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, Open Stack, 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.

Open Stack

- Open Stack presents another interesting challenge: Others can make changes to the code.
  - Rackspace versions of Cloud Servers API vs. Open Stack 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 between 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 are **centralized**, extensions are **decentralized**
  - 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.
  - Extensions are maintained by third parties: Rackspace, OpenStack developers, etc. Anyone can create an Extension.
- Versions deal with the **core functionality**, extensions deal with **specialized/niche functionality**.
- New versions appear infrequently, new extensions can be added quickly.
  - Versions provide a stable platform on which to develop
  - Extensions bring new features to the market quickly, and in a compatible manner.
- Both extensions and versions are queryable.
  - You can programmatically tell what versions and extensions are available.

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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                alias="RS-PIE"
                >
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        <description>
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        </description>
    </extension>
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```

Sample Extension Query

- Links to Documentation (in different formats)

```
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    </extension>
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Sample Extension Query

- Unique Extension IDs

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Sample Extension Query

- Vendor Identifiers

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</extensions>
```

Vendor Identifiers

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

RS	Rackspace
OS	OpenStack
EXT	Multi-Vendor
ARB	ARB Approved

- Namespaces also help ID the vendor

http://docs.rackspacecloud.com/...	Rackspace
http://docs.openstack.com/ext/OS/...	OpenStack
http://docs.openstack.com/ext/ARB/...	ARB Approved

- Open Stack should maintain a registry of prefix and namespaces.

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.
  - Any attribute may be added
  - Elements added after last element assuming “Unique Particle Attribution” is not violated
  - JSON Always uses alias

```
<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 actions use alias

```
<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

- Headers, append name with an X- followed by the alias
  - X-**RS-CBS**-Header1: Value
  - X-**RS-CBS**-Header2: Value
- States, use alias

```
<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

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 EXT.
  - Multi-Vendor (EXT) → ARB Approved → Core Feature
- An extension may start as a vendor specific extension, and become a multi-vendor extension.
  - Vendor Specific → Multi-Vendor (EXT) → 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 extensions 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 none-the-less.

Challenges

Implementation Challenges

- Services must be implemented in such a manner that the extensible part of the code is separate form 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 the service.
  - Describing this WADL may be a manual process - at least initially
  - There may be a need to maintain a separate WADLs, that describes each extension separately
  - 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, though that would be challenging.
  - 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 too.

Thanks