Hewlett Packard Enterprise

DMFUG 2019

DMF7 Database In-depth

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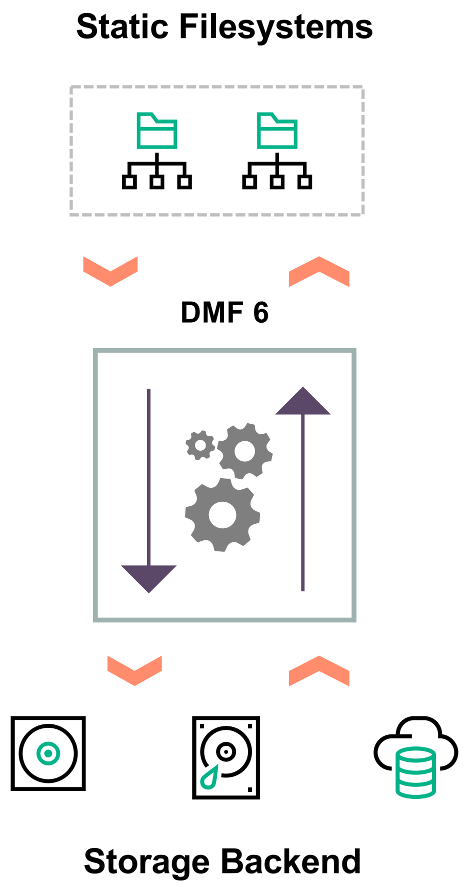
Confidentiality Notice

Evolving DMF

From Traditional Archive System …

Ye Olde HSM

- Transparently Tiers Data
  - Scans Filesystem
  - Migrates files to free up space
  - Recalls on user access or via GET command
- Focuses on Space Management

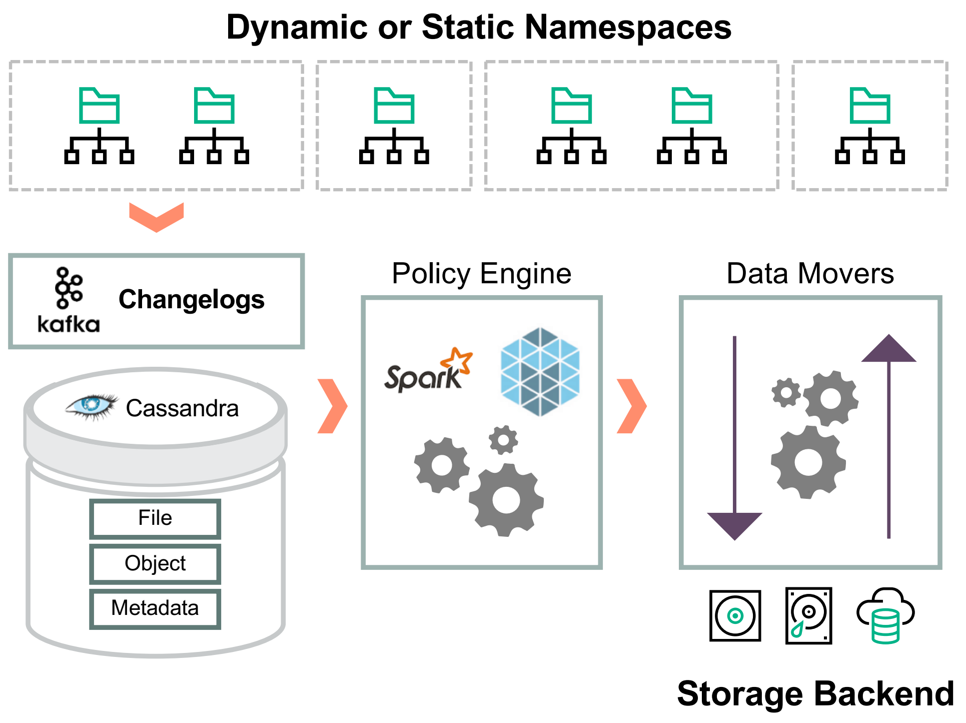


Evolving DMF

… To Data Curator

Manage more data workflows (IML)

- Retains transparent tiering (HSM)
- Captures and stores filesystem metadata
- Provides metadata queries
- Provides metada-driven policies
- Versions data
- Can destage files and stage data from backend into filesystems
- Configures and creates namespaces
- Delivers scalability and HA
- Modular architecture – can accommodate multiple filesystem types



60 3rd party RPMs
61 DMF7 RPMs
1638 files
262243 loc

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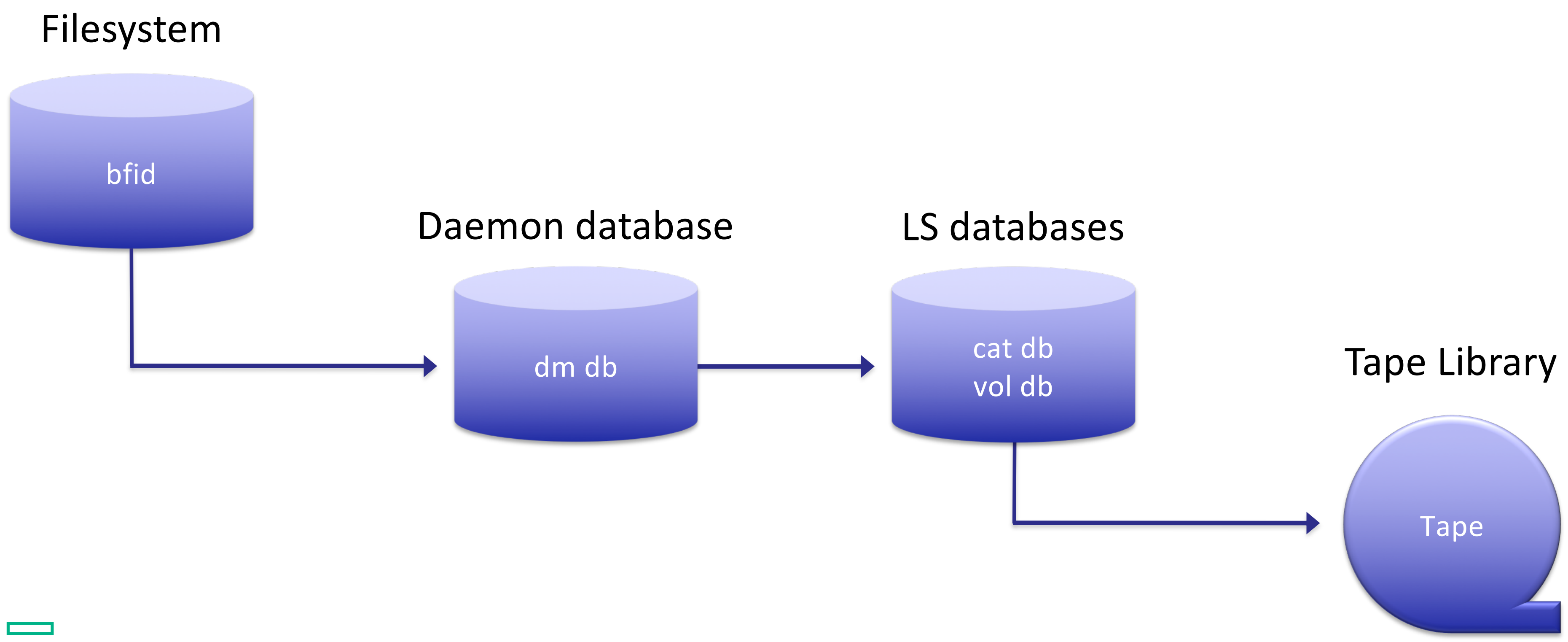
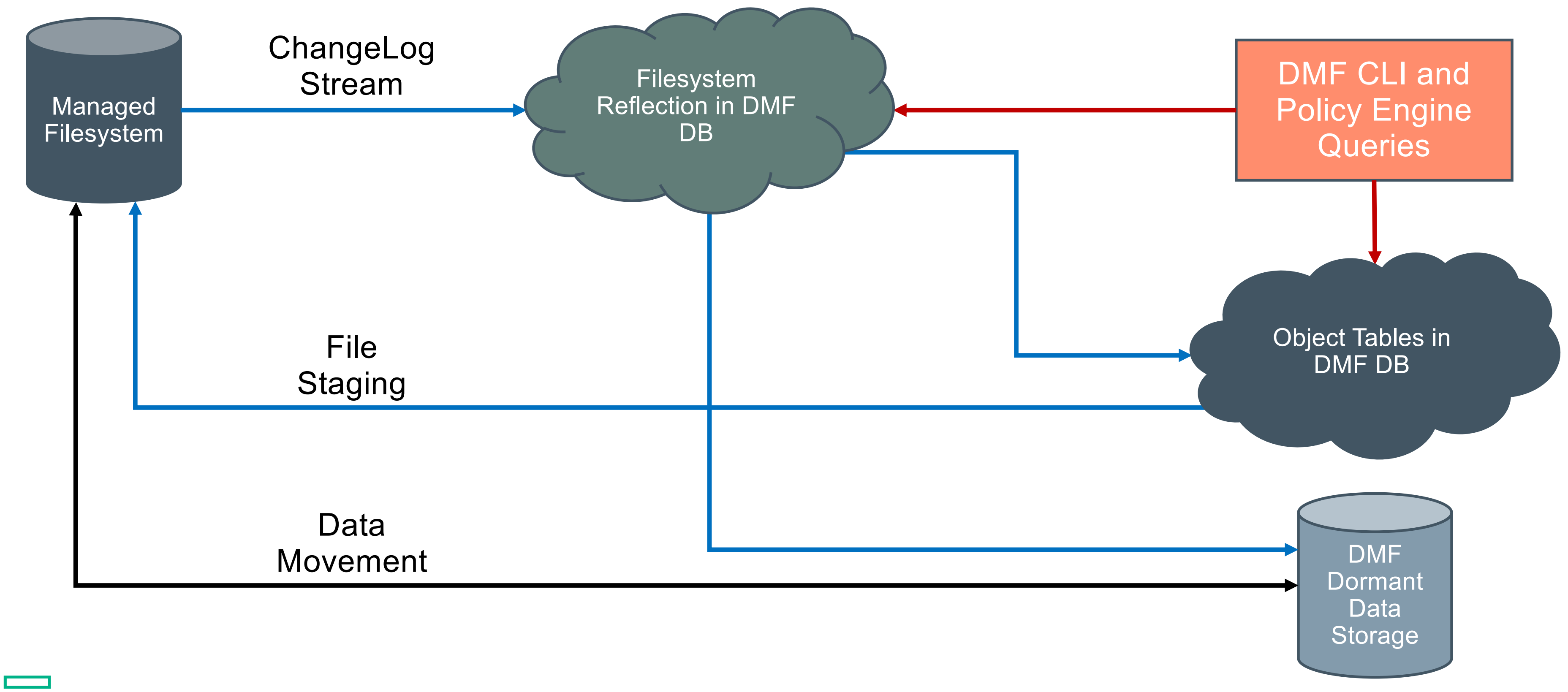
Evolving DMF

From a Simple Data Model …



Evolving DMF

… To Full Metadata Management



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System-Wide Components
Apache™ Cassandra Database

- Open-source, distributed, wide column store, NoSQL database management system designed to handle large amounts of data across many commodity servers, providing high availability with no single point of failure http://cassandra.apache.org/
- De-centralized, durable, fast, elastic, fault tolerant, proven
  - Linear scalability and proven fault-tolerance on commodity hardware or cloud infrastructure make it the perfect platform for mission-critical data
  - Instagram, eBay, GitHub, Netflix and many others use Cassandra
- BASE Architecture
  - Basically Available, Soft state, Eventual consistency
    - Requests can fail or data may be changing
    - System state changes over time
    - If input stops, the state eventually reaches consistency
- CQL, cqlsh
  - Column family
  - No joins or subqueries

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System-Wide Components

Cassandra Database

- DMF7 DB has 2 main keyspaces
  - Filesystem Reflection
    - One record per inode in the managed filesystem
  - Object
    - One record per managed version

Purpose	Keyspace	Description	Tables
Filesystem metadata	dmf_fs_<filesystem-id> per filesystem	Reflects current state of the filesystem provided by filesystem scanner, changelog processor and pathfinder. Includes working storage for capturing staging query results	file_inode, file_name, file_xattr, file_dirs, managed_file, file_to_object, file_policy, file_policy_state, file_staging, filesystem_usage
Backend DMF objects	dmf_object	Contains timestamped snapshot of filesystem metadata and pointers to object's data in external repositories	object_version, data_set, object_metadata, object_policy, object_policy_state, object_chunk, object_attr

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DMF7 Filesystem Reflection

– Independent keyspace per filesystem namespace

– Stores metadata for every inode in the managed filesystem

– Populated by scan and changelog stream

– Stores the HSM state for every inode

– Stores a pointer to the staged object version for every managed file

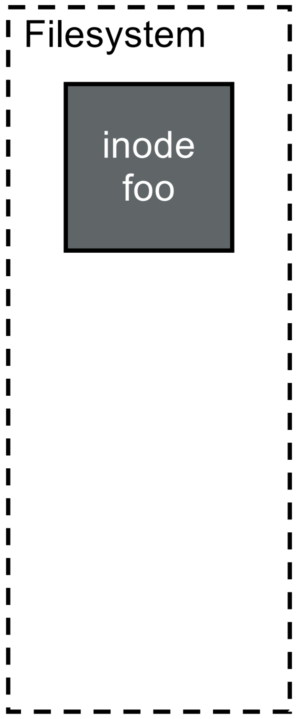
– Stores POSIX inode, xattr, filename, and directory metadata separately

– Directory hierarchy is maintained by a dedicated component called the DMF7 PathFinder

– All query and policy operations use only the reflection

– DMF7 is not looking at the filesystem itself to make policy decisions

DMF7 DB: A File foo



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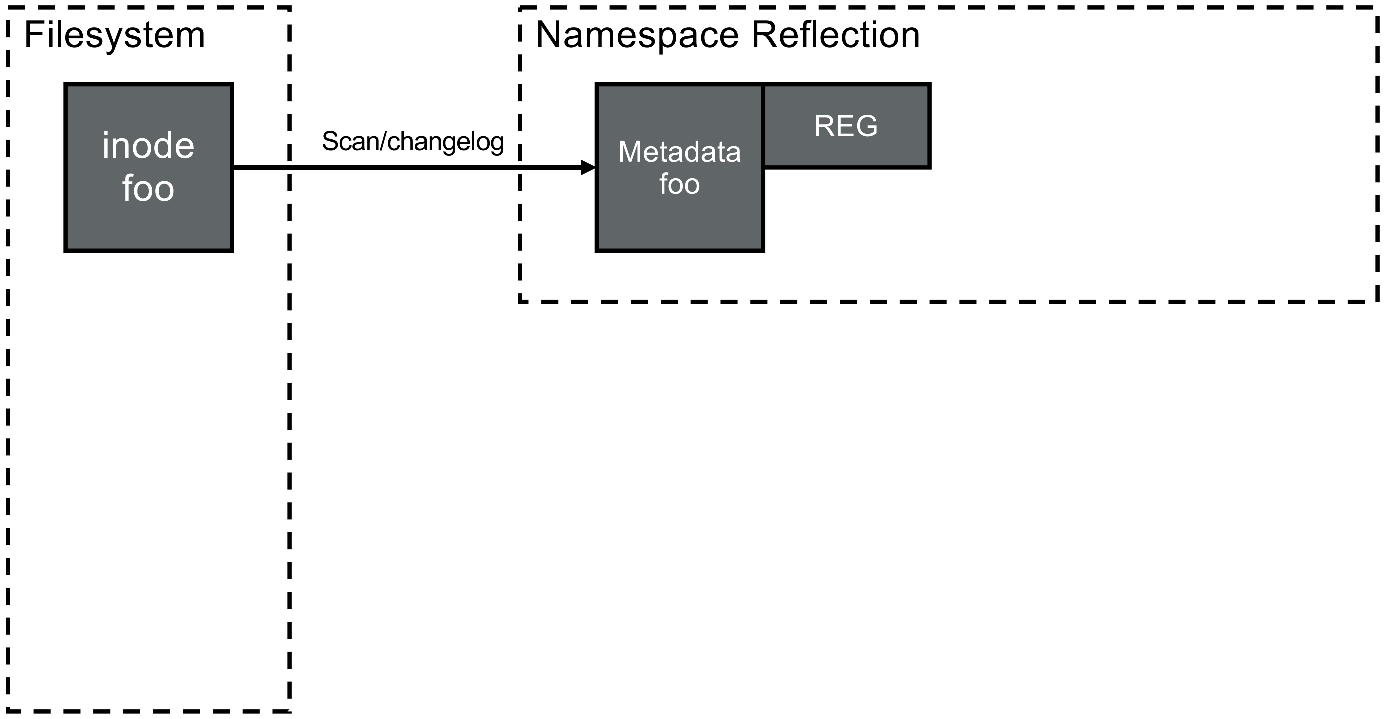
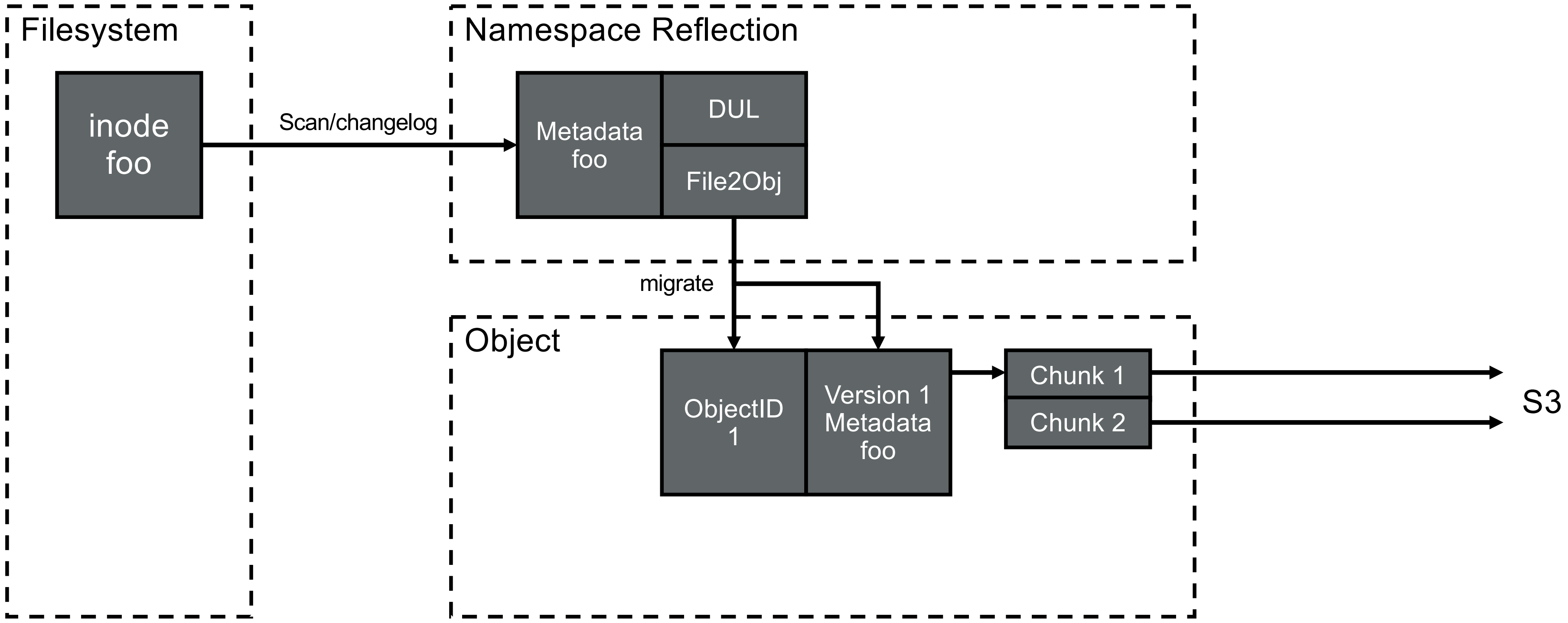
DMF7 DB: A REG File foo in a DMF Managed Namespace



DMF7 DB: DUL File foo with One Copy in S3



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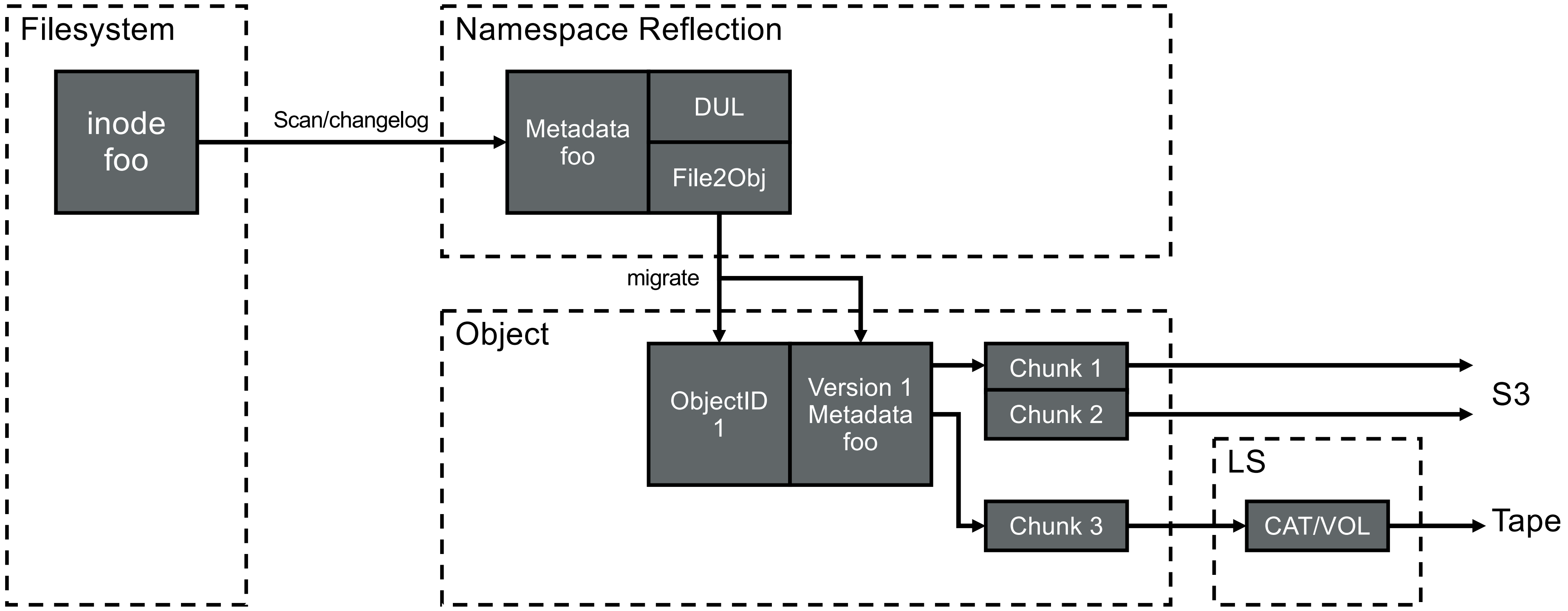
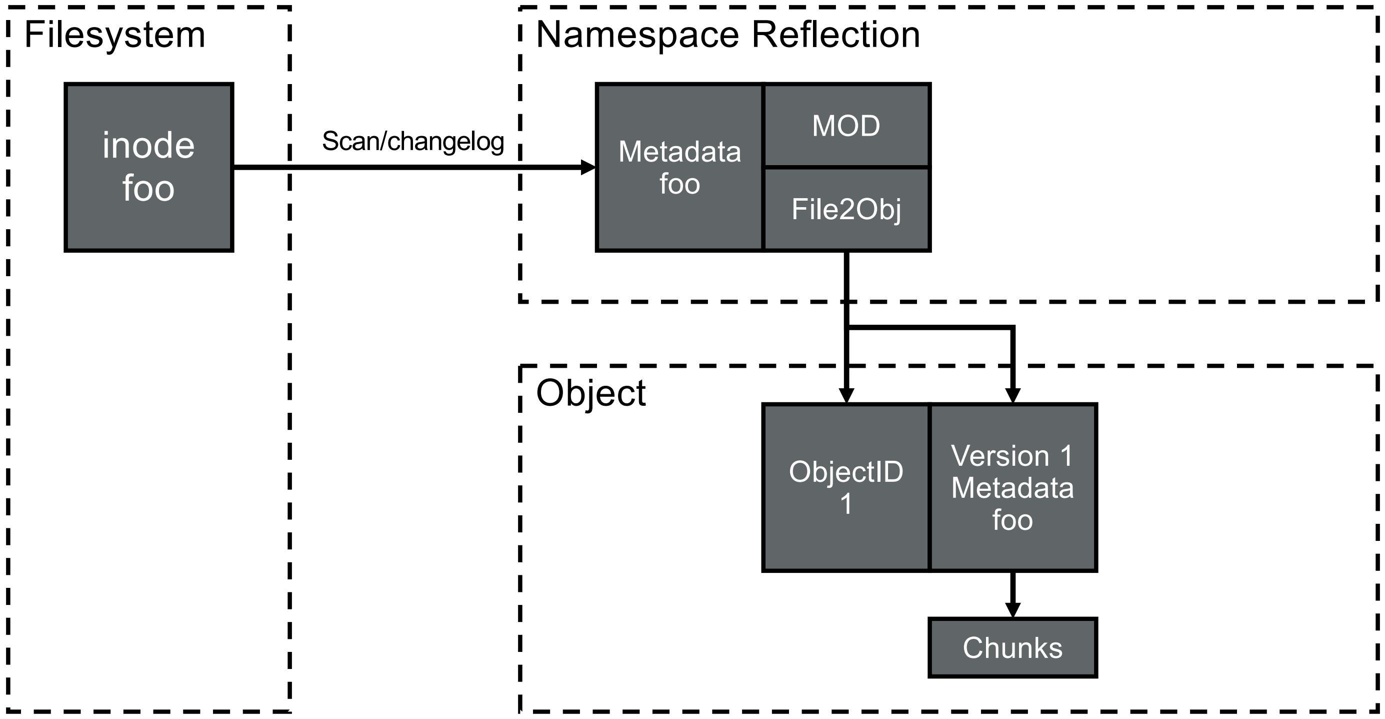
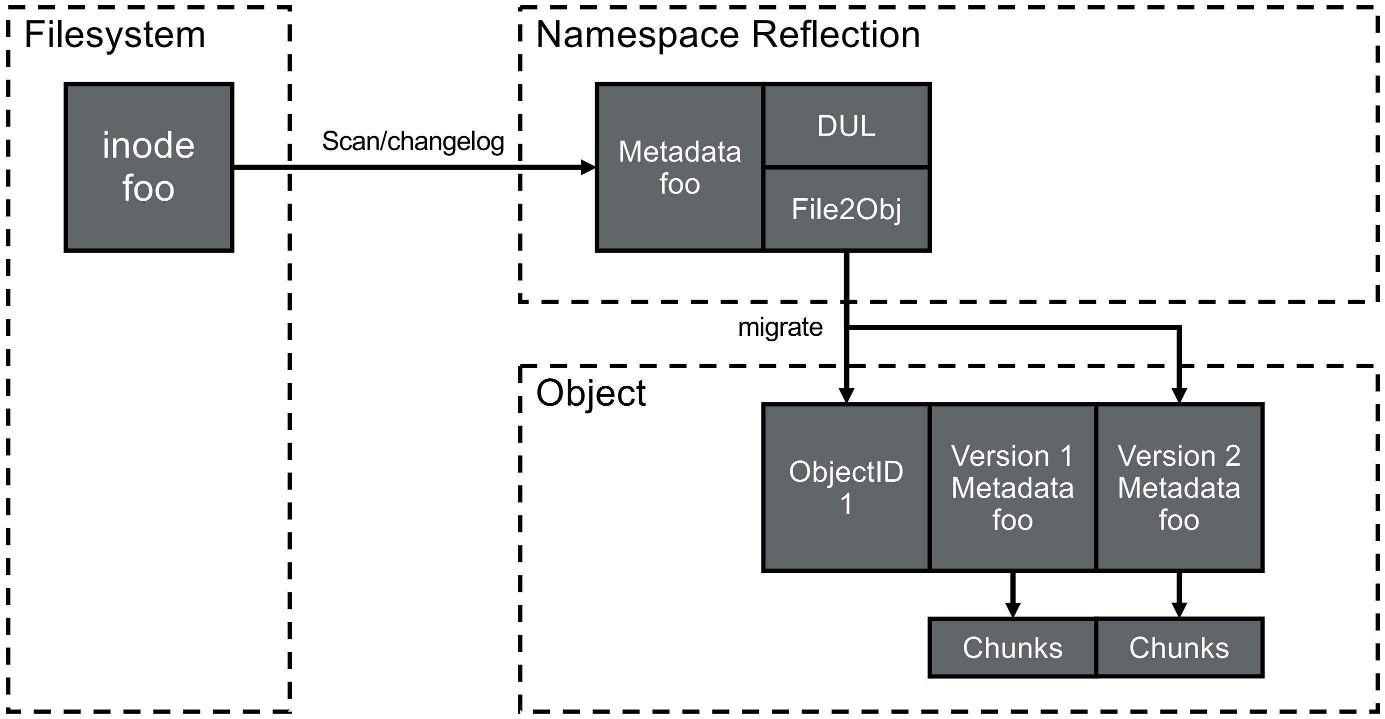
DMF7 DB: DUL File foo with Two Copies



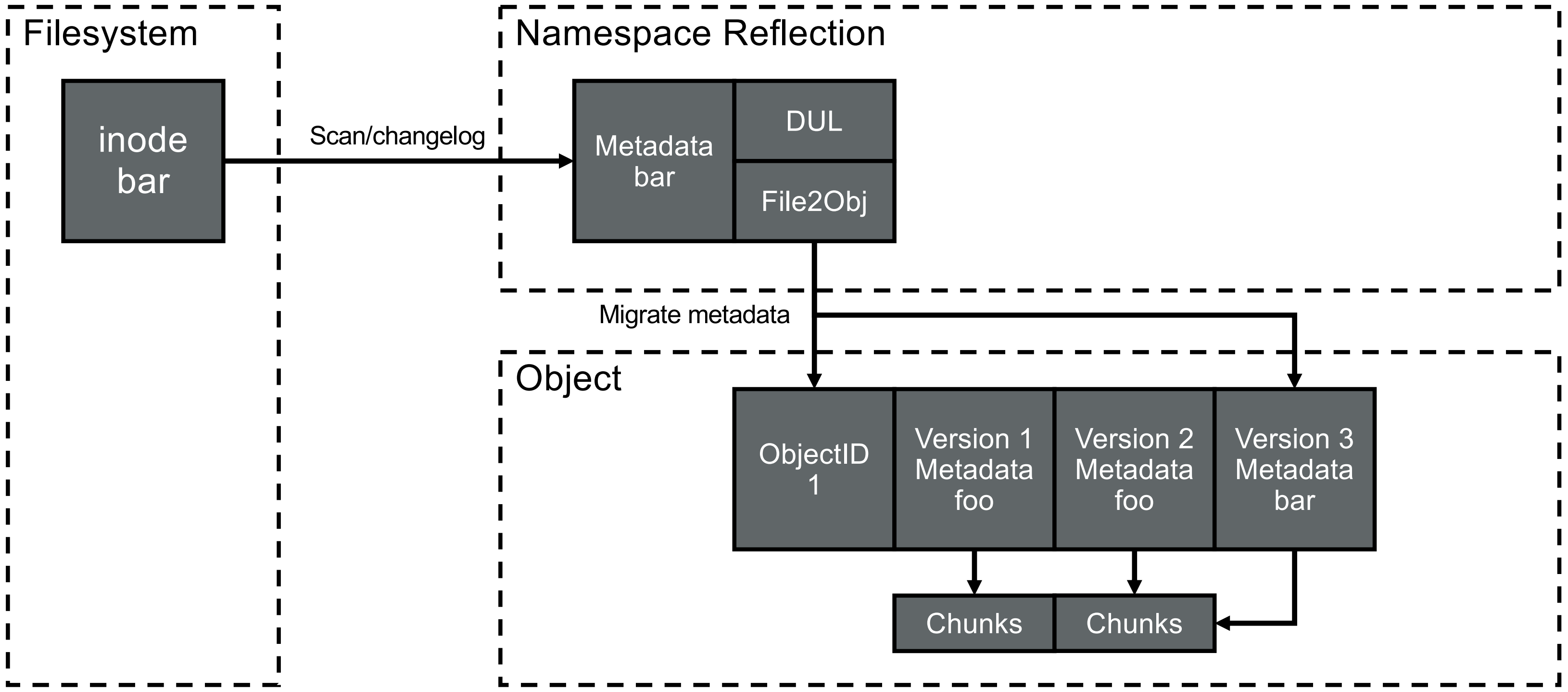
DMF7 DB: foo is Modified



DMF7 DB: foo is Versioned by Changing the Data



DMF7 DB: foo is Versioned by Changing Name to bar



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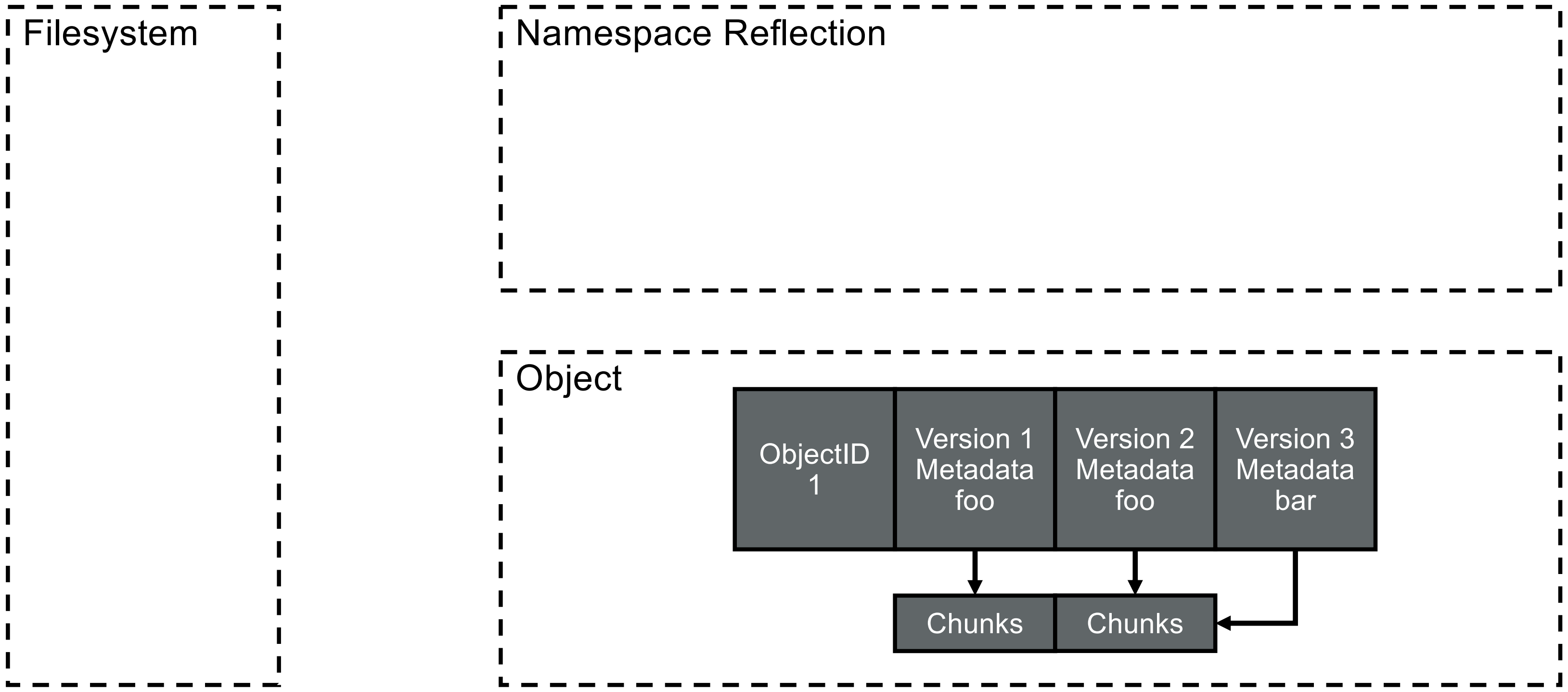
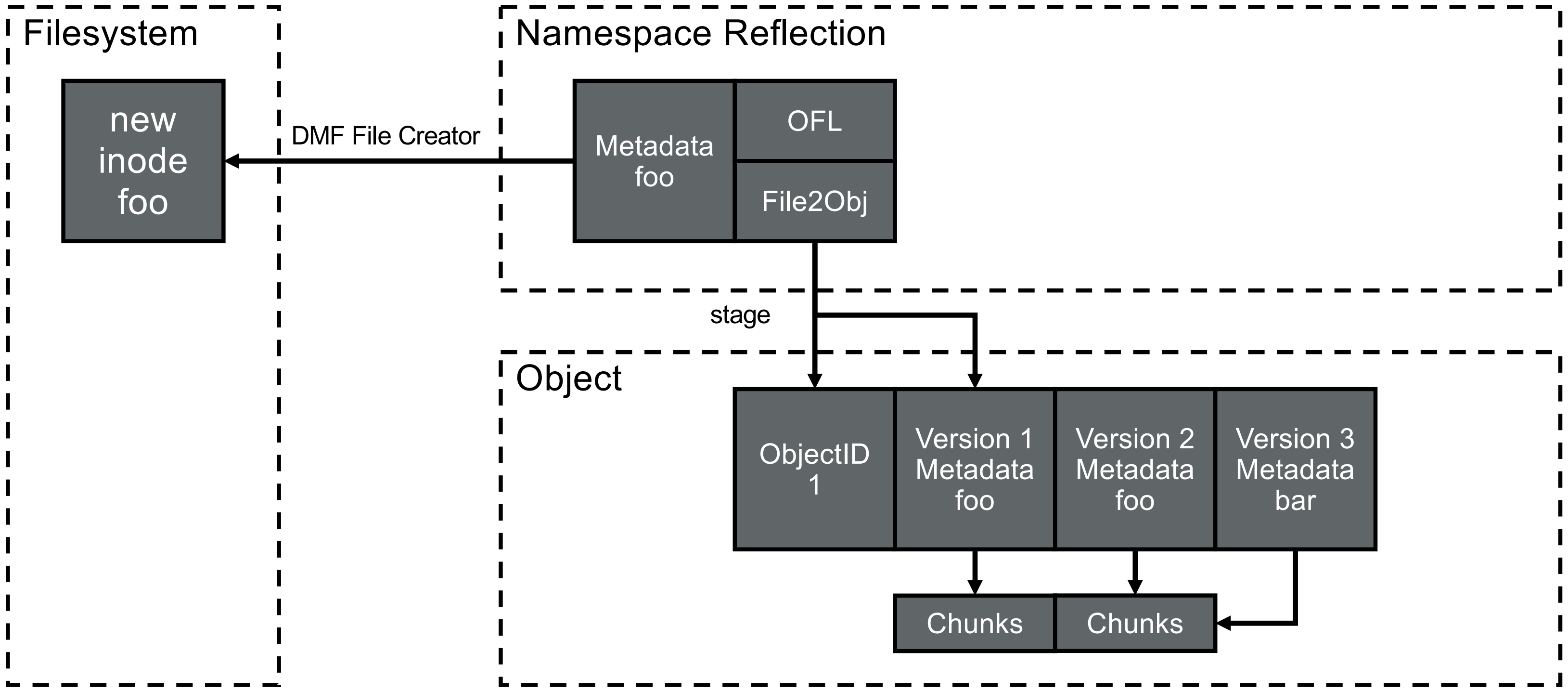
DMF7 DB: Destage bar



DMF7 DB: Stage foo from Version 1



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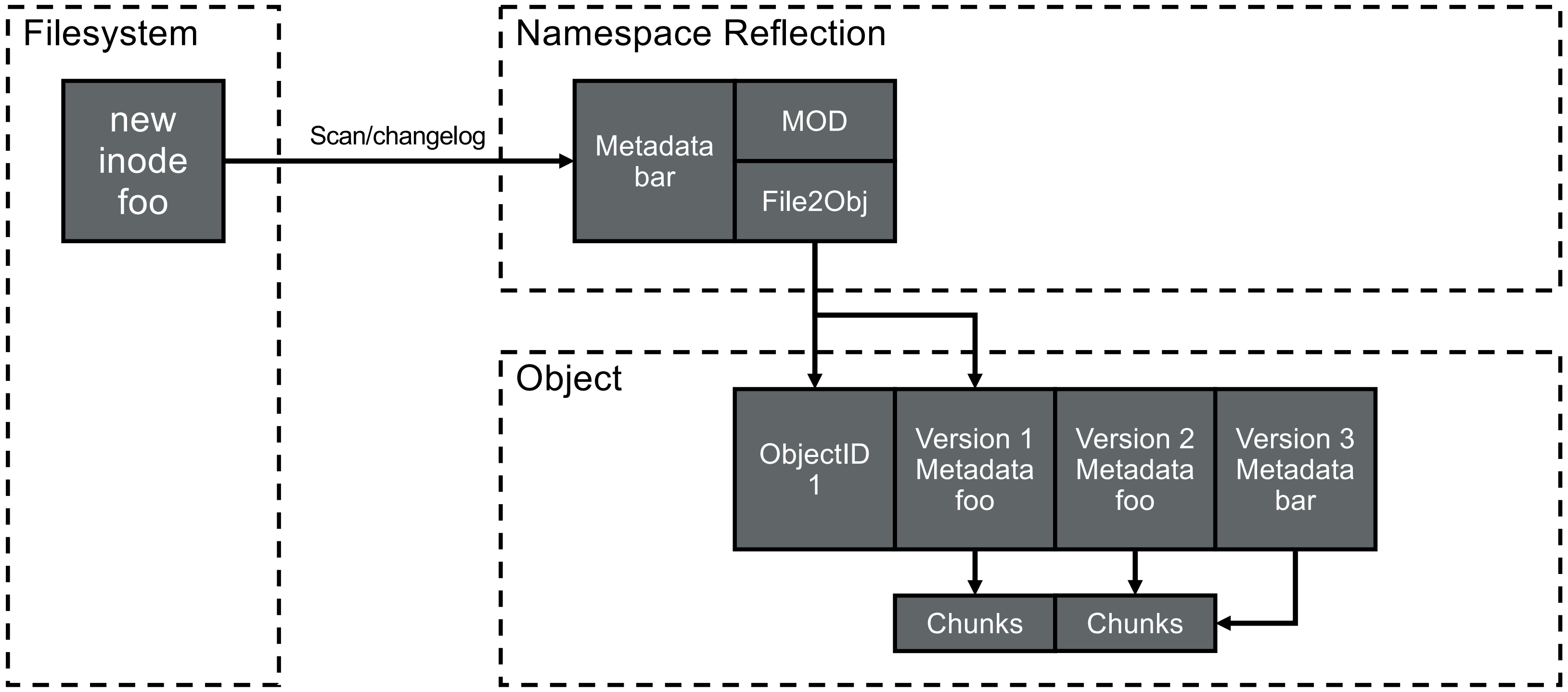
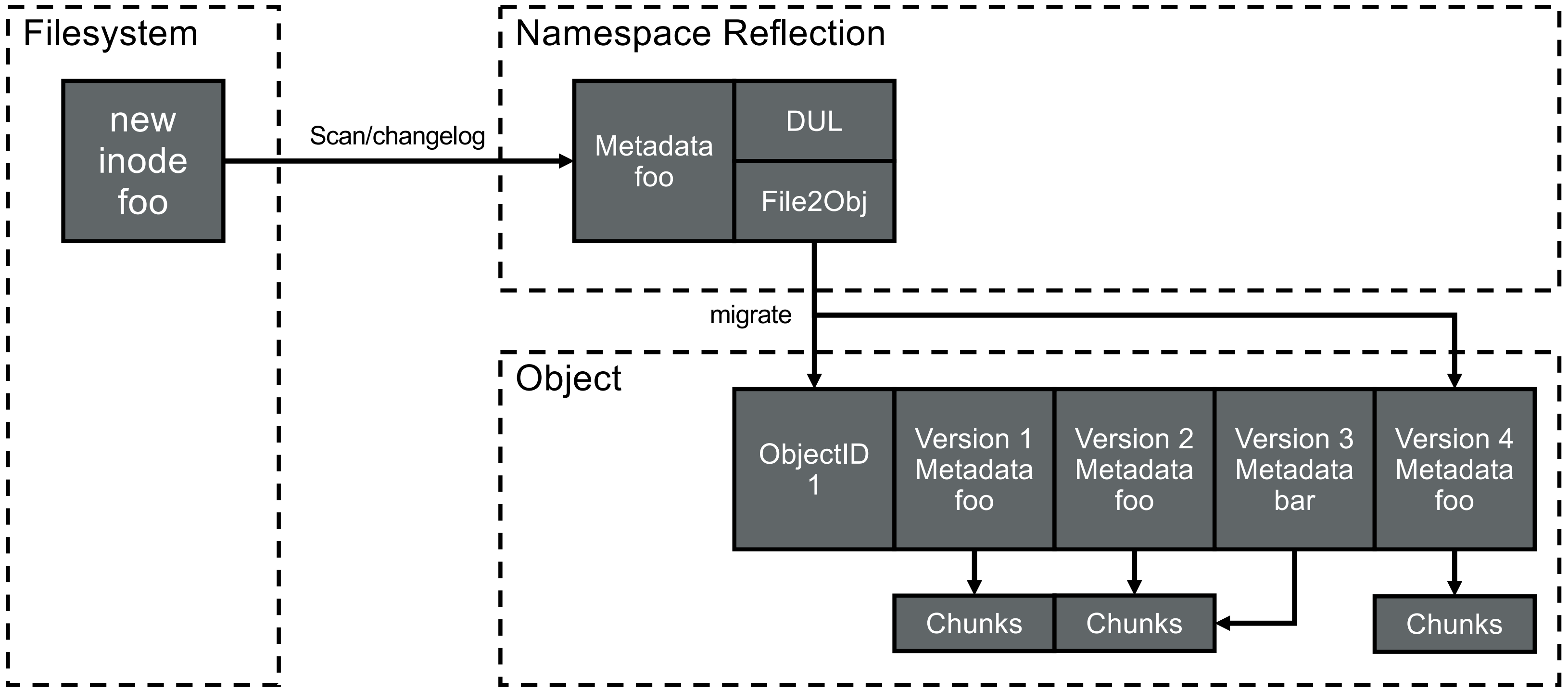
DMF7 DB: foo is Modified Again



DMF7 DB: foo is Versioned Again



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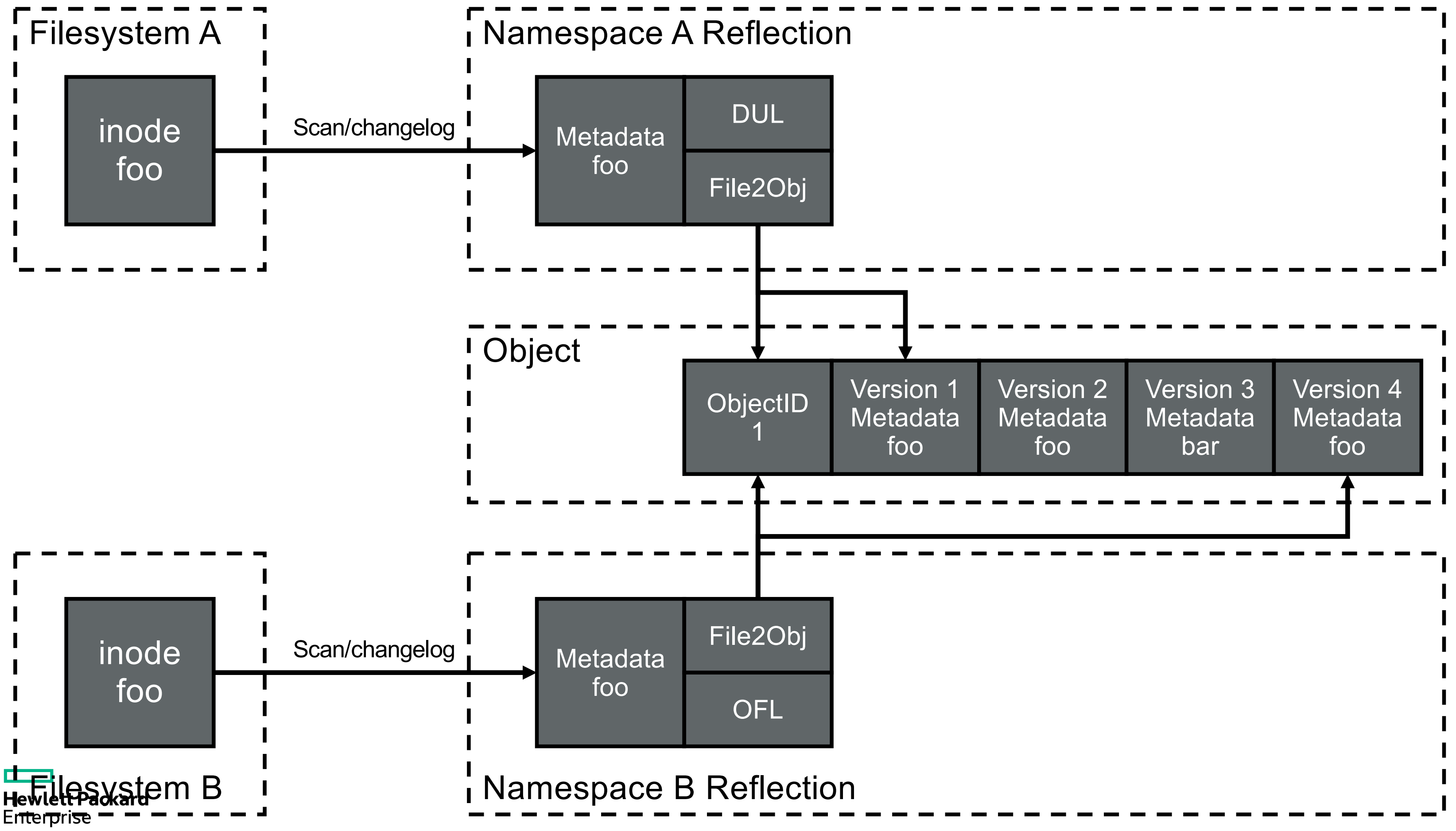
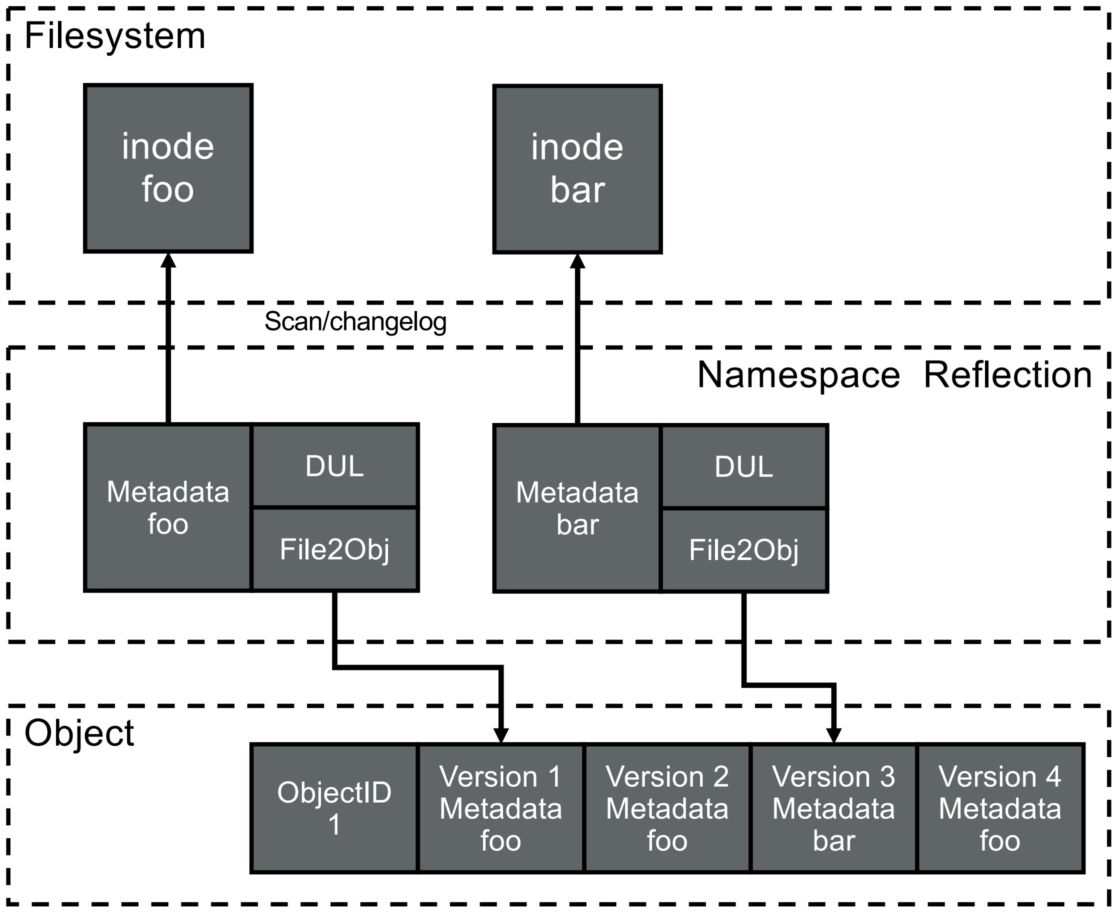
DMF7 DB: This is Possible



DMF7 DB: This is Also Possible



DMF7 DB: Notes on Sizing

- The database is replicated
- The default Replication Factor for all keyspaces is 3
- Full POSIX metadata, including all extended attributes, are stored in both the reflection and object version
- Length of file and directory names effects size in DB
- Number and size of extended attributes effects size in DB
- Each Object Version carries full metadata
- Ultimate size of the database is driven by
  - Number of inodes in the managed filesystem(s)
  - Length of file and directory names
  - Size and number of extended attributes
  - Number of Object Versions

Thank You