A Multi-Mission Solution for Rapid Telemetry Query and Display

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Purpose of AltiMOS

- JPL instruments contributed to a continuous record of ocean surface topography for the past 25 years
- Three missions under development will continue similar measurements into the 2030s
- Goal: using Jason-3 as a pilot mission, architect and set up a modernized MOS/GDS system
  - New system should have at a minimum all the features of the existing Jason-3 GDS
    - New system does not need to handle realtime telemetry viewing for Jason-3, but may need to for future missions
  - Take advantage of existing multi-mission and JPL heritage GDS components
  - Utilize shared or common hardware and software across AltiMOS missions where appropriate

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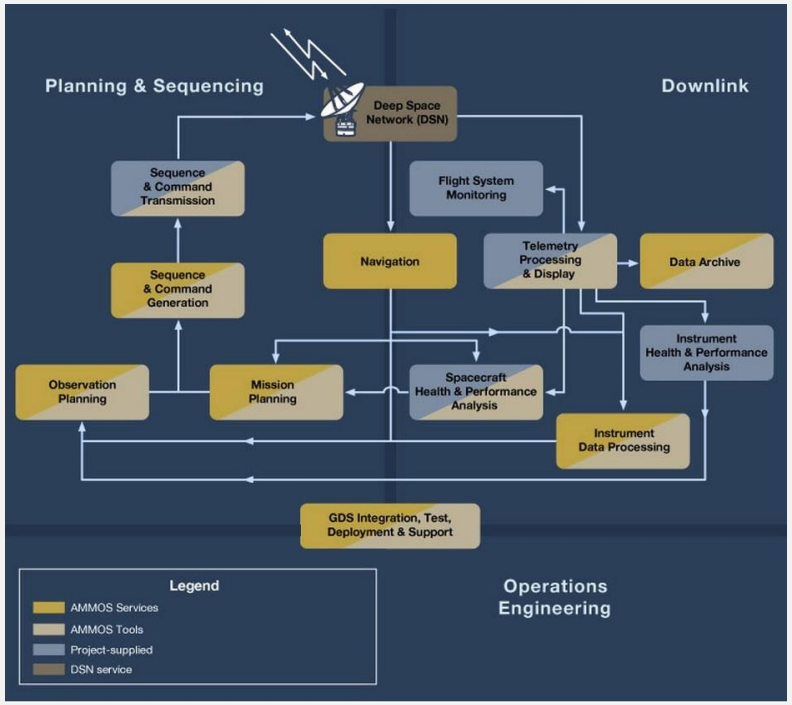
Multi-Mission Software

- The Advanced Multi-Mission Operations System (AMMOS) reduces mission costs by providing Mission Operations System (MOS) products and services common to multiple missions.
- AMMOS reduces mission development cost and schedule with functions that missions would otherwise develop and maintain themselves.
- AMMOS is available to NASA and partner organizations.
- Website: ammos.jpl.nasa.gov
- Contact: ammos_info@jpl.nasa.gov



- Example: AMMOS Mission Processing and Control System (AMPCS) is a product that provides the following functions
  - Sequence & Command Transmission
  - Telemetry Processing & Display
  - Telemetry Archive

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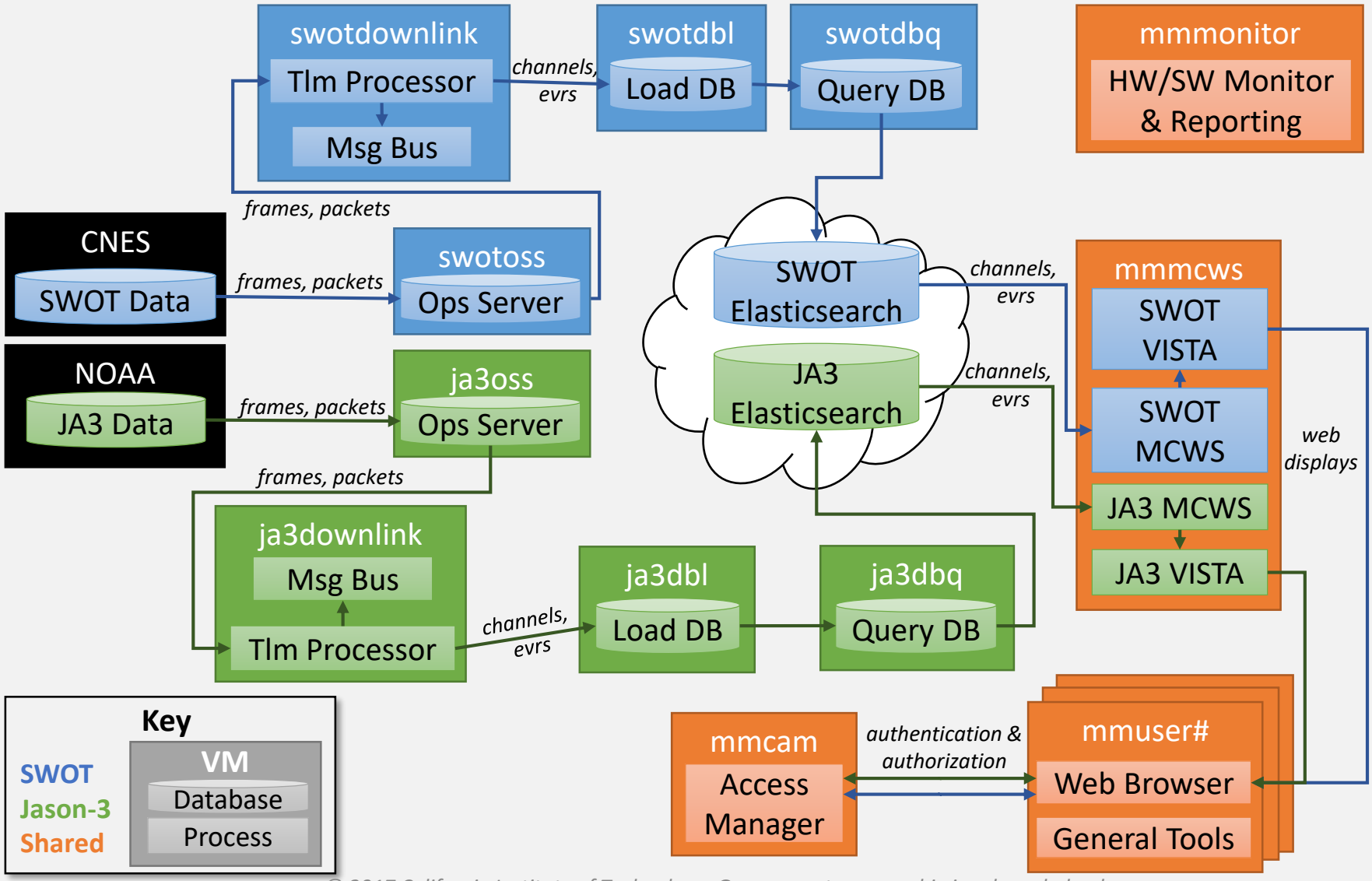
GDS Architecture for Two Missions



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Enabling Technology

- Amazon GovCloud
  - Compute instances (EC2), data storage (S3 and EBS), notification service (SNS), message bus (SQS)
- Apache applications for cloud and big data
  - Hardware resource management (Mesos), container orchestration (Marathon), processing engine (Spark)
- Elasticsearch - open source product by Elastic Co.
  - Distributed search and analytics engine
- AltiMOS use based on JPL heritage from MSL and SMAP missions
  - JPL-developed infrastructure takes advantage of ES data aggregation features to enable fast telemetry query
  - Interfaces with multi-mission telemetry database via CSV file

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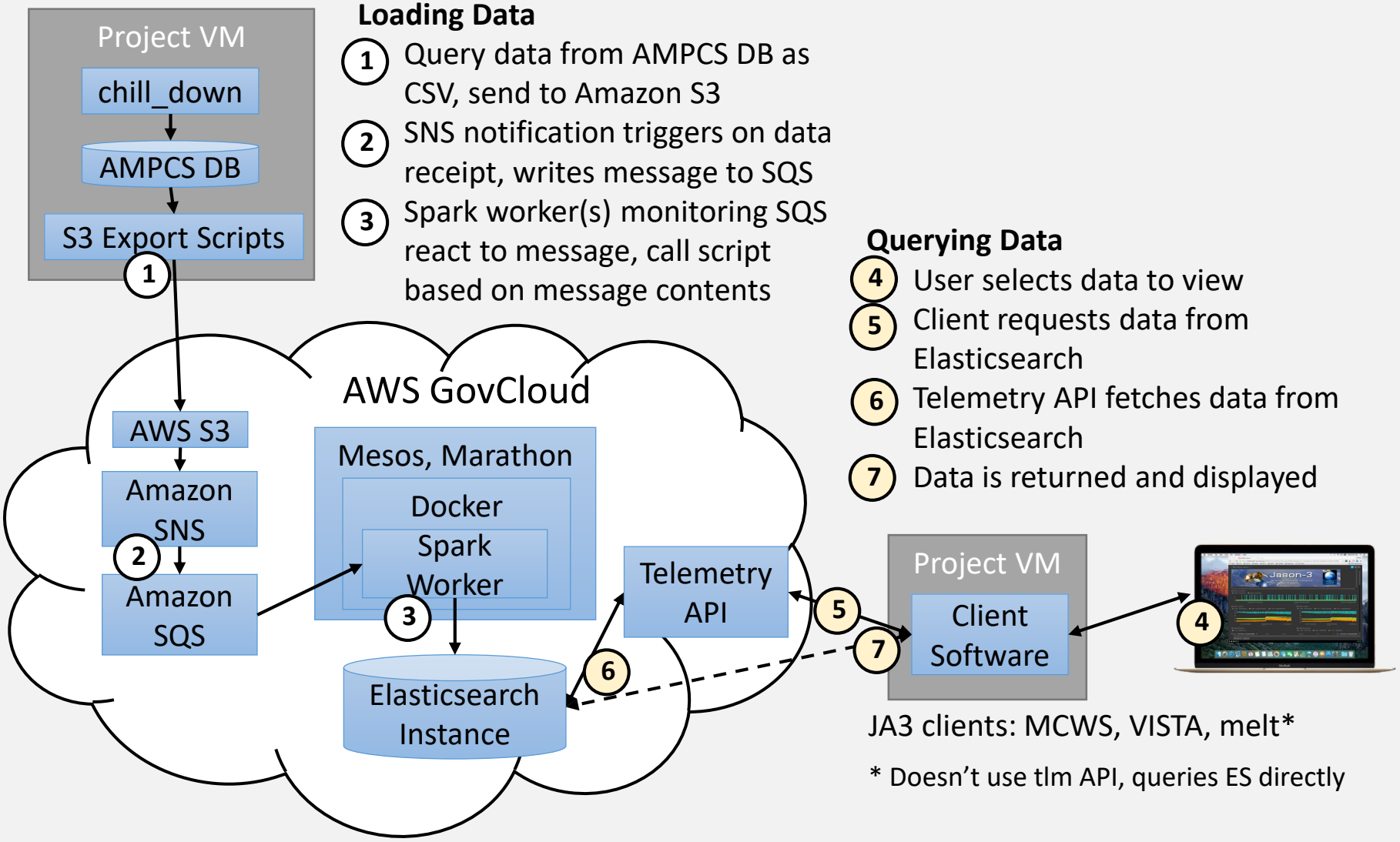
Processing & Query Data Flow



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Lessons Learned & Next Steps

- Learning curve
  - Team needs to learn several new technologies
  - Multiple knowledgeable eyes on the architecture preferred
- Establishing new ways of doing things
  - Often requires some trial and error; start slow and improve incrementally
  - Different projects have different needs, ex. Mars vs. Earth
- Cloud-based costs can add up quickly
  - Not currently dynamically scaling our hardware up and down
  - ES requires replicas, so pay to store same data twice
- Next steps
  - Archive large indices to cheaper storage, auto-restore as needed
  - Add index to improve “on change” query performance

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Backup

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Earth Altimetry Missions

- European-built spacecraft flying JPL instruments
  - Topex/Poseidon (1992 - 2005)
  - Jason-1 (2001 - 2013)
  - Jason-2/OSTM (2008 - present)
  - Jason-3 (2016 - present)
  - Jason-CS/Sentinel-6
    - Sentinel-6a (2020 - 2026)
    - Sentinel-6b (2026 - 2031)
  - SWOT (2021 - 2024)
- All have contributed to a 25-year continuous record of ocean surface topography data

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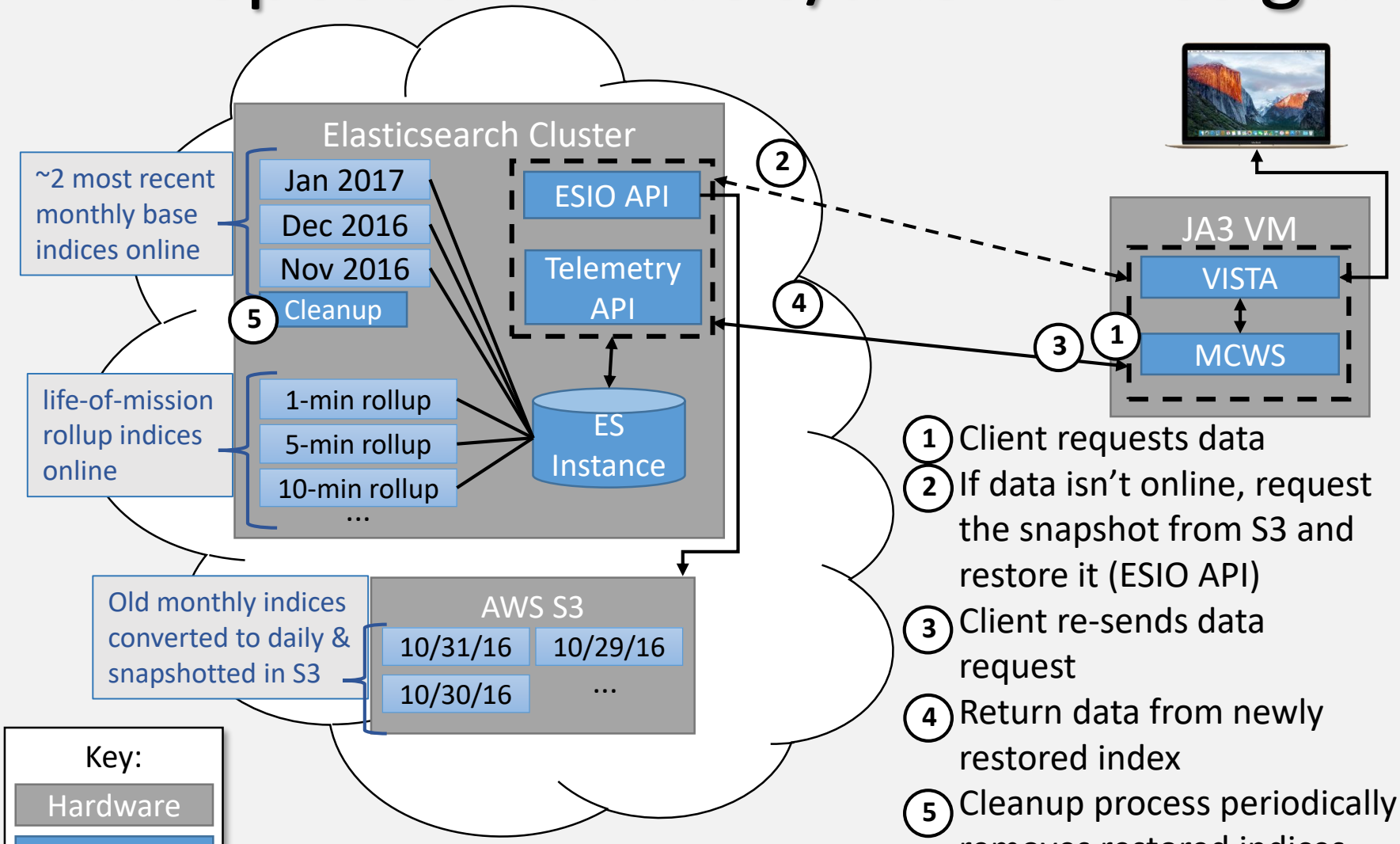
Proposed AltiMOS/JA3 ES Design



1. Client requests data
2. If data isn't online, request the snapshot from S3 and restore it (ESIO API)
3. Client re-sends data request
4. Return data from newly restored index
5. Cleanup process periodically removes restored indices

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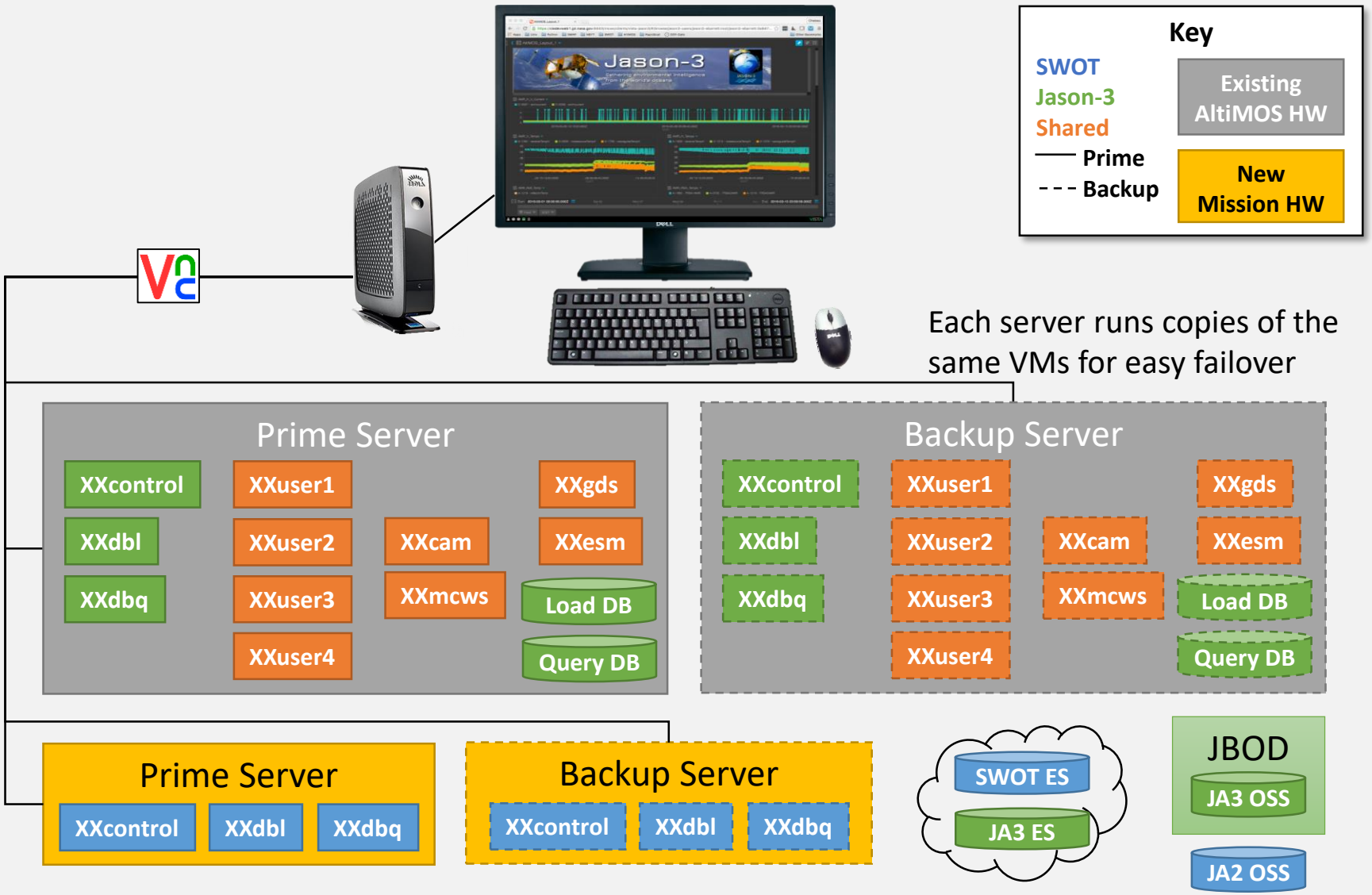
Shared Hardware Architecture



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