Semantic Orchestration of Resources in the CineGrid Exchange.

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http://cinegrid.uvalight.nl
Using the CineGrid Exchange

• Streaming and distributing very high quality video requires a lot of information which takes very long email discussions to answer them.

  – *Is it technically possible to stream from Amsterdam to the display in front of me?*
  
  – *Is it more efficient to stream from Amsterdam to Tokyo or from San Diego?*
  
  – *What resources can we use in Tokyo?*
A user perspective

- Users don't want to 'engineer' the underlying network.
- Users don't want to think about codecs/formats.
- Users don't want to deal with software incompatibilities.
- Users simply want to play/edit/use the media in the highest possible quality.
Describing the CineGrid infrastructure.

- To see what resources we have.
- To see which person to contact.
- To spot weaknesses/bottlenecks in the network.
- To find the most efficient way for transporting data.
- To let our applications interact with the network.
- To let the network engineer itself (eventually).
A semantic approach

- RDF (Resource Description Framework) and OWL (Web Ontology Language) are ways to achieve this.
- Possibility to import and re-use objects from other ontologies.
- It's distributed every node can maintain its own copy of a description and link to others when necessary.
- Easy to query using SPARQL/SQWRL.
- Formal and strict way to describe data using triplets and inheritance.

Exchange: CineGrid

hasElement

Node: Amsterdam
Cinegrid Description Language

- Uses RDF and OWL
- Implements the Exchange -> Node -> Device -> hierarchy.
- Allows us to describe services provided by these devices.
- Uses NDL which describes the underlying network infrastructure.
UML representation of CDL

Element
  - Domain
    - Homepage
    - TechContact
    - AdminContact
  - Device
    - Identifier
  - Host
    - hostName
    - OS
  - Cluster
    - hasElements: (Host)
  - Node
    - hasElements: (not Node or Exchange)
  - Exchange
    - hasElements: (not Exchange)

Service
  - Display
    - pixelsX
    - pixelsY
  - DisplayService
    - pixelsX
    - pixelsY
  - StorageService
    - totalDiskSpace
    - freeDiskSpace
  - StreamService
    - capabilities
    - maxStreams

NTTDisplayService
SAGEDisplayService
NFSService
iRODSService
NTTStreamService
SAGEStreamService
ZaxelStreamService
Using CDL

![CDL Diagram]

- **Node**: http://www.someplace.org/ucsd-cdl.owl#Calit2
- **Exchange**: CineGrid
- **Cluster**: das3
- **Host**: dasnode1, dasnode2, cgex, suitcees

Diagram showing relationships and connections among nodes and hosts.
Link CDL to NDL using `sameAs` Property

```
<cdl:hasElements>
  <cdl:Host rdf:ID="cgvideo">
    <cdl:hasDomain rdf:resource="#UvA-SNE"/>
    <owl:sameAs rdf:resource="http://cinegrid.uvalight.nl/owl/ndl-amsterdam.owl#cgvideo"/>
    <cdl:providerService>
      <cdl:SAGEDisplayService rdf:ID="SAGEDisplayService_cgvideo">
        <cdl:pixelsX rdf:datatype="http://www.w3.org/2001/XMLSchema#int" rdf:datatype="http://www.w3.org/2001/XMLSchema#int">
          3840</cdl:pixelsX>
        <cdl:providerBy rdf:resource="#cgvideo"/>
          2160</cdl:pixelsY>
      </cdl:SAGEDisplayService>
    </cdl:providerService>
    <cdl:providesService>
      <cdl:LocalStorageService rdf:ID="LocalStorageService_cgvideo">
        <cdl:providerBy rdf:resource="#cgvideo"/>
        <cdl:providesService>
          <cdl:SAGEStreamingService rdf:ID="SAGEStreamingService_cgvideo">
            <cdl:providerBy rdf:resource="#cgvideo"/>
            <cdl:providesService>
              <cdl:hasElements>
              </cdl:hasElements>
            </cdl:hasElements>
          </cdl:SAGEStreamingService>
        </cdl:providesService>
      </cdl:LocalStorageService>
    </cdl:providesService>
  </cdl:Host>
</cdl:hasElements>
```

NDL

```
<ndl:hasDevice rdf:ID="cgvideo">
  <ndl:hasInterface rdf:resource="#cgvideo-eth3"/>
  <ndl:hasInterface>
    <ndl:StaticInterface rdf:ID="#cgvideo-eth1">
      <ndl:connectedTo>
        <ndl:ConnectionPoint rdf:ID="#Internet8"/>
      </ndl:connectedTo>
    </ndl:StaticInterface>
    <ndl:hasInterface>
      <ndl:hasInterface>
        <ndl:StaticInterface rdf:ID="#cgdaemon-eth1">
          <ndl:connectedTo>
            <ndl:ConnectionPoint rdf:ID="#Internet5"/>
          </ndl:connectedTo>
        </ndl:StaticInterface>
      </ndl:hasInterface>
    </ndl:hasInterface>
  </ndl:hasInterface>
</ndl:hasDevice>
```

CDL
CDL/NDL Mapping
Use SQWRL to retrieve Information

- Semantic Query-Enhanced Web Rule Language
- Don't worry about classes and subclasses. Because of automatic reasoning you can work on data directly.
- Example: Directly connected nodes can be retrieved by the following query:

```
cdl:hasElements((node1, host1) ^
ndl-topo:hasInterface(host1, if1) ^
ndl-topo:connectedTo(if1, if2) ^
ndl-topo:hasInterface(host2, if2) ^
cdl:hasElements(node2, host2) ->
sqwrl:select(node1, node2)
```

SC09 Demo

Introduction

This page demonstrates querying on the CineGrid Description Language (CDL) owl ontology. CDL uses NDL to describe the networking component.

On this map you can see the nodes and links defined in owl description of the CineGrid Exchange. On the bottom there is a log too the interesting stuff that happens on the background.

Select a service from the right to see which nodes are able to provide the service.

Legend

- Unselected Node
- From Node
- To Node
- Filtered Node

Log

By Ralph Koning, Universiteit van Amsterdam. Created using, Mochau, Mozilla, Google Maps API
Future work

- Extending CDL
  - Defining new services and properties.
  - Actually describing the network in CDL/NDL.
- Content metadata
  - Formalize description of content with focus on the technical aspects/requirements.
- We need to make our applications aware of CDL and the content requirements.
Things we need to proceed with CDL.

- To proceed with our work and tests on CDL we need input from the community.
  - We need network/service descriptions for each of the CineGrid nodes.
  - We need to have a discussion about what kind of information on services and devices we need to store in OWL.
- Contact me afterwards or send me a mail.
Thanks

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WWW: http://cinegrid.uvalight.nl
Demo: http://cgdevil.uvalight.nl/cdl