ORACLE

Exadata Database Machine: Maximum Availability Architecture (MAA)

Platinum MAA Tier with GoldenGate Microservices Architecture

October 2022

MAA reference architectures

Availability service levels

Bronze

Dev, test, prod

Single instance DB

Restartable

Backup/restore

Silver

Prod/departmental

Bronze +

Database HA with RAC

Application continuity

Sharding (optional)

Gold

Business critical

Silver +

DB replication with Active Data Guard

Platinum

Mission critical

Gold +

GoldenGate

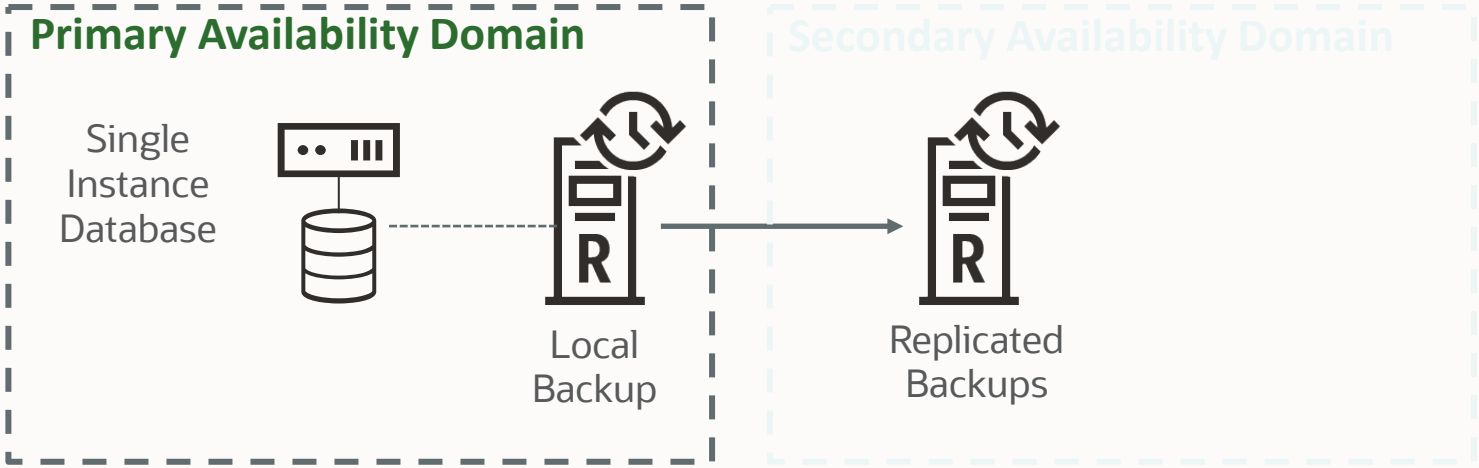
Edition-based redefinition

All tiers exist with on-premises and cloud. However, platinum currently must be configured manually while bronze to gold are covered with some form of cloud automation depending on the desired MAA architecture (i.e., multiple standby databases still must be manually configured in cloud today)

BRONZE

Dev, Test, Prod - Single Instance or Multitenant Database with Backups

- Single Instance with Clusterware Restart
- Advanced backup/restore with RMAN
  - Optional ZDLRA with incremental forever and near zero RPO
- Storage redundancy and validation with ASM
- Multitenant Database/Resource Management with PDB features
- Online Maintenance
- Some corruption protection
- Flashback technologies



Outage Matrix

Unplanned Outage	RTO / RPO Service Level Objectives (f1)
Recoverable node or instance failure	Minutes to an hour
Disasters: corruptions and site failures	Hours to days. RPO since last backup or near zero with ZDLRA
Planned Maintenance	
Software/hardware updates	Minutes to an hour
Major database upgrade	Minutes to an hour

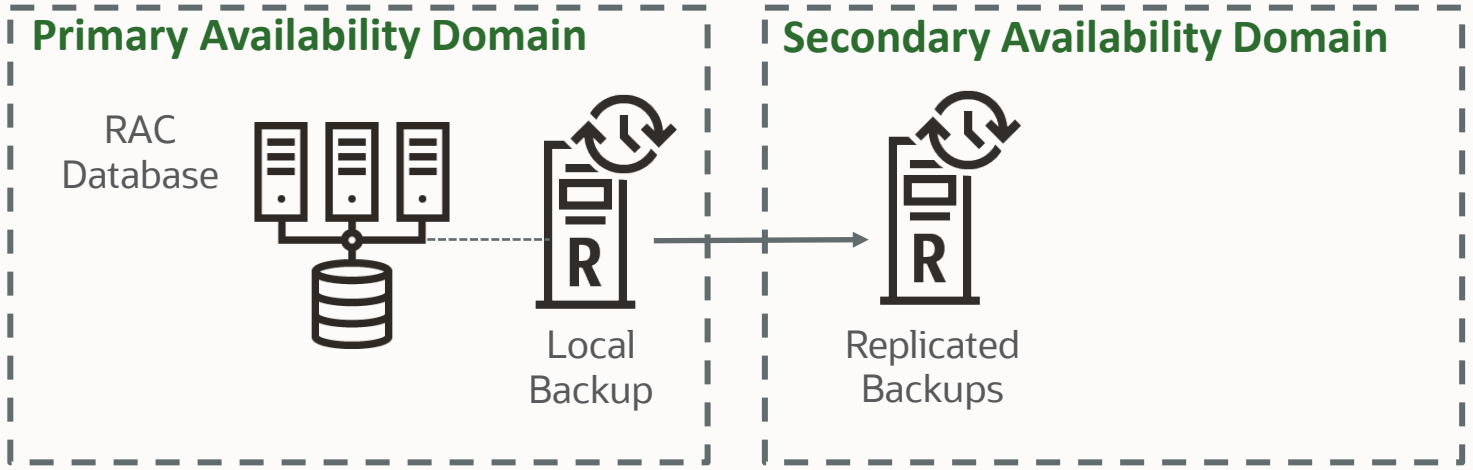
f1 : RPO=0 unless explicitly specified

SILVER

Prod/Departmental

Bronze +

- Real Application Clustering (RAC)
- Application Continuity
- Sharding (Optional)
  - Provides fault isolation, scalability and geographical distribution



Outage Matrix

Unplanned Outage	RTO/RPO Service Level Objectives(f1)
Recoverable node or instance failure	**Single digit seconds** (f2)
Disasters: corruptions and site failures	Hours to days. RPO since last backup or near zero with ZDLRA
Planned Maintenance	
Software/Hardware updates	**Zero** (f2)
Major database upgrade	Minutes to hour

f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices; Batch jobs should be deferred outside planned maintenance window.

Checklist found in MAA OTN

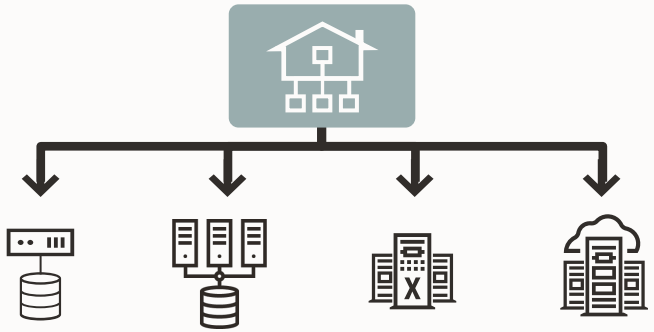
https://www.oracle.com/a/tech/docs/application-checklist-for-continuous-availability-for-maa.pdf

Planned Maintenance with Oracle Fleet Patching and Provisioning

Gold image repository

- 11.2.0.4
- 12.1.0.2
- 12.2.0.1
- 19.3.0
- 19.11.0
- 21.1.0

FPP server



Supported targets:
11.2, 12.1, 12.2, 18c, 19c, 21c

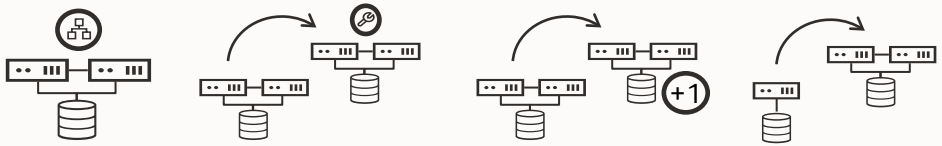
RAC, RAC One Node or Single Instance
on **Exadata** or Commodity HW

- **MAA-compliant** for **PLANNED MAINTENANCE** (Session Draining)
- Centralized operations
- Fleet-ready: operates 1000s of nodes
- Provides Automation and Standardization

GI and DB home management

Oracle Database (SI, RAC, RACON)

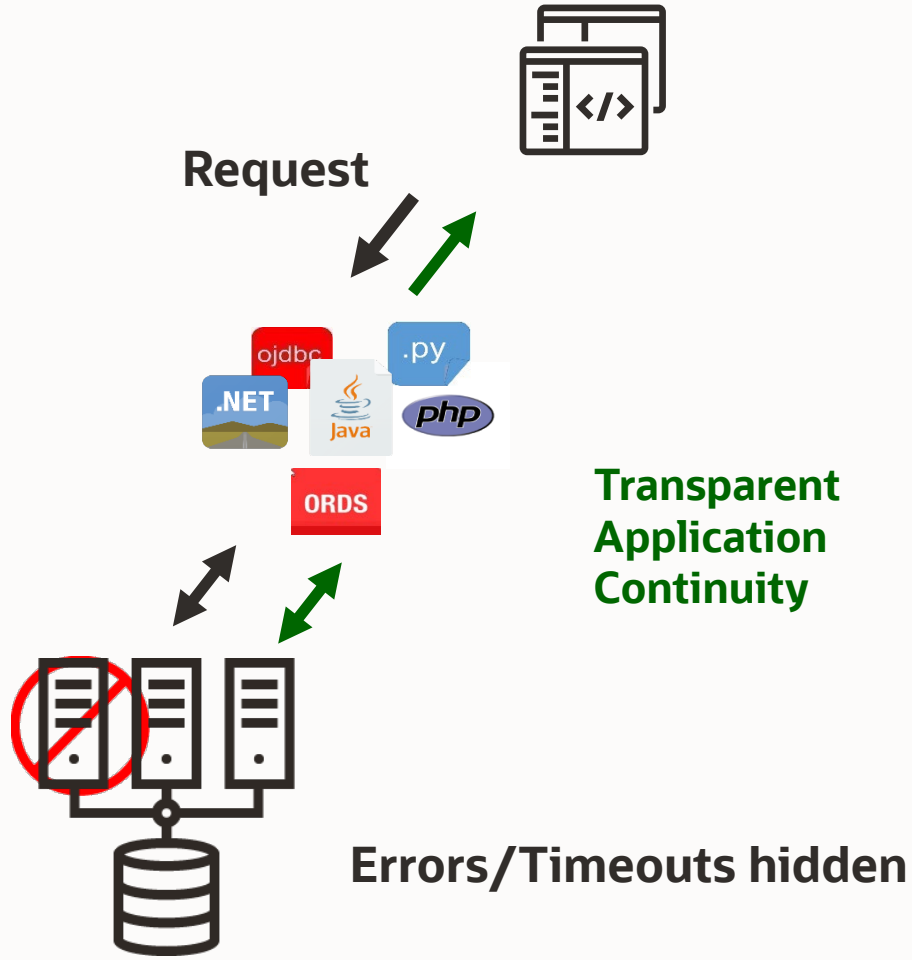
Oracle Grid Infrastructure



Other features

Transparent Application Continuity (TAC)

Application does not see errors during outages

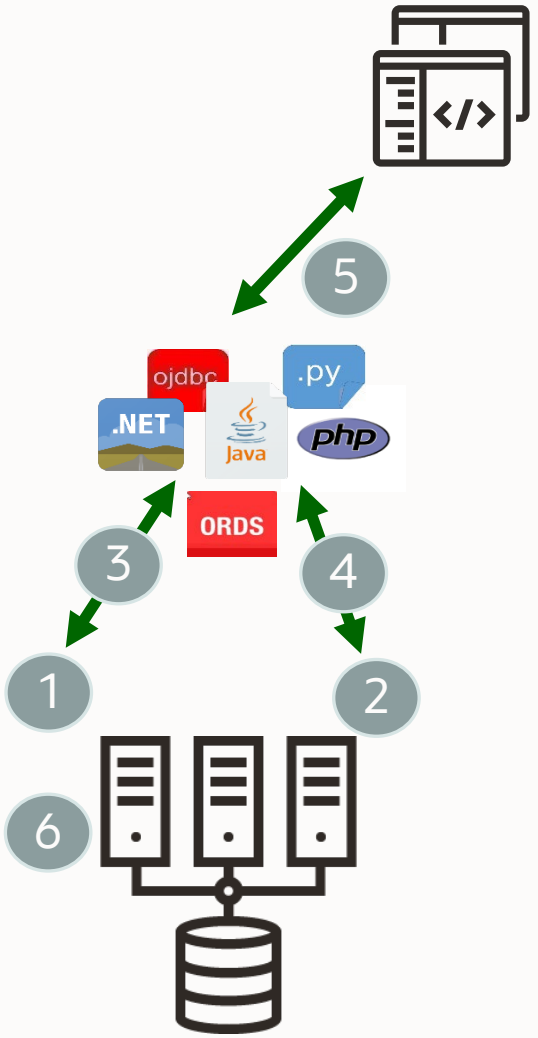


- Uses Application Continuity and Oracle Real Application Clusters
- Transparently tracks and records session information in case there is a failure
- Built inside of the database, so it works without any application changes
- Rebuilds session state and replays in-flight transactions upon unplanned failure
- Planned maintenance can be handled by TAC to drain sessions from one or more nodes
- Adapts as applications change: protected for the future

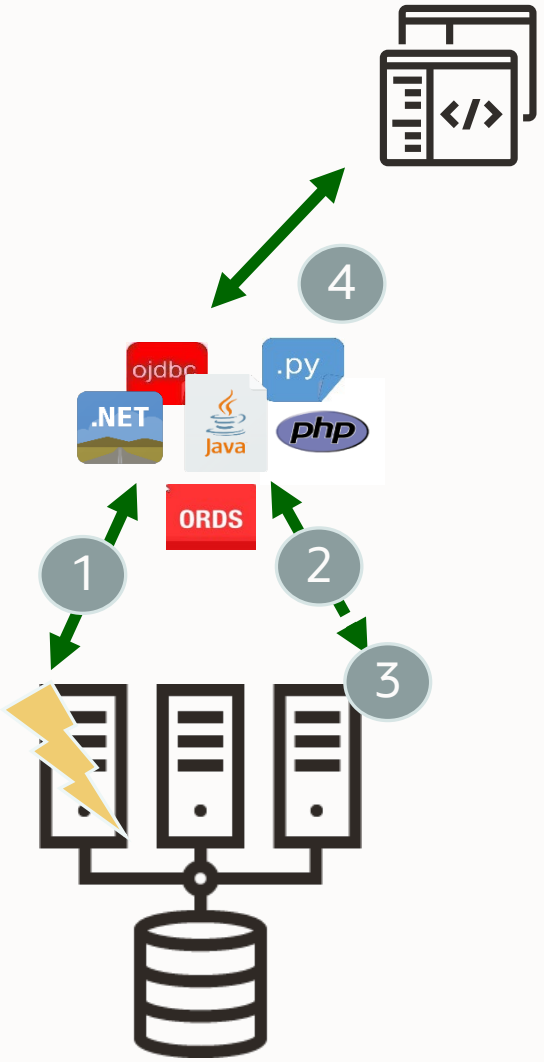
Planned Maintenance

Planned Maintenance (without the Outages!):

1. Database Service is relocated or stopped
2. Service starts on another RAC instance
3. Sessions connected to the service are drained
4. New sessions connect to Service on another instance
5. Results from Database Request returned to user
6. Maintenance activities can start on first node (rolling)



Unplanned Outages, without Impact



<u>Outage or Interruption at Database</u>:

1. Database Request interrupted by an Outage or timeout
2. Session reconnects to the RAC Cluster and
3. Database Request replays automatically
4. Result from Database Request returned to user

GOLD

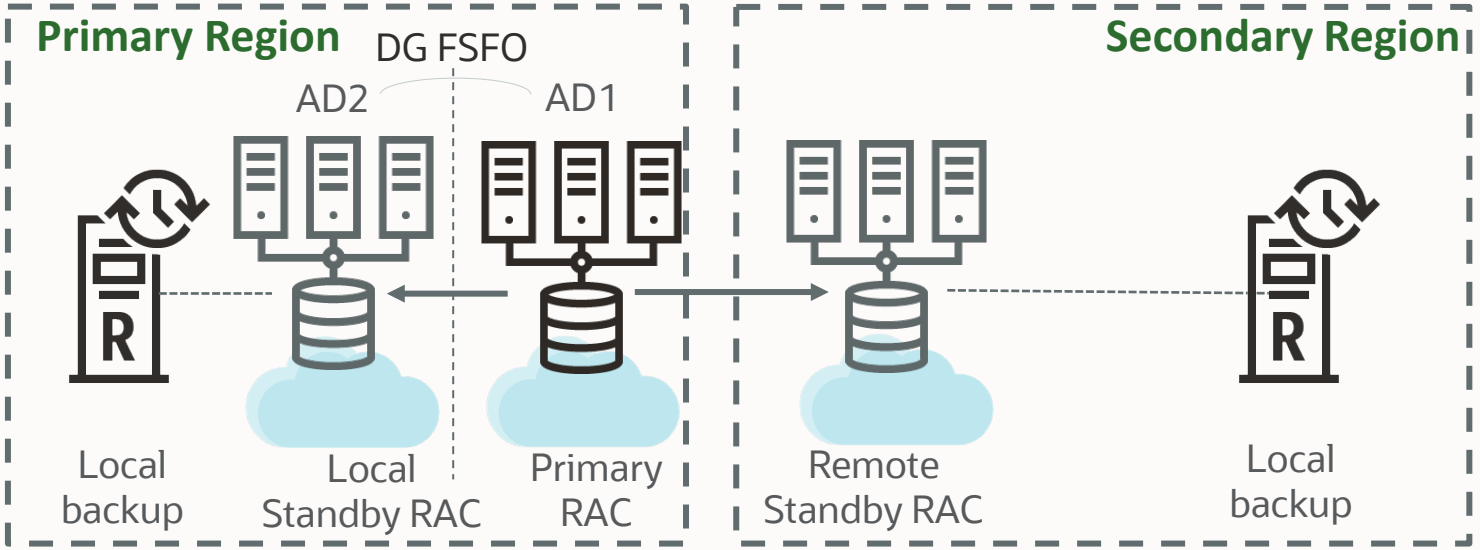
Mission Critical

Silver +

- Active Data Guard
  - Comprehensive Data Protection

MAA Architecture:

- At least one standby required across AD or region.
- Primary in one data center(or AD) replicated to a Standby in another data center
- Active Data Guard Fast-Start Failover (FSFO)
- Local backups on both primary and standby

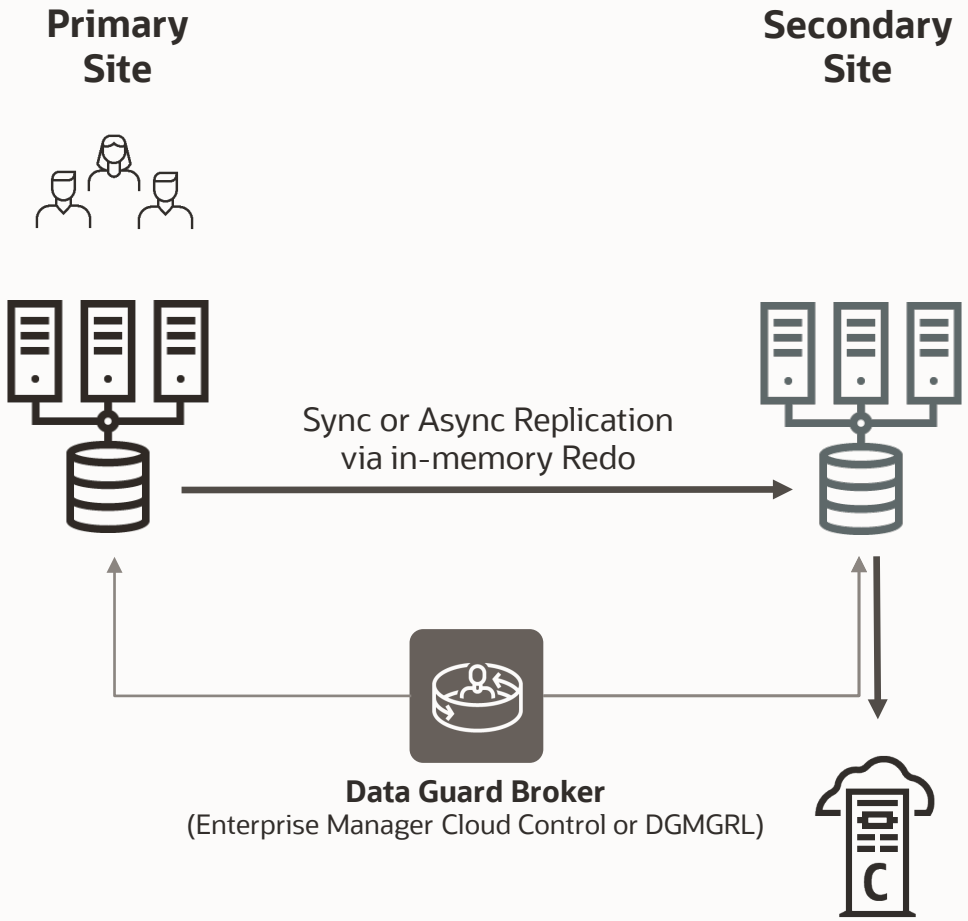


Outage Matrix

Unplanned Outage	**RTO/RPO Service Level Objectives** (f1)
Recoverable node or instance failure	Single digit seconds (f2)
Disasters: corruptions and site failures	**Seconds to 2 minutes. RPO zero or seconds**
Planned Maintenance	
Software/Hardware updates	Zero (f2)
Major database upgrade	**Less than 30 seconds**

f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices; Batch jobs should be deferred outside planned maintenance window.

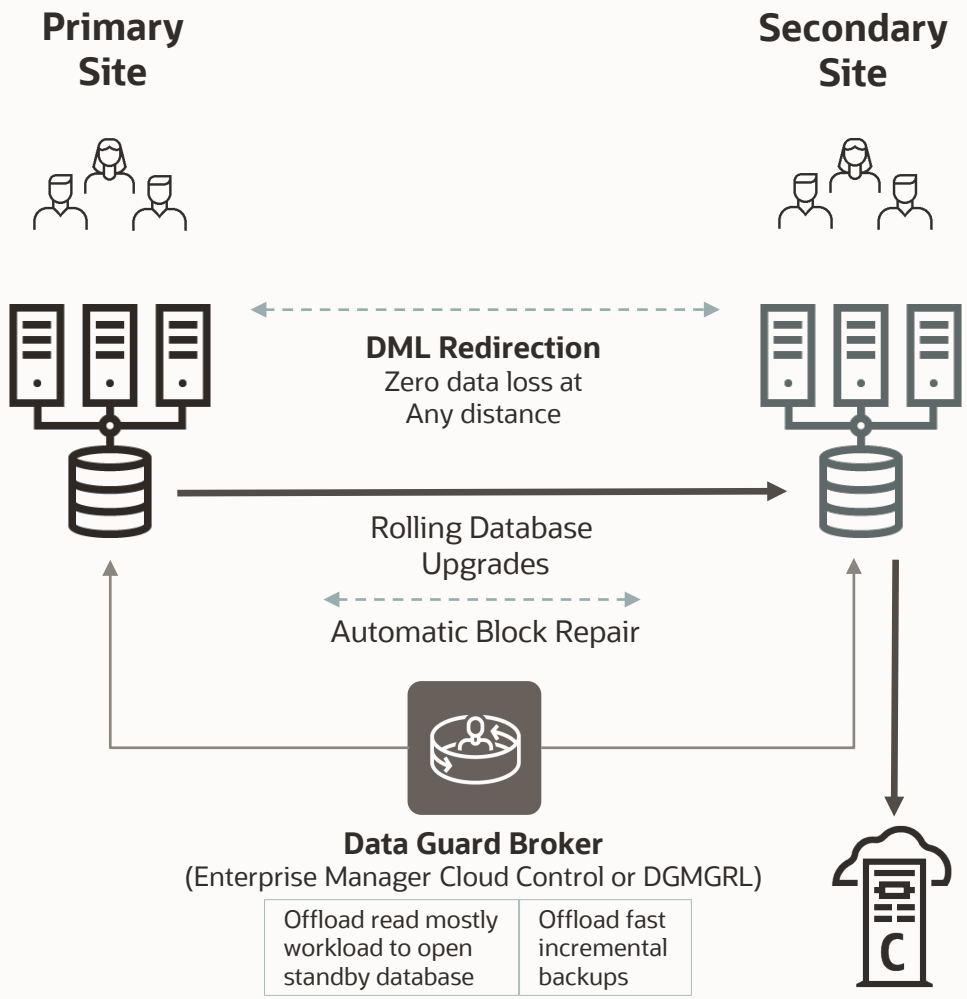
Oracle Data Guard (DG)



- **Basic DR (included with DB EE)**
  - License primary and secondary sites
- **Active-passive**
  - Standby is used only for failovers
- **Automatic failover to Standby site**
- **Zero / near-zero data loss**
- **Continuous data validation**
- **Simple migrations and upgrades**

https://www.oracle.com/database/technologies/high-availability/dataguard-activedataguard-demos.html

Oracle *Active* Data Guard (ADG)

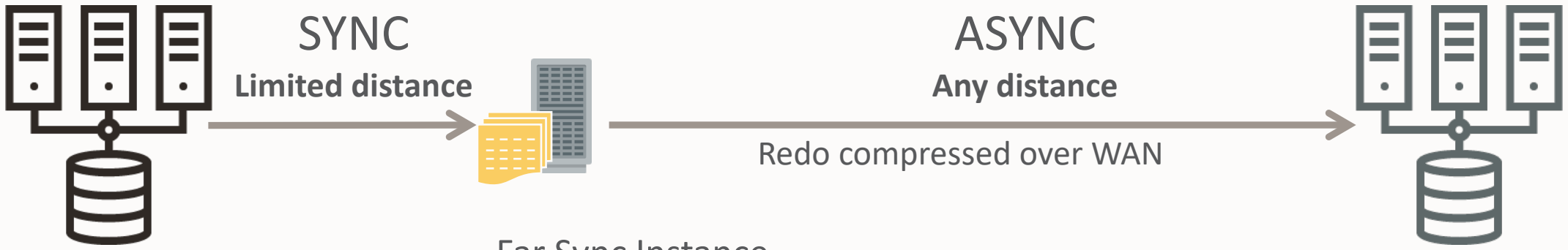


- **Advanced Disaster Recovery**
- **Active-active***
  - Queries, reports, backups
  - Occasional updates (19c)
  - Assurance of knowing system is operational
- **Automatic block repair**
- **Application Continuity**
- **Zero data loss across any distance**
- **Many other features**

https://www.oracle.com/database/technologies/high-availability/dataguard-activedataguard-demos.html

Active Data Guard Far Sync

Zero Data Loss Protection at Any Distance



Primary Database
- Production copy

Far Sync Instance
- Oracle control file and log files
- No database files
- No media recovery
- Offload transport compression and/or encryption

Active Standby Database
- Zero data loss failover target
- Database open read-only
- Continuous Oracle validation
- Manual or automatic failover

PLATINUM

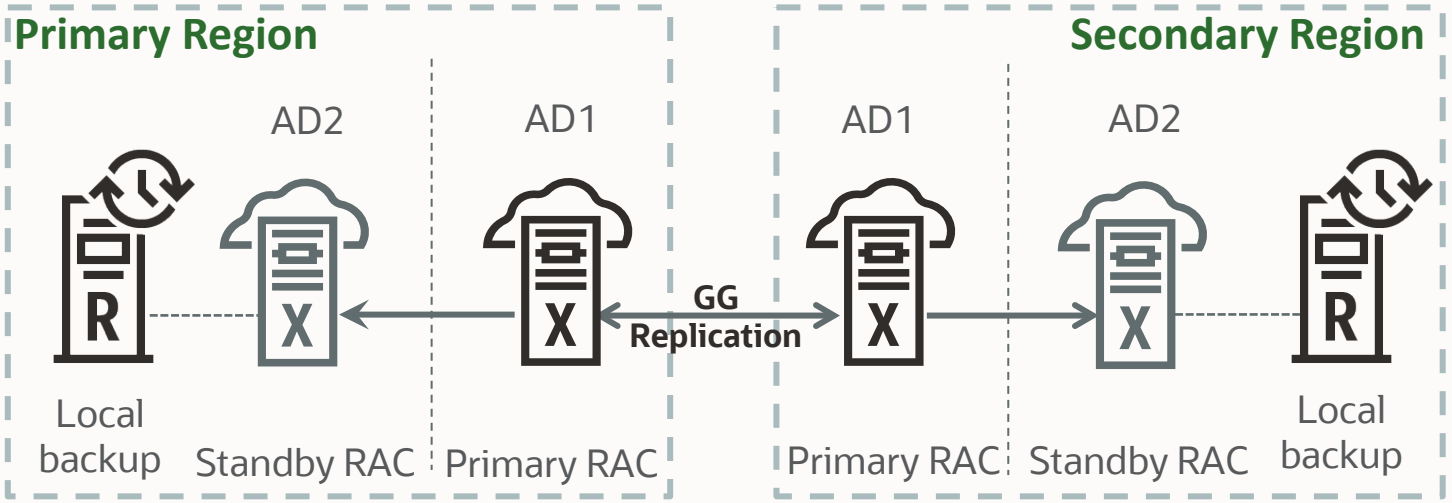
Extreme Critical

Gold +

- GoldenGate Active/Active Replication
- Optional Global Data Services (GDS) to help with application failover to GG or ADG databases
- *Note: this requires much higher operational and management investment*

MAA Architecture:

- Primary GG in one data center replicated to another Primary GG in a different region
- Each GoldenGate "primary" replica protected by Exadata and Active Data Guard
- Standby can be across ADs for data center failure protection or across regions for regional disaster failures



Outage Matrix

Unplanned Outage	RTO/RPO Service Level Objectives (f1)
Recoverable node or instance failure	Zero- or single-digit seconds brownout (f2)
Disasters including corruptions and site failures	Zero (f3) RPO=Zero if Data Guard SYNC or FAR SYNC
Planned Maintenance	
Most common software/hardware updates	Zero (f2)
Major database upgrade, application upgrade	Zero (f3) (f4)

f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices
f3: Application failover is custom or with Global Data Services
f4: Edition based redefinition is incompatible with GoldenGate

Comparison between Gold and Platinum MAA

1. Supports Large Enterprise Applications (large 6-12 node RACs). Proven and Validated.
2. RPO=0 for database, cluster or site failures
3. RTO=near zero for all outages including AD failure
4. Architecture proposal must be incorporated in multi-AD database architecture

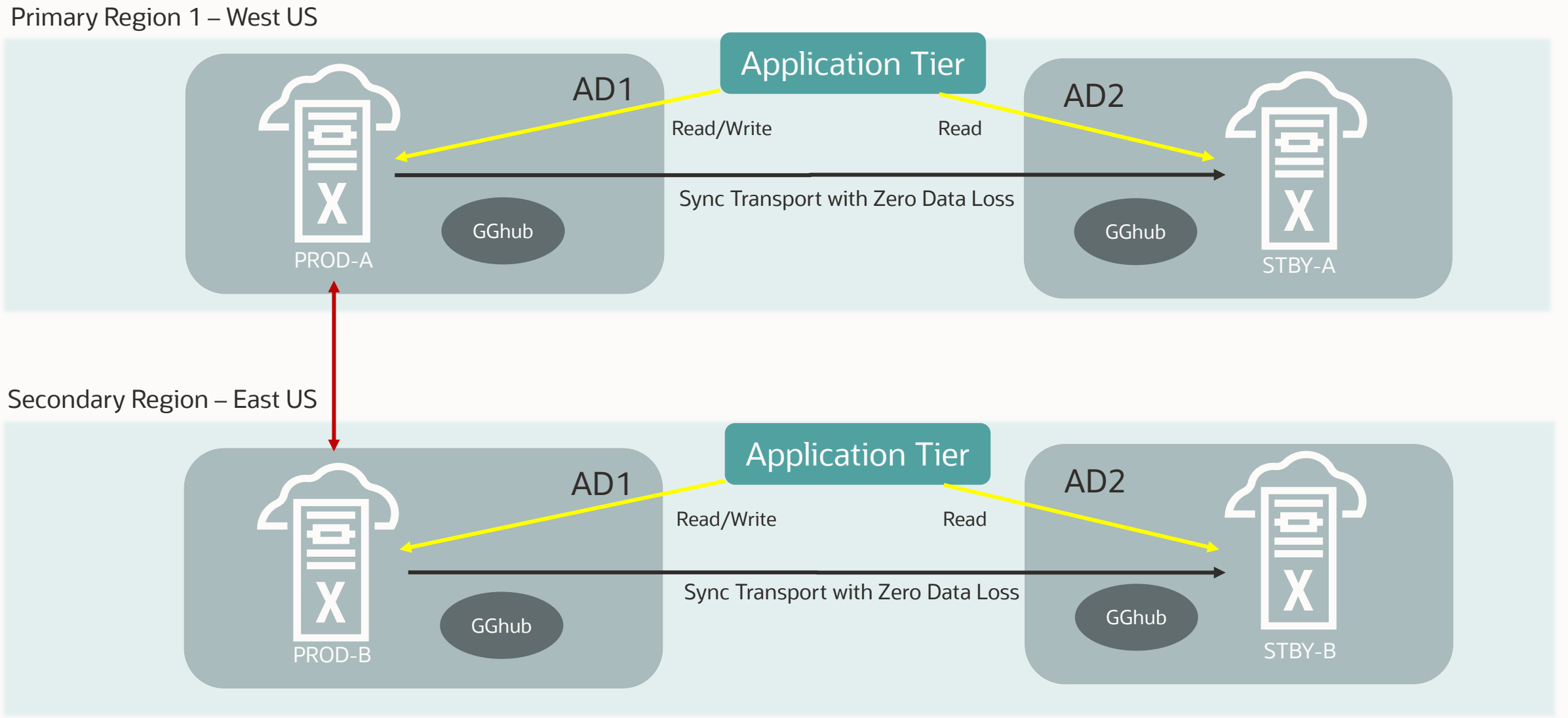
Requirements	Gold MAA	Platinum MAA
Supports large Enterprise RAC applications	✓	✓
RPO=0 for single or double AZ failures	✓	✓
RTO=near zero (single digit secs)	✗ (< 90 secs)	✓
Integrate into Multi-AZ architecture	✓	✓

Oracle Maximum Availability Architecture – Platinum MAA Tier

Sample configurations for unexpected outages

Platinum Reference Architecture – Option 1 (AD Failure - Zero RPO)

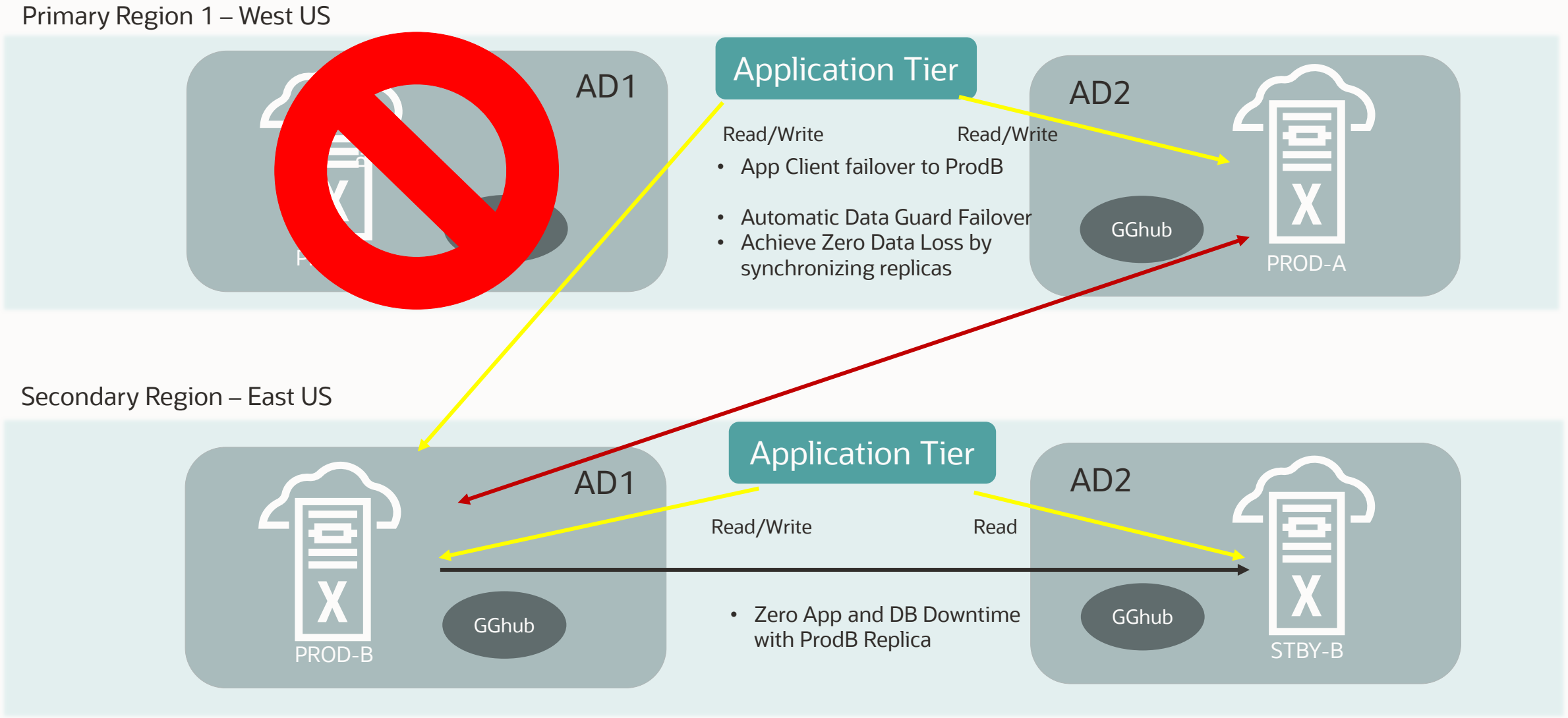
RPO=0 for AD failure, RTO=0 with App Failover to GG replica, GGhub to offload GG processing in each region



Active Data Guard Fast-Start Failover, **Oracle GoldenGate Replication**

Reference Architecture – Zero App Downtime and Zero Data Loss

(Disaster Scenario: Loss of Entire Availbility Domain or Data Center)

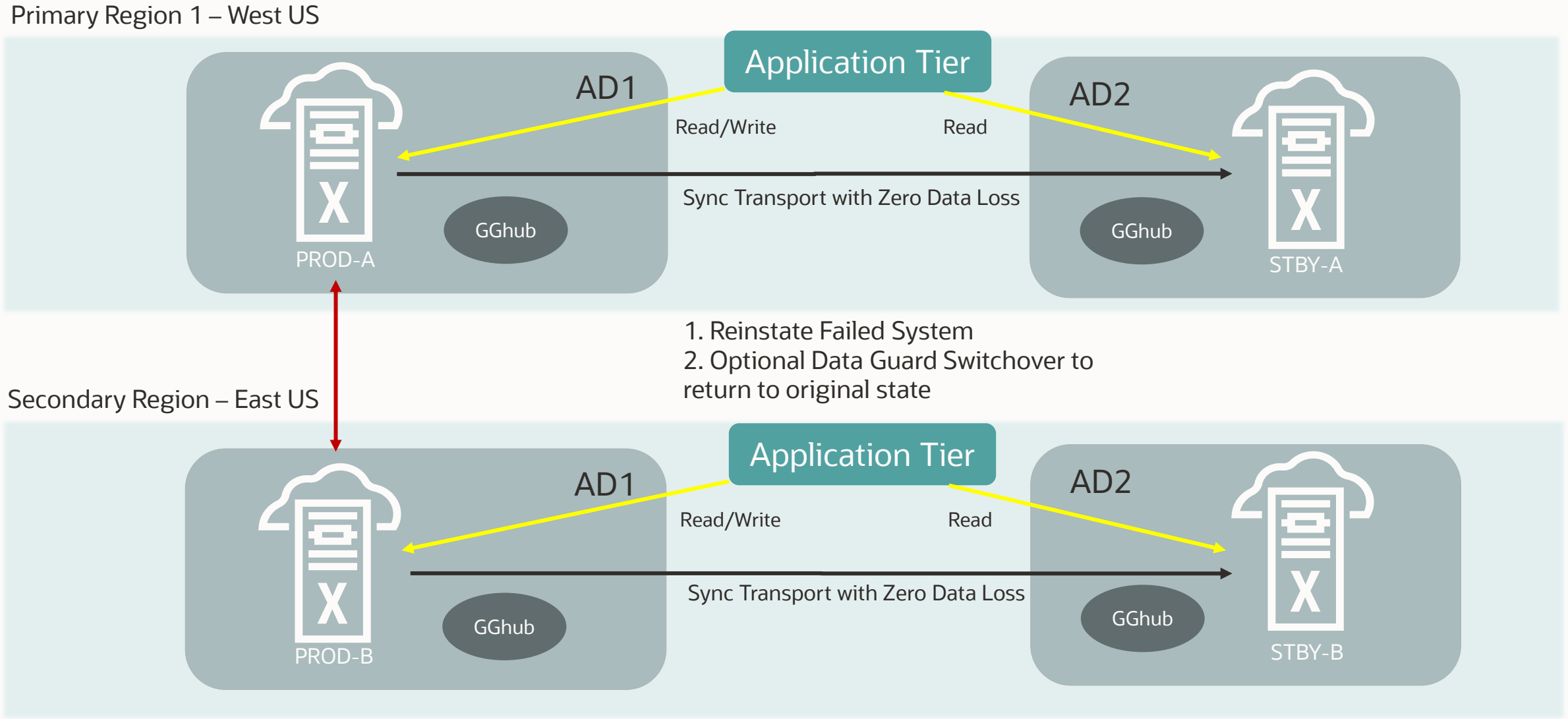


Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Reference Architecture – Reinstate & switching back

Prod-A returns to being primary and STBY-A once again becomes the standby

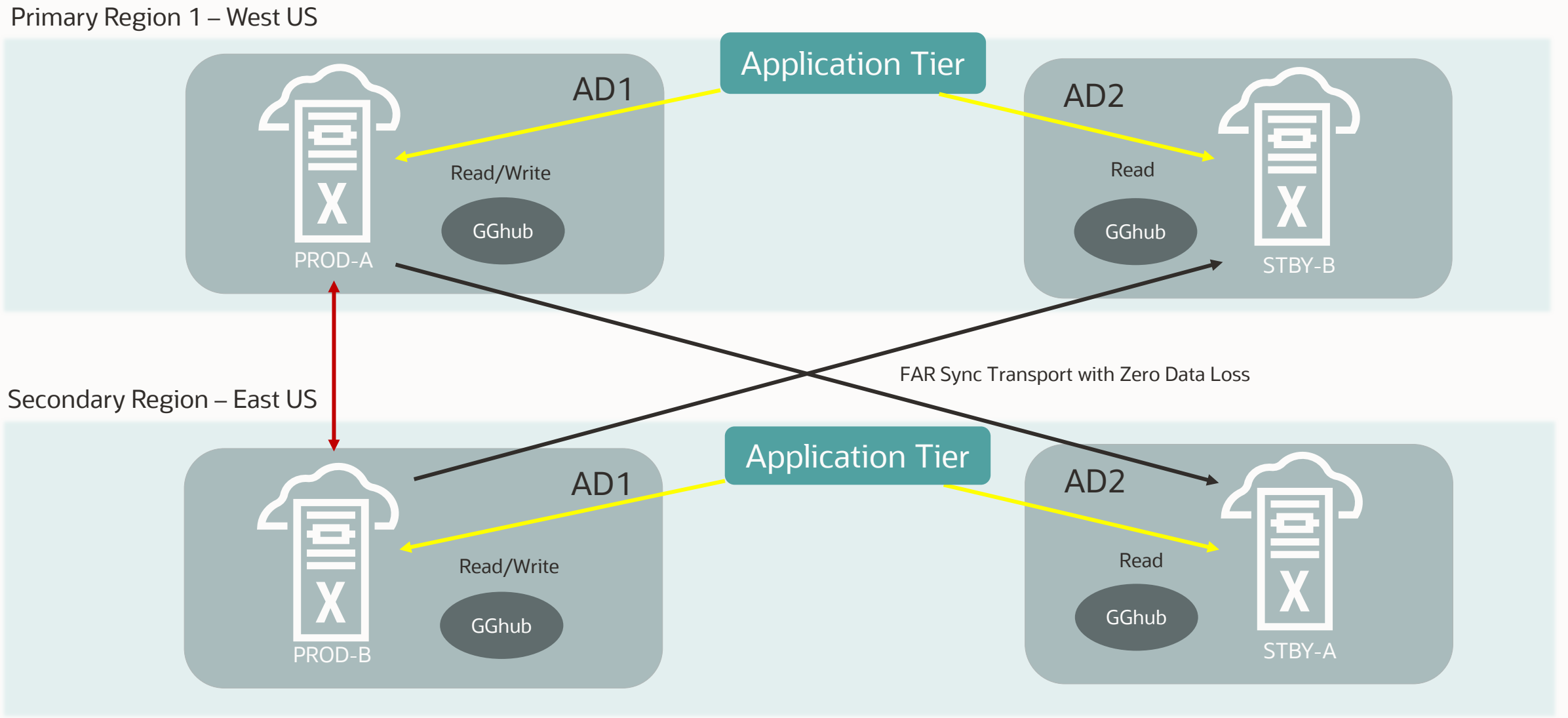


Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Platinum Reference Architecture – Option 2 (Regional Failure - Zero RPO)

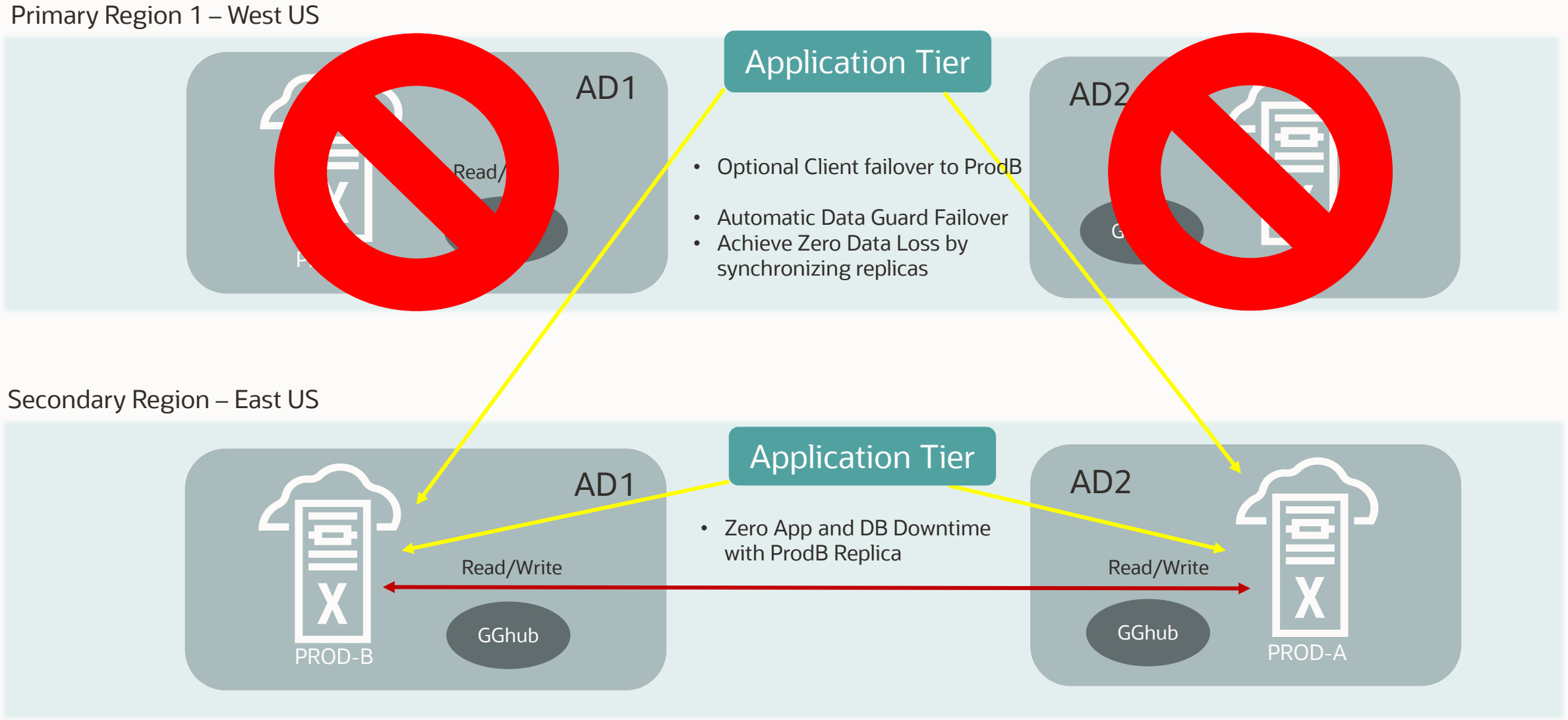
RPO=0 for AD or Regional failure, RTO=0 with App Failover to GG replica, GGhub to offload GG processing in each region



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Platinum Reference Architecture
(Disaster Scenario: Loss of Region or all Availability Domains in region)

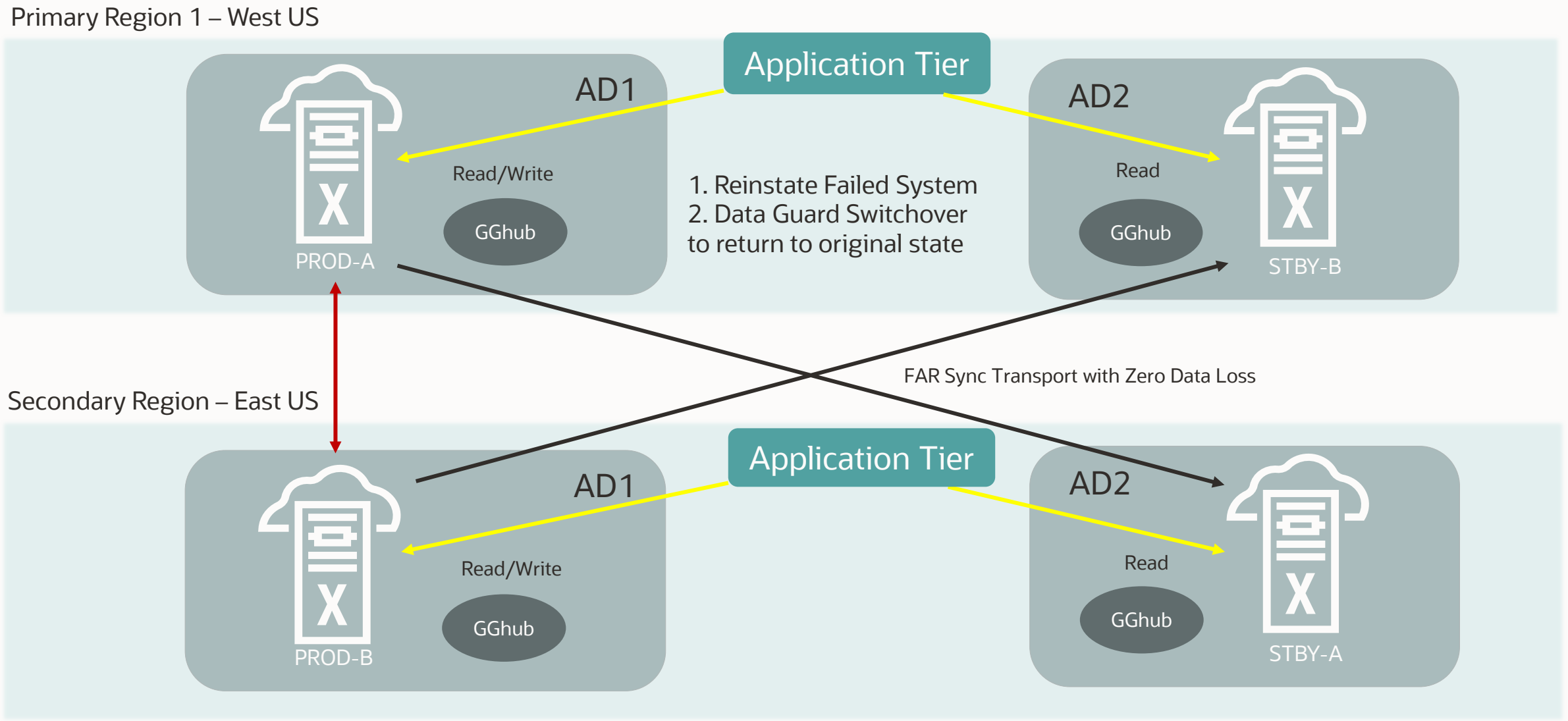


Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Reference Architecture – Reinstate & switching back

Prod-A returns to being primary and STBY-B once again becomes the standby for PROD-B



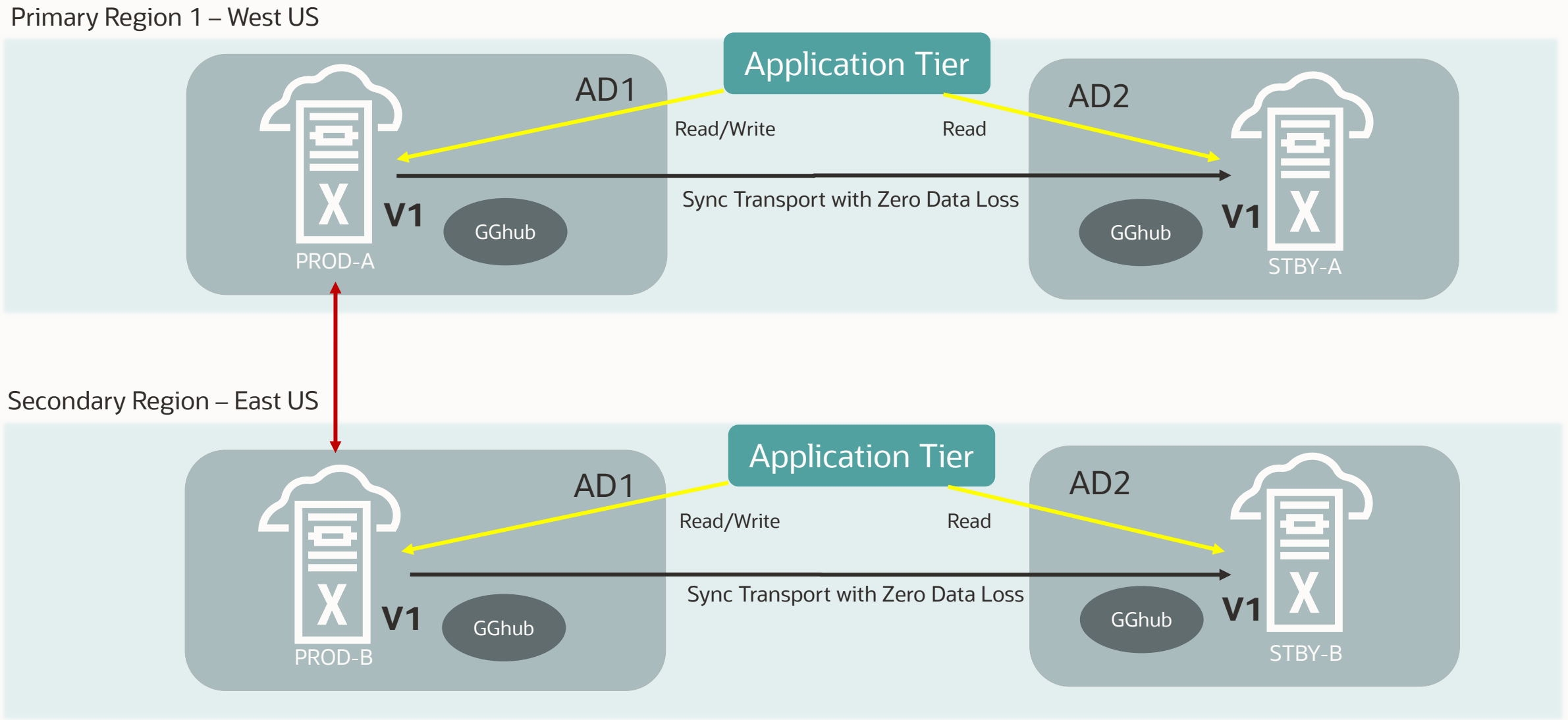
Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Oracle Maximum Availability Architecture – Platinum MAA Tier

Sample configurations for planned maintenance

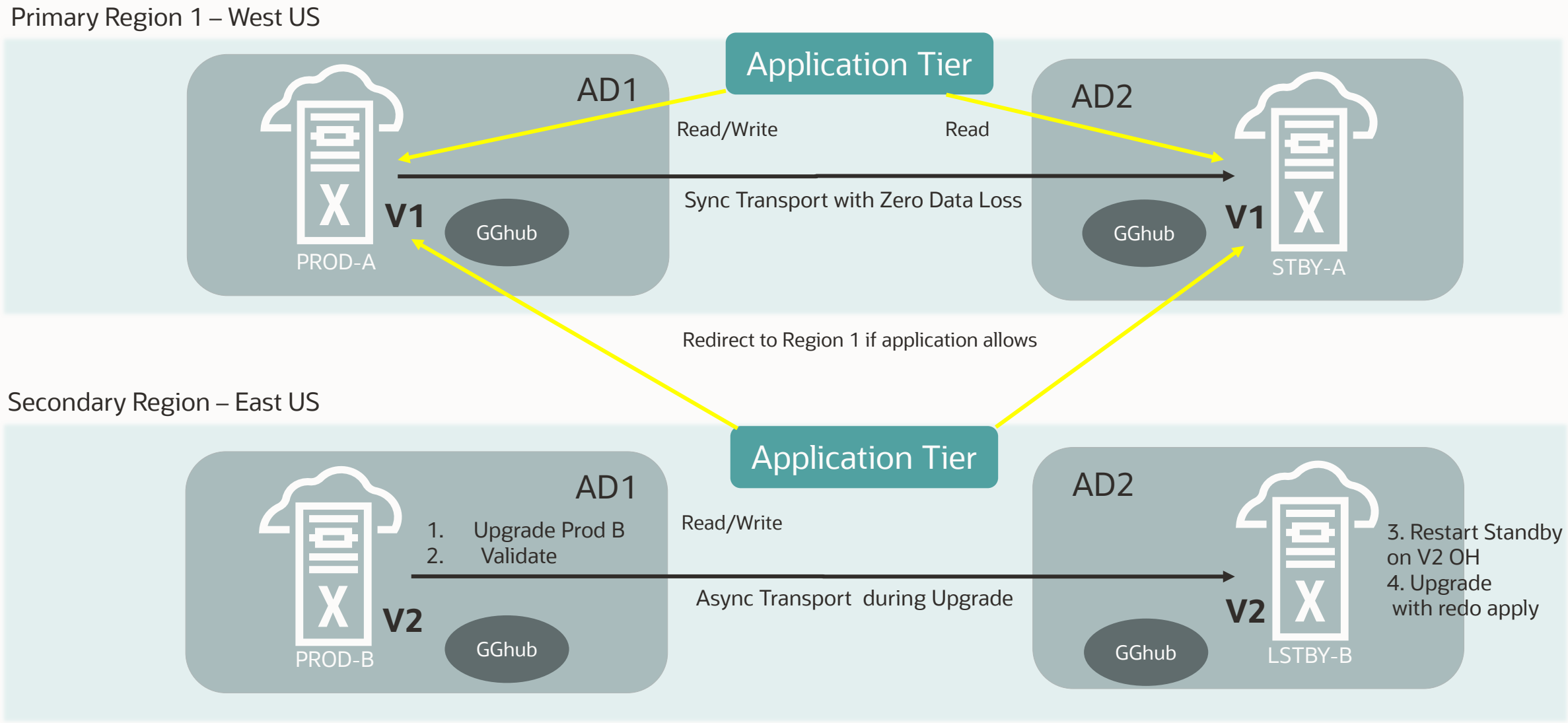
Reference Architecture – Upgrade Scenario (Option 1 configuration)



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

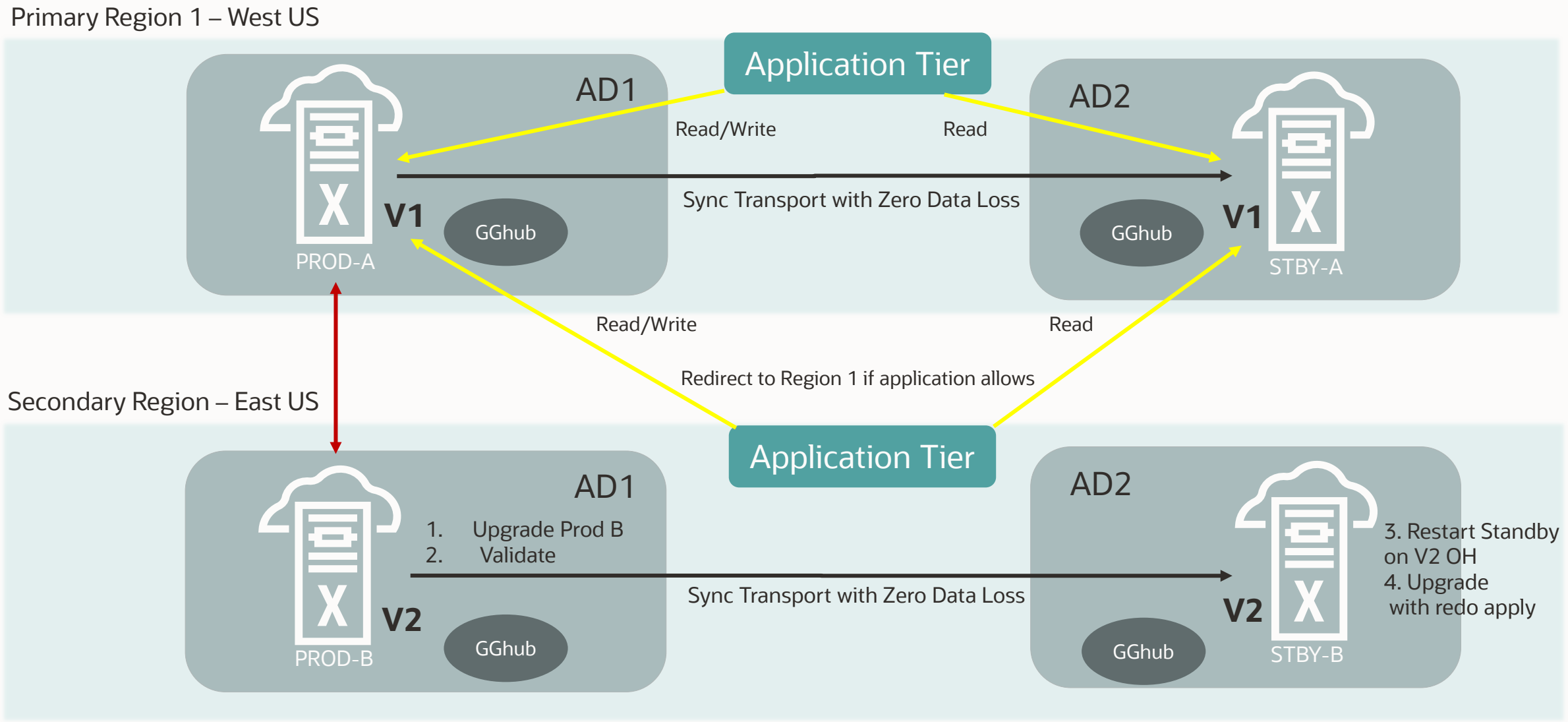
Rolling Upgrade starting with secondary region



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

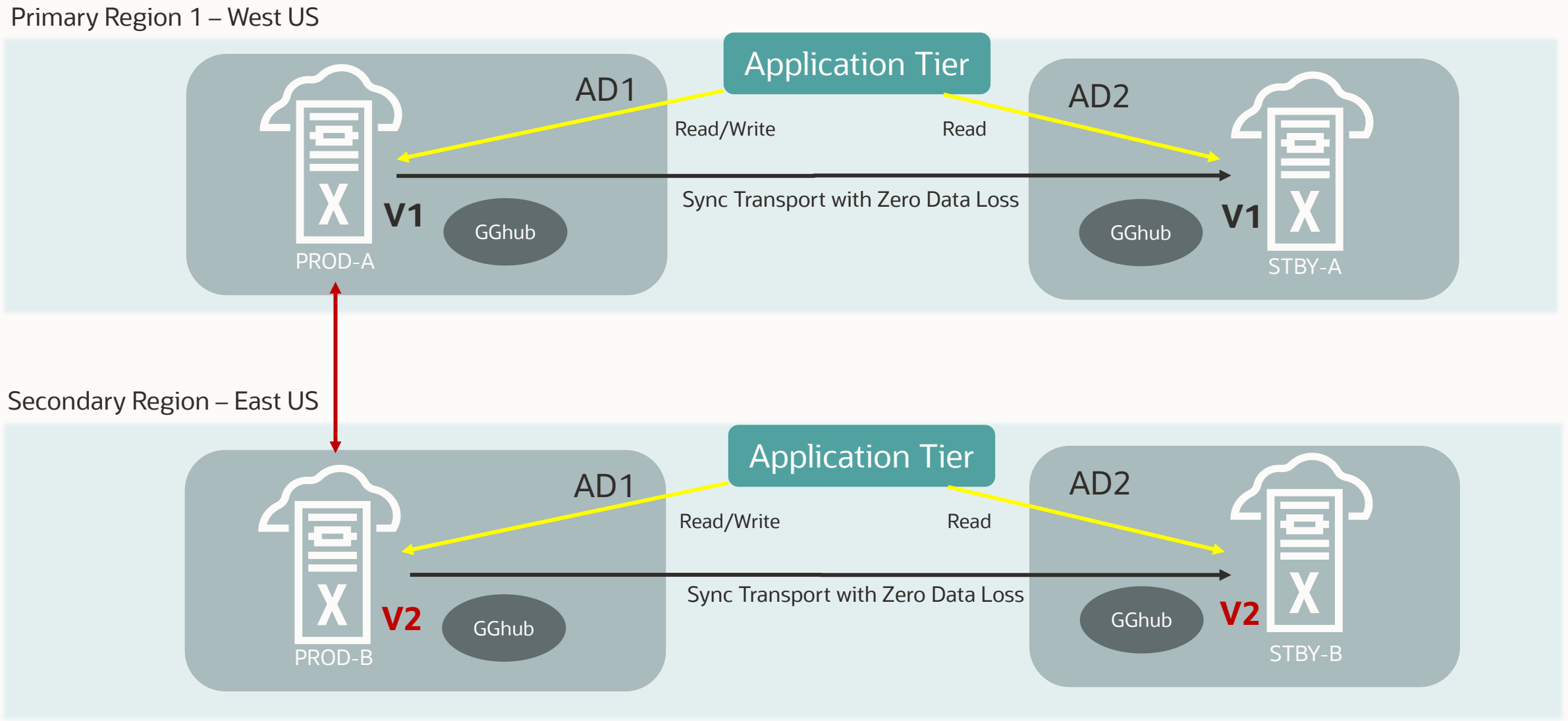
Rolling Upgrade starting with secondary region



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Reference Architecture – Upgrade Scenario (Option 1 configuration)



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Platinum Advantages for Upgrade

Final Decision Point

Benefits

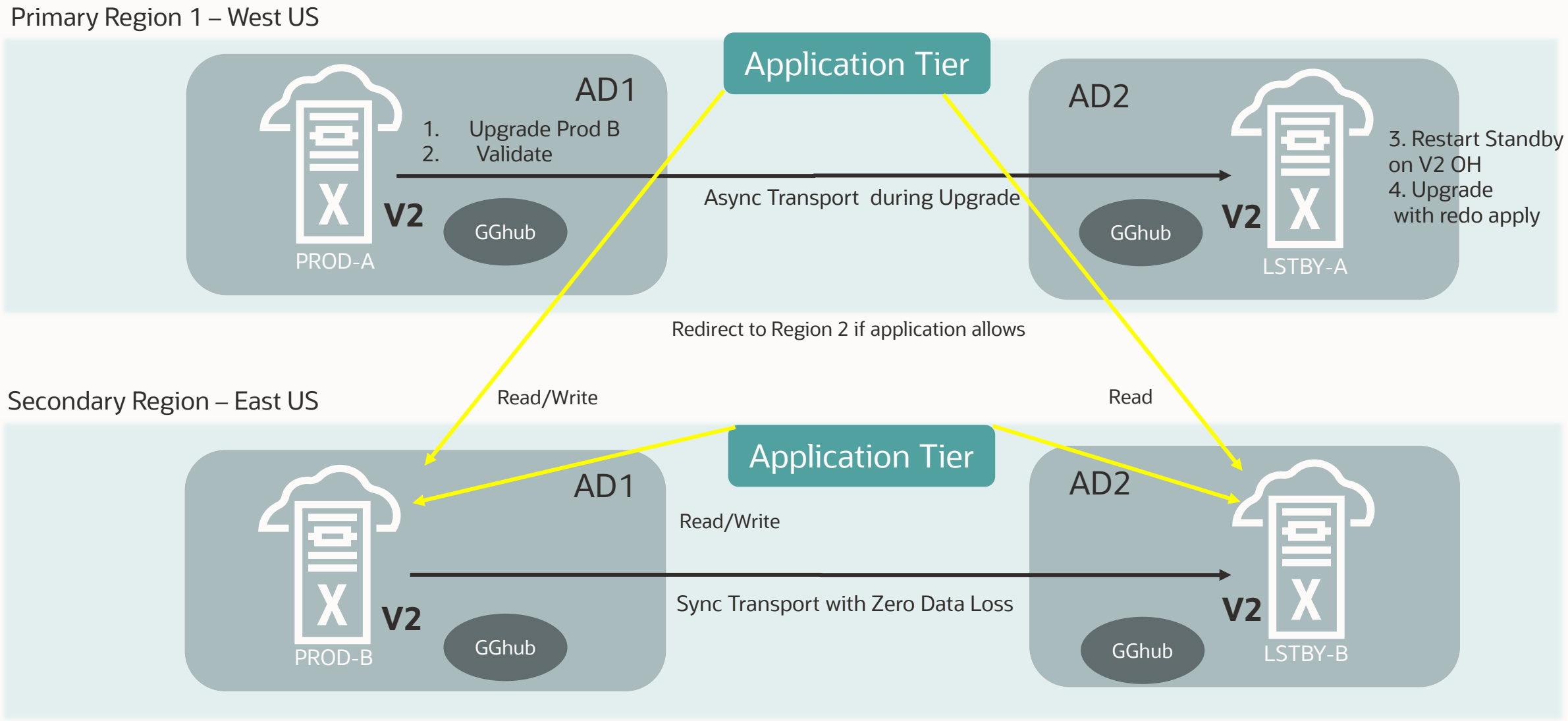
1. Zero Downtime and Zero Data Loss
2. Evaluate V1 and V2 at the same time
3. GoldenGate replication between V1 and V2 provides simple switchover and fallback

Once V2 has been validated and deemed acceptable, then:

- Repeat process and upgrade both V1 primary and standby at the same time

28

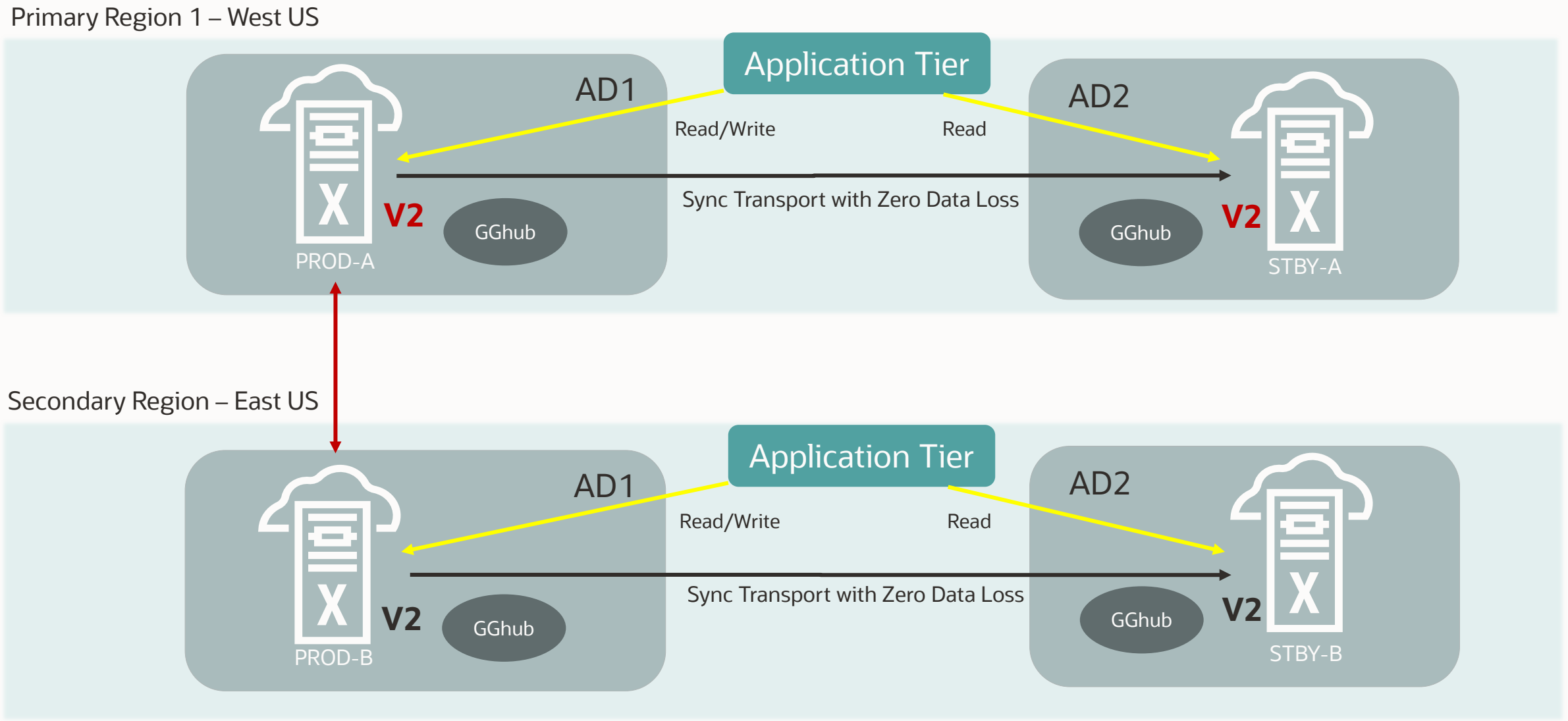
Rolling Upgrade for primary region after secondary region is complete



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Rolling Upgrade is complete (return to original configuration)



Active Data Guard Fast-Start Failover,

Oracle GoldenGate Replication

Unplanned Outages for Platinum MAA with Exadata

Unplanned Outages	Database Downtime (RTO)	Application Impact	Data Loss (RPO)	Key Enablers
Exadata Cluster Network Fabric or Storage Failures	Zero	Zero or Near Zero	Zero	Exadata ASM Disk Groups in High Redundancy
RAC Instance or Node Failures	Zero	Single Digit Seconds	Zero	Exadata and/or RAC Application Continuity with MAA Checklist
Data Corruptions	Zero	Zero or Isolated Failure	Zero or Isolated Logical Impact	Active Data Guard MOS 1302539.1 Flashback Technologies ZDLRA
Disasters including database, cluster or site failures	Zero since GG replica is available	Zero or Near Zero Single Digit Seconds with GDS	Zero	Oracle GoldenGate Data Guard Fast-Start Failover Custom App Failover or Global Data Services

31

Planned Maintenance for Platinum MAA with Exadata

Planned Maintenance	Database Downtime (RTO)	Application Impact	Key Enablers
Exadata Infrastructure SW or HW Updates	Zero	Zero or Near Zero	Exadata Platform ASM Disk Groups in High Redundancy
Database and Grid Infrastructure Software Updates	Zero	Zero	RAC Application Continuity Continuous Availability - Application Checklist for Continuous Service for MAA Solutions
Database Upgrades or non-Rolling Updates	Zero	Zero or Near Zero	GoldenGate Custom Application failover or Global Data Services

32

Oracle Maximum Availability Architecture – Platinum MAA Tier

Cloud Maximum Availability Architecture Guidelines

Cloud MAA configuration

	RMAN			RAC	DATA GUARD				GG
	Auto Backup	Backup Replicas	Standby Backup	App Services	Auto DG Config	Auto Failover	Cross Region	Auto Patching	Setup for Platinum
ExaDB (ExaCS)	✓	✓	✓	✓	✓	✓	✓	✓ ✓	✓
ExaDB-CC (ExaCC)	✓	✓	✓	✓	✓	✓	✓	✓ ✓	✓
BaseDB RAC	✓	✓	✓	✓	✓	✓	✓	✓ ✓	✓
ADB-Shared	✓	✗	✗	✓	✓	✓	✓	✓	✓
ADB-Dedicated	✓	✓	✓	✓	✓	✓	✓	✓	✓

*

✓ Out of the box

✓ Automated via control plane

✓ Manual setup

✗ Not yet available

Oracle Maximum Availability Architecture – Platinum MAA Tier

Summary & Resources

Summary: MAA Platinum Benefits and Trade Offs

Benefits

- Platinum MAA deployed with many Oracle Enterprise Customers
- RTO near-zero, RPO=zero
- Supports large RAC configurations and large existing workloads
- Work with existing applications with zero or minimum application changes

Considerations

- Gold MAA (RTO 1 min, RPO=0 or near-zero depending on Active Data Guard protection mode) is simpler with zero application changes and lower cost
- Automatic confliction detection and resolution required
- Bi-directional replication using two read-write primaries is an option

Platinum MAA – Cloud Resources

On-premises:

- Platinum MAA: Oracle GoldenGate Microservices Architecture Integrated with Oracle Active Data Guard **- NEW**
- Oracle GoldenGate Classic Architecture With Oracle Real Application Clusters Configuration **– UPDATED**

Cloud:

- Platinum MAA: Oracle GoldenGate Microservices Architecture on Oracle Exadata Database Service Integrated with Oracle Active Data Guard
- Oracle GoldenGate Microservices Architecture on Oracle Exadata Database Service Configuration Best Practices

Applicable to both:

- Oracle MAA Reference Architectures
- Oracle MAA Platinum Tier for Oracle Exadata
- Application check list for continuous availability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