

API Extensions

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Agenda

- The Problem
- Extensions
- Extensions in REST
- Promoting Extensions
- Challenges

The Problem

Standardization vs Innovation and Differentiation

- We want to propose our APIs as Open Standards...
 - Defining Standard APIs good for Rackspace, OpenStack, and our Customers
 - We want to encourage others to implement our APIs
 - Standards need to be stable
 - Hard to develop against something that's in constant flux
 - Standards need to be general
 - May be impossible for someone to adopt our standards if they are very specific to our business...
 - How do you standardize the idea of Managed Cloud in the Cloud Servers API? Does it make sense to do this?
 - The more general and stable the API, the more likely others will adopt it.
- We want to innovate and allow others to innovate
 - Quickly add features that differentiate Rackspace OpenStack from other implementations
 - Without breaking our clients
 - Without going through an approval process
 - We want to allow others to also make changes to the API
 - More likely to adopt OpenStack APIs if they can be modified
 - We may benefit from these changes
 - Developers should feel free to experiment with new features without worrying about the implications to the API as a standard.

OpenStack

- Open Stack presents another interesting challenge: Others can make changes to the code.
 - Rackspace Version of Cloud Servers API vs.
 - OpenStack Version vs.
 - Other Modified versions.
 - What does Cloud Servers API 1.1 mean if we have different implementations all with different capabilities?
 - How do we ensure compatibility among the different versions?

Extensions

Case Study: OpenGL

- The problem we're facing is not new.
OpenGL faced a similar problem in the 90's
 - How do you define an open graphics library that:
 - Is considered a standard specification
 - Allows vendors to differentiate their products by adding special features
 - And yet is a governed spec
 - An architecture review board (ARB):
 - » Proposes and approves specification changes
 - » Marks new releases
 - » Ensures conformance testing
 - The solution was to allow extensions in the specification
 - Vendors can define special features as of extensions
 - A very successful strategy
 - The core OpenGL API is general and uncluttered and an accepted standard.
 - Over 500 extensions have been defined over OpenGL's lifetime
 - Best become standard features; others abandoned
 - Different extensions for the same feature? Let the best one win.
 - Many innovations came via the extension process: vertex and fragment shaders, etc.
 - Extensions have been defined by many different vendors: NVidia, ATI, Apple, IBM, Intel, ...

Extensions

- Extensions add capability to the API beyond those of the specification
- An API specification must be written to allow for extensibility
 - We need flexibility in the contract to allow for new data elements, actions, states, headers, and resource types.
 - The core API specification defines the extension mechanism, but extensions themselves are not part of the core.
- Implementors are only required to implement the core API.
- Extensions can be promoted
 - Extensions follow a promotion path, at the end of which an extension may become part of the next version of the core API.

Extensions vs. Versions

Versions	Extensions
Centralized: Versions are maintained by the entity that controls the API Spec: The OpenStack Architecture Board. Only the ARB can create a new version, only the ARB defines what OpenStack Compute 1.1 means.	Decentralized: Extensions are maintained by third parties: Rackspace, OpenStack developers, etc. Anyone can create an Extension.
Deal with Core Functionality	Deal with Specialized/Niche Functionality
Appear infrequently: Versions provide a stable platform on which to develop.	Appear frequently: Extensions bring new features to the market quickly, and in a compatible manner.
Are Queryable: You can programmatically tell what versions are available by doing a GET on the base URL (/) of the API endpoint.	Are Queryable: You can programmatically tell what extensions are available by doing a GET on the extensions resource (/v1.1/extensions).

Extensions vs. Versions

- Our APIs should be both Extensible and Versionable

Extensions in REST

Sample Extension Query

- Extensions are queryable via `/extensions`

```
<extensions xmlns="http://docs.openstack.org/api-specs/v1.0"
  xmlns:atom="http://www.w3.org/2005/Atom"
  >
  <extension name="Public Image Extension"
    namespace="http://docs.rackspacecloud.com/servers/api/ext/pie/v1.0"
    alias="RS-PIE"
    >
    <atom:link rel="describedby" type="application/pdf"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-pie-20111111.pdf"/>
    <atom:link rel="describedby" type="application/vnd.sun.wadl+xml"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-pie.wadl"/>
    <description>
      Adds the capability to share an image with other users.
    </description>
  </extension>
  <extension name="Cloud Block Storage"
    namespace="http://docs.rackspacecloud.com/servers/api/ext/cbs/v1.0"
    alias="RS-CBS"
    >
    <atom:link rel="describedby" type="application/pdf"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs-20111201.pdf"/>
    <atom:link rel="describedby" type="application/vnd.sun.wadl+xml"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs.wadl"/>
    <description>
      Allows mounting cloud block storage volumes.
    </description>
  </extension>
</extensions>
```

Sample Extension Query

- Human Readable Name and Description

```
<extensions xmlns="http://docs.openstack.org/api-specs/v1.0"
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      href="http://docs.rackspacecloud.com/servers/api/ext/cs-pie.wadl"/>
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    </description>
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  <extension name="Cloud Block Storage"
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    alias="RS-CBS"
    >
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      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs-20111201.pdf"/>
    <atom:link rel="describedby" type="application/vnd.sun.wadl+xml"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs.wadl"/>
    <description>
      Allows mounting cloud block storage volumes.
    </description>
  </extension>
</extensions>
```

Sample Extension Query

- Links to Documentation (in different formats)

```
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    <atom:link rel="describedby" type="application/vnd.sun.wadl+xml"
      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs.wadl"/>
    <description>
      Allows mounting cloud block storage volumes.
    </description>
  </extension>
</extensions>
```

Sample Extension Query

- Unique Extension IDs

```
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      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs.wadl"/>
    <description>
      Allows mounting cloud block storage volumes.
    </description>
  </extension>
</extensions>
```

Sample Extension Query

- Vendor Identifiers

```
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  >
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    namespace="http://docs.rackspacecloud.com/servers/api/ext/pie/v1.0"
    alias="RS-PIE"
    >
    <atom:link rel="describedby" type="application/pdf"
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    <atom:link rel="describedby" type="application/vnd.sun.wadl+xml"
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      href="http://docs.rackspacecloud.com/servers/api/ext/cs-cbs.wadl"/>
    <description>
      Allows mounting cloud block storage volumes.
    </description>
  </extension>
</extensions>
```


Vendor Identifiers

- An extension alias always contains a prefix that identifies the vendor.
Prefixes are **not** case sensitive:

```
<extension name="Public Image Extension"  
  namespace="http://docs.rackspacecloud.com/servers/api/ext/pie/v1.0"  
  alias="RS-PIE">
```

Prefix	Vendor
OS	OpenStack
MLTI	Multi-Vendor
ARB	ARB Approved
RS	Rackspace
NASA	Nasa
CTX	Citrix
...	...

Vendor Identifiers

- Namespaces also help ID the vendor

Namespace	Vendor
http://docs.openstack.com/ext/OS/...	OpenStack
http://docs.openstack.com/ext/ARB/...	ARB Approved
http://docs.rackspacecloud.com/...	Rackspace
http://docs.nasa.org/...	Nasa
http://docs.citrix.com/....	Citrix
...	...

Vendor ID Registry

- OpenStack should maintain a registry of Vendor IDs (prefix and namespaces).
- Anyone should be able to register a Vendor ID.

What can be extended

- Extensions may define:
 - New data types, elements, attributes
 - New actions
 - New headers
 - New states
 - New resources

Data Extensions

- Add additional Data.

- In XML, attribute may be added to elements so long as they are in the extension namespace
- In XML, Elements added after last element assuming “Unique Particle Attribution” is not violated
- In JSON, use alias followed by a colon “:”

```
<image xmlns="http://docs.rackspacecloud.com/servers/api/v1.0"
  xmlns:RS-PIE="http://docs.rackspacecloud.com/servers/api/ext/pie/v1.0"
  id="1" name="CentOS 5.2"
  serverId="12"
  updated="2010-10-10T12:00:00Z"
  created="2010-08-10T12:00:00Z"
  status="ACTIVE"
  RS-PIE:shared="true"
/>
```

```
{
  "image" : {
    "id" : 1,
    "name" : "CentOS 5.2",
    "serverId" : 12,
    "updated" : "2010-10-10T12:00:00Z",
    "created" : "2010-08-10T12:00:00Z",
    "status" : "ACTIVE",
    "RS-PIE:shared" : true
  }
}
```

New Actions

- In XML, actions are defined in the extension namespace
- In JSON, use alias followed by a colon ":" for the action name

```
<mount_volume xmlns="http://docs.rackspacecloud.com/servers/api/ext/cbs/v1.0"  
  CBSID="123"/>
```

```
{  
  "RS-CBS:mount_volume" : {  
    "CBSID" : "123"  
  }  
}
```

New Headers and States

- With headers, append name with an X- followed by the alias
 - X-**RS-CBS**-Header1: Value
 - X-**RS-CBS**-Header2: Value
- With states, use alias followed by a “:”

```
<image xmlns="http://docs.rackspacecloud.com/servers/api/v1.0"
  xmlns:RS-PIE="http://docs.rackspacecloud.com/servers/api/ext/pie/v1.0"
  id="1" name="CentOS 5.2"
  serverId="12"
  updated="2010-10-10T12:00:00Z"
  created="2010-08-10T12:00:00Z"
  status="RS-PIE:PrepareShare" progress="80"
  RS-PIE:shared="true"
/>
```

```
{
  "image" : {
    "id" : 1,
    "name" : "CentOS 5.2",
    "serverId" : 12,
    "updated" : "2010-10-10T12:00:00Z",
    "created" : "2010-08-10T12:00:00Z",
    ""status" : "RS-PIE:PrepareShare"",
    "progress" : 80,
    "RS-PIE:shared" : true
  }
}
```

New Resources

- Extensions are always defined at
/path/to/resource/**ext/ext-alias/newResource**
All major resources can reference a /ext
- A CBS Volume:
/v1.0/12345/servers/ext/RS-CBS/volume

Promoting Extensions

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New Features Should Start as Extensions

- This gives us the ability to try things out before a feature enters the standard.
- Allows competing extensions to co-exist

Promotion Path

- Extensions may follow a promotion path
 - Vendor Specific → ARB Approved → Core Feature
- Some extensions may be developed by multiple vendors; these are known as Multi-Vendor extension, the prefix is MLTI.
 - Multi-Vendor (MLTI) → ARB Approved → Core Feature
- An extension may start as a vendor specific extension and become a multi-vendor extension.
 - Vendor Specific → Multi-Vendor (MLTI) → ARB Approved → Core Feature

Promotion Path

- Not all extensions should be promoted to core features
 - Extensions may implement niche functionality that doesn't make sense in the core API.

ARB Approved Extensions

- The ARB “blesses” an extension by making it an ARB-approved extension.
- ARB-approved extensions use ARB as the vendor prefix.
- An ARB-approved extension denotes
 - That the extension is being considered for the next revision of the specification
 - That extension is a niche extension that is very useful; it may not make it as a standard feature, but implementors are encouraged to implement it nonetheless.

Challenges

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Implementation Challenges

- Services must be implemented in such a manner that the extensible part of the code is separate from the core implementation. This is doable with modern service toolkits, but must be done with care.
 - Filter approach: The extension is implemented via middle-ware filters
 - Sub-Type Services: Services can be extended in OOP languages; extensions can be written in separate service implementations.

WADLs

- In order to promote accuracy the default service WADL should contain a description of all of the extensions active in a particular implementation.
 - Doing a get on version details (**/v1.1/**) should give you a pointer to a WADL that describes the service with all available extensions.
 - There may be a need to maintain multiple WADLs, these WADLs describe only the changes made by the extension. These are the WADLs pointed to by the extension resource (**/v1.1/extensions**).
 - We need to educate developers on how to write extensible schemas and WADLs.

Language Bindings

- Extensions should be supported at the language binding layer
 - Language bindings may be written to detect and give access to extensions given a WADL
 - A simpler approach may be to allow the language bindings themselves to be extensible, so that extensions may be simply added to an existing binding.
 - The language binding framework, should support this even if we didn't define extensions, as this helps with version changes.

Thanks

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