
AWS
re:Invent
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STG404

Reduce time to recovery with Amazon EBS direct APIs & flexible snapshot proxy

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Agenda

Introductions

Amazon EBS snapshots

Amazon EBS direct APIs

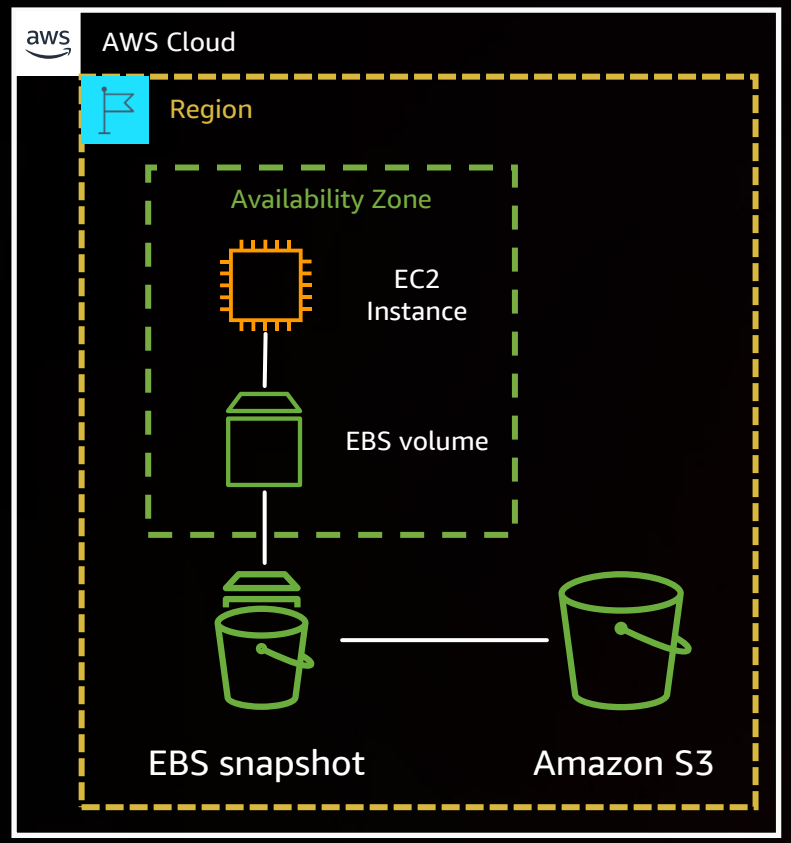
Flexible snapshot proxy

Use cases

Open discussion/Q&A

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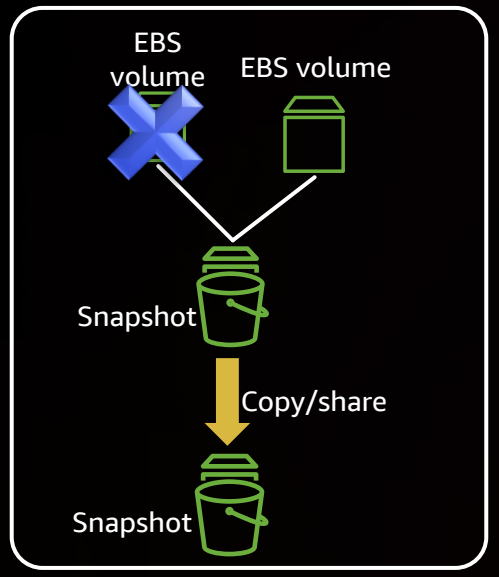
What are EBS snapshots?



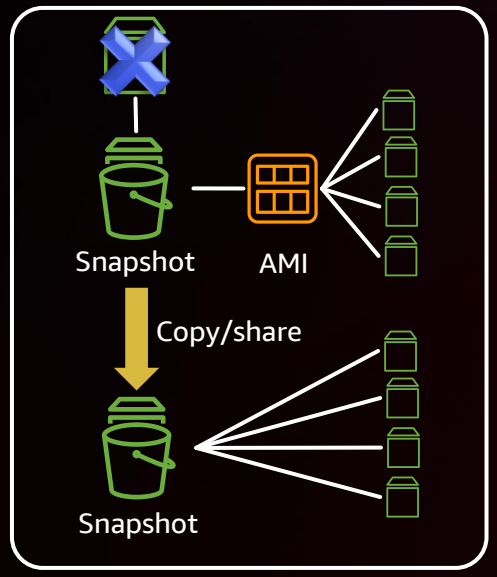
- **Point-in-time** backups of EBS volumes
- Stored on Amazon S3
- Properties:
  - **Incremental** – only changed blocks stored
  - **Crash consistent** – completed I/Os persisted in next snapshot
  - Can be **shared and copied** across accounts and Regions

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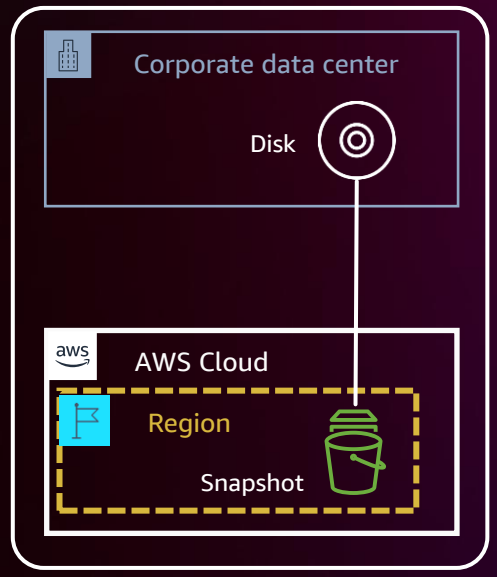
How are snapshots used?



Amazon EBS backup and disaster recovery



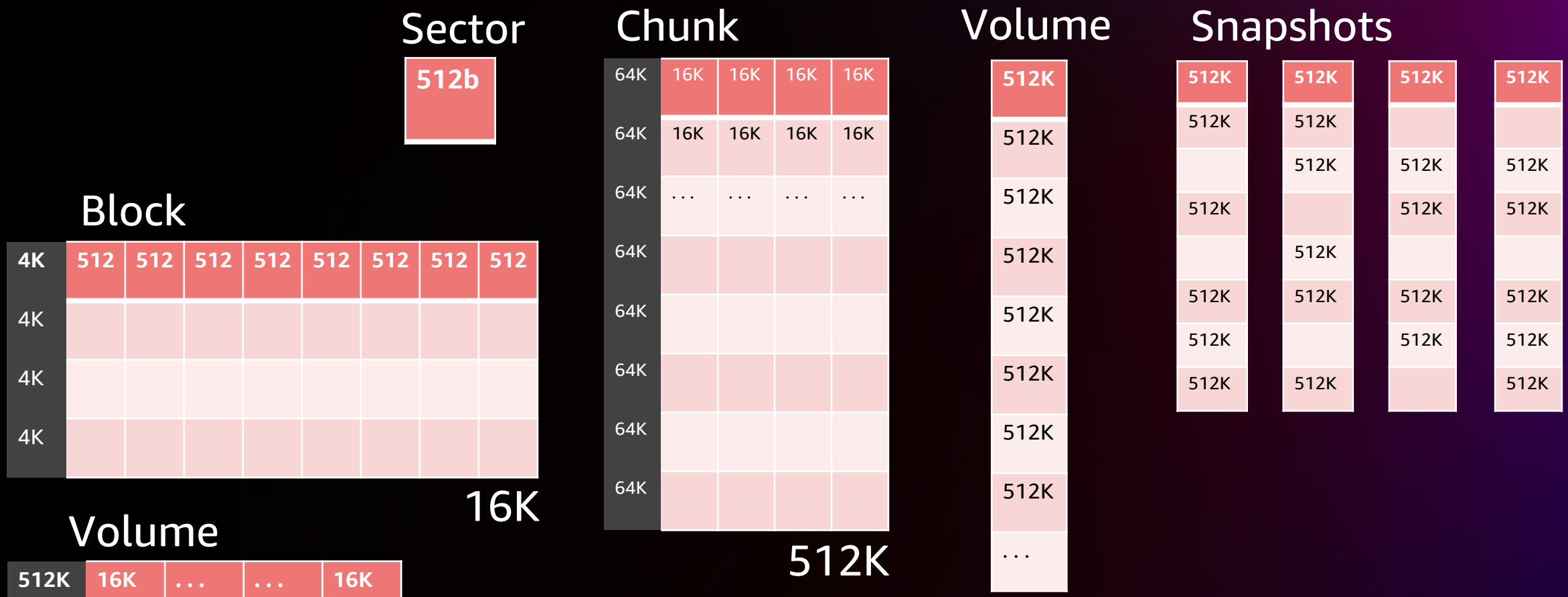
Refresh, scale-up, data handoff workflows



Non-EBS backup and migration

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Blocks and chunks



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EBS snapshots: Direct API

- **ListSnapshotBlocks** – returns the block indexes and block tokens for blocks in the specified snapshot
- **ListChangedBlocks** – returns the block indexes and block tokens for blocks that are different between two specified snapshots of the same volume/snapshot lineage
- **GetSnapshotBlock** – returns the data in a block for the specified snapshot ID, block index, and block token
- **StartSnapshot**, **PutSnapshotBlock**, **CompleteSnapshot** – used to create and write to a snapshot

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EBS snapshots: Direct API internals

- Direct API currently uses **512KiB** block size
- Volumes use **16KiB** (gp2,gp3,io1,io2), **1MiB** (st1,sc1)
- Any write to volume **initializes** a volume block; even zero-format
- Worst-case example: misaligned **8KiB** write at chunk boundary can generate **1MiB** of delta
- List operations use NextToken – iterate until complete; up to 10,000 chunks (5GiB of chunks) returned per call; ~0.12s/call
- Direct APIs are limited to **1,000 API calls/s/snapshot**, which gives you **500MB/s**; real-world speeds of up to **485MB/s** have been achieved

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Flexible snapshot proxy

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How did it start?

- Simple Python demo for common Amazon EBS direct API operations
- Reference implementation for builders
- List and diff for visibility of snapshot size
- Upload and download EBS snapshots
- Inspired by optimizing awslabs/coldsnap

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Performance goals

- Operate at direct API quota of 1000 calls/sec
- 500 MB/sec transfer; fast list and diff
- Multi-thread everything
- Reuse TCP connections (boto3 client) where possible
- Optimize the download, sparse chunk detection
- Compress data on the wire to minimize bandwidth

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Features

- Upload block volumes
- Parallel clone of snapshot to volumes
  - Close to 10 GB/s clone performance (1 snap → 20 volumes)
  - Limited by x2i (80Gbps) and direct APIs (1,000 x 512KiB/second)
- Direct snapshot → snapshot copy (no temporary files)
  - Works across accounts and Regions
  - Enables A ← B → C “airgap” workflows
  - Gets around account limit for concurrent snapshot copies
  - Still ~500 MB/s (US to Sydney, Tokyo, etc.), (1.8 TB/hr)
- Differential snapshot → snapshot copy

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File and object sources and destinations

- Copy snapshot to Amazon S3 (Standard/INT/Snow/AWS Outpost)
  - Coalesce chunks (64 chunks per segment, skip sparse, split on gap)
  - Zstandard compression, independent segment checksum
  - By tuning segment size, optimize for S3 IA, S3 One Zone-IA, S3 Glacier Instant Retrieval
  - Store all metadata in object name; only LIST/LISTv2, no HEAD
- Still ~500MB/s (1.8 TB/hr)
- Restore snapshot from Amazon S3
- Ingest image (.raw, .vhd, . . .) into Amazon EBS, distribute
- Save snapshot as image on NFS/SMB

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Current state (December 2022)

- https://github.com/awslabs/flexible-snapshot-proxy
- Apache 2.0 license
- Contributions welcome
- Modular architecture allows third-party integrations
- Use as standalone utility or as a library
- AWS Lambda support*
- Available via Python Package Index (PyPI)

* Support for EBS volumes requires Amazon EC2/Amazon EKS

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Whiteboard: Architecture and workflow

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Costs

- List: $0.12 per PiB
- Get: $6 per TiB
- Put: $12 per TiB
- Store: $0.05 per Gb-month
- VPC endpoint:
  - $10 per TiB (first 1 PiB)
  - $7.2 per AZ-month
- Amazon S3: varies depending on compress ratio and tier
- Data transfer: varies (cross-Region vs. internet)

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Amazon EBS at re:Invent

Date	Time		Session Title
Wednesday, November 30	8:30 AM	STG314	Amazon EBS snapshots: Build protection and cost-optimize
Wednesday, November 30	9:15 AM	STG220	Best practices for moving on-premises applications to Amazon EBS
Wednesday, November 30	12:15 PM	STG406	Automated data protection & backup compliance with Amazon EBS snapshots
Wednesday, November 30	1:45 PM	STG219	Build resilient architectures with Amazon EBS
Wednesday, November 30	5:30 PM	STG306	Best practices for Amazon EBS volumes & performance monitoring using CloudWatch

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Thank you!

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