

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

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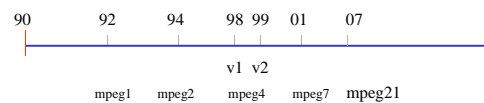
Terms

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

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From MPEG-1 to MPEG-21



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

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MPEG Family

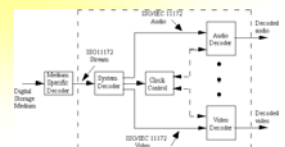
MPEG-1 – Coding of moving pictures and audio for digital storage media (CD-ROM, MP3), 11/92
MPEG-2 – Generic Coding of moving pictures and audio information (DVD, Digital TV), 11/94
MPEG-4 – Coding of Audiovisual Objects for MM appls Ver1 09/98, Ver2 11/99
MPEG-7 – Multimedia content description for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

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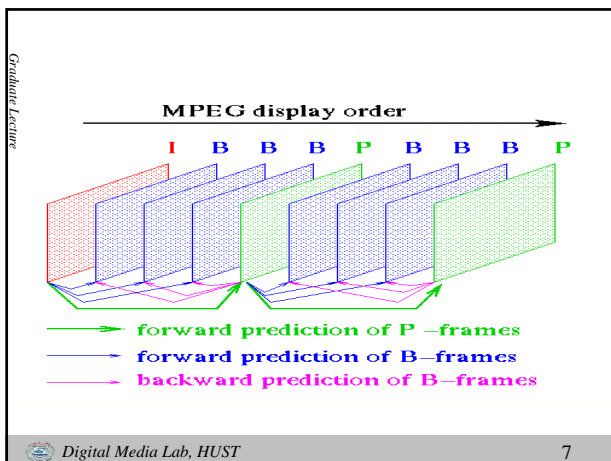
MPEG 1 (ISO/IEC 11172)

- 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



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Graduate Lecture

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

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Graduate Lecture

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

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Graduate Lecture

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”

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Graduate Lecture

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

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Graduate Lecture

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.**

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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*

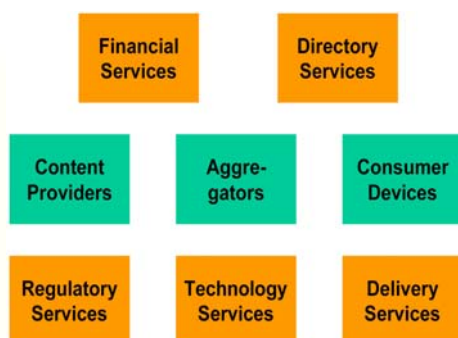
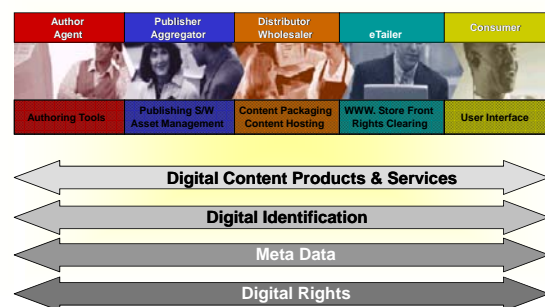
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Multimedia Framework Context

- 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

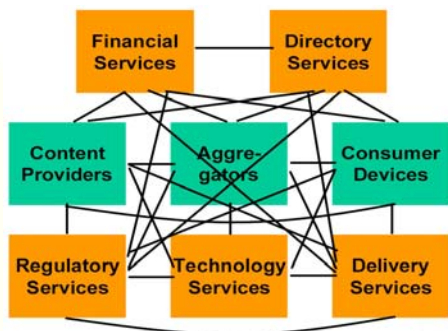
Digital Supply Chain



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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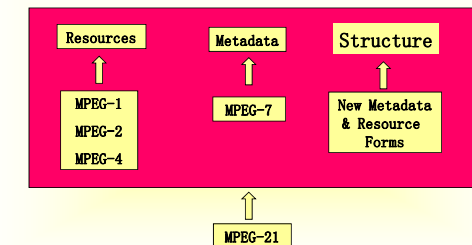
Digital Item Declaration

- 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

Digital Item



Benefits of Digital Item

- **Tangibility**
 - content is more than files on a disk
- **Deliverability**
 - more automated, less end-user involvement
- **Configurability**
 - 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

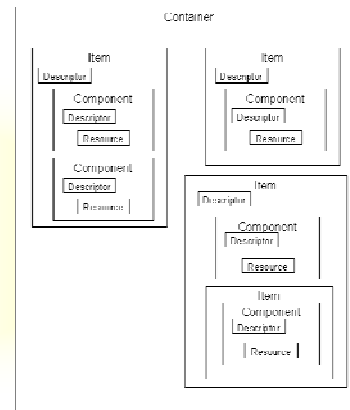
- **Abstract Digital Item model**
 - Structural elements
 - Configuration elements
 - Referential elements
 - Special purpose elements
- **Schema for concrete DID representation**
 - XML-based Digital Item Declaration Language (DIDL)

Basic Structural Elements

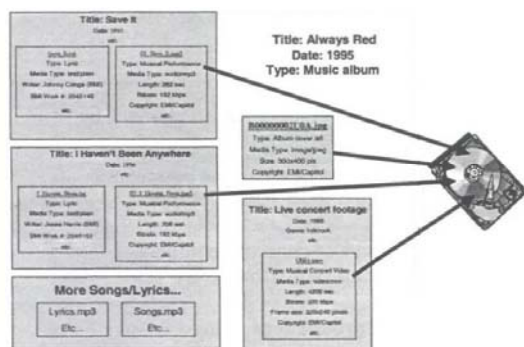
- **Resource**
 - Identifies or encapsulates a single media resource
 - Places no restrictions on media types or formats
- **Statement**
 - Expresses structured set of **specific** metadata values
 - MPEG-7 or other XML-based metadata
- **Component**
 - Resource combined with relevant **Descriptors**

More on Basic Structural Elements

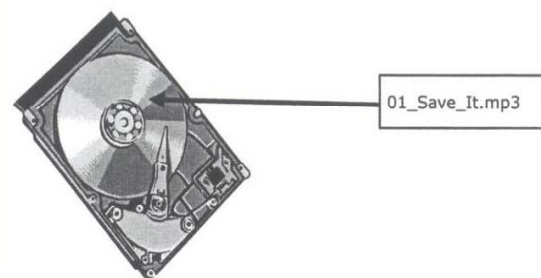
- **Descriptor**
 - Expresses metadata for an element through encapsulation
 - **Statement** (structured metadata)
 - **Component** (unstructured metadata)
 - May contain (sub)-Descriptors
- **Item**
 - Atomic unit of content
 - Embodies DI
 - May contain (sub)-Items
- **Container**
 - Logical grouping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



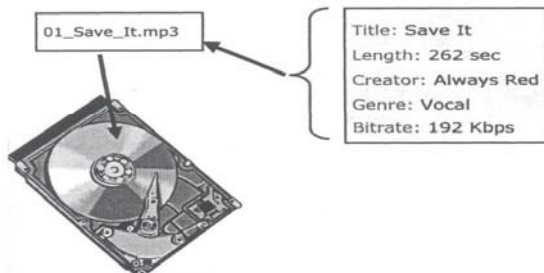
Abstract Model



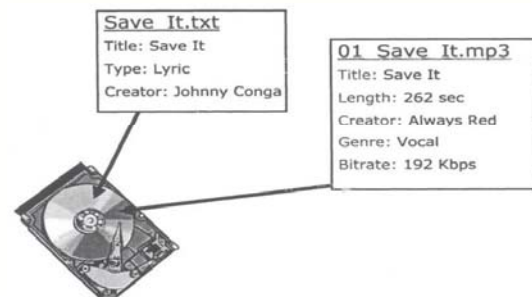
Resource



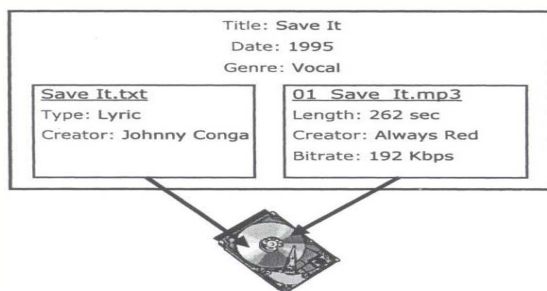
Statement



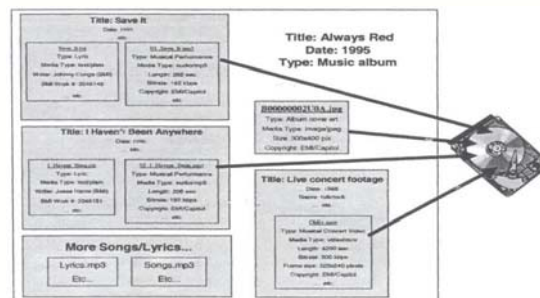
Component



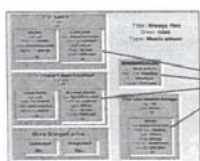
ITEM



ITEM



Digital Item Declaration Language



```

<Title>
<Condition REQUIRED="MUST">
<Condition REQUIRED="MUST, SHOULD">
<Description NAME="TYPE" VALUE="MUSIC_ALBUM">
<Description NAME="Track" VALUE="1" />
<Description NAME="Title" VALUE="Save It" />
<Description NAME="Genre" VALUE="Vocal" />
<Description NAME="CoverImage" VALUE="CD" />
<Description NAME="Length" VALUE="262" />
<Description NAME="Bitrate" VALUE="192" />
<Description NAME="Creator" VALUE="Always Red" />
<Description NAME="Date" VALUE="1995" />
<Description NAME="Lyrics" VALUE="Lyrics.txt" />
<Description NAME="MP3" VALUE="01 Save It.mp3" />
<Description NAME="Live concert footage" VALUE="Live concert footage.mp3" />
<Description NAME="More Songs/Lyrics" VALUE="More Songs/Lyrics.txt" />
<Description NAME="Lyrics.mp3" VALUE="Lyrics.mp3" />
</Title>

```

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Digital Item Identification-DII

- 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

- 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,
 - DOI
 - ISBN
 - etc

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

- ISO/IEC 21000-5
- **Current WD 3.0 based on XrML**
 - XrML is serving as the basis for further work
 - ODRL also evaluated
- **Targets for Standardization**
 - Machine-readable language
 - Declare rights and permissions using the terms as defined in the Rights Data Dictionary
 - RDD-REL are intended to provide *flexible, interoperable* mechanisms to support *transparent* and *augmented* use of digital resources
 - REL supports guaranteed end-to-end *interoperability, consistency* and *reliability* between different *systems* and *services*

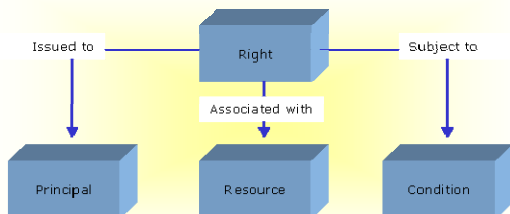
Rights Expression Language-REL

- **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

REL Data Model



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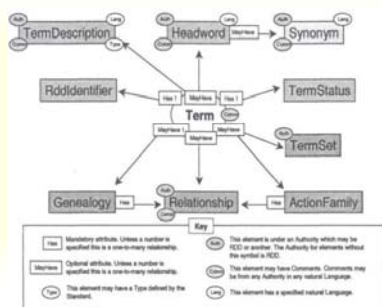
Rights Data Dictionary-RDD

- 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

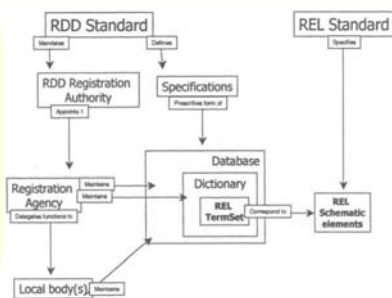
Rights Data Dictionary

- 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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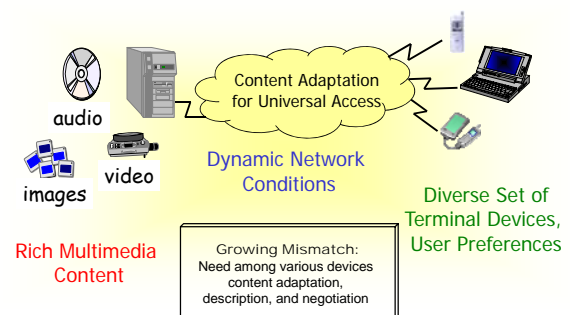
Digital Item Adaptation-DIA

- 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

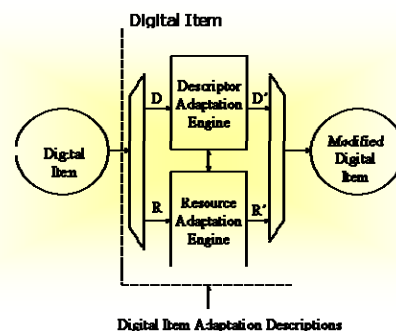
UMA Concept



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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References

- 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>

References

- Documents available at:
http://leonardo.telecomitalialab.com/mpeg/working_documents.htm
 - MPEG-21 Overview
 - MPEG-21 Use Case Scenarios
 - MPEG-21 Requirements
 - Study of Proposed Draft Technical Report (ISO/IEC 21000-1)

Thanks

