MULTI TENANCY

COST-EFFICIENT AND SCALABLE PATTERNS FOR SOFTWARE-AS-A-SERVICE

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AGENDA

- Software-as-a-Service
  - What, Why, How?
- Multi Tenancy
  - What, Why, How?
  - Challenges & Design Concerns
- Examples & Demo
- Conclusions

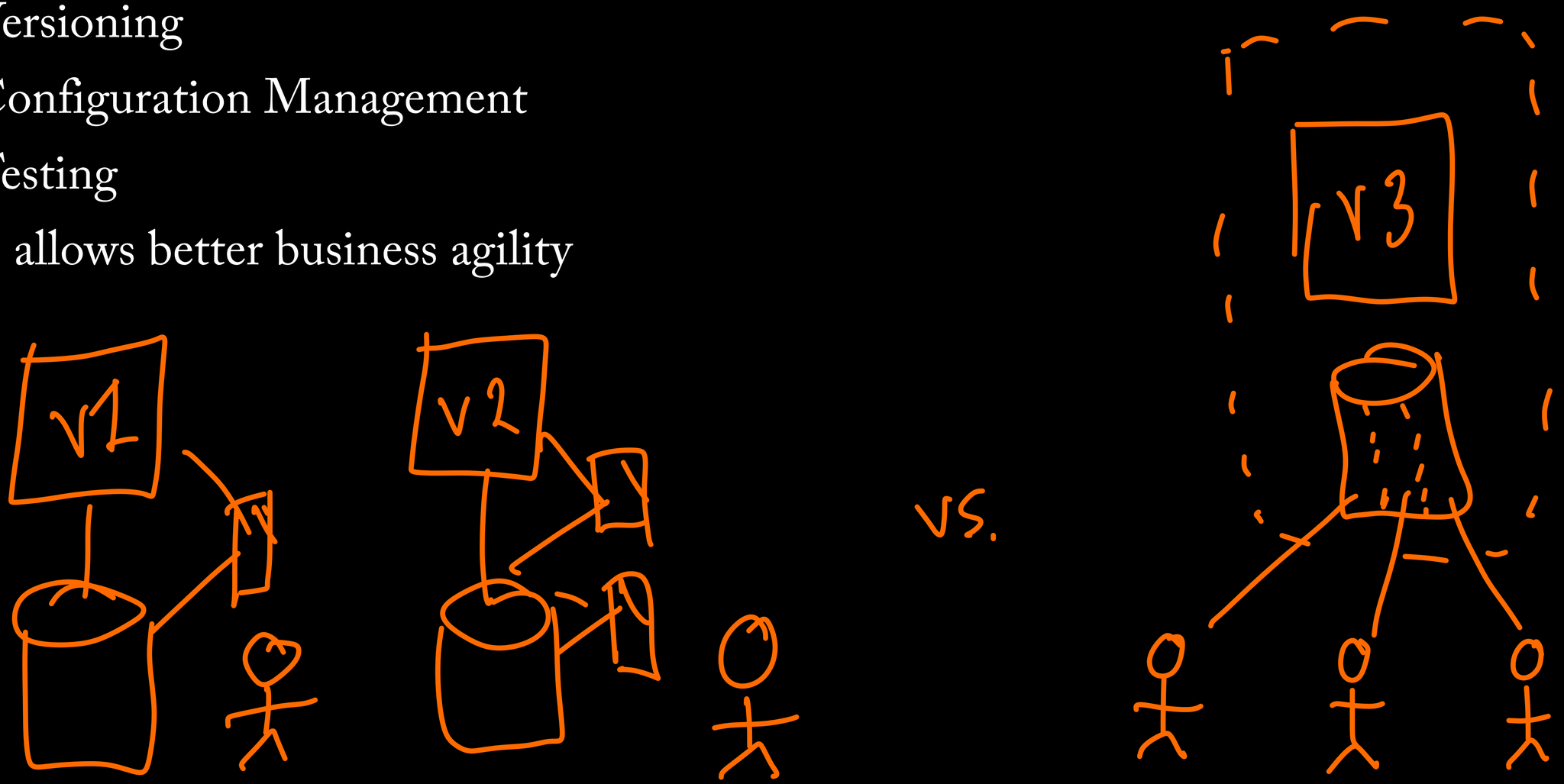
"Agenda by Abel, & MQ MSK WCA LosAngeles Graffiti Art" by anarchosyn

SOFTWARE-AS-A-SERVICE

- Software as a Service (SaaS) is a software delivery and licensing model in which software is licensed on a subscription basis and is centrally hosted, often in a cloud environment.

DRIVER: SIMPLICITY

- Customers need no infrastructure
- Greatly simplified Application Lifecycle for the provider
  - Versioning
  - Configuration Management
  - Testing
    - » allows better business agility



DRIVER: ECONOMY OF SCALE

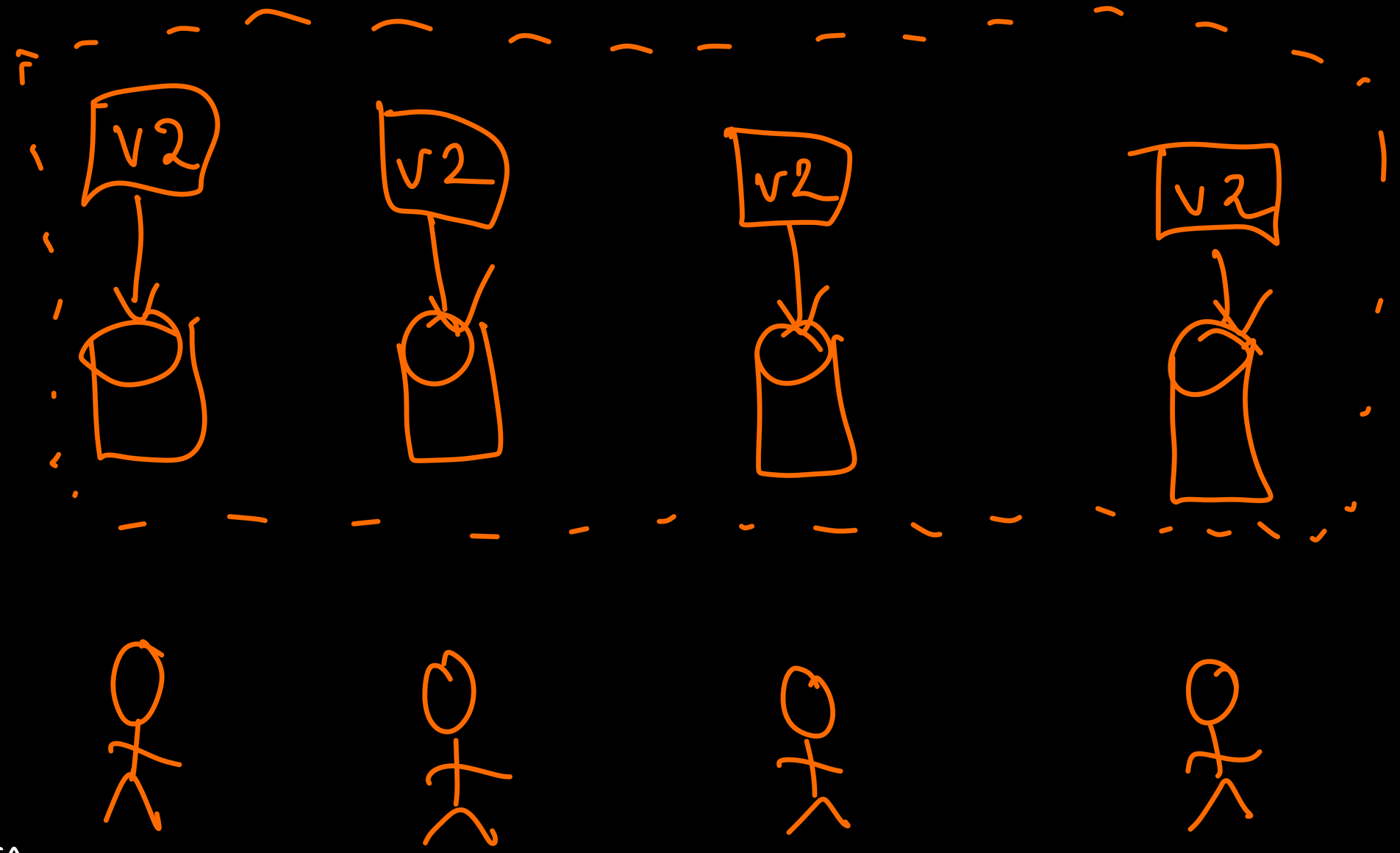
- Lowered “entrance fee”, including “Freemium” models
- Cost efficiency in both hardware and software
- The wet dream of software companies: Annual Recurring Revenue via Subscriptions.

DRIVER: DATA AGGREGATION & BUSINESS INTELLIGENCE

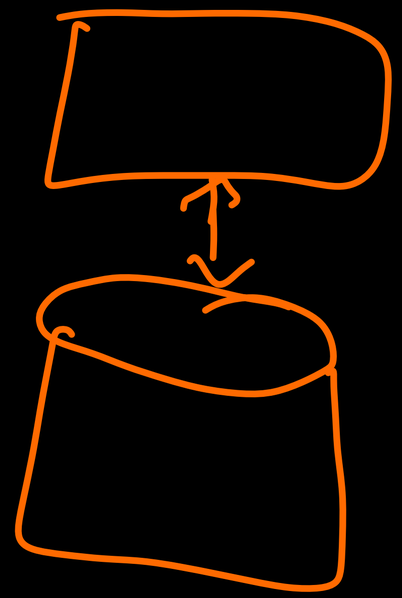
- With access to multiple customer's uniform data (if allowed), the opportunities for data mining and business intelligence are endless

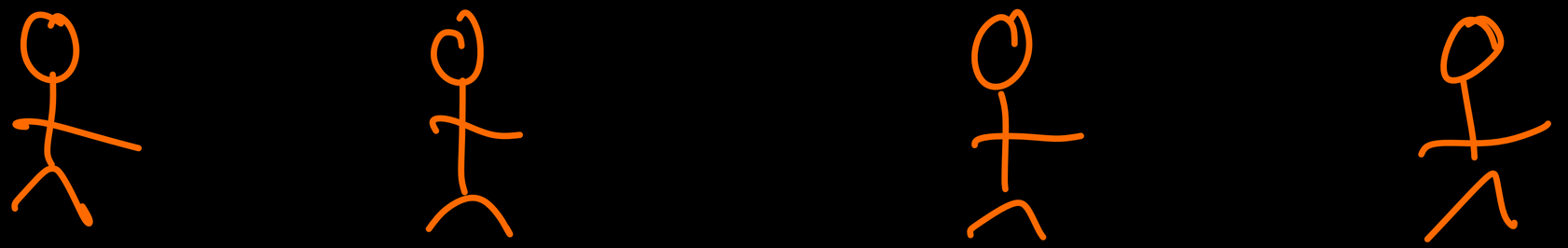
https://becominghuman.ai/data-science-in-a-nutshell-data-mining-958b983c6b23

SAAS TOPOLOGIES: DEDICATED OR “SINGLE TENANT”

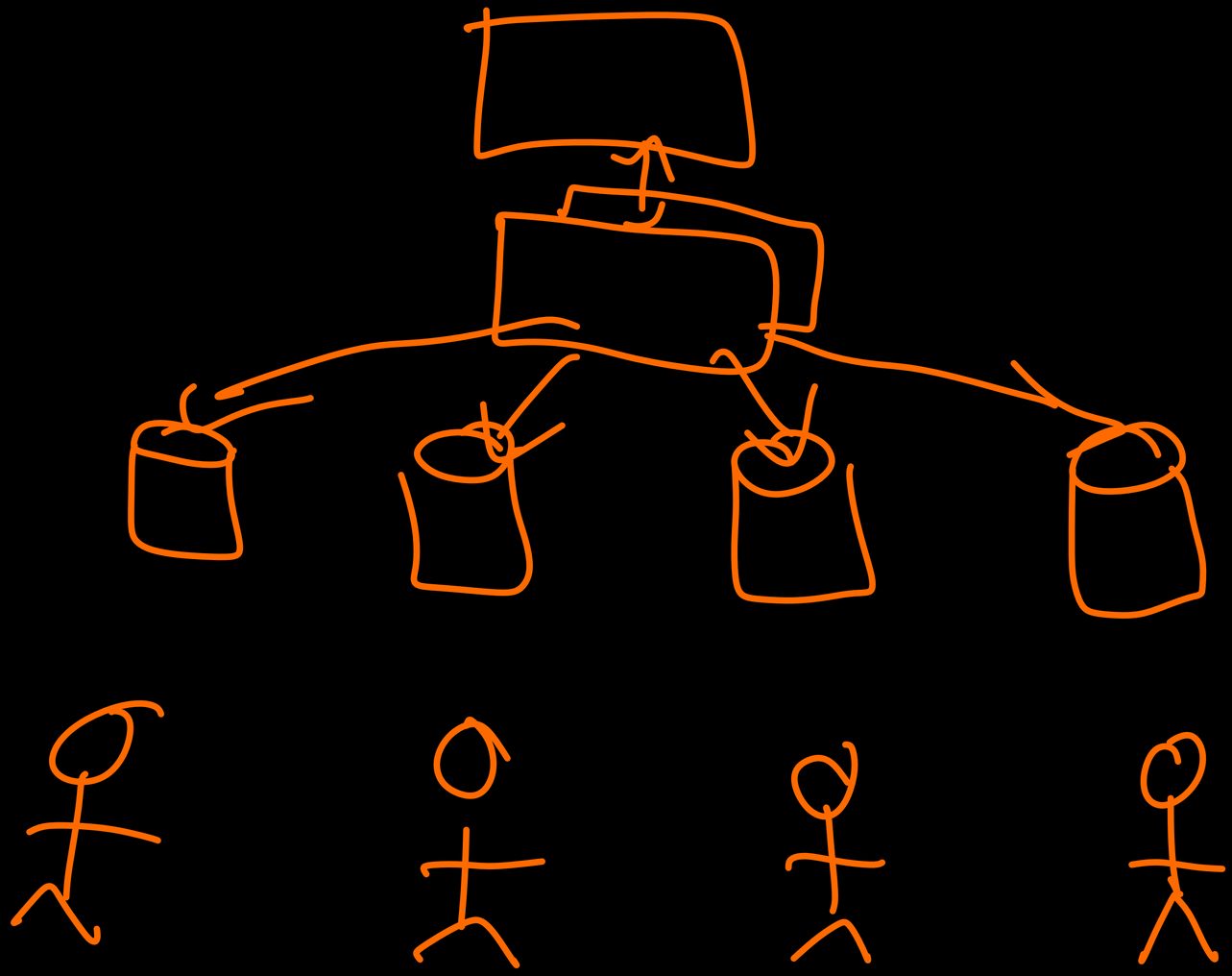


SAAS TOPOLOGIES: SHARED OR “MULTI TENANT”





SAAS TOPOLOGIES: … OR MORE OFTEN A MIX



BALANCING CONFLICTING REQUIREMENTS

- Shared resources vs
- Logical or Physical separation

DRIVING NON-FUNCTIONAL ASPECTS

- **Data separation requirements?**
- **Number of tenants?**
- **Tenant onboarding requirements?**
  - Frequency
  - Lead time requirements
- **Customizability requirements?**

Figure FONT: http://www.withinreach.com.au/SiteAssets/Lists/Posts/AllPosts/wordcloudweb.png

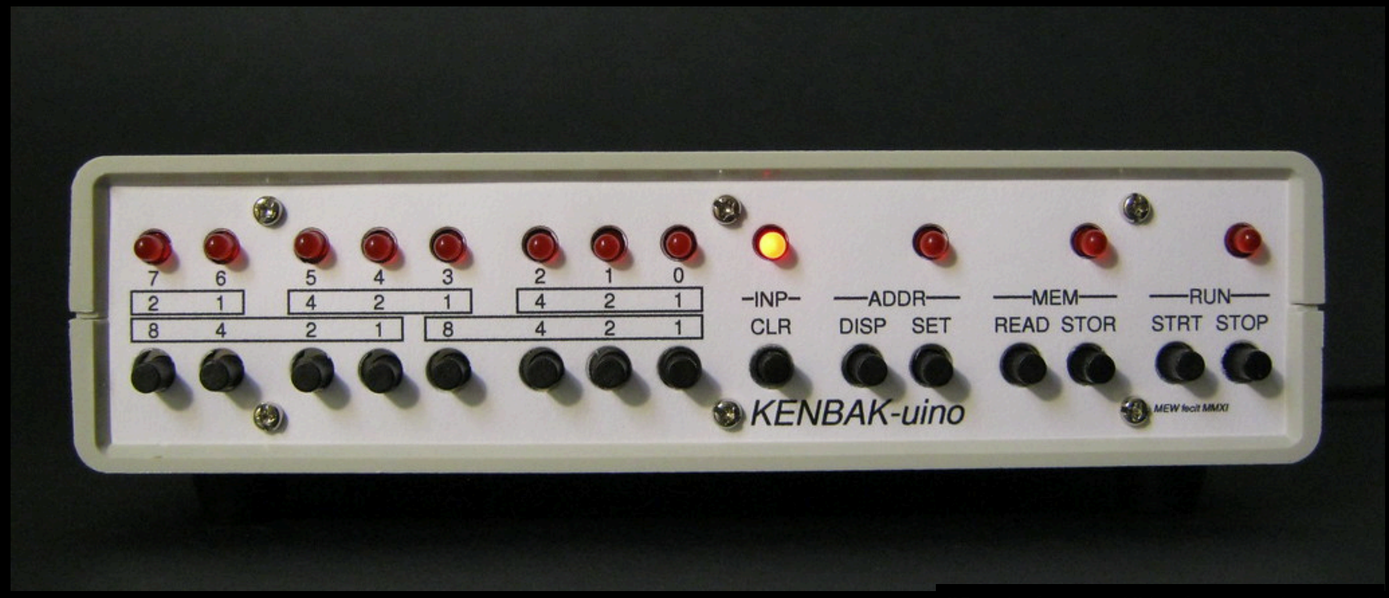
MULTI TENANCY DESIGN CONCERNS

- Customizability

"Custom Fondant M&M Character Cupcakes!!!!" by DixieBelleCupcakeCafe

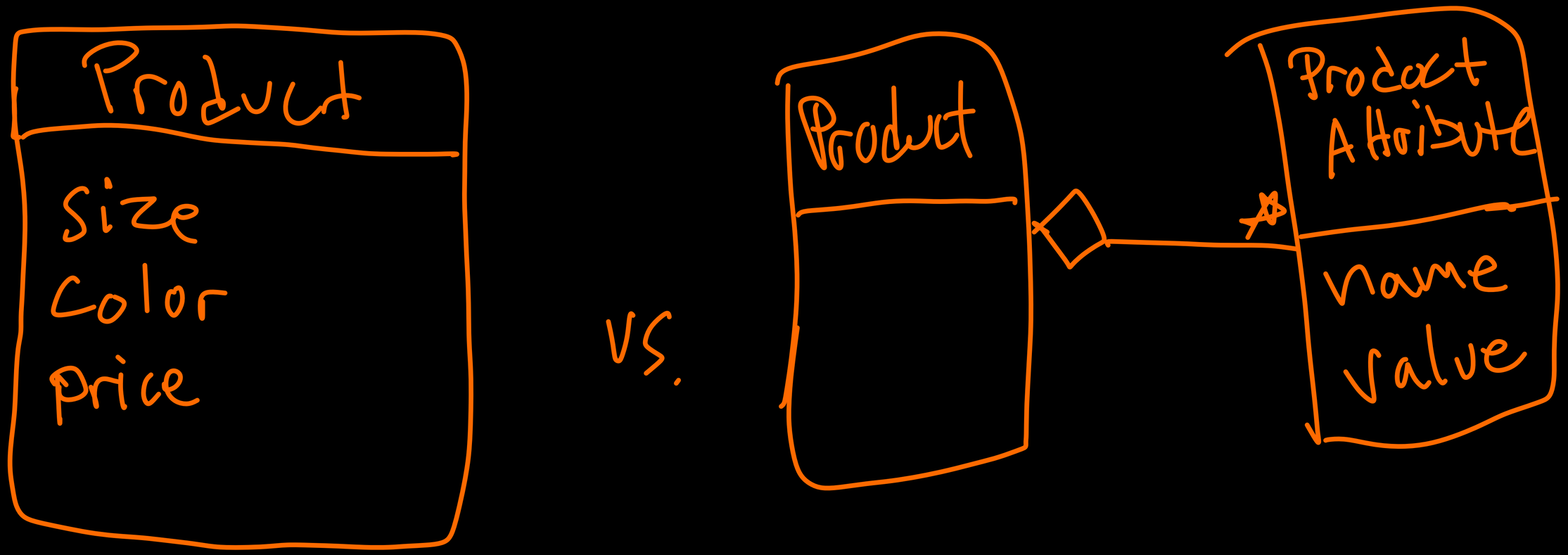
MULTI-TENANCY CUSTOMIZATION PATTERN: CONFIGURATION

- Tenant-specific Configuration Properties, available through Tenant Context
- Feature Toggling operated by Tenant Context
- Custom Branding and Co-branding via Templates (colour schemes, logos, etc.)



"Ready for Input" by funny-polynomial

MULTI-TENANCY CUSTOMIZATION PATTERN: META MODELING



MULTI TENANCY DESIGN CONCERNS

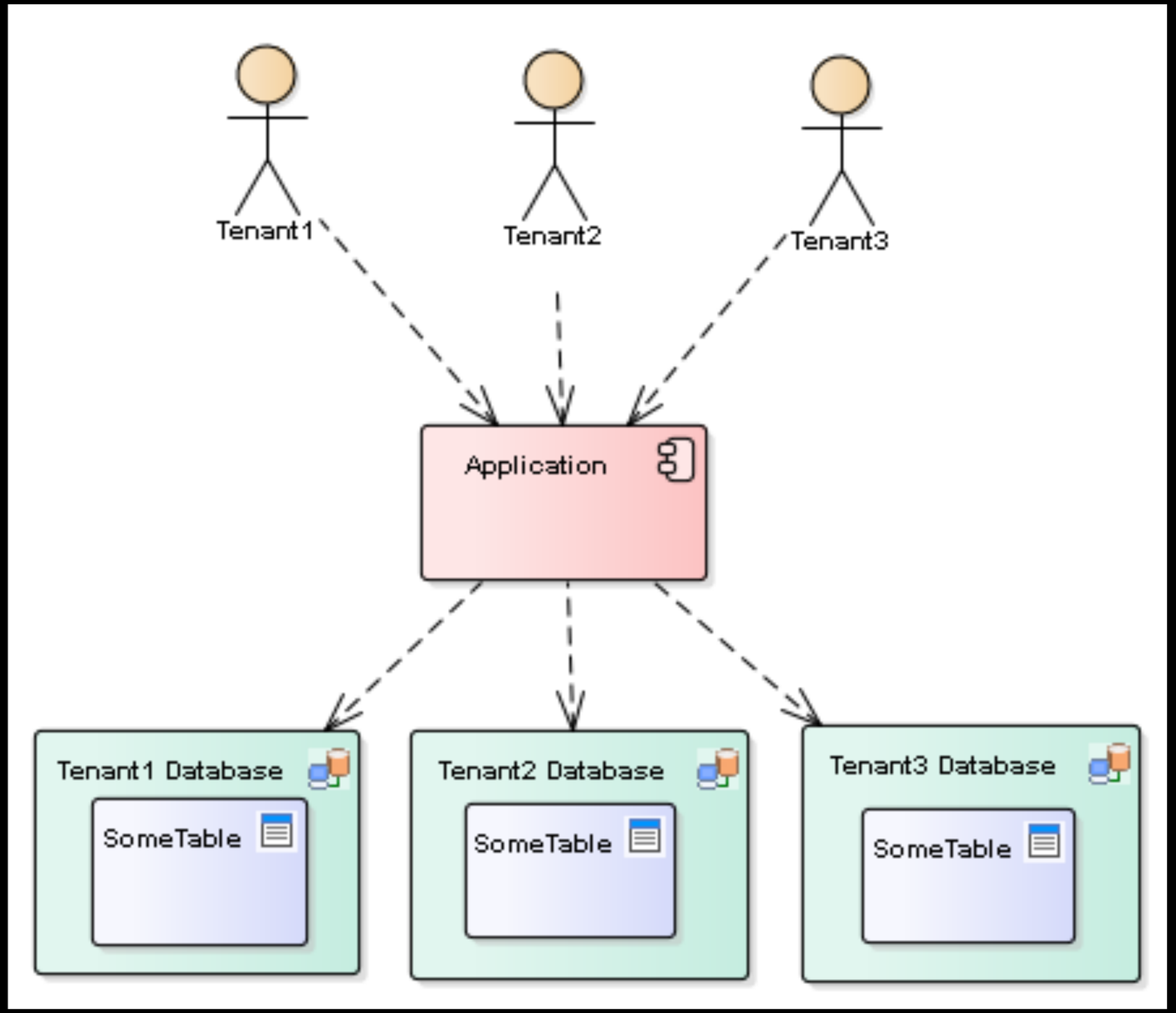
- Customizability
- Performance Isolation

"Easter eggs wearing face mask and in self-isolation" by Ivan Radic

MULTI TENANCY DESIGN CONCERNS

- Customizability
- Performance Isolation
- Persistence & Data Isolation

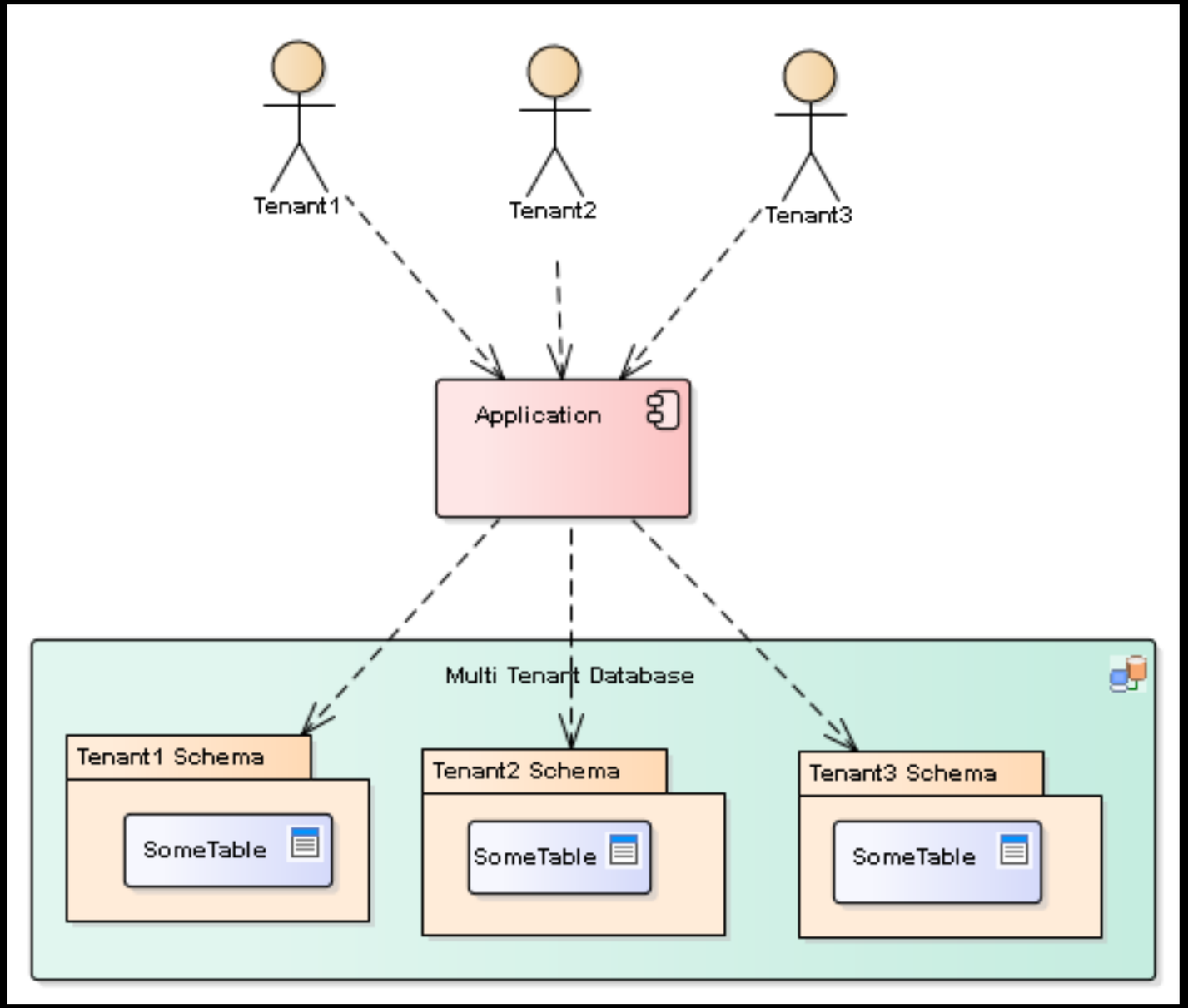
MULTI-TENANCY PERSISTENCE PATTERNS: DATABASE PER TENANT



MULTI-TENANCY PERSISTENCE PATTERNS: DATABASE PER TENANT

- Pros:
  - Conceptually simple
  - Strong data isolation guaranteed by database
  - Simplifies per tenant management & maintenance
  - Simplifies per tenant performance isolation
- Cons:
  - Overhead in resource requirements
  - Complicates db migrations
  - Scales to hundreds of tenants?

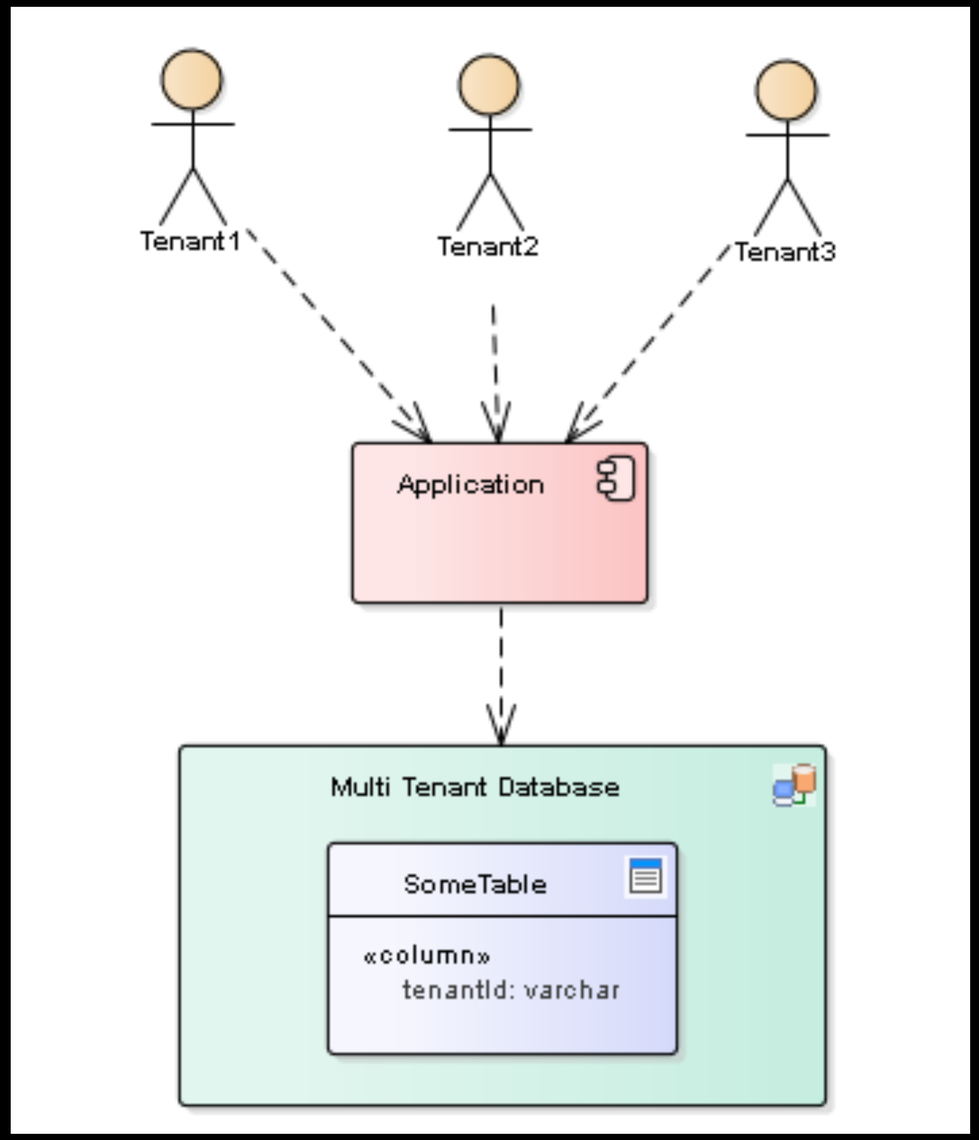
MULTI-TENANCY PERSISTENCE PATTERNS: SCHEMA PER TENANT



MULTI-TENANCY PERSISTENCE PATTERNS: SCHEMA PER TENANT

- Pros:
  - Conceptually simple
  - Relatively strong data isolation guaranteed by database
  - Simplifies per tenant management & maintenance
- Cons:
  - Slight overhead in resource requirements
  - Complicates db migrations
  - Scales to thousands of tenants?

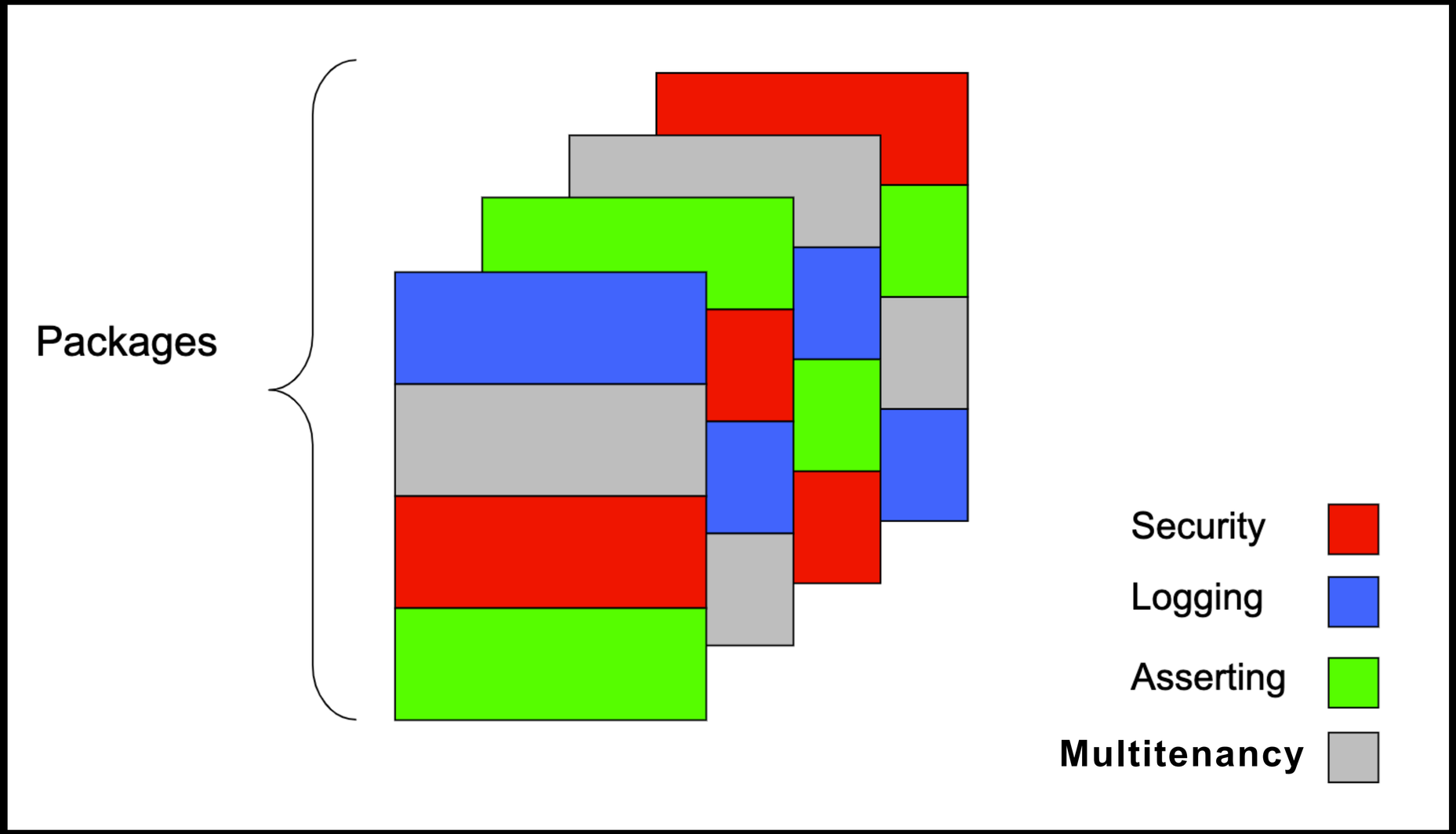
MULTI-TENANCY PERSISTENCE PATTERNS: SHARED DATABASE



MULTI-TENANCY PERSISTENCE PATTERNS: SHARED DATABASE

- Pros:
  - Minimal overhead
  - Simpler data maintenance and migrations
  - Scales to any number of tenants
- Cons:
  - Data Partitioning guarantee only by application code
  - Database may become too big and need sharding to scale

MULTI TENANCY AS A CROSS-CUTTING CONCERN



MULTI TENANCY DATA ISOLATION AS A CROSS-CUTTING CONCERN

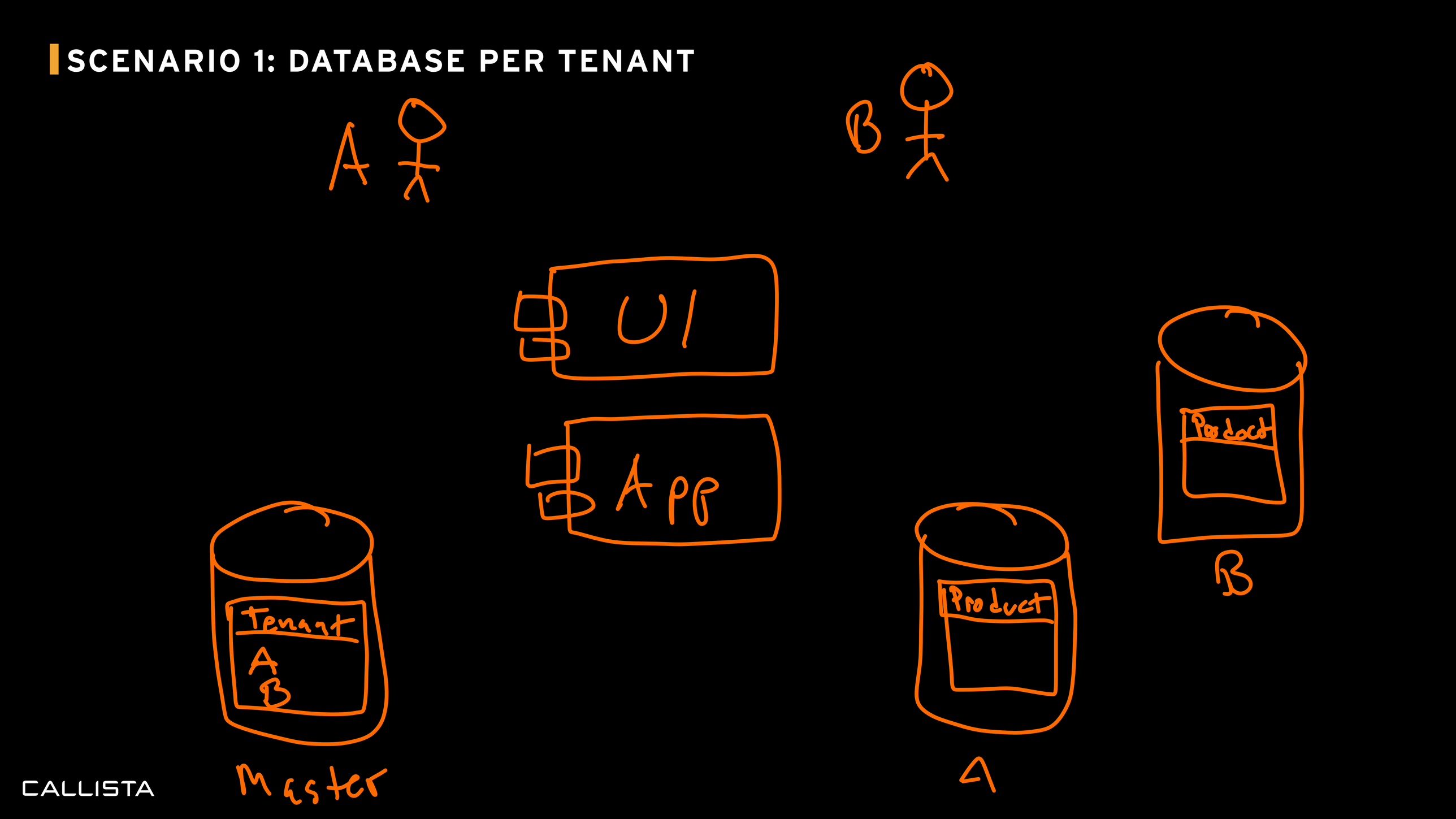
- Tenant Resolution
- Tenant Context Propagation
- Datasource Connection management
- Schema Manipulation
- Query Generation

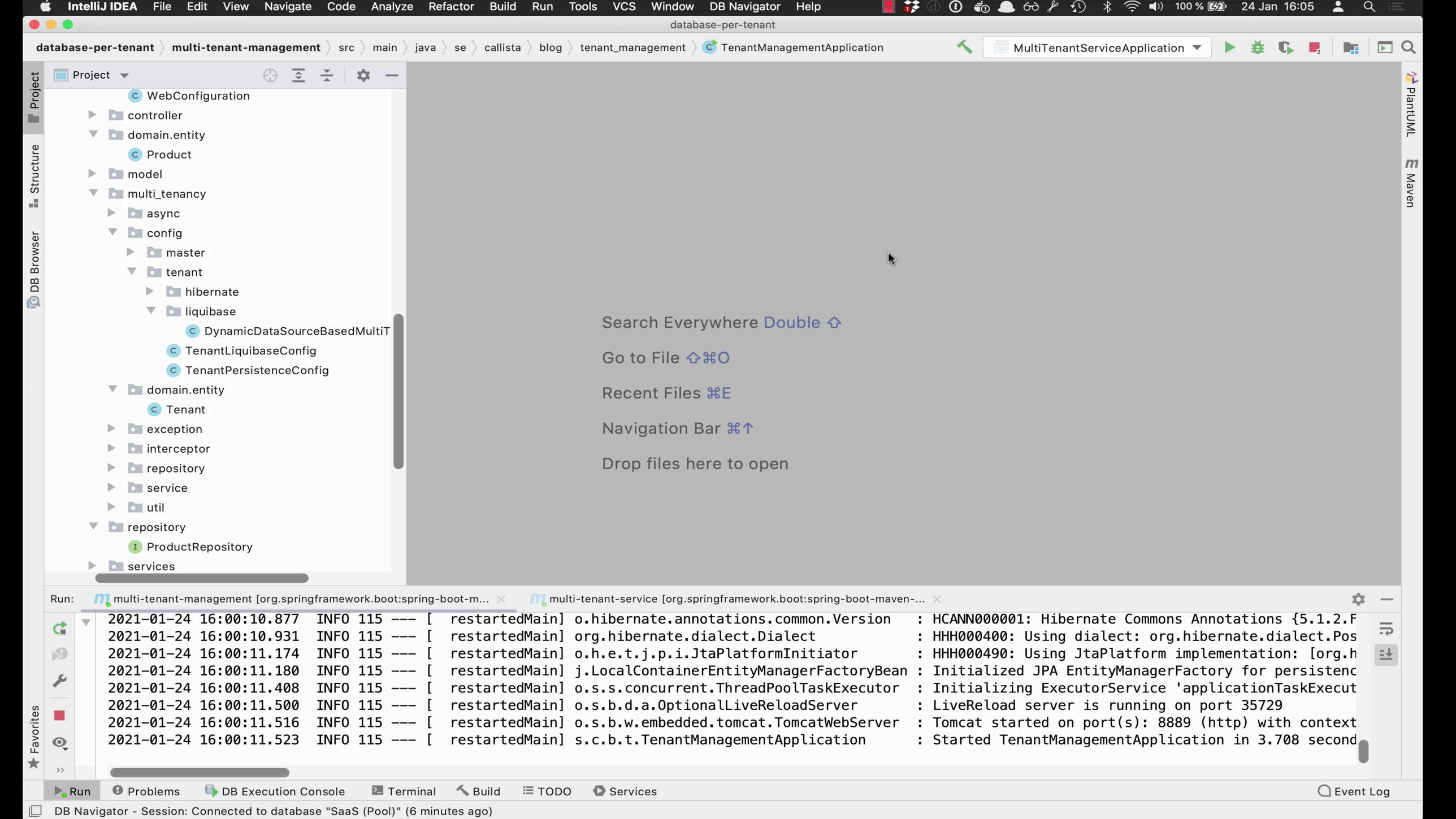
Demo

MULTI-TENANCY WITH SPRING DATA JPA

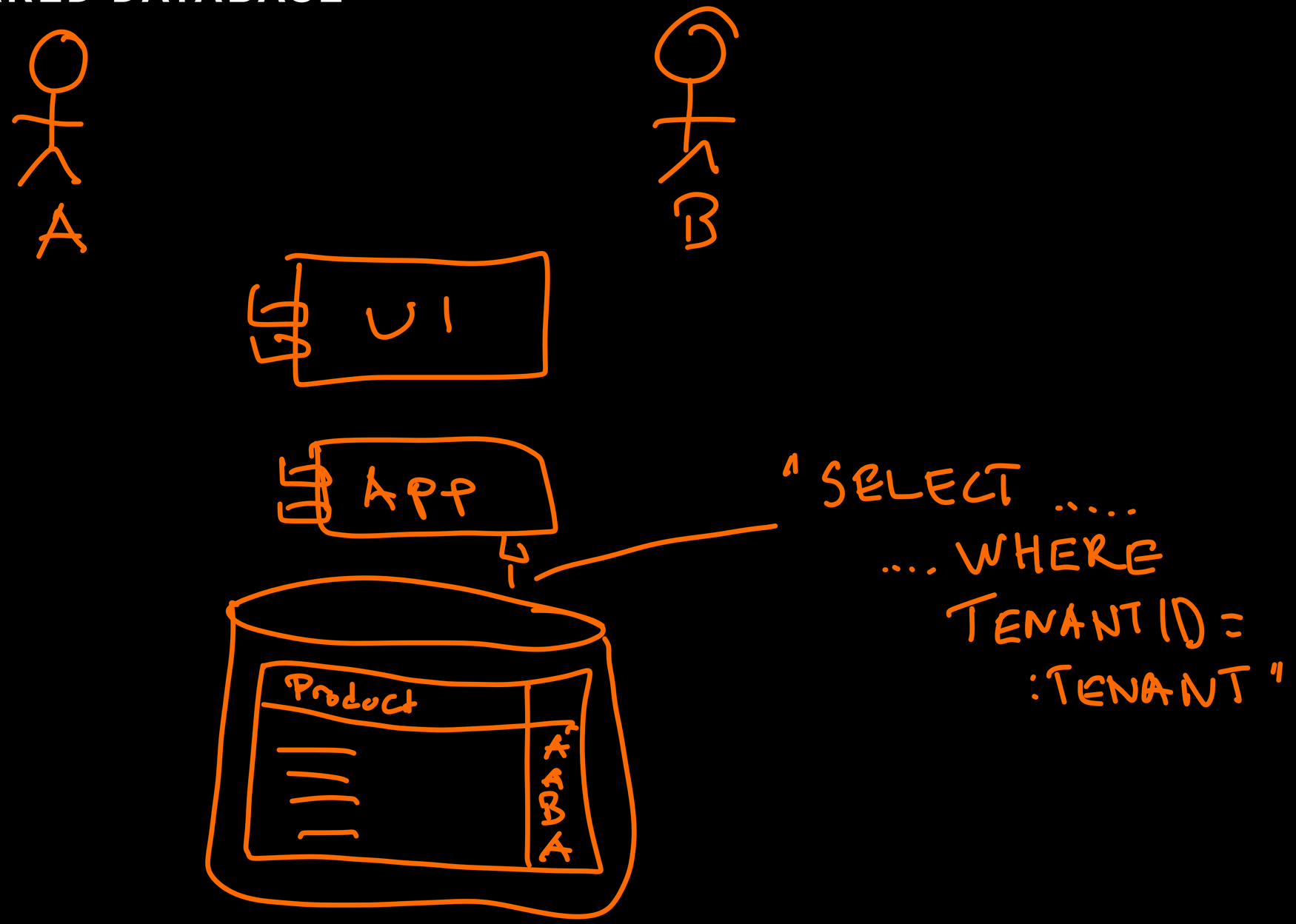
HTTPS://GITHUB.COM/CALLISTAENTERPRISE/BLOG-MULTITENANCY

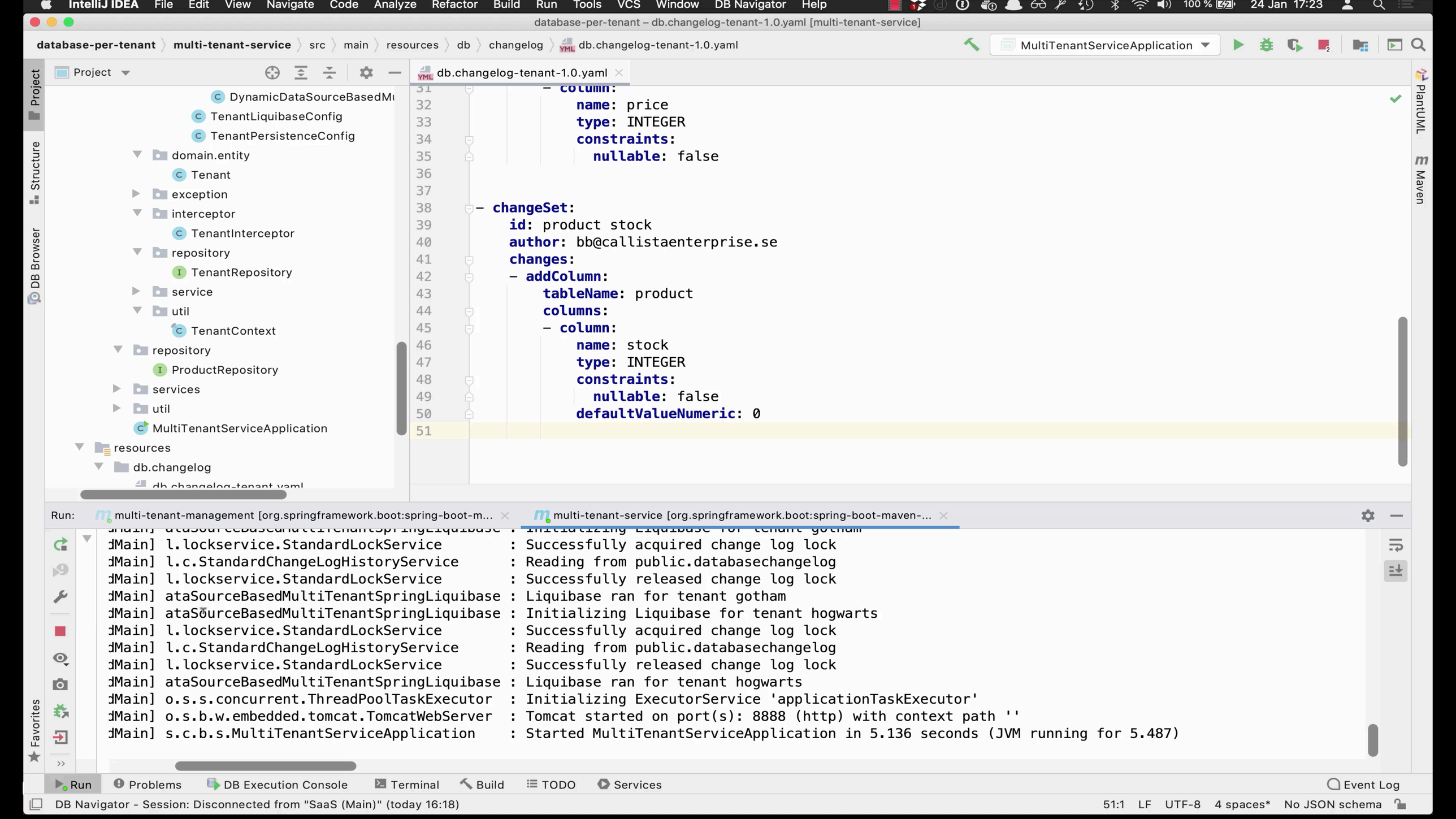
SCENARIO 1: DATABASE PER TENANT




IntelliJ IDEA File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window DB Navigator Help
100 % 24 Jan 16:05
database-per-tenant
database-per-tenant multi-tenant-management src main java se callista blog tenant_management TenantManagementApplication
MultiTenantServiceApplication
Project
WebConfiguration
controller
domain.entity
Product
model
multi_tenancy
async
config
master
tenant
hibernate
liquibase
DynamicDataSourceBasedMultiT
TenantLiquibaseConfig
TenantPersistenceConfig
domain.entity
Tenant
exception
interceptor
repository
service
util
repository
ProductRepository
services
Search Everywhere Double ⇧
Go to File ⇧⌘O
Recent Files ⌘E
Navigation Bar ⌘↑
Drop files here to open
Run: multi-tenant-management [org.springframework.boot:spring-boot-m...
multi-tenant-service [org.springframework.boot:spring-boot-maven-...
2021-01-24 16:00:10.877 INFO 115 --- [restartedMain] o.hibernate.annotations.common.Version : HCANN000001: Hibernate Commons Annotations {5.1.2.F
2021-01-24 16:00:10.931 INFO 115 --- [restartedMain] org.hibernate.dialect.Dialect : HHH000400: Using dialect: org.hibernate.dialect.Pos
2021-01-24 16:00:11.174 INFO 115 --- [restartedMain] o.h.e.t.j.p.i.JtaPlatformInitiator : HHH000490: Using JtaPlatform implementation: [org.h
2021-01-24 16:00:11.180 INFO 115 --- [restartedMain] j.LocalContainerEntityManagerFactoryBean : Initialized JPA EntityManagerFactory for persistenc
2021-01-24 16:00:11.408 INFO 115 --- [restartedMain] o.s.s.concurrent.ThreadPoolTaskExecutor : Initializing ExecutorService 'applicationTaskExecut
2021-01-24 16:00:11.500 INFO 115 --- [restartedMain] o.s.b.d.a.OptionalLiveReloadServer : LiveReload server is running on port 35729
2021-01-24 16:00:11.516 INFO 115 --- [restartedMain] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port(s): 8889 (http) with context
2021-01-24 16:00:11.523 INFO 115 --- [restartedMain] s.c.b.t.TenantManagementApplication : Started TenantManagementApplication in 3.708 second
Run Problems DB Execution Console Terminal Build TODO Services Event Log
DB Navigator - Session: Connected to database "SaaS (Pool)" (6 minutes ago)

SCENARIO 2: SHARED DATABASE




IntelliJ IDEA File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window DB Navigator Help
100 % 24 Jan 17:23
database-per-tenant – db.changelog-tenant-1.0.yaml [multi-tenant-service]
database-per-tenant multi-tenant-service src main resources db changelog db.changelog-tenant-1.0.yaml
MultiTenantServiceApplication
Project
DynamicDataSourceBasedMu
TenantLiquibaseConfig
TenantPersistenceConfig
domain.entity
Tenant
exception
interceptor
TenantInterceptor
repository
TenantRepository
service
util
TenantContext
repository
ProductRepository
services
util
MultiTenantServiceApplication
resources
db.changelog
db.changelog-tenant-1.0.yaml
- column:
name: price
type: INTEGER
constraints:
nullable: false
- changeSet:
id: product stock
author: bb@callistaenterprise.se
changes:
- addColumn:
tableName: product
columns:
- column:
name: stock
type: INTEGER
constraints:
nullable: false
defaultValueNumeric: 0
Run: multi-tenant-management [org.springframework.boot:spring-boot-m...
multi-tenant-service [org.springframework.boot:spring-boot-maven-...
dMain] l.lockservice.StandardLockService : Successfully acquired change log lock
dMain] l.c.StandardChangeLogHistoryService : Reading from public.databasechangelog
dMain] l.lockservice.StandardLockService : Successfully released change log lock
dMain] ataSourceBasedMultiTenantSpringLiquibase : Liquibase ran for tenant gotham
dMain] ataSourceBasedMultiTenantSpringLiquibase : Initializing Liquibase for tenant hogwarts
dMain] l.lockservice.StandardLockService : Successfully acquired change log lock
dMain] l.c.StandardChangeLogHistoryService : Reading from public.databasechangelog
dMain] l.lockservice.StandardLockService : Successfully released change log lock
dMain] ataSourceBasedMultiTenantSpringLiquibase : Liquibase ran for tenant hogwarts
dMain] o.s.s.concurrent.ThreadPoolTaskExecutor : Initializing ExecutorService 'applicationTaskExecutor'
dMain] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port(s): 8888 (http) with context path ''
dMain] s.c.b.s.MultiTenantServiceApplication : Started MultiTenantServiceApplication in 5.136 seconds (JVM running for 5.487)
Run Problems DB Execution Console Terminal Build TODO Services Event Log
DB Navigator - Session: Disconnected from "SaaS (Main)" (today 16:18)
51:1 LF UTF-8 4 spaces* No JSON schema

SUMMING UP

Software-as-a-Service (SaaS) via Software Multitenancy provides **great benefits** both for the customer and the service provider:

- **Simpler**
- **Cheaper**

SUMMING UP

Architecting for Multitenancy require careful considerations. The biggest challenge lies in **data isolation** between tenants. As often, there is no “one-size-fits-all” pattern, but a set of proven patterns with different tradeoffs.

RECOMMENDATIONS

- Use **Database-per-tenant** or **Schema-per-tenant** if a strong data separation guarantee is the top priority and the number of tenants is modest. Pay attention to a database **migrations** mechanism.
- Use **Shared-Database-with-Discriminator** for maximum scalability if the number of tenants is high.
- Encapsulate the Multitenancy strategy implementation into a coherent **cross-cutting concern**, for flexibility and maintainability.

Time for questions!

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