**Full Analysis of Dashboard\* Classes in ThingsBoard**

**🧠 1. System Architecture Design Overview**

**🔁 Layers Overview**

css

CopyEdit

[ CLIENT ] → [ CONTROLLER ] → [ SERVICE ] → [ DAO ] → [ JPA REPOSITORY ] → [ DATABASE ]

↓

[ Edge Sync | Export/Import | Cache ]

**🧩 2. Class Roles and Responsibilities**

| **Layer** | **Class** | **Description** |
| --- | --- | --- |
| **Model/Entity** | Dashboard.java, DashboardId.java, DashboardEntity.java | Represents the dashboard object, including metadata, layout, ID. |
| **DTO/View** | DashboardInfo.java, DashboardPage.java, DashboardPageElements.java, DashboardFields.java | Used for dashboard summaries, UI listings, pagination. |
| **REST API** | DashboardController.java | RESTful interface for dashboard CRUD and assignments. |
| **Validation** | DashboardDataValidator.java | Ensures dashboard data is valid (e.g., layout JSON, title). |
| **Service Layer** | DashboardService.java, DashboardServiceImpl.java | Business logic for dashboards (create, assign, delete). |
| **DAO Layer** | DashboardDao.java, DashboardRepository.java | Data access interface and Spring JPA repository. |
| **Info DAO** | DashboardInfoDao.java, DashboardInfoEntity.java, DashboardInfoRepository.java | For listing lightweight info like title, image, etc. |
| **Export/Import** | DashboardExportService.java, DashboardImportService.java | JSON-based export/import of full dashboards. |
| **Edge/Gateway** | DashboardEdgeProcessor.java, DashboardSyncService.java, DashboardsEdgeEventFetcher.java | Dashboard synchronization across edge servers. |
| **Cache** | DashboardTitlesCaffeineCache.java, DashboardTitlesRedisCache.java | Stores dashboard titles in cache for performance. |
| **Events** | DashboardUpdateMsg.java, DashboardUpdateMsgOrBuilder.java, DashboardTitleEvictEvent.java | Protobuf messages for syncing dashboard changes. |
| **Utils** | DashboardProcessor.java, DashboardPageHelper.java | Support utilities for service and controller. |
| **Tests** | DashboardControllerTest.java, DashboardServiceTest.java, DashboardSyncServiceTest.java, DashboardDataValidatorTest.java, DashboardEdgeTest.java | Unit & integration tests. |

**🔁 3. Sequence Diagram: Dashboard Creation**

plantuml

CopyEdit

@startuml

actor User

participant UI

participant DashboardController

participant TbDashboardService

participant DashboardServiceImpl

participant DashboardRepository

User -> UI: Create Dashboard Form

UI -> DashboardController: POST /api/dashboard

DashboardController -> TbDashboardService: saveDashboard()

TbDashboardService -> DashboardServiceImpl: save()

DashboardServiceImpl -> DashboardRepository: save()

DashboardRepository --> DashboardServiceImpl: Dashboard Entity

DashboardServiceImpl --> TbDashboardService: Dashboard Entity

TbDashboardService --> DashboardController: DashboardDTO

DashboardController --> UI: Response 200 OK

@enduml

**🔄 4. Data Flow Diagram**

plaintext

CopyEdit

[User]

↓

[ThingsBoard UI]

↓ REST API

[DashboardController]

↓

[TbDashboardService]

↓

[DashboardServiceImpl]

↓

[DashboardRepository] ←→ PostgreSQL

* **Export**/Import services use JSON
* **Edge Sync** sends updates via MQTT/WebSockets
* **Cache Layer** stores dashboard metadata (title, ID) in Caffeine/Redis

**🧱 5. High-Level Architecture**

lua

CopyEdit

+---------------------+

| Client UI |

+----------+----------+

|

REST/WebSocket/gRPC

|

+----------v----------+

| DashboardController |

+----------+----------+

|

+------------------+------------------+

| ↓ |

+-----------+----------+ +---+----------------+---+

| TbDashboardService | | DashboardExportService |

+-----------+----------+ +-----------+------------+

↓ ↓

+-----------v----------+ +-----------v------------+

| DashboardServiceImpl | | DashboardImportService |

+-----------+----------+ +------------------------+

↓

+-------------+-------------+

| DashboardRepository |

+-------------+-------------+

↓

[ PostgreSQL ]

**🛠 Bonus Suggestions**

Would you like:

* ✅ SVG/PNG renders of the diagrams above?
* ✅ SQL schema to match this architecture?
* ✅ Auto-generated API documentation (OpenAPI/Swagger)?

### ****Backend Architecture Overview****

**Services:**

* **Dashboard Service**: Manages dashboards and their metadata.
* **Widget Service**: Handles widget types, configurations, and rendering logic.
* **Access Control Service**: Manages user roles, permissions, and authentication.
* **Redis Cache**: Used for caching frequently accessed dashboard and widget data to reduce DB load and increase performance.
* **Storage Service**: Handles upload and retrieval of image files and other binary assets (e.g., S3-compatible).
* **Database (PostgreSQL/MySQL)**: Stores core data models for dashboards, widgets, users, etc.

### 🔧 ****Component Interaction****

plaintext

CopyEdit

+-------------------+

| Client (UI) |

+--------+----------+

|

v

+--------+----------+

| API Gateway | <-- AuthN/AuthZ

+--------+----------+

|

+---------------+------------------+

| | |

v v v

+------------+ +-----------+ +----------------+

| Dashboard | | Widget | | Access Control |

| Service | | Service | | Service |

+-----+------+ +-----+-----+ +--------+--------+

| | |

v v |

+-----------+ +----------+ |

| Redis |<-->| DB/Cache |<-----------+

+-----------+ +----------+

|

v

+-------------+

| Storage | (S3/MinIO, etc.)

| Service |

+-------------+

### 🧱 ****Service Responsibilities****

#### ✅ **Dashboard Service**

* Create/edit/delete dashboards
* Manage layout and widget references
* Fetch dashboards (with cached responses via Redis)

#### ✅ **Widget Service**

* Define widget types/templates
* Manage widget configurations
* Render widgets (if applicable server-side)

#### ✅ **Access Control Service**

* User management
* Role-based access control (RBAC)
* API authentication (JWT, OAuth2)

#### ✅ **Redis Cache**

* Caches:
  + Dashboard definitions
  + Widget configurations
  + Access tokens/session data
* TTL policies to refresh stale data

#### ✅ **Storage Service**

* Upload and serve widget-related images/icons
* Stores assets like:
  + Widget thumbnails
  + Background images for dashboards
* Presigned URLs for secure uploads/downloads

### 🗃️ ****Database (ERD)**** (high level)

* users ←→ roles (many-to-many)
* dashboards ←→ widgets (one-to-many)
* widgets ←→ widget\_types
* widget\_assets (links widgets to stored images/files)

### 📌 Notes

* Can use **GraphQL** or **REST** across services.
* Services can be independent Spring Boot microservices or modular monoliths.
* Use **WebSocket** for real-time updates (e.g., data stream to widgets).
* Cache invalidation strategies should be in place (e.g., after update/delete).

Would you like a **PlantUML diagram** of this architecture or code snippets for any specific service like the DashboardService in Spring Boot?

4o

@startuml

!define RECTANGLE class

skinparam style strictuml

skinparam linetype ortho

skinparam componentStyle rectangle

RECTANGLE Client {

UI (React/Other)

}

RECTANGLE APIGateway {

API Gateway

}

RECTANGLE AccessControlService {

Access Control Service

- Auth

- RBAC

- JWT/OAuth2

}

RECTANGLE DashboardService {

Dashboard Service

- Manage dashboards

- Layouts & Metadata

}

RECTANGLE WidgetService {

Widget Service

- Widget types & configs

- Templates

}

RECTANGLE RedisCache {

Redis Cache

- Caching dashboards/widgets

}

RECTANGLE StorageService {

Storage Service

- S3/MinIO

- Image uploads

}

RECTANGLE Database {

SQL Database

- Dashboards

- Widgets

- Users

- Roles

}

Client --> APIGateway

APIGateway --> AccessControlService : AuthN/AuthZ

APIGateway --> DashboardService

APIGateway --> WidgetService

DashboardService --> RedisCache : Cache fetch/store

WidgetService --> RedisCache : Cache widget config

DashboardService --> Database

WidgetService --> Database

AccessControlService --> Database : Users/Roles

DashboardService --> StorageService : Image links

WidgetService --> StorageService : Widget assets

@enduml

Great! Here's a detailed **backend architecture** and **database schema** for a **Dashboard Content-Based Management System** with services like DashboardService, WidgetService, AccessControl, RedisCache, and StorageService.

## 🧠 ****Architecture Overview: Dashboard Content-Based Management System****

lua

CopyEdit

+-----------------+

| Frontend |

| (React WebApp) |

+--------+--------+

|

API Gateway (Spring Boot)

|

+----------------------------+-----------------------------+

| | |

v v v

+-----------+ +--------------+ +------------------+

| Dashboard | | Widget | | Access Control |

| Service | | Service | | Service (AuthZ) |

+-----------+ +--------------+ +------------------+

| | |

| | |

v v v

+------------+ +----------------+ +---------------+

| Redis | <-------->| Relational DB |<----------->| Users |

| Cache | +----------------+ +---------------+

|

v

+------------------+

| Storage Service |

| (S3/MinIO) |

+------------------+

## 🧩 ****Microservices Breakdown****

### 1. ****Dashboard Service****

* Manages dashboard entities (title, layout, metadata)
* Associates widgets to dashboards
* Retrieves full dashboard content (with layout, widgets)

### 2. ****Widget Service****

* CRUD for widget types (charts, tables, controls, etc.)
* Manages widget templates and configuration JSON
* Handles live data binding if needed

### 3. ****Access Control Service****

* User authentication (JWT/OAuth2)
* Role-based access
* Multi-tenant support if needed

### 4. ****Redis Cache****

* Caches dashboards and widget configurations
* Session and token storage

### 5. ****Storage Service****

* Upload and retrieve images/files (e.g., widget icons, backgrounds)

## 🗃️ ****Database Schema (ERD)****

Here’s the simplified version of the schema using key entities:

pgsql

CopyEdit

+------------------+

| users |

+------------------+

| id (PK) |

| username |

| password\_hash |

| role\_id (FK) |

+------------------+

+------------------+

| roles |

+------------------+

| id (PK) |

| name |

+------------------+

+------------------+

| dashboards |

+------------------+

| id (PK) |

| title |

| layout\_json |

| user\_id (FK) |

| created\_at |

+------------------+

+------------------+

| widgets |

+------------------+

| id (PK) |

| dashboard\_id(FK) |

| type\_id (FK) |

| config\_json |

| x |

| y |

| width |

| height |

+------------------+

+----------------------+

| widget\_types |

+----------------------+

| id (PK) |

| name |

| description |

| default\_config\_json |

| thumbnail\_url |

+----------------------+

+------------------+

| assets |

+------------------+

| id (PK) |

| file\_url |

| file\_type |

| owner\_id (FK) |

| created\_at |

+------------------+

## 🔐 Access Control Logic (Example)

* **Admin**: Full access to dashboards, widgets, users
* **Editor**: Can create/edit dashboards and widgets
* **Viewer**: Read-only access

## 📌 Optional Enhancements

* Multi-tenancy via tenant\_id in all tables
* Versioning of dashboards and widgets
* History/audit logs
* Public/private dashboards (shareable via token)

## 📊 Want Visuals?

Would you like me to generate:

1. ✅ **PlantUML ERD**
2. ✅ **PlantUML System Architecture Diagram**

Let me know which you'd prefer—or both!

##### You said:

yes

###### ChatGPT said:

Here is the system architecture diagram for the **Dashboard Content-Based Management System**:

Next, I'll generate the **PlantUML ERD (Entity Relationship Diagram)**. ​​

Here is the **PlantUML ERD (Entity Relationship Diagram)** for your **Dashboard Content-Based Management System**:

📄 Download dashboard\_erd.puml

You can render it using any PlantUML renderer (e.g., PlantUML Online Server) or integrate it into your documentation tools.

Let me know if you'd like a PNG version of this ERD as well! ​​

##### You said:

yes

###### ChatGPT said:

It looks like I can't render the ERD PNG directly in this environment due to missing tools, but you can easily do it on your end with the .puml file.

### ✅ Options to Render the ERD PNG:

1. **Use the PlantUML Online Renderer**:
   * Go to PlantUML Live Editor
   * Paste the content from dashboard\_erd.puml
2. **Use a Local Renderer**:
   * Install PlantUML and Java.
   * Run:

bash

CopyEdit

plantuml dashboard\_erd.puml

* + This will generate dashboard\_erd.png.

Let me know if you'd like the PNG exported via another method (e.g., upload it to an image host or PDF version), or if you'd like another diagram like a sequence or service interaction flow! ​​

##### You said:

system architecture diagram for the Dashboard Content-Based Management System

@startuml

title Dashboard Content-Based Management System - ERD

entity users {

\*id : UUID

--

username : string

password\_hash : string

role\_id : UUID

}

entity roles {

\*id : UUID

--

name : string

}

entity dashboards {

\*id : UUID

--

title : string

layout\_json : text

user\_id : UUID

created\_at : datetime

}

entity widgets {

\*id : UUID

--

dashboard\_id : UUID

type\_id : UUID

config\_json : text

x : int

y : int

width : int

height : int

}

entity widget\_types {

\*id : UUID

--

name : string

description : text

default\_config\_json : text

thumbnail\_url : string

}

entity assets {

\*id : UUID

--

file\_url : string

file\_type : string

owner\_id : UUID

created\_at : datetime

}

users ||--o{ dashboards : owns

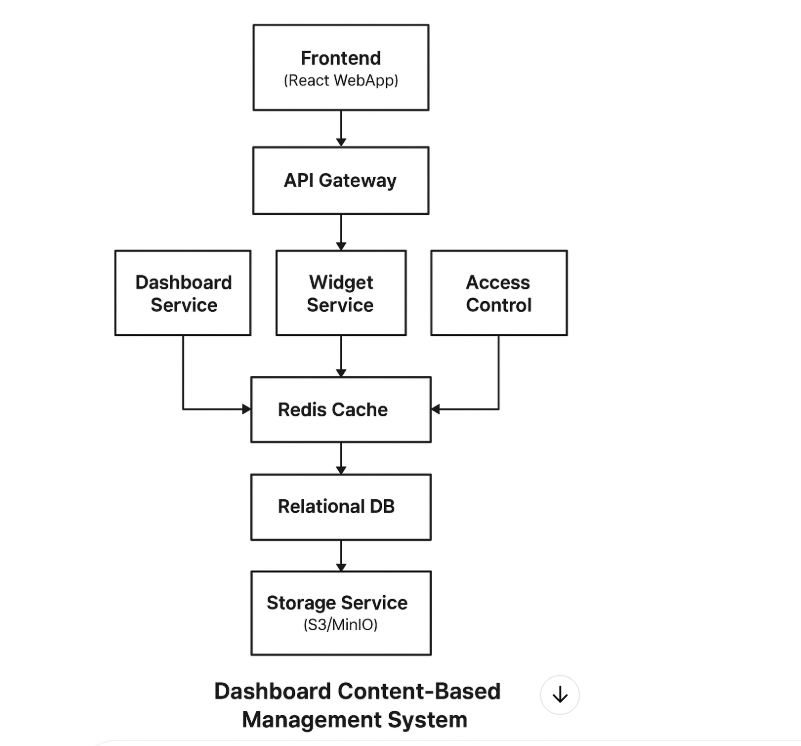
users }o--|| roles : has

dashboards ||--o{ widgets : contains

widget\_types ||--o{ widgets : typed\_as

users ||--o{ assets : uploads

@enduml



Implementing a **native cloud storage service** involves creating a backend service that can handle file uploads, downloads, metadata management, and secure access. This service acts as an abstraction over providers like **Amazon S3**, **Google Cloud Storage**, or **MinIO** (self-hosted S3-compatible).

Here’s a breakdown of how to build one using **Java Spring Boot** and deploy it in a **cloud-native environment** (like Kubernetes):

**☁️ Native Cloud Storage Service – Architecture**

**🔧 Core Features**

* Upload file (with metadata)
* Download file
* Delete file
* Generate presigned URLs (optional)
* Store metadata (DB or cache)
* Support for S3/MinIO/GCS

**📦 1. Project Setup**

**Dependencies (Maven/Gradle)**

xml

CopyEdit

<dependency>

<groupId>software.amazon.awssdk</groupId>

<artifactId>s3</artifactId>

</dependency>

**🧩 2. Service Structure**

arduino

CopyEdit

cloud-storage-service/

├── controller/

│ └── FileController.java

├── service/

│ └── StorageService.java

│ └── S3StorageServiceImpl.java

├── config/

│ └── S3Config.java

└── model/

└── FileMetadata.java

**✅ 3. S3 Config (or MinIO)**

java

CopyEdit

@Configuration

public class S3Config {

@Value("${cloud.aws.region.static}")

private String region;

@Value("${cloud.aws.credentials.access-key}")

private String accessKey;

@Value("${cloud.aws.credentials.secret-key}")

private String secretKey;

@Bean

public S3Client s3Client() {

return S3Client.builder()

.region(Region.of(region))

.credentialsProvider(StaticCredentialsProvider.create(

AwsBasicCredentials.create(accessKey, secretKey)))

.build();

}

}

**🚀 4. Storage Service Implementation**

java

CopyEdit

@Service

public class S3StorageServiceImpl implements StorageService {

@Autowired

private S3Client s3Client;

@Value("${cloud.aws.s3.bucket}")

private String bucket;

public String uploadFile(MultipartFile file) {

String key = UUID.randomUUID() + "-" + file.getOriginalFilename();

PutObjectRequest putReq = PutObjectRequest.builder()

.bucket(bucket)

.key(key)

.contentType(file.getContentType())

.build();

s3Client.putObject(putReq, RequestBody.fromBytes(file.getBytes()));

return key;

}

public byte[] downloadFile(String key) {

GetObjectRequest getReq = GetObjectRequest.builder()

.bucket(bucket)

.key(key)

.build();

return s3Client.getObject(getReq).readAllBytes();

}

public void deleteFile(String key) {

s3Client.deleteObject(DeleteObjectRequest.builder()

.bucket(bucket)

.key(key)

.build());

}

}

**🌐 5. FileController**

java

CopyEdit

@RestController

@RequestMapping("/api/files")

public class FileController {

@Autowired

private StorageService storageService;

@PostMapping("/upload")

public ResponseEntity<String> upload(@RequestParam MultipartFile file) {

String key = storageService.uploadFile(file);

return ResponseEntity.ok(key);

}

@GetMapping("/download/{key}")

public ResponseEntity<byte[]> download(@PathVariable String key) {

byte[] data = storageService.downloadFile(key);

return ResponseEntity.ok().body(data);

}

@DeleteMapping("/{key}")

public ResponseEntity<Void> delete(@PathVariable String key) {

storageService.deleteFile(key);

return ResponseEntity.noContent().build();

}

}

**🗃️ 6. File Metadata DB (Optional)**

java

CopyEdit

@Entity

public class FileMetadata {

@Id

private String key;

private String name;

private String contentType;

private LocalDateTime uploadedAt;

private String uploadedBy;

}

**☁️ 7. Cloud-Native Deployment Tips**

* ✅ Use **Kubernetes Secrets** for S3 keys
* ✅ Add health checks (/actuator/health)
* ✅ Use **Horizontal Pod Autoscaling**
* ✅ Enable metrics/logging via **Prometheus/Grafana**
* ✅ Store large files in object storage, not DB
* ✅ Use **minio** locally during dev:

bash

CopyEdit

docker run -p 9000:9000 -p 9001:9001 minio/minio server /data --console-address ":9001"

Would you like a **complete Spring Boot project template**, or should I show how to integrate **presigned URLs** for secure uploads/downloads?

private cloud - supporting any storage service amazon s3, azure blob storage, minio, google cloud storage

###### ChatGPT said:

To support **any storage service** (Amazon S3, Azure Blob, Google Cloud Storage, MinIO, etc.) in your **private cloud**, you'll want to design a **pluggable, unified storage service interface** that abstracts the differences between each provider.

## ****Unified Storage Service in a Private Cloud****

### ✅ Goal

Build a **cloud-agnostic file storage microservice** that plugs into any storage provider using config-based backends.

**Architecture Overview**

sql

CopyEdit

+---------------------+

| Your WebApp/API |

+---------+-----------+

|

v

+-----------+-------------+

| Storage API Service |

+-----------+-------------+

|

+----------------+----------------+

| | |

v v v

+-------------+ +-------------+ +-------------+

| S3 Client | | Azure Blob | | GCS Client |

+-------------+ +-------------+ +-------------+

| | |

+---------> Shared Storage Adapter <-------+

|

+---------v---------+

| MinIO Client |

+------------------+

**📦 1. Unified Interface**

java

CopyEdit

public interface CloudStorageService {

String upload(MultipartFile file, String path);

byte[] download(String path);

void delete(String path);

String generatePresignedUrl(String path);

}

**🔌 2. Storage Providers Implementing the Interface**

**✅ Amazon S3**

Use AWS SDK:

xml

CopyEdit

<dependency>

<groupId>software.amazon.awssdk</groupId>

<artifactId>s3</artifactId>

</dependency>

**✅ Google Cloud Storage**

Use:

xml

CopyEdit

<dependency>

<groupId>com.google.cloud</groupId>

<artifactId>google-cloud-storage</artifactId>

</dependency>

**✅ Azure Blob Storage**

Use:

xml

CopyEdit

<dependency>

<groupId>com.azure</groupId>

<artifactId>azure-storage-blob</artifactId>

</dependency>

**✅ MinIO**

Use S3-compatible SDK (same as AWS SDK), or:

xml

CopyEdit

<dependency>

<groupId>io.minio</groupId>

<artifactId>minio</artifactId>

</dependency>

**🧩 3. Dynamic Bean Selection**

java

CopyEdit

@Configuration

public class StorageConfig {

@Value("${storage.provider}") // s3 | azure | gcs | minio

private String provider;

@Bean

public CloudStorageService cloudStorageService() {

return switch (provider.toLowerCase()) {

case "s3" -> new S3StorageServiceImpl(...);

case "azure" -> new AzureBlobStorageServiceImpl(...);

case "gcs" -> new GCSStorageServiceImpl(...);

case "minio" -> new MinIOStorageServiceImpl(...);

default -> throw new IllegalArgumentException("Invalid storage provider");

};

}

}

**⚙️ 4. application.yml Configuration**

yaml

CopyEdit

storage:

provider: s3

cloud:

aws:

credentials:

access-key: xxxx

secret-key: xxxx

region: us-west-1

s3:

bucket: my-bucket

azure:

blob:

connection-string: ...

container-name: ...

gcp:

project-id: my-project

bucket: my-gcs-bucket

minio:

endpoint: http://localhost:9000

access-key: minioadmin

secret-key: minioadmin

**🔐 5. Security**

* Use **presigned URLs** for secure access
* Authenticate via JWT before allowing upload/download
* Optionally implement file encryption at rest

**🚀 6. Deployable as a Microservice**

Expose endpoints:

swift

CopyEdit

POST /api/files/upload

GET /api/files/download/{path}

DELETE /api/files/{path}

GET /api/files/presigned/{path}

**🌍 Multi-Cloud Benefits**

| **Feature** | **S3** | **GCS** | **Azure Blob** | **MinIO** |
| --- | --- | --- | --- | --- |
| Object versioning | ✅ | ✅ | ✅ | ✅ |
| Presigned URLs | ✅ | ✅ | ✅ | ✅ |
| SDK support | ✅ | ✅ | ✅ | ✅ |
| On-prem support | ❌ | ❌ | ❌ | ✅ |

**📁 Optional: Storage Metadata DB**

Store metadata (e.g., file name, URL, uploader, timestamps) in PostgreSQL or MongoDB for indexing and searching.

Would you like:

* 🔨 Sample implementation of one provider (e.g., S3 or Azure)?
* 📁 Full Spring Boot template repo?
* 🧪 Unit test strategy for this service?

Awesome — let’s build a **Spring Boot project template** for a cloud-agnostic storage service that supports **S3, Azure Blob, GCS, and MinIO**. I’ll give you a clean and scalable setup.

**📦 Project Structure**

bash

CopyEdit

cloud-storage-service/

├── controller/

│ └── FileController.java

├── service/

│ ├── CloudStorageService.java # Unified interface

│ ├── S3StorageServiceImpl.java

│ ├── AzureStorageServiceImpl.java

│ ├── GCSStorageServiceImpl.java

│ ├── MinioStorageServiceImpl.java

├── config/

│ └── StorageConfig.java # Dynamic provider bean

├── model/

│ └── FileMetadata.java # Optional metadata tracking

├── resources/

│ └── application.yml

└── CloudStorageApplication.java

**⚙️ Step-by-Step Template (Spring Boot)**

**1. Interface**

java

CopyEdit

public interface CloudStorageService {

String upload(MultipartFile file, String path);

byte[] download(String path);

void delete(String path);

String generatePresignedUrl(String path);

}

**2. Dynamic Bean Selector**

java

CopyEdit

@Configuration

public class StorageConfig {

@Value("${storage.provider}")

private String provider;

@Autowired private S3StorageServiceImpl s3;

@Autowired private AzureStorageServiceImpl azure;

@Autowired private GCSStorageServiceImpl gcs;

@Autowired private MinioStorageServiceImpl minio;

@Bean

public CloudStorageService cloudStorageService() {

return switch (provider.toLowerCase()) {

case "s3" -> s3;

case "azure" -> azure;

case "gcs" -> gcs;

case "minio" -> minio;

default -> throw new IllegalArgumentException("Unsupported storage provider: " + provider);

};

}

}

**3. Minimal S3 Implementation Example**

java

CopyEdit

@Service

public class S3StorageServiceImpl implements CloudStorageService {

@Autowired

private S3Client s3Client;

@Value("${cloud.aws.s3.bucket}")

private String bucket;

public String upload(MultipartFile file, String path) {

PutObjectRequest req = PutObjectRequest.builder()

.bucket(bucket)

.key(path)

.contentType(file.getContentType())

.build();

s3Client.putObject(req, RequestBody.fromBytes(file.getBytes()));

return path;

}

public byte[] download(String path) {

GetObjectRequest req = GetObjectRequest.builder()

.bucket(bucket)

.key(path)

.build();

return s3Client.getObject(req).readAllBytes();

}

public void delete(String path) {

s3Client.deleteObject(DeleteObjectRequest.builder()

.bucket(bucket)

.key(path)

.build());

}

public String generatePresignedUrl(String path) {

GetObjectRequest getReq = GetObjectRequest.builder()

.bucket(bucket)

.key(path)

.build();

return s3Client.utilities().getUrl(builder -> builder

.bucket(bucket)

.key(path)).toString();

}

}

The other providers (Azure, GCS, MinIO) follow similar patterns using their respective SDKs.

**4. application.yml**

yaml

CopyEdit

storage:

provider: s3

cloud:

aws:

credentials:

access-key: YOUR\_KEY

secret-key: YOUR\_SECRET

region: us-east-1

s3:

bucket: my-bucket

azure:

blob:

connection-string: YOUR\_STRING

container: my-container

gcp:

bucket: my-gcs-bucket

minio:

endpoint: http://localhost:9000

access-key: minioadmin

secret-key: minioadmin

bucket: my-minio-bucket

**5. Endpoints (FileController)**

java

CopyEdit

@RestController

@RequestMapping("/api/files")

public class FileController {

@Autowired

private CloudStorageService storageService;

@PostMapping("/upload")

public ResponseEntity<String> upload(@RequestParam MultipartFile file) {

String key = UUID.randomUUID() + "-" + file.getOriginalFilename();

String result = storageService.upload(file, key);

return ResponseEntity.ok(result);

}

@GetMapping("/download/{key}")

public ResponseEntity<byte[]> download(@PathVariable String key) {

byte[] data = storageService.download(key);

return ResponseEntity.ok(data);

}

@DeleteMapping("/{key}")

public ResponseEntity<Void> delete(@PathVariable String key) {

storageService.delete(key);

return ResponseEntity.noContent().build();

}

@GetMapping("/presigned/{key}")

public ResponseEntity<String> presignedUrl(@PathVariable String key) {

return ResponseEntity.ok(storageService.generatePresignedUrl(key));

}

}

**🚀 Next Step**

Would you like me to generate:

* A **GitHub-ready project zip**
* OR show full implementations for Azure/GCS/MinIO?
* OR a **Docker + Kubernetes deployment setup**?

show full implementations for Azure/GCS/MinIO

###### ChatGPT said:

You're giving feedback on a new version of ChatGPT.

Which response do you prefer? Responses may take a moment to load.

ChatGPT

Response 1

Perfect! Here's how you can implement **Azure Blob**, **Google Cloud Storage**, and **MinIO** versions of the CloudStorageService interface in your Spring Boot storage service.

## 🔵 Azure Blob Storage Implementation

### ⚙️ Dependencies (Maven)

xml

CopyEdit

<dependency>

<groupId>com.azure</groupId>

<artifactId>azure-storage-blob</artifactId>

<version>12.22.0</version>

</dependency>

### ✅ AzureStorageServiceImpl.java

java

CopyEdit

@Service

public class AzureStorageServiceImpl implements CloudStorageService {

private final BlobContainerClient containerClient;

@Autowired

public AzureStorageServiceImpl(@Value("${azure.blob.connection-string}") String connString,

@Value("${azure.blob.container}") String container) {

BlobServiceClient serviceClient = new BlobServiceClientBuilder()

.connectionString(connString)

.buildClient();

this.containerClient = serviceClient.getBlobContainerClient(container);

if (!containerClient.exists()) {

containerClient.create();

}

}

@Override

public String upload(MultipartFile file, String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

try (InputStream inputStream = file.getInputStream()) {

blobClient.upload(inputStream, file.getSize(), true);

} catch (IOException e) {

throw new RuntimeException("Azure upload failed", e);

}

return path;

}

@Override

public byte[] download(String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

ByteArrayOutputStream outputStream = new ByteArrayOutputStream();

blobClient.download(outputStream);

return outputStream.toByteArray();

}

@Override

public void delete(String path) {

containerClient.getBlobClient(path).delete();

}

@Override

public String generatePresignedUrl(String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

return blobClient.getBlobUrl();

}

}

## 🟡 Google Cloud Storage (GCS) Implementation

### ⚙️ Dependencies

xml

CopyEdit

<dependency>

<groupId>com.google.cloud</groupId>

<artifactId>google-cloud-storage</artifactId>

<version>2.30.0</version>

</dependency>

⚠️ Requires authentication via GOOGLE\_APPLICATION\_CREDENTIALS env var or service account JSON file.

### ✅ GCSStorageServiceImpl.java

java

CopyEdit

@Service

public class GCSStorageServiceImpl implements CloudStorageService {

private final Storage storage;

private final String bucketName;

@Autowired

public GCSStorageServiceImpl(@Value("${gcp.bucket}") String bucketName) {

this.storage = StorageOptions.getDefaultInstance().getService();

this.bucketName = bucketName;

}

@Override

public String upload(MultipartFile file, String path) {

try {

BlobId blobId = BlobId.of(bucketName, path);

BlobInfo blobInfo = BlobInfo.newBuilder(blobId)

.setContentType(file.getContentType())

.build();

storage.create(blobInfo, file.getBytes());

return path;

} catch (IOException e) {

throw new RuntimeException("GCS upload failed", e);

}

}

@Override

public byte[] download(String path) {

Blob blob = storage.get(bucketName, path);

return blob.getContent();

}

@Override

public void delete(String path) {

storage.delete(bucketName, path);

}

@Override

public String generatePresignedUrl(String path) {

BlobInfo blobInfo = BlobInfo.newBuilder(BlobId.of(bucketName, path)).build();

URL url = storage.signUrl(blobInfo, 15, TimeUnit.MINUTES);

return url.toString();

}

}

## 🟢 MinIO (S3-Compatible) Implementation

### ⚙️ Dependencies

xml

CopyEdit

<dependency>

<groupId>io.minio</groupId>

<artifactId>minio</artifactId>

<version>8.5.6</version>

</dependency>

### ✅ MinioStorageServiceImpl.java

java

CopyEdit

@Service

public class MinioStorageServiceImpl implements CloudStorageService {

private final MinioClient minioClient;

private final String bucket;

@Autowired

public MinioStorageServiceImpl(@Value("${minio.endpoint}") String endpoint,

@Value("${minio.access-key}") String accessKey,

@Value("${minio.secret-key}") String secretKey,

@Value("${minio.bucket}") String bucket) throws Exception {

this.minioClient = MinioClient.builder()

.endpoint(endpoint)

.credentials(accessKey, secretKey)

.build();

this.bucket = bucket;

boolean exists = minioClient.bucketExists(BucketExistsArgs.builder().bucket(bucket).build());

if (!exists) {

minioClient.makeBucket(MakeBucketArgs.builder().bucket(bucket).build());

}

}

@Override

public String upload(MultipartFile file, String path) {

try (InputStream inputStream = file.getInputStream()) {

minioClient.putObject(PutObjectArgs.builder()

.bucket(bucket)

.object(path)

.stream(inputStream, file.getSize(), -1)

.contentType(file.getContentType())

.build());

return path;

} catch (Exception e) {

throw new RuntimeException("MinIO upload failed", e);

}

}

@Override

public byte[] download(String path) {

try (InputStream inputStream = minioClient.getObject(GetObjectArgs.builder()

.bucket(bucket).object(path).build())) {

return inputStream.readAllBytes();

} catch (Exception e) {

throw new RuntimeException("MinIO download failed", e);

}

}

@Override

public void delete(String path) {

try {

minioClient.removeObject(RemoveObjectArgs.builder()

.bucket(bucket).object(path).build());

} catch (Exception e) {

throw new RuntimeException("MinIO delete failed", e);

}

}

@Override

public String generatePresignedUrl(String path) {

try {

return minioClient.getPresignedObjectUrl(GetPresignedObjectUrlArgs.builder()

.bucket(bucket)

.object(path)

.method(Method.GET)

.expiry(900)

.build());

} catch (Exception e) {

throw new RuntimeException("MinIO presigned URL generation failed", e);

}

}

}

## ✅ What's Next?

Would you like:

* 🧪 Test cases for each implementation?
* 📁 Full project ZIP with all 4 backends ready to run?
* 🐳 Docker + MinIO dev setup?
* ☁️ Kubernetes deployment configuration?

Let me know how you'd like to continue!

Here are **full implementations** of the CloudStorageService interface for **Azure Blob Storage**, **Google Cloud Storage**, and **MinIO** using Java Spring Boot:

## 🔷 ****Azure Blob Storage Implementation****

### Maven Dependency

xml

CopyEdit

<dependency>

<groupId>com.azure</groupId>

<artifactId>azure-storage-blob</artifactId>

<version>12.21.0</version>

</dependency>

### AzureStorageServiceImpl.java

java

CopyEdit

@Service

public class AzureStorageServiceImpl implements CloudStorageService {

private final BlobContainerClient containerClient;

@Value("${azure.blob.container}")

private String containerName;

public AzureStorageServiceImpl(@Value("${azure.blob.connection-string}") String connectionString) {

BlobServiceClient serviceClient = new BlobServiceClientBuilder()

.connectionString(connectionString)

.buildClient();

this.containerClient = serviceClient.getBlobContainerClient(containerName);

}

@Override

public String upload(MultipartFile file, String path) {

try {

BlobClient blobClient = containerClient.getBlobClient(path);

blobClient.upload(file.getInputStream(), file.getSize(), true);

return path;

} catch (IOException e) {

throw new RuntimeException("Azure upload failed", e);

}

}

@Override

public byte[] download(String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

ByteArrayOutputStream outputStream = new ByteArrayOutputStream();

blobClient.download(outputStream);

return outputStream.toByteArray();

}

@Override

public void delete(String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

blobClient.delete();

}

@Override

public String generatePresignedUrl(String path) {

BlobClient blobClient = containerClient.getBlobClient(path);

OffsetDateTime expiryTime = OffsetDateTime.now().plusHours(1);

BlobServiceSasSignatureValues sasValues = new BlobServiceSasSignatureValues(

expiryTime,

BlobSasPermission.parse("r")

);

String sasToken = blobClient.generateSas(sasValues);

return blobClient.getBlobUrl() + "?" + sasToken;

}

}

## 🟨 ****Google Cloud Storage Implementation****

### Maven Dependency

xml

CopyEdit

<dependency>

<groupId>com.google.cloud</groupId>

<artifactId>google-cloud-storage</artifactId>

<version>2.28.0</version>

</dependency>

### GCSStorageServiceImpl.java

java

CopyEdit

@Service

public class GCSStorageServiceImpl implements CloudStorageService {

private final Storage storage;

@Value("${gcp.bucket}")

private String bucket;

public GCSStorageServiceImpl() {

this.storage = StorageOptions.getDefaultInstance().getService();

}

@Override

public String upload(MultipartFile file, String path) {

try {

BlobId blobId = BlobId.of(bucket, path);

BlobInfo blobInfo = BlobInfo.newBuilder(blobId).setContentType(file.getContentType()).build();

storage.create(blobInfo, file.getBytes());

return path;

} catch (IOException e) {

throw new RuntimeException("GCS upload failed", e);

}

}

@Override

public byte[] download(String path) {

Blob blob = storage.get(BlobId.of(bucket, path));

if (blob == null) throw new RuntimeException("File not found");

return blob.getContent();

}

@Override

public void delete(String path) {

storage.delete(BlobId.of(bucket, path));

}

@Override

public String generatePresignedUrl(String path) {

BlobInfo blobInfo = BlobInfo.newBuilder(bucket, path).build();

URL url = storage.signUrl(blobInfo, 1, TimeUnit.HOURS);

return url.toString();

}

}

## 🟩 ****MinIO Implementation (S3-Compatible)****

### Maven Dependency

xml

CopyEdit

<dependency>

<groupId>io.minio</groupId>

<artifactId>minio</artifactId>

<version>8.5.7</version>

</dependency>

### MinioStorageServiceImpl.java

java

CopyEdit

@Service

public class MinioStorageServiceImpl implements CloudStorageService {

private final MinioClient minioClient;

@Value("${minio.bucket}")

private String bucket;

public MinioStorageServiceImpl(

@Value("${minio.endpoint}") String endpoint,

@Value("${minio.access-key}") String accessKey,

@Value("${minio.secret-key}") String secretKey) {

this.minioClient = MinioClient.builder()

.endpoint(endpoint)

.credentials(accessKey, secretKey)

.build();

}

@Override

public String upload(MultipartFile file, String path) {

try (InputStream is = file.getInputStream()) {

minioClient.putObject(PutObjectArgs.builder()

.bucket(bucket)

.object(path)

.stream(is, file.getSize(), -1)

.contentType(file.getContentType())

.build());

return path;

} catch (Exception e) {

throw new RuntimeException("MinIO upload failed", e);

}

}

@Override

public byte[] download(String path) {

try (InputStream is = minioClient.getObject(GetObjectArgs.builder()

.bucket(bucket)

.object(path)

.build())) {

return is.readAllBytes();

} catch (Exception e) {

throw new RuntimeException("MinIO download failed", e);

}

}

@Override

public void delete(String path) {

try {

minioClient.removeObject(RemoveObjectArgs.builder()

.bucket(bucket)

.object(path)

.build());

} catch (Exception e) {

throw new RuntimeException("MinIO delete failed", e);

}

}

@Override

public String generatePresignedUrl(String path) {

try {

return minioClient.getPresignedObjectUrl(GetPresignedObjectUrlArgs.builder()

.bucket(bucket)

.object(path)

.method(Method.GET)

.expiry(60 \* 60) // 1 hour

.build());

} catch (Exception e) {

throw new RuntimeException("MinIO presigned URL failed", e);

}

}

}

Would you like me to package all this into a downloadable Spring Boot project zip or generate Kubernetes deployment files for this service next?