Salesforce
Using Edition-Based Redefinition

for Near-Zero-Downtime Releases

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Agenda

- Salesforce.com Overview
  - Enterprise Cloud Challenges at Massive Scale
- Implementing Edition-Based Redefinition (EBR)
- EBR Phased Rollout
- Planned Maintenance Benefits

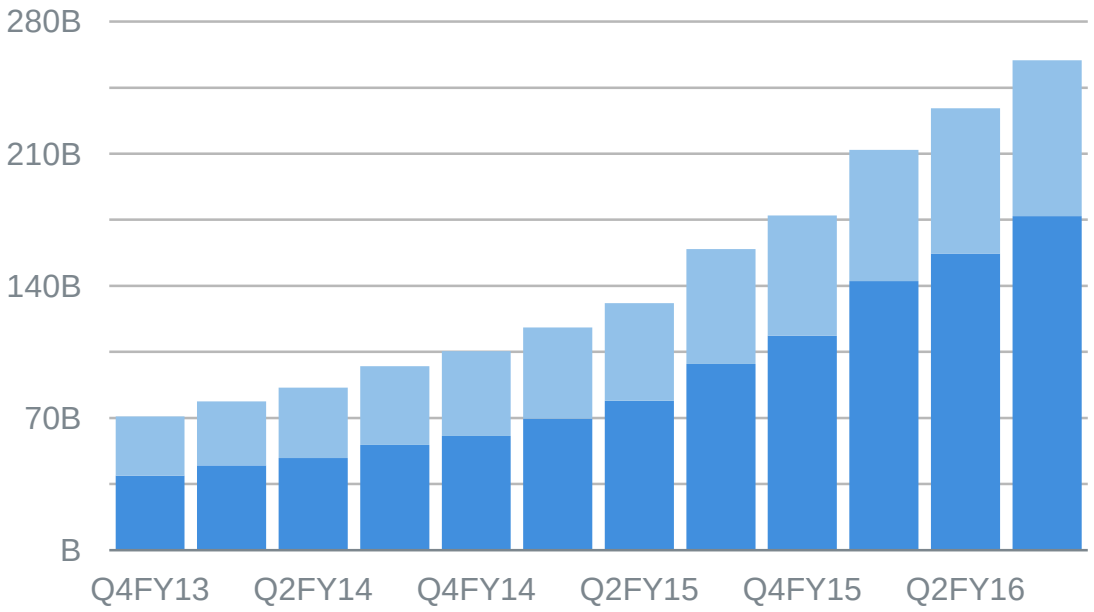
Salesforce Overview

Delivering Enterprise Cloud Transactions at Scale

Further Improving Response Times

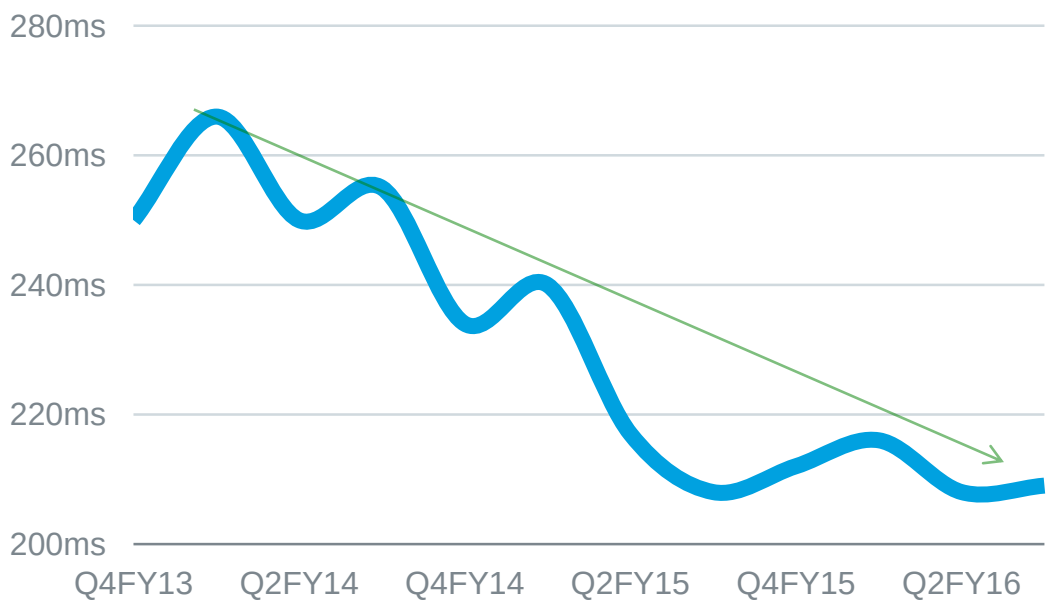
Transactions Per Quarter

259B Transactions in Q3FY16
63% YoY Growth (Q3FY15-Q3FY16)



Average Page Time

209ms Latency in Q3FY16
Flat (Reduction) YoY



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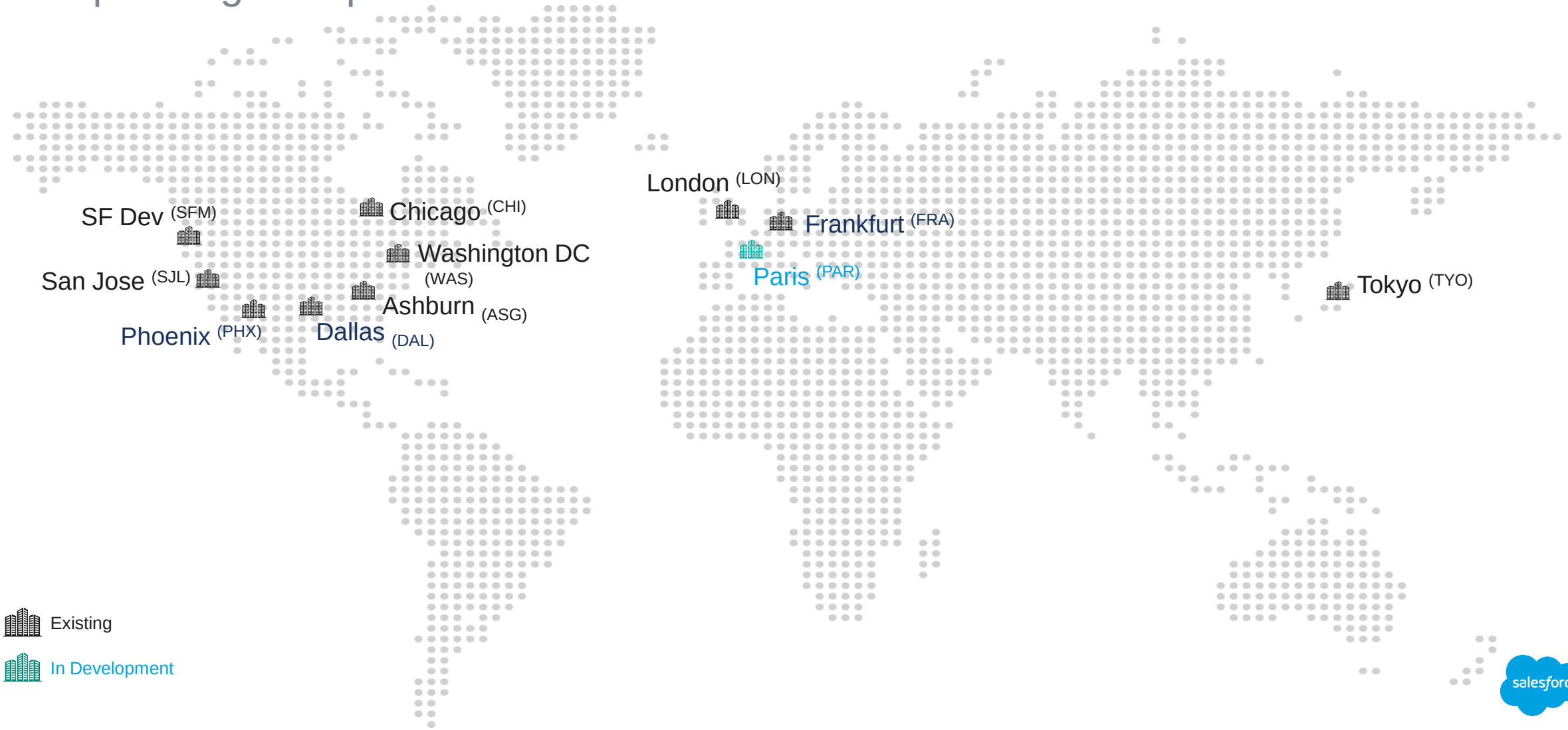
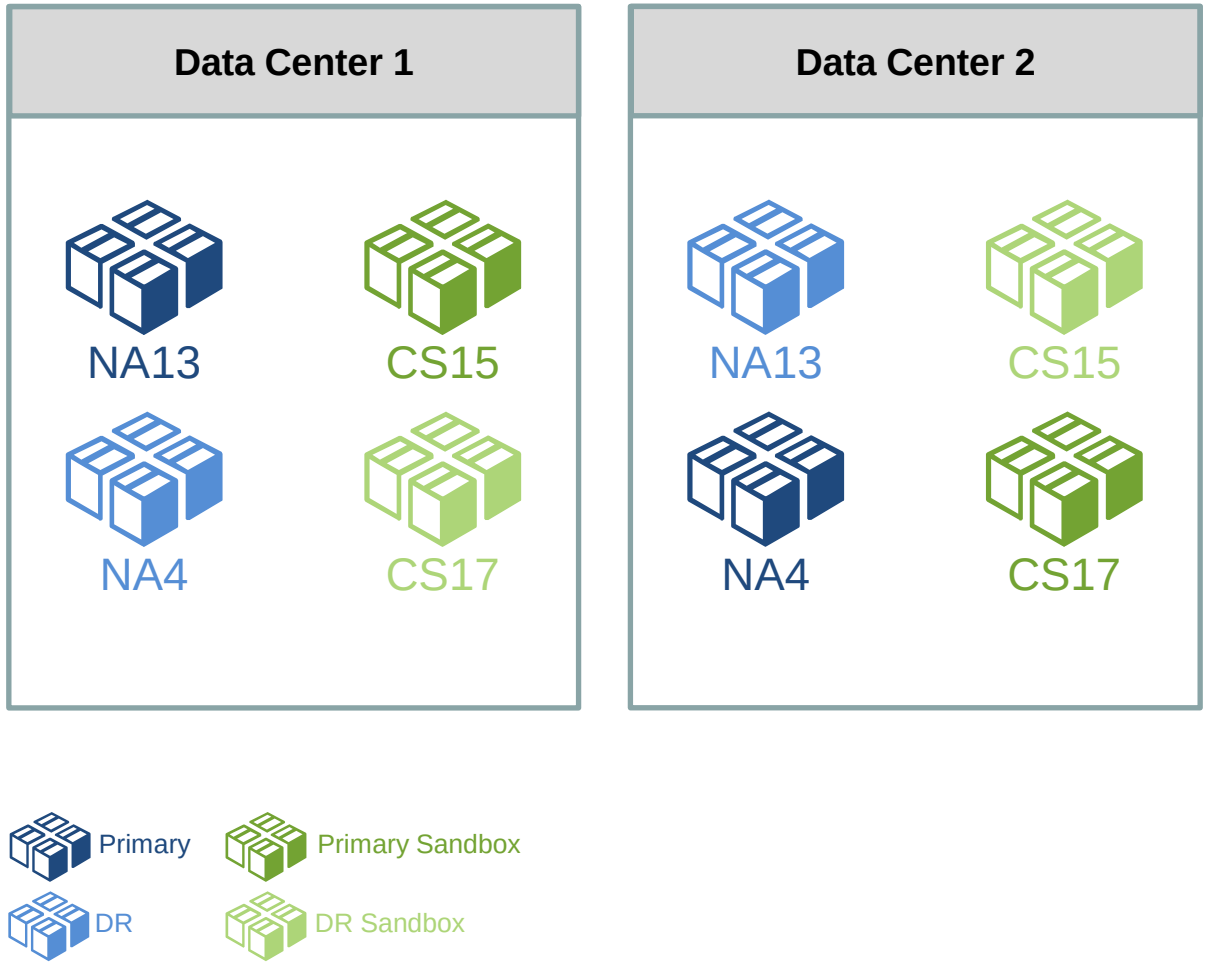
Global Enterprise Cloud Data Centers

Expanding Multiple Sites Worldwide



Designed for Enterprise Scalability and Reliability

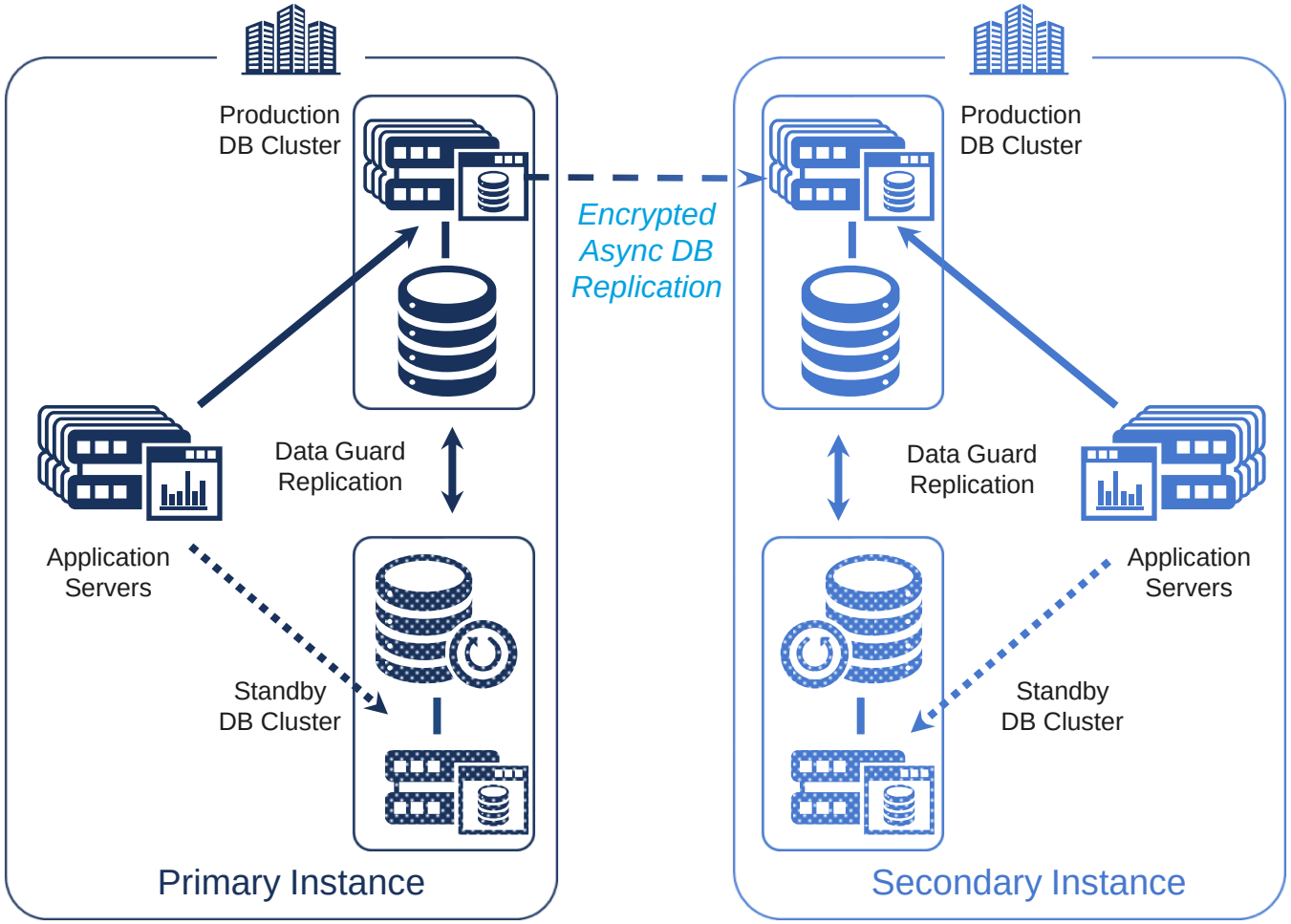
Disaster Recovery is Key Design Requirement



- We scale horizontally through multiple production Salesforce instances
  - 47 Core
  - 47 Sandbox (used for Customer UAT)
- **Every** core production (NA, EU, AP) instance has an exact replica (mirror) in a second data center
- **Every** sandbox (CS) instance also has an exact replica in a second data center

Tremendous Focus on Core DB Reliability

While also ensuring high performance



Very large average DB sizes

- Core DB: **35+TB**
- Sandbox DB: **50+TB**

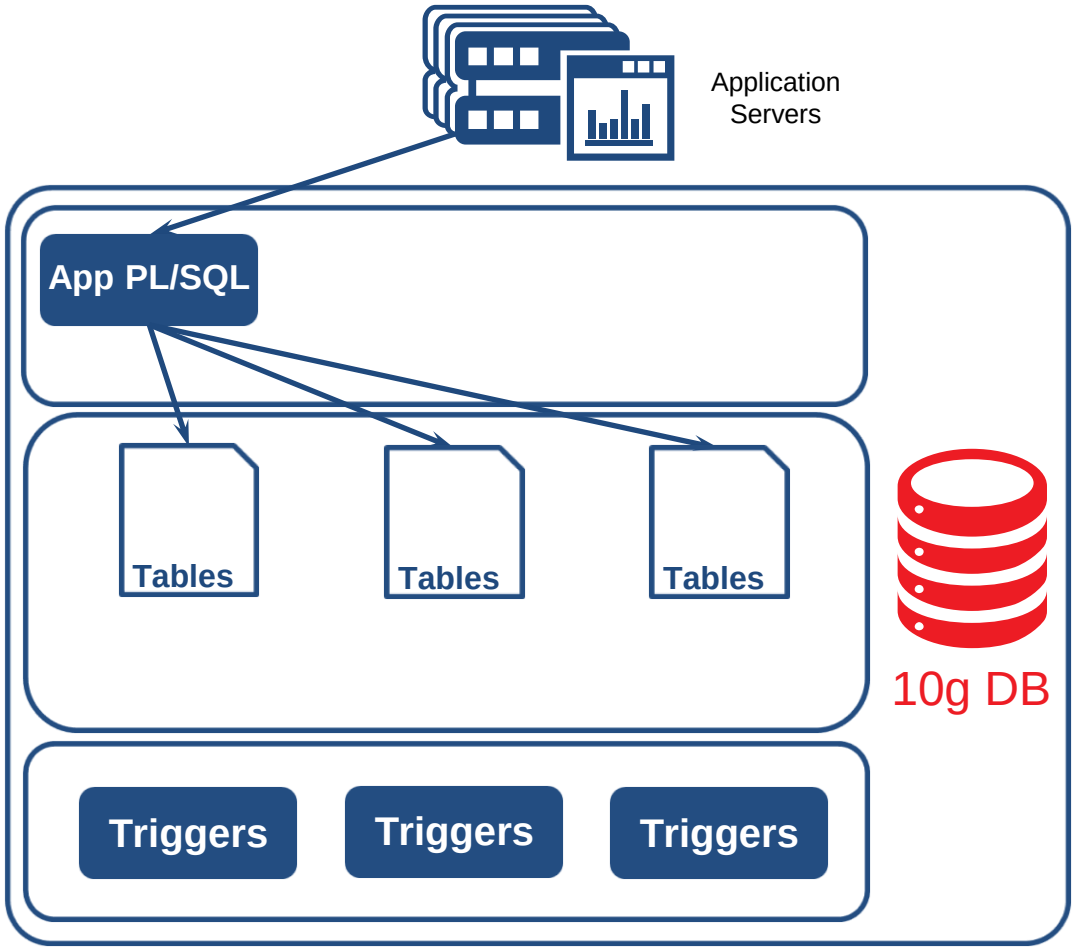
Scale vertically through RAC Clusters

Heavy use of Data Guard

Overview of Oracle DB at Salesforce.com

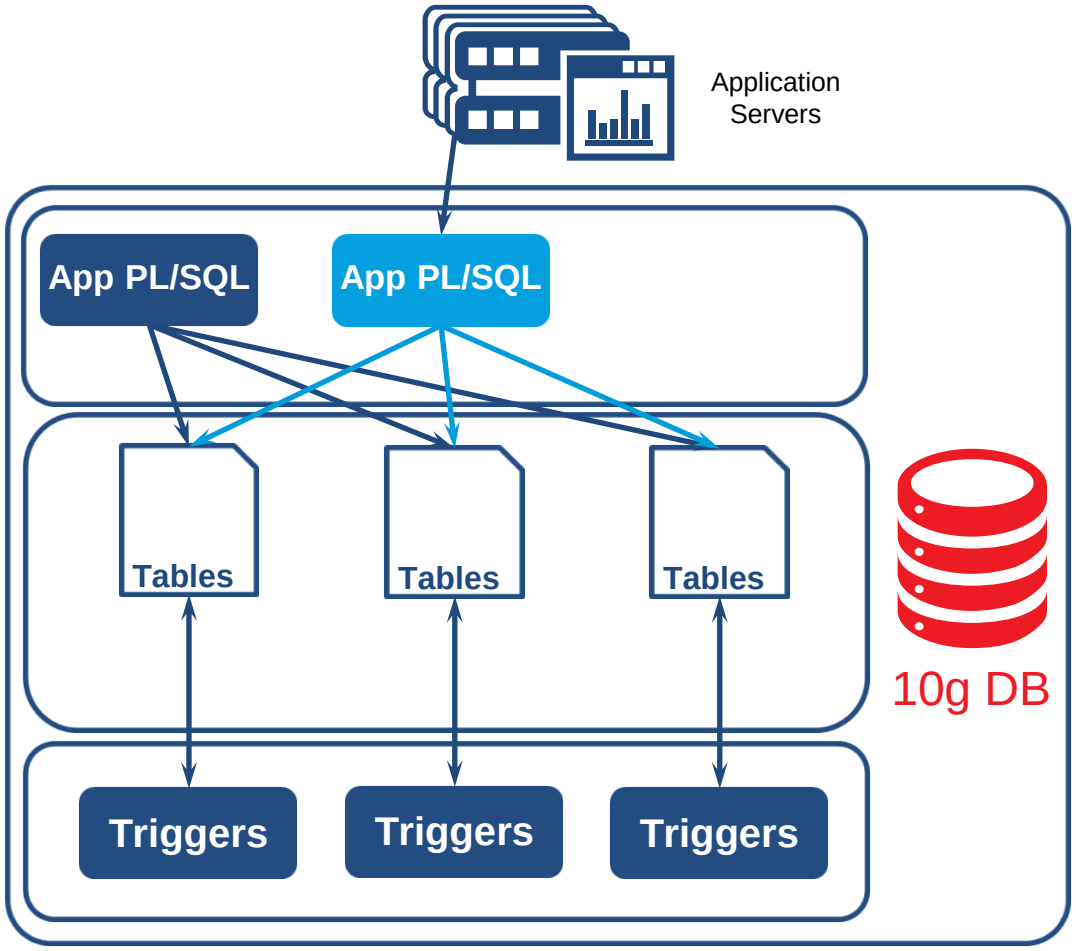
- We have classes of schemas for PL/SQL and tables, tables and PL/SQL do not co-exist inside schemas
- Metadata enables customisation of each customer's view of the service
  - Implications: requires large shared pools
- Use of multitenancy inside our tables
  - Implemented our own version of "multi-tenancy"
  - Each DB contains one version of each app table
  - Each row has a unique customer id
  - Careful security measures are in place to ensure customers see only their data
  - More details see https://developer.salesforce.com/page/Multi_Tenant_Architecture

Salesforce Application Upgrades Before 2010



- Major releases used to take 6 hours per release
  - Minimal use of “upgrade time” triggers
  - Large “batch” DML operations inside the planned maintenance window
- We knew we could do better
- Redesigned the upgrade process and moved to a technique of triggers that are aware of the major release version and upgrade only DB triggers

Salesforce Application Upgrades in 2010



- Major releases require many DDL operations to introduce new tables, columns, index changes
- Deliver 3 major releases and many minor update releases per year
- Minimal downtime for major releases
  - 30 minute “upgrade pre-release scripts”
  - With <5 minute restart
- No downtime for minor update releases

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Application Upgrades at Salesforce

- Each new major release has it's own "release specific" trigger code
- Implemented through the use of package variables
- Each app server connection establishes context and sets the "release version"

```
CREATE OR REPLACE TRIGGER app_trigger.t_v24_accounts
AFTER UPDATE
ON app_data.accounts
BEGIN
    IF app_plsql.global_context.getAppVersion = app_plsql.release.release_version.RELEASE_24 THEN
        ….;
    END IF;
END t_v24_accounts;
/
```

Application Upgrades at Salesforce

- This technique reduced planned maintenance from 6 hours to 30 minutes per major release
- Why 30 minutes?
  - Quiesce the database and the app servers
  - Run DDL and recompile PL/SQL
  - Restart app servers
- Could continue to iterate and improve our custom code to reduce this further
- Essentially attempting to do something very similar to EBR
- EBR will provide us with what we implemented but out of the box

Implementing EBR

Wait Didn’t We Invent That Already?

What is Edition-Based Redefinition

Oracle Definition* of EBR:

“Edition-based redefinition enables you to upgrade the database component of an application while it is in use, thereby minimizing or eliminating down time.”

* http://docs.oracle.com/cd/E11882_01/appdev.112/e10471/adfns_editions.htm#ADFNS020

Application Upgrades at Salesforce

- We “editions enabled” our schemas containing tables and PL/SQL
- We created editioning views against all tables
- We can load new versions on our PL/SQL code inside new editions
- We can perform DDL on tables without invalidating PL/SQL

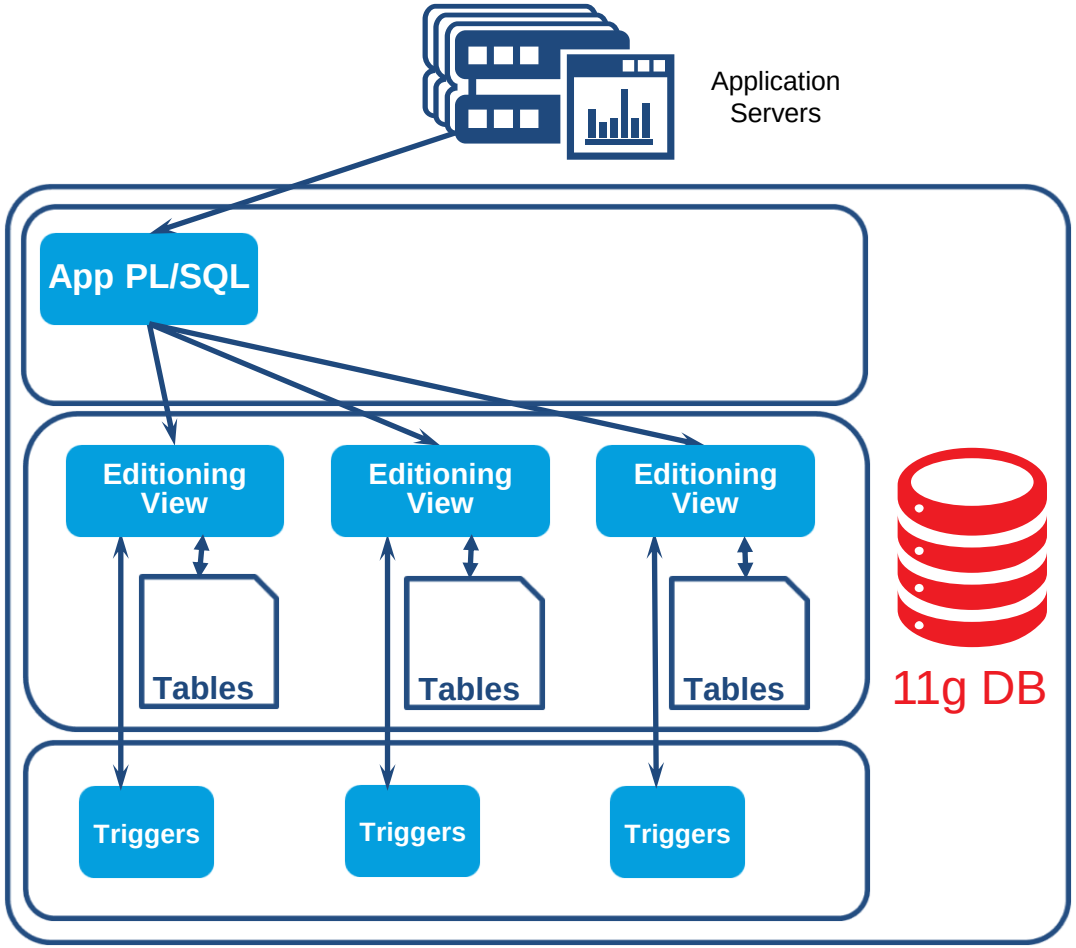
Salesforce Implementation of EBR

Following Oracle Recommended Best Practices

- How are we implementing EBR
  - All schemas containing data are editions enabled
  - All application PL/SQL schemas are editions enabled
  - All application schemas refer to editioning views inside our schemas containing data
  - No application schemas have any grants on any tables

Salesforce Implementation of EBR

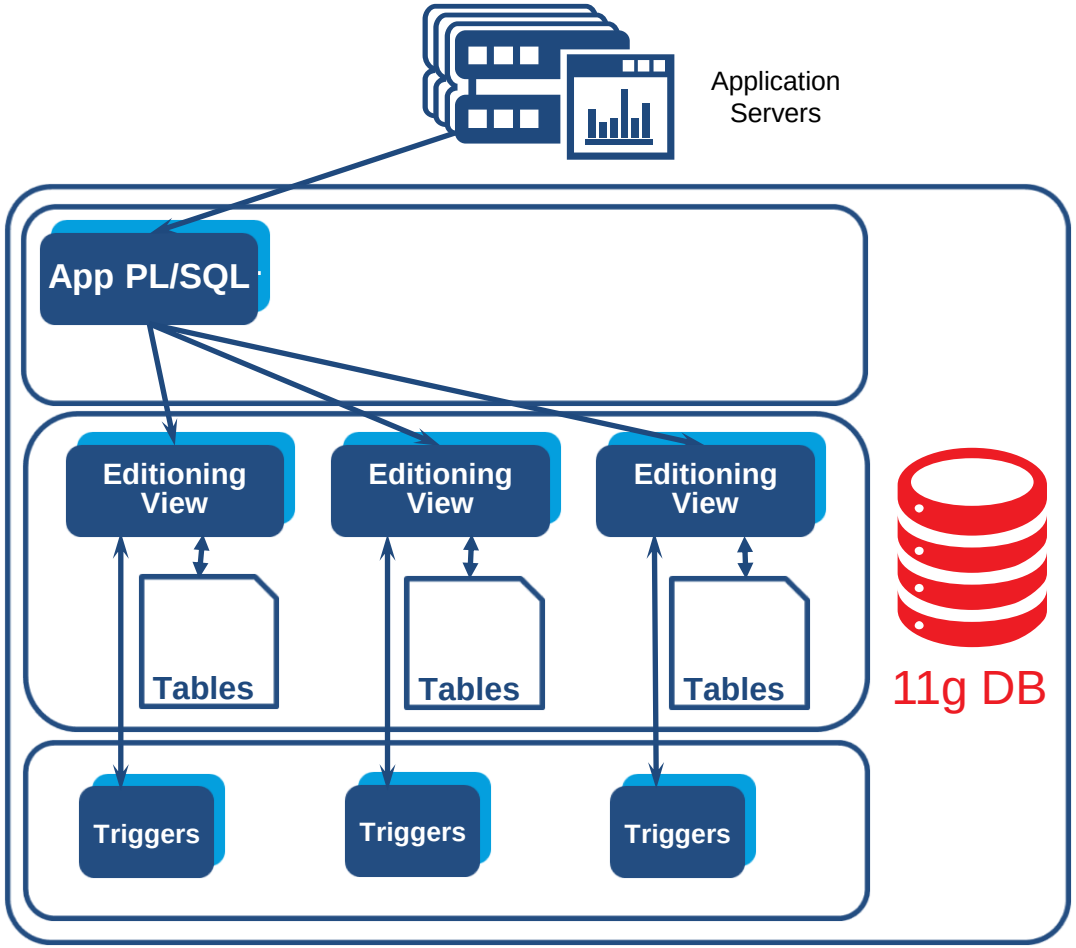
EBR Running Current Edition



- All schemas are editioned
- All Application PL/SQL code no longer refers to tables directly
- All tables have a corresponding editioning view

Salesforce Implementation of EBR

EBR Running New Edition



- A new release is made by creating a new edition
- Upgrade time triggers can be implemented as cross edition triggers
- When moving to a new release we change the running edition

EBR Phased Rollout

Rolling out EBR at Salesforce

Taking a Phased Approach

- We are conservative when rolling out significant changes
- Initial rollout to two production environments (GUS and 1 Sandbox)
- Remaining instances upgraded in subsequent release

Rolling out EBR at Salesforce

Taking a Phased Approach

Maintenance Calendar ?

Monthly All | Calendar List

Instance(s)	Name	Start (UTC)	End (UTC)	Message
NA0, NA6, NA21, NA29	Database Maintenance	Jan 17 2016, 05:00	Jan 17 2016, 05:45	This instance will not be available during this maintenance window.
NA0, NA3, NA16, NA21, NA32	Spring '16 Major Release	Feb 13 2016, 04:00	Feb 13 2016, 04:05	This instance will not be available during this maintenance window.
NA0, NA3, NA16, NA21, NA32	Summer '16 Major Release	Jun 11 2016, 03:00	Jun 11 2016, 03:05	This instance will not be available during this maintenance window.
NA0, NA3, NA16, NA21, NA32	Winter '17 Major Release	Oct 15 2016, 03:00	Oct 15 2016, 03:05	This instance will not be available during this maintenance window.

Dates and times subject to change. **Safe harbor.**

EBR will be implemented in the 30 minute planned maintenance window of a major release

EBR is implemented with no new maintenance for our customers

EBR is implemented to minimize application changes

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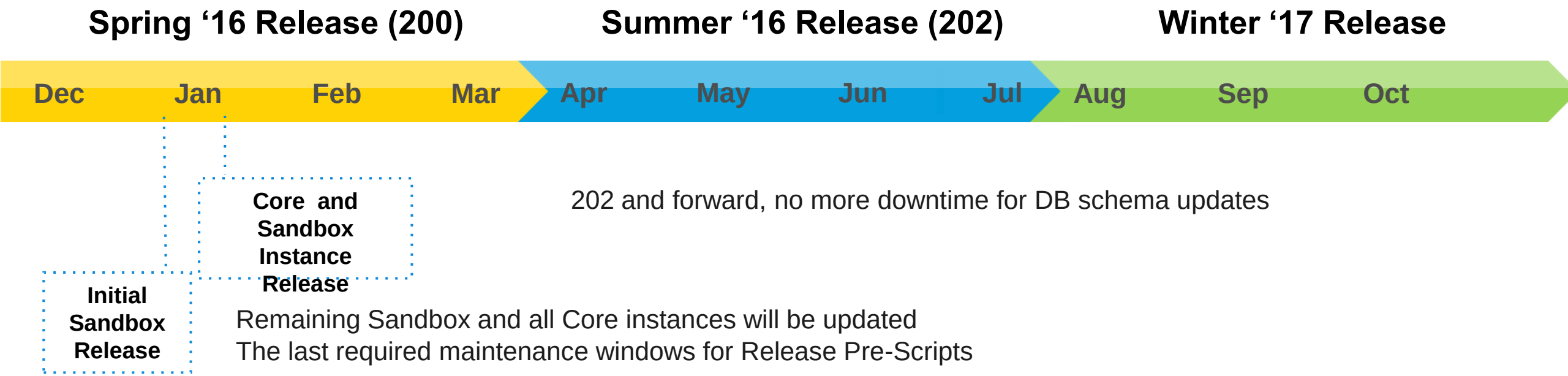
Phased EBR Releases

Ensures High-Quality Deployments



The Rollout of EBR at Salesforce

- Steps to implement EBR
  - Editions enable all schemas containing data and application PL/SQL
  - Revoke all access to base tables
  - Rename all base tables
  - Drop all triggers on base tables
  - Build editioning views on base tables using the original name
  - Grant access on all editioning views to PL/SQL schemas
  - Recreate all triggers (against editioning views)
  - Recompile all PL/SQL
  - Almost all of this generated through data dictionary queries

Impact of Phased Rollout of EBR

A Staggered Rollout Will Have Implications

- For a release we effectively doubled our requirements for automated testing and performance testing
- Must ensure the correctness of both the EBR and the non-EBR version of the service
- Easier to test against an unchanging DB (offline), trigger-based version also increased the testing requirements
- This is more work for developers working on upgrade code
- The elapsed time of the planned maintenance will be completely predictable

Planned DB Maintenance Benefits

Benefits of EBR at Salesforce

- Reduces planned maintenance for major releases
  - The 11gR2 fine grained dependency model means no PL/SQL/editioning view invalidations
  - More non-blocking DDL inside 11gR2 such as ALTER TABLE ADD COLUMN
- When we reduced the downtime from 6 hours to 30 minutes it increased the number of triggers required
- We now have two versions of triggers on the table
  - One for release N and another for release N+1
- With EBR we place these triggers in separate editions
- There will be a performance improvement with the reduction of triggers

thank you