Designing and Using an Audio-Visual Description Core Ontology

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Outline

- Motivations
- Methodology and content
  - Focusing on domain needs
  - Focusing on upper-level considerations
  - Reconciliation
- Use
- Conclusion

Uses of AV Document Descriptions

- Archival and description of documents from a cultural heritage point of view: INA

- Exchanging program identification and characterization for interactive TV: *TV-Anytime*

- Diffusion of program information (news agencies): *ProgramGuideML*

- Storing and sharing AV content descriptions (automatic extraction results): *MPEG7 standard*

$\Rightarrow$ Development of standard vocabularies, syntactic specifications

Meaning problem

- Description deep meaning cannot be accessed and processed by systems
  - Knowledge is often implicit (labels and comments in natural language)
  - Formal specifications are mostly syntactic

- Formal semantics should be interesting
  - Reasoning with AV document descriptions
  - Interoperability with formal domain-specific ontologies, allowing to mix AV and domain-related reasoning

  $\Rightarrow$ **Need for a formal ontology to better manipulate AV content**

Can we find an AV core ontology?

- There are many common needs amongst observed applications
  - Characterization of programs and sequences
  - Decomposition of programs and sequences
  - Ability to introduce description of the activities that constitute the context of AV documents (roles of people involved, way production and broadcast are achieved)

- These concepts are close to a "neutral" archival viewpoint

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Methodology

- Grounding conceptualization by observed purposes and domain initiatives

  $\Rightarrow$ justification of the C.O. by making it compliant with shared views on the domain

- Articulation with an upper-level ontology

  $\Rightarrow$ justification of the C.O. by making it compliant with shared views on high-level categories and axiomatizations

$\Rightarrow$ **Get a fully shareable and interoperable C.O.**

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MPEG 7 and AV C.O.

- Large effort

- Existing formal ontologies adaptations
  - [Hunter, SWWS'2001] (RDFS)
  - [Tsinaraki, CAISE'2004] (OWL)

- MPEG7 main features
  - Descriptors focused on the physical features of the AV signal
  - Higher-level description schemes rather centred on grammatical specifications

$\Rightarrow$ **More "conceptual" DSs need some development to catch core domain needs**
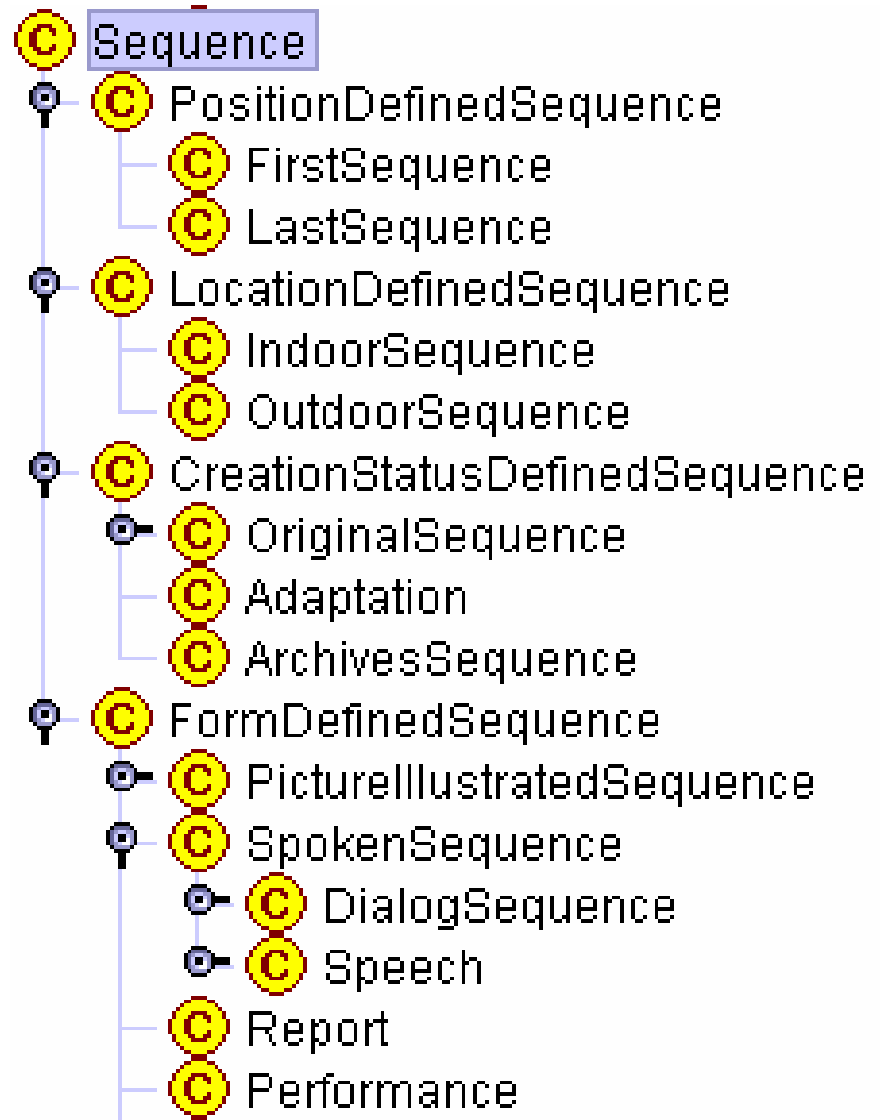
C.O. content

- Concerning AV objects:
  - distinction sequence/program
  - decomposition and qualification of those objects
  - link to external world themes and entities (content description)

- Underlying use patterns for elicited categories
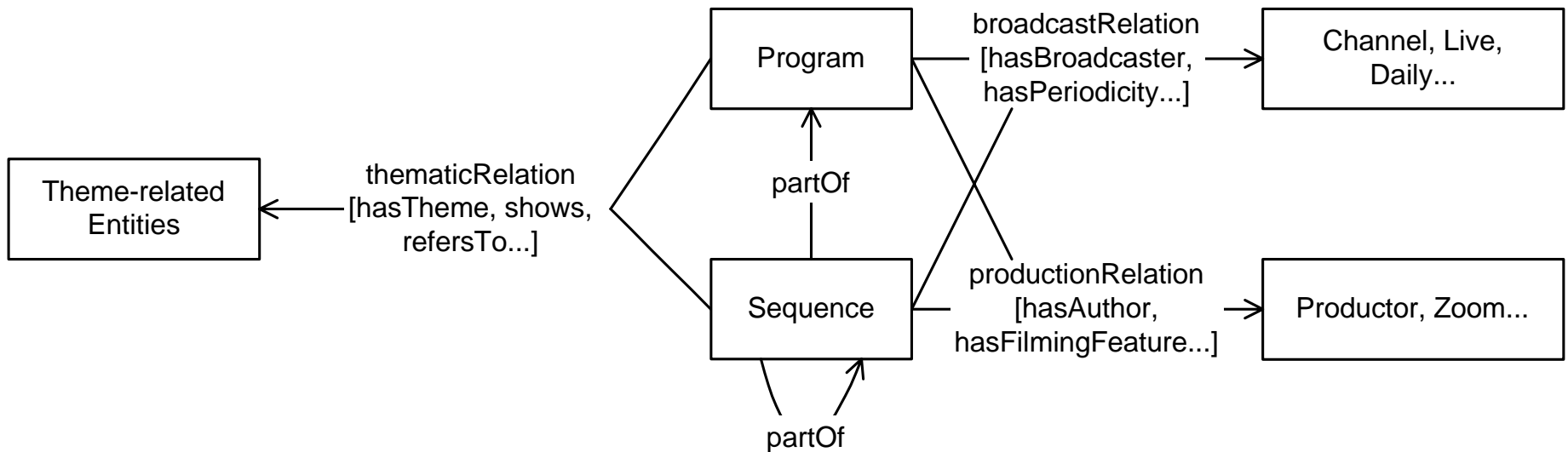
Example:

Upper-level categorization of sequences

Towards Formal Semantics

- Formal definitions of concepts (NC, SC)
- Relational axioms (composition)
- An OWL example:

```
<owl:Class rdf:ID="DialogSequence">
  <rdfs:subClassOf rdf:resource="#SpokenSequence"/>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty>
        <owl:ObjectProperty rdf:about="#hasParticipant"/>
      </owl:onProperty>
      <owl:minCardinality rdf:datatype="&xsd;int">2</owl:minCardinality>
    </owl:Restriction>
  </rdfs:subClassOf>
</owl:Class>
```
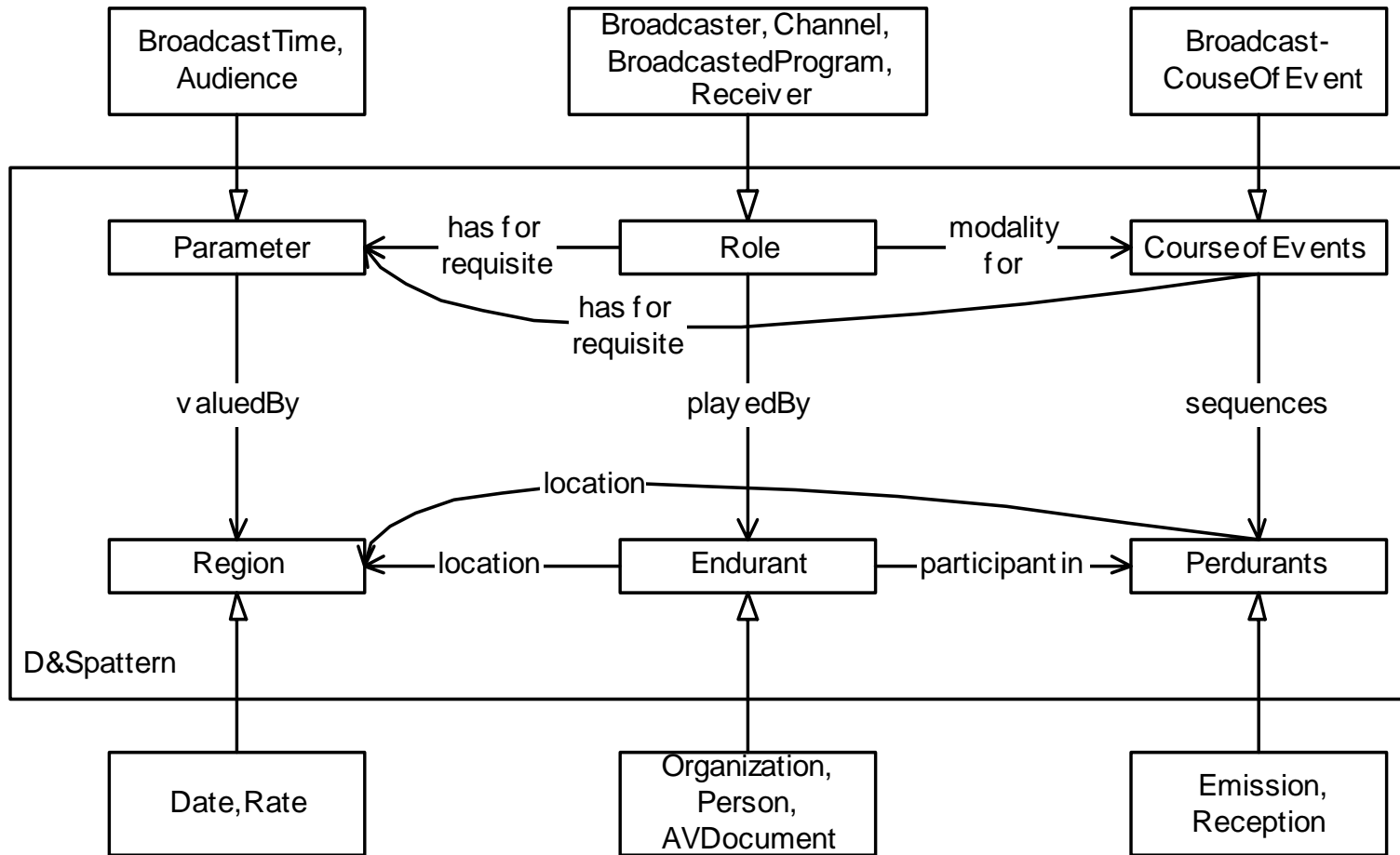
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Upper-level foundations

- Chosen framework:
  - DOLCE [Gangemi, EKAW 2002]
  - Description & Situation extension [Gangemi, ODBASE 2003]

- Provides:
  - Upper-level concepts and relations
  - Ontological design pattern

$\Rightarrow$ **Both of them can be specialized to match domain needs**

D&S pattern specialization

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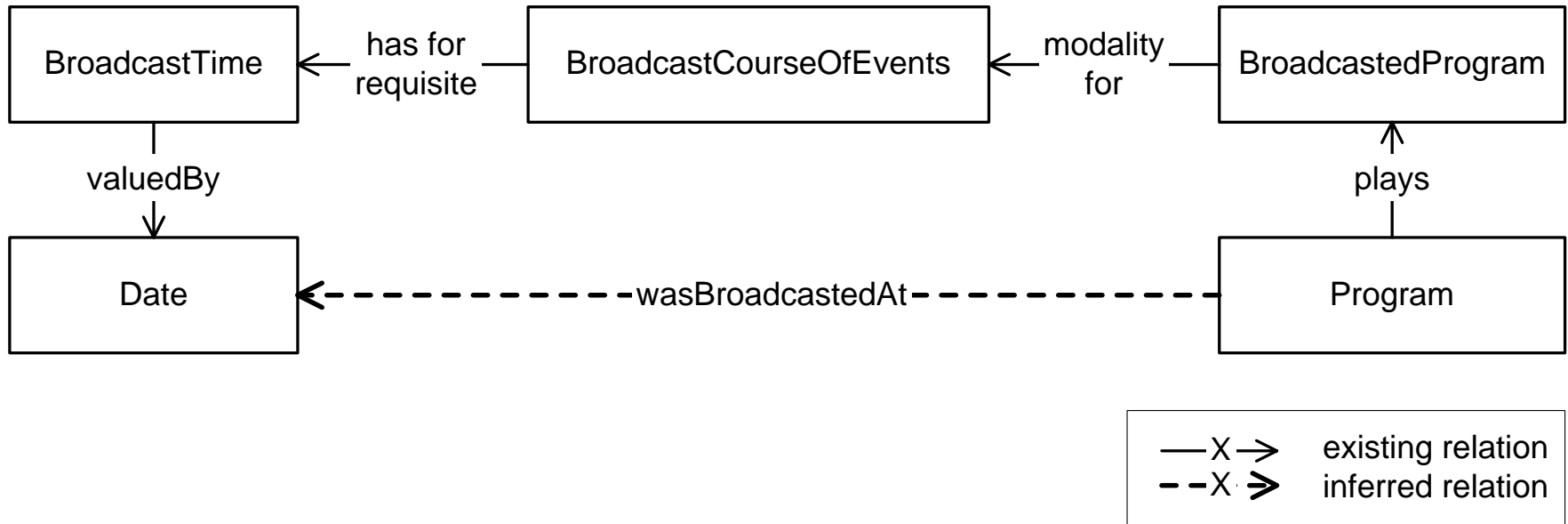 - **Reconciliation**
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Articulation with domain needs

- Do foundationally motivated choices really fit domain needs?
  - Some notions are too abstract
  - Some relational paths are too long

$\Rightarrow$ ***descriptions may be far from domain concerns***

- To be usable in the domain, core notions have to be adapted to domain uses
  - Goal:
    - Articulation between upper-level AV pattern and use patterns
  - How?
    - With formal rules allowing KBS to deal simultaneously with both forms of knowledge

Relational shortcut example (1)

BroadcastTime ←— has for requisite —— BroadcastCourseOfEvents ←— modality for —— BroadcastedProgram

BroadcastTime —valuedBy→ Date

BroadcastedProgram ↑ plays Program

Date ←- - - - - wasBroadcastedAt - - - - - Program

—X→ existing relation
- -X-➤ inferred relation

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Relational shortcut example (2)

```xml
<ruleml:imp>
  <ruleml:_body>
    <swrlx:classAtom>
      <owlx:Class owlx:name="Program" />
      <ruleml:var>prgm</ruleml:var>
    </swrlx:classAtom>
    <swrlx:classAtom>
      <owlx:Class owlx:name="BroadcastedProgram" />
      <ruleml:var>bcPrgm</ruleml:var>
    </swrlx:classAtom>
    <swrlx:classAtom>
      <owlx:Class owlx:name="BroadcastCourseOfEvents" />
      <ruleml:var>bcCOE</ruleml:var>
    </swrlx:classAtom>
    <swrlx:classAtom>
      <owlx:Class owlx:name="BroadcastTime" />
      <ruleml:var>bcTime</ruleml:var>
    </swrlx:classAtom>
    <swrlx:classAtom>
      <owlx:Class owlx:name="Date" />
      <ruleml:var>date</ruleml:var>
    </swrlx:classAtom>
    <swrlx:individualPropertyAtom  swrlx:property="&dolce;plays">
      <ruleml:var>prgm</ruleml:var>
      <ruleml:var>bcPrgm</ruleml:var>
    </swrlx:individualPropertyAtom>
    <swrlx:individualPropertyAtom  swrlx:property="&dolce;modality-for">
      <ruleml:var>bcPrgm</ruleml:var>
      <ruleml:var>bcCOE</ruleml:var>
    </swrlx:individualPropertyAtom>
    <swrlx:individualPropertyAtom  swrlx:property="&dolce;has-for-requisite">
      <ruleml:var>bcCOE</ruleml:var>
      <ruleml:var>bcTime</ruleml:var>
    </swrlx:individualPropertyAtom>
    <swrlx:individualPropertyAtom  swrlx:property="&dolce;valued-by">
      <ruleml:var>bcTime</ruleml:var>
      <ruleml:var>date</ruleml:var>
    </swrlx:individualPropertyAtom>
  </ruleml:_body>
  <ruleml:_head>
    <swrlx:individualPropertyAtom  swrlx:property="wasBroadcastedAt">
      <ruleml:var>prgm</ruleml:var>
      <ruleml:var>date</ruleml:var>
    </swrlx:individualPropertyAtom>
  </ruleml:_head>
</ruleml:imp>
```

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How to use a core AV ontology?

- Domain extension (and restriction)
  - Complementary vocabulary: roles, kinds of AV creation processes and effects, etc.
  - Focusing choices: for some sub-domains, no need for complex description of specific AV actions (broadcast)

- Application extension
  - Fine-grained vocabulary and reasoning knowledge customization
  - Articulation with ontologies describing "world" domains (with formal knowledge involving concepts and relations from both ontologies)

Applications

- TV-Anytime
  - We can now create formal descriptions referring to TV-Anytime vocabulary

- [Troncy, ISWC 2003]
  - AV ontology has been used in conjunction with a domain ontology (cycling) to formally describe structure and content of sports-related AV documents

- OPALES project
  - Similar experiment, characterization of sequences and their AV features from a pedagogical viewpoint

Conclusion

- Dual legitimacy for a core ontology
  - Domain relevance (user needs)
  - Upper-level compliance (Dolce)

  $\Rightarrow$ **Reasoning knowledge as reconciliation**

- Limitations and problems
  - Time-consuming effort (adaptation, rules, etc.)
  - Is full-scale reasoning feasible?
  - Limits between core and domain conceptualizations
  - TV bias (*publication* instead of *broadcast*?)