Overview of MPEG-21

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Outline of contents

• Introduction
  • Vision, technologies, and strategy
  • Digital Item Declaration
  • Digital Item Identification
  • Intellectual property management and protection
  • Rights Expression Language
  • Rights Data Dictionary
  • Digital Item Adaptation
  • Reference

Terms

MPEG-21 – Multimedia Framework
MPEG-21 Standard No. ISO/IEC 21000

MPEG Family

MPEG-1 – Coding of moving pictures and audio for digital storage media (CD-ROM, MP3), 11/92
MPEG-2 – Generic Coding of moving pictures and audio information (DVD, Digital TV), 11/94
MPEG-4 – Coding of Audiovisual Objects for MM appls Ver1 09/98, Ver2 11/99
MPEG-7 – Multimedia content description for AV material 08/01
MPEG-21 – Multimedia framework: Integration of multimedia technologies, 2/07

From MPEG-1 to MPEG-21

• MPEG-3, ever defined, but abandoned
• MPEG-5 and -6, not defined

MPEG 1 (ISO/IEC 11172)

• Completed in 1991
• Digital storage media with bit rates up to ~1.5Mbps
• Removes intra- and inter-frame redundancy with block-based DCT and motion compensation
• Generates I, P and B-frames
• Progressive pictures only
• Optimized for SIF (352x240) resolution
• Fixed 4:2:0 color format
MPEG-2 (ISO/IEC 13818)
- Completed in 1994
- Greater input format flexibility
- Higher data rates
- Better error resilience
- Field/frame prediction modes (interlace support)
- Field/frame DCT coding syntax
- Downloadable quantization matrix
- Scalability extensions
  - Spatial
  - Temporal
  - SNR
- Display syntax
  - 3:2 pull-down
  - pan-and-scan
  - color formats

MPEG-4 (ISO/IEC 14496)
- 1993: “Very Low Bit-Rate Audio/Visual Coding”
- 1994: Updated to “Coding of Audio/Visual Objects”
- Key objectives
  - Common technology for multiple services
    - interactive
    - Broadcast
    - Conversational
  - Extension of interactivity as with elements in a multimedia scene
  - Integration of natural and synthetic content
  - Coverage over wide range of access conditions
    - low bit-rates,
    - error prone channels
    - scalable coding
  - Management and protection of intellectual property

MPEG-7 (ISO/IEC 15938)
- Content Management
  - Increasing availability of multimedia content
  - Finding, selecting, filtering desired material difficult
  - Desire for information about the content
- Objective
  - Standardized content-based descriptions for multiple types of audio-visual information
  - Enable rapid and efficient content identification
  - Suitability for large range of applications
- MPEG-1, -2 and -4 represent the content
  - “the bits”
- MPEG-7 represents information about the content
  - “the bits about the bits”

MPEG-21 (ISO/IEC 21000)
- What?
  - Multimedia Framework for multimedia delivery and consumption
  - Content creator and content consumer as focal points
- Why?
  - Many elements (standards) exist for delivery and consumption of multimedia contents
  - Absence of ‘big picture’ to describe how elements relate to each other
  - Increase interoperability to allow existing components to be used together by filling gaps
- Why now?
  - HW building blocks and infrastructure in place
  - Compression, transmission, description standards are ready

MPEG-21
- MPEG-21 is an open standards-based framework for multimedia delivery and consumption.
- It aims to enable the use of multimedia resources across a wide range of networks and devices.
Parts of the MPEG-21 Standard

- ISO / IEC 21000 - 1: Vision, technologies, and strategy
- ISO / IEC 21000 - 2: Digital Item Declaration (DID)
- ISO / IEC 21000 - 3: Digital Item Identification (DII)
- ISO / IEC 21000 - 4: Intellectual property management and protection (IPMP)
- ISO / IEC 21000 - 5: Rights Expression Language (REL)
- ISO / IEC 21000 - 6: Rights Data Dictionary (RDD)
- ISO / IEC 21000 - 7: Digital Item Adaptation (DIA)
- ISO / IEC 21000 - 8: Reference software
- ISO / IEC 21000 - 9: File format
- ISO / IEC 21000 - 10: Digital Item Processing (DIP)
- ISO / IEC 21000 - 11: Evaluation methods for persistent association technologies
- ISO / IEC 21000 - 12: Test bed for MPEG-21 resource delivery

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Multimedia Framework Context

- Ubiquity of international communication networks such as the Internet challenges traditional business models
  - Shift from physical to electronic commerce
  - Rights management complexities
- Increasingly complex consumption infrastructure
  - Deployment of coexisting heterogeneous networks
  - Wide range of powerful and flexible terminals
- Standards can provide a common infrastructure for trading digital assets

Digital Supply Chain

- Author
- Agent
- Publisher
- Aggregator
- Distributor
- Wholesaler
- eTailer
- Consumer

Authoring Tools
- Publishing S/W
- Asset Management
- Content Packaging
- Content Hosting
- WWW. Store Front
- Rights Clearing

User Interface
- Digital Rights
- Meta Data
- Digital Content Products & Services

Multiple Flows and Transactions

Between any two points there are flows:
- Information about content
- Authentication between peer entities
- Content
- Content usage rights
- Technology usage rights
- Delivery usage rights
- Money
Current Practice

Today’s media contain implicit or explicit rules:

- A book can be read and resold
- A CD may be played, but may not be copied
- A video cassette is for private consumption, can be rented but may not be copied
- A public broadcast can be watched because license fee has been paid
- A commercial broadcast can be watched because one undertakes to watch commercials
- A pay TV broadcast can be watched because one has paid a monthly subscription

Future Practice?

- The Multimedia Framework gives unlimited flexibility:
  - One can buy an MPEG-21 Digital Item and:
    - Copy it to a portable device once only
    - Rent it for 24 hours
    - Rent it for 10 playbacks
    - Distribute it to 10 friends and get a copy for free
    - Access it for free at a low quality, and for a fee at high quality

MPEG-21 Objectives

- Vision
  - To define a multimedia framework to enable transparent use of multimedia resources across a wide range of networks and devices used by different communities
- Purpose
  - Enable electronic creation, delivery, trade of digital multimedia content
- Goals
  - Provide access to information and services from almost anywhere at anytime with ubiquitous terminals and networks
  - Identify, describe, manage, and protect multimedia content to support delivery chain of content creation, production, delivery, and consumption

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Digital Item Declaration

- ISO/IEC 21000-2
- Reached FDIS in May 2002
- Purpose & Conceptual Model
  - Declare a Digital Item’s makeup and structure
  - Composite whole composed of various parts
- Syntactic Representation
  - XML-based Digital Item Declaration Language (DIDL)
- Features
  - Hierarchical, generic structure
  - Flexible meta-data expression
  - Reusable and configurable elements
Digital Item

- A structured digital object with a standard representation, identification and meta-data
- The fundamental unit of distribution and transaction in the MPEG-21 framework
- Digital Item = resource + metadata + structure
- Resource: individual asset, e.g., MPEG-2 video
- Metadata: descriptive information, e.g., MPEG-7
- Structure: relationships among parts of the item

Benefits of Digital Item

- Tangibility（确切性）
  - content is more than files on a disk
- Deliverability (可交付性)
  - more automated, less end-user involvement
- Configurability（可配置性）
  - express options/augmentations for specific users, groups, locales, prices, etc.

DID Features

- Domain-neutral
  - Flexible abstract structural model provides wide applicability
- Metadata untangled from content
  - Metadata left more accessible
- Diverse media and metadata types supported
  - Integrates existing standards
  - Permits mixing multiple standards and proprietary formats
- Configurable
  - Allows generation of multiple DIs from single source DI
- After-Market markup
  - Where user may not be authorized to modify the original, comments and highlights on DI is supported

DID Provides

- Abstract Digital Item model
  - Structural elements
  - Configuration elements
  - Referential elements
  - Special purpose elements
- Schema for concrete DID representation
  - XML-based Digital Item Declaration Language (DIDL)

Basic Structural Elements

- Resource
  - Identifies or encapsulates a single media resource
  - Places no restrictions on media types or formats
- Statement
  - Expresses structured set of specific metadata values
  - MPEG-7 or other XML-based metadata
- Component
  - Resource combined with relevant Descriptors
More on Basic Structural Elements

- **Descriptor**
  - Expresses metadata for an element through encapsulation
    - Statement (structured metadata)
    - Component (unstructured metadata)
    - May contain (sub)-Descriptors
- **Item**
  - Atomic unit of content
  - Embodies DI
  - May contain (sub)-Items
- **Container**
  - Logical grouping of related Items

Abstract Model

Resource

Statement

Component
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Digital Item Identification

- ISO/IEC 21000-3
- Provides means to uniquely identify and describe Digital Items
- Defines the relationship between Digital Items and existing ID systems
  - This part does not specify any new ID systems
- Identification
  - syntax: URI of the form
    urn:mpeg:mpeg21:diid:sss:nnn
    • sss denotes the identification system
    • nnn denotes a unique identifier within that identification system

Digital Item Identification-DII

- Purpose
  - Uniquely identify Digital Items and related entities
- Features
  - Globally unique, like a Universal Product Code (UPC)
  - URN based Syntax
- Standardizes
  - Syntactical mapping to commonly used identification systems
    - cIDF-Content ID Forum
    - DOI-Digital Object Identifier
    - ISBN-International Standard Book Number
    - etc
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Intellectual Property Management and Protection-IPMP

• ISO/IEC 21000-4
• Multimedia Digital Rights Management (DRM)
  – Enables users to express their rights, interest, and agreements related to Digital Items (DI’s)
  – Enables users to derive appropriate levels of assurance that those rights, interests and agreements will be persistently and reliably managed and protected across a wide range of networks and devices

IP Management and Protection

• Management and protection
  – MPEG-4 audio-visual objects
  – MPEG-7 descriptors and description schemes
  – Other DI types including personal data and rights to its use
• Three parts to the standard underway
  – IPMP Framework
  – Rights Expression Language (REL)
  – Rights Data Dictionary (RDD)
IP Management and Protection

- Provides a tools framework for Intellectual Property Management
- Major goal of Content Industry
- No single secret
- No monopoly (垄断)
  - Different companies’ offerings can interoperate
  - One terminal can access to all content
  - Content companies may select IPMP vendors with the trust model that suites their own needs

Conditional Access
Digital Rights Management

- Conditional Access (CA)
  - Encryption unlocked by a simple YES/NO system
  - End user given key allowing access
  - Involves encryption/decryption functionality
- Digital Rights Management (DRM)
  - Complex system
  - Based on satisfaction of specific requirement associated with content consumption
  - License is given to party who has agreed to satisfy requirements
  - End user can only use license after proving identity as party having agreed to satisfy requirements

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Rights Expression Language-REL

- Objective
  - Clear, Concise, Unambiguous, Machine-Readable expressions of the content owners intended permissions for use
- Serves all members of the value chain
  - Complex expressions need root of distribution
  - Simple expressions at point of consumption

REL Data Model

- Four basic entities and relationship
- Basic relationship defined by REL assertion “grant”
- Grant consists of
  - Principal to whom grant is issued
  - Right that grant specified
  - Resource to which right in grant applies
  - Condition that must be met before right can be exercised
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Rights Data Dictionary-RDD

- ISO/IEC 21000-6
- Scheduled for CD July 2002
- WD3.0 based on <indecs>2rdd data dictionary
  - This was the starting point used for RDD
- Targets for Standardization
  - Model
  - Core set of terms
  - The relation between the RDD and the core set of descriptive terms in the REL

Rights Data Dictionary

- Provides reference set of semantic meanings for terms used in rights transactions
- Provides tools to contextually analyze a Rights term to map the term to the reference set of semantics
- RDD allows parties to understand what terms mean in their own different environment

RDD Standardized Term Attributes

REL/RDD Relationship
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Digital Item Adaptation-DIA

- ISO/IEC 21000-7
- Scheduled for CD Dec 2002
- Targets for standardization
  - Usage Environment Description Tools
  - Resource Adaptability Tools
  - Systems Related Tools

Universal Multimedia Access (UMA)

- Many devices, networks, content formats
  - Devices exist with varying capabilities
  - Network conditions are always changing
  - Number of content representation formats is increasing
- "Adaptive delivery" of multimedia content and "Content re-purposing" for consistent vision
- MPEG-21 vision for Terminals & Networks

UMA Concept

Digital Item Adaptation (DIA)

- Usage environment description tools
  - Terminal capabilities
  - Network characteristics
  - User characteristics
  - Natural environment characteristics
- Resource adaptability tools
  - Binary media resource adaptability
  - Metadata adaptation
  - QoS management tools
- Multimedia content format and description links
- Wide range of application domains
- Semantically compatible with existing standards

Concept of DIA
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• Documents available at:
  http://leonardo.telecomitalialab.com/mpeg/working_documents.htm
  – MPEG-21 Requirements (includes specific DIA requirements)
  – Overview of MPEG-21 DIA Core Experiments
• Participate in AHG on MPEG-21 DIA
  – mailing list is open to the public <mpeg21-uma@merl.com>
  – to subscribe send email to Anthony Vetro <avetro@merl.com>

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