Storage Types - Block Storage and File Storage What is the type of storage of your hard disk? Block Storage You've created a file share to share a set of files with your colleagues in a enterprise. What type of storage are you using? File Storage 149 Use case: Harddisks attached to your computer s Typically, ONE Block Storage de vice can be connected to ONE virtual ser ver (E X C E P TIONS) You c an a t t a c h r e a d onl y b loc k d e vices wi t h m u l tip le virt u a l ser ver s and cert ain c lou d p r o vider s a re e x p loring m u l ti-wri ter dis k s a s wel l! HOWEVER, you can connect multiple di fferent block storage devices to one virtual ser ver Used as: Di r e c t - a t t a c h ed s t o r a g e ( D A S ) - Simil ar to a h a r d dis k S t o r a g e A r e a N e t w o r k ( S A N ) - Hi g h - s peed ne t w ork connec ting a pool of s tor a ge d e vices U s e d b y D a t a b a s e s - O r a c l e a n d Mic r o s o ft S Q L S e r v e r Blo c k S t o r a g e 150 Media workflows need huge shared storage for supporting processes like video editing Enterprise users need a quick way to share files in a secure and organized way These file shares are shared by several virtual servers File Storage 151 GCP - Block Storage and File Storage Block Storage: Persistent Disks: Network Block Storage Zonal: Data replicated in one zone Regional: Data replicated in multiple zone Local SSDs: Local Block Storage File Storage: Filestore: High performance file storage 152 GCP - Block Storage Two popular types of block storage can be attached to VM instances: Local SSDs Persistent Disks Local SSDs are physically attached to the host of the VM instance Temporary data Lifecycle tied to VM instance Persistent Disks are network storage More durable Lifecycle NOT tied to VM instance 153 Local SSDs Physically attached to the host of VM instance: Provide very high (IOPS) and very low latency (BUT) Ephemeral storage - Temporary data (Data persists only until instance is running) Enable live migration for data to survive maintenance events Data automatically encrypted HOWEVER, you CANNOT configure encryption keys! Lifecycle tied to VM instance ONLY some machine types support Local SSDs Supports SCSI and NVMe interfaces Remember: Choose NVMe-enabled and multi-queue SCSI images for best performance Larger Local SSDs (more storage), More vCPUs (attached to VM) => Even Better Performance 154 Local SSDs - Advantages and Disadvantages Advantages Very Fast I/O (~ 10-100X compared to PDs) Higher throughput and lower latency Ideal for use cases needing high IOPs while storing temporary information Examples: Caches, temporary data, scratch files etc Disadvantages Ephemeral storage Lower durability, lower availability, lower flexibility compared to PDs You CANNOT detach and attach it to another VM instance 155 Network block storage attached to your VM instance Provisioned capacity Very Flexible: Increase size when you need it - when attached to VM instance Performance scales with size For higher performance, resize or add more PDs Independent lifecycle from VM instance Attach/Detach from one VM instance to another Options: Regional and Zonal Zonal PDs replicated in single zone. Regional PDs replicated in 2 zones in same Region. Typically Regional PDs are 2X the cost of Zonal PDs Use case : Run your custom database Persistent Disks (PD) 156 Persistent Disks vs Local SSDs Feature Persistent Disks Local SSDs Attachment to VM instance As a network drive Physically attached Lifecycle Separate from VM instance Tied with VM instance I/O Speed Lower (network latency) 10-100X of PDs Snapshots Supported Not Supported Use case Permanent storage Ephemeral storage 157 Persistent Disks - Standard vs Balanced vs SSD Feature Standard Balanced SSD Underlying Storage Hard Disk Drive Solid State Drive Solid State Drive Referred to as pd-standard pd-balanced pd-ssd Performance - Sequential IOPS (Big Data/Batch) Good Good Very Good Performance - Random IOPS (Transactional Apps) Bad Good Very Good Cost Cheapest In Between Expensive Use cases Big Data (cost efficient) Balance between cost and performance High Performance 158 Take point-in-time snapshots of your Persistent Disks You can also schedule snapshots (configure a schedule): You can also auto-delete snapshots after X days Snapshots can be Multi-regional and Regional You can share snapshots across projects You can create new disks and instances from snapshots Snapshots are incremental: Deleting a snapshot only deletes data which is NOT needed by other snapshots Keep similar data together on a Persistent Disk: Separate your operating system, volatile data and permanent data Attach multiple disks if needed This helps to better organize your snapshots and images Persistent Disks - Snapshots 159 Avoid taking snapshots more often than once an hour Disk volume is available for use but Snapshots reduce performance (RECOMMENDED) Schedule snapshots during off-peak hours Creating snapshots from disk is faster than creating from images: But creating disks from image is faster than creating from snapshots (RECOMMENDED) If you are repeatedly creating disks from a snapshot: Create an image from snapshot and use the image to create disks Snapshots are incremental: BUT you don't lose data by deleting older snapshots Deleting a snapshot only deletes data which is NOT needed by other snapshots (RECOMMENDED) Do not hesitate to delete unnecessary snapshots Persistent Disks - Snapshots - Recommendations 160 (Remember) Machine Image is different from Image Multiple disks can be attached with a VM: One Boot Disk (Your OS runs from Boot Disk) Multiple Data Disks An image is created from the boot Persistent Disk HOWEVER, a Machine Image is created from a VM instance: Machine Image contains everything you need to create a VM instance: Configuration Metadata Permissions Data from one or more disks Recommended for disk backups, instance cloning and replication Playing with Machine Images 161 Let's Compare https://cloud.google.com/compute/docs/machine-images 162 gcloud compute disks list/create/delete/resize/snapshot gcloud compute disks create my-disk-1 --zone=us-east1-a What should be the size and type? --size=SIZE (1GB or 2TB) --type=TYPE (default - pd-standard) (gcloud compute disk-types list) What should be on the disk? --image --image-family --source-disk --source-snapshot How should data on disk be encrypted? --kms-key --kms-project gcloud compute disks resize example-disk-1 --size=6TB Only increasing disk size is supported gcloud compute disks snapshot test --zone=us-central1-a --snapshotnames=snapshot-test You can also play with the snapshots which are created: gcloud compute snapshots list/describe/delete Playing with Disks - Command Line 163 gcloud compute images Actions: create/delete/deprecate/describe/export/import/list/update Creating Images gcloud compute images create my-image From a Disk - --source-disk=my-disk --source-disk-zone=us-east1-a From a Snapshot - --source-snapshot=source-snapshot From another image - --source-image=source-image --source-image-project=source-image-project From latest non deprecated image from a family - --source-image-family=source-image-family --source-imageproject=source-image-project Deprecate Image gcloud compute images deprecate IMAGE --state=DEPRECATED Exports virtual disk images gcloud compute images export --image=my-image --destination-uri=gs://my-bucket/my-image.vmdk - -export-format=vmdk --project=my-project Other Examples: gcloud compute images delete my-image1 my-image2 gcloud compute images list --format="value(NAME)" Playing with Images - Command Line 164 (Remember) gcloud commands for machine images are IN BETA Commands: Create Machine Image: gcloud beta compute machine-images create MACHINE\_IMAGE\_NAME --source-instance SOURCE\_INSTANCE\_NAME Create an Instance from the Machine Image: gcloud beta compute instances create VM\_NAME --zone ZONE --source-machine-image SOURCE\_MACHINE\_IMAGE\_NAME Playing with Machine Images - Command Line 165 Storage - Scenarios - Persistent Disks Scenario Solution You want to improve performance of Persistent Disks (PD) Increase size of PD or Add more PDs. Increase vCPUs in your VM. You want to increase durability of Persistent Disks (PD) Go for Regional PDs (2X cost but replicated in 2 zones) You want to take hourly backup of Persistent Disks (PD) for disaster recovery Schedule hourly snapshots! You want to delete old snapshots created by scheduled snapshots Configure it as part of your snapshot scheduling! 166 Shared cloud file storage: Supports NFSv3 protocol Provisioned Capacity Suitable for high performance workloads: Up to 320 TB with throughput of 16 GB/s and 480K IOPS Supports HDD (general purpose) and SSD (performance-critical workloads) Use cases : file share, media workflows and content management Cloud Filestore 167 Review - Global, Regional and Zonal Resources Global Images Snapshots Instance templates (Unless you use zonal resources in your templates) Regional Regional managed instance groups Regional persistent disks Zonal Zonal managed instance groups Instances Persistent disks You can attach a disk only to instances in the same zone as the disk 168 Storage - Scenarios Scenario Solution You want Very High IOPS but your data can be lost without a problem Local SSDs You want to create a high perfomance file sharing system in GCP which can be attached with multiple VMs Filestore You want to backup your VM configuration along with all its attached Persistent Disks Create a Machine Image You want to make it easy to launch VMs with hardened OS and customized software Create a Custom Image