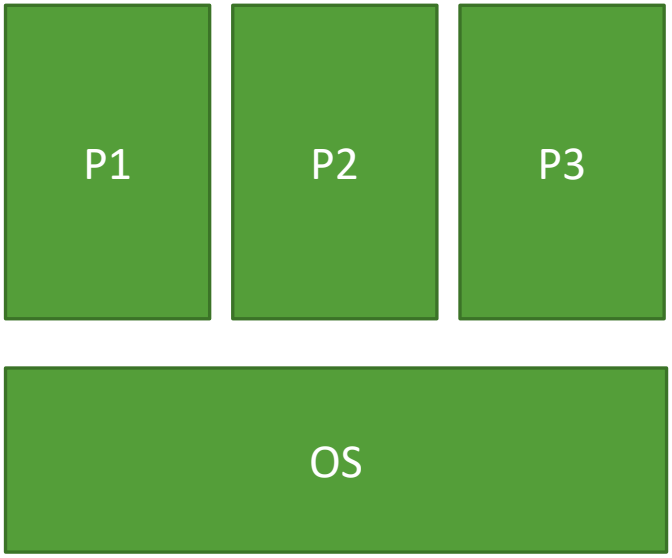
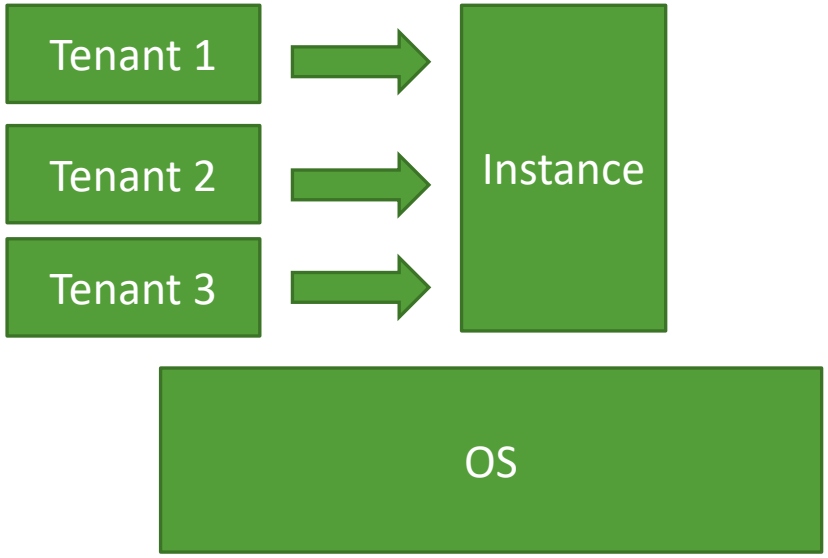
Multitenancy

Multitenant Compute Architecture

Multi Processing System

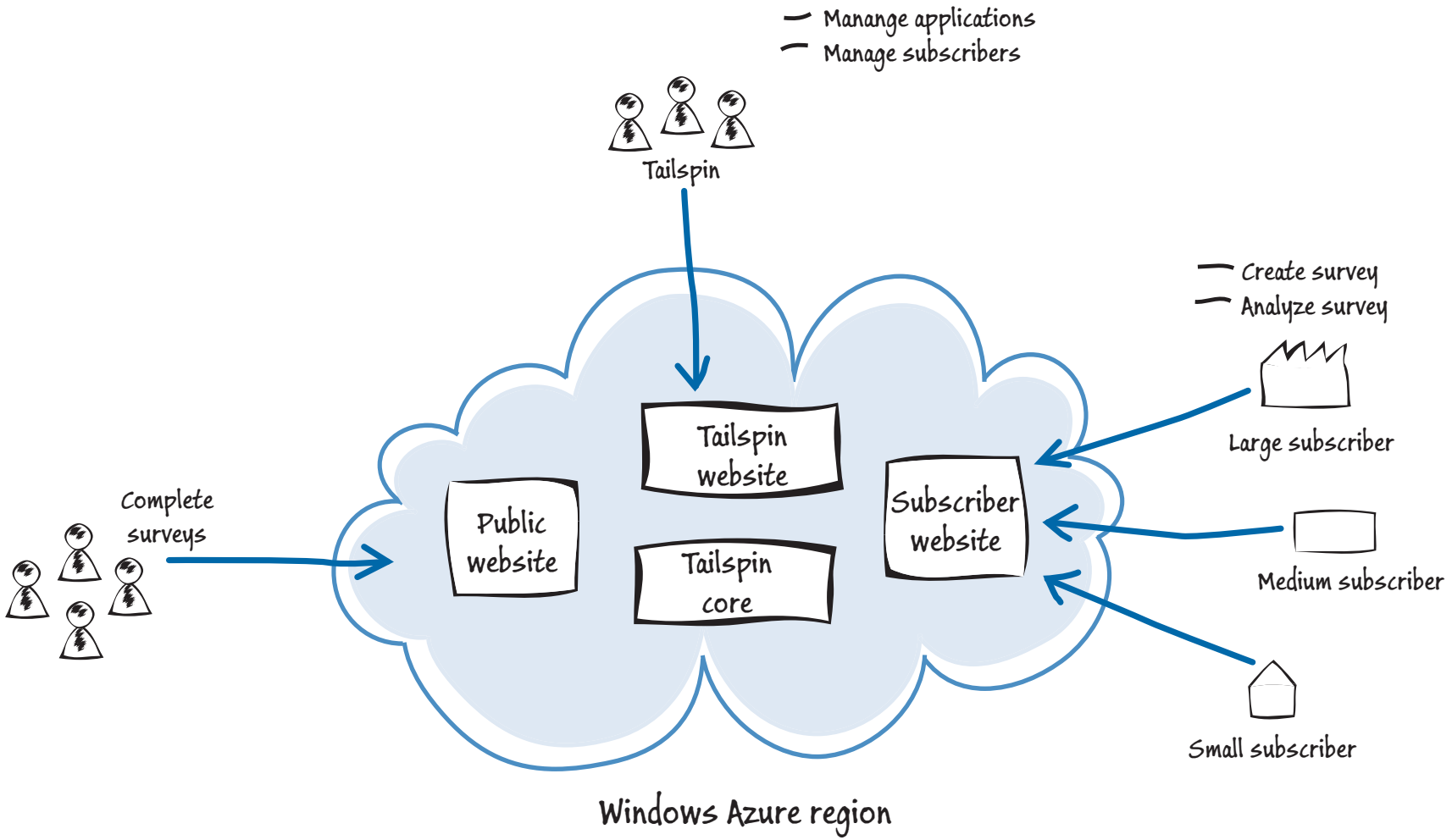


Process specific data is saved and loaded back for the OS to proceed

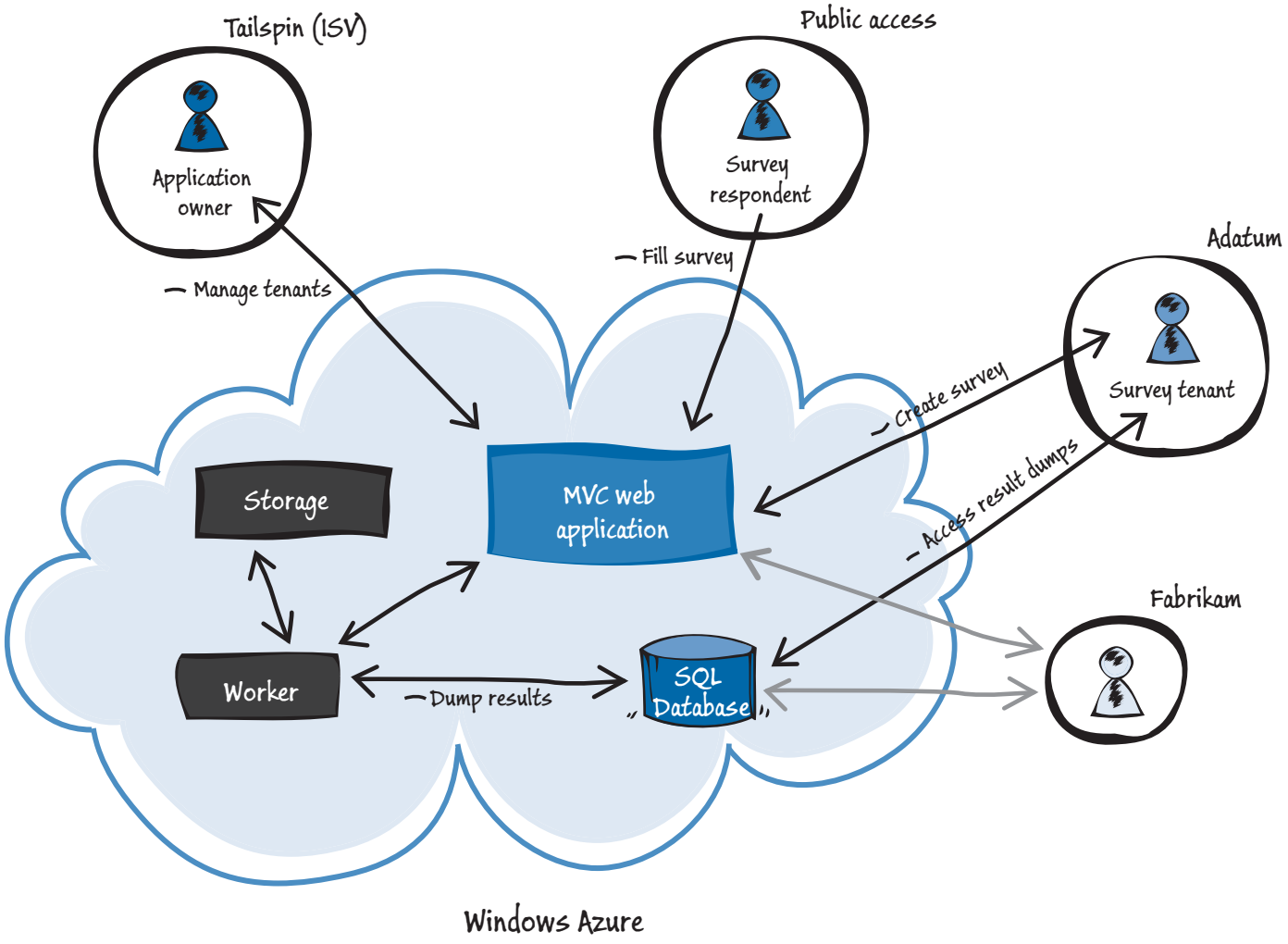


Tenant specific data is saved and loaded back for the Instance to proceed

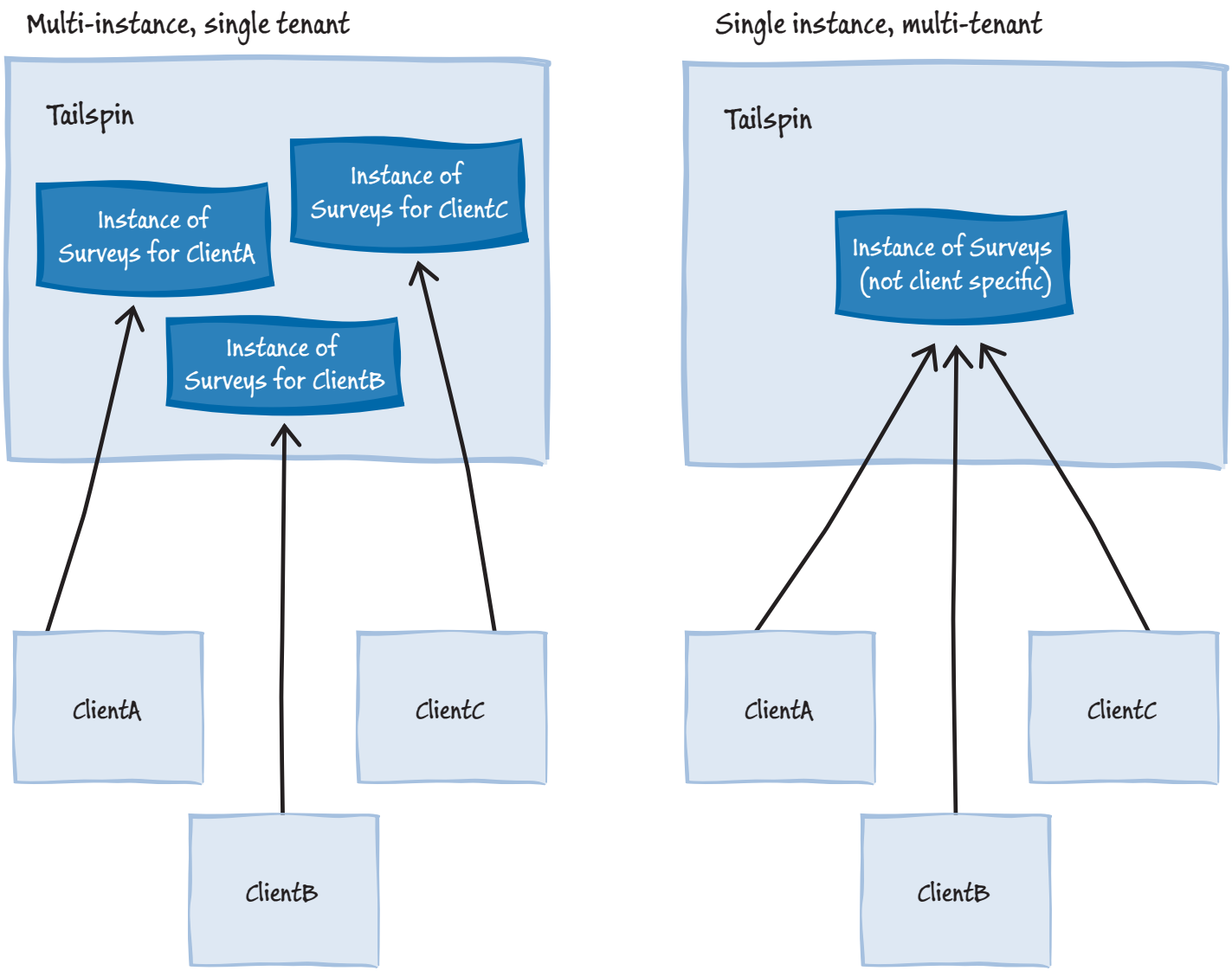
Tailspin - Surveys Company



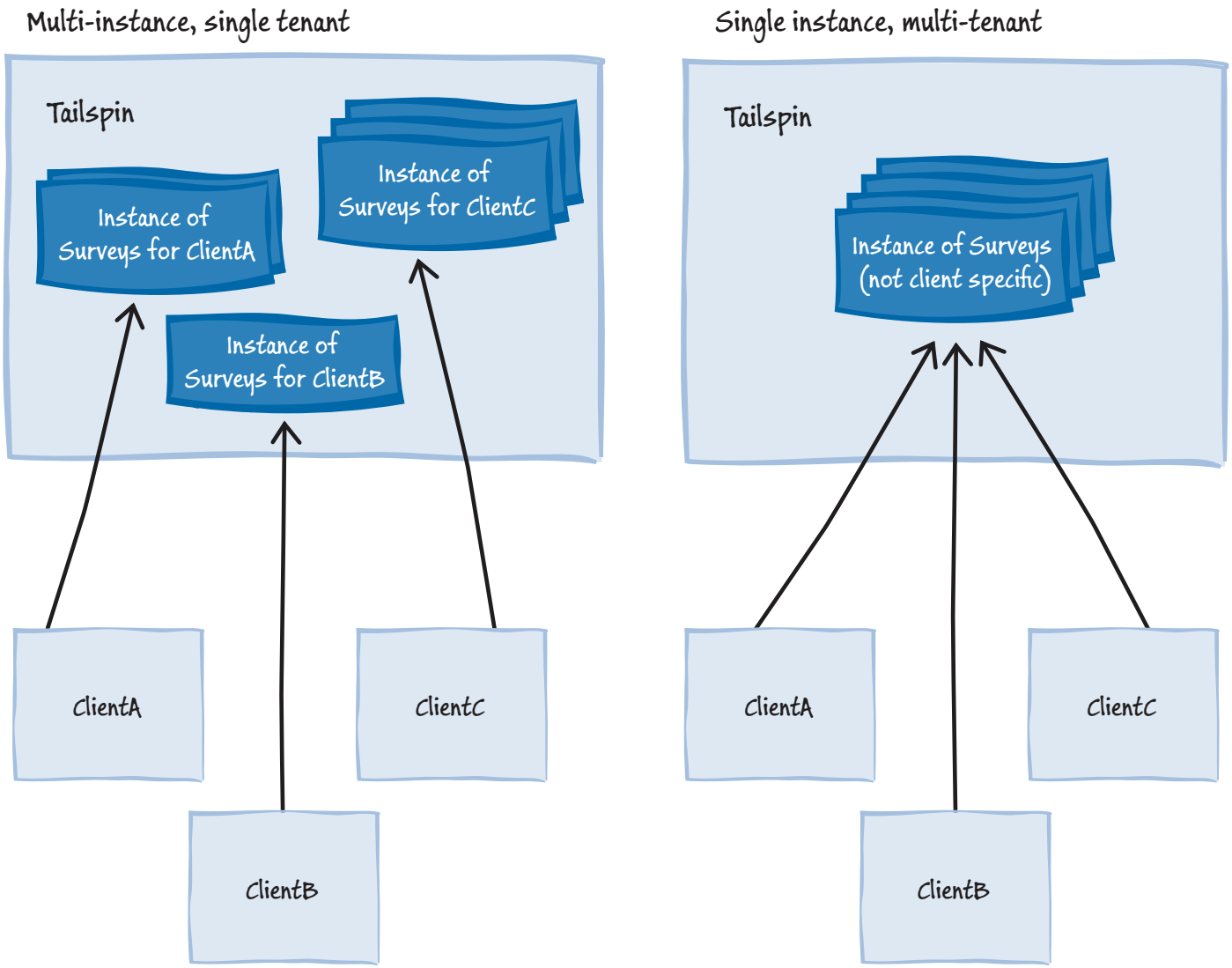
Application Architecture



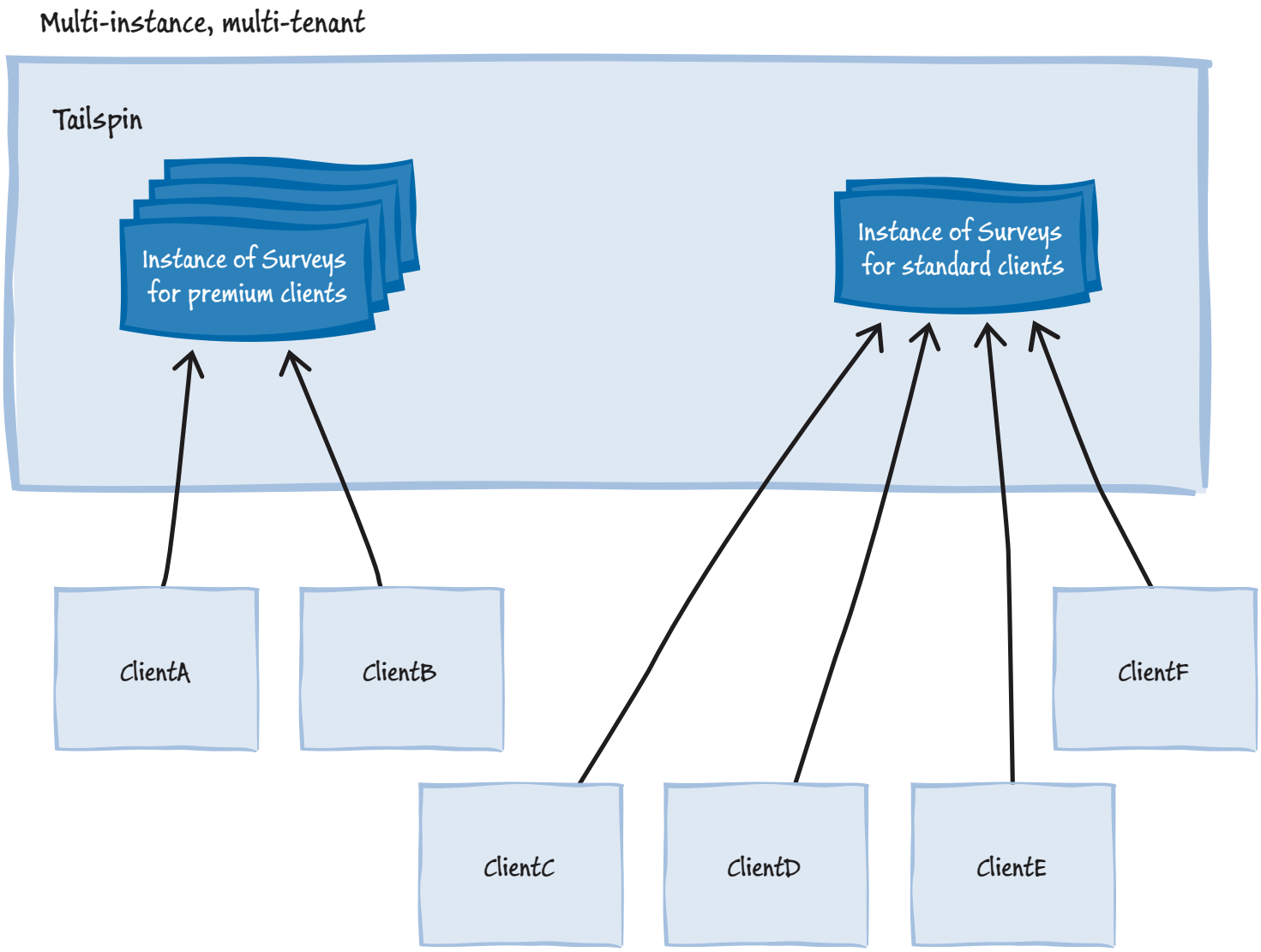
Logical View - Single / Multi Tenant Architecture



Scale Out


Multi-instance, single tenant
Tailspin
Instance of Surveys for ClientA
Instance of Surveys for ClientC
Instance of Surveys for ClientB
ClientA
ClientC
ClientB
Single instance, multi-tenant
Tailspin
Instance of Surveys (not client specific)
ClientA
ClientC
ClientB

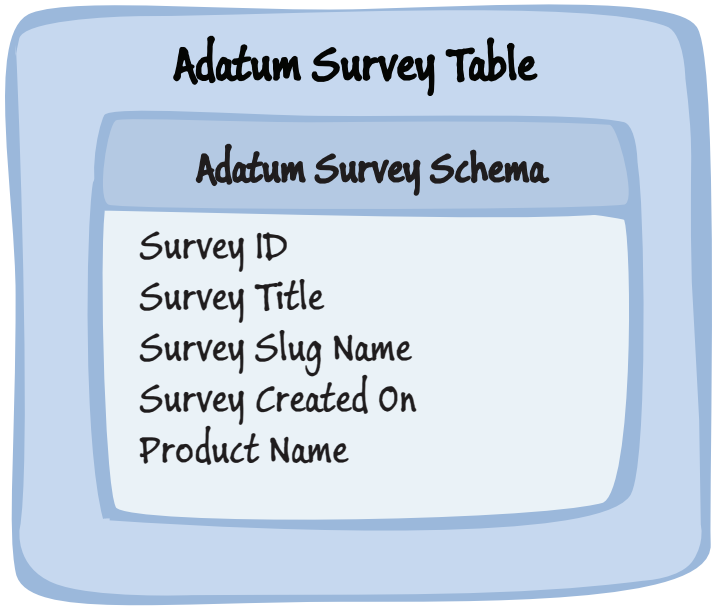
Multiple Multitenant Instances

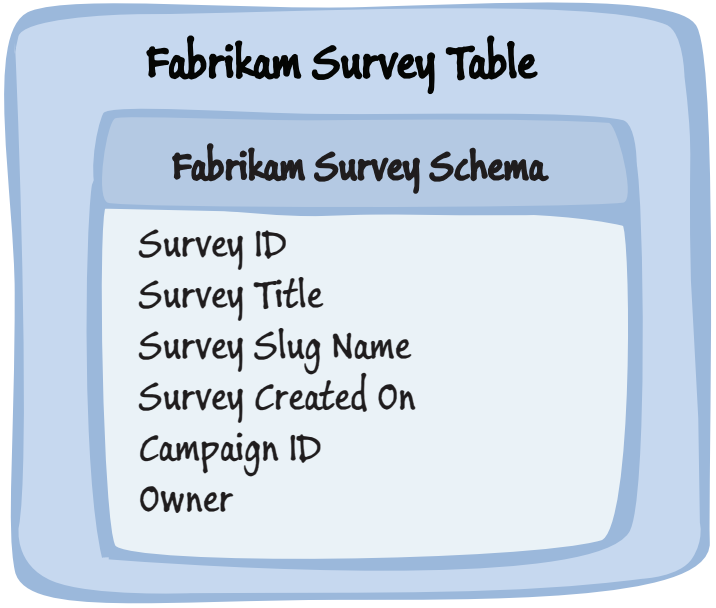


Multitenant Data Architecture

Data Architecture # 01

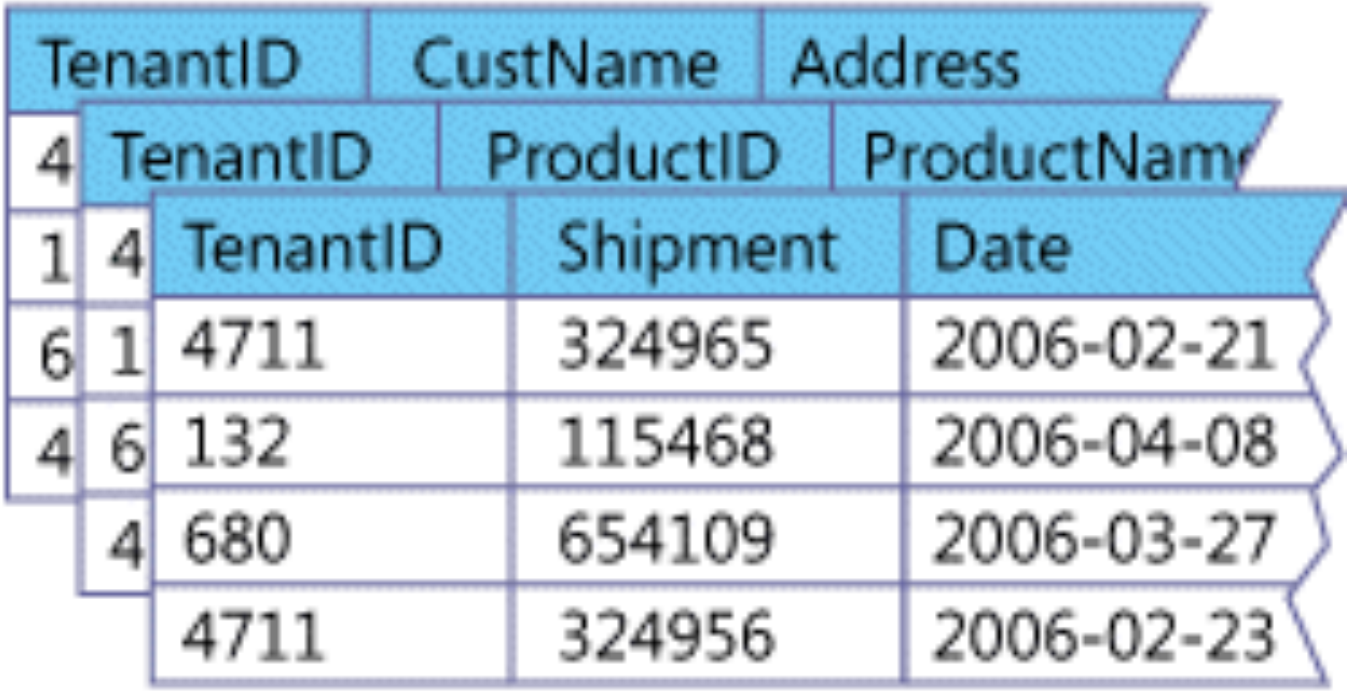
Separate table per tenant





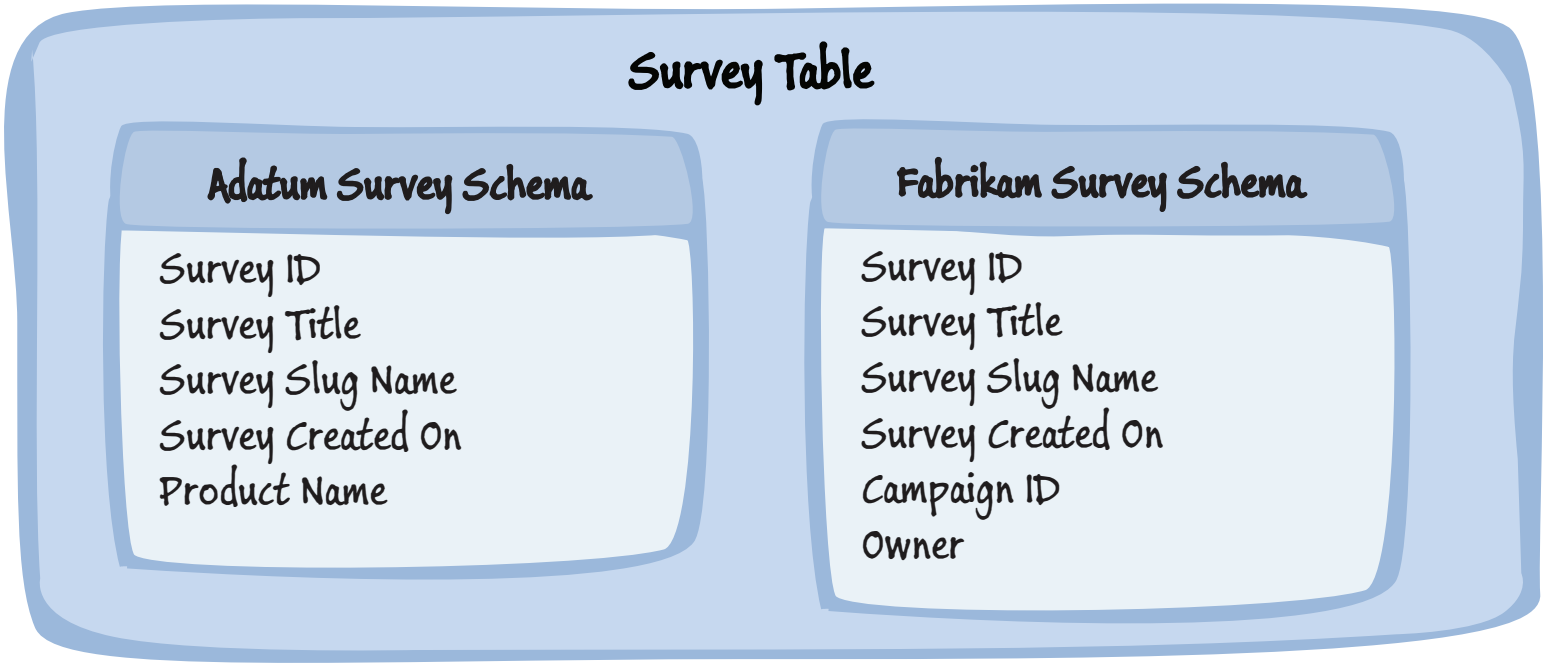
Data Architecture # 02

Single Table Same Schema



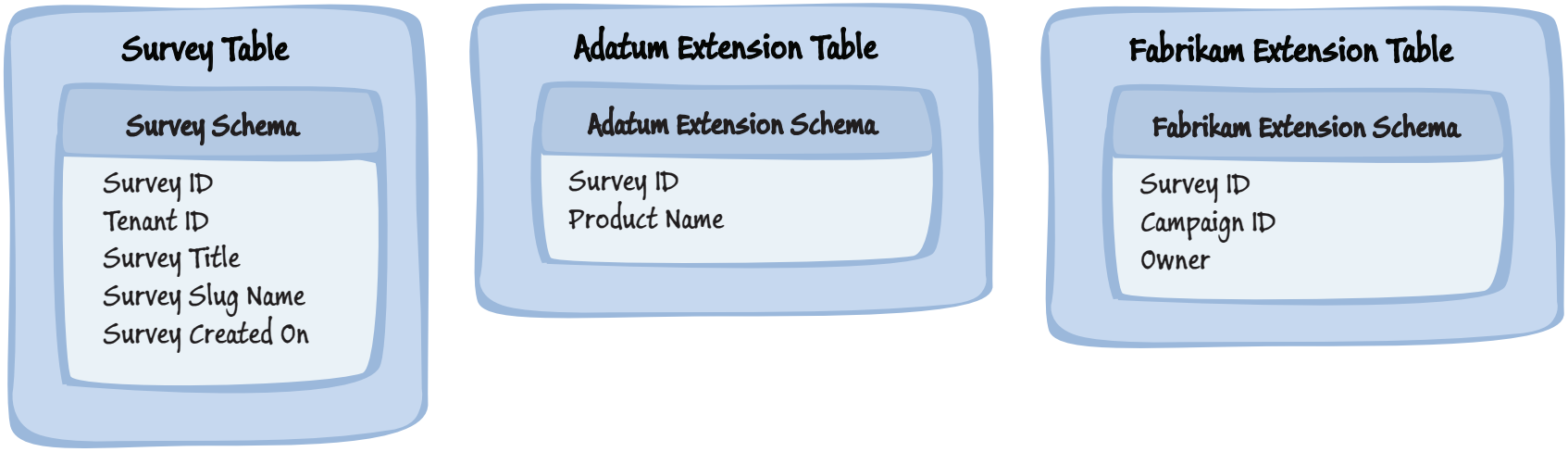
Data Architecture # 03

Single table with multiple schemas



Data Architecture # 04

Single schema with separate table holding custom data



Option 1 — Using a Single Table

Application Data

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID	Header record
Tenant ID, Month, Year	Detail Entity ID	Detail record (standard schema)
Tenant ID, Month, Year	Detail Entity ID	Detail record (extended schema)

Option 2 — Table per Tenant

Tenant A (uses standard detail record schema)

Partition Key	Row Key	Entry Type
Month, Year	Header Entity ID	Header record
Month, Year	Header Entity ID, Detail Entity ID	Detail record (standard schema)

Tenant B (uses extended detail record schema)

Partition Key	Row Key	Entry Type
Month, Year	Entity ID	Header record
Month, Year	Header Entity ID, Detail Entity ID	Detail record (extended schema)

Option 3 — Table per Base Entity Type

Header Records

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID	Header record

Detail Records

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID, Detail Entity ID	Detail record (standard schema, standard tenants)
Tenant ID, Month, Year	Header Entity ID, Detail Entity ID	Detail record (extended schema, premium tenants)

Option 4 — Table per Entity Type

Header Records

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID	Header record

Detail Records (standard tenants)

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID, Detail Entity ID	Detail record (standard schema, standard tenants)

Detail Records (premium tenants)

Partition Key	Row Key	Entry Type
Tenant ID, Month, Year	Header Entity ID, Detail Entity ID	Detail record (extended schema, premium tenants)

Option 5 — Table per Entity Type per Tenant

Tenant A Header Records

Partition Key	Row Key	Entry Type
Month, Year	Header Entity ID	Header record

Tenant B Header Records

Partition Key	Row Key	Entry Type
Month, Year	Header Entity ID	Header record

Tenant A Detail Records (standard schema)

Partition Key	Row Key	Entry Type
Month, Year	Header Entity ID, Detail Entity ID	Detail record (standard schema, standard tenants)

Tenant B Detail Records (extended schema)

Partition Key	Row Key	Entry Type
Month, Year	Header Entity ID, Detail Entity ID	Detail record (extended schema, premium tenants)

Scalability

Scaling & Replication

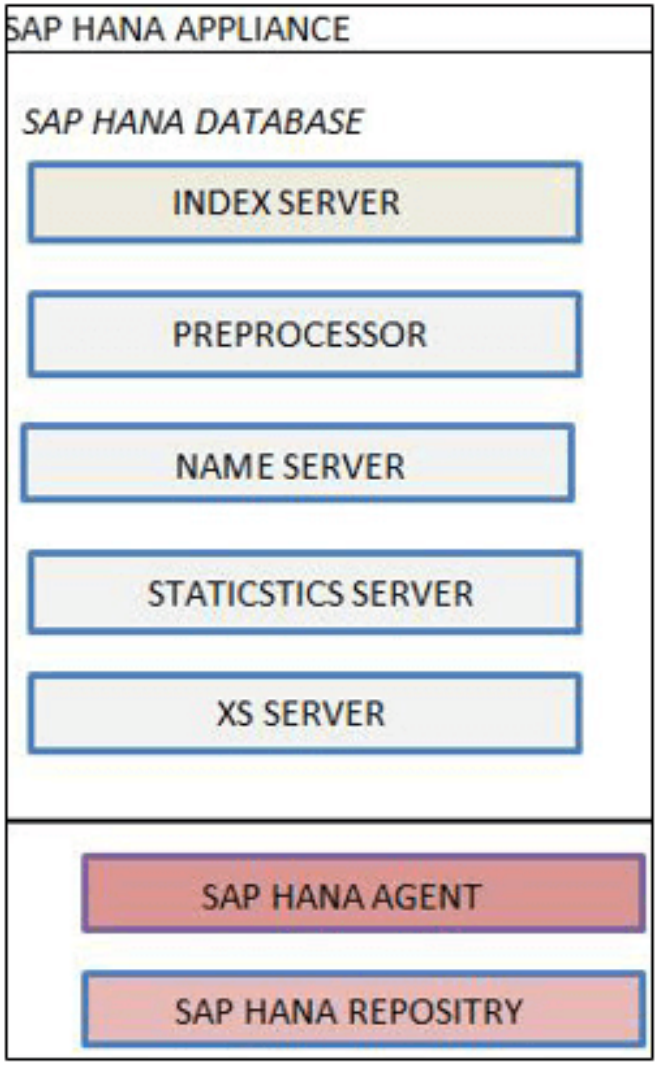
- Databases can be scaled up (by moving to a larger server that uses more powerful processors, more memory, and quicker disk drives)
- scaled out (by partitioning a database onto multiple servers).
- Different strategies are appropriate when scaling a shared database versus scaling dedicated databases.
- When developing a scaling strategy, it's important to distinguish between scaling your application (increasing the total workload the application can accommodate) and scaling your data (increasing your capacity for storing and working with data).
- **Replication** involves copying all or part of a database to another location, and then keeping the copy or copies synchronized with the original - Single Master vs Multiple Master

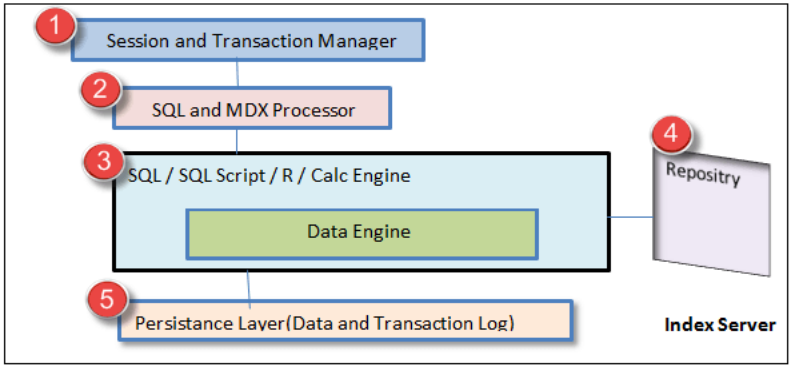
Scaling by Partitioning

- Partitioning involves pruning subsets of the data from a database and moving the pruned data to other databases or other tables in the same database.
- Partition a database by relocating whole tables, or by splitting one or more tables up into smaller tables horizontally or vertically.
- Horizontal partitioning means that the database is divided into two or more smaller databases using the same schema and structure, but with fewer rows in each table.
- Vertical partitioning means that one or more individual tables are divided into smaller tables with the same number of rows, but with each table containing a subset of the columns from the original.
- Replication and partitioning are often used in combination with one another when scaling databases.

SAP HANA Database

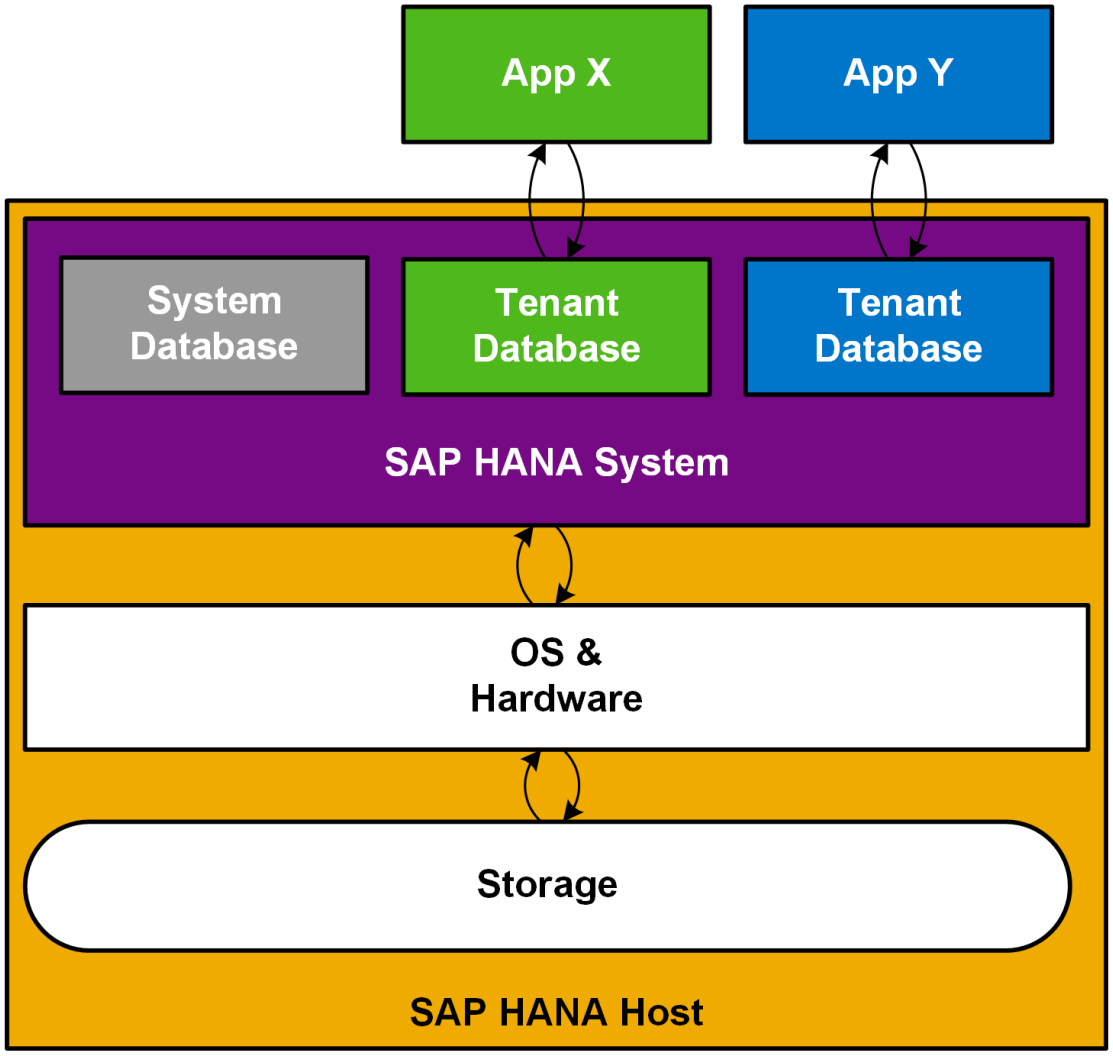
HANA Database



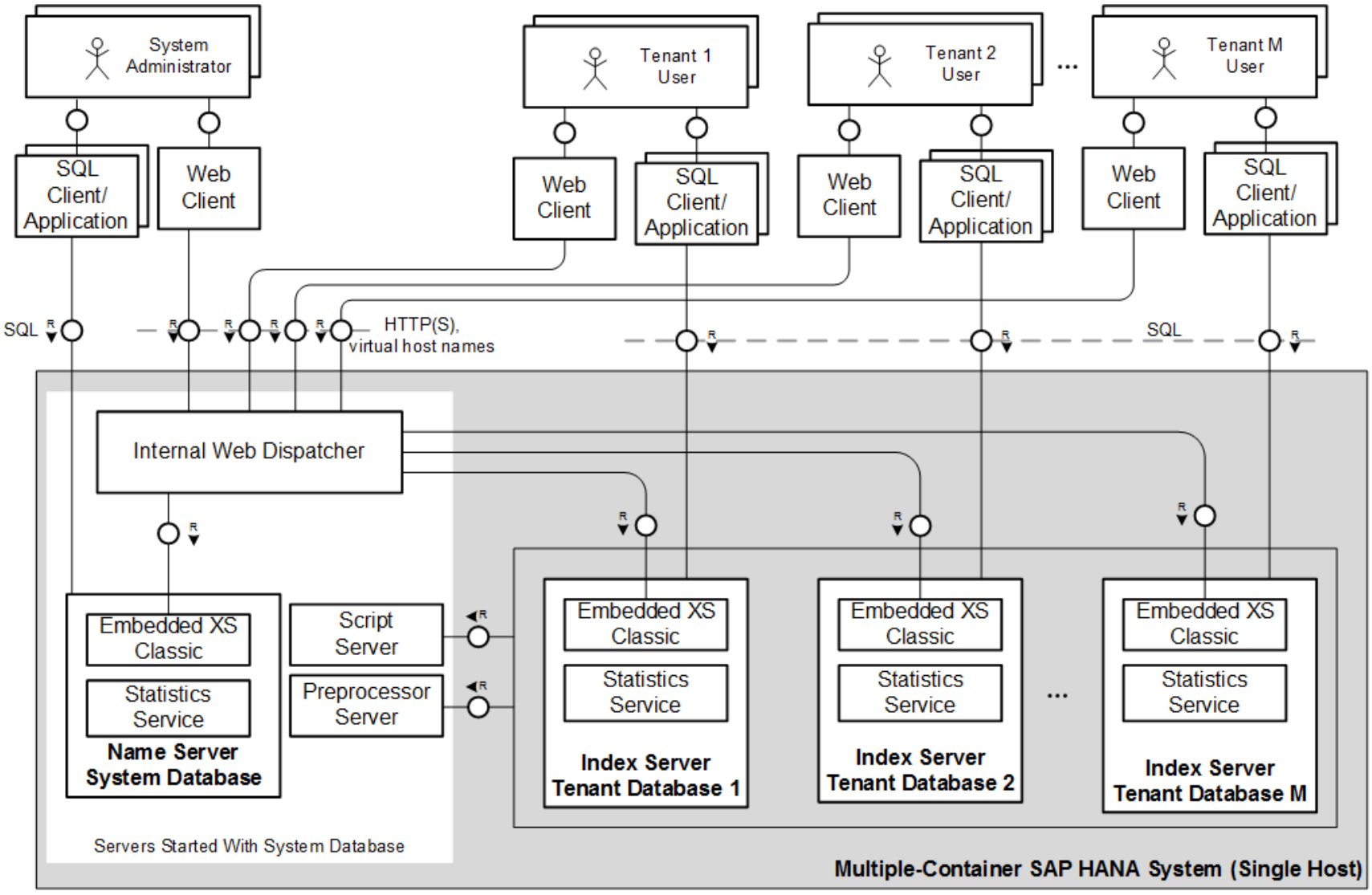


- **Pre processor Server -** Text Analysis and extract data from a text when the search function is used.
- **Name Server -** contains all information about the system landscape.
- **Statistic Server** responsible for collecting the data related to status, resource allocation / consumption and performance of SAP HANA system.
- **XS Server** XS contains XS Engine to connect to external clients

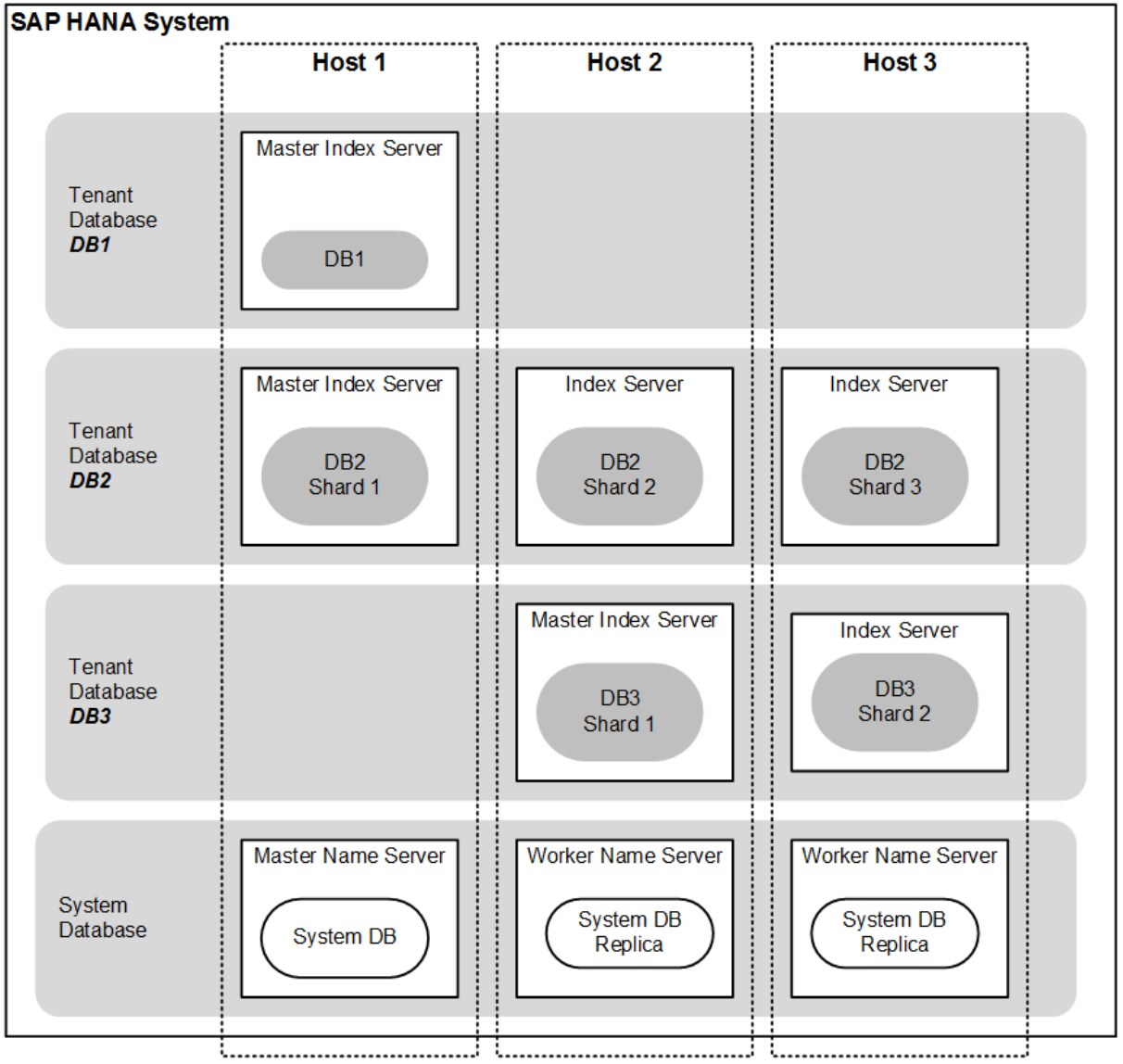
Multi Tenant HANA - Container based



Single Host Multitenant



Multi Host / Multi Tenant



Answer Key

Q - SAP

a. Why do you think that SAP has gone for a **hybrid landscape** and not cloud only approach?
b. Will this approach reduce the impact of SAP's promotion of cloud among its customers? Justify.

Many of you have written that it is NOT easy to go for Cloud Only approach

But you say that it will not impact SAP's promotion of asking its clients to go for Cloud

Even for SAP it is not easy

Many of you have copy pasted some stuff from Web ! **Mostly irrelevant**

One can refer but don't do copy paste

•**Ans:** A. SAP has gone for a hybrid landscape and not cloud only approach because of below reasons:
Not an easy task as it seems to be.
•Integration of SAP ERP to SAP Ariba
•Integration of SAP Successfactors with SAP Business Suite
•Integration of Fiori Apps on the SAP Cloud Platform.
•Data Security Concerns from customers.
•"The Pay for Performance" Operations.
•Integrated Data Management

Actually Not, it will not impact SAP's Promotion of cloud first because:
It will give customers and innovators new opportunities and mindset.
It will increase dealing with new complexities and skills.
It will help in the Cloud adoption rate.
It will give more flexibility.
It will increase business agility

Q - Laptop 4 Marks

You use your Laptop for all your Business requirements. Recently you got an access to AWS Cloud.

a. Create a DR strategy for your LAPTOP using the AWS Cloud
b. Explain how does the strategy meet your DR goals? (Hint: You must state your DR Goals)

You are expected to state your Goal (something similar to this)

Recovery Time Objective (RTO) : How long you can be afford to be offline.

Recovery Point Objective (RPO): How much data loss that you can sustain

Strategy align with goals and explanation on how does it align

Then create a strategy…explain how does the strategy meet your goal

Some of you have written

Data Migration is one of your goals for DR ??

Many have given same wrong answer!

Q - Virtualization 5 marks

a. Explain the three Virtualization technologies being used in cloud computing
b. Why does that AWS use HVM as default?
c. ..few questions are expected to be straight

Interesting observation - Many of you have not written HVM as one of the Virtualization technologies

Q - IAAS, PAAS, SAAS 3 Marks

Uber offers a Mobility Service. Here the service is CAB + Driver at the customer disposal. The customer uses the service to go from one place to another place.
On Similar lines for each of IAAS, PAAS, SAAS **provide a tangible definition of the Service / Product and state how does the customer use that product**

Definitions of SAAS, PAAS, IAAS are required
SAAS - what is the product/ service, who is the user, what does he do with the product

Many of you did not come out of Uber

Many of you have written same wrong answer!

Q - High Availability 6 marks

a. What is the role of Load balancers & Auto-scaler services in achieving High Availability?
b. What are the other services that enable high availability

All of you have written about LB & AS

But the question is about availability

That means some failure happens or you perceive that some resource is unhealthy

In that case

LB - can route the traffic

AS - can spawn new instances and the LB can route traffic

Q - Cloud Computing 4 Marks

"Mobile devices/applications will benefit from cloud computing" – Industry expert
Explain the reasons you think that this statement is true or provide arguments supporting the contrary. Justify your answer with examples

Many of you have written fairly well

Power, Platform, Data sharing, Any where / time etc

Many of you have ignored examples / justification part of the question

Q - Cloud Watch 3 Marks

"In AWS, auto scaling can be triggered by cloud-watch alarms"
State a few cloud watch metrics that can be used to trigger scaling. Justify the answer with end to end description of the use cases

Many of you have written about group size… that is more of boundary parameters

I will go with
CPU usage, memory usage, Number of transactions, number retries etc

Q - VM vs Container 3 Marks

A new application is being developed using Micro Services Architecture.
Discuss the use of VM vs Container as deployment architecture for the above application

The Key word is Micro Services
Major difference between VM and Container is OS

Some discussions expected on OS requirements
What if one of the micro services prefers a different OS?

Cloud Computing Course Plan

Refer the Course Handout

Term 2
We will have the Lab Session in the last week of Nov
We may use that for Quiz / Assignment

Like last term you will be doing an assignment
Will be announced in the next Class

Topics for this term

- PAAS
- SAAS
- Security in Cloud computing
- Multi Tenancy
- Distributed File System
- Capacity management

Development - IDE
Runtime Library / Framework - Updates
Development / Test / staging environment
Production environment
Versions - does it run on old versions
Continuous deployment
Multiple languages
Architecture - Client server / N-Tier / Micro Services / Big Data / Big Compute / Event Driven
Orchestrate business logic by combining apps (integration)
Extension of Applications - Mobile Front end / Analytics / IOT