Smaug

Resource Protect and Restore Workflow

Smaug Resource Operations Workflow

- In **Protect** and **Restore** operations, each resource has work to be done (for example: backup data, restore data, etc). Such work is named **Activity**

- The **Activity** is implemented in the resource Protection Plugin (for example: CinderBackup Protection Plugin for a Volume)

Smaug Resource Operations Workflow

- The **Activity** nature can be different: (between resources, between implementations)
    - Depends on child resources vs. Independent
    - Calls to OpenStack API vs. Proprietary APIs
    - Calls to Synchronous APIs vs. calls to Asynchronous APIs
    - Long activity vs. short activity
    - High resource demand vs. low resource demand

Task Flow Construction

In order for Smaug to be able to handle all such cases, Activity is split into two:

- **ParallelActivity** - starts immediately and independently of child resources' activities
- **SyncActivity** - starts after both ParallelActivity and child resources' SyncActivities are complete

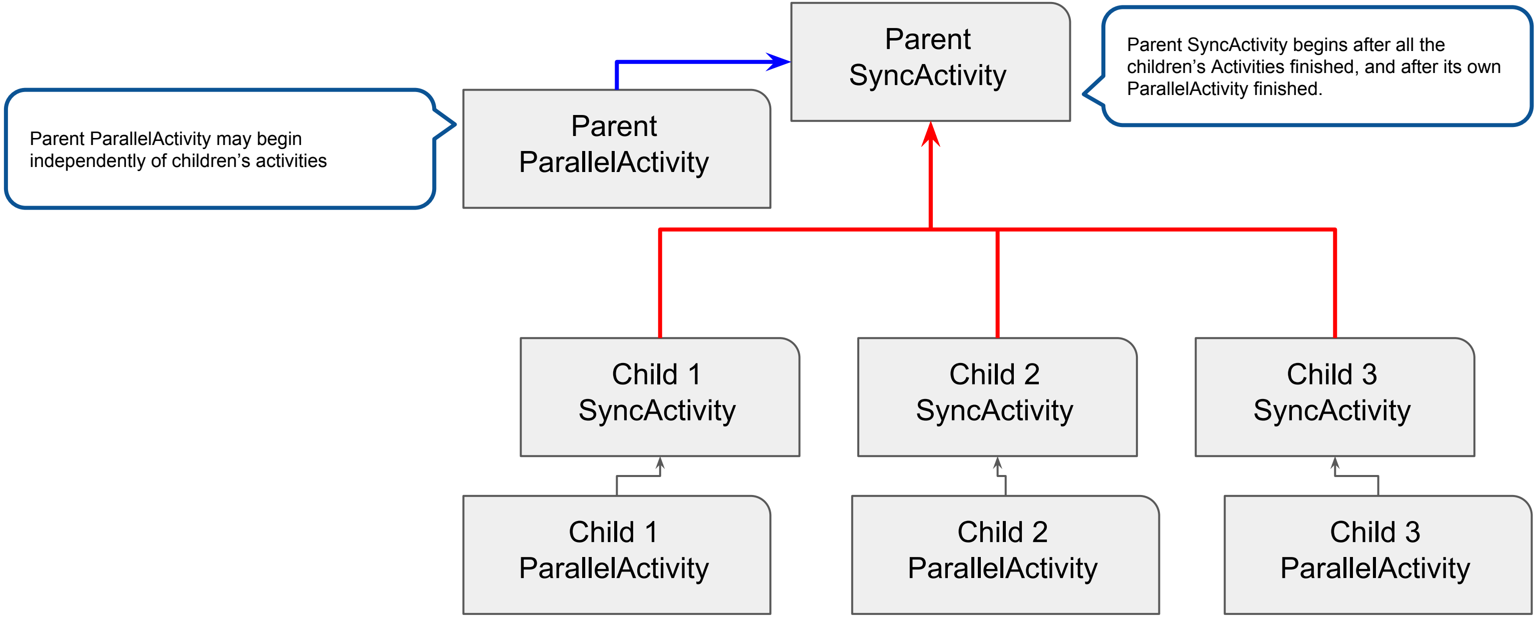
Both are supplied as **methods** by the **Protection Plugin**.

The only constraint is:
SyncActivity completes, once all operations started by the Protection Plugin for this resource are complete.

Task Flow Construction

Infrastructure is responsible for:

- Constructing **taskflow** tasks from **SyncActivity** and **ParallelActivity** methods
- Linking the resource **SyncActivity** task to depend on the resource **ParallelActivity** task (in **blue**)
- Linking the resource **SyncActivity** task to depend on child resources' **SyncActivity**'s tasks (in **red**)



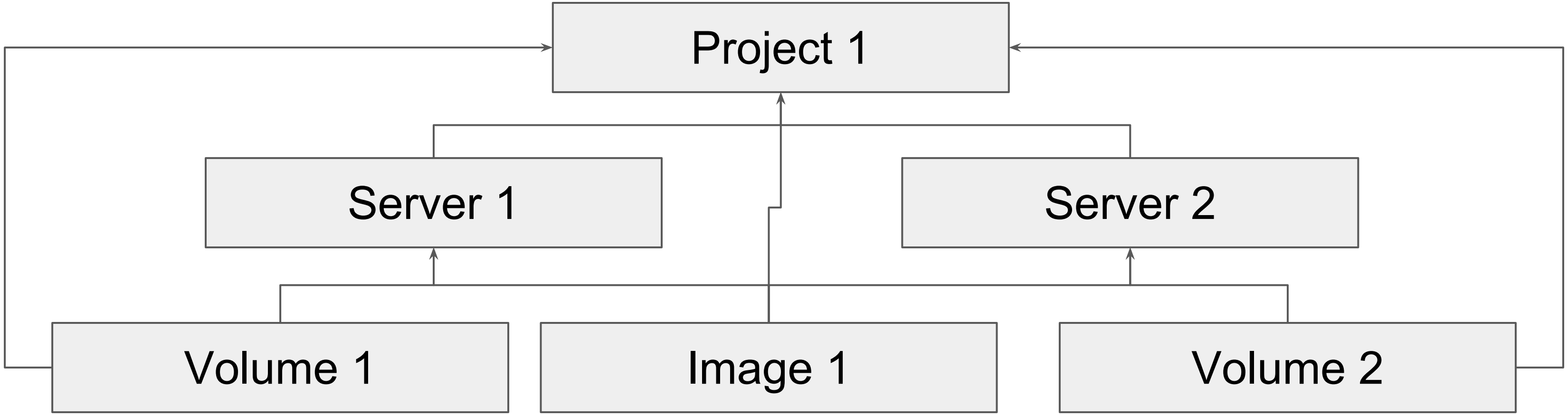
Parent ParallelActivity may begin independently of children's activities

Parent SyncActivity begins after all the children's Activities finished, and after its own ParallelActivity finished.

Task Flow Construction

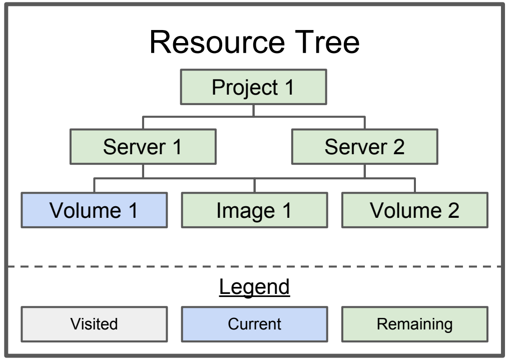
Example of constructing a task flow from an existing resource tree

Example Resource Tree



(For convenience, Project links to Volumes and Images in the resource tree will not be displayed from now on)

Constructing Activity Tasks Based on Resource Tree



Resource Tree

Project 1

Server 1

Server 2

Volume 1

Image 1

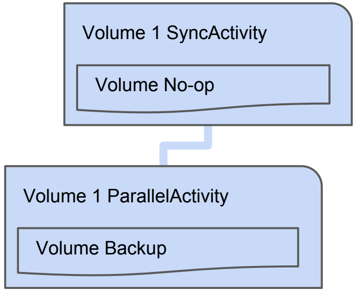
Volume 2

Legend

Visited

Current

Remaining



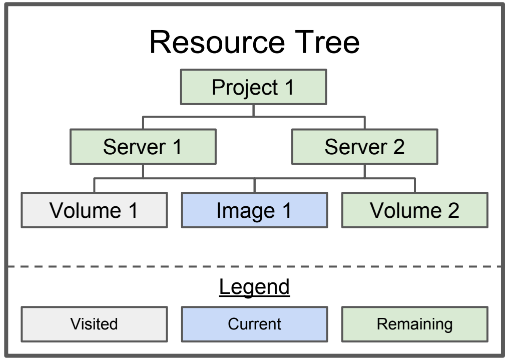
Volume 1 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

Constructing Activity Tasks Based on Resource Tree



Resource Tree

Project 1

Server 1

Server 2

Volume 1

Image 1

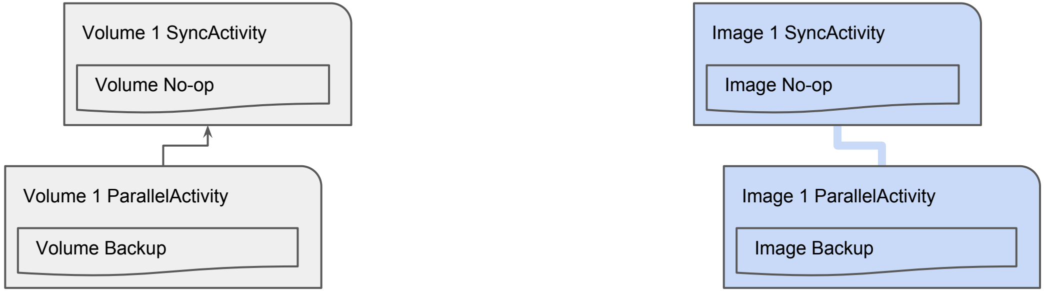
Volume 2

Legend

Visited

Current

Remaining



Volume 1 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

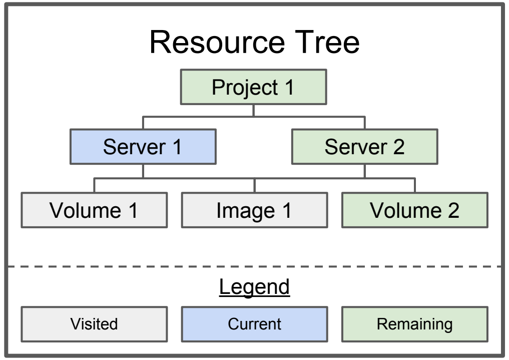
Image 1 SyncActivity

Image No-op

Image 1 ParallelActivity

Image Backup

Constructing Activity Tasks Based on Resource Tree



Resource Tree

Project 1

Server 1

Server 2

Volume 1

Image 1

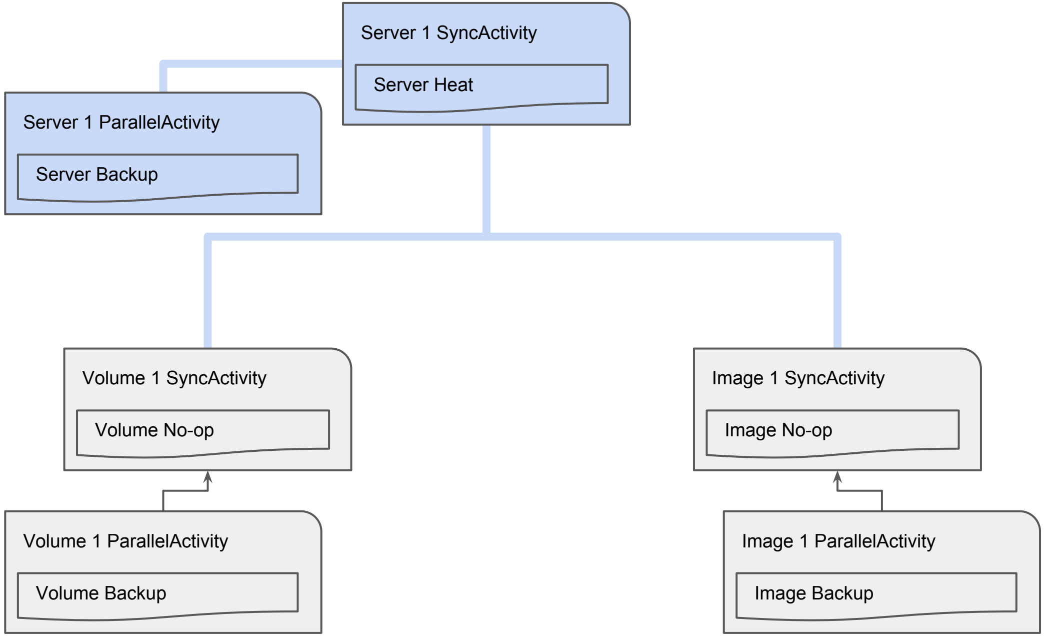
Volume 2

Legend

Visited

Current

Remaining



Server 1 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

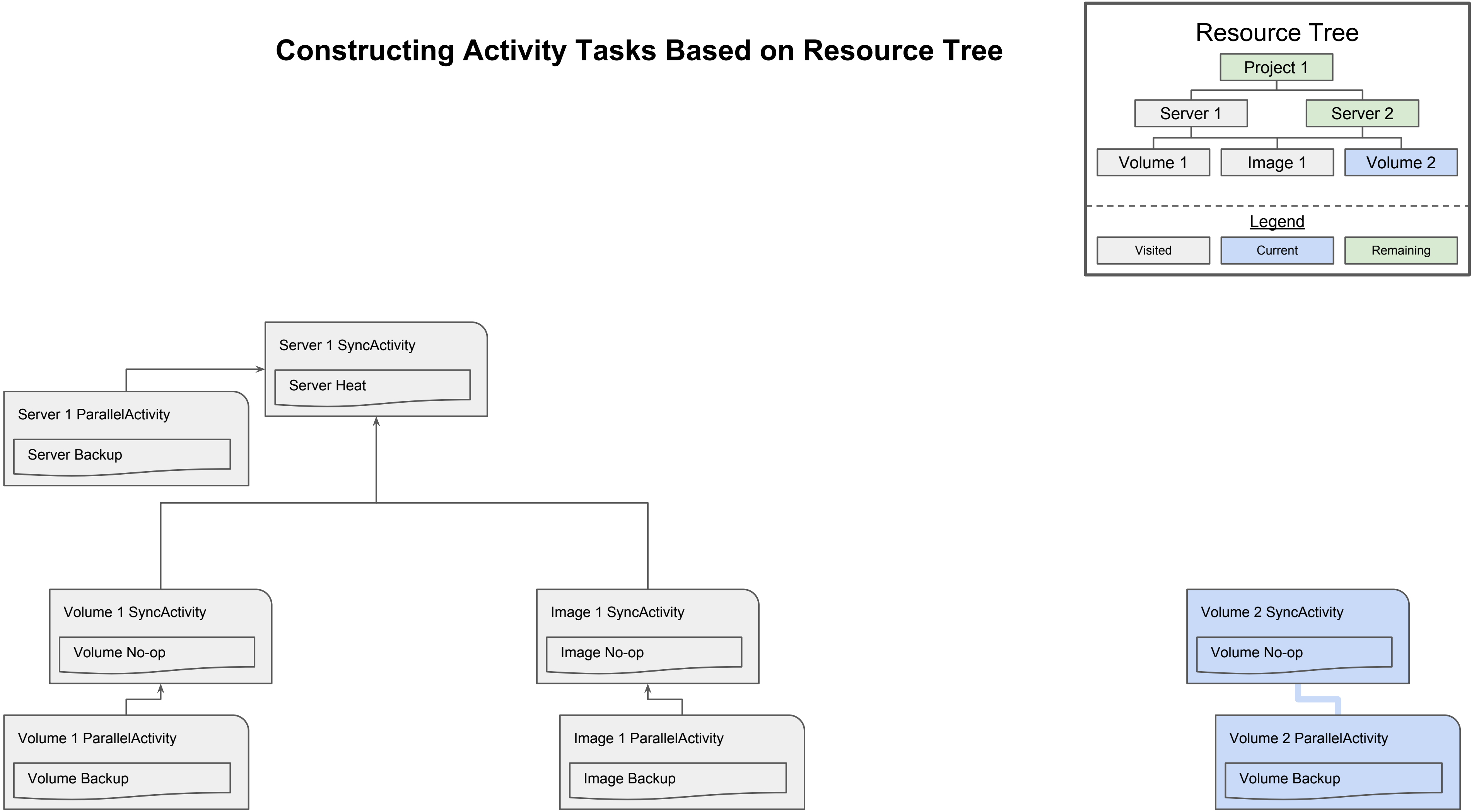
Volume 1 ParallelActivity

Volume Backup

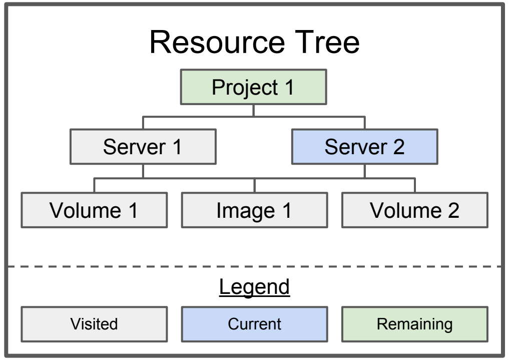
Image 1 ParallelActivity

Image Backup

Constructing Activity Tasks Based on Resource Tree



Constructing Activity Tasks Based on Resource Tree



Resource Tree

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Volume 1

Image 1

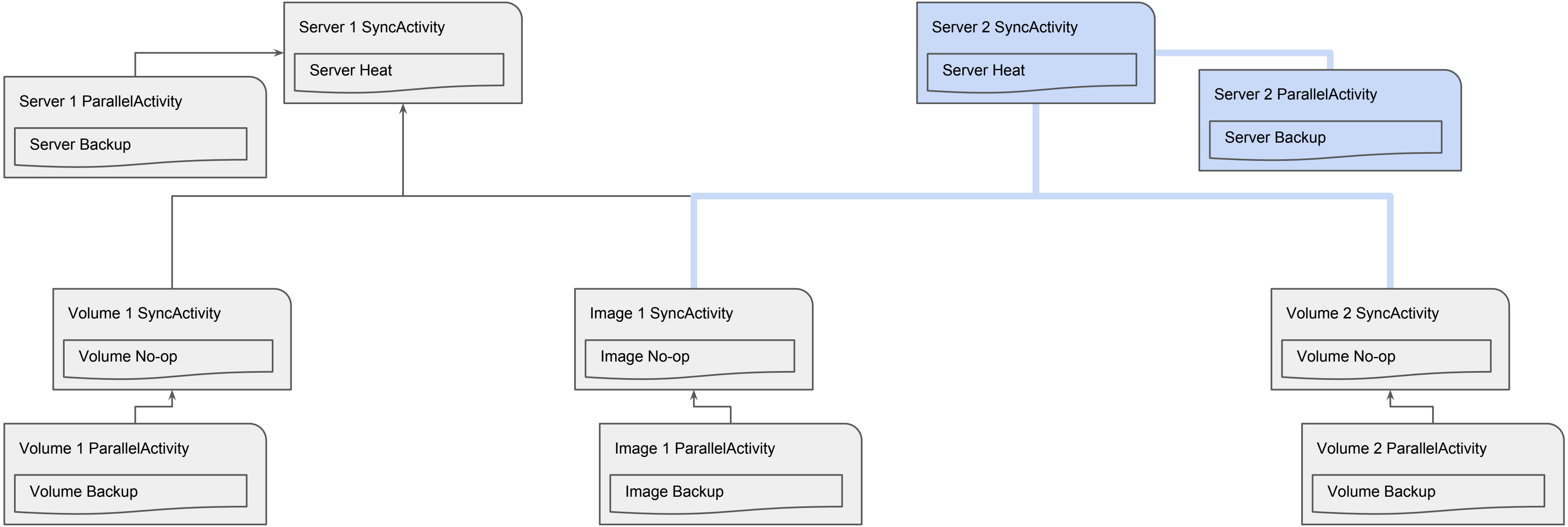
Volume 2

Legend

Visited

Current

Remaining



Server 1 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 SyncActivity

Server Heat

Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

Image 1 SyncActivity

Image No-op

Image 1 ParallelActivity

Image Backup

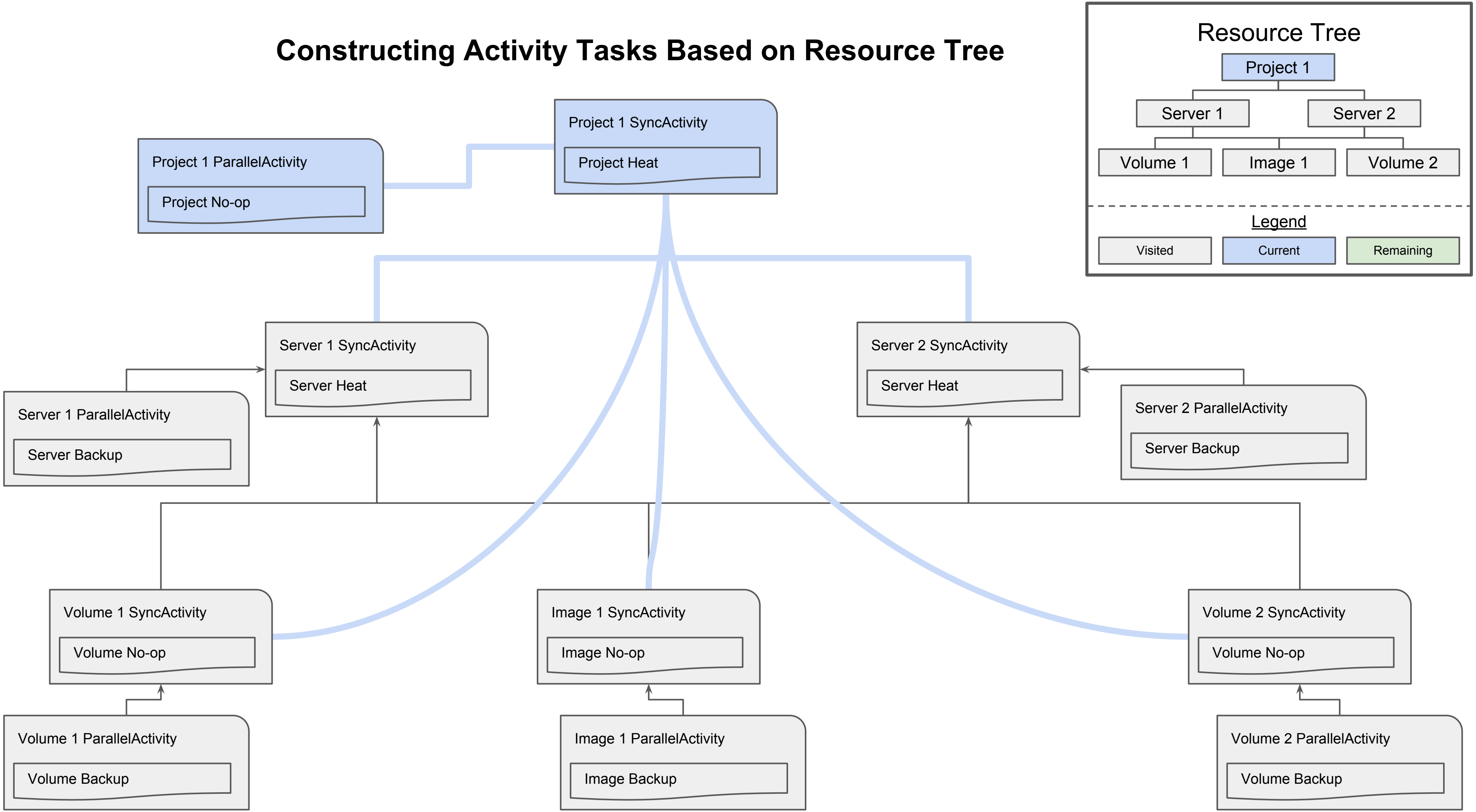
Volume 2 SyncActivity

Volume No-op

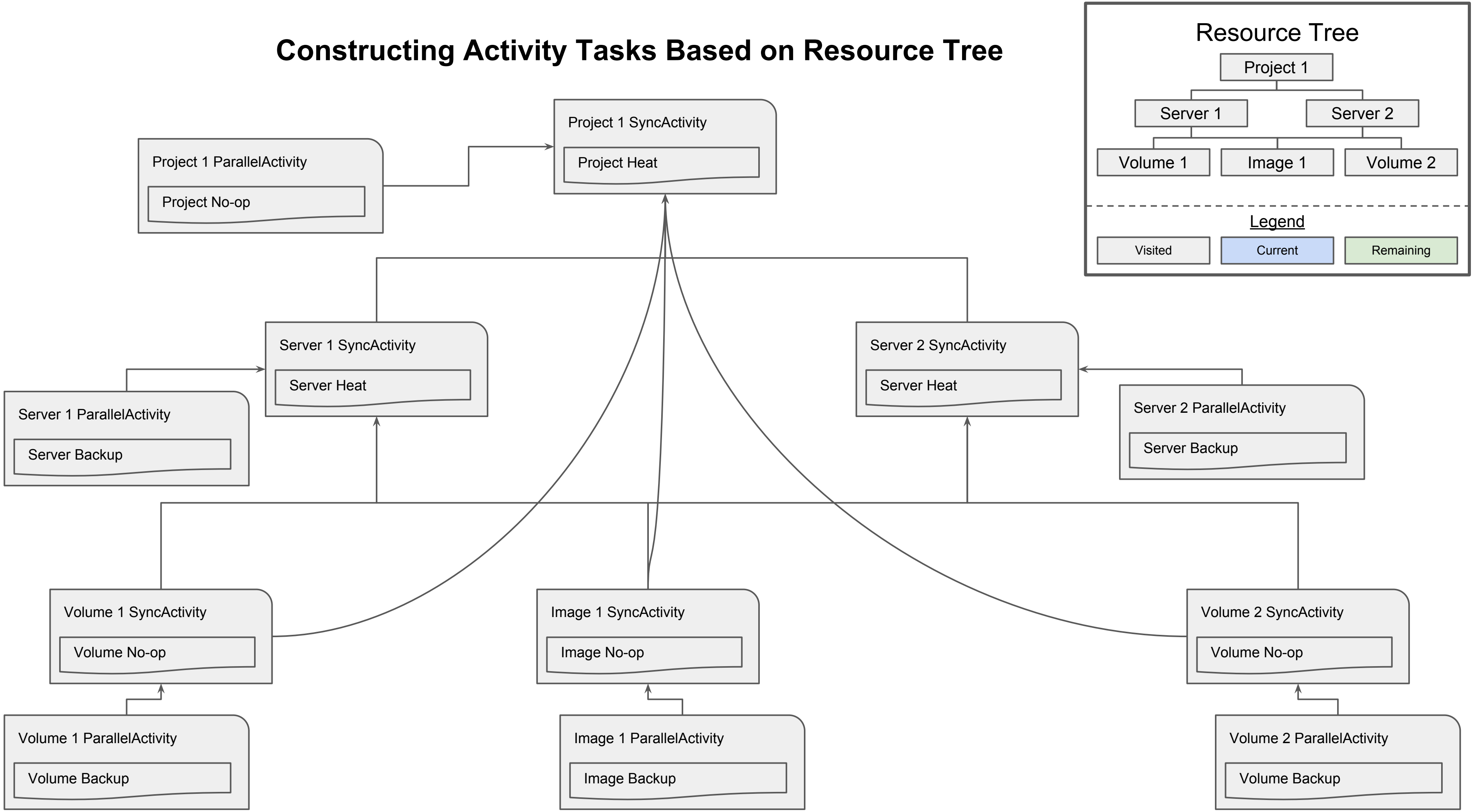
Volume 2 ParallelActivity

Volume Backup

Constructing Activity Tasks Based on Resource Tree



Constructing Activity Tasks Based on Resource Tree



Resource Tree

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Server 2

Volume 1

Image 1

Volume 2

Legend

Visited

Current

Remaining

Project 1 ParallelActivity

Project No-op

Project 1 SyncActivity

Project Heat

Server 1 SyncActivity

Server Heat

Server 2 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

Volume 2 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

Image 1 ParallelActivity

Image Backup

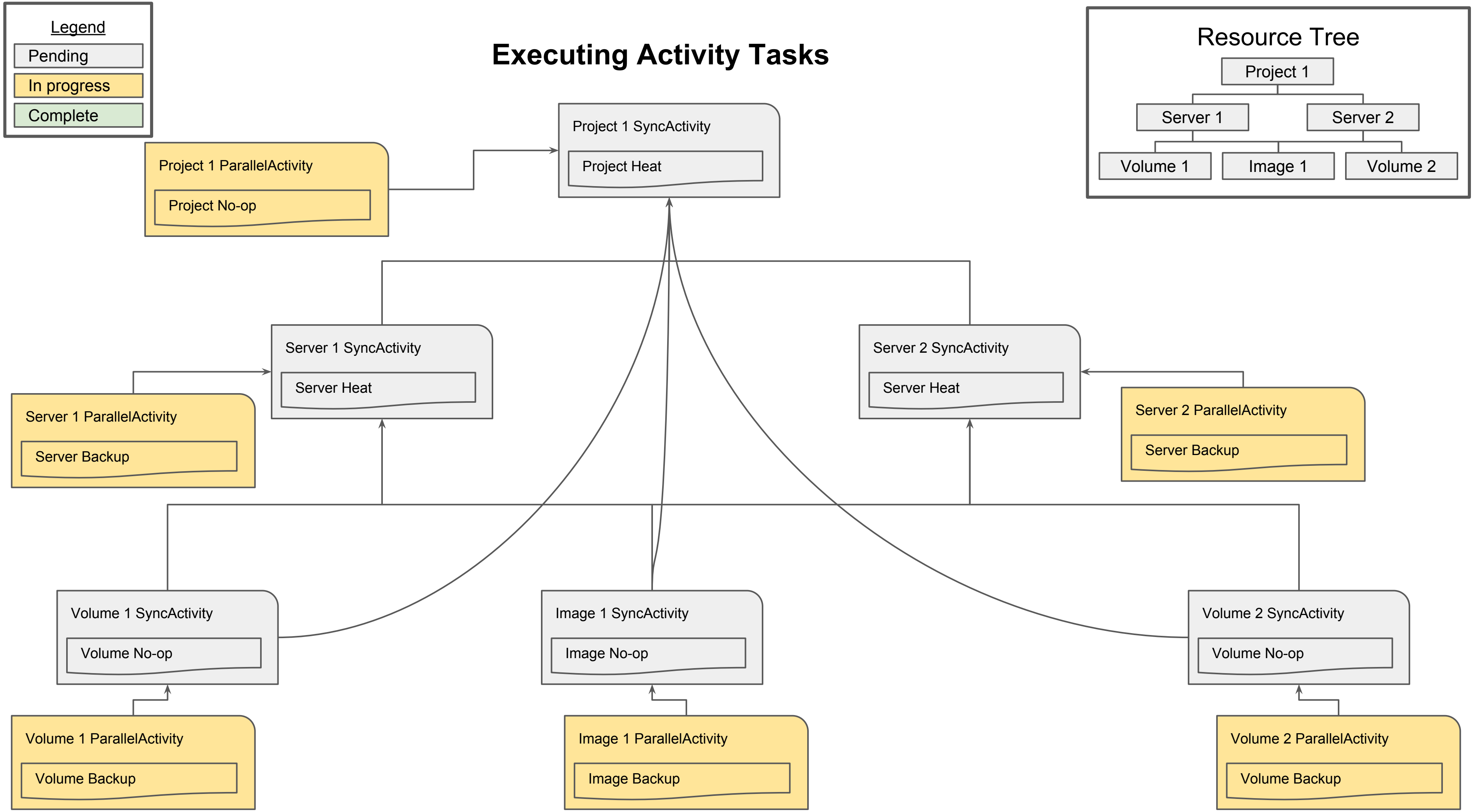
Volume 2 ParallelActivity

Volume Backup

Task Flow Execution

Example of a naïve, completely parallel run of the constructed task flow

Executing Activity Tasks



Legend

- Pending
- In progress
- Complete

Resource Tree

- Project 1
  - Server 1
  - Server 2
    - Volume 1
    - Image 1
    - Volume 2

Project 1 SyncActivity

Project Heat

Project 1 ParallelActivity

Project No-op

Server 1 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 SyncActivity

Server Heat

Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

Image 1 SyncActivity

Image No-op

Image 1 ParallelActivity

Image Backup

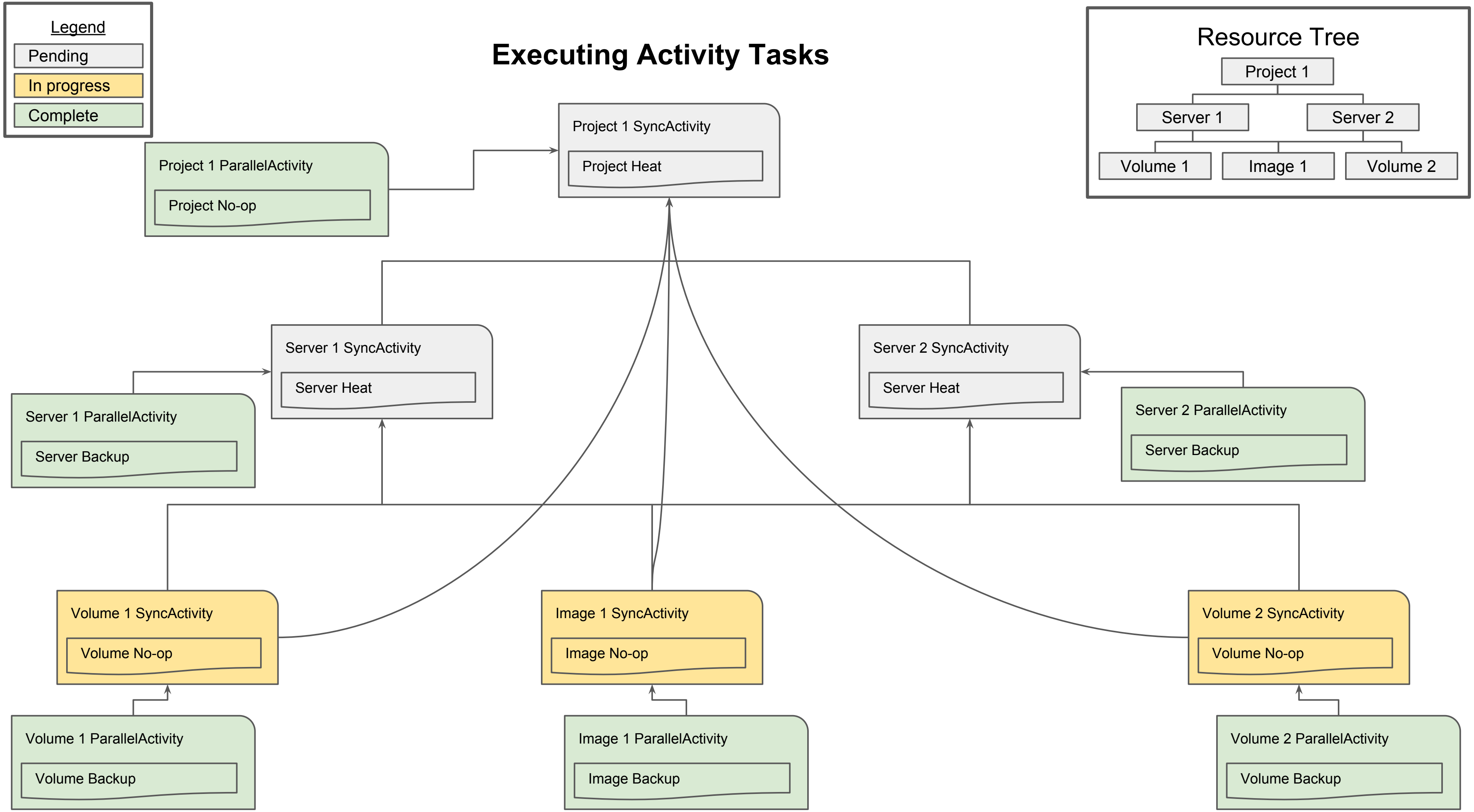
Volume 2 SyncActivity

Volume No-op

Volume 2 ParallelActivity

Volume Backup

Executing Activity Tasks



Legend

- Pending
- In progress
- Complete

Resource Tree

Project 1

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Server 2

Volume 1

Image 1

Volume 2

Project 1 SyncActivity

Project Heat

Project 1 ParallelActivity

Project No-op

Server 1 SyncActivity

Server Heat

Server 2 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

Volume 2 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

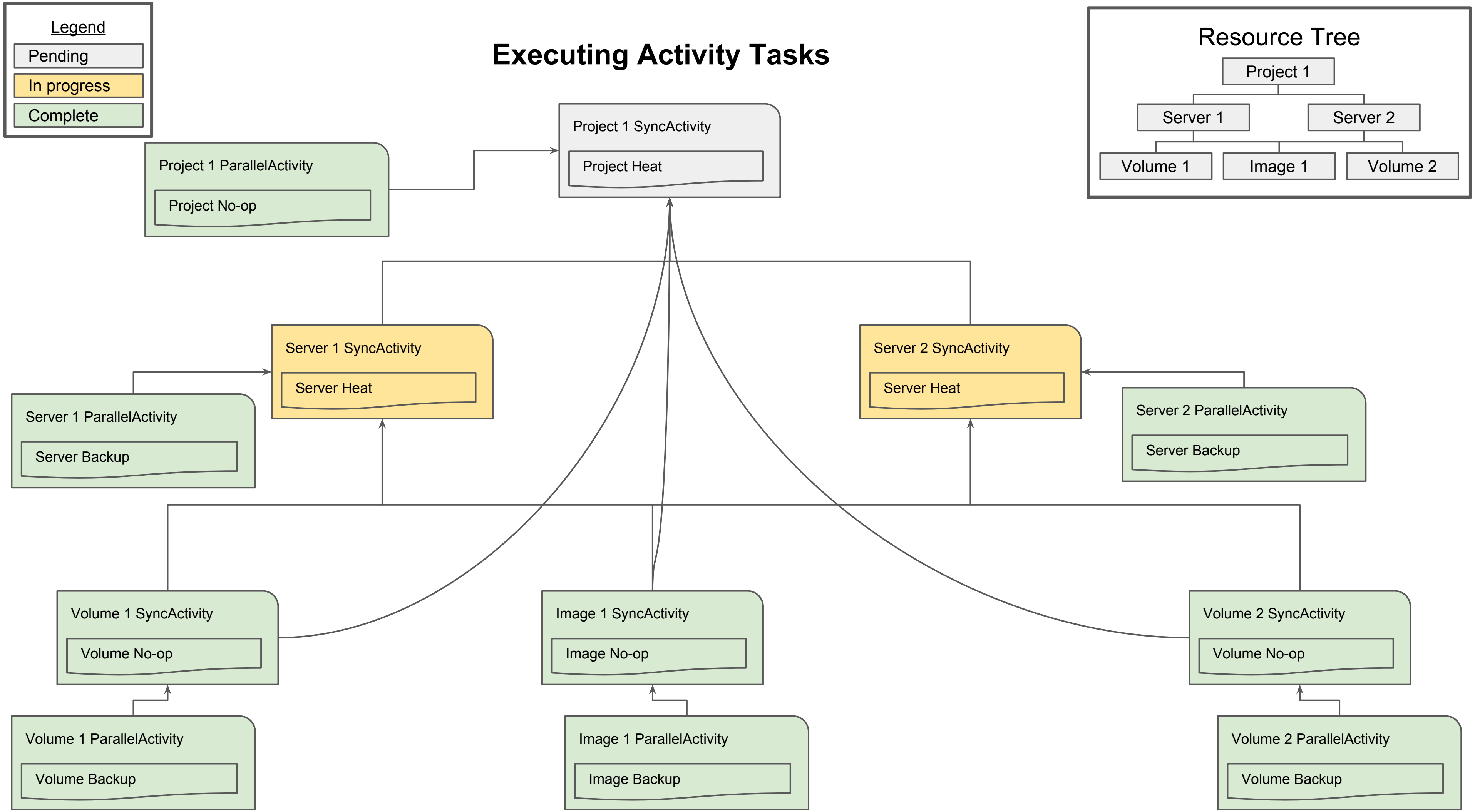
Image 1 ParallelActivity

Image Backup

Volume 2 ParallelActivity

Volume Backup

Executing Activity Tasks



Legend

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Resource Tree

Project 1

Server 1

Server 2

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Image 1

Volume 2

Project 1 ParallelActivity

Project No-op

Project 1 SyncActivity

Project Heat

Server 1 SyncActivity

Server Heat

Server 2 SyncActivity

Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

Volume 2 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

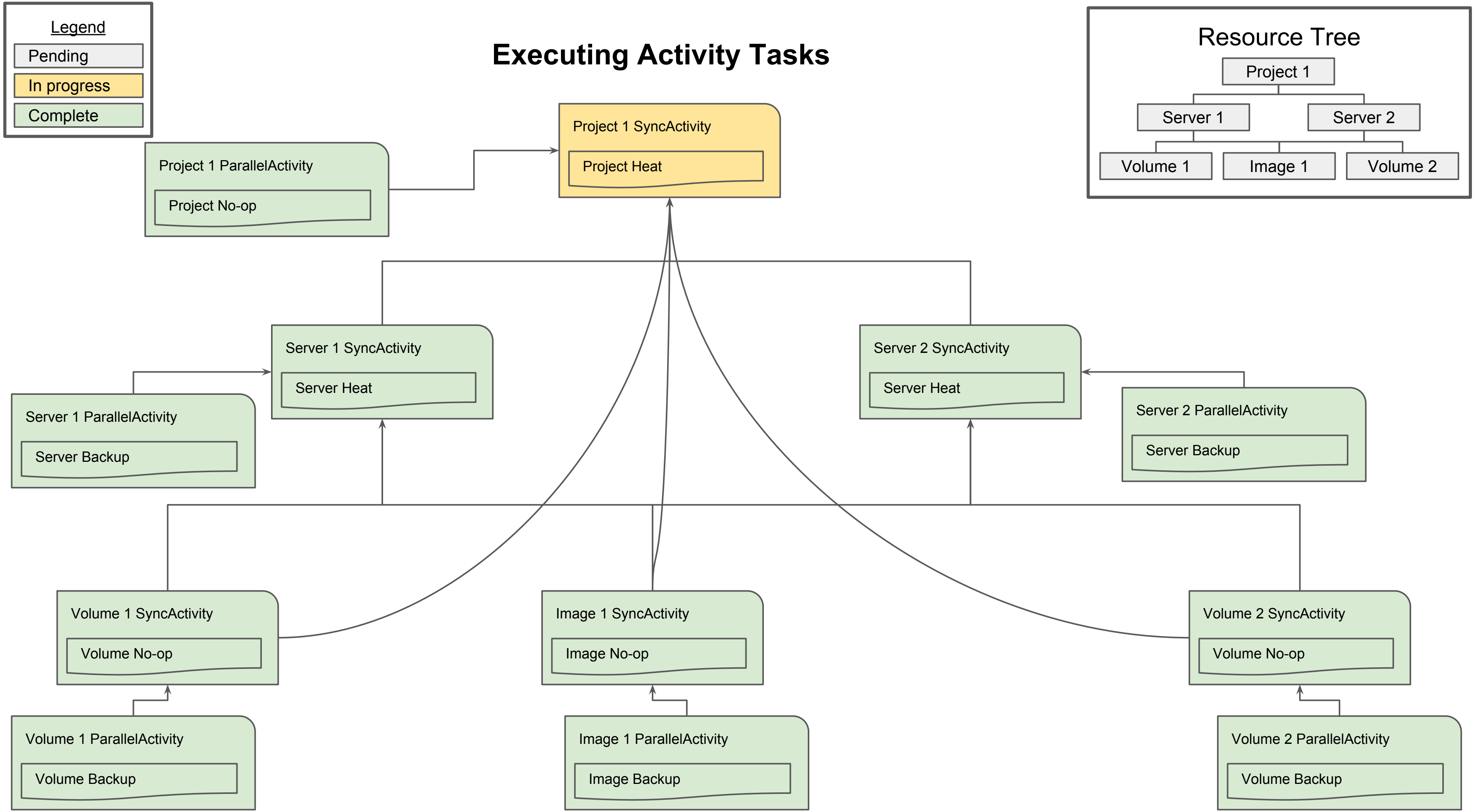
Image 1 ParallelActivity

Image Backup

Volume 2 ParallelActivity

Volume Backup

Executing Activity Tasks



Legend

Pending

In progress

Complete

Resource Tree

Project 1

Server 1

Server 2

Volume 1

Image 1

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Project 1 SyncActivity

Project Heat

Project 1 ParallelActivity

Project No-op

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Server Heat

Server 1 ParallelActivity

Server Backup

Server 2 SyncActivity

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Server 2 ParallelActivity

Server Backup

Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

Volume 2 SyncActivity

Volume No-op

Volume 1 ParallelActivity

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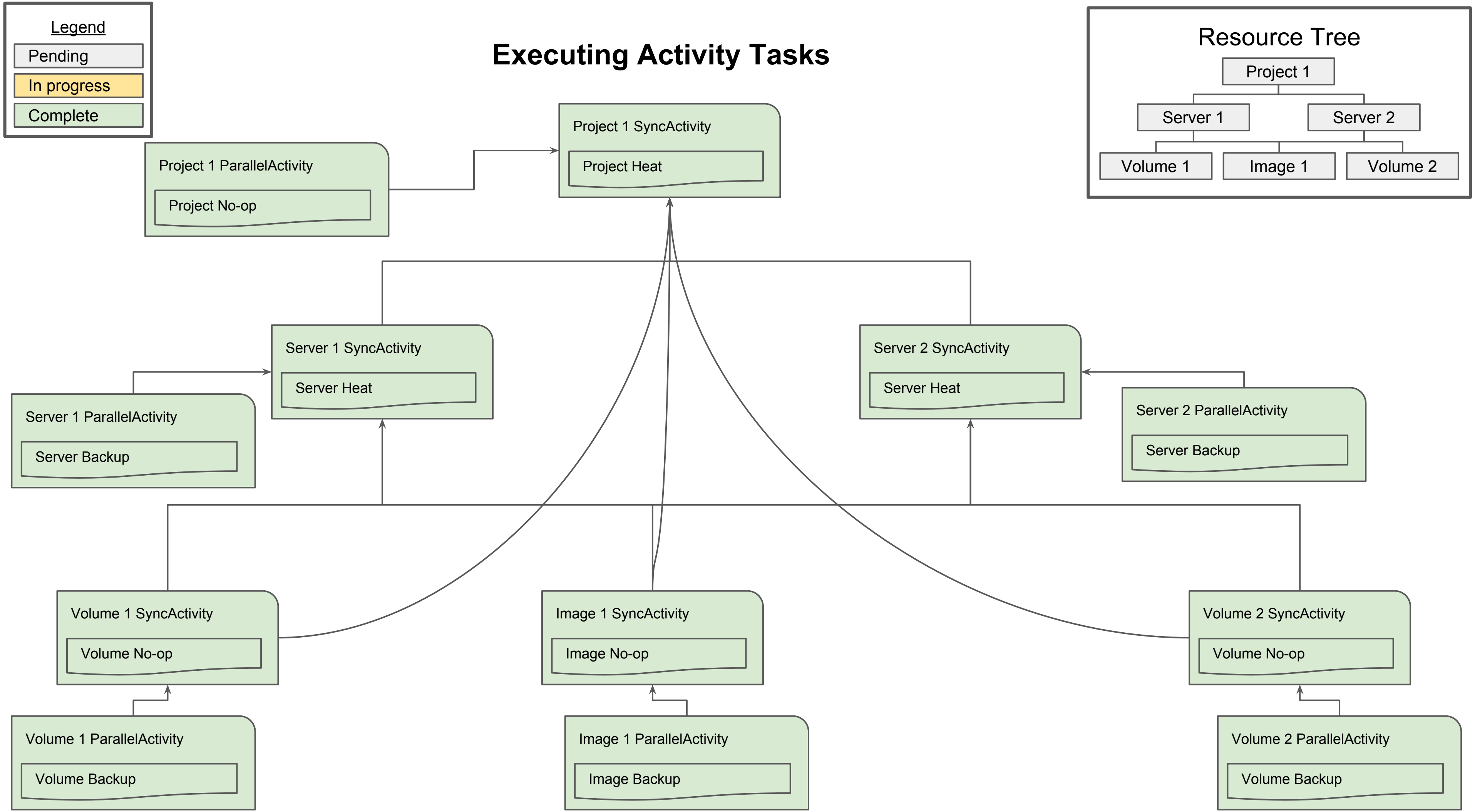
Image 1 ParallelActivity

Image Backup

Volume 2 ParallelActivity

Volume Backup

Executing Activity Tasks



Legend
- Pending
- In progress
- Complete

Resource Tree

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Volume 2

Project 1 ParallelActivity

Project No-op

Project 1 SyncActivity

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Server 1 ParallelActivity

Server Backup

Server 1 SyncActivity

Server Heat

Server 2 SyncActivity

Server Heat

Server 2 ParallelActivity

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Volume 1 SyncActivity

Volume No-op

Image 1 SyncActivity

Image No-op

Volume 2 SyncActivity

Volume No-op

Volume 1 ParallelActivity

Volume Backup

Image 1 ParallelActivity

Image Backup

Volume 2 ParallelActivity

Volume Backup

Smaug Resource Operations Workflow

Depends on child resources vs. Independent

- Work which is independent of the child resources, can be started in the **ParallelActivity**
- Work which depends on the child resources can be performed in the **SyncActivity**
- A protection plugin may have both dependent and independent work, or one of them

Smaug Resource Operations Workflow

Calls to OpenStack API vs. Proprietary APIs

- Both **ParallelActivity** and **SyncActivity** are implemented by the Protection Plugins, no dependency on OpenStack APIs

Smaug Resource Operations Workflow

Calls to Synchronous APIs vs. call of Asynchronous APIs

Long activity vs. short activity

- Calling Asynchronous APIs requires synchronization in either the **ParallelActivity** or the **SyncActivity**
- Simple synchronous APIs can be performed in both **ParallelActivity** and **SyncActivity**
- Heavy-duty synchronous APIs can be started in the background from **ParallelActivity** (for example, using a new thread), and synced back in the **SyncActivity** (instead of blocking the workflow executor)

Smaug Resource Operations Workflow

High resource demand vs. low resource demand

- **ParallelActivity** can send heavy-duty activities to a queue, which will limit the amount of concurrent heavy-duty jobs
- **SyncActivity** can be used to wait until the queued jobs complete