The MPEG-21 Multimedia Framework for Integrated Management of Environments enabling Quality of Service

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Outline

- UMA: Universal Multimedia Access
- MPEG-21 Overview
  - Concept and MPEG-21 Parts
  - Digital Item Declaration
  - Rights Expression Language
  - Digital Item Adaptation
- End-to-end management enabling UMA: the ENTHRONE solution based on MPEG-21
- Conclusions

UMA Challenge and Concept

Universal Multimedia Access := any content should be available anytime, anywhere
Universal Multimedia Experiences := User should have worthwhile, informative experience anytime, anywhere

Heterogeneous Networks, Dynamic Conditions

Rich Multimedia Content

Diverse Set of Terminal Devices, User Preferences

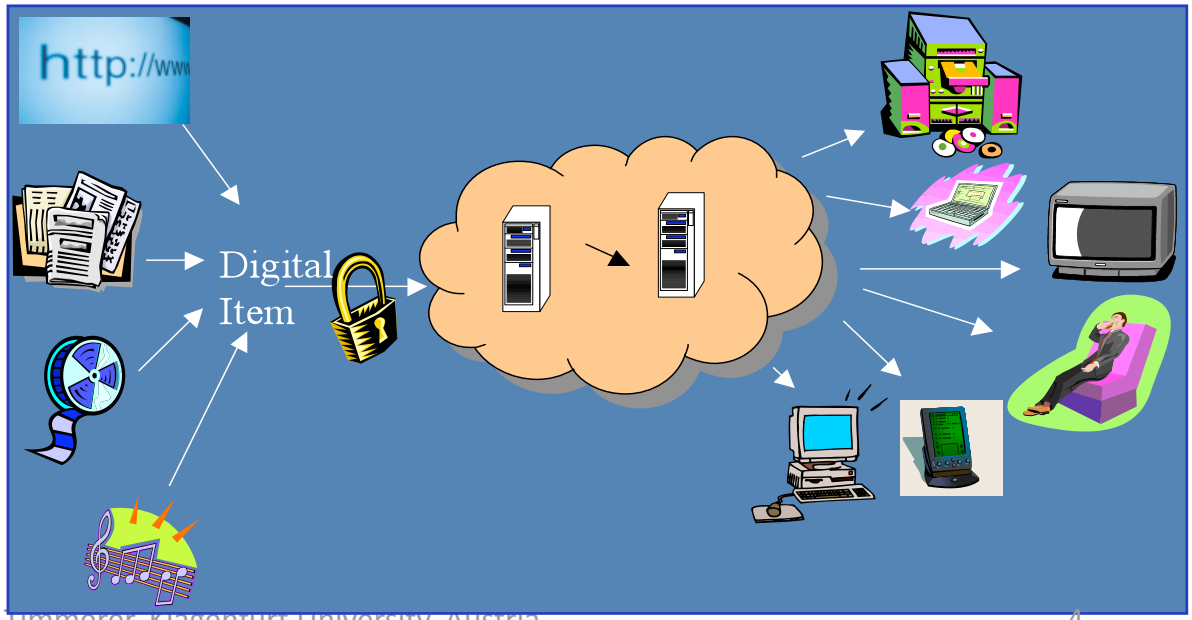
Growing mismatch

⇓

Need for scalable content, descriptions, negotiation, adaptation

Introduction to MPEG-21 – Vision

- … to enable transparent and augmented use of multimedia resources across a wide range of networks, devices, user preferences, and communities, notably for trading (of bits)
- Assumption: every human is potentially a node of a network involving billions of …
  - content providers
  - value adders
  - packagers
  - service providers
  - consumers
  - resellers



MPEG-21: Basic Concepts

What ? – Digital Items (DIs)

- A **Digital Item (DI)** is a structured digital object with a standard representation, identification, and metadata within the MPEG-21 framework
- Digital Items are "the content"

Who ? – Users

- A **User** is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item
- Users will assume rights and responsibilities according to their interaction with other Users
- All parties that have a requirement within MPEG-21 to interact are categorized equally as Users

MPEG-21: Basic Concepts

DIGITAL ITEM = RESOURCES + METADATA + STRUCTURE

Resources: individual assets, (distributed) content

Metadata: (distributed) data about or pertaining to the DI or its resources

Structure: relationships among the parts of the DI

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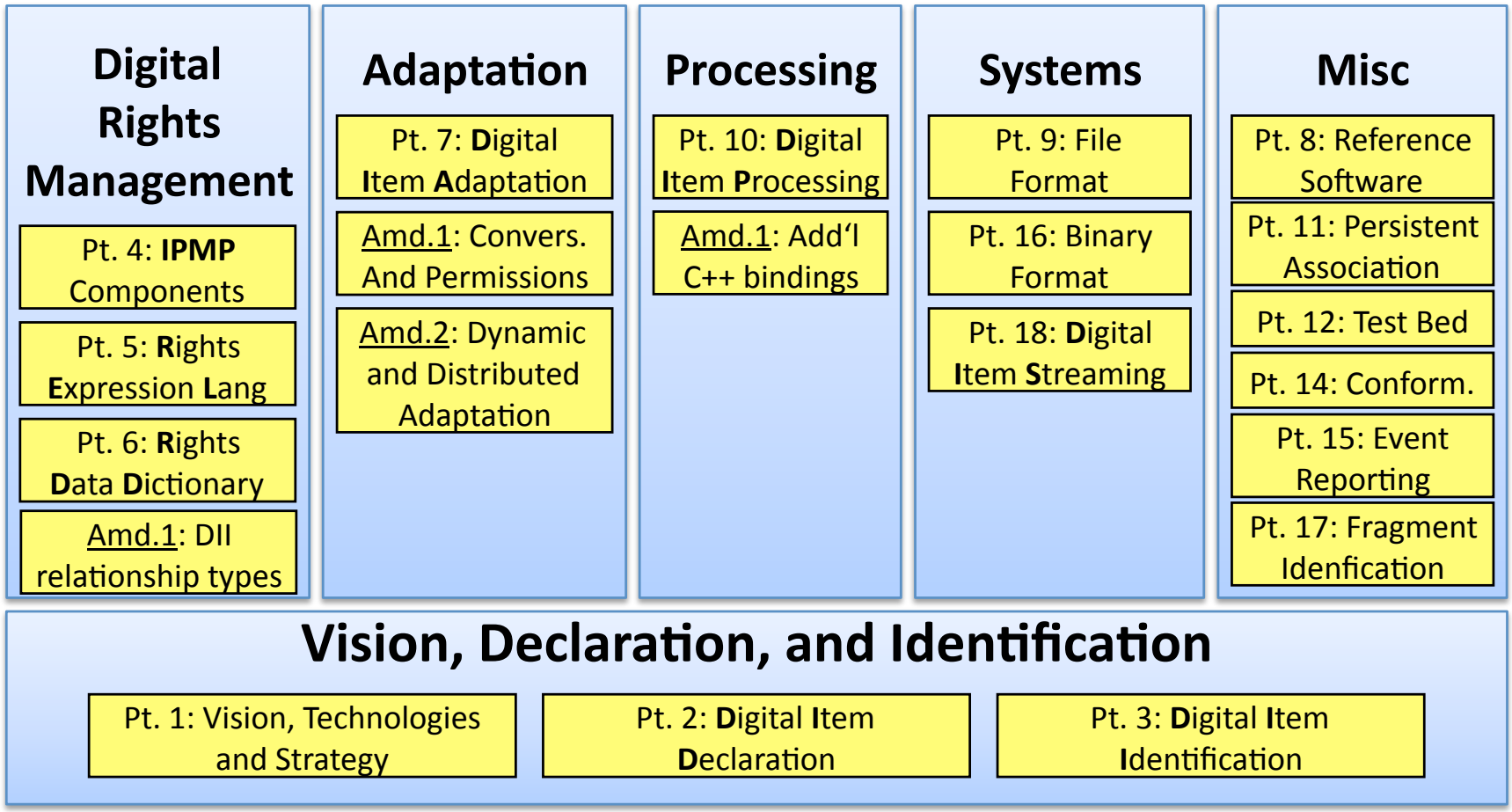
MPEG-21 Organisation – Parts



Digital Item Declaration

Why declare Digital Items?

Currently, multimedia applications are based on transfer / processing / presentation / ... of:

- Different **media resources/types**, with different representations
  - Still images (JPEG, JPEG2000, GIF, PNG, ...)
  - Video (MPEG-4, QuickTime, ...) and audio (WAV, MP3, ...)
  - Text (txt, doc, pdf, ...)
  - ...
- **Metadata**
  - Descriptive information about actual data (MPEG-7, …)
  - DRM information (rights expressions, IPMP, …)
  - Configuration information (usage environment descriptions, …)
  - ...
- But how do these elements relate to each other ? ⇨ **Structure**

Structure

Resources (e.g., MPEG-4, other/new formats)

Metadata (e.g., MPEG-7, other/new formats)

⇨ **MPEG-21 Solution: Digital Item Declaration Language (DIDL)**

Digital Item Declaration (DID) – instance conforming to DIDL

IPMPDIDL: how to include IPMP information and protected parts of DIs in a DID

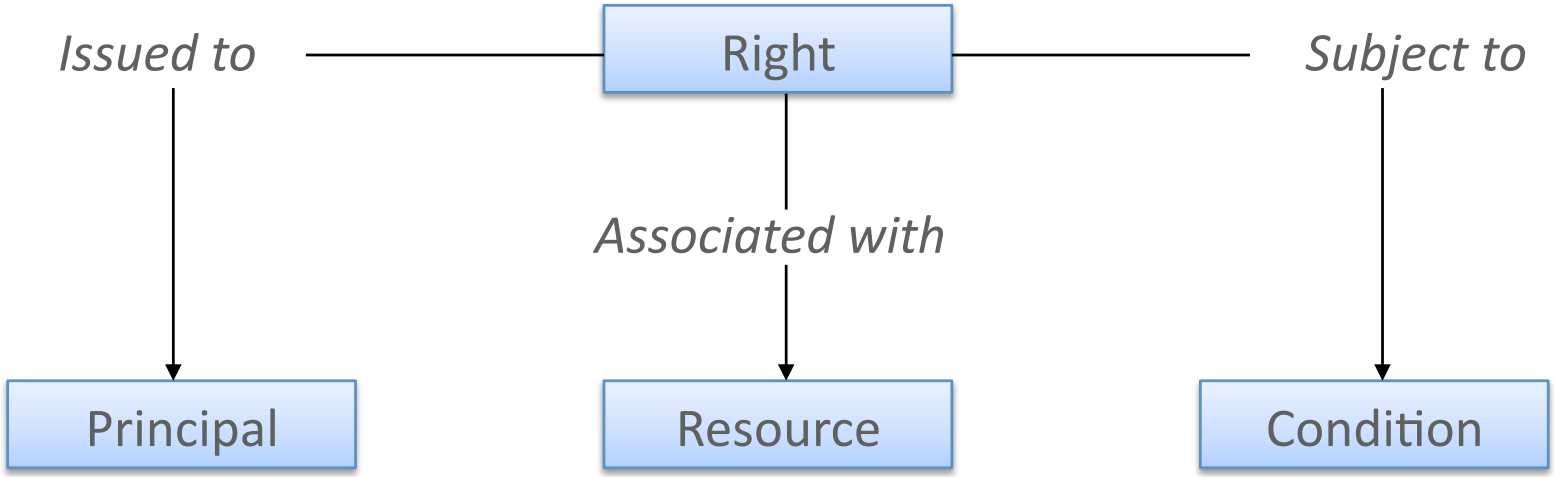
DID Example


```
<DIDL>
 <Item>
  <Descriptor>
   <Statement mimeType="text/plain">Best of Mozart</Statement>
  </Descriptor>
  <Descriptor>
   <Component><Resource mimeType="image/jpg" ref="cover.jpg"/></Co
  </Descriptor>
  <Item>
   <Descriptor>
    <Statement mimeType="text/plain">Le nozze di Figaro KV 492, Overtüre, 4:08</Statement>
   </Descriptor>
   <Component>
    <Descriptor>
     <Statement mimeType="text/plain">Bitrate 192kbps</Statement>
    </Descriptor>
    <Resource mimeType="audio/m4a" ref="track01.m4a"/>
   </Component>
  </Item>
  <!-- further items ... -->
 </Item>
</DIDL>
```

Rights Expression Language

REL := machine-readable language that can declare rights and permissions on digital resources

- Grant: four basic entities and their relationship



⇨ Using this model, flexible rights expressions can be generated

- License: grant and issuer

REL Example

Grant: "John may play DI in 2008"

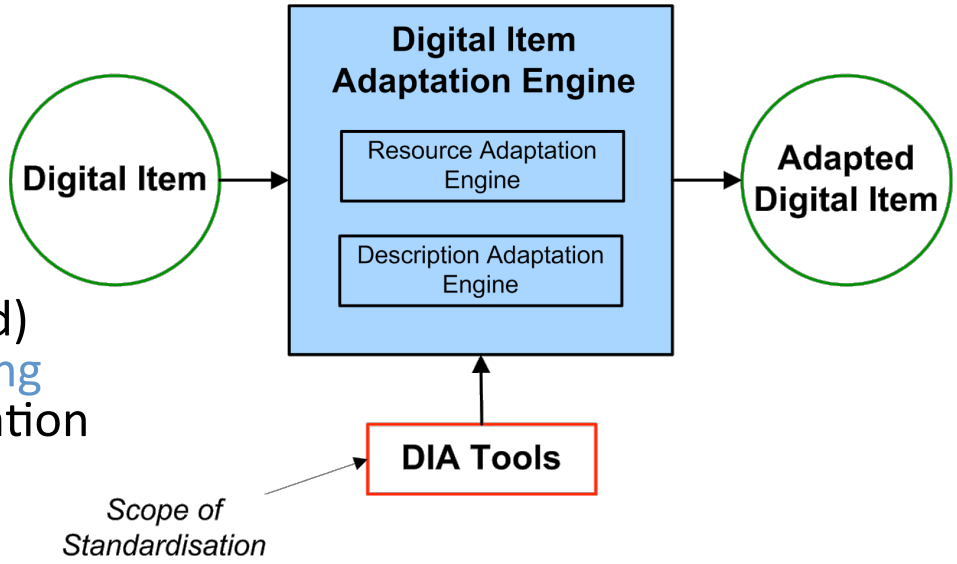
```
<license>
 <grant>
  <keyHolder licensePartId="John">…</keyHolder>          Principal
  <mx:play/>                                             Right
  <mx:diReference>                                       Resource
    <mx:identifier>urn:grid:a1-abcde-1234567890-f</mx:identifier>
  </mx:diReference>
  <validityInterval>                                     Condition
    <notBefore>2008-01-01T00:00:00</notBefore>
    <notAfter>2008-12-31T23:59:59</notAfter>
  </validityInterval>
 </grant>
 <issuer>                                                Issuer
   <keyHolder licensePartId="Xin">…</keyHolder>
 </issuer>
</license>
```

Digital Item Adaptation

DIA := syntax and semantics of tools that assist in the adaptation of Digital Items

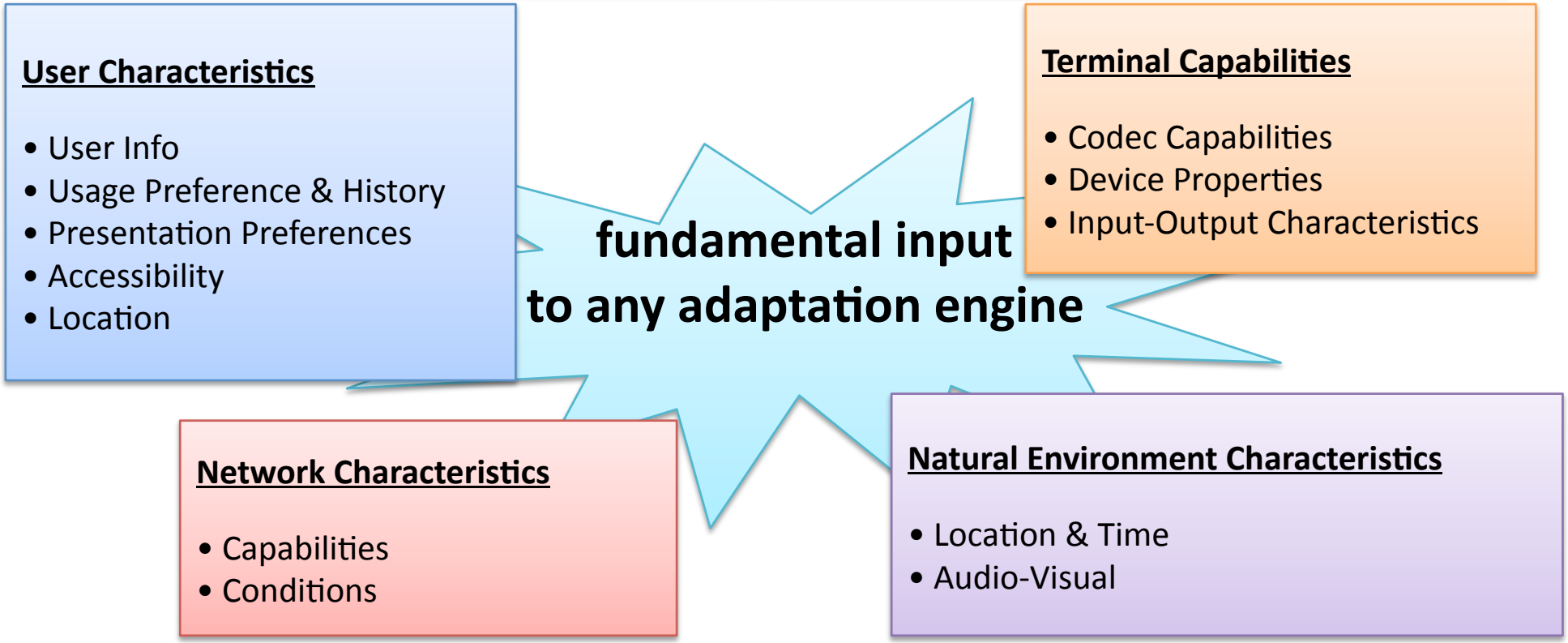
Goals:

- Satisfy transmission, storage and consumption constraints as well as Quality of Service (QoS) management
- Enable transparent access to (distributed) advanced multimedia content by shielding users from network and terminal installation issues



- Codec Format-independent mechanisms that provide support for Digital Item Adaptation in terms of:
  - Resource adaptation
  - Description adaptation
  - Quality of Service management
- The adaptation engines themselves are non-normative tools

Usage Environment Description (UED)



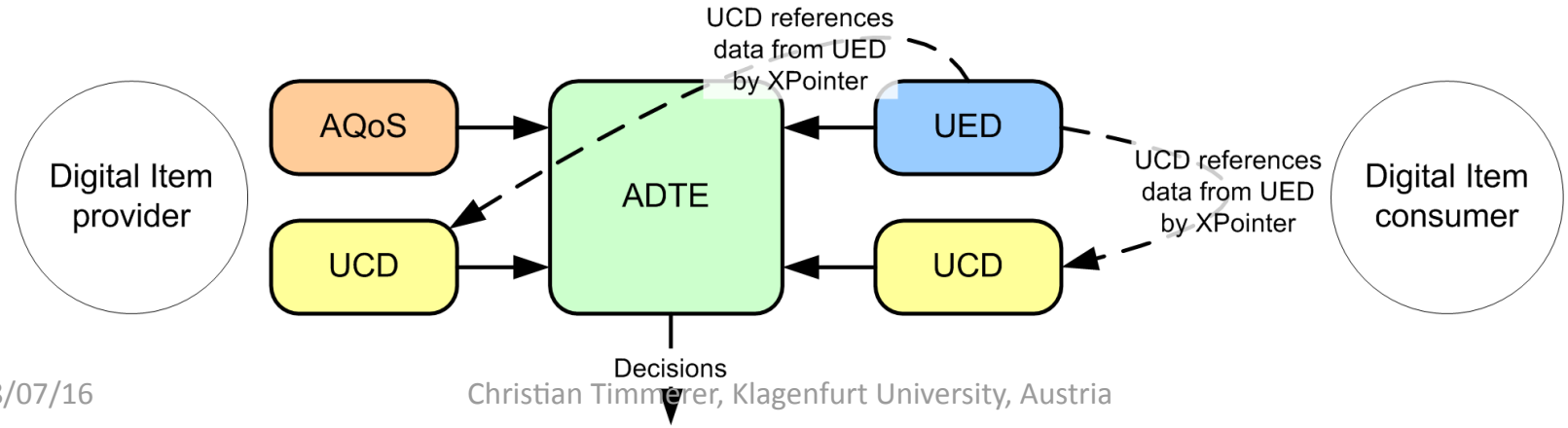
Context-related metadata describes the usage environment in terms of terminal capabilities; network characteristics; user characteristics; natural environment characteristics;

e.g., codec capabilities = mp2, ML@MP; available bandwidth=1500kbps; visually impaired; high-level ambient noise;

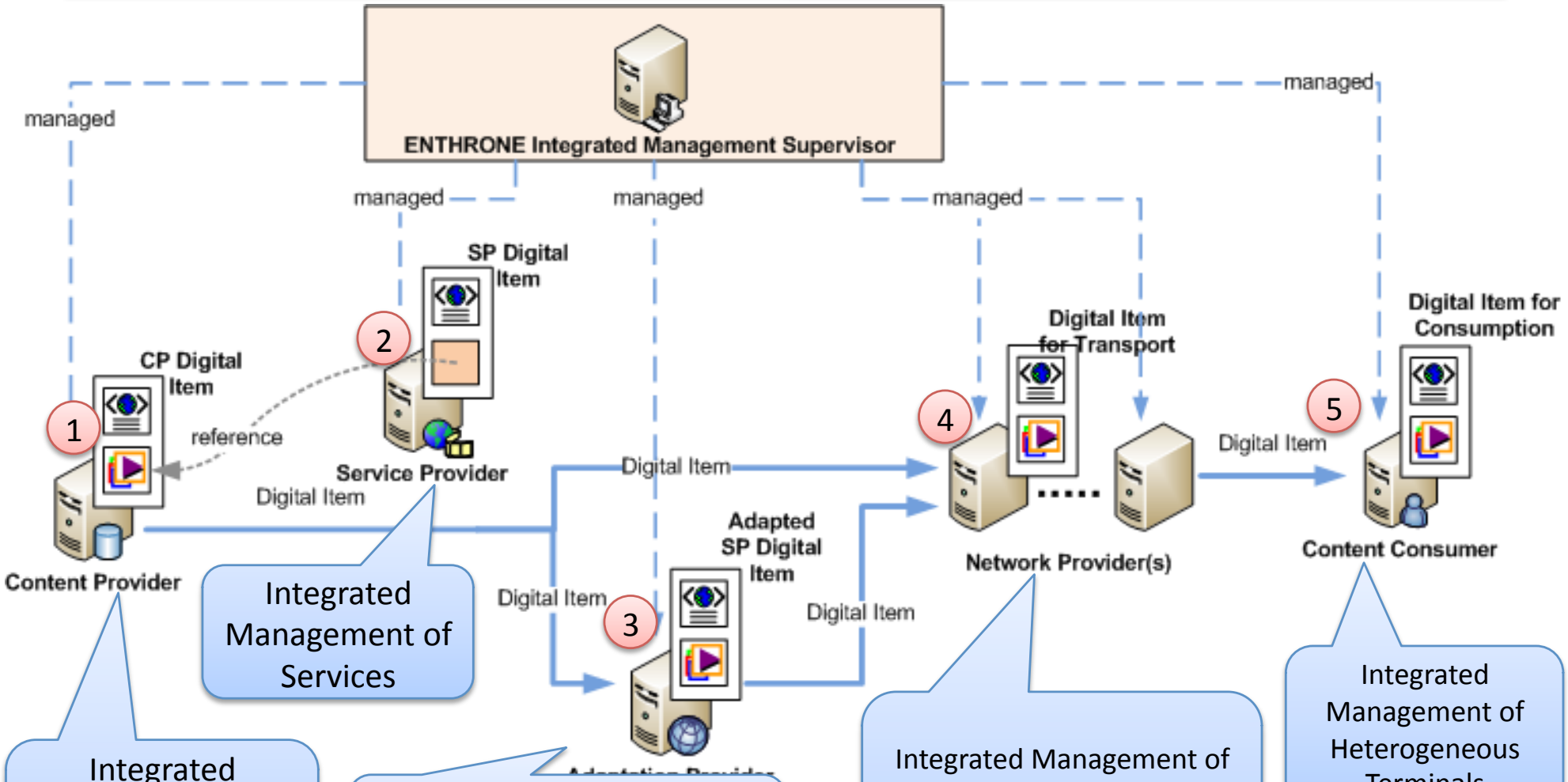
AdaptationQoS and Universal Constraints Description

- **Content-related metadata – AdaptationQoS –** describes the relationship between constraints; feasible adaptation operations satisfying these constraints; associated utilities (qualities);

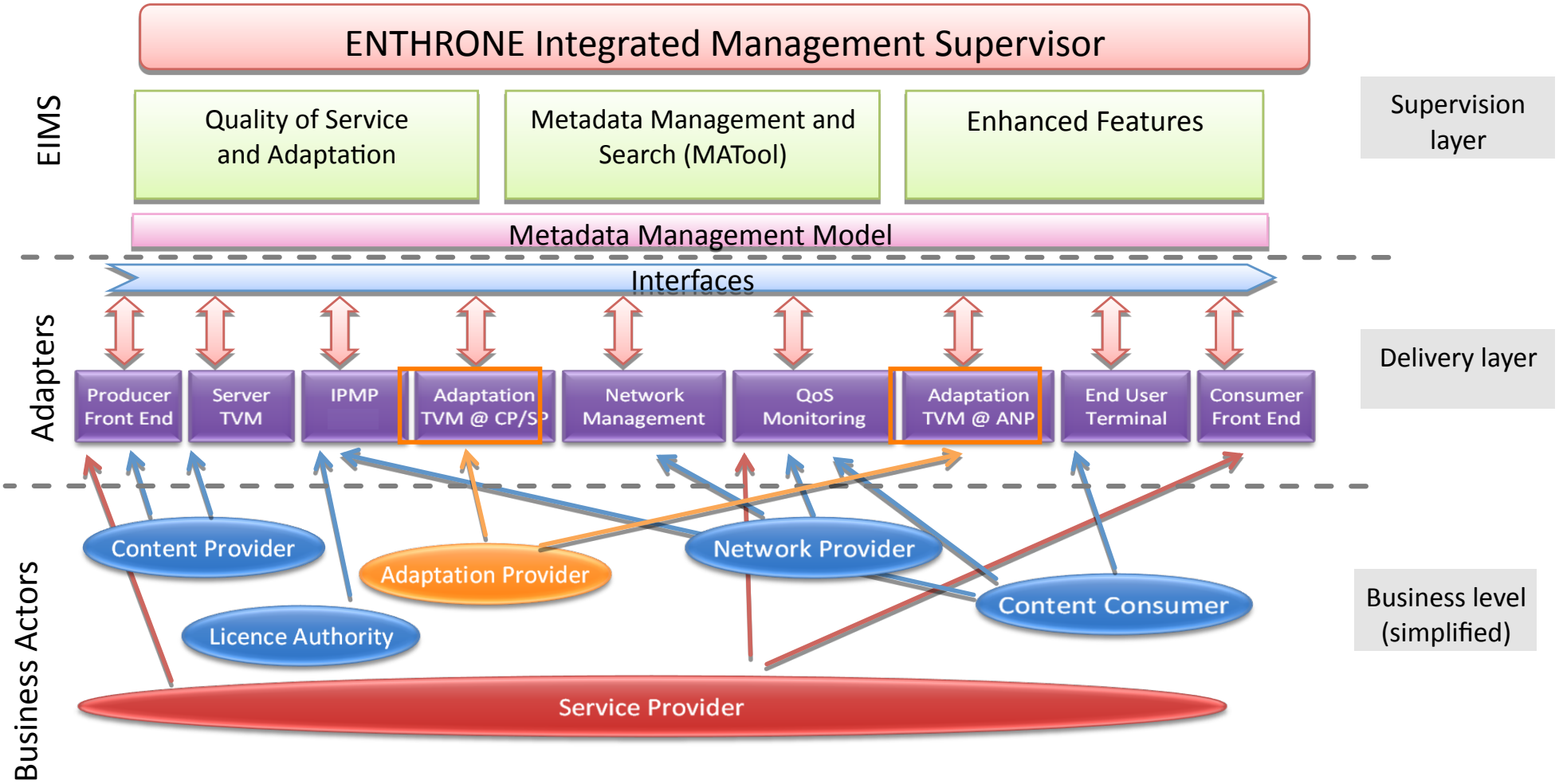
  e.g., available bandwidth is 384kbps, terminal display is CIF; reduce bit-rate; quality at QCIF/30fps/QP=10 versus CIF/10fps/QP=15
  e.g., **bit-rate = 256kbps, frame-rate=30fps, resolution=CIF, etc.**
- **Universal Constraints Description (UCD)**: mathematical approach based on an optimization problem
  - find values for the variables representing adaptation parameters that do not violate the limitation constraints (feasibility) and maximize the optimization constraint (optimality, objective function)



End-to-End QoS through Integrated Management of Content, Networks and Terminals



ENTHRONE System Architecture



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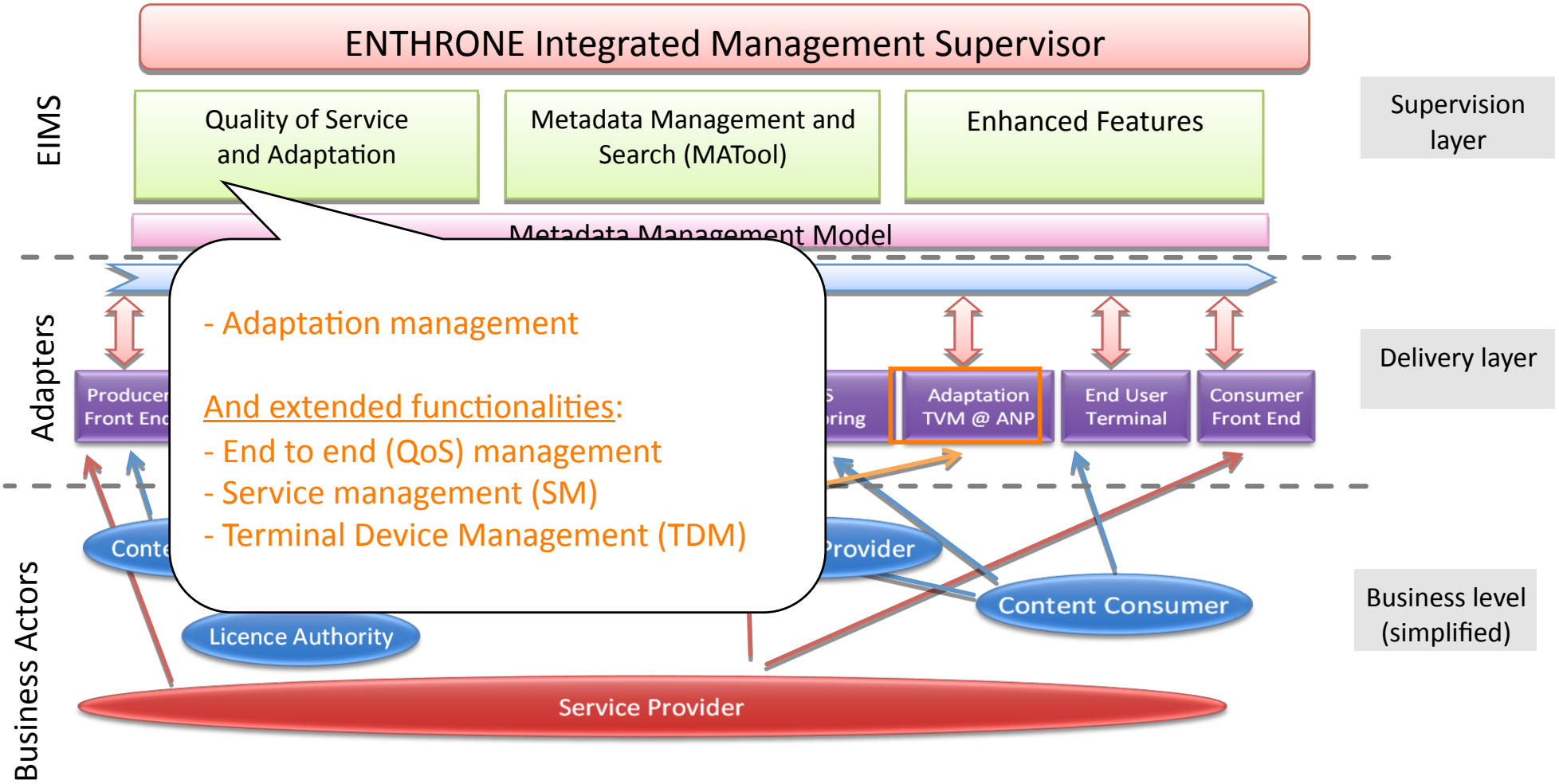

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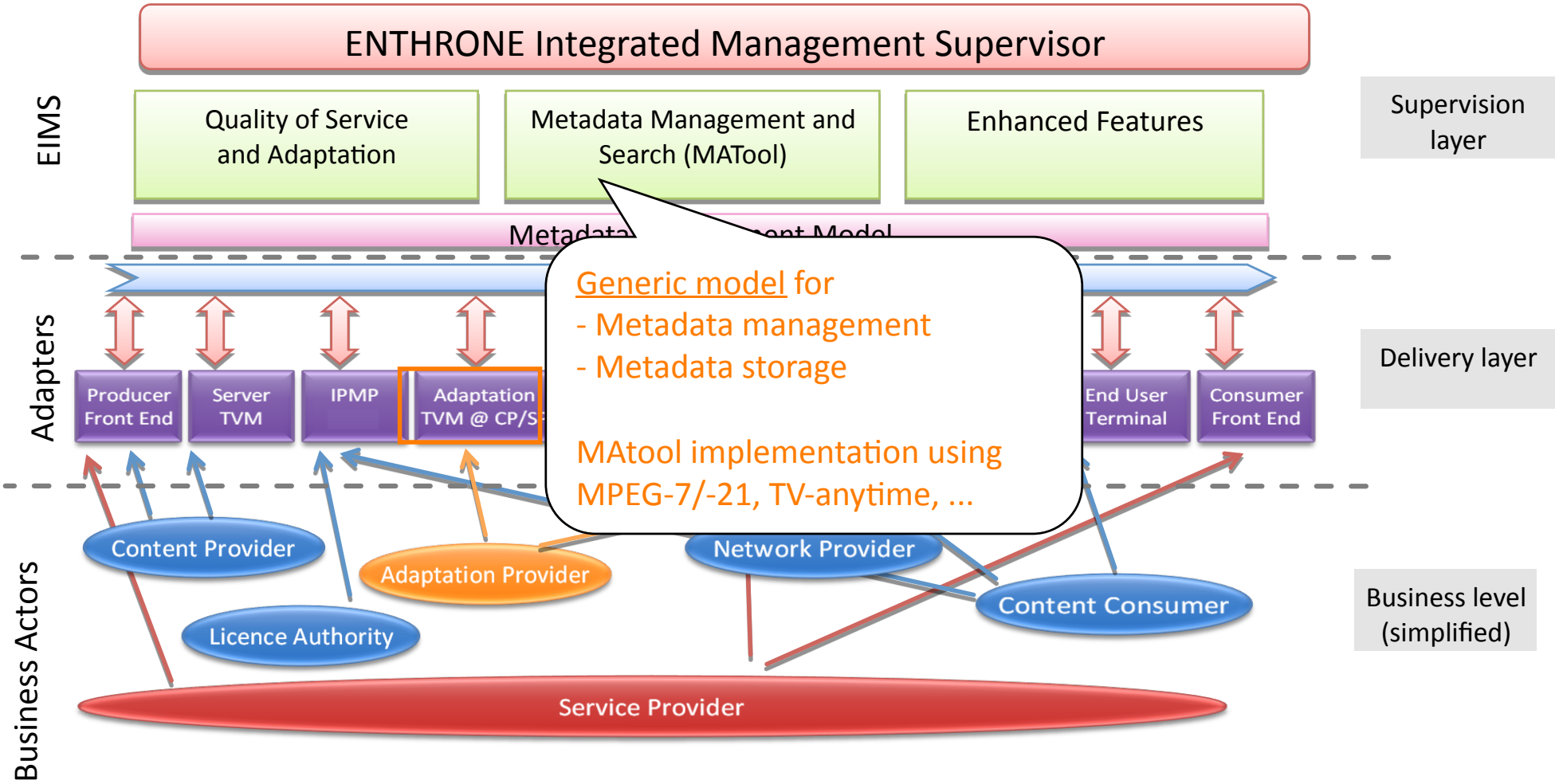

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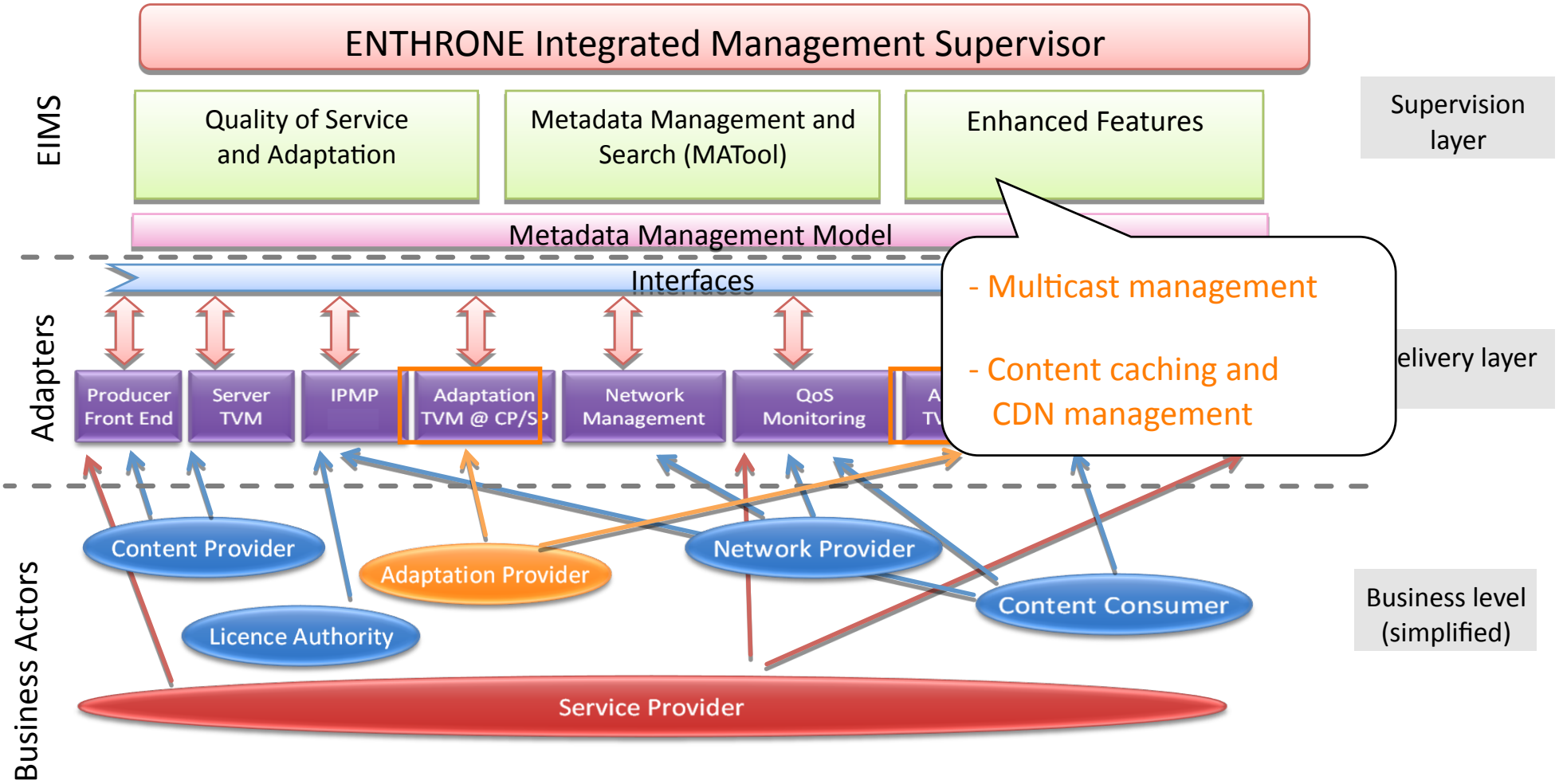

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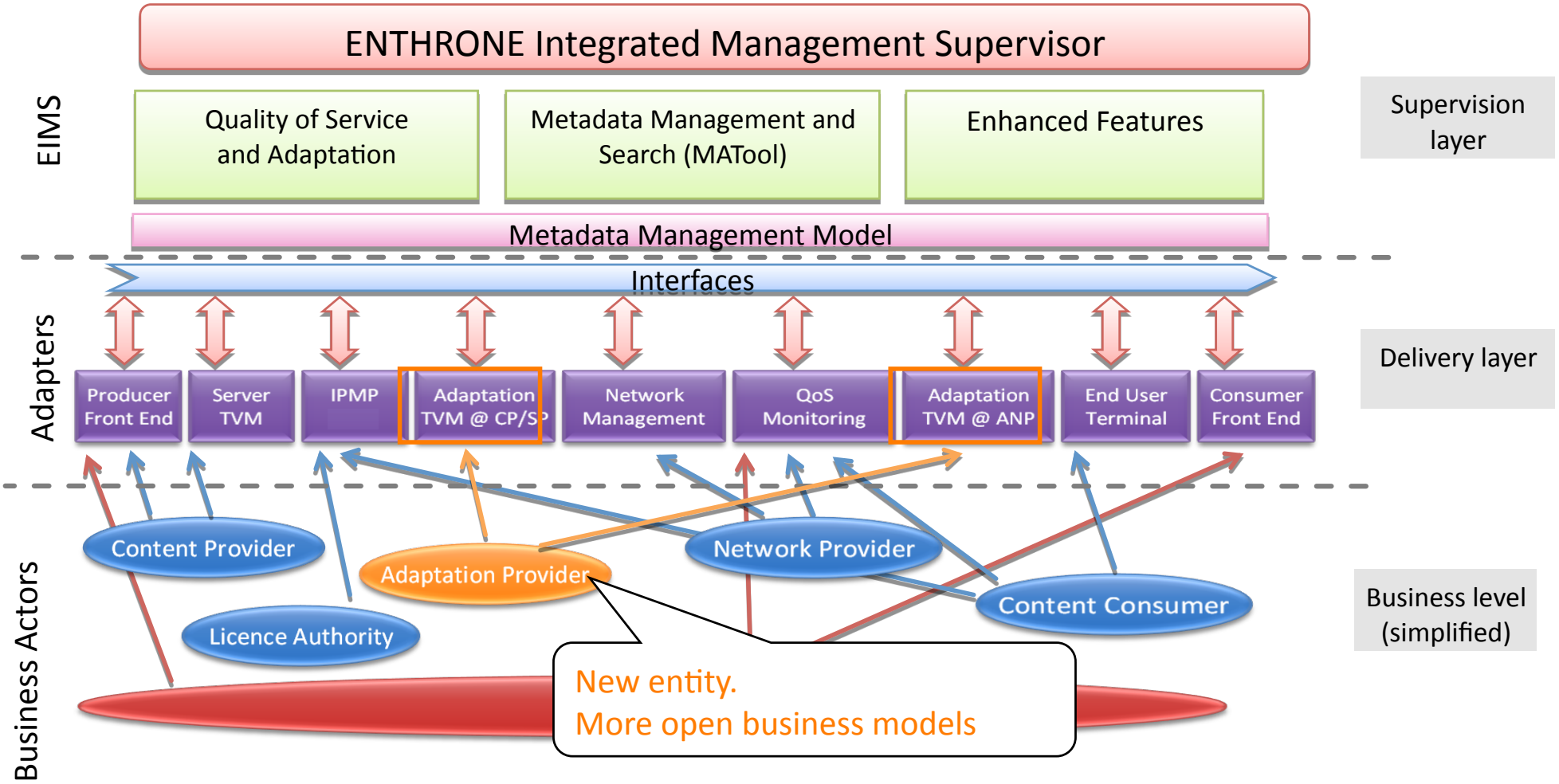
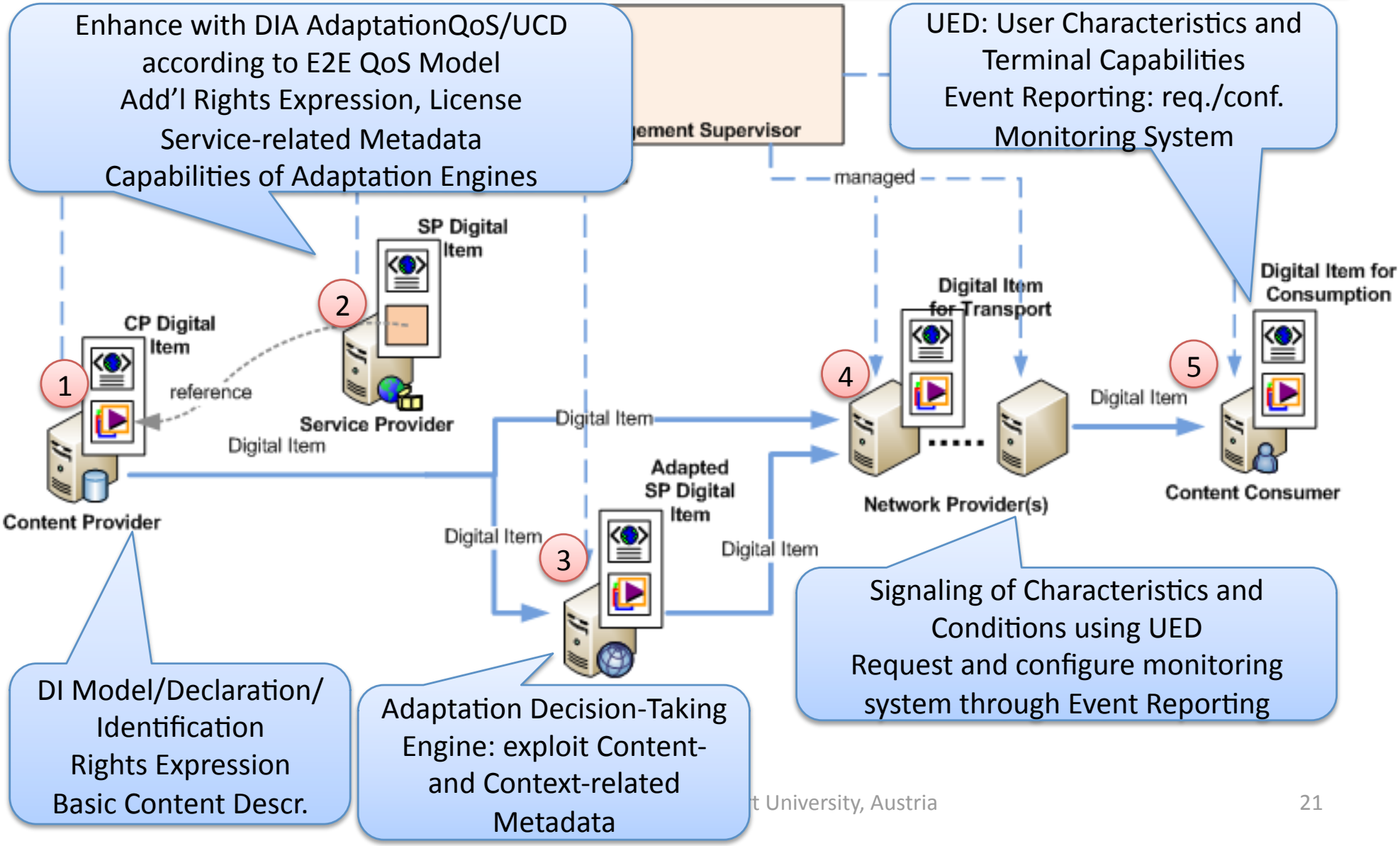


MPEG-21 for End-to-End QoS Management enabling UMA



Conclusions

- MPEG-21 Multimedia Framework
  - ✔ Develop "big picture": understand how the components of the framework are related and identify where gaps in the framework exist
  - ✔ Fill the gaps: develop new standard specifications where needed
  - ✖ Integrate: achieve the integration of standards to support harmonized technologies for the management of multimedia
- ENTHRONE
  - Integrated end-to-end management enabling QoS
  - Heterogeneous contents, networks, and terminals
  - Subsystems with well-defined functionality and interfaces
  - Service-enabling technology

Thank you for your attention

... questions, comments, etc. are welcome ...

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