Capability languages in C-GMA

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Talk outline

1. C-GMA concepts
   - Motivation
   - Metadata dimensions
   - Components
   - Specifications
2. Capability languages
   - XML based
   - ClassAd based
3. Summary

C-GMA – capability based GMA

- C-GMA goal: *define GMA-based open framework to build monitoring infrastructures*.
- Why to extend GMA?
  - GMA goal *“minimal specification that will support required functionality and allow interoperability”* not achieved
  - despite being are GMA-compliant, implementations are not interoperable
  - diversity of requirements – no single implementation can fulfill all.

C-GMA main concepts

- specialized components co-exist in single infrastructure
- they may cooperate when necessary or profitable

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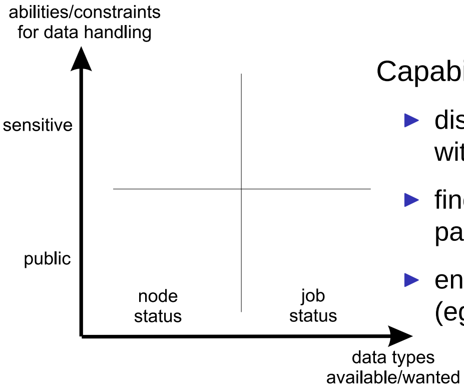
Another metadata dimension



Capability dimension

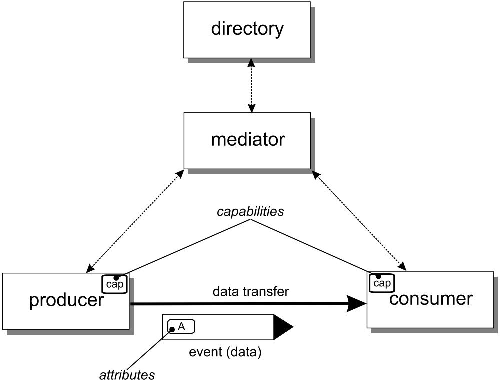
- distinguish the same data type with different constraints
- find optimal source of data for particular purpose
- enforce interoperability
  (eg. compatible protocols only)

- Both dimensions are taken into account when looking for matching party

Capabilities and attributes

- capabilities – component metadata
  - component properties (*persistent, trustworthy*)
  - interaction constraints (*protocol X*)
- attributes – event metadata
  - labels on data items – GMA events
  - expected handling of data (*sensitive* – pass to trustworthy compontent only)
  - data properties
- capabilities and attributes may refer to each other

C-GMA components



- producer, consumer, directory – inherited from GMA
- mediator – perform two-dimensional matching

Two layer specification

- A single C-GMA world is specified at two layers:
  - Capability layer – unique specification
    - fixed language to express both capabilities and attributes
    - mandatory component interfaces
  - Data-definition layer – multiple different specifications
    - Data types of published and requested data.
    - Data-definition language (DDL).
- Components withing a single world are interoperable
  - i.e. they co-exist withing the single world, knowing about one another, but not necessarily talking to each other
- There may be still more independent C-GMA worlds

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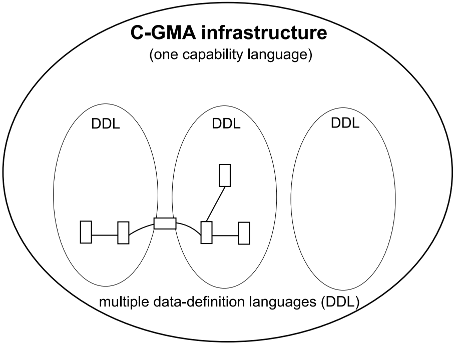
Capability vs. data-definition language


C-GMA infrastructure
(one capability language)
DDL
DDL
DDL
multiple data-definition languages (DDL)

- Typical DDL is native language of current GMA implementation.
- Bridge components “speaking” in two DDL are expected.

Capability and attribute languages

- One common language for all components in a given C-GMA world.
- Capability language requirements:
  - Express both component capabilities and data attributes.
  - *Component matching* operation $[P_{CAP}, C_{CAP}] \rightarrow$ [can communicate each other?]
  - *Attribute matching* operation $[Data_A, P_{CAP}, C_{CAP}] \rightarrow$ [can handle this data?]
- Two proposals: one based on XML and XPath, second on ClassAds.

Considered capability language definitions

- XML and XPath
  - Attributes and capabilities are expressed as XML documents.
  - Constraints – XPath expressions on merged documents.
- ClassAds (Classified Advertisements)
  - Developed for description of jobs and computing elements in Condor.
  - Symmetric expression of properties.
  - Extensible – attributes needn’t be defined a priori.
  - Mutual constraints – using “Requirements” expressions.
  - `http://www.cs.wisc.edu/condor/classad/`

Capability language based on XML

- $Data_A, P_{CAP}, C_{CAP}$ expressed as XML documents.
- Such XML document may contain:
    - Static values (elements `<cap>` and `<attr>`).
    - Requirements – XPath expression evaluated in context of compound XML document (element `<req>`).
- Explicit and implicit requirements.
    - Explicit requirements – `<req>` element containing XPath expression.
    - Implicit requirements – shortcut for mutual equality test.
        - Additional attribute `common-cap` for `<cap>` element.
        - Requirement of compliance with named party in appropriate element (referenced by value of the attribute).

Capability language based on XML – example

Producer capabilities

```
<producer>
  <cap name="protocol" common-cap="consumer">https</cap>
</producer>
```

Consumer capabilities

```
<consumer>
  <cap name="protocol" common-cap="producer">https</cap>
  <cap name="securityLevel">5</cap>
</consumer>
```

Data attributes

```
<data>
  <attr name="minSecLevel">4</attr>
  <req test="consumer/cap[@name=’securityLevel’] >=
    data/attr[@name=’minSecLevel’]" />
</data>
```

Capability language based on XML – matching

- $Data_A, P_{CAP}, C_{CAP}$ documents merged together into a single XML document
- XPath expressions evaluated in the context of its root element.
- All the `<req>` elements to be evaluated to true.

Capability language based on ClassAds

- $Data_A, P_{CAP}, C_{CAP}$ expressed as ClassAd's
- ClassAd may contain
  - Static values – attributes and capabilities.
  - Requirements – logical expression; exact syntax and evaluation functions given by ClassAd implementation
- Matching done in the context of nested ClassAd

Composed ClassAd

```
{ Producer = {
  ...
  }
  Data = {
  ...
  }
  Consumer = {
  ...
  }
}
```

- References to other ClassAds can be used.
- All requirements expressions must evaluate to true.

Capability language based on ClassAd – example

Producer capabilities

```
{ Protocol = {http, https}; }
```

Consumer capabilities

```
{
  Protocol      = {https};
  SecurityLevel = 5;
  Requirements  = member(Protocol, .Producer.Protocol);
}
```

Data attributes

```
{
 MinSecLevel = 4;
 Requirements = (.Consumer.SecurityLevel >= MinSecLevel);
}
```

Summary

- C-GMA proposal to address GMA drawbacks
- Formalization of C-GMA concepts into exact requirements on the two-layer specification
  - C-GMA interaction phases (matching vs. claiming)
  - capability language requrements
- Proposal of two specifications (XML and ClassAd)
- Proof-of-concept implementation (ClassAd base matching)
- Proposal for distributed registry based on Content based publish/subscribe messaging systems.

References and contacts

- References
  - GMA specification `http://www-didc.lbl.gov/GGF-PERF/GMA-WG/`
  - CGW04 paper
  - CoreGRID P2P paper
  - CESNET technical report
- More information
  - CGW05 paper
  - CESNET team contact: `sitera@civ.zcu.cz, egee-jra1@muni.cz`

THANK YOU