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.

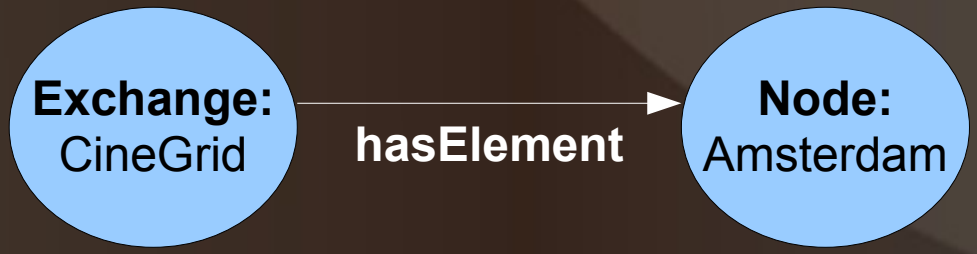
- Users simply want to play/edit/use the media in the highest possible quality.

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

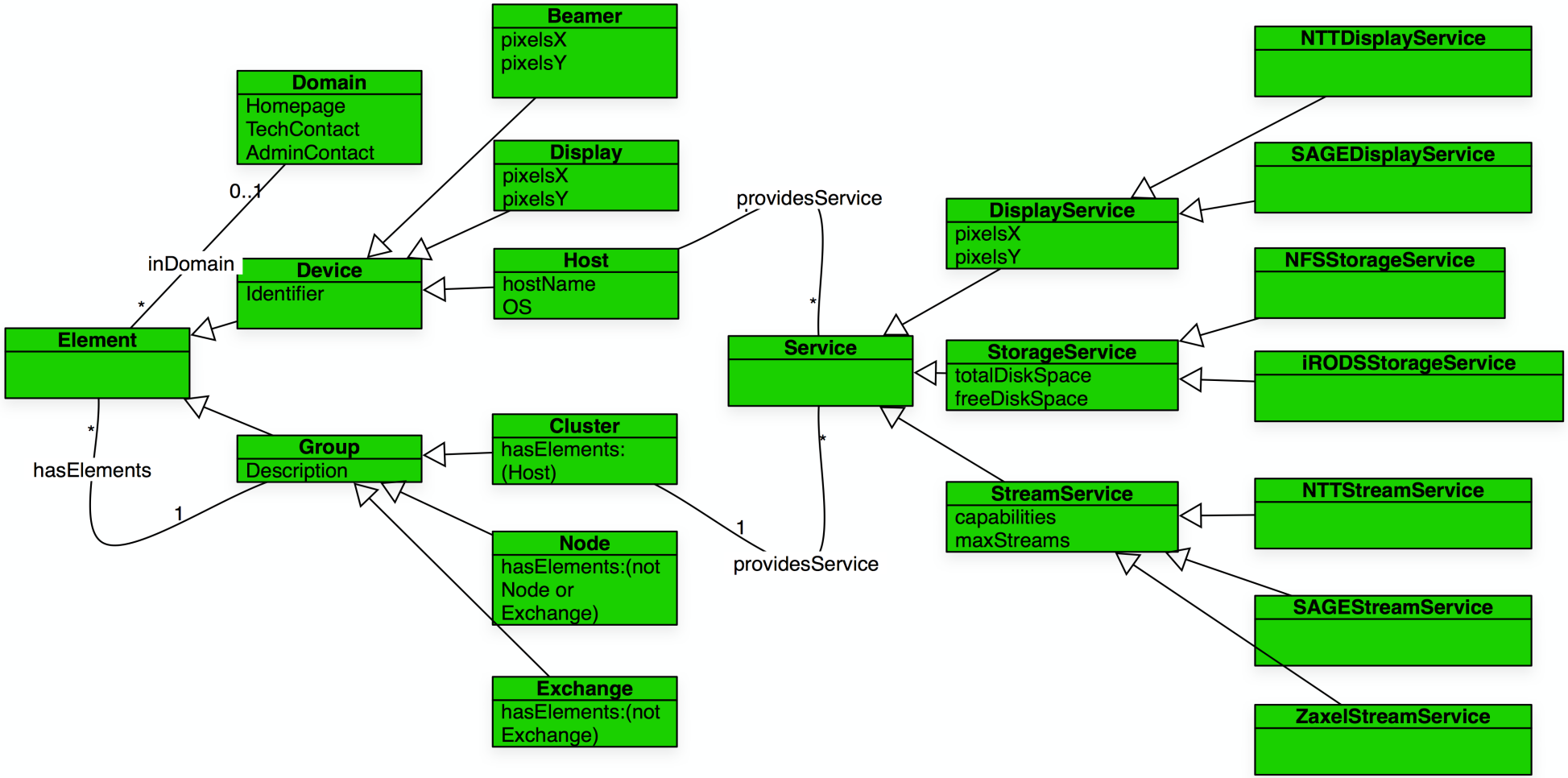
- RDF (Resource Description Framework) and OWL (Web Ontology Language) are ways to achieve this.
- Possibility to import and re-use objects from other ontologies.
- Its is distributed every node can maintain his own copy of a description and link to others when necessary.
- Easy to query using SPARQL/SQWRL.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



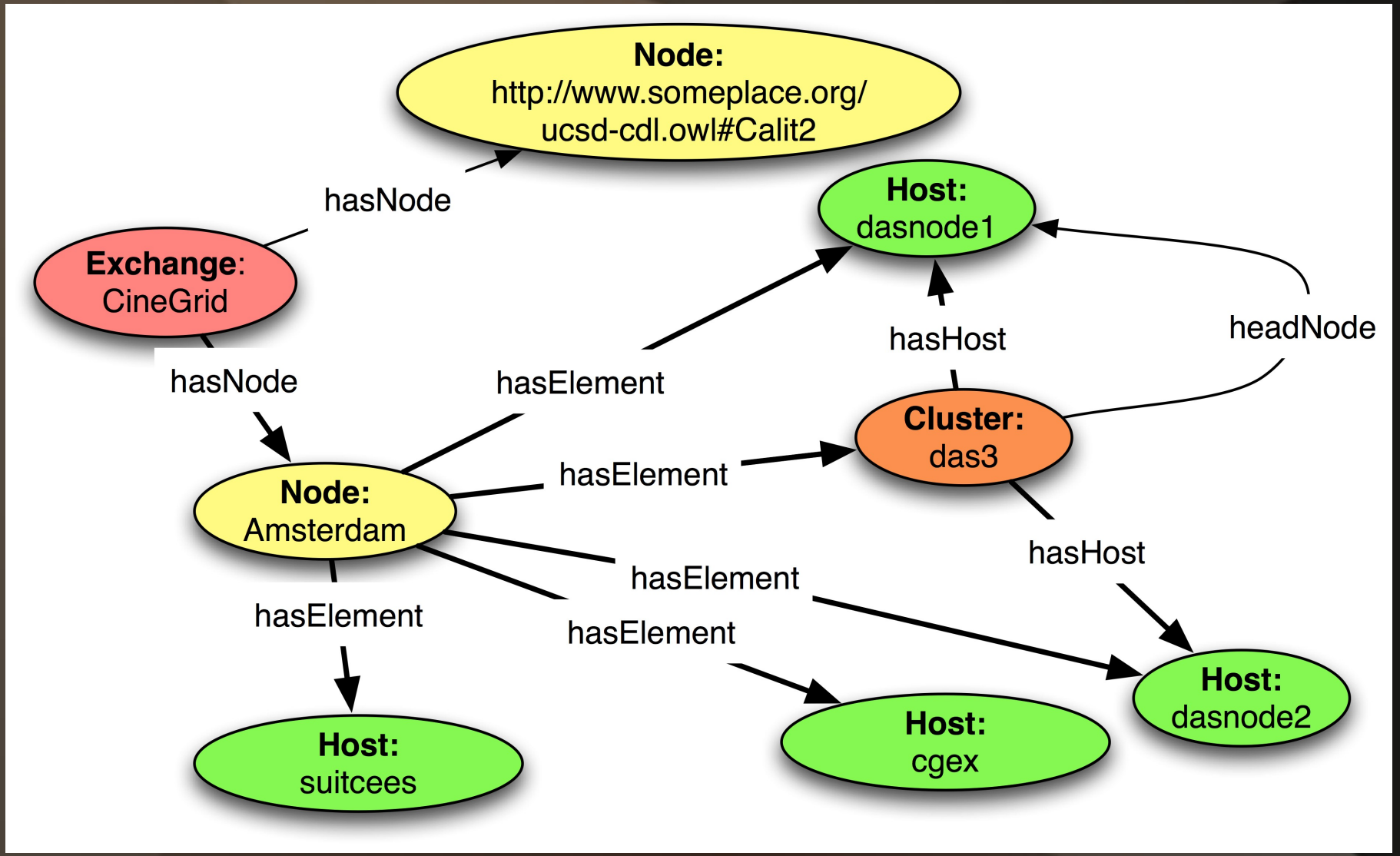
Cinegrid Description Language

- 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



Using CDL


Node:
http://www.someplace.org/
ucsd-cdl.owl#Calit2
hasNode
Host:
dasnode1
Exchange:
CineGrid
hasNode
hasElement
hasHost
headNode
Cluster:
das3
hasElement
Node:
Amsterdam
hasHost
hasElement
hasElement
hasElement
Host:
dasnode2
Host:
suitcees
Host:
cgex

Link CDL to NDL using sameAs Property

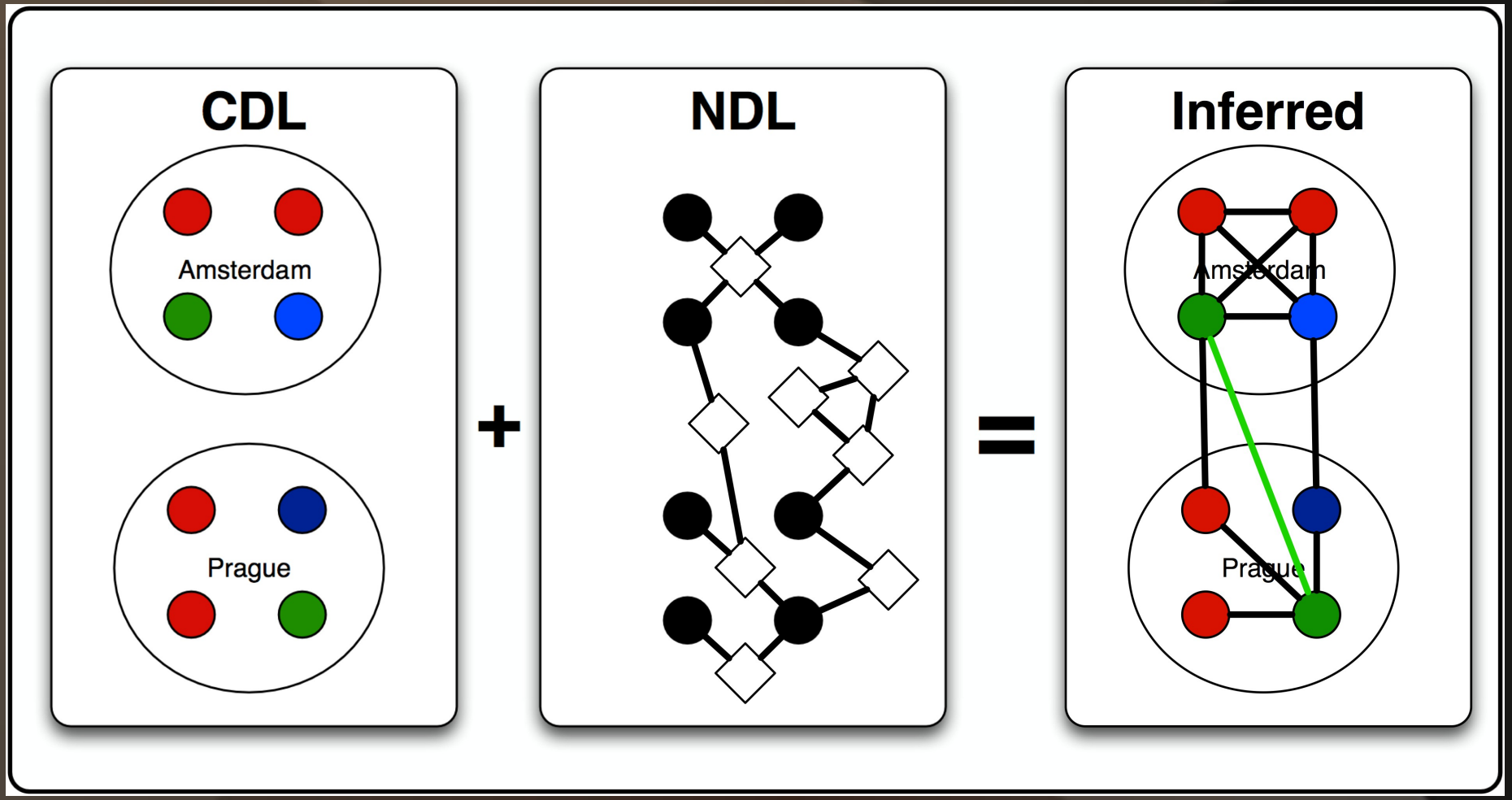
```
<cdl:hasElements>
  <cdl:Host rdf:ID="cgvideo">
    <cdl:hasDomain rdf:resource="#UvA-SNE"/>
    <owl:sameAs rdf:resource="http://cinegrid.uvalight.nl/owl/ndl-amsterdam.owl#cgvideo"/>
    <cdl:providesService>
      <cdl:SAGEDisplayService rdf:ID="SAGEDisplayService_cgvideo">
        <cdl:pixelsX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

CDL

NDL

```
    <ndl-domain:inAdminDomain>
      <ndl-domain:AdministrativeDomain rdf:ID="UvA-SNE"/>
    </ndl-domain:inAdminDomain>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >Development machine.</rdfs:comment>
  </ndl-topo:Device>
  <ndl-topo:Device rdf:ID="cgvideo">
    <ndl-topo:hasInterface rdf:resource="#cgvideo-eth3"/>
    <ndl-topo:hasInterface>
      <ndl-topo:StaticInterface rdf:ID="cgvideo-eth1">
        <ndl-topo:connectedTo>
          <ndl-topo:ConnectionPoint rdf:ID="Internet8"/>
        </ndl-topo:connectedTo>
      </ndl-topo:StaticInterface>
    </ndl-topo:hasInterface>
    <ndl-domain:inAdminDomain rdf:resource="#UvA-SNE"/>
  </ndl-topo:Device>
  <ndl-topo:Device rdf:ID="cgdaemon">
    <ndl-domain:inAdminDomain rdf:resource="#UvA-SNE"/>
    <ndl-topo:hasInterface>
      <ndl-topo:StaticInterface rdf:ID="cgdaemon-eth1">
        <ndl-topo:connectedTo>
          <ndl-topo:ConnectionPoint rdf:ID="Internet5"/>
        </ndl-topo:connectedTo>
      </ndl-topo:StaticInterface>
```

CDL/NDL Mapping

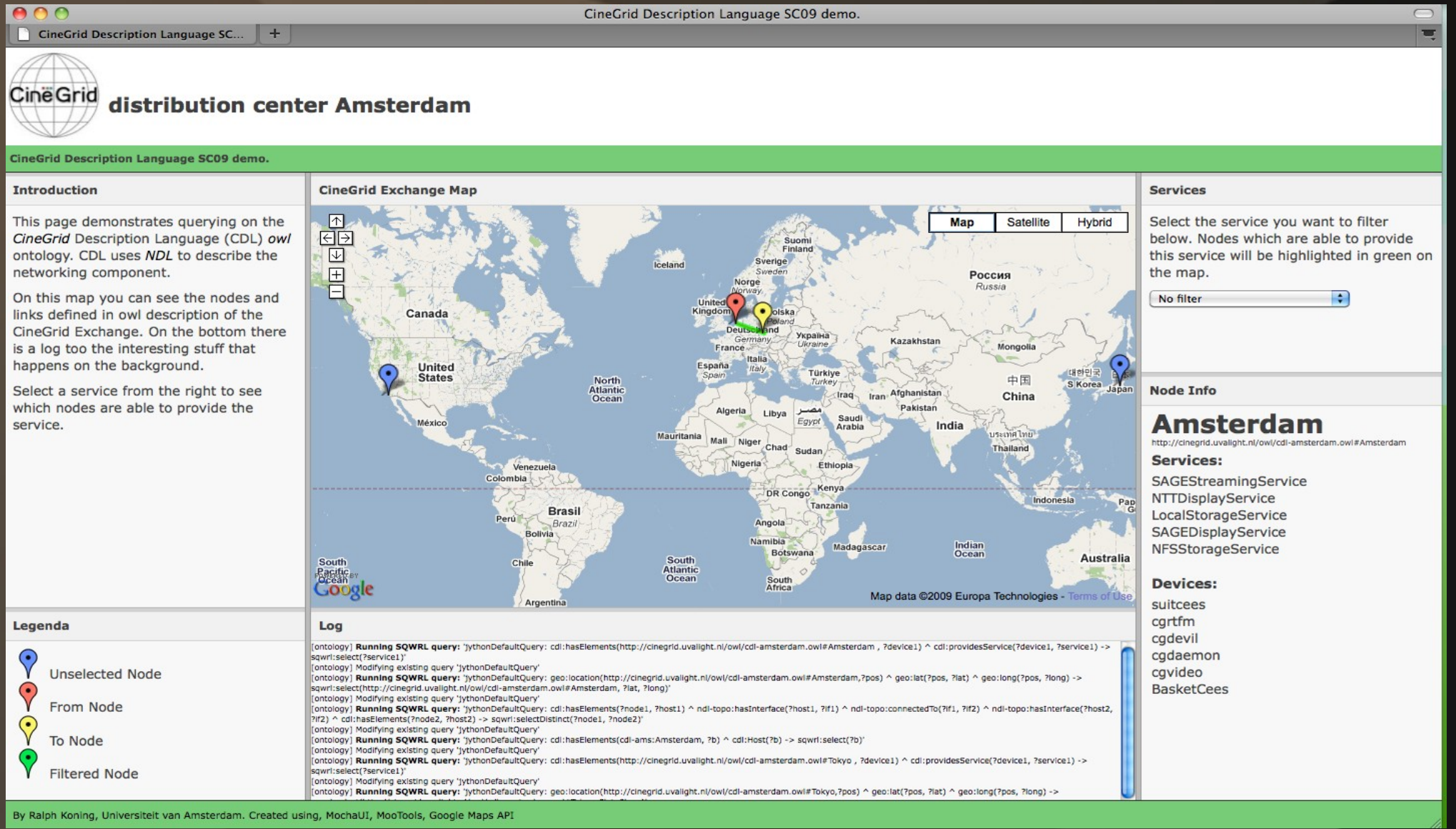


Use SQWRL to retrieve Information

- 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


CineGrid Description Language SC09 demo.
CineGrid Description Language SC...
distribution center Amsterdam
CineGrid Description Language 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.
CineGrid Exchange Map
Map
Satellite
Hybrid
Map data ©2009 Europa Technologies - Terms of Use
Services
Select the service you want to filter below. Nodes which are able to provide this service will be highlighted in green on the map.
No filter
Node Info
Amsterdam
http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Amsterdam
Services:
SAGEStreamingService
NTTDisplayService
LocalStorageService
SAGEDisplayService
NFSStorageService
Devices:
suitcees
cgrtfm
cgdevil
cgdaemon
cgvideo
BasketCees
Legenda
Unselected Node
From Node
To Node
Filtered Node
Log
[ontology] Running SQWRL query: 'jythonDefaultQuery: cdl:hasElements(http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Amsterdam , ?device1) ^ cdl:providesService(?device1, ?service1) -> sqwrl:select(?service1)'
[ontology] Modifying existing query 'jythonDefaultQuery'
[ontology] Running SQWRL query: 'jythonDefaultQuery: geo:location(http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Amsterdam,?pos) ^ geo:lat(?pos, ?lat) ^ geo:long(?pos, ?long) -> sqwrl:select(http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Amsterdam, ?lat, ?long)'
[ontology] Modifying existing query 'jythonDefaultQuery'
[ontology] Running SQWRL query: 'jythonDefaultQuery: cdl:hasElements(?node1, ?host1) ^ ndl-topo:hasInterface(?host1, ?if1) ^ ndl-topo:connectedTo(?if1, ?if2) ^ ndl-topo:hasInterface(?host2, ?if2) ^ cdl:hasElements(?node2, ?host2) -> sqwrl:selectDistinct(?node1, ?node2)'
[ontology] Modifying existing query 'jythonDefaultQuery'
[ontology] Running SQWRL query: 'jythonDefaultQuery: cdl:hasElements(cdl-ams:Amsterdam, ?b) ^ cdl:Host(?b) -> sqwrl:select(?b)'
[ontology] Modifying existing query 'jythonDefaultQuery'
[ontology] Running SQWRL query: 'jythonDefaultQuery: cdl:hasElements(http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Tokyo , ?device1) ^ cdl:providesService(?device1, ?service1) -> sqwrl:select(?service1)'
[ontology] Modifying existing query 'jythonDefaultQuery'
[ontology] Running SQWRL query: 'jythonDefaultQuery: geo:location(http://cinegrid.uvalight.nl/owl/cdl-amsterdam.owl#Tokyo,?pos) ^ geo:lat(?pos, ?lat) ^ geo:long(?pos, ?long) ->
By Ralph Koning, Universiteit van Amsterdam. Created using, MochaUI, MooTools, 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