Schema Upgrades In A Continuous Delivery Environment

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Reactive Credentials

Timeline	July 2015	July 2016
Architecture	JEE - 1 Tomcat app	15 Microservices, 5 in API
Frameworks	JPA, Spring Integration	Scala, Play, Akka Streams
Messaging	RabbitMQ	Kafka
Processing	Queued Batches	Reactive Streams
Datastores	MySQL, Cassandra	MongoDB, Cassandra
DevOps	GCP - VMs - SSH deploy	AWS VPC - 100% Docker
Stress/Load	1000s Meas / Sec	1 Million Meas / Sec
People	6+ JEE Developers	2.5 Scala Developers

Updating legacy monoliths

- Long development and release cycles
- Complex testing, if any testing for older products
- Use a down page to block requests and warn consumers
- Take the database offline, back it up, upgrade it, ...
- Install new application code
- Start everything back up and start praying for no rollback
- Its like throwing mash potatoes on the wall and hoping it sticks.

What wrong with this approach

- Too many things changing all at once.
- Modifying code and data stores at the same time
- Stored procedures - wrong place for business logic
- Incur higher-risks due to increased chances of rollbacks
- “Cost of management confidence” from rollbacks
- You are our own self-inflicted Chaos Monkey

A Trilogy of Topics to Guide us

1. Continuous delivery for fast and reliable changes
2. Guidelines for deploying changes
3. Special Note about Relational Databases
4. Rules for validating each step
5. Don't Panic because you brought your towel

1. Continuous delivery for fast and reliable changes

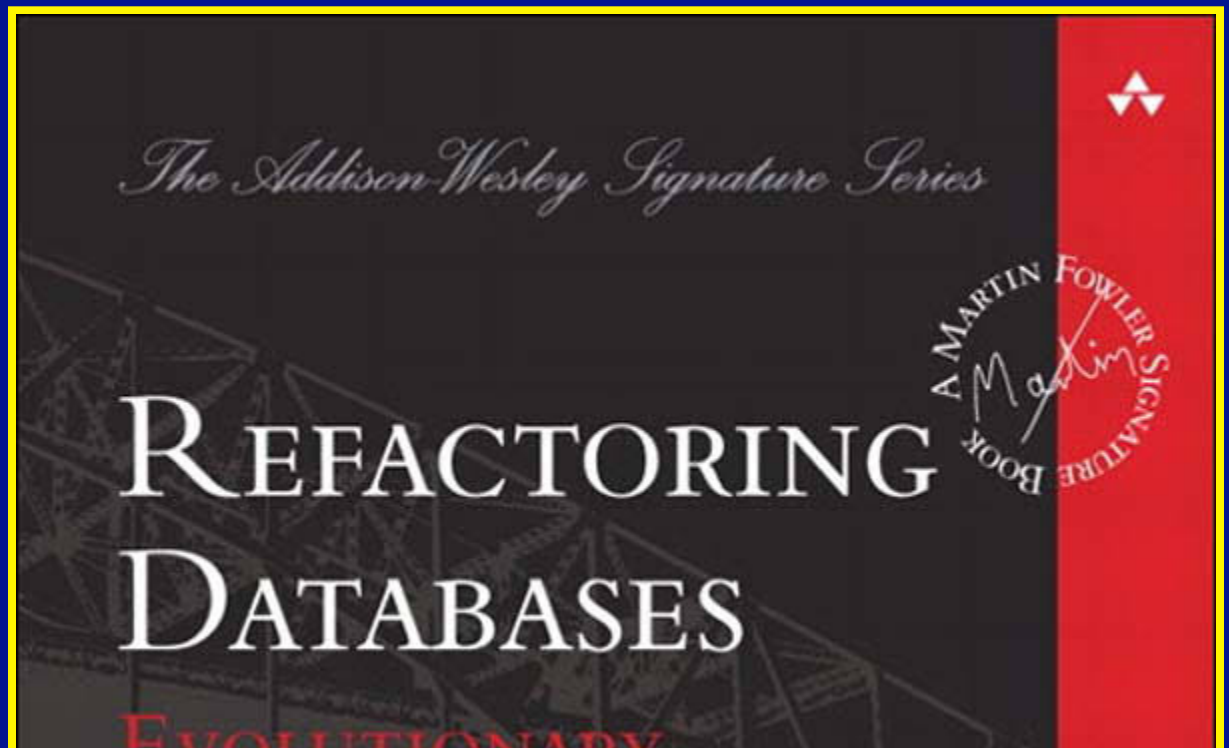
- Deploy iterations are in hours and NOT weeks, months or years
- Automated builds and testing to validate non breaking changes
- Fast deploys force updates to be small, and thus a smaller risk
- Version Control
  - Applications "as Code"
  - Infrastructure "as Code"
  - Schema Changes "as Code"
- Version Control - EVERYTHING!

2. Guidelines for deploying changes

- Only deploy 1 small change at a time
- Execute this as a sequence of small steps- Saga Pattern
- Only change application code or a datastore, not both
- DRY Violations - ORM frameworks and DDL
- Relational - stored procedures violate #3
- Datastores - always update asynchronously
- Work very hard to not be our own Chaos Monkey
- Two approaches for delivering changes
  - Run inside the micro service app itself, upon startup
  - 12 factor apps
    #12 Run admin/management tasks as one-off processes

3. Special Note about Relational

4.Rules for validating each step

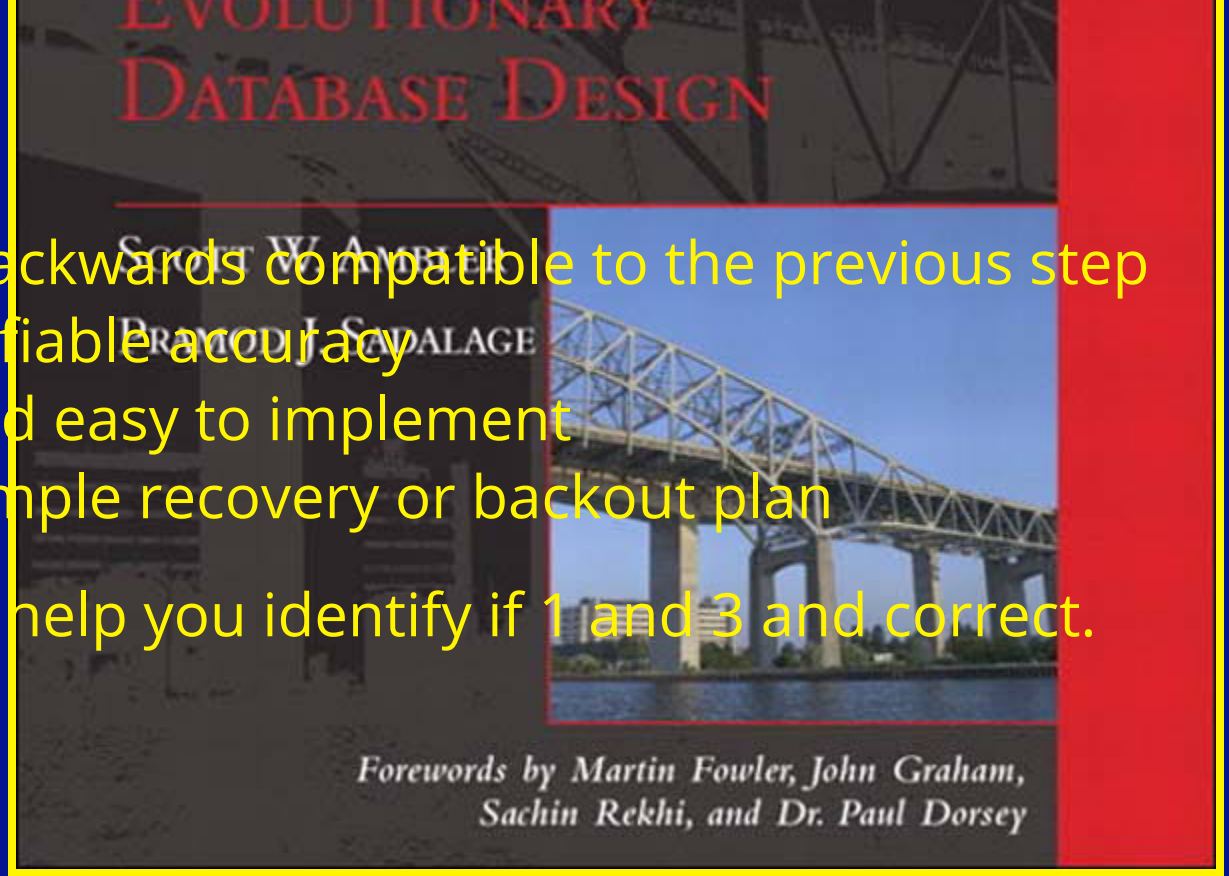


Each Step Must :

Databases

1. Compatibility - Be backwards compatible to the previous step
2. Accuracy - Have verifiable accuracy
3. Simple - Be small and easy to implement
4. Back out - Have a simple recovery or backout plan

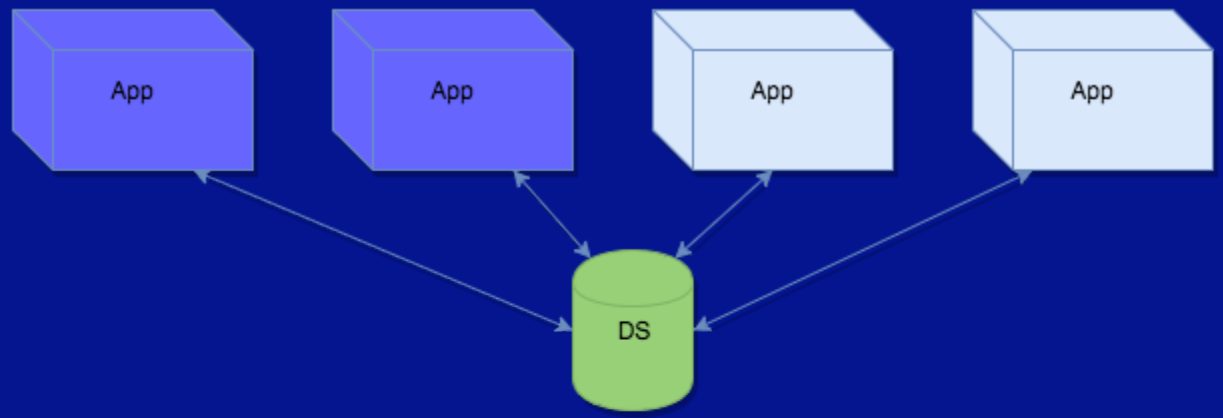
Note: Number 4 will help you identify if 1 and 3 and correct.



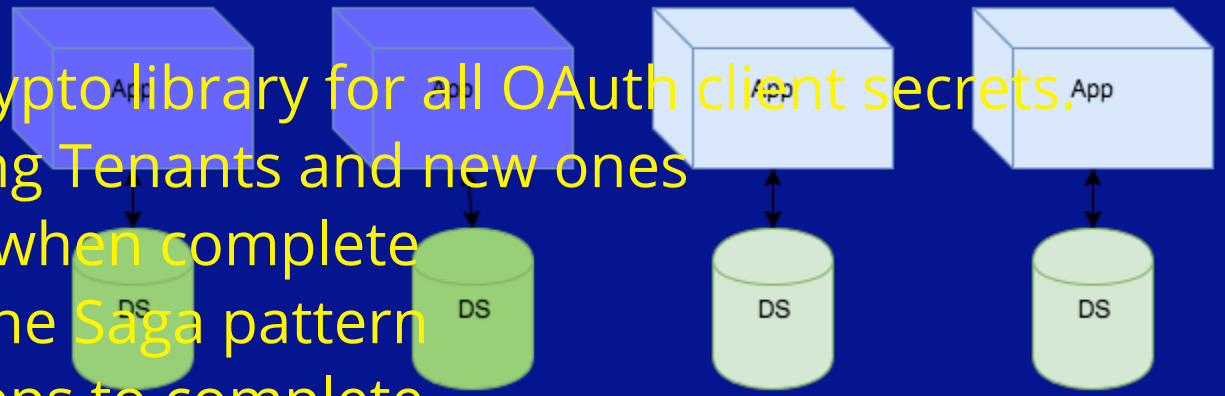
Example Schema Upgrade

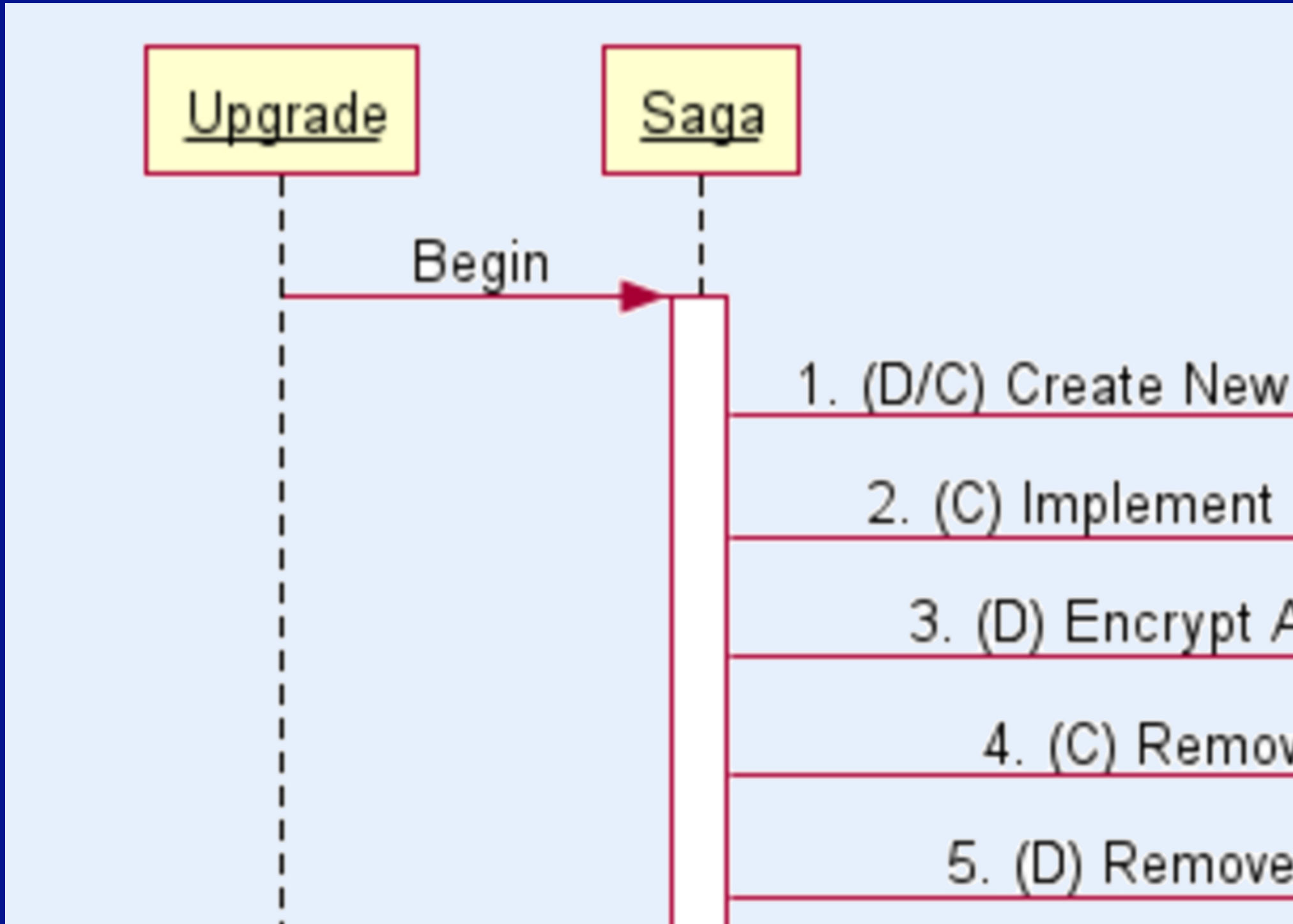
5. Don't Panic

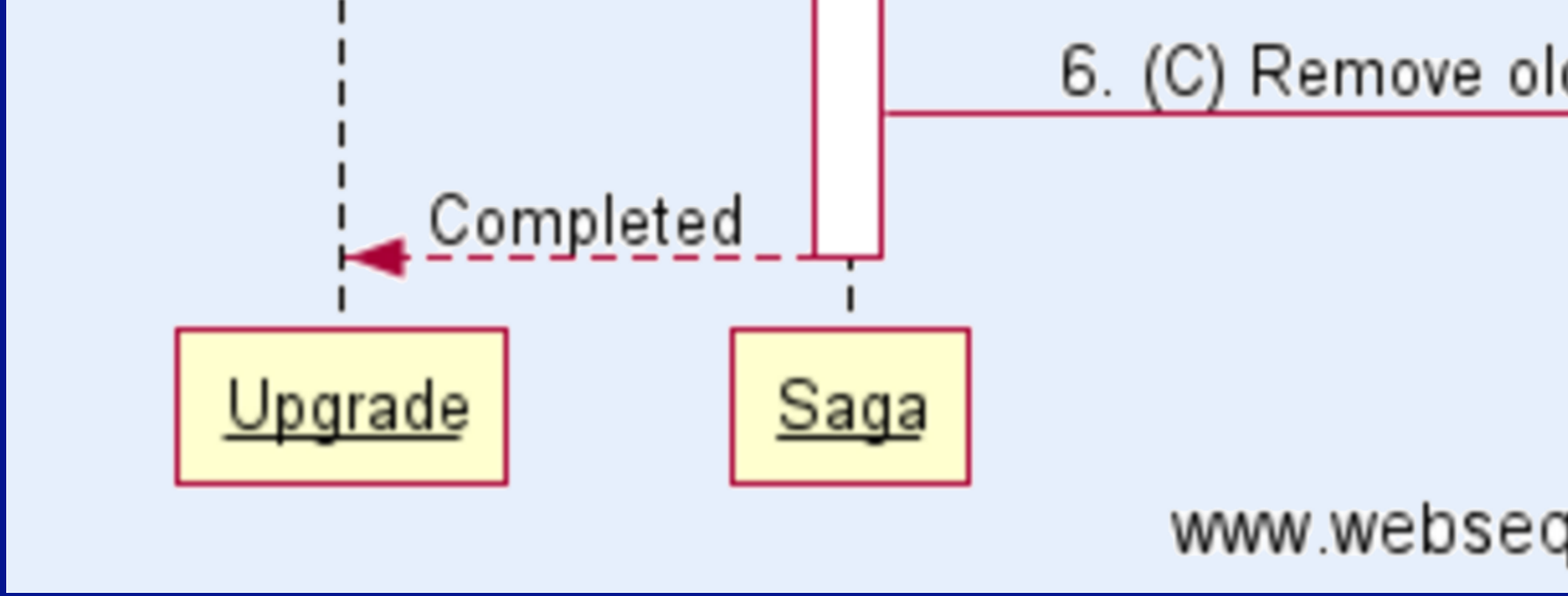
Think about this scenario



- Replace legacy Crypto library for all OAuth client secrets.
- Apply to all existing Tenants and new ones
- Remove old data when complete
- This is a form of the Saga pattern
- This will take 6 steps to complete




Upgrade
Saga
Begin
1. (D/C) Create New
2. (C) Implement
3. (D) Encrypt A
4. (C) Remov
5. (D) Remove


6. (C) Remove ol
Completed
Upgrade
Saga
www.webseq

Step 1 (D/C) New Column

Before - reads - old column, writes - old column

```
case class Tenant(_id: UUID, clientSecret: String)

{ "_id" : "...", "clientSecret" : "..." }
```

After - reads - old column, writes - old column

```
case class Tenant(_id: UUID, clientSecret: Option[String], secret:Option[String]) {
    def getSecret: String = clientSecret get
}

{ "_id" : "...", "clientSecret" : "..." }
```

- Compatibility - no data is lost, new column not in play
- Accuracy - unit tests on domain object
- Simple - very small code change
- Back out - restore domain object to "before" case

Step 2（C）New Crypto

Before – reads – old column, writes – old column

```
case class Tenant(_id: UUID, clientSecret: Option[String], secret:Option[String]) {
    def getSecret: String = clientSecret get
}

{ "_id" : "...", "clientSecret" : "..." }
```

After – reads – new then old, writes – new and old

```
case class Tenant(_id: UUID, clientSecret: Option[String], secret:Option[String]) {
    def getSecret: String = secret orElse clientSecret get
}
{ "_id" : "...", "clientSecret" : "..." }
{ "_id" : "...", "clientSecret" : "...", "secret" : "..." }
```

- Compatibility - no data is lost, both columns in play
- Accuracy - tests on domain object and domain updates
- Simple - small code change
- Back out - restore domain object to "before" case

Step 3（D）Encrypt all secrets

Write schema upgrade to re-encrypt all secrets in datastore

1. Get all Tenant data where secret column is empty
2. De-crypt clientSecret and re-encrypt using new algorithm
3. Update with new value where secret column is empty

```
case class Tenant(_id: UUID, clientSecret: Option[String], secret:Option[String]) {
    def getSecret: String = secret orElse clientSecret get
}

{ "_id" : "...", "clientSecret" : "...", "secret" : "..." }
```

- Compatibility - no data is lost, new column now populated
- Accuracy - query database by hand, verify no missing data
- Simple - just the code to populate the new column
- Back out - none, if previous step worked, this will too

Step 4 (C) Remove Field

Before - reads - new then old, writes - new and old

```
case class Tenant(_id: UUID, clientSecret: Option[String], secret:Option[String]) {
    def getSecret: String = secret orElse clientSecret get
}
{ "_id" : "...", "clientSecret" : "...", "secret" : "..." }
```

After - reads - new column, writes - new column

```
case class Tenant(_id: UUID, secret: String)

{ "_id" : "...", "clientSecret" : "...", "secret" : "..." }
{ "_id" : "...",                         "secret" : "..." }
```

- Compatibility - no data is lost, new column is in play
- Accuracy - unit tests on domain object
- Simple - very small code change
- Back out - restore domain object to "before" case

Step 5（D）Remove old data

Remove data from old column where new column data exists

Before - reads - new column, writes - new column

```
case class Tenant(_id: UUID, secret: String)

{ "_id" : "...", "clientSecret" : "...", "secret" : "..." }
{ "_id" : "...",                         "secret" : "..." }
```

After - reads - new column, writes - new column

```
case class Tenant(_id: UUID, secret: String)

{ "_id" : "...", "secret" : "..." }
```

- Compatibility - only data that is not used is removed
- Accuracy - only data removed is verified to be stale
- Simple - just the code to clean out the old column
- Back out - none needed, all removed data is not used

Step 6（C）Delete old Crypto

Change app to remove old crypto algorithm and jar(s).

```
case class Tenant(_id: UUID, secret: String)

{ "_id" : "...", "secret" : "..." }
```

- Compatibility - removing code that is not active
- Simple - very small code change
- Accuracy - unit tests on domain object
- Back out - none needed

Optional, re-activate the ORM->DDL validation

We are Done!

def questions = ???

Thank You

Use case (LONG TERM)

- upgrade "encryption" algorithm of passwords for all users
- "encryption" is a one-way hashing algorithm
- cannot simple "undo" an already hashed password
- So, how do we do this?
- When a user successfully logs in, we can use that password to re-hash it using the new algorithm, both algorithms for read.
- Wait for password expiration rules to kick in, 180 days
- Hash passwords using random UUIDs for all expired accounts
- Remove old hashing algorithm and jar(s)