VMs and Images

Overview

VMs offer many useful features such as live migration which allows them to remain up even during maintenance events

Rightsizing recommendations allow you to use the right sized machines for your workloads

Google offers sustained use and committed use discounts which help reduce your cloud bill

Images help you instantiate new VMs with the OS and applications of your choice baked in

Virtual Machines

3 Compute Choices

| Compute Engine | Container Engine | App Engine |

3 Compute Choices

Compute Engine

Container Engine

App Engine

Live Migration

- Keeps your VM instances **running** even during a hardware or software update

- Live migrates your instance to another host in the same zone **without rebooting VMs**

  - infrastructure maintenance and upgrades

  - network and power grid maintenance

  - Failed hardware

  - Host and BIOS updates

  - Security changes etc

Live Migration

- VM gets a notification that it needs to be evicted

- A new VM is selected for migration, the empty "target"

- A connection is **authenticated** between the two

Live Migration Stages

- **Pre-migration brownout:** VM executing on source when most of the state is sent from source to target

- **Blackout:** A brief moment when the VM is not running anywhere.

- **Post-migration brownout:** VM is on the target, the source is present and might offer support (forwards packets from the source to target VMs till networking is updated)
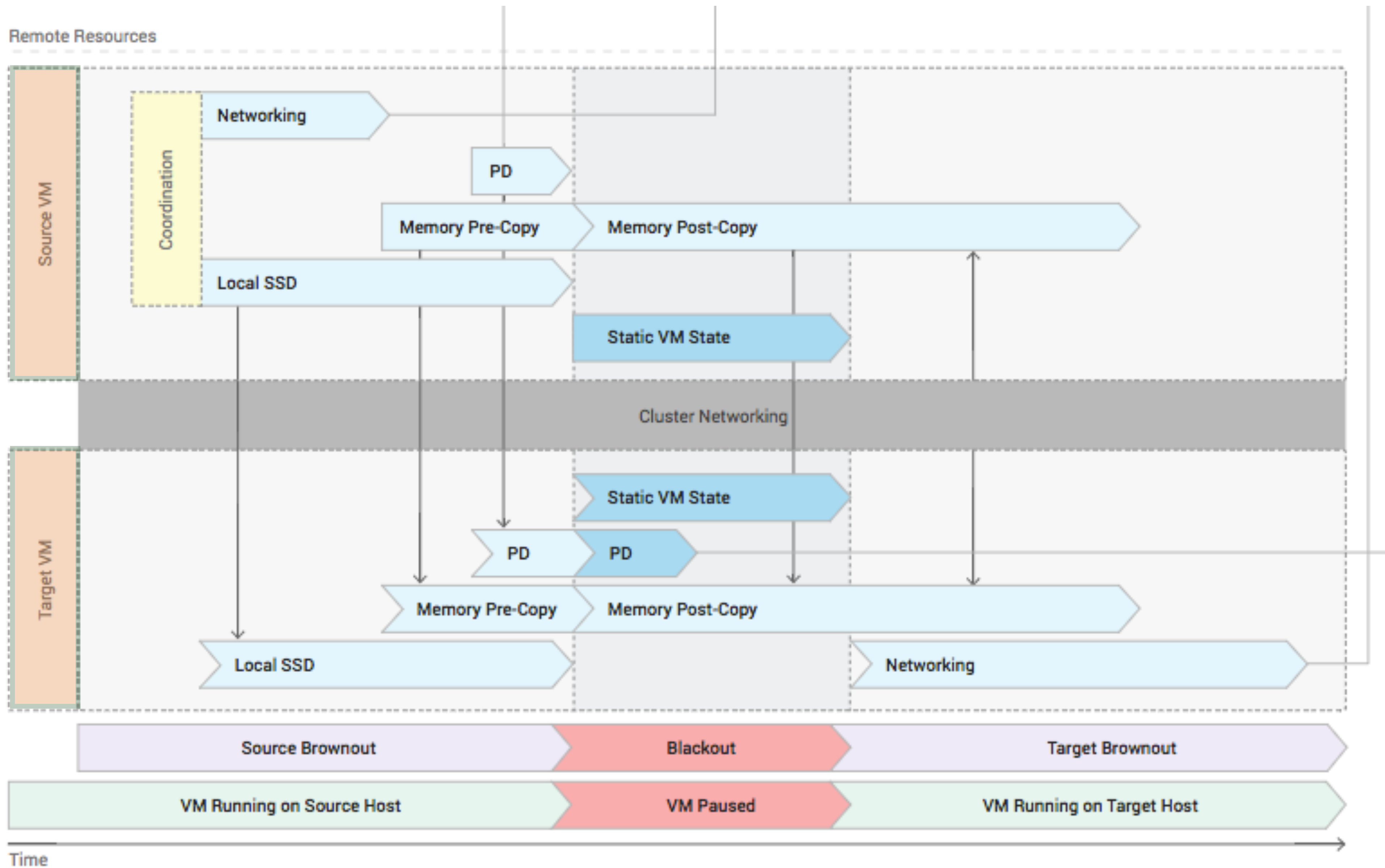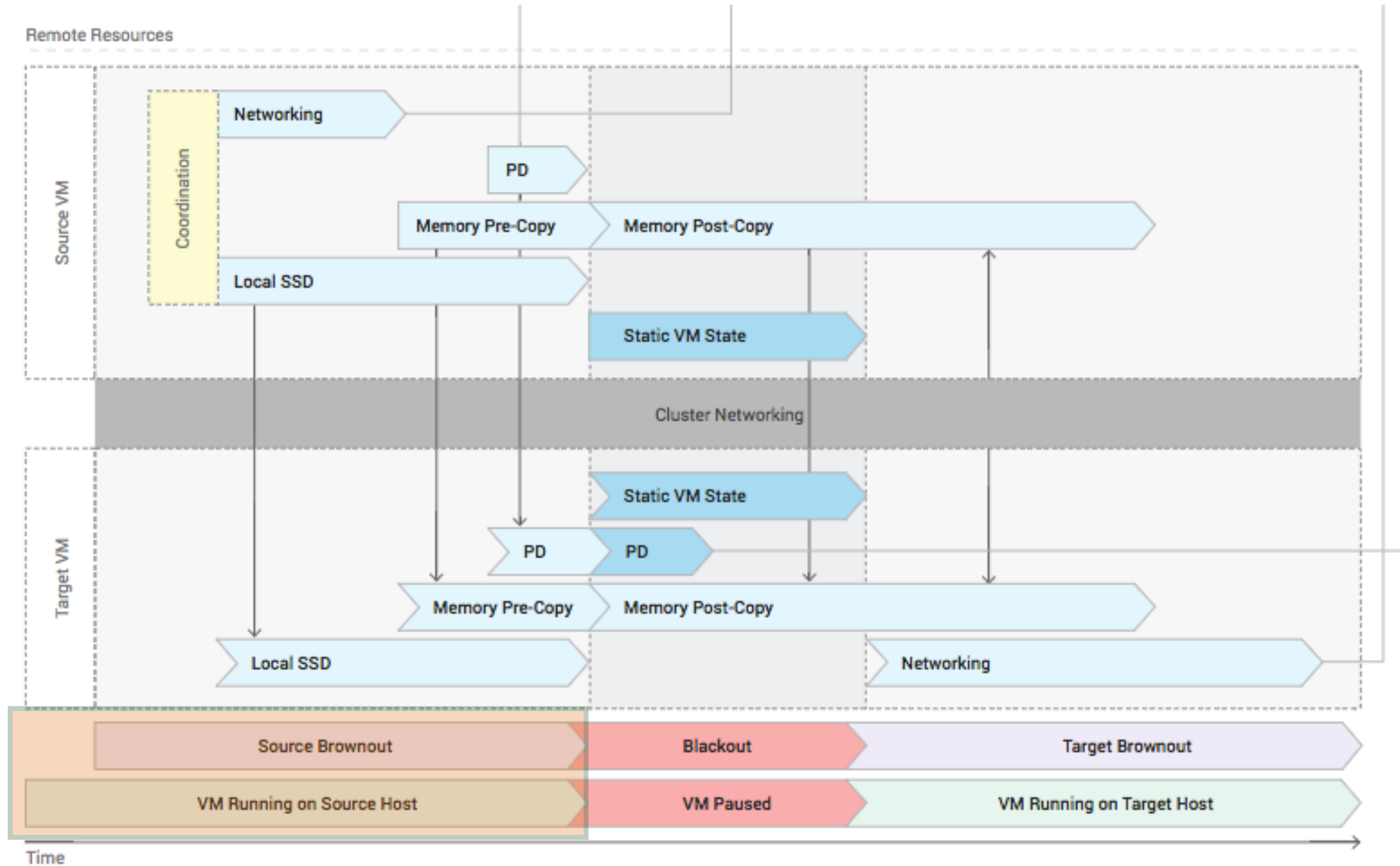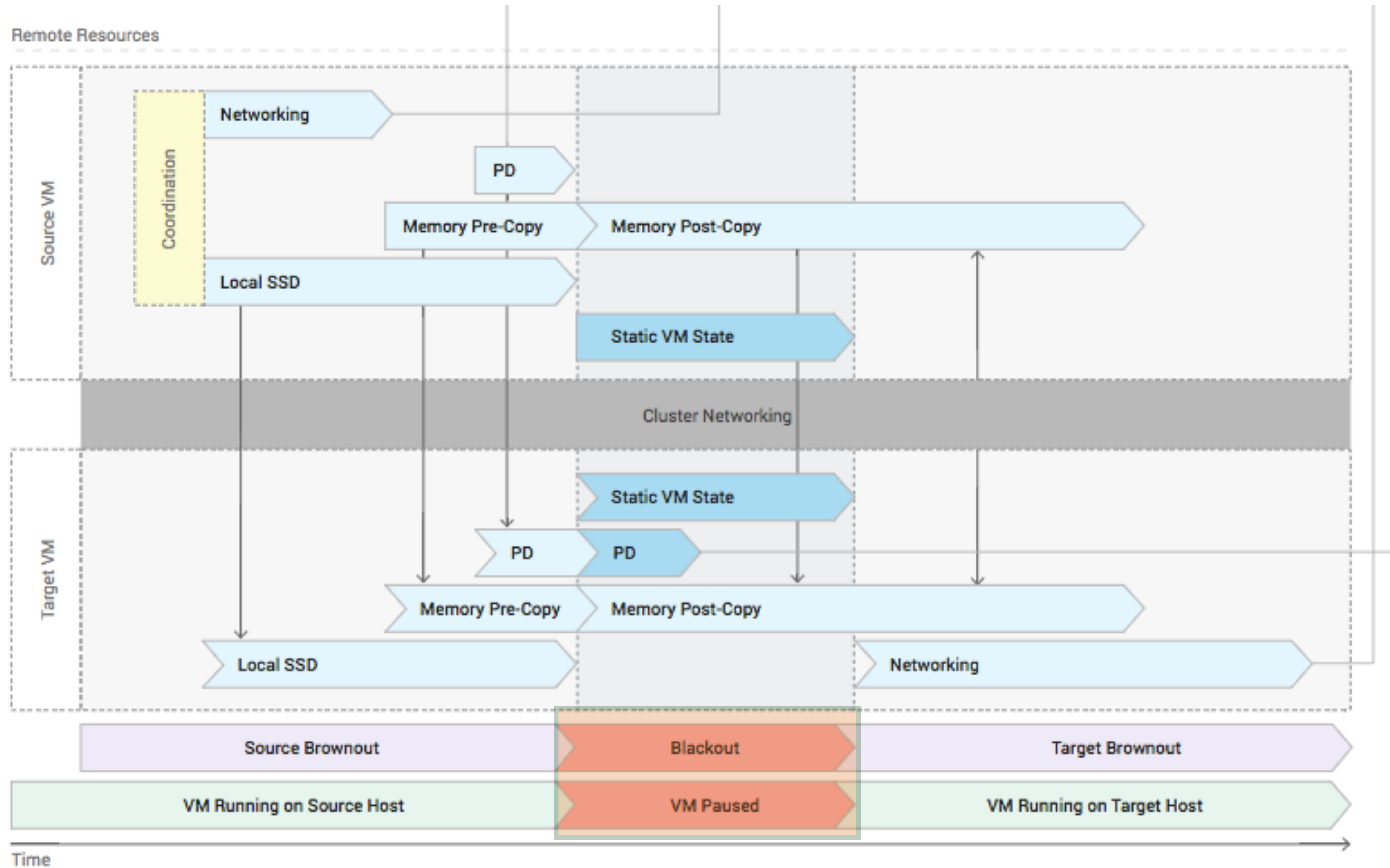
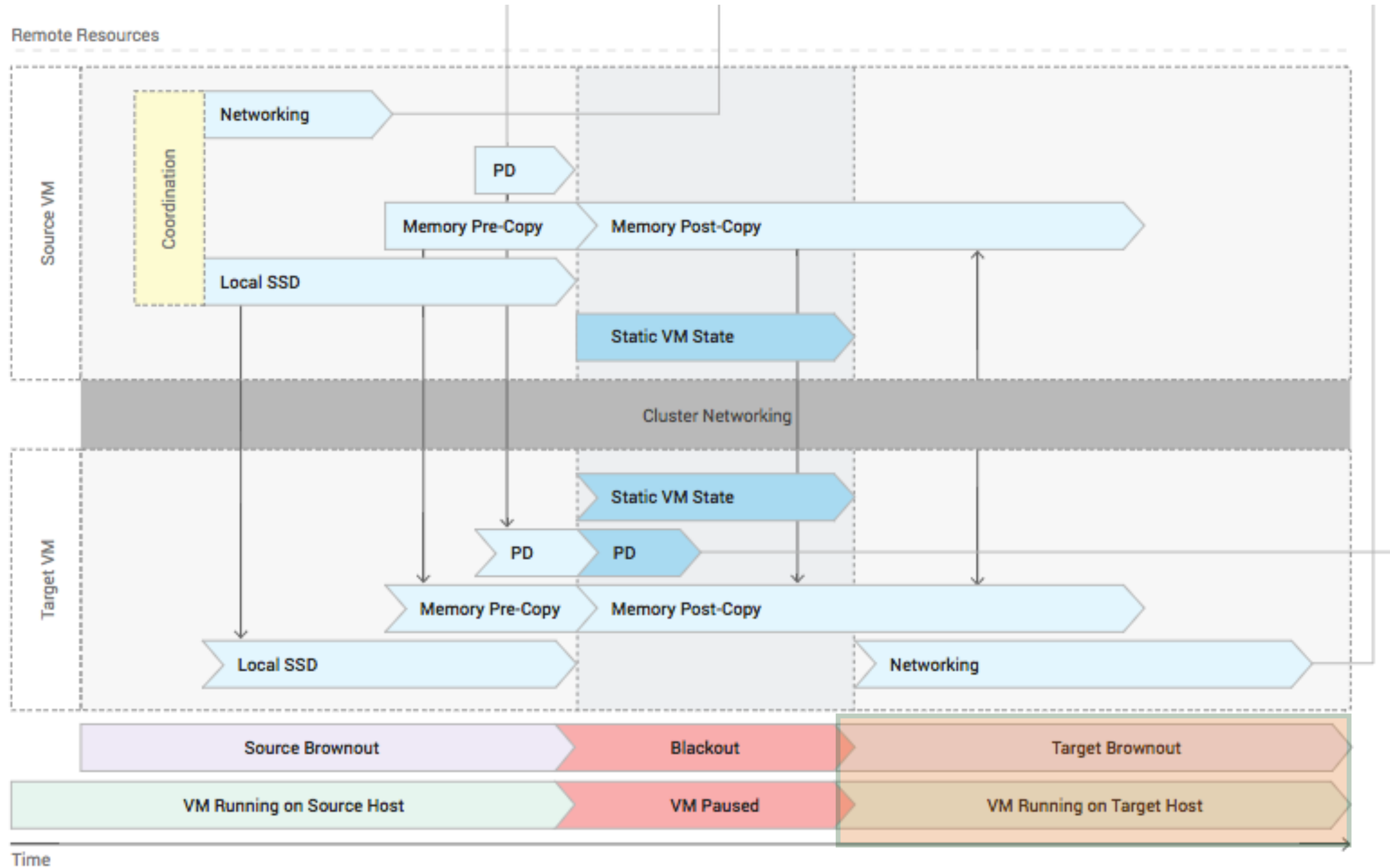# Live Migration
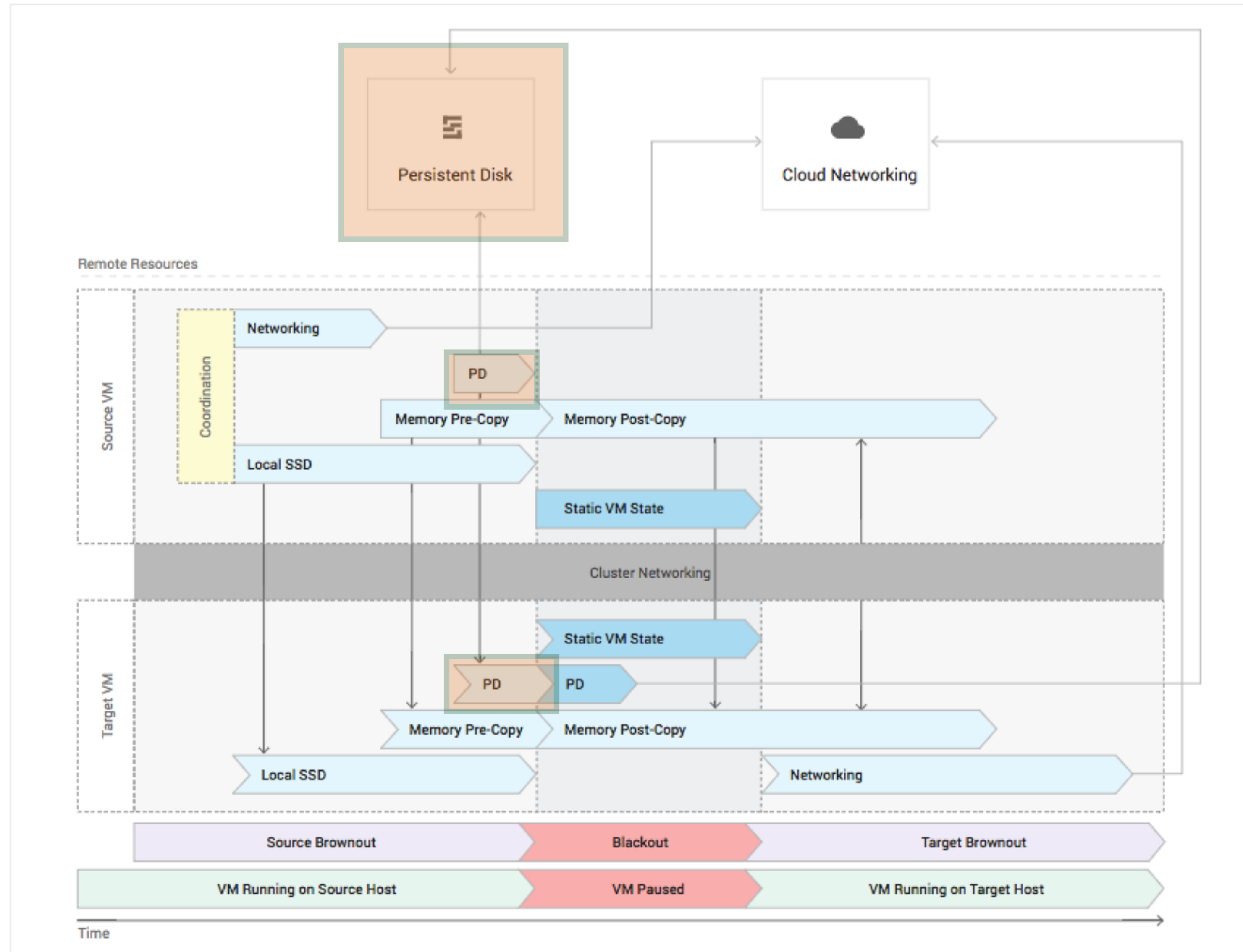
Live Migration
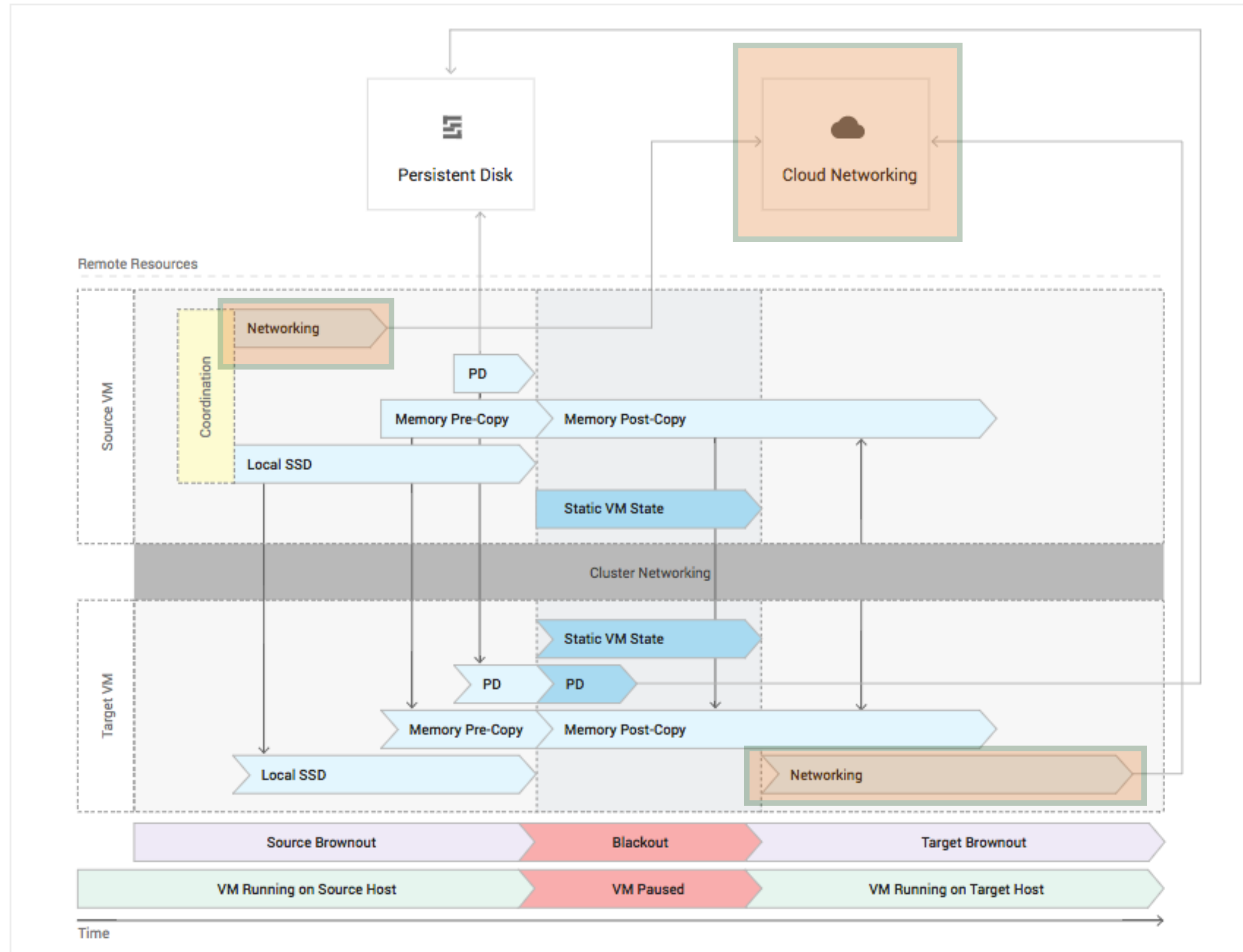
Live Migration

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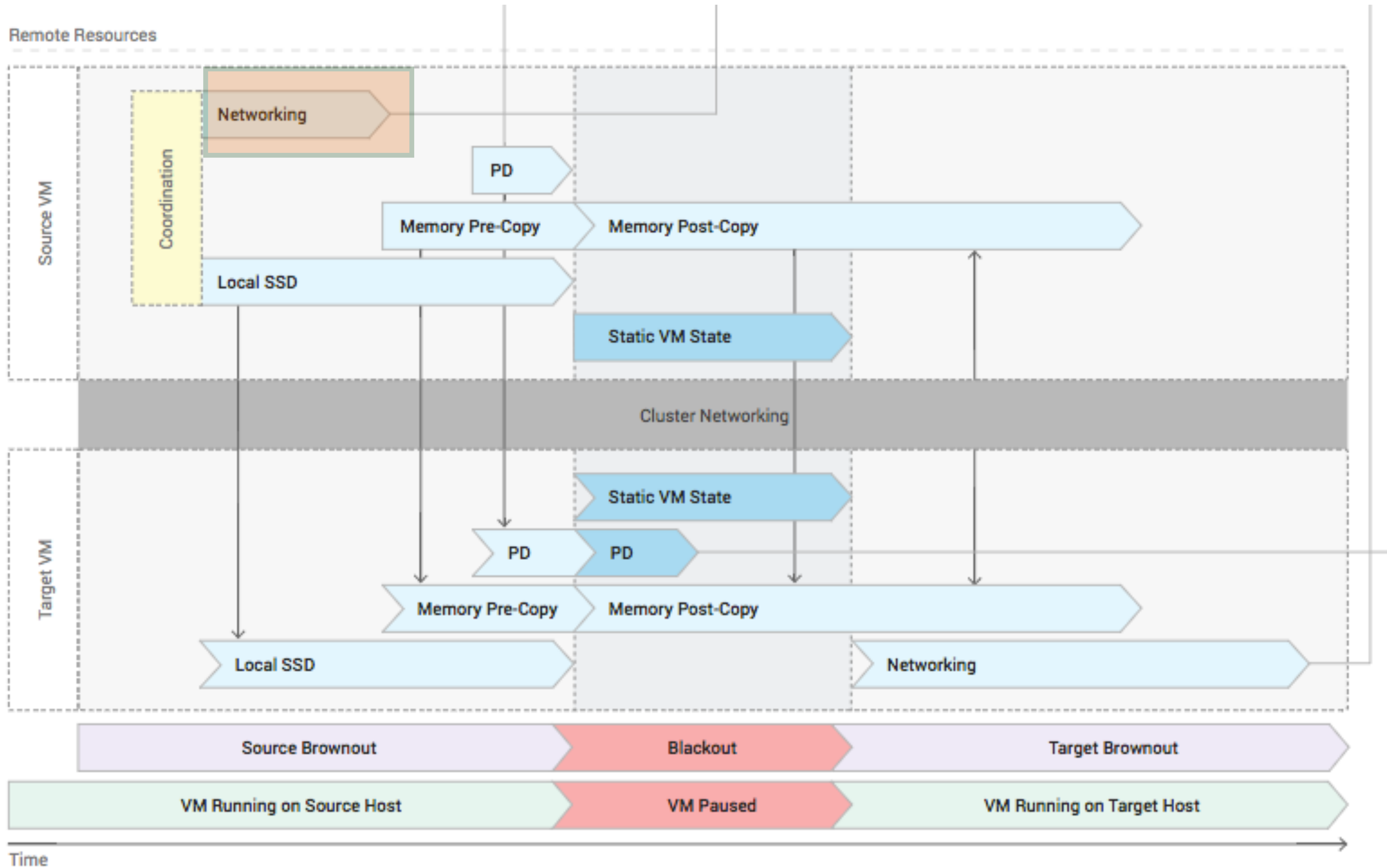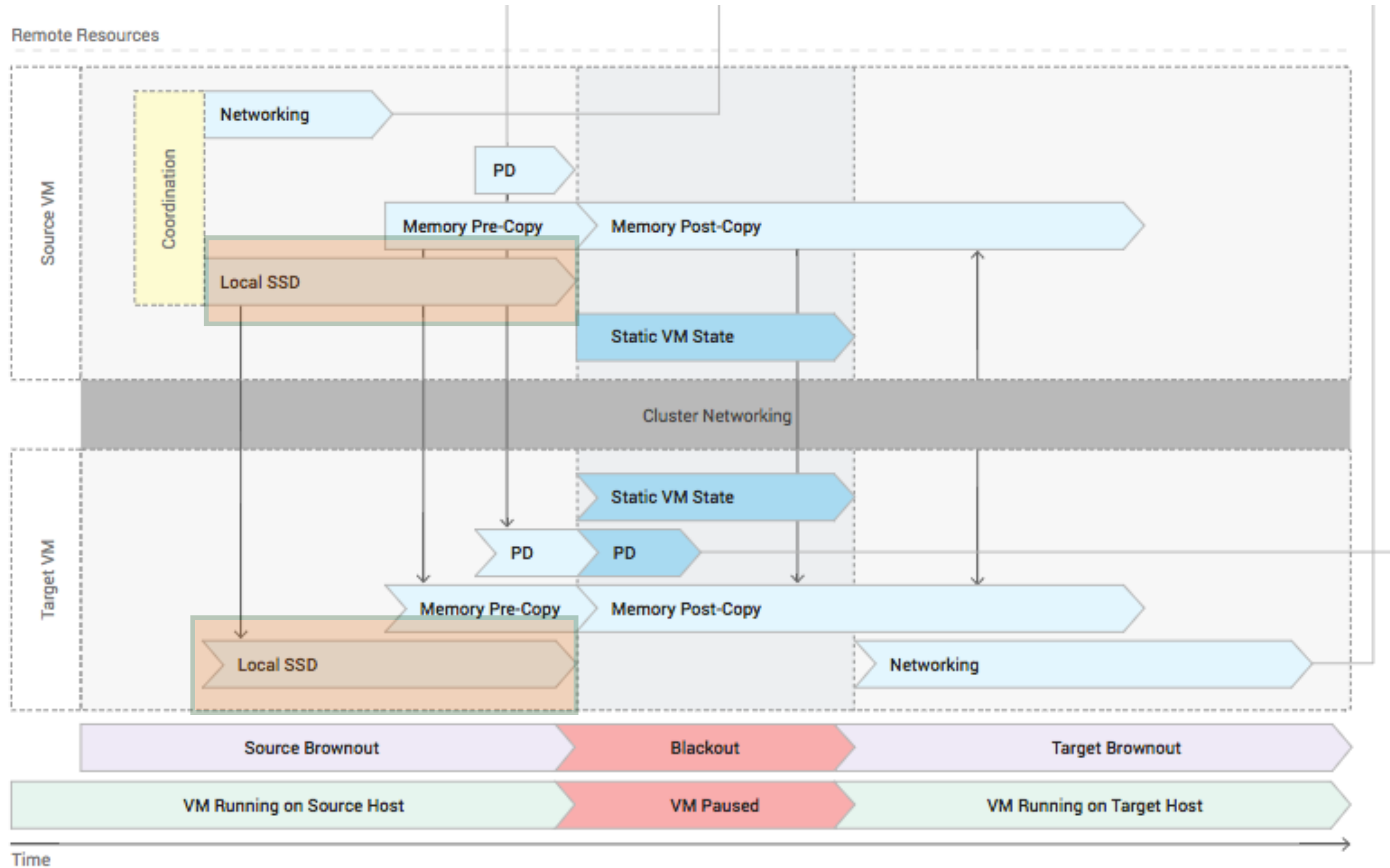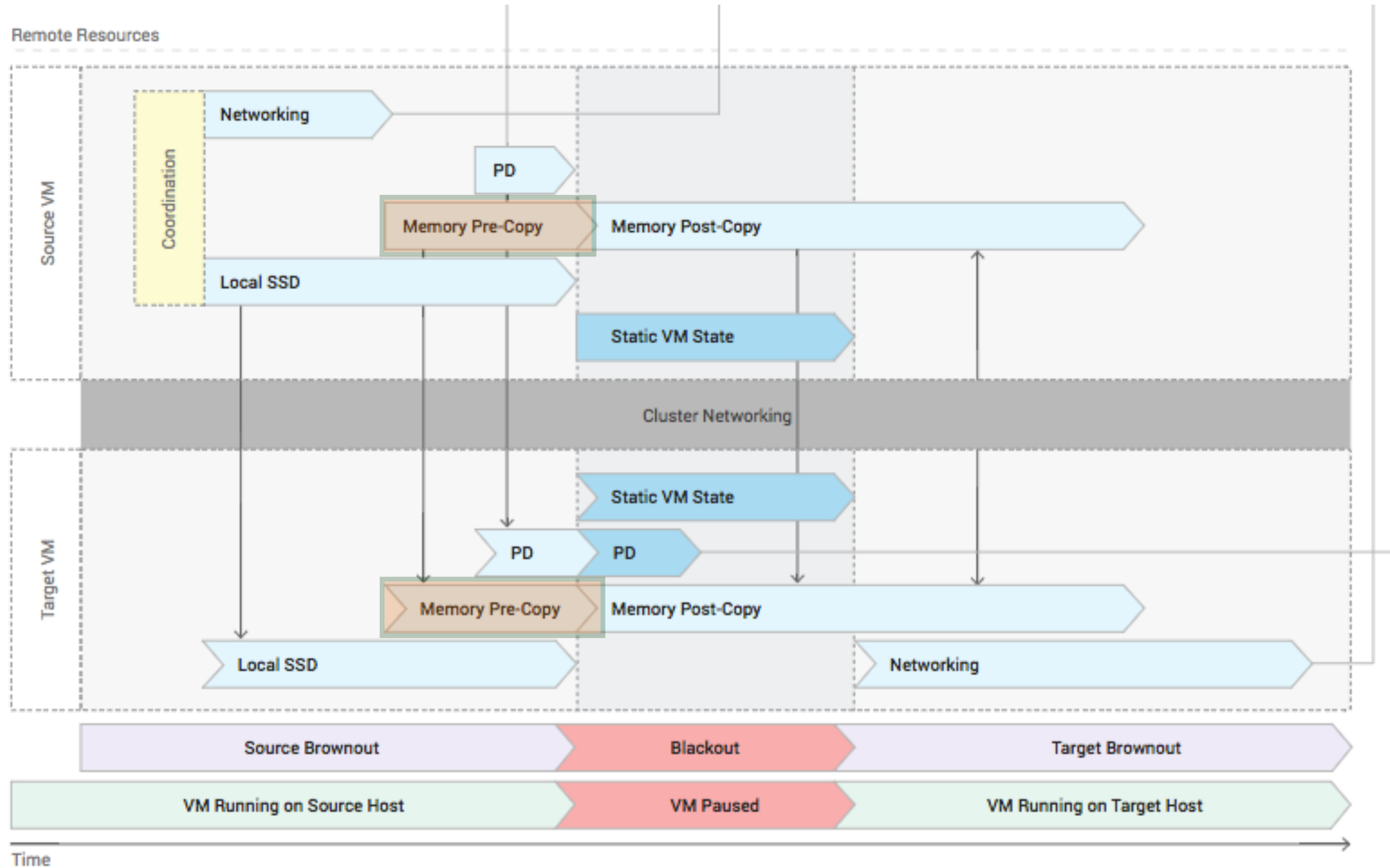
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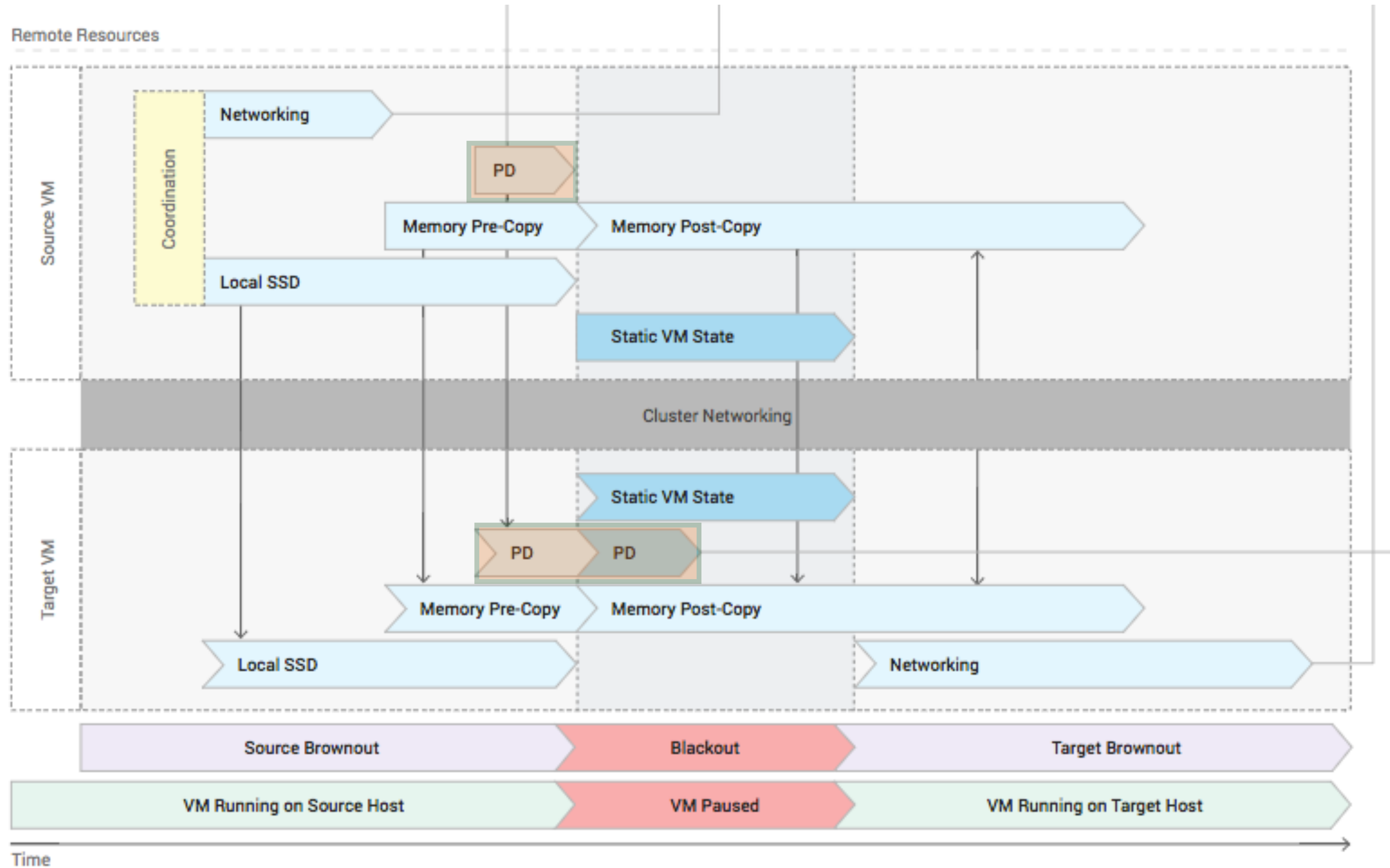
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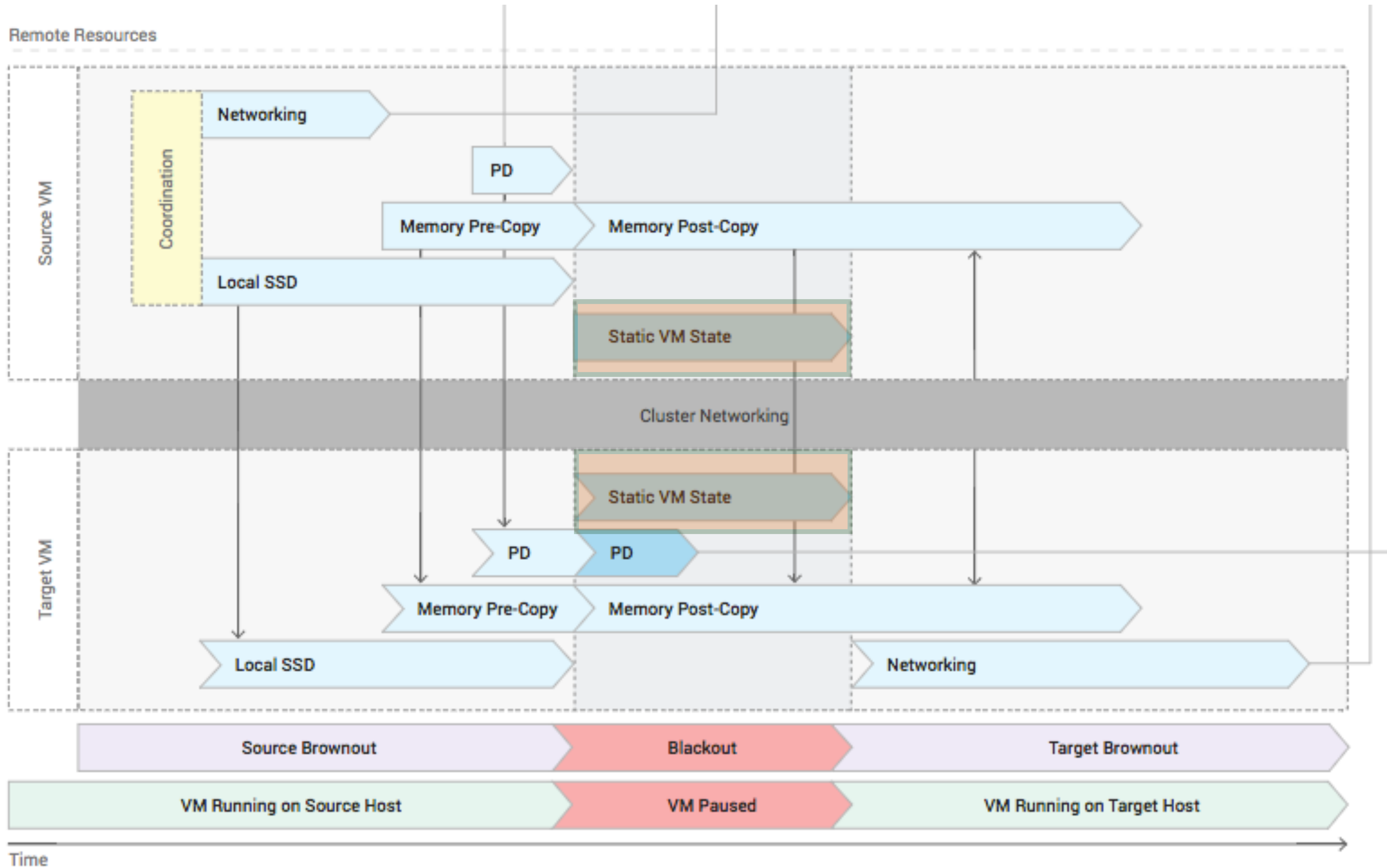
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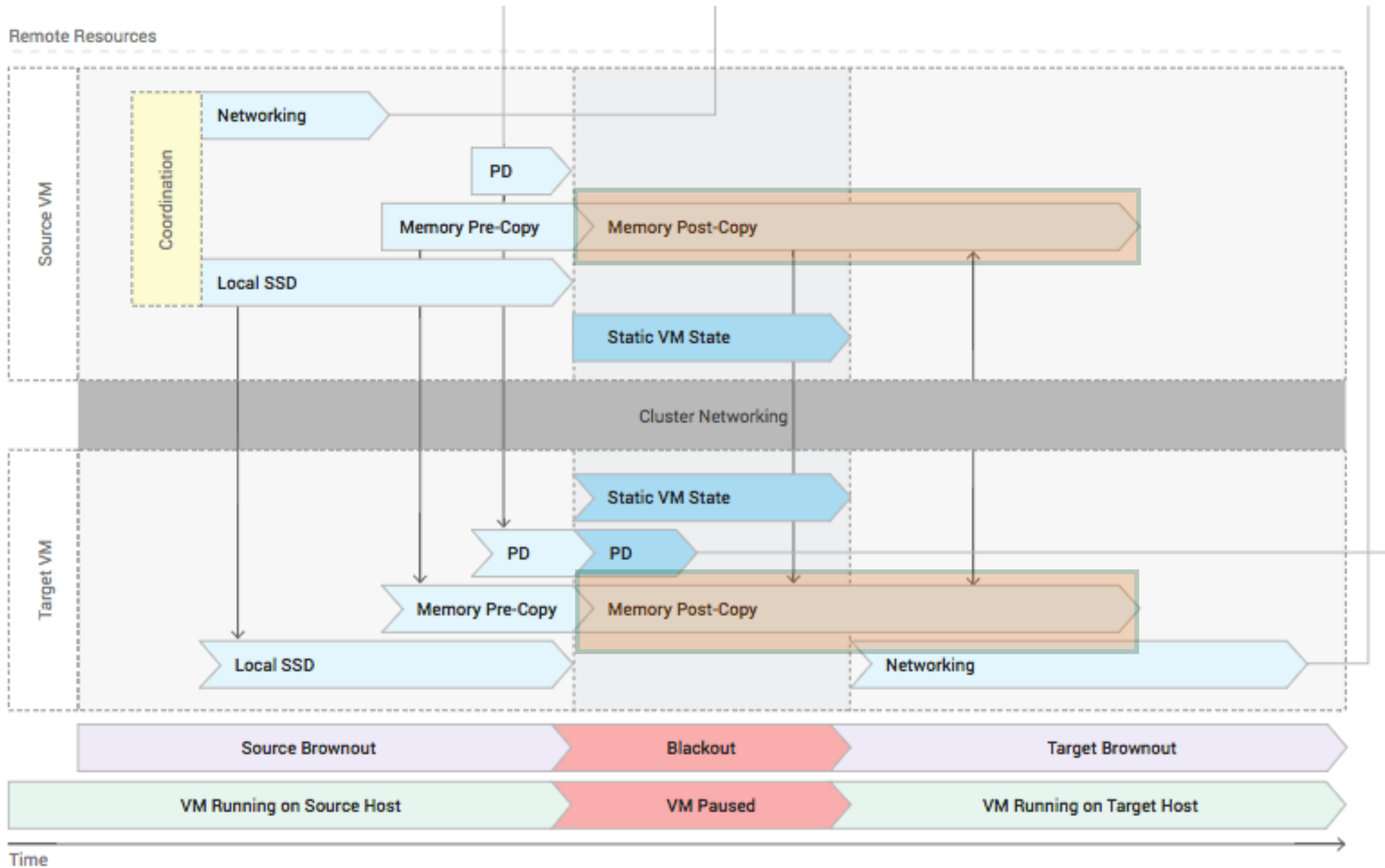
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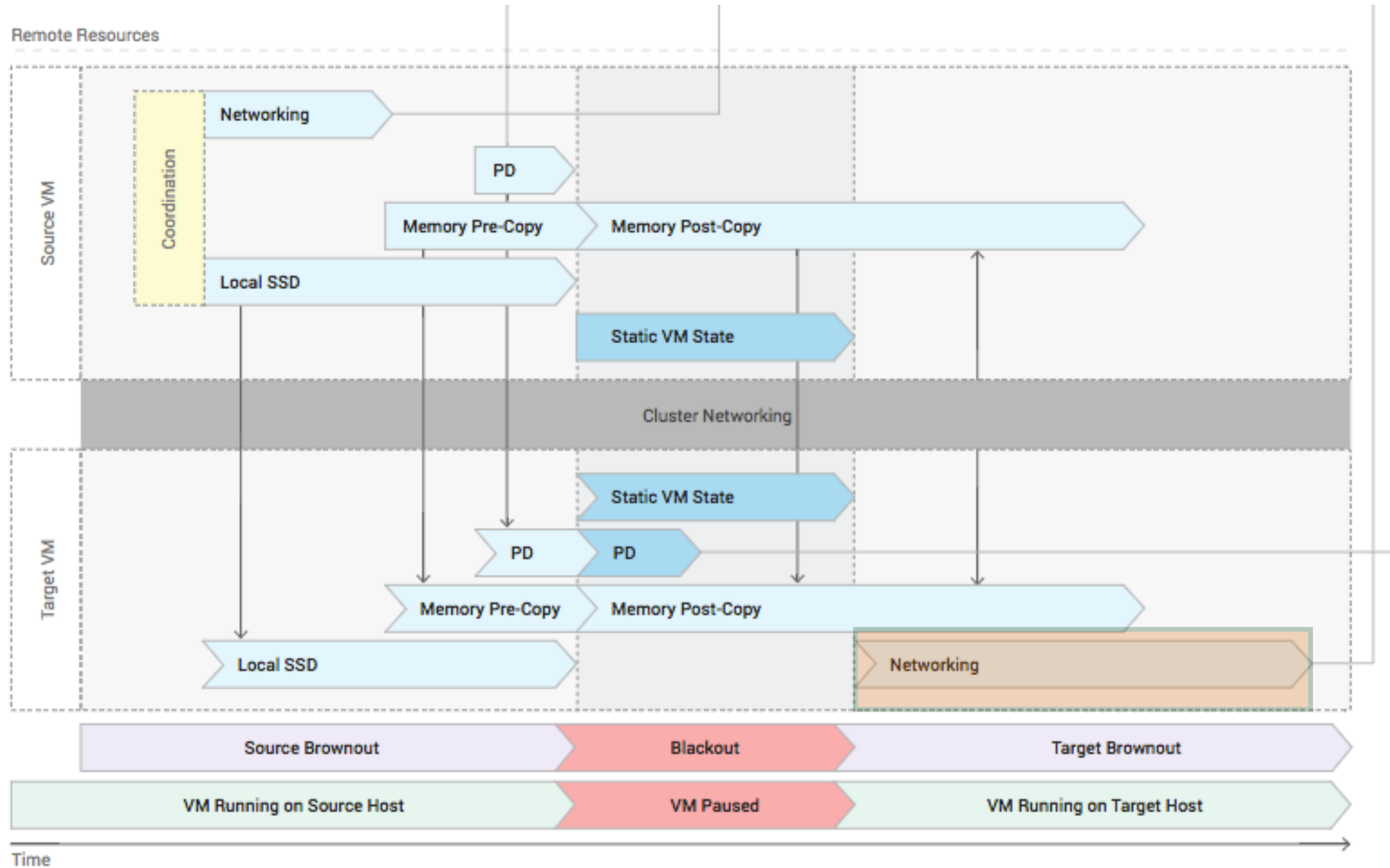
Live Migration

Instances with GPUs cannot be live migrated

Get a 60 minute notice before termination

Instances with **local SSDs** attached can be live migrated

Preemptible instances **cannot** be live migrated, they are always terminated

VM Machine Types and Pricing

Cloud Platform Free Tier

- **1 f1-micro VM instance** per month (US regions, excluding Northern Virginia).

- **30 GB of Standard persistent disk** storage per month.

- **5 GB of snapshot storage** per month.

- **1 GB egress** from North America to other destinations per month (excluding Australia and China).

Machine Types

Pre-defined

Custom

Billing Model

- All machines types are charged for a minimum of 1 minute

- After 1 minute instances are charged in 1 second increments

Machine Types

Pre-defined

Custom

Standard Machine Types

| | Iowa ▼ | | Monthly ⬤ Hourly |

Machine type	Virtual CPUs	Memory	Price (USD)	Preemptible price (USD)
n1-standard-1	1	3.75GB	$0.0475	$0.0100
n1-standard-2	2	7.5GB	$0.0950	$0.0200
n1-standard-4	4	15GB	$0.1900	$0.0400
n1-standard-8	8	30GB	$0.3800	$0.0800
n1-standard-16	16	60GB	$0.7600	$0.1600
n1-standard-32	32	120GB	$1.5200	$0.3200
n1-standard-64	64	240GB	$3.0400	$0.6400
n1-standard-96 (Beta) Skylake Platform only	96	360GB	$4.5600	$0.9600

Standard Machine Types

Iowa ▾			Monthly 🔵 Hourly	

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n1-standard-16	16	60GB	$0.7600	$0.1600
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If your ideal machine is **between** predefined types use **custom** machine types

It might end up being more cost effective

Shared Core

- Ideal for applications that do not require a lot of resources

- Small, non-resource intensive applications

Shared Core Bursting

- f1-micro machine types offer **bursting** capabilities that allow instances to use additional physical CPU for short periods of time

- Bursting happens **automatically** when needed

- The instance will automatically take advantage of available CPU in bursts

- Bursts are not permanent, only possible **periodically**

High Memory Machines

- More memory per vCPU as compared with regular machines

- Useful for tasks which require more memory as compared to processing

- 6.5 GB of RAM per core

High Memory Machine Types

| Iowa ▾ | | | | Monthly ⬤ Hourly |

Machine type	Virtual CPUs	Memory	Price (USD)	Preemptible price (USD)
n1-highmem-2	2	13GB	$0.1184	$0.0250
n1-highmem-4	4	26GB	$0.2368	$0.0500
n1-highmem-8	8	52GB	$0.4736	$0.1000
n1-highmem-16	16	104GB	$0.9472	$0.2000
n1-highmem-32	32	208GB	$1.8944	$0.4000
n1-highmem-64	64	416GB	$3.7888	$0.8000
n1-highmem-96 (Beta) Skylake Platform only	96	624GB	$5.6832	$1.2000
Custom machine type	If your ideal machine shape is in between two predefined types, using a custom machine type could save you as much as 40%. Read more about Custom Machine Types.			

High Memory Machine Types

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High CPU Machines

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High CPU Machine Types

Monthly ⬤ Hourly

Machine type	Virtual CPUs	Memory	Price (USD)	Preemptible price (USD)
n1-highcpu-2	2	1.80GB	$0.0709	$0.0150
n1-highcpu-4	4	3.60GB	$0.1418	$0.0300
n1-highcpu-8	8	7.20GB	$0.2836	$0.0600
n1-highcpu-16	16	14.40GB	$0.5672	$0.1200
n1-highcpu-32	32	28.80GB	$1.1344	$0.2400
n1-highcpu-64	64	57.6GB	$2.2688	$0.4800
n1-highcpu-96 (Beta) Skylake Platform only	96	86.4GB	$3.402	$0.7200
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Custom Machines

- If none of the predefined machine types fit your workloads, use a custom machine type

- Save the cost of running on a machine which is more powerful than what you need

- Billed according to the **number of vCPUs** and the **amount of memory** used

Google offers two additional kinds of discounts

Sustained use and committed use discounts

Sustained Use Discounts

- Discounts for running a VM instance for a significant portion of the billing month

- Say you run an instance for 25% of the month, you get a discount for every incremental minute

- Applied automatically, no action to avail of these

Sustained Use Discounts

Usage Level (% of month)	% at which incremental is charged	Example incremental rate (USD/hour) for an n1-standard-1 instance
0%-25%	100% of base rate	$0.0475
25%-50%	80% of base rate	$0.0380
50%-75%	60% of base rate	$0.0285
75%-100%	40% of base rate	$0.0190

Sustained Use Discounts

Usage Level (% of month)	% at which incremental is charged	Example incremental rate (USD/hour) for an n1-standard-1 instance
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25%-50%	80% of base rate	$0.0380
50%-75%	60% of base rate	$0.0285
75%-100%	40% of base rate	$0.0190

Inferred Instances

- Compute engine gives you the maximum available discount by **clubbing instance usage** together

- Different instances running the same **predefined machine type** are combined to create inferred instances

Inferred Instances
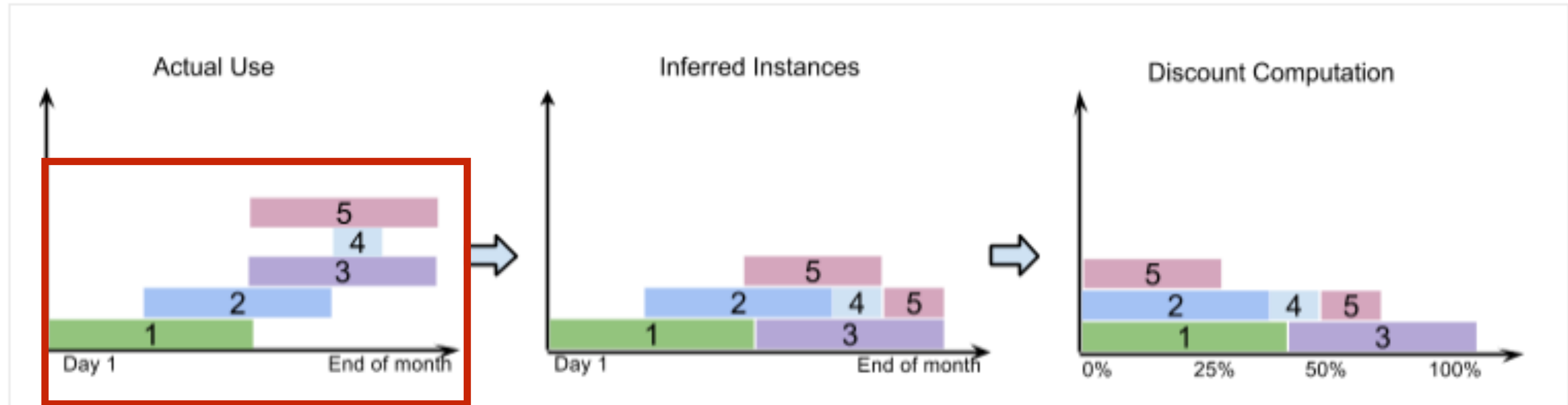
Inferred Instances
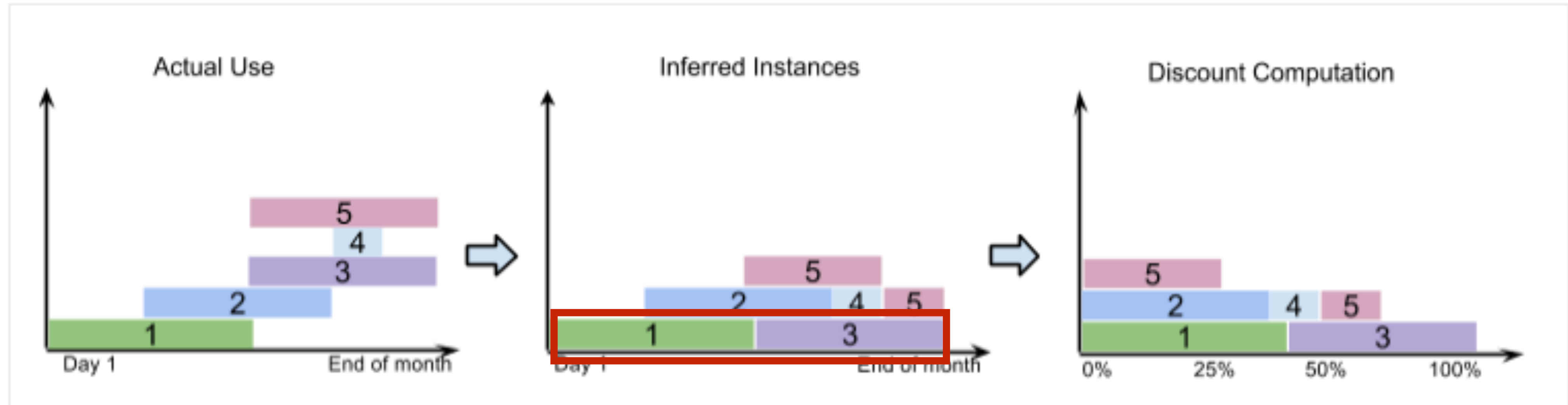
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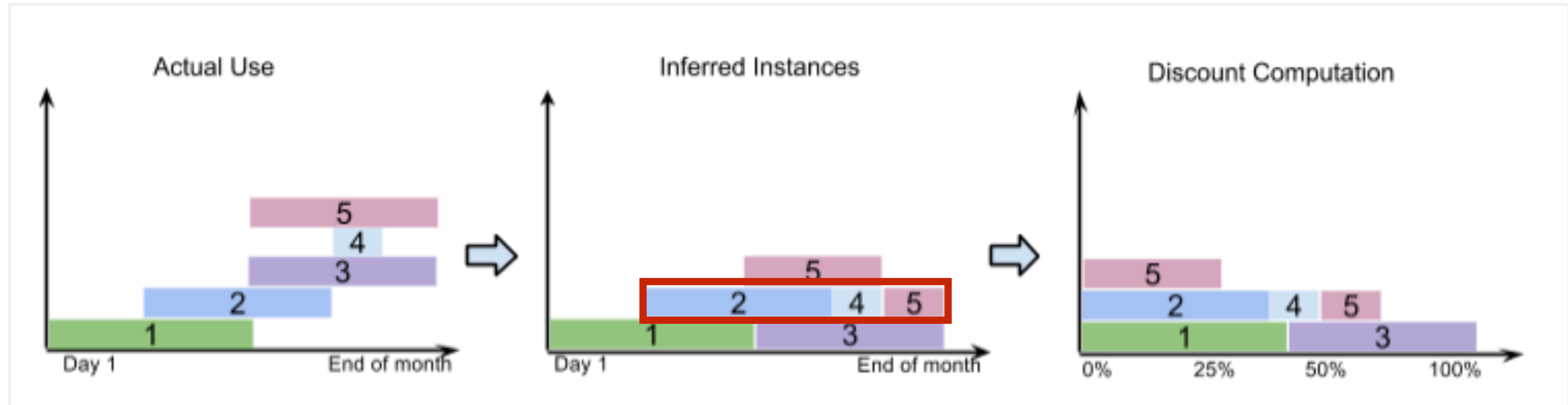
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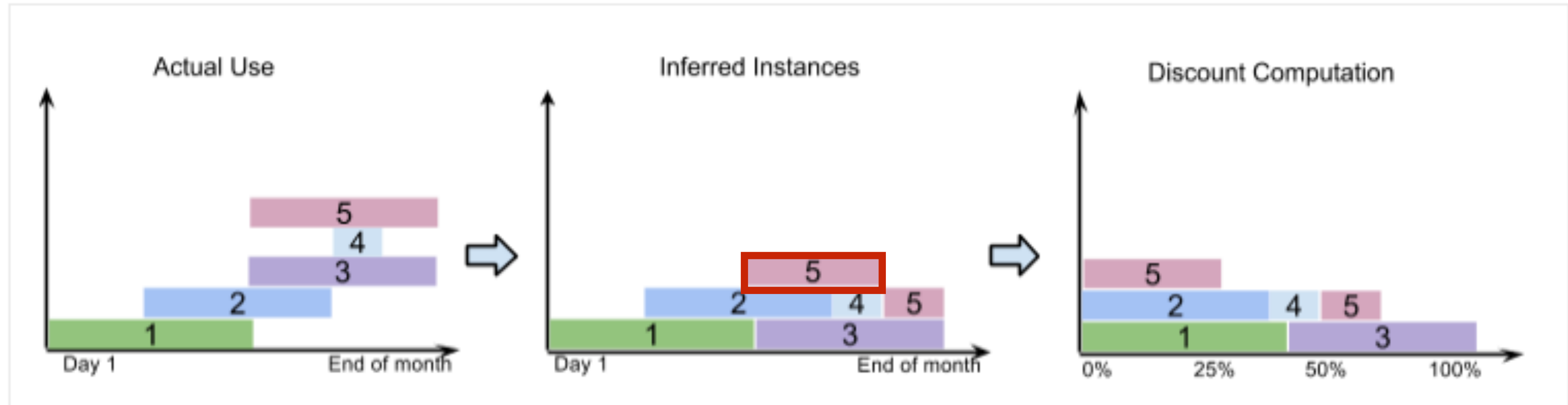
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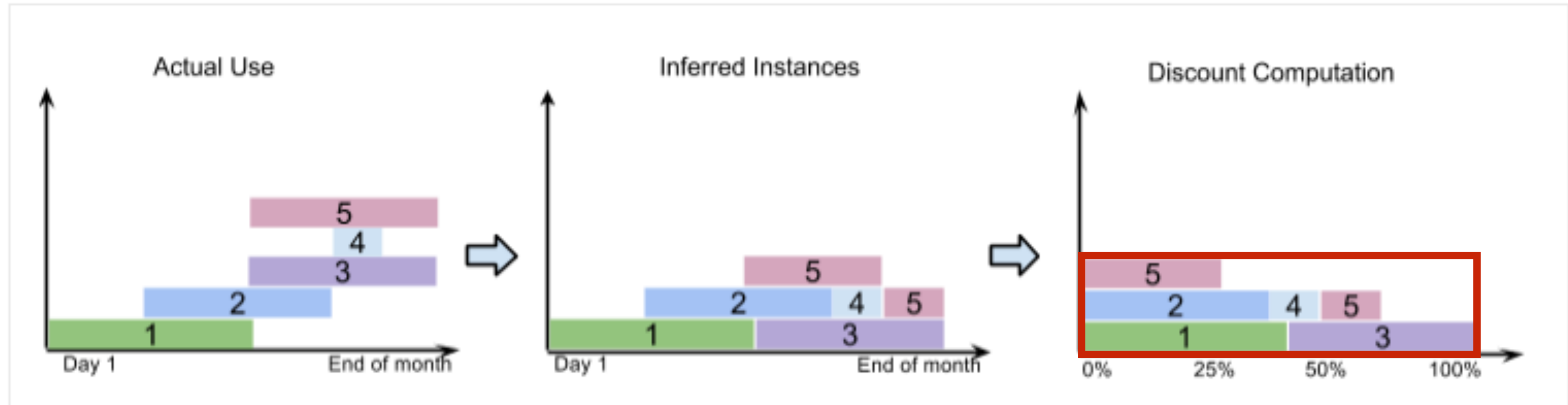
Sustained Discounts for Custom Machines

- Calculates sustained use discounts by combining **memory** and **CPU usage**

- Tries to combine resources to qualify for the biggest sustained usage discounts possible

Sustained Discounts for Custom Machines
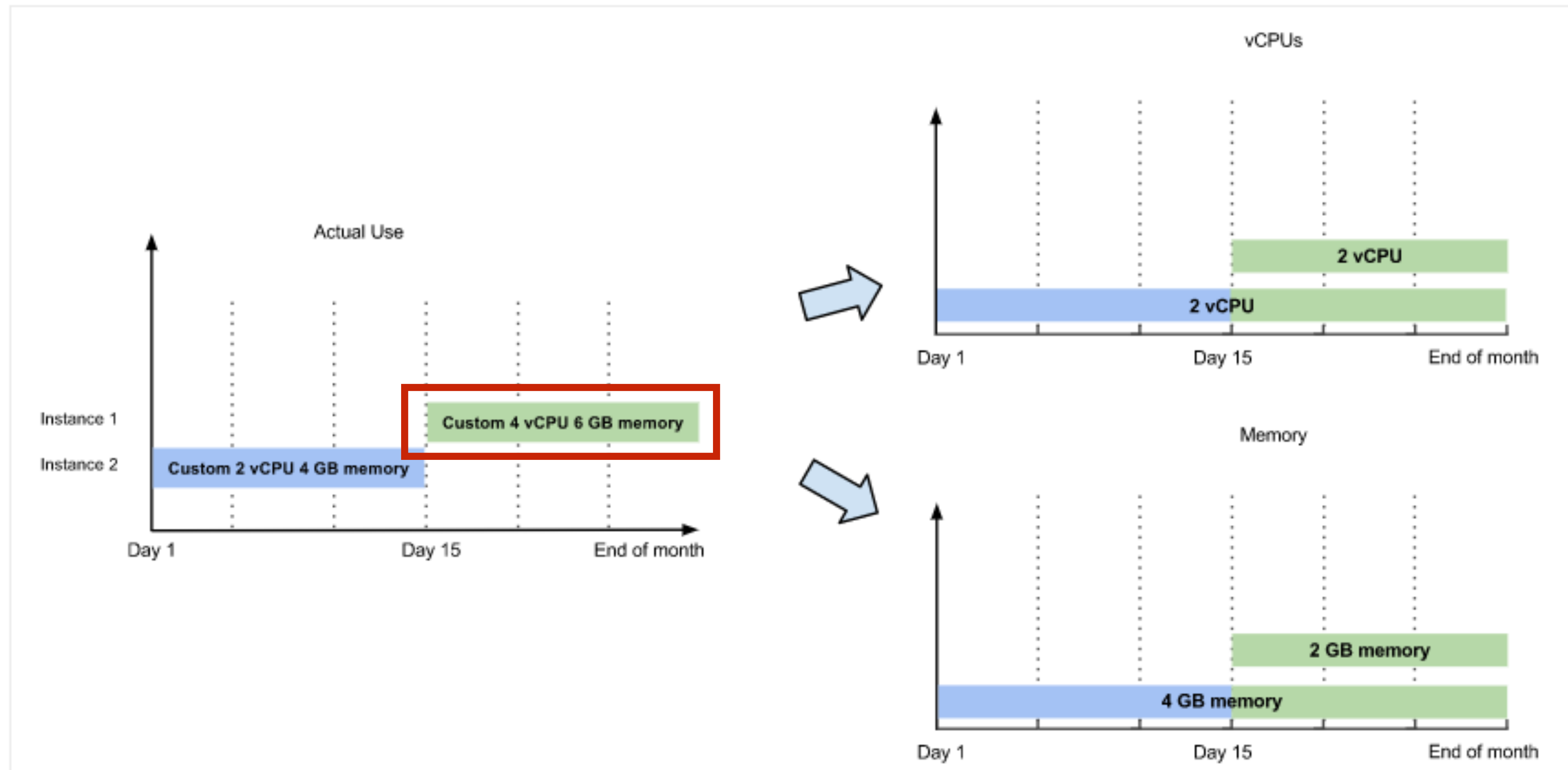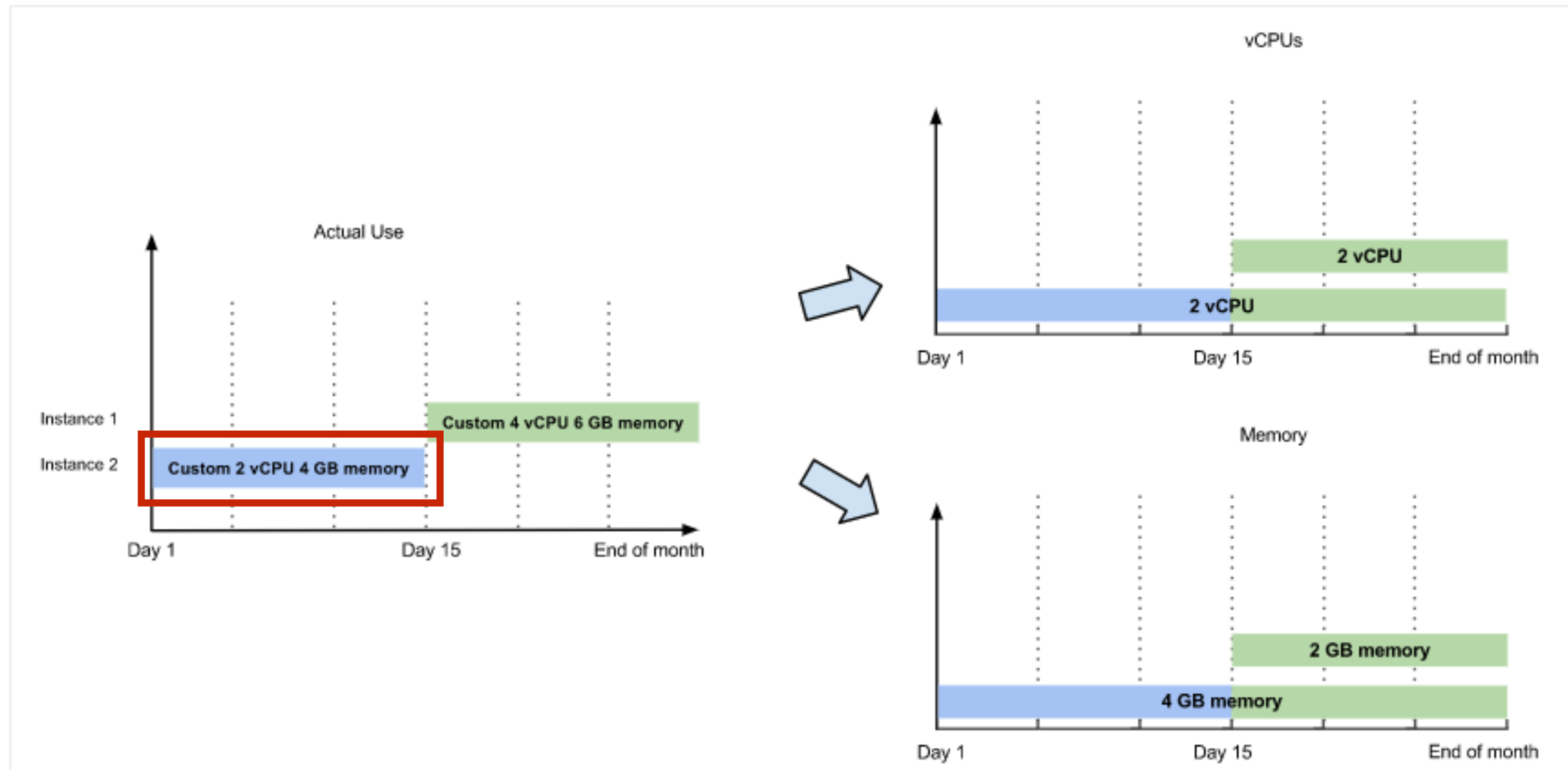
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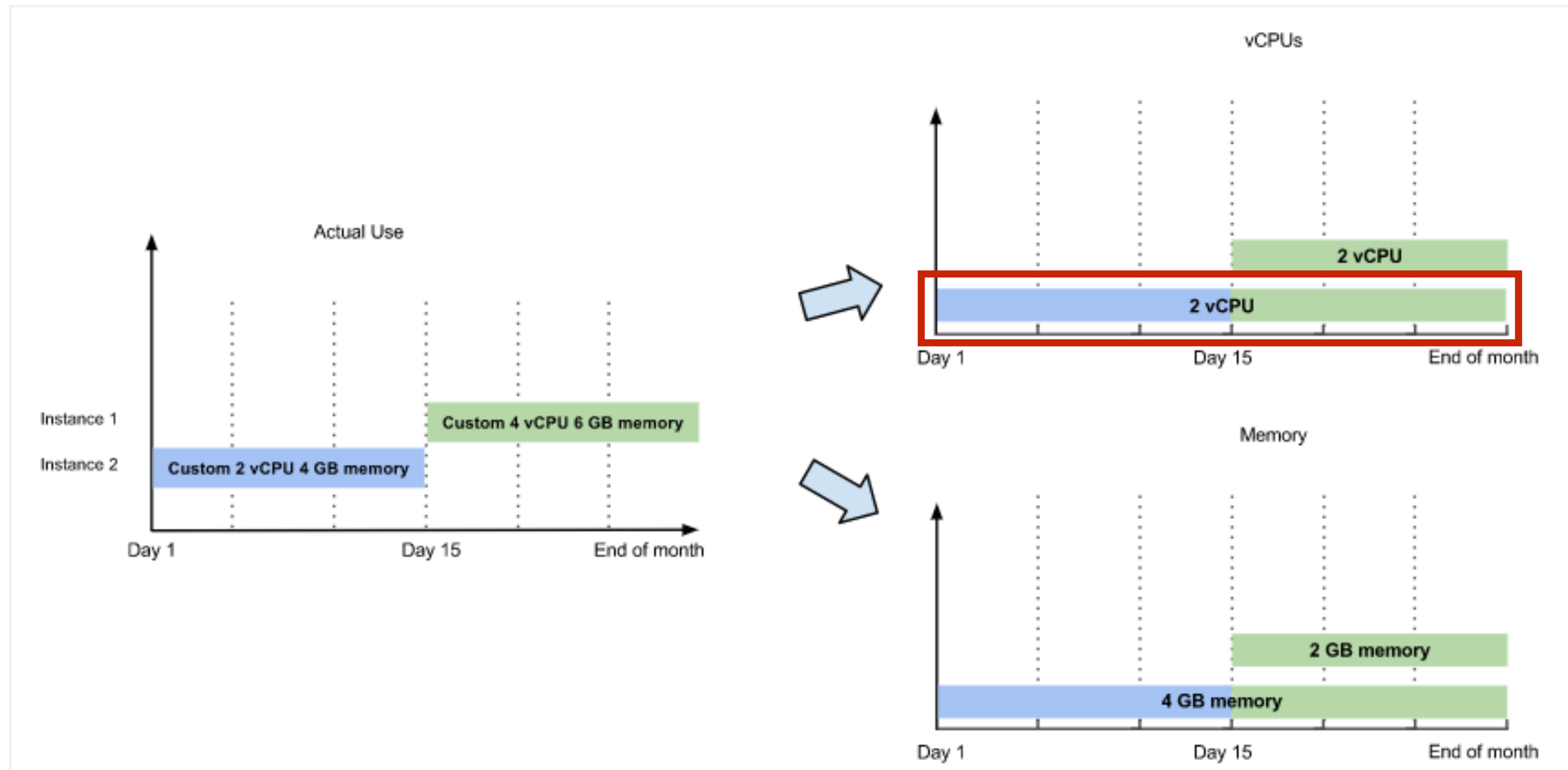
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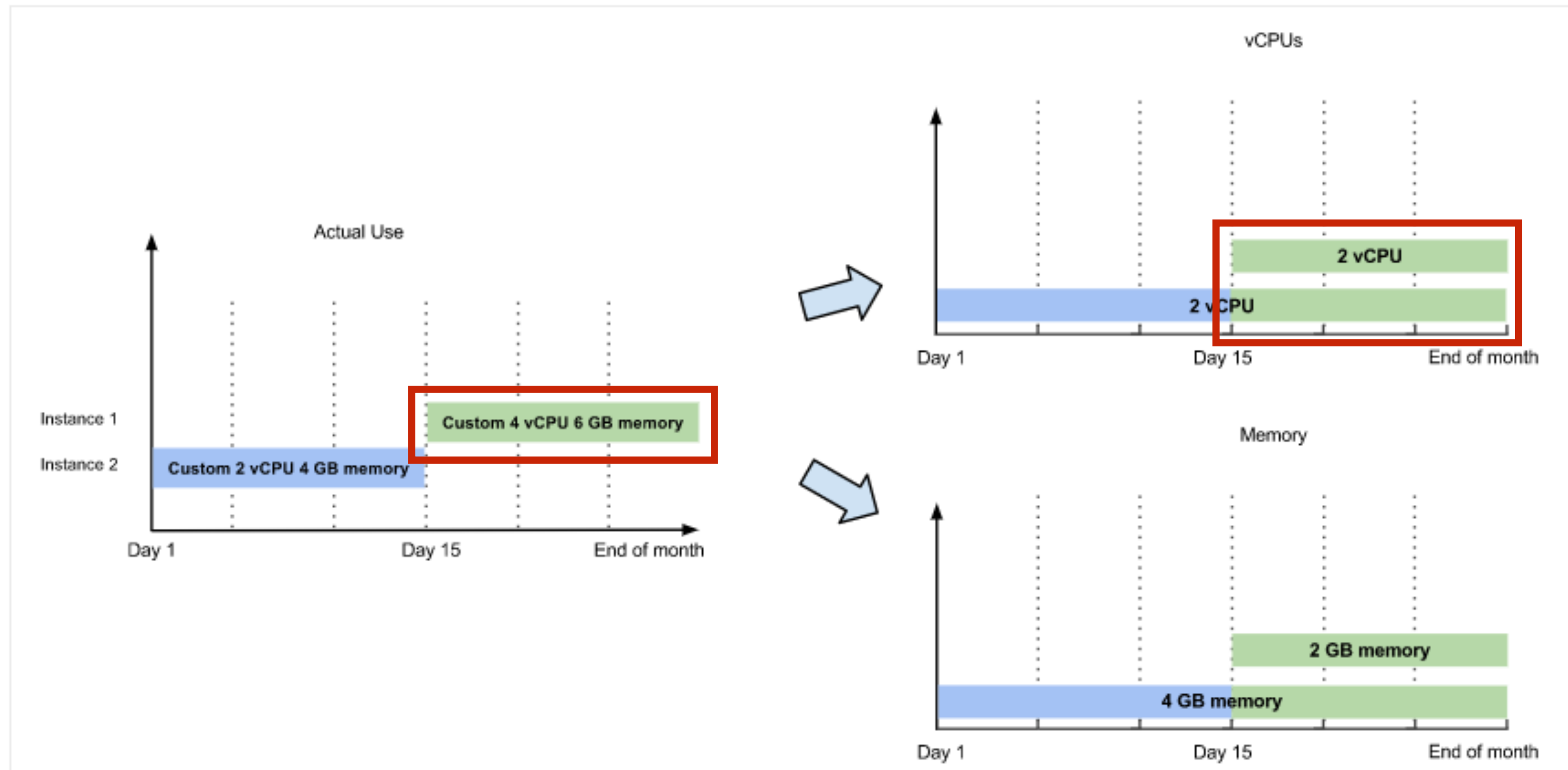
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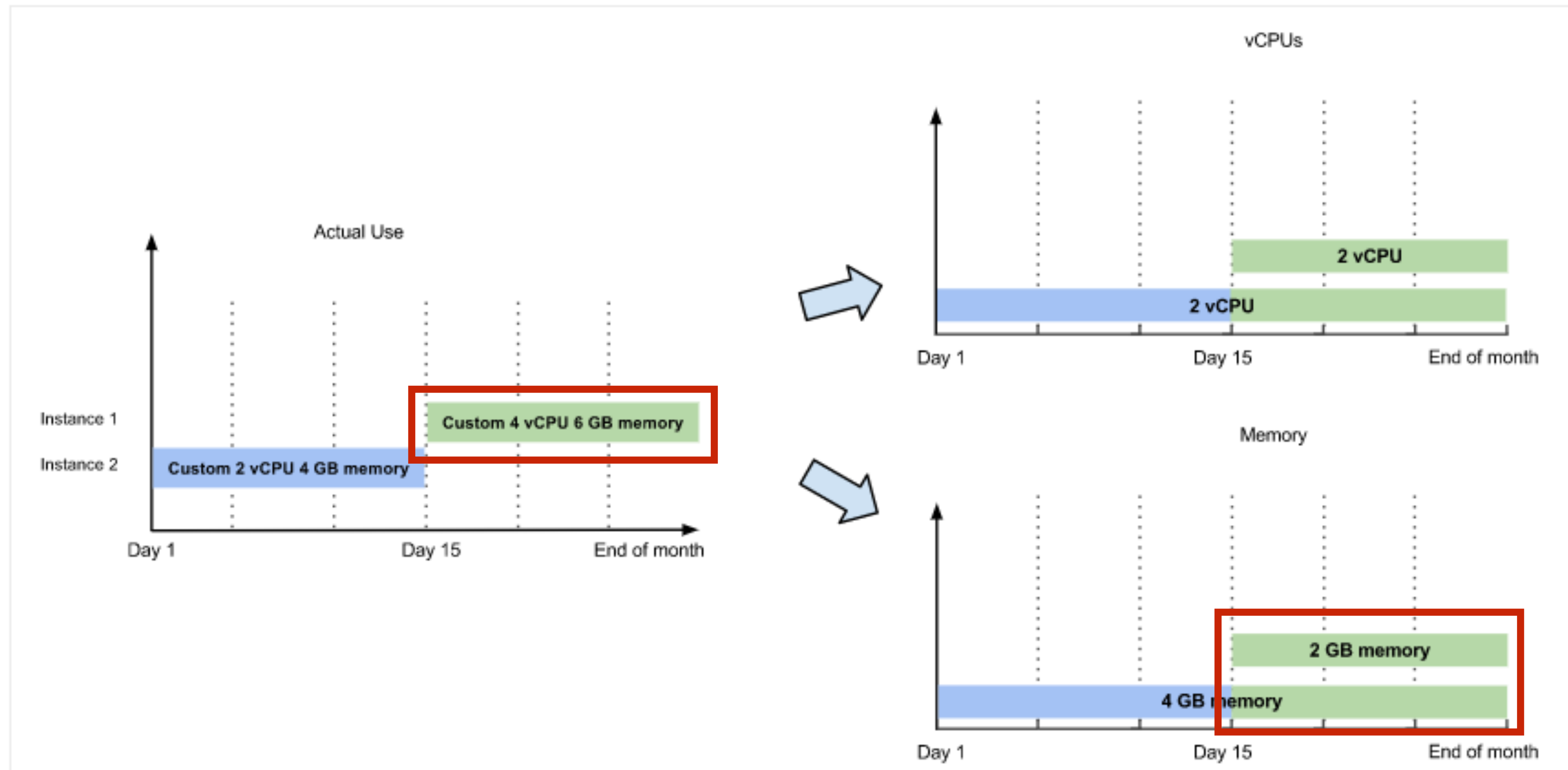
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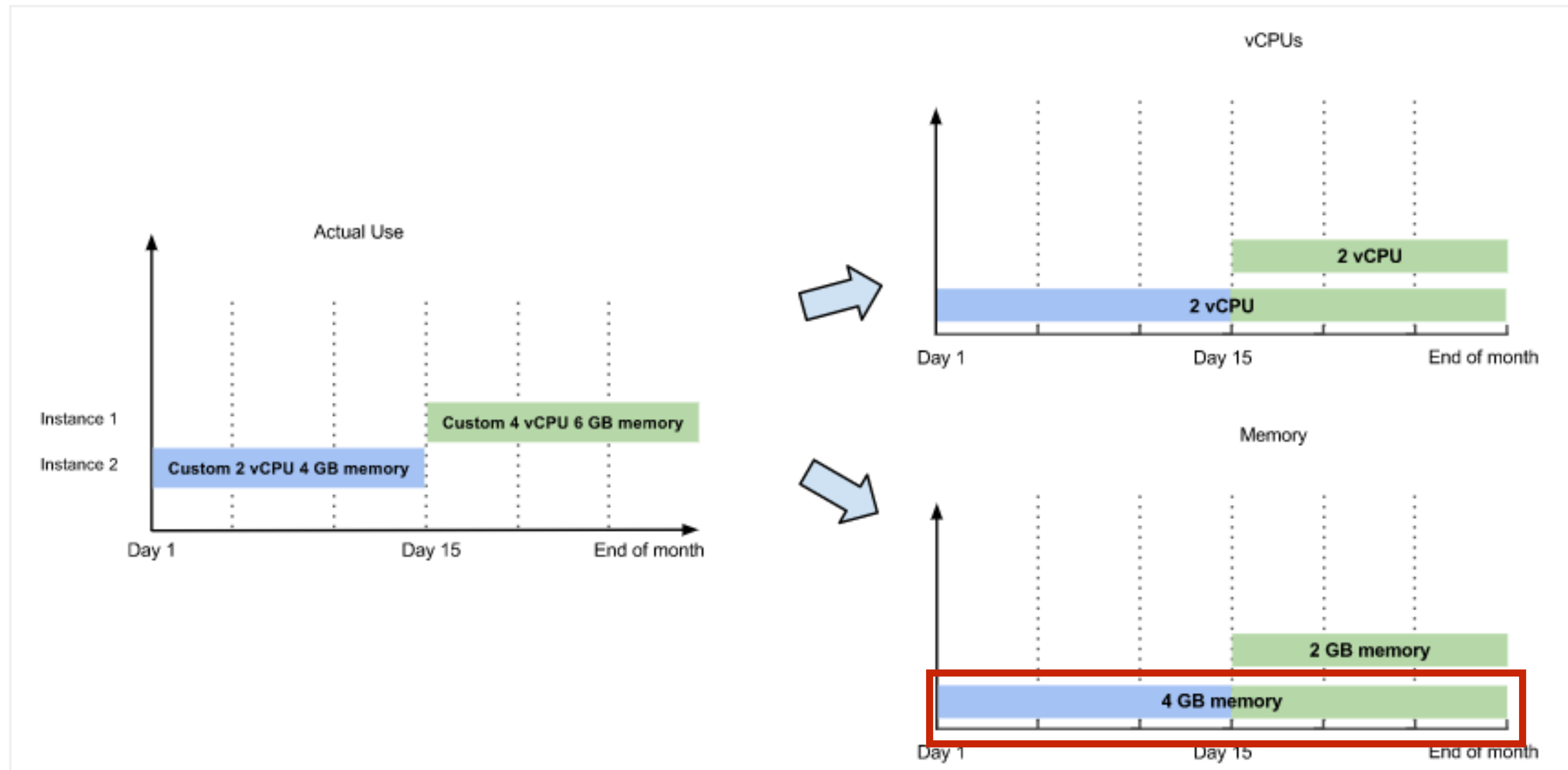
Rightsizing Recommendations

Rightsizing Recommendations

- Compute Engine provides machine recommendations to help optimize resource utilization

- Automatically generated based on system metrics gathered by Stackdriver monitoring

- Uses last 8 days of data for recommendations

Rightsizing Recommendations

- **low or high CPU utilization?** Use a machine type with fewer vCPUs or more vCPUs

- **low or high memory usage?** Use a machine type with less or more memory

RAM Disk

RAM Disk

- Allocate high performance memory to use as a disk

- A RAM disk has very **low latency and high performance**

- Used when your application expects a file system structure and can't store data in memory

- No storage redundancy or flexibility

- **Shares memory with your applications**

- Contents stays only as long as the VM is up

Images

Image

An image in Compute Engine is a cloud resource that provides a reference to an immutable disk.

(https://cloud.google.com/solutions/image-management-best-practices)

Images

- Used to create boot disks for VM instances

- **Public images:**

  - provided and maintained by Google, open source communities, third party vendors

  - all projects have access and can use them

- **Custom images:**

  - Available only to your project

  - Create a custom image from boot disks and other images

Images

- Most of the **public images** can be used for **no cost**

- Some **premium** images may have an additional cost

- Custom images that you import to compute engine add no cost to your instance

- They incur an **image storage charge** when stored in your project (tar and gzipped file)

- Images are configured as a part of the **instance template** of a managed instance group

Image Contents

- Boot loader

- Operating system

- File system structure

- Software

- Customizations

Images to Create an Instance

A bundle of raw bytes used to create a pre-populated hard disk
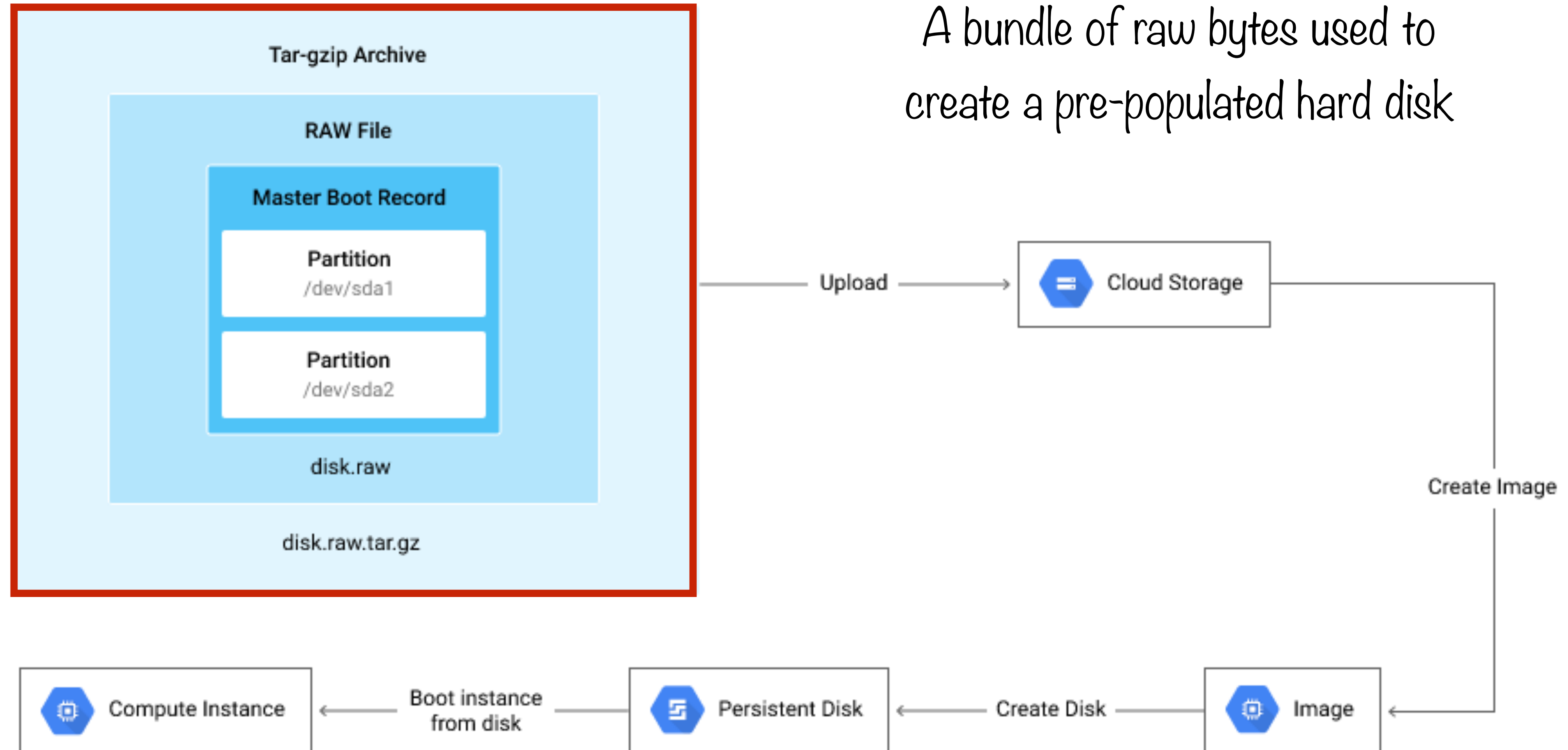
Images to Create an Instance

Master boot record and a bootable partition are required for the image to be bootable

Tar-gzip Archive

RAW File

Master Boot Record

Partition
/dev/sda1

Partition
/dev/sda2

disk.raw

disk.raw.tar.gz

Upload → Cloud Storage

Create Image

Compute Instance ← Boot instance from disk ← Persistent Disk ← Create Disk ← Image
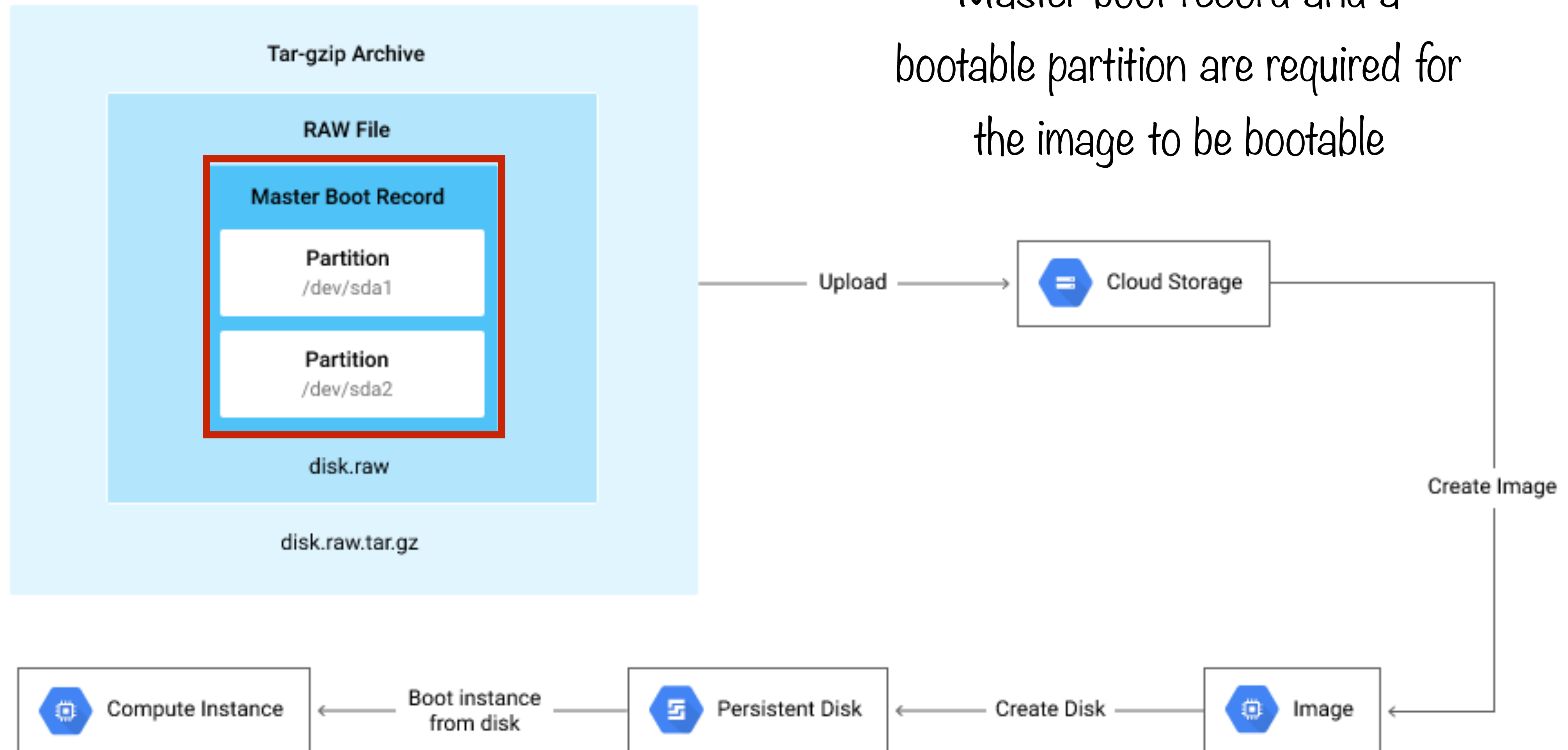
Images to Create an Instance

Upload the *.tar.gz to Cloud Storage and register it as an image

Tar-gzip Archive

RAW File

Master Boot Record

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/dev/sda1

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/dev/sda2

disk.raw

disk.raw.tar.gz

Upload → Cloud Storage

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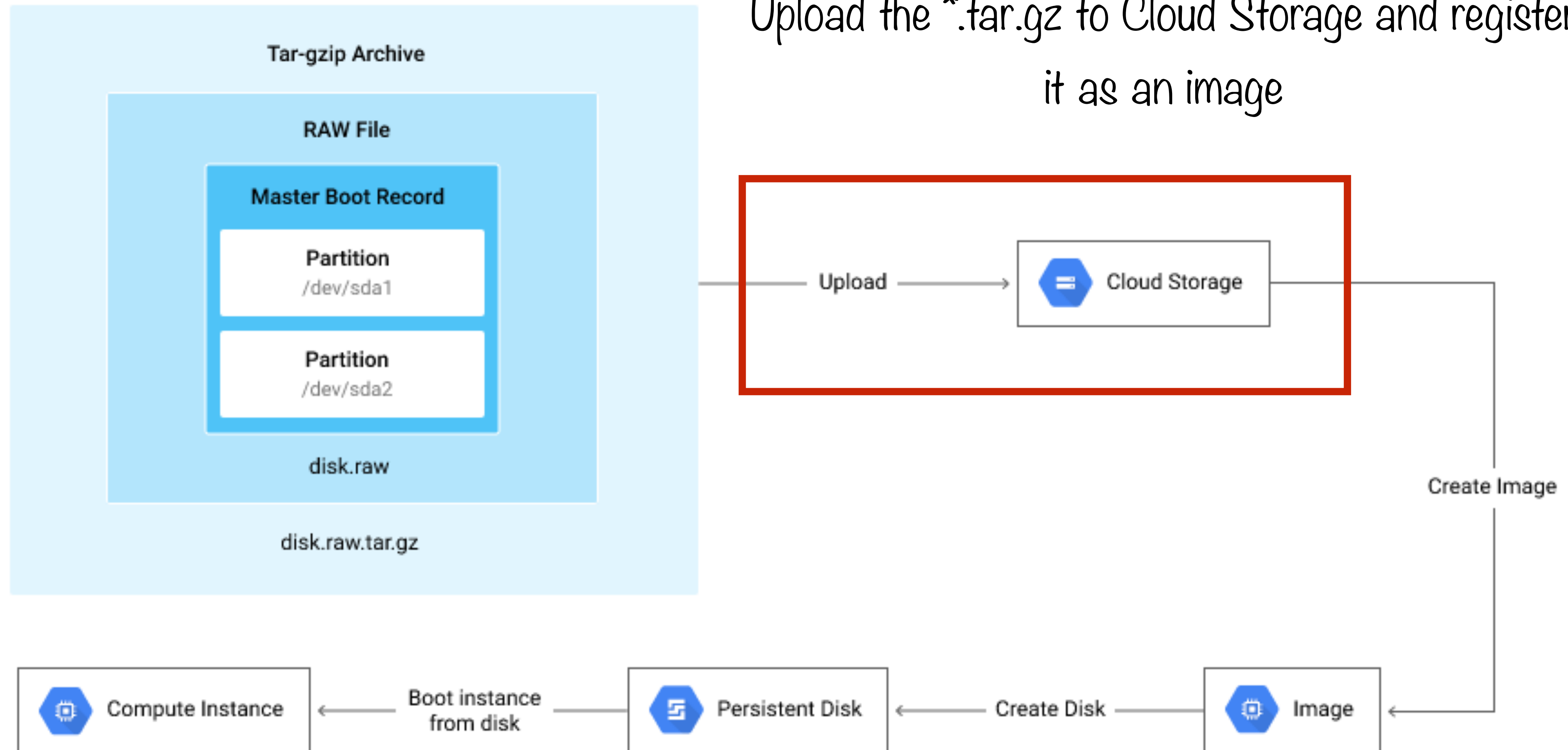
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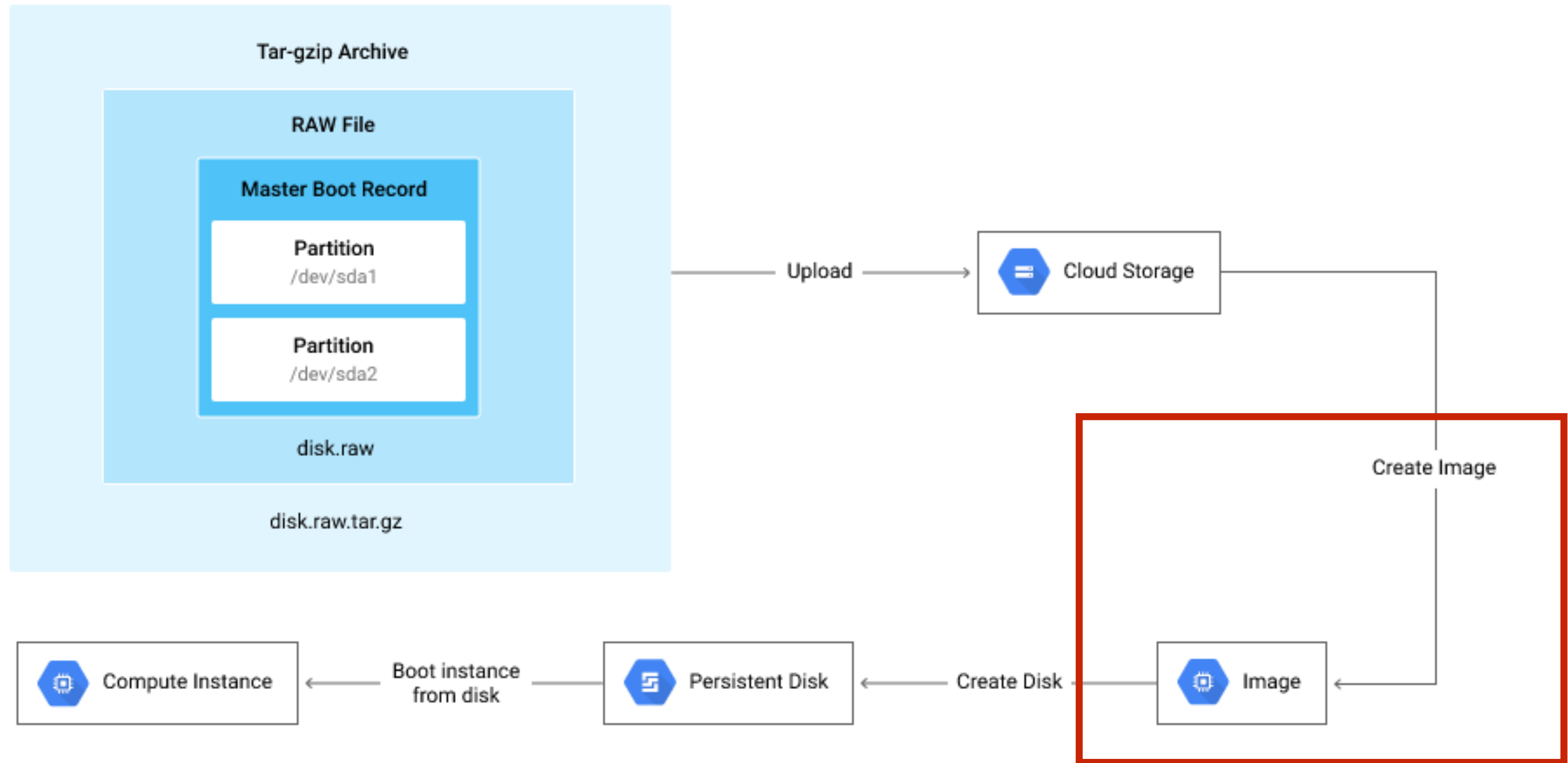
Images to Create an Instance

Use it to create exact replicas of the original disk in any region of the platform
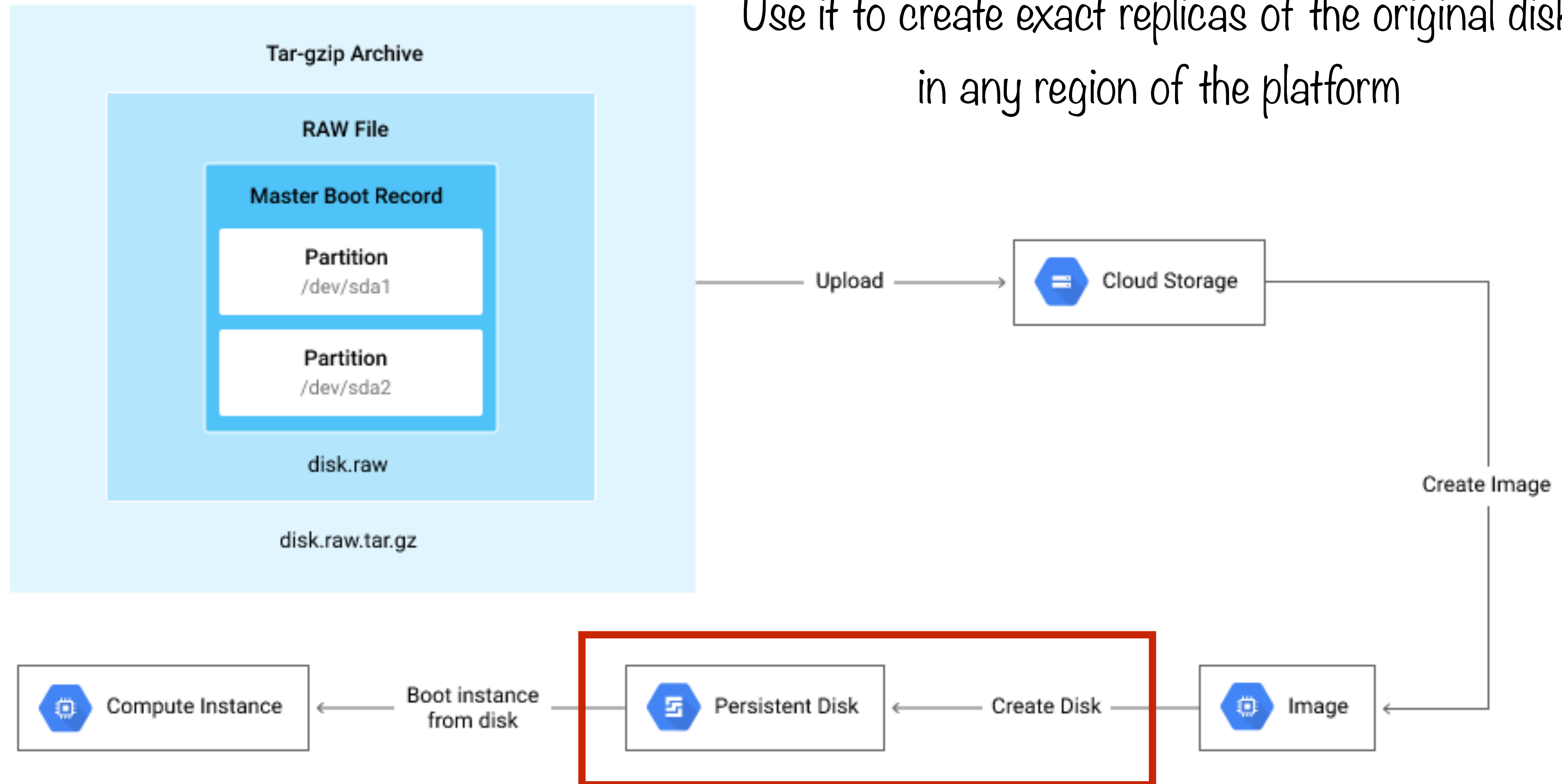
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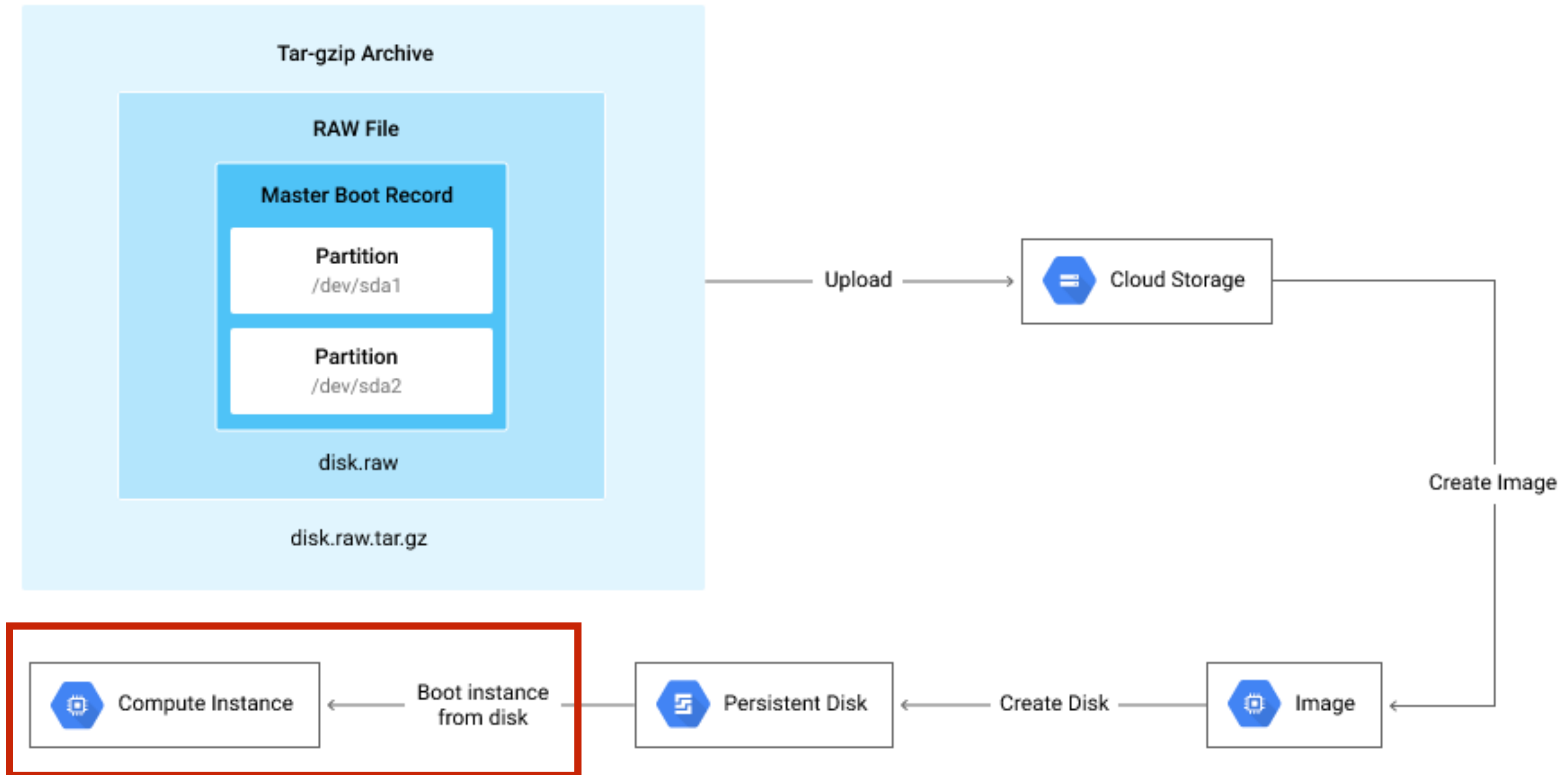
Premium Images

- Additional per second charges, same charges across the world

  - Red Hat Enterprise Linux, Microsoft Windows

- Changes based on the machine type used

- SQL Server images are charged per minute

Public Images

	Name	Size	Created by	Family	Creation time
☐ ✅	centos-6-v20171213	10 GB	CentOS	centos-6	Dec 14, 2017, 11:23:13 PM
☐ ✅	centos-7-v20171213	10 GB	CentOS	centos-7	Dec 14, 2017, 11:24:16 PM
☐ ✅	coreos-alpha-1618-0-0-v20171206	9 GB	CoreOS	coreos-alpha	Dec 7, 2017, 5:16:11 AM
☐ ✅	coreos-beta-1590-2-0-v20171206	9 GB	CoreOS	coreos-beta	Dec 7, 2017, 5:16:36 AM
☐ ✅	coreos-stable-1576-4-0-v20171206	9 GB	CoreOS	coreos-stable	Dec 7, 2017, 5:16:47 AM
☐ ✅	cos-beta-63-10032-71-0	10 GB	Google	cos-beta	Dec 9, 2017, 12:01:00 AM
☐ ✅	cos-dev-64-10176-7-0	10 GB	Google	cos-dev	Dec 8, 2017, 4:57:31 AM
☐ ✅	cos-stable-62-9901-80-0	10 GB	Google		Dec 16, 2017, 3:20:16 AM
☐ ✅	cos-stable-63-10032-71-0	10 GB	Google	cos-stable	Dec 8, 2017, 11:33:20 PM
☐ ✅	debian-8-jessie-v20171213	10 GB	Debian	debian-8	Dec 14, 2017, 11:21:25 PM
☐ ✅	debian-9-stretch-v20171213	10 GB	Debian	debian-9	Dec 14, 2017, 11:25:20 PM
☐ ✅	rhel-6-v20171213	10 GB	RedHat	rhel-6	Dec 14, 2017, 11:28:11 PM
☐ ✅	rhel-7-v20171213	10 GB	RedHat	rhel-7	Dec 14, 2017, 11:27:08 PM
☐ ✅	sles-11-sp4-v20171211	10 GB	SUSE Linux Enterprise	sles-11	Dec 12, 2017, 12:57:18 AM
☐ ✅	sles-12-sp2-sap-v20171211	10 GB	SUSE Linux Enterprise	sles-12-sp2-sap	Dec 11, 2017, 11:51:07 PM
☐ ✅	sles-12-sp3-sap-v20171211	10 GB	SUSE Linux Enterprise	sles-12-sp3-sap	Dec 11, 2017, 11:52:46 PM
☐ ✅	sles-12-sp3-v20171211	10 GB	SUSE Linux Enterprise	sles-12	Dec 12, 2017, 12:29:30 AM
☐ ✅	sql-2012-enterprise-windows-2012-r2-dc-v20171212	50 GB	Microsoft	sql-ent-2012-win-2012-r2	Dec 15, 2017, 3:22:23 AM
☐ ✅	sql-2012-standard-windows-2012-r2-dc-v20171212	50 GB	Microsoft	sql-std-2012-win-2012-r2	Dec 15, 2017, 2:36:59 AM
☐ ✅	sql-2012-web-windows-2012-r2-dc-v20171212	50 GB	Microsoft	sql-web-2012-win-2012-r2	Dec 15, 2017, 2:58:44 AM

Startup Scripts

- Used to customize the instance created using a public image

- The script runs commands that deploys the application as it boots

- Script should be **idempotent** to avoid inconsistent or partially configured state

Baking

- A more **efficient** way to provision infrastructure

- Create a custom image with your **configuration** incorporated into the public image

Startup Scripts vs. Baking

Startup Scripts

Baking

Longer for the instance to be ready

Much faster to go from boot to application readiness

Startup scripts might fail and has to be idempotent

Much more reliable for application deployments

Rollback has to be handled for applications and image separately

Version management is easier, easier to rollback to previous versions

The script will need to install dependencies during application deployment

Fewer external dependencies during application bootstrap

Each deployment might reference different versions if the latest version of the software has changed

Scaling up creates instances with identical software versions

Image Lifecycle

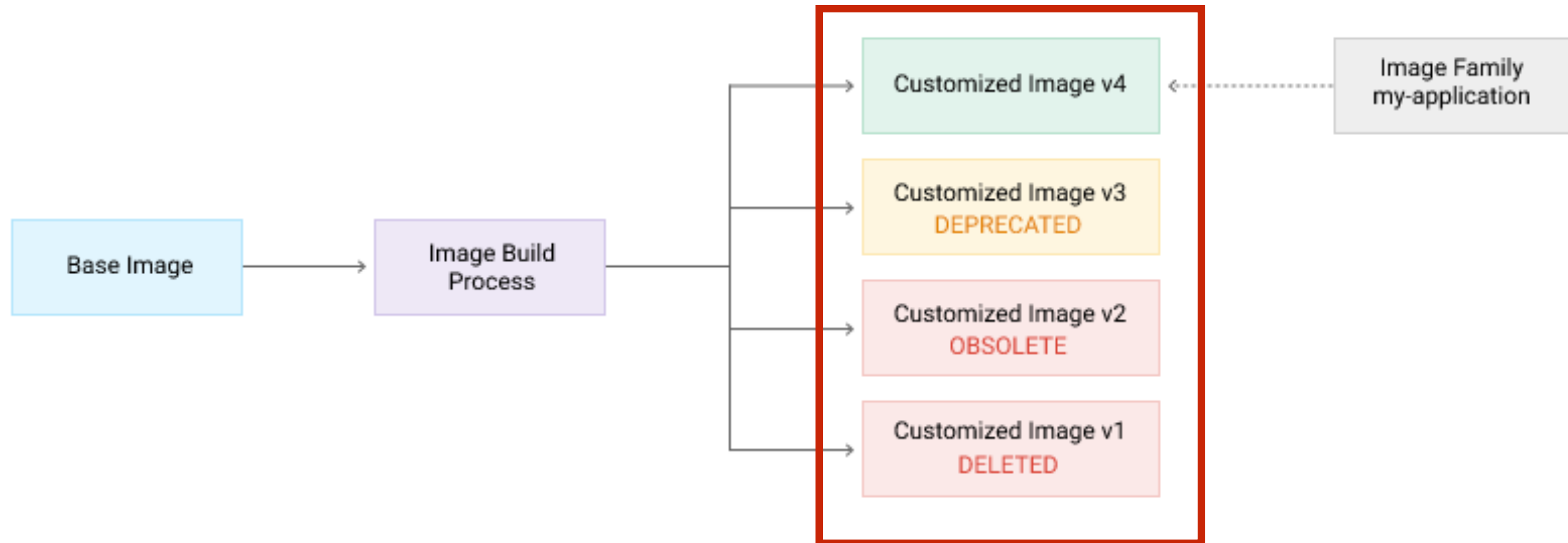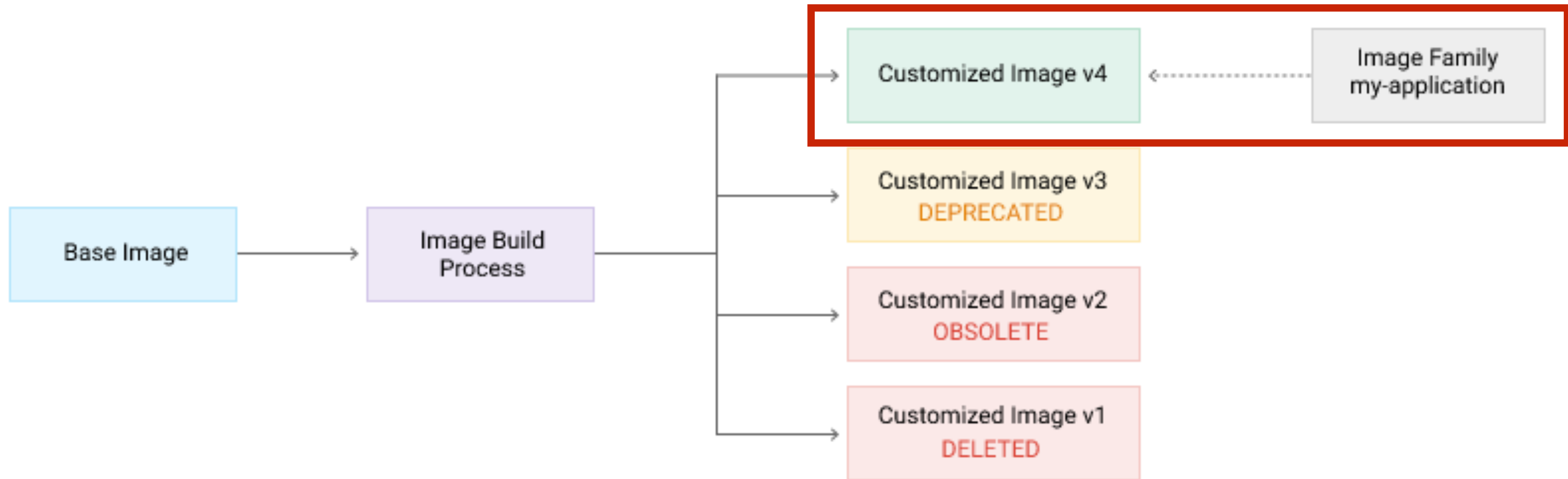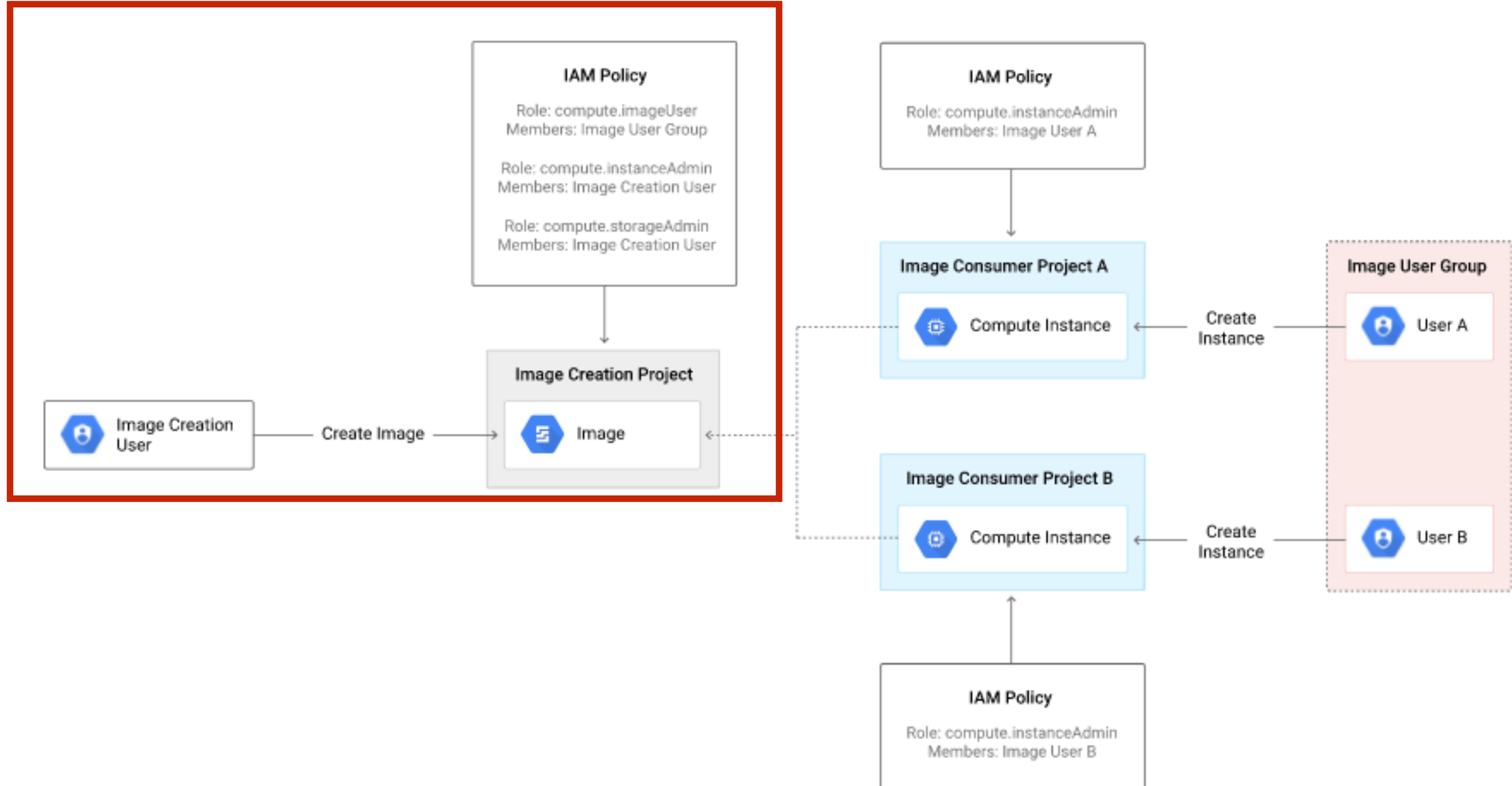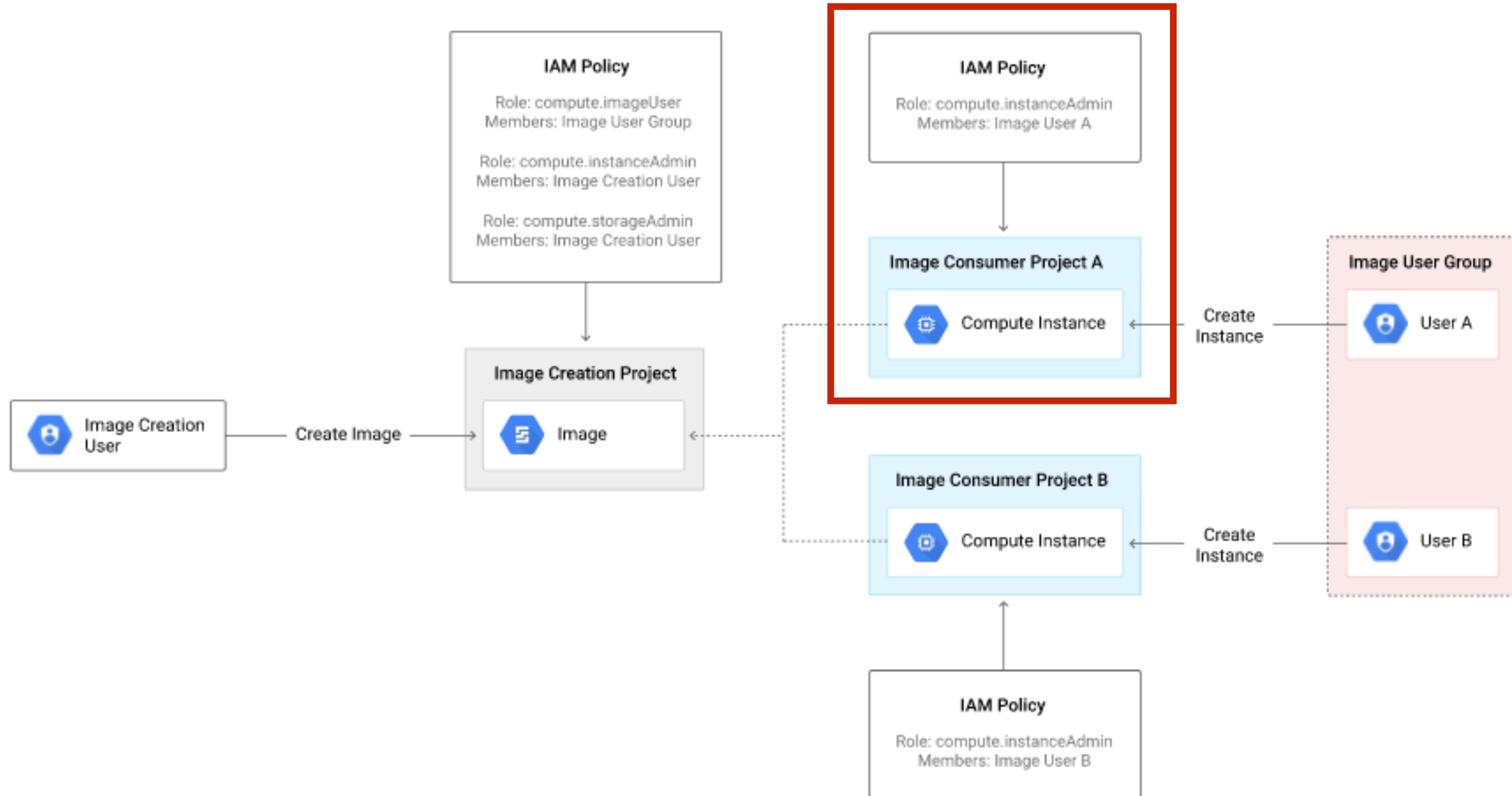| State	Description
DEPRECATED	Images that are no longer the latest, but can still be launched by users. Users will see a warning at launch that they are no longer using the most recent image.
OBSOLETE	Images that should not be launched by users or automation. An attempt to create an instance from these images will fail. You can use this image state to archive images so their data is still available when mounted as a non-boot disk.
DELETED	Images that have already been deleted or are marked for deletion in the future. These cannot be launched, and you should delete them as soon as possible.

Image Lifecycle

Image Lifecycle

Sharing Images Between Projects

Sharing Images Between Projects

IAM Policy

Role: compute.imageUser
Members: Image User Group

Role: compute.instanceAdmin
Members: Image Creation User

Role: compute.storageAdmin
Members: Image Creation User

IAM Policy

Role: compute.instanceAdmin
Members: Image User A

Image Consumer Project A

Compute Instance

Image User Group

User A

Create
Instance

Image Creation User

Create Image

Image Creation Project

Image

Image Consumer Project B

Compute Instance

Create
Instance

User B

IAM Policy

Role: compute.instanceAdmin
Members: Image User B

Sharing Images Between Projects

Sharing Images Between Projects