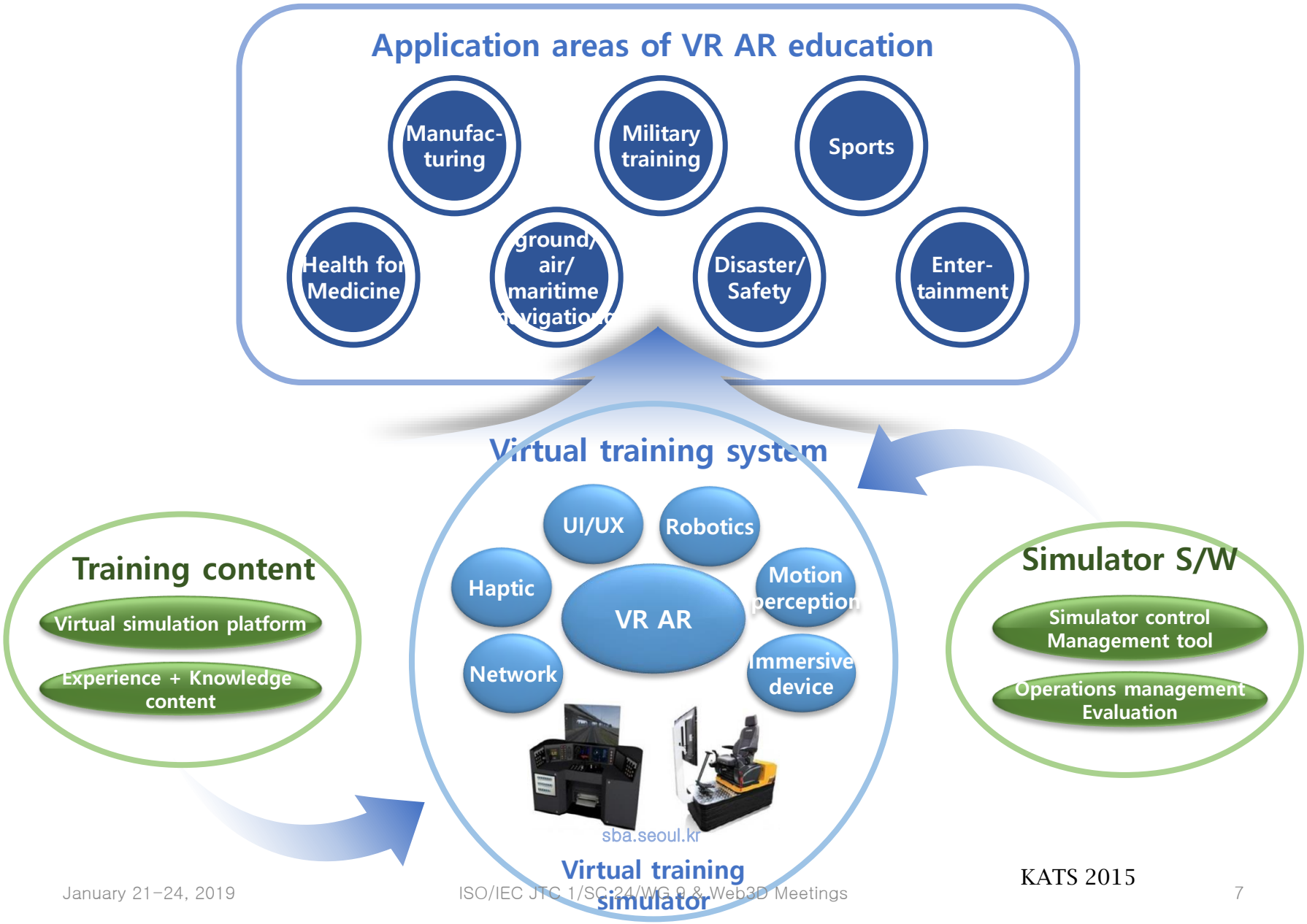
Terms and Definitions

- VR
- AR
- MR
- Sensor
- Systems integration
- VR AR for education
- Virtual education system
- Virtual training system
- …

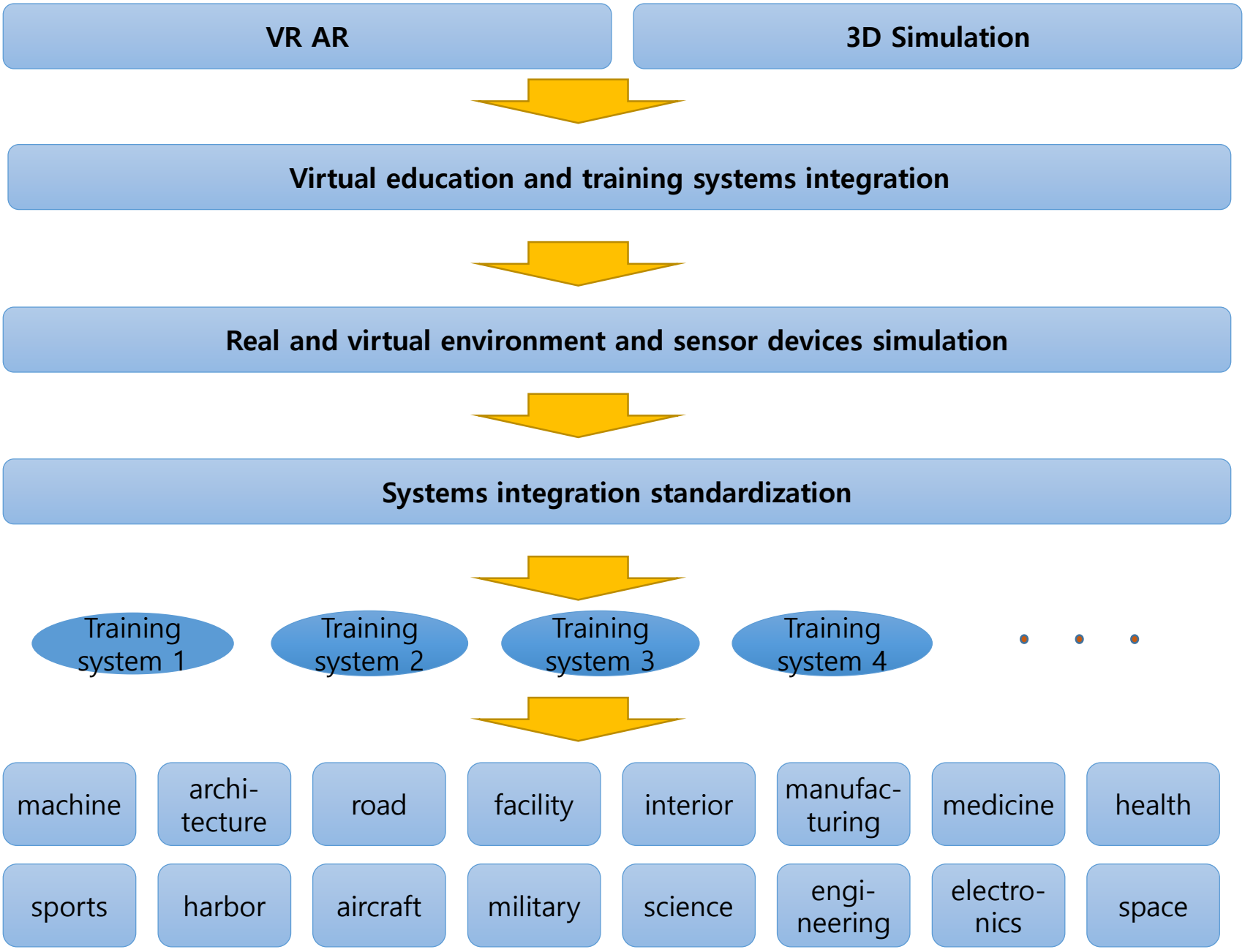
Concepts

- Systems integration (JTC 1 Systems Integration Standardization Guidelines, ISO/IEC JTC 1 Standing Document N 24)
  - The progressive assembling of system components into the whole system
- Systems integration (wikipedia.org)
  - Systems integration is defined in engineering as the process of bringing together component sub-systems into one system
  - An aggregation of subsystems cooperating so that the system is able to deliver an overarching functionality
- Systems integration for virtual education and training
  - Virtual education and training is a representative area that systems integration technology should be applied to
- Virtual education and training
  - Computer simulated education and training using VR and AR technologies
  - Provides for repetitive and empirical learning in immersive virtual environments
- Virtual education and training systems
  - Computer HW and SW integrated systems for virtual education and training in virtual environments

Virtual education and training systems



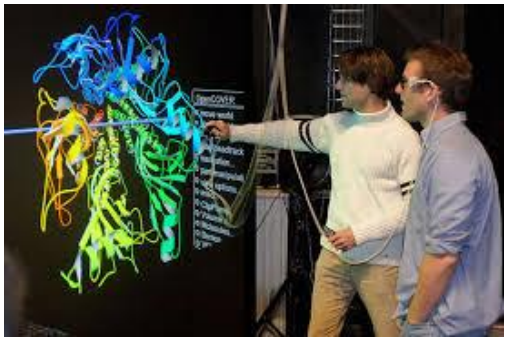
Application areas of virtual education and training systems



Virtual Education and Training Systems Technologies and Application Areas

- VR/AR/MR integration into training and education systems
  - Information modeling and exchange
  - Visualization and simulation
  - Sensor representation
  - Real world representation
  - Graphical user interaction
- Areas related to VR/AR/MR information modeling and rendering
  - Science and engineering education
  - Medical education
  - Training for manipulating industrial equipment or devices
    - Ex: flight, car, ship, heavy vehicle, heavy equipment, army, transportation
  - Manuals for manipulating electronic and manufacturing products
    - Ex: camera, video, 3D printer, 3D scanner, home appliance
  - Education materials for making products
    - Ex: clothing, furniture, interior design, food, manually produced products

VR AR Based Education (1)



sites.google.com

linkedin.com

clicktoeducation.com

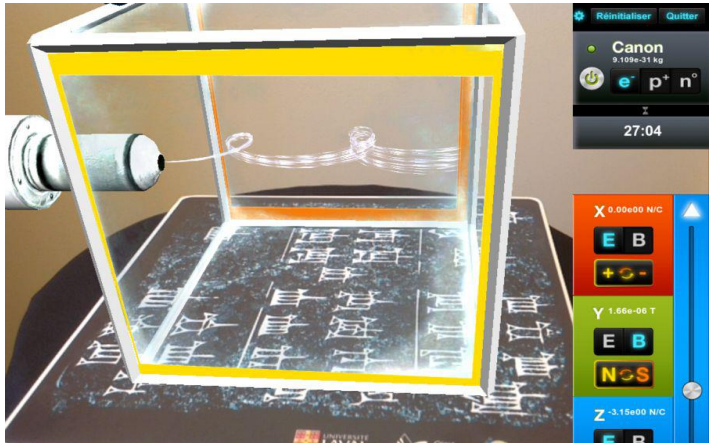
learncube.com

webschool.in

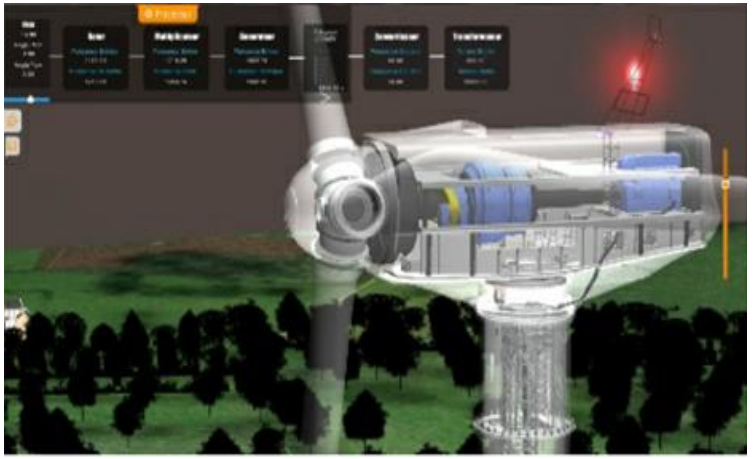
Education content and materials

Learning and teaching

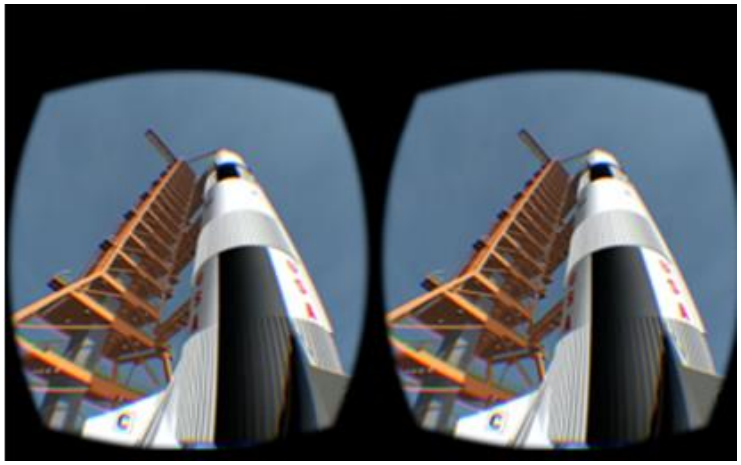
VR AR Based Education (2)



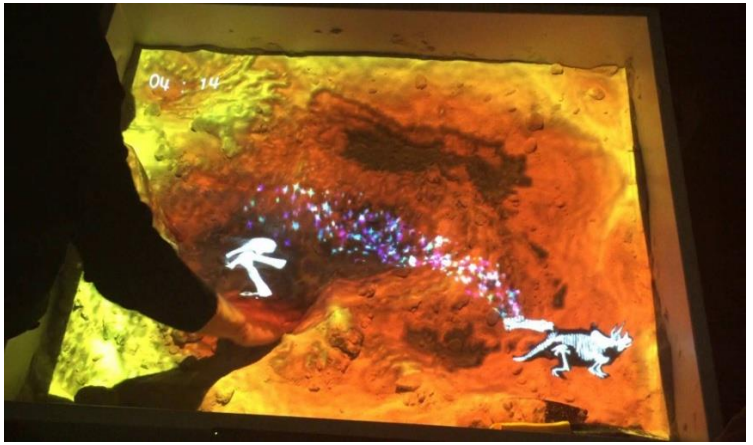
Movement of charged particles (AR case)
(Canada)



Project EAST Consortium (VR case)
(France)



Apollo 11 (VR case)
(VR Experience)



SendDraft (MR case)
(Korea)

VR AR Based Training Systems (1)

Driving simulation
(Road Traffic Authority, 2013)

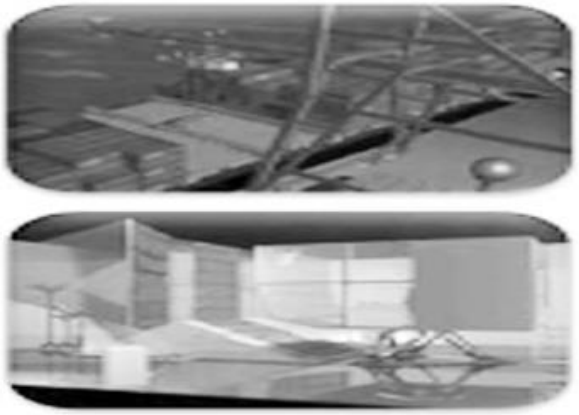
CycleOps virtual training
(CycleOps, 2012)

Boeing CRVS
(The Boeing Company)

Military training
(STI, USA)

VR AR Based Training Systems (2)

Excavator simulator
(KETI)



Harbor crane training simulator
(Total Soft Bank)

Virtual medical education
(Virtual Medical Coaching)

Virtual military training

Virtual Education Systems with Learning and Teaching Technology

- Knowledge information modeling and representation
  - How to create a knowledge information database
  - How to represent visual information in virtual spaces
  - Combine with learning and teaching methods
- Learning technology
  - Learning methods for knowledge information
  - User interface
- Teaching technology
  - Teaching methods for knowledge information
  - User interface
  - Communication between learners and teachers

IoT Sensors for Virtual Training Systems (Examples)

- Automotive sensors
  - Light, temperature, position, ultrasonic, camera, etc.
- Bicycle sensors
  - Speed, position, light, cadence, etc.
- Flight sensors
  - Time of flight camera, displacement, inclination, ultrasonic, rotary, etc.
- Military sensors
  - Accelerometer, inclination, camera, night vision, etc.
- Medical sensors
  - Pressure, flow, oxygen, radiation, position, temperature, etc.
- Other VR training area sensors

Standard Technology for Virtual Education and Training Systems

- Virtual environment representation for education and training
  - VR/AR scene representation
  - Education and training information representation
- Virtual simulation interface with virtual environments
  - A virtual scene control interface with sensor devices
- Virtual simulation with real world environments and sensors
  - A sensor control interface with sensor devices for training
- Education and training information database description and manipulation

Virtual Education and Training Systems with IoT Sensors

- Representation of virtual education and training environments
  - Includes sensor representation
- Interaction with real and virtual education and training environments
  - Includes interaction with sensors
- Simulation of virtual education and training environments
  - Includes sensor simulation
- Interfaces for managing and controlling virtual education and training environments
  - Includes interfaces for managing and controlling sensors

Standards and Standardization for Virtual Education and Training Systems in SC24

- Representation of virtual education and training environments
  - 3D virtual worlds
- Interaction with real and virtual training environments
  - IoT sensor and device representation and interactions with 3D scenes
- Simulation of virtual training environments
  - 3D visual training, learning, and teaching simulation
- Interfaces for managing and controlling virtual training environments
  - User interfaces for training, learning, and teaching information control from/to real and virtual worlds

SC24 Standards for Virtual Education and Training Systems

- ISO/IEC 14772: 1997 VRML (Virtual Reality Modeling Language)
- ISO/IEC 14772-2: 2004 VRML97 Functionality and External Authoring Interface
- ISO/IEC 19775-1 V3.3: 2013 X3D (Extensible 3D)
- ISO/IEC 19775-2 V3.3: 2015 X3D Scene Authoring Interface (SAI)
- ISO/IEC 19776-1 V3.3: 2015 X3D Encoding: XML
- ISO/IEC 19776-2 V3.0: 2005 X3D Encoding: Classic VRML
- ISO/IEC 19776-3 V3.3: 2015 X3D Encoding: Compressed Binary
- ISO/IEC 19774: 2006 Humanoid Animation
- ISO/IEC 19777-1 V3.0:2005 X3D Language Bindings: ECMAScript (JavaScript)
- ISO/IEC 19777-2 V3.0:2006 X3D Language Bindings: Java
- ISO/IEC 18023-1: 2006 SEDRIS (Synthetic Environment Data Representation and Interchange Specification) Part 1: Functional Specification
- ISO/IEC 18023-2: 2006 SEDRIS Part 2: Abstract Transmittal Format
- ISO/IEC 18023-3: 2006 SEDRIS Part 3: Transmittal Format Binary Encoding
- ISO/IEC 18024-4: 2006 SEDRIS Part 4: C
- ISO/IEC 18025: 2014 EDCS (Environmental Data Coding Specification)
- ISO/IEC 18026: 2009 SRM (Spatial Reference Model)
- ISO/IEC 18041-4: 2007 EDCS Language Bindings – Part 4: C
- ISO/IEC 18042-4: 2006 SRM Language Bindings – Part 4: C

SC24 Work Items for Virtual Education and Training Systems

- ISO/IEC 18039:201x DIS MAR Reference Model (JAhG with SC29)
- ISO/IEC 18040:201x CD Live Actor and Entity Representation in MAR
- ISO/IEC 18520:201x CD Benchmarking of Vision-based Geometric Registration and Tracking Method
- ISO/IEC 18038:201x WD Sensor Representation in MAR
- ISO/IEC 19774-1:201x CD Humanoid Animation (H-Anim) – Part 1: Architecture
- ISO/IEC 19774-2:201x CD Humanoid Animation (H-Anim) – Part 2: Motion data animation
- ISO/IEC 21858:20xx CD MAR Content Information Model

Standards and Standardization for Virtual Education and Training Systems in SC29

- Activities related to JPEG (WG1) will be added later
- MPEG (WG11) has been working on standard technologies and solutions for both areas since 1995

Title	Standard	Status	Applications
BIFS	MPEG-4	IS	Navig. in 3D spaces
ARAF	MPEG-A	IS	Augmented Reality
HEVC	MPEG-H	IS	Video for VR
3D Audio	MPEG-H	IS	Audio for VR
OMAF	MPEG-I	FDIS	Virtual Reality (3DoF)
OMAF v2	MPEG-I	FDIS (Oct '18)	Virtual Reality (3DoF+)
Point Cloud Compression	MPEG-I	CfP	Virtual Reality (6DoF)
HNSS container	MPEG-I?	Draft CfP	AR/VR

SC29 Standards for Virtual Education and Training Systems

- ISO/IEC 14496-11:2015 Scene Description and Application Engine (BIFS: NInary Format for Scenes)
  - A format for representing multimedia scenes and its application engine
- ISO/IEC 14496-12:2015 ISO base media file format
  - A file format for multimedia data
- ISO/IEC 14496-16:2011 Animation Framework eXtension (AFX)
  - A set of compression format for 3DG objects
- ISO/IEC 14496-20:2008 Lightweight Application Scene Representation
  - An XML-based scene description and interaction format
- ISO/IEC 14496-25:2011 3D Graphics Compression Model
  - A model for 3DG compression
- ISO/IEC 23000-13:2017 Augmented reality application format
  - A format to enable consumption of 2D/3D multimedia content
- ISO/IEC 23000-18:2017 Media Linking Application Format
  - A format connecting a specific spatio-temporal portion of a source content with a specific spatio-temporal portion of a destination content
- ISO/IEC 23000-20:2017 Omnidirectional Media Application Format
  - A format for omnidirectional video
- ISO/IEC 23008-2:2017 High efficiency video coding
  - A novel video format with a compression capability twice that of AVC. This standard includes the metadata for 360VR
- ISO/IEC 23008-3:2013 3D Audio
  - 3D audio signals and flexible rendering for the playback of 3D audio in a wide variety of listening scenarios.(as in HEVC)

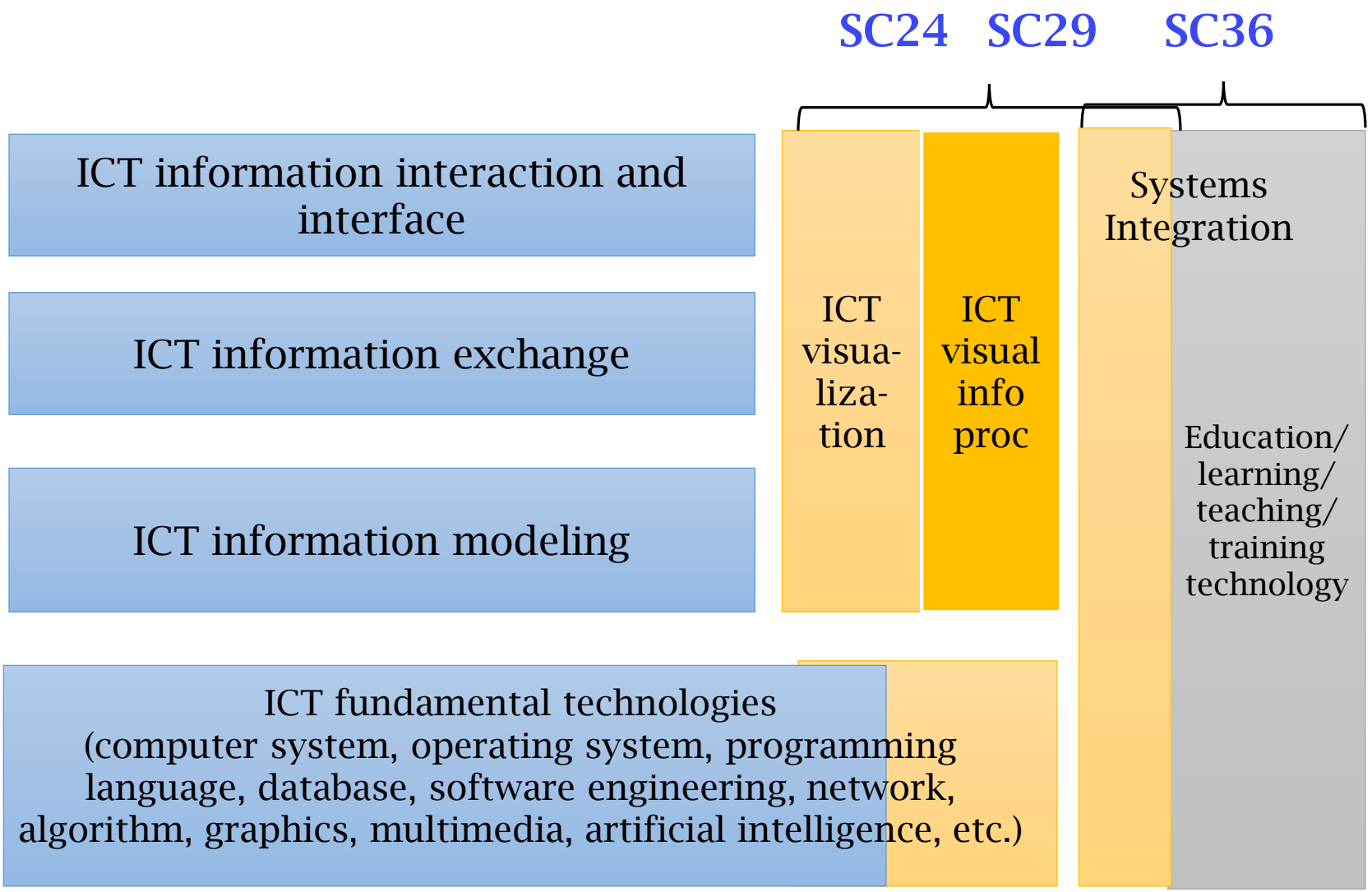
SC29 Work Items for Virtual Education and Training Systems

- ISO/IEC 23090-2 Omnidirectional Media Format v.2
  - A format for omnidirectional video
- ISO/IEC 23090-3 Immersive Video
  - Coded representation of immersive video
- ISO/IEC 23090-4 Immersive Audio
  - Coded representation of immersive audio
- ISO/IEC 23090-5 Point Cloud Coding
  - Coded representation of Point Clouds
- ISO/IEC 23090-6 Immersive Media Metrics
  - Metric for immersive media
- ISO/IEC 23090-7 Immersive Media Metadata
  - Metadata Immersive Media
- ISO/IEC 23090-? HNSS container (DCfP)
  - AR/VR container
- ISO/IEC 18039 Mixed and Augmented Reality Reference Model
  - A Mixed and Augmented Reality Reference Model developed jointly with SC24/WG9

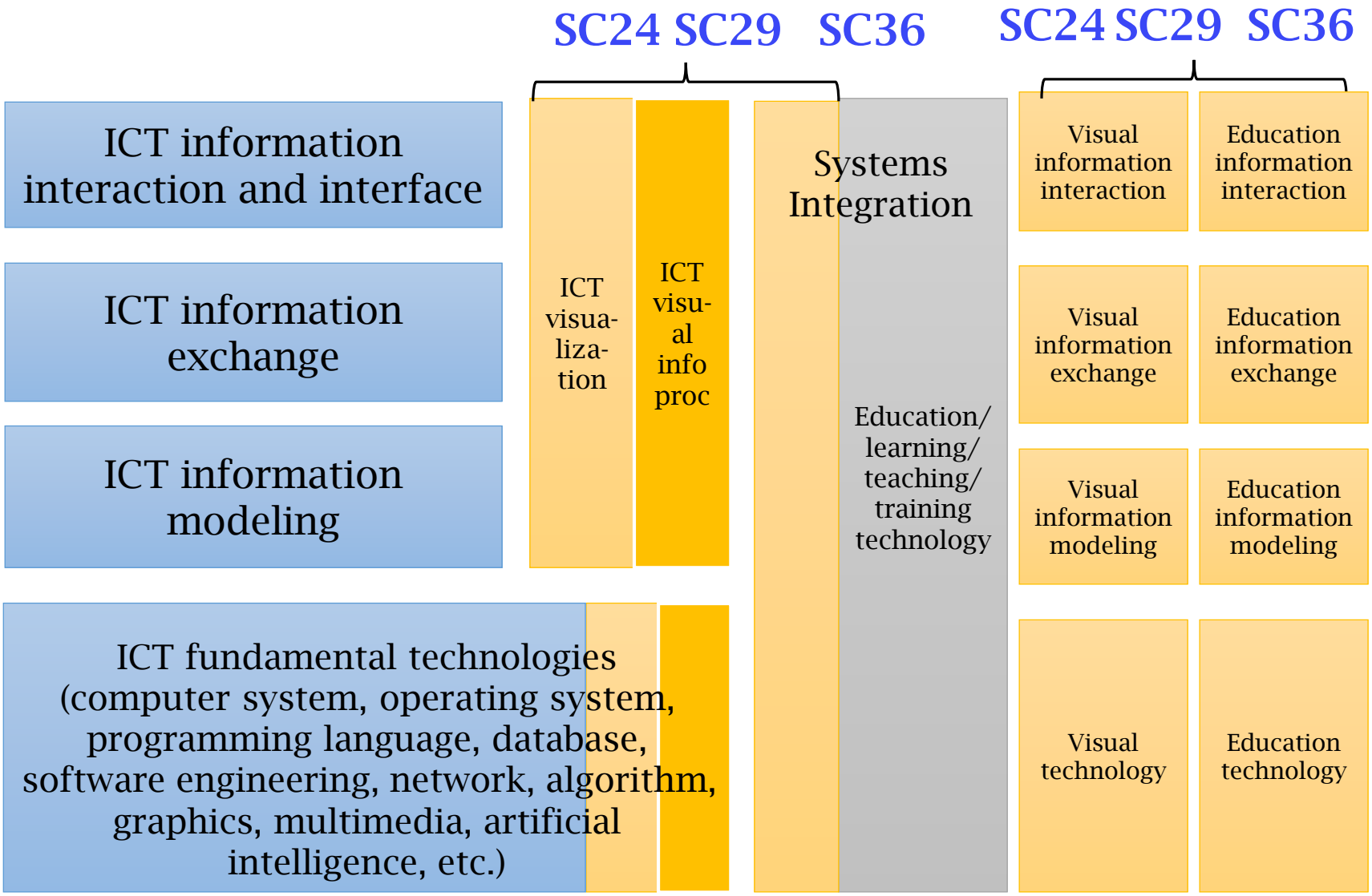
SC36 Work Items relevant to AR/VR

- ISO/IEC 19788 Information technology -- Learning, education and training -- Metadata for learning resources
- ISO/IEC 20748 Information technology for learning, education and training -- Learning analytics interoperability
- ISO/IEC TR 20821 Learning environment components for automated contents adaptation
- ISO/IEC 22602 Competency models expressed in MLR (in development)
- ISO/IEC 24751 Information technology for learning, education and training -- AccessForAll Framework For Individualized Accessibility
- ISO/IEC TR 18121 Information technology -- Learning, education and training -- Virtual experiment framework
- ISO/IEC 19778 Information technology -- Learning, education and training -- Collaborative technology -- Collaborative workplace
- ISO/IEC 12988 Information technology -- A code of practice for the use of information technology (IT) in the delivery of assessments

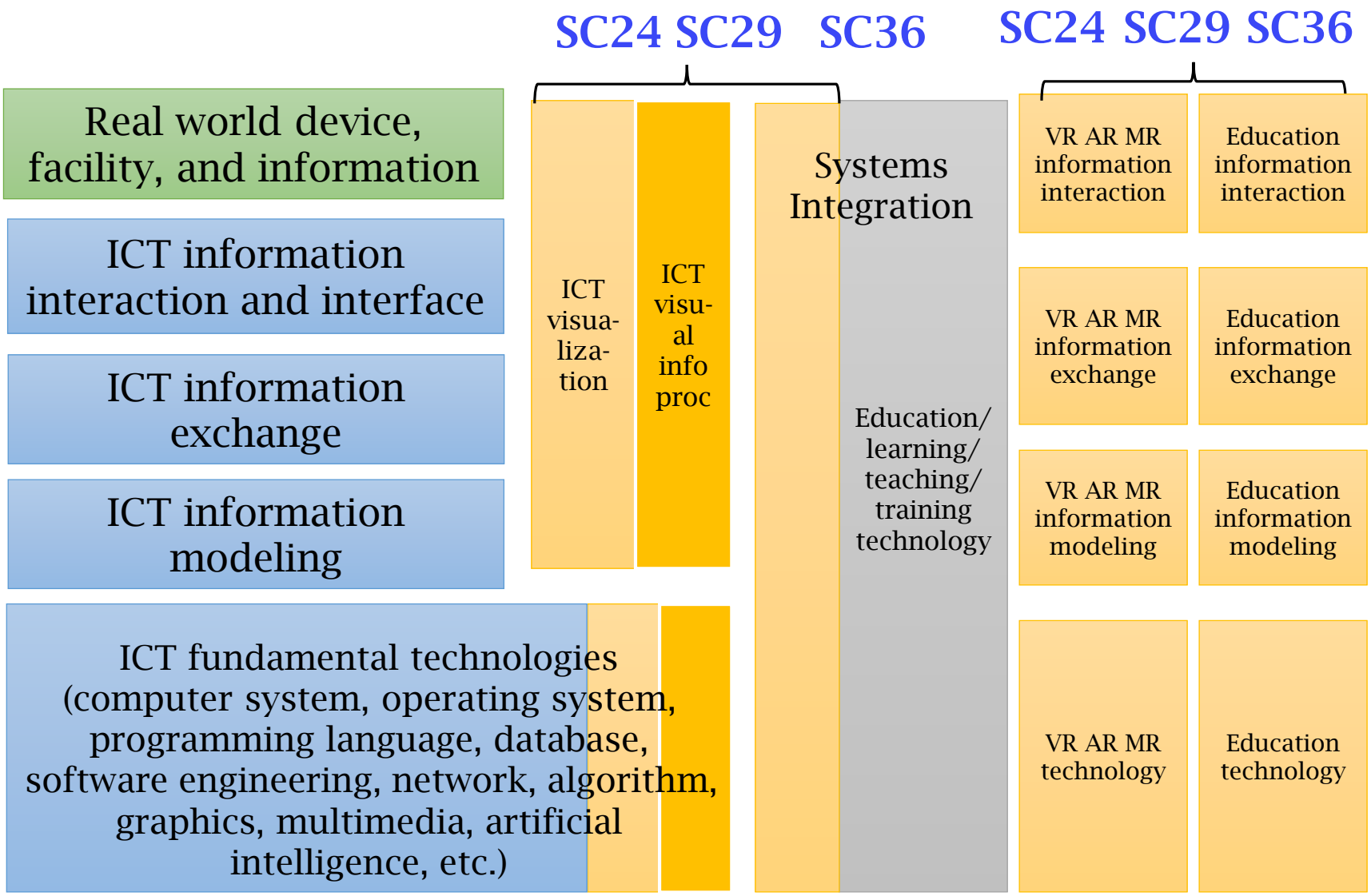
Architecture for Virtual Education and Training (1)



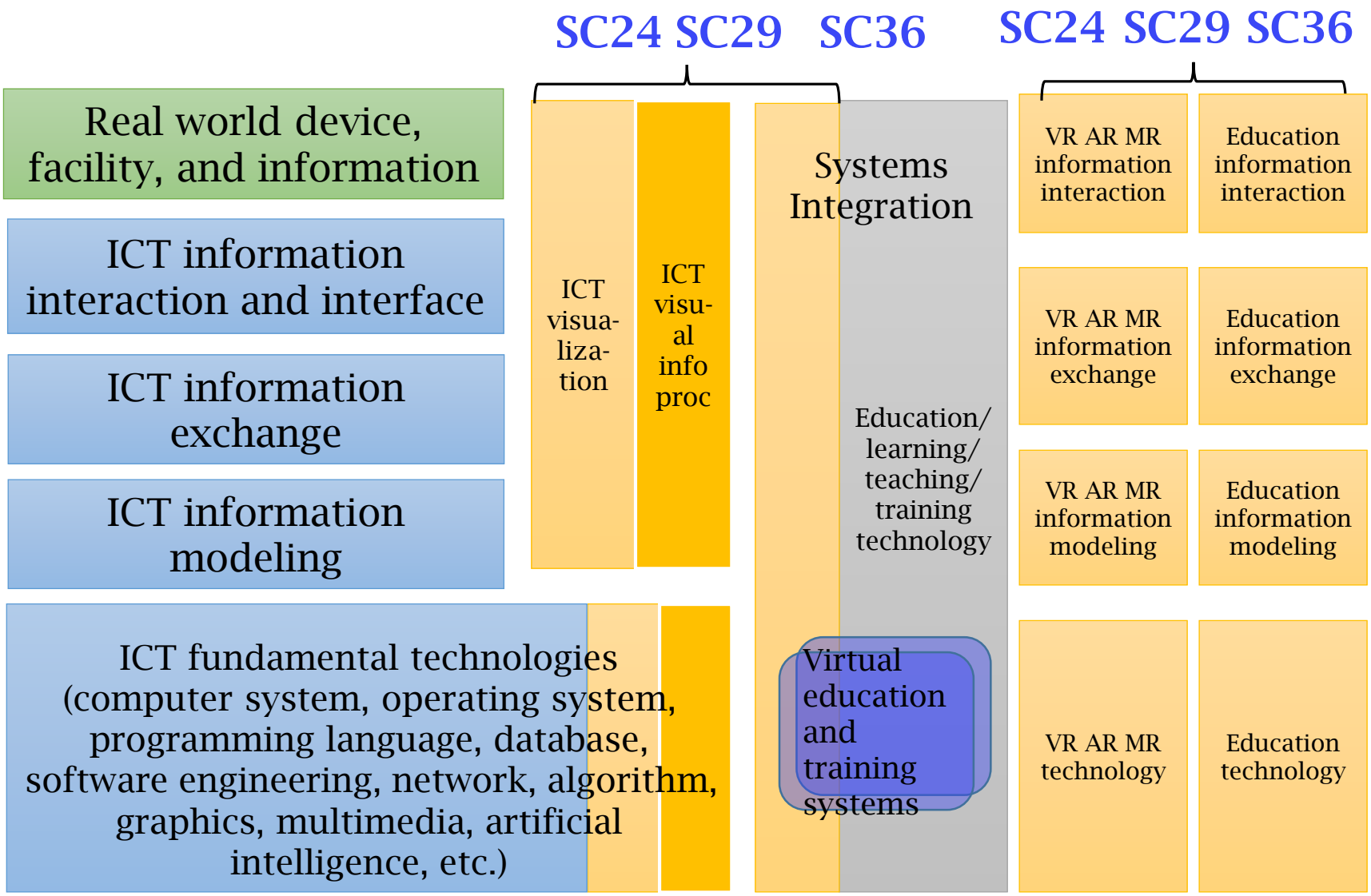
Architecture for Virtual Education and Training (2)



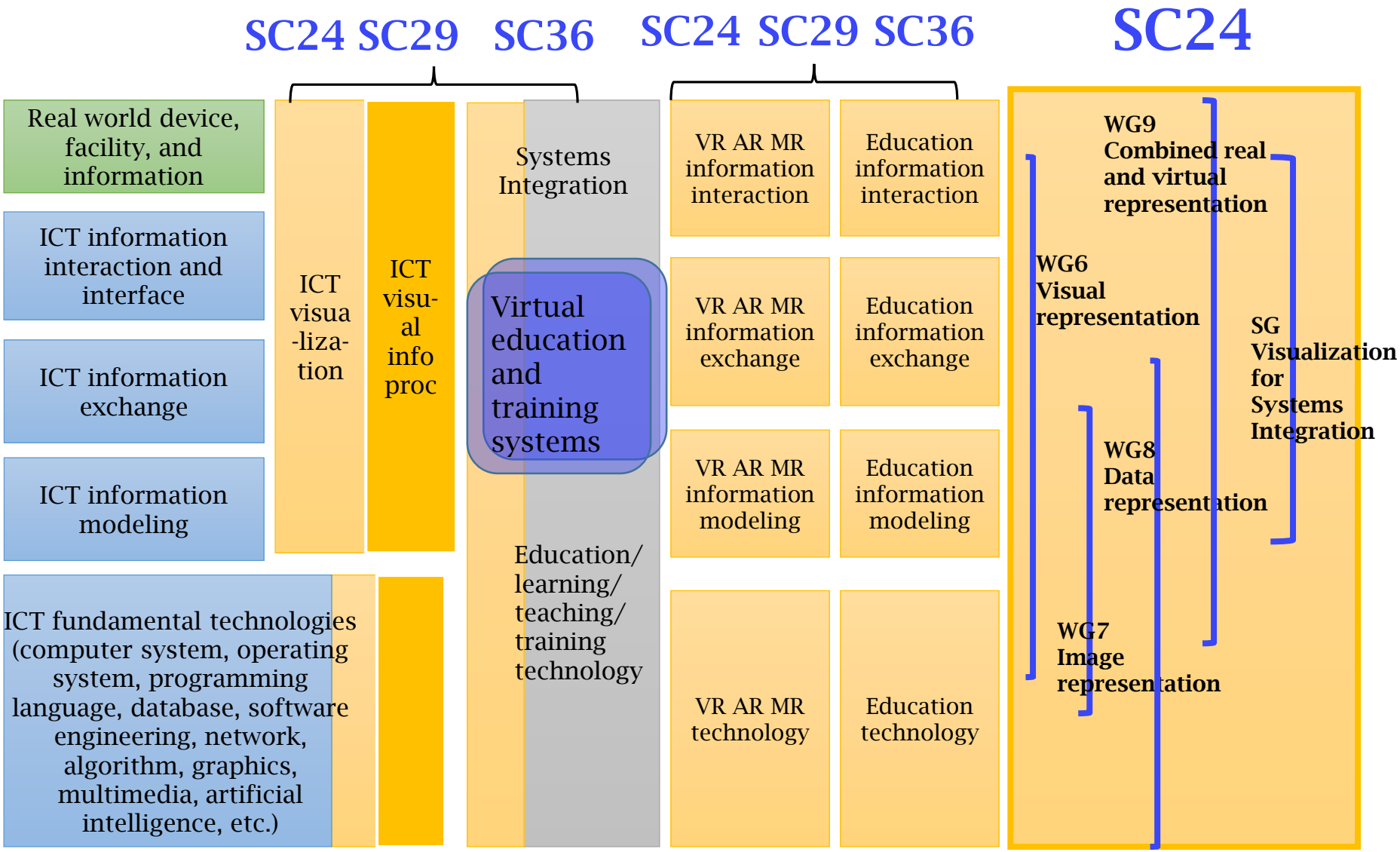
Architecture for Virtual Education and Training (3)



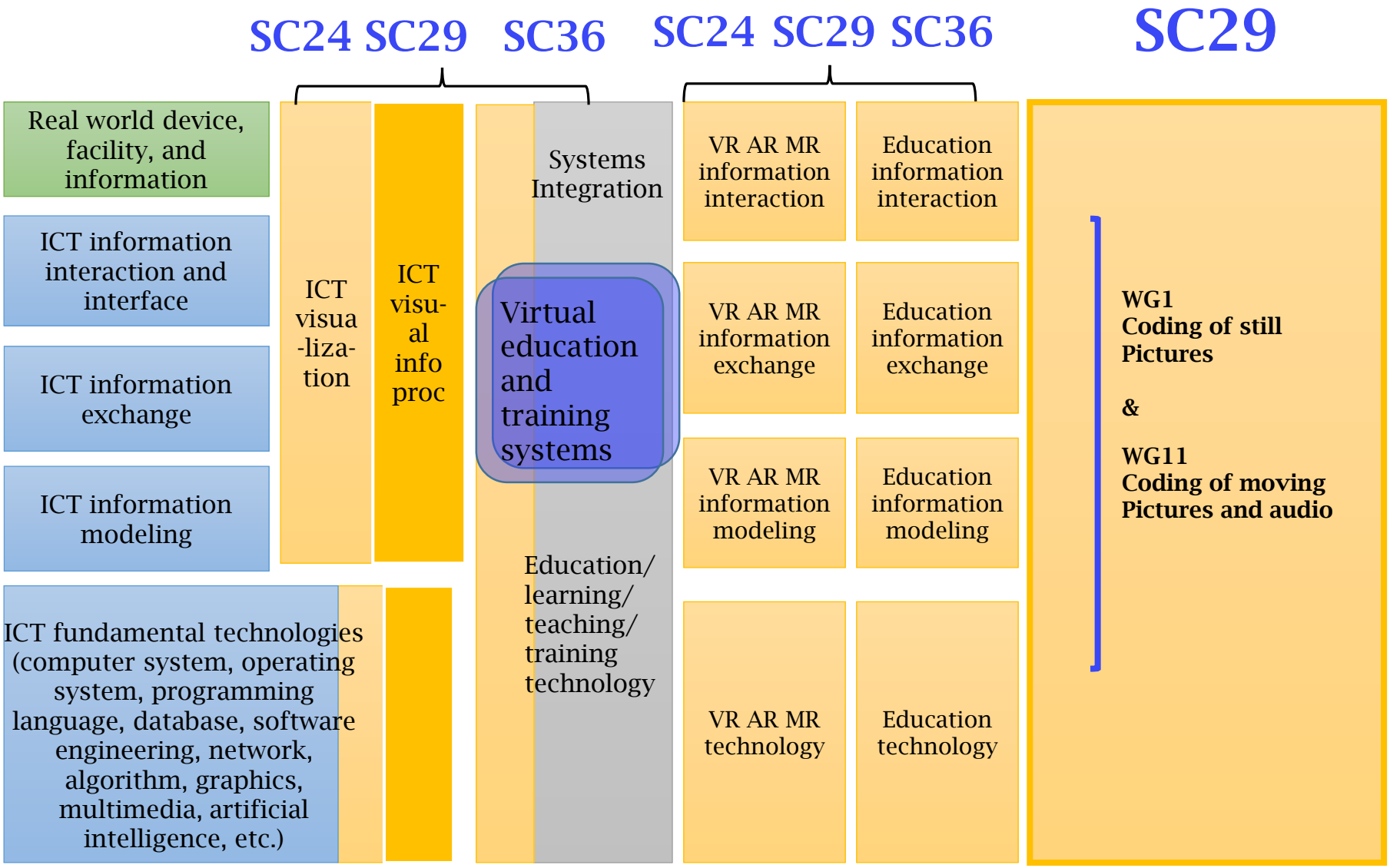
Architecture for Virtual Education and Training (4)



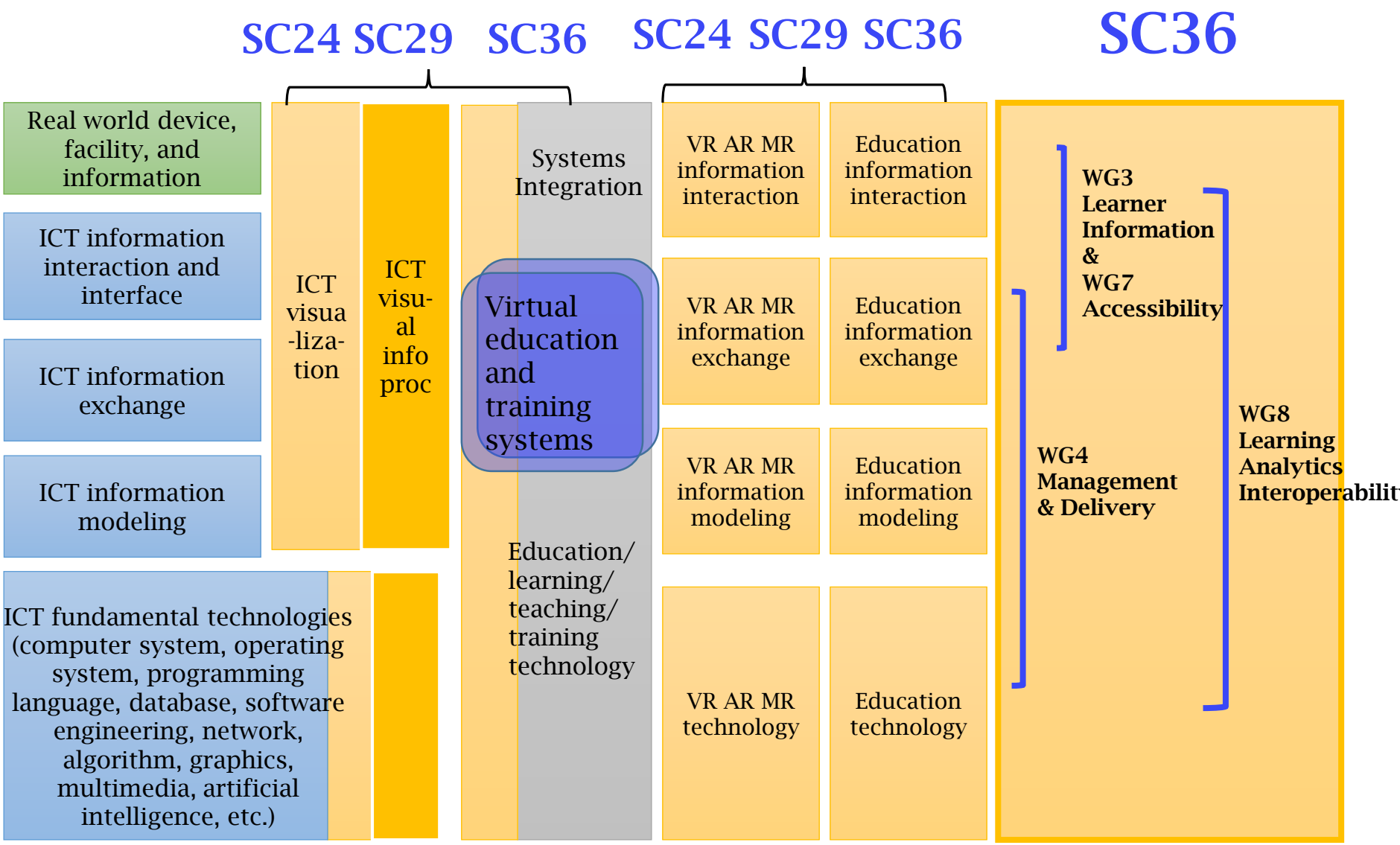
Architecture for Virtual Education and Training (5)



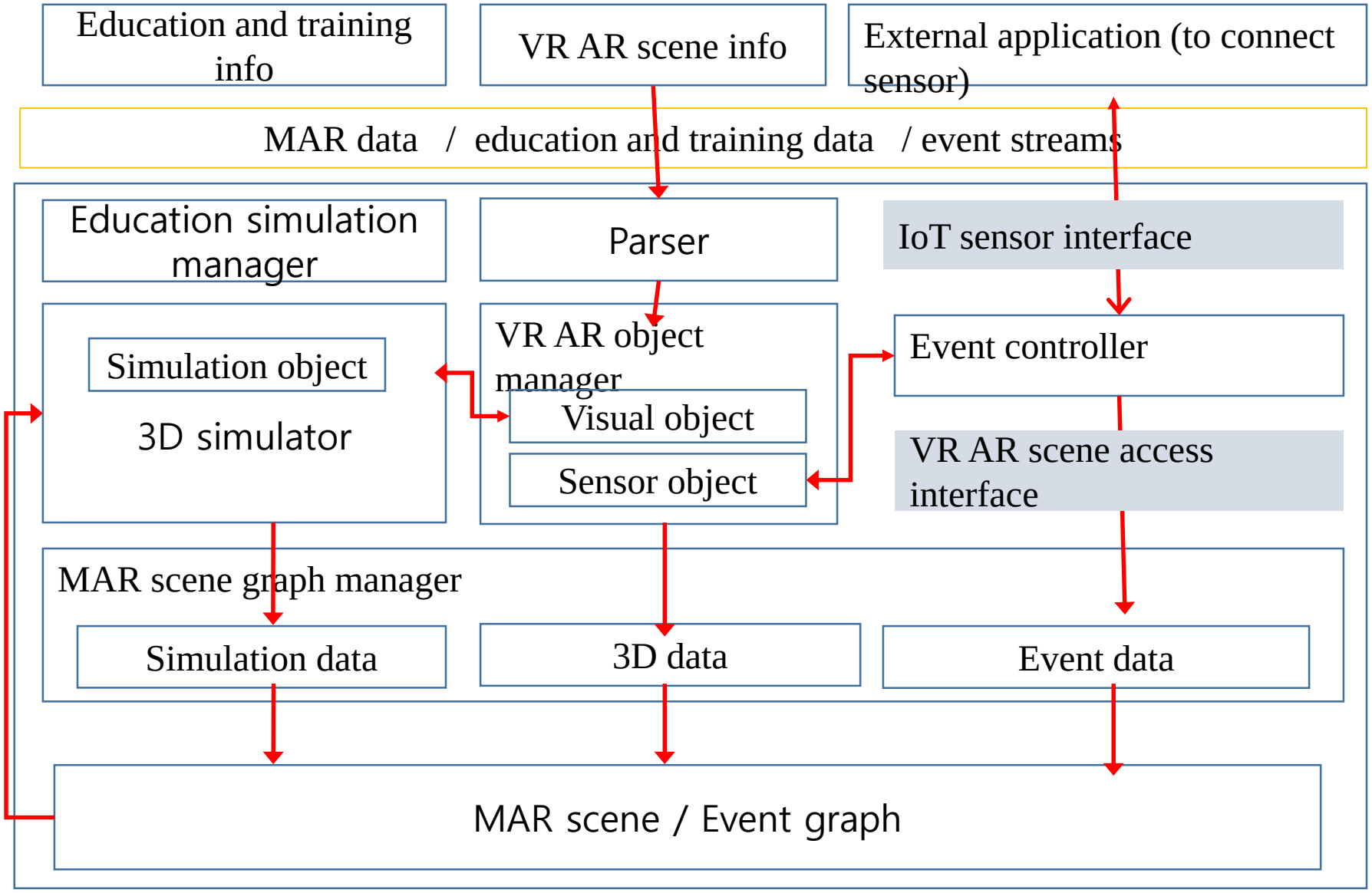
Architecture for Virtual Education and Training (6)



Architecture for Virtual Education and Training (7)



System Framework for Virtual Education and Training Systems



SC24 Study Group for Visualization for Systems Integration

- A SG for Visualization for Systems Integration was created (SC24 Plenary Meeting, Arlington, VA, USA, 2017-8-11)
- Areas in scope
  - Smart city visualization
  - Virtual education and training systems
  - 3D printing and scanning information exchange
  - 3D wearable services
  - 3D digital human representation and information model
  - 3D medical and health information services

SC36 AHG on environments and resources for AR & VR

Resolution 27 (Melbourne 2017): Extension of the AHG 1 on environments and resources for Augmented Reality (AR) and Virtual Reality (VR)

Noting the report on environments and resources for AR/VR (SC 36N3519 and N3544), SC36 extends one year of an AHG on environments and resources for AR and VR with the following terms of reference:

- To investigate AR and VR technology for LET perspective
- To develop standardization topics and/or use cases collaborating with WGs

The membership of the AHG is open and this AHG expects the following activities:

- Continuation of webinars using ISO WebEx
- Based on work done to prepare a document for wide distribution to SC36 P, L, and O members with this document introducing issues and attached survey document to facilitate responses and inputs

Note 1: SC36 members are requested to provide comments and/or resources.
Note 2: SC36 members can provide more use cases or revise collected use cases via the survey.

Conclusions

- Virtual education and training systems
  - VR/AR/MR
  - IoT sensors
  - Systems integration
- JTC1 standards and standardization for virtual training and education systems
  - SC 24, SC 29, and SC 36 standards and work items
  - Other standards would be included
- Standards based architecture for virtual education and training systems
- Standards based information modeling for virtual education and training systems
- Guidelines for developing VR AR based education and training systems