Design Document - Template

Template Guide

Purpose of This Document

The **Design Document** defines the **HOW** of a product or feature. It serves as the technical blueprint for:

- **Architecture**: How will the system be structured?
- **Components**: What are the building blocks?
- **Interactions**: How do components communicate?
- **Data Models**: What data structures are needed?
- **APIs**: What interfaces will be exposed?

> **Key Insight**: A good Design Document translates PRD requirements into actionable technical specifications that engineers can implement.

How to Use This Template

```
┌─────────────────────────────────────────────────────────────┐
│                 HOW TO USE THIS TEMPLATE                     │
├─────────────────────────────────────────────────────────────┤
│                                                             │
│ STEP 1: COPY & RENAME                                       │
│ ─────────────────────                                       │
│                                                             │
│ Copy this file and rename it:                               │
│ • Format: DD-[PROJECT]-[DATE]-[topic].md                    │
│ • Example: DD-ATCS-20241222-hero-mode.md                    │
│                                                             │
│ STEP 2: REFERENCE THE PRD                                   │
│ ─────────────────────                                       │
│                                                             │
│ Link to the approved PRD this design implements.            │
│ Ensure design decisions trace back to requirements.         │
│                                                             │
│ STEP 3: FILL IN SECTIONS                                    │
│ ─────────────────────                                       │
│                                                             │
│ Replace [PLACEHOLDERS] with actual content.                 │
│ Include diagrams where helpful (ASCII art preferred).       │
│                                                             │
│ STEP 4: TECHNICAL REVIEW                                    │
│ ─────────────────────                                       │
│                                                             │
│ Share with engineering team for feedback.                   │
│ Address all technical concerns before approval.             │
│                                                             │
│ STEP 5: GET APPROVAL                                        │
│ ─────────────────────                                       │
│                                                             │
│ Obtain sign-off from Engineering Lead and Architect.        │
│ Update status from "Draft" to "Approved".                   │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```
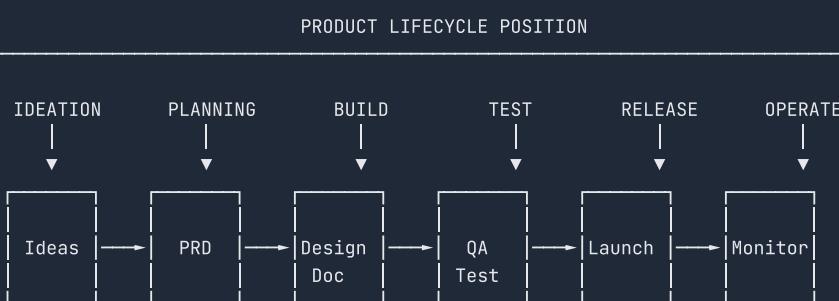
Product Lifecycle Position

```
┌─────────────────────────────────────────────────────────────┐
│                 PRODUCT LIFECYCLE POSITION                   │
├─────────────────────────────────────────────────────────────┤
│                                                             │
│  IDEATION    PLANNING    BUILD     TEST    RELEASE   OPERATE │
│     │           │          │        │         │        │    │
│     ▼           ▼          ▼        ▼         ▼        ▼    │
│  ┌──────┐   ┌──────┐  ┌──────┐  ┌──────┐ ┌──────┐ ┌───────┐ │
│  │Ideas │──▶│ PRD  │─▶│Design│─▶│ QA   │▶│Launch│▶│Monitor│ │
│  │      │   │      │  │ Doc  │  │ Test │ │      │ │       │ │
│  └──────┘   └──────┘  └──────┘  └──────┘ └──────┘ └───────┘ │
│                          │                                  │
│                          ▼                                  │
│            ┌───────────────────────────────────────────┐    │
│            │        ★ DESIGN DOC IS HERE ★             │    │
│            │                                           │    │
│            │  The Design Document bridges PLANNING (PRD) and BUILD phases. │
│            │  It translates product requirements into technical solutions. │
│            │                                           │    │
│            │  Created AFTER PRD approval, BEFORE implementation begins. │
│            └───────────────────────────────────────────┘    │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```

Key Stakeholders

Role	Responsibility	Involvement
Engineering Lead	Author and owner of the Design Doc	Creates, maintains, drives approval
Software Architect	Architecture review and guidance	Reviews, validates patterns
Product Manager	Requirement alignment	Reviews, confirms PRD mapping
Senior Engineers	Technical feasibility review	Reviews, provides feedback
Security Engineer	Security review	Reviews security aspects
VP Engineering	Final approval	Approves

Who Works on This Document

Phase	Contributors
Drafting	Engineering Lead (primary), Senior Engineers
Review	Architecture, Security, Product, QA
Approval	VP Engineering, Software Architect
Maintenance	Engineering Lead

Design Document Template

1. Overview

1.1 Document Purpose

> [1-2 sentences describing what this design document covers]

Example:

> This document describes the technical design for the Hero Mode feature, enabling automated aircraft management when crew becomes incapacitated.

1.2 Related Documents

Document	Link	Relationship
PRD	[PRD-XXXX-YYYY-NNN]	Parent requirements
Tech Spec	[TS-XXXX-YYYY-NNN]	Implementation details
API Spec	[API-XXXX-YYYY-NNN]	Interface definitions

1.3 Design Goals
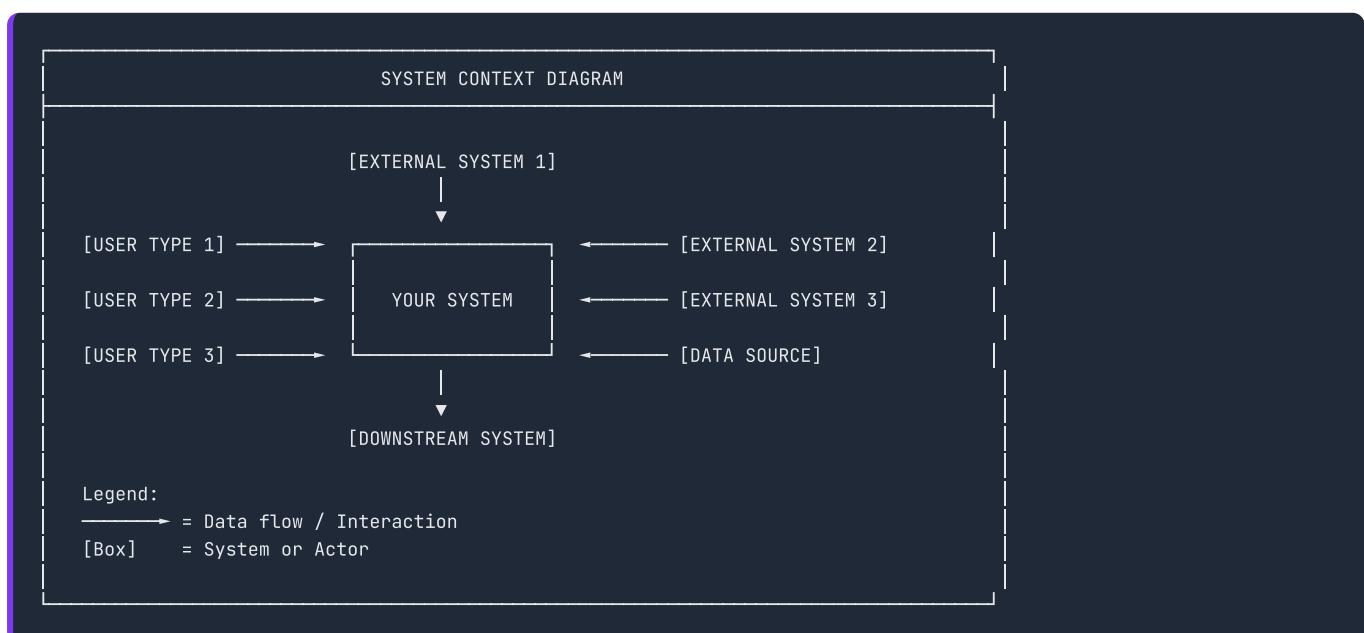
Goal	Description	Priority
[Goal 1]	[What we're optimizing for]	P0
[Goal 2]	[What we're optimizing for]	P1

1.4 Non-Goals
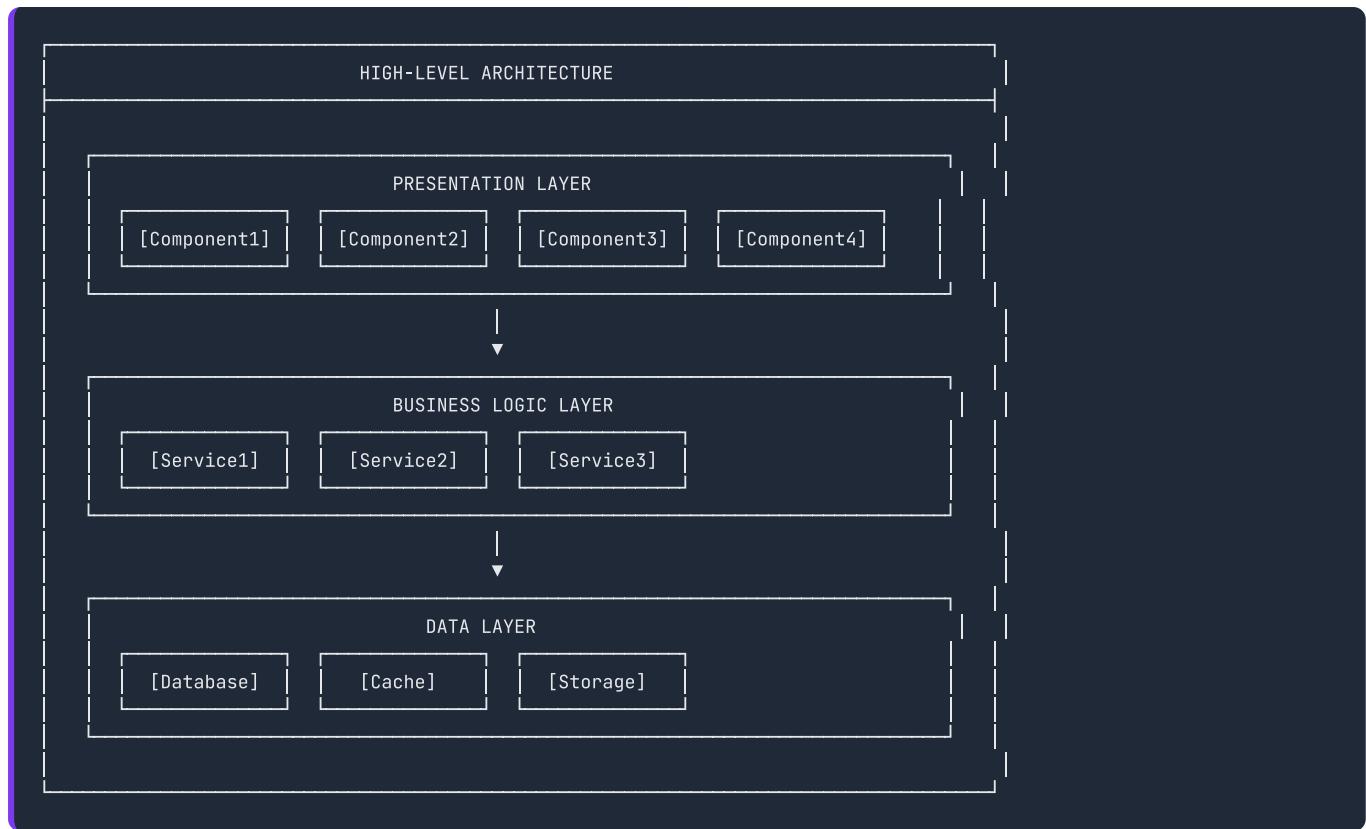
Non-Goal	Rationale
[What we're NOT designing]	[Why it's out of scope]

2. System Architecture

2.1 System Context

```
┌──────────────────────────────────────────────────────────┐
│                  SYSTEM CONTEXT DIAGRAM                   │
├──────────────────────────────────────────────────────────┤
│                                                          │
│                    [EXTERNAL SYSTEM 1]                    │
│                           │                              │
│                           ▼                              │
│  [USER TYPE 1] ────────▶ ┌──────────┐ ◀──── [EXTERNAL SYSTEM 2] │
│                          │          │                    │
│  [USER TYPE 2] ────────▶ │ YOUR SYSTEM │ ◀──── [EXTERNAL SYSTEM 3] │
│                          │          │                    │
│  [USER TYPE 3] ────────▶ └──────────┘ ◀──── [DATA SOURCE] │
│                           │                              │
│                           ▼                              │
│                   [DOWNSTREAM SYSTEM]                     │
│                                                          │
│   Legend:                                                │
│   ──────────▶  = Data flow / Interaction                 │
│   [Box]        = System or Actor                         │
│                                                          │
└──────────────────────────────────────────────────────────┘
```

2.2 High-Level Architecture

```
┌─────────────────────────────────────────────────────────────┐
│                  HIGH-LEVEL ARCHITECTURE                     │
├─────────────────────────────────────────────────────────────┤
│  ┌───────────────────────────────────────────────────────┐  │
│  │                  PRESENTATION LAYER                    │  │
│  │  ┌──────────┐  ┌──────────┐  ┌──────────┐  ┌──────────┐│  │
│  │  │[Component1]│  │[Component2]│  │[Component3]│  │[Component4]││  │
│  │  └──────────┘  └──────────┘  └──────────┘  └──────────┘│  │
│  └───────────────────────────────────────────────────────┘  │
│                           │                                  │
│                           ▼                                  │
│  ┌───────────────────────────────────────────────────────┐  │
│  │                 BUSINESS LOGIC LAYER                   │  │
│  │  ┌──────────┐   ┌──────────┐   ┌──────────┐           │  │
│  │  │[Service1]│   │[Service2]│   │[Service3]│           │  │
│  │  └──────────┘   └──────────┘   └──────────┘           │  │
│  └───────────────────────────────────────────────────────┘  │
│                           │                                  │
│                           ▼                                  │
│  ┌───────────────────────────────────────────────────────┐  │
│  │                      DATA LAYER                        │  │
│  │  ┌──────────┐   ┌──────────┐   ┌──────────┐           │  │
│  │  │[Database]│   │ [Cache]  │   │[Storage] │           │  │
│  │  └──────────┘   └──────────┘   └──────────┘           │  │
│  └───────────────────────────────────────────────────────┘  │
└─────────────────────────────────────────────────────────────┘
```
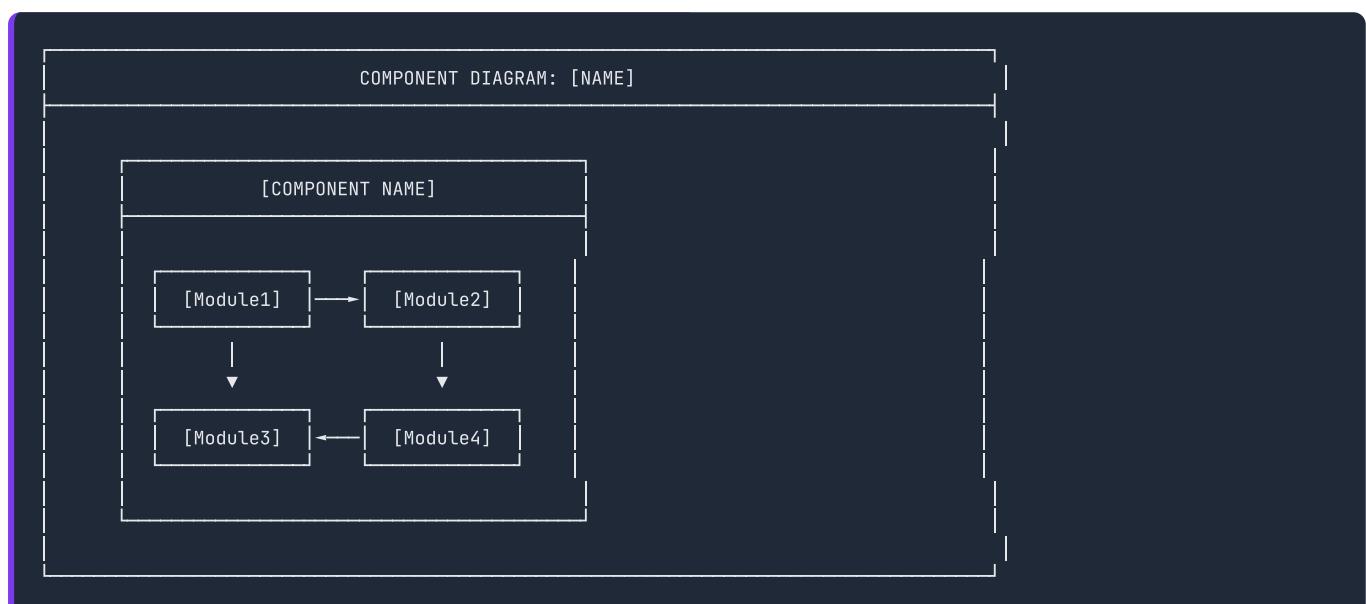
3. Component Design

## 3.1 Component: [Component Name]
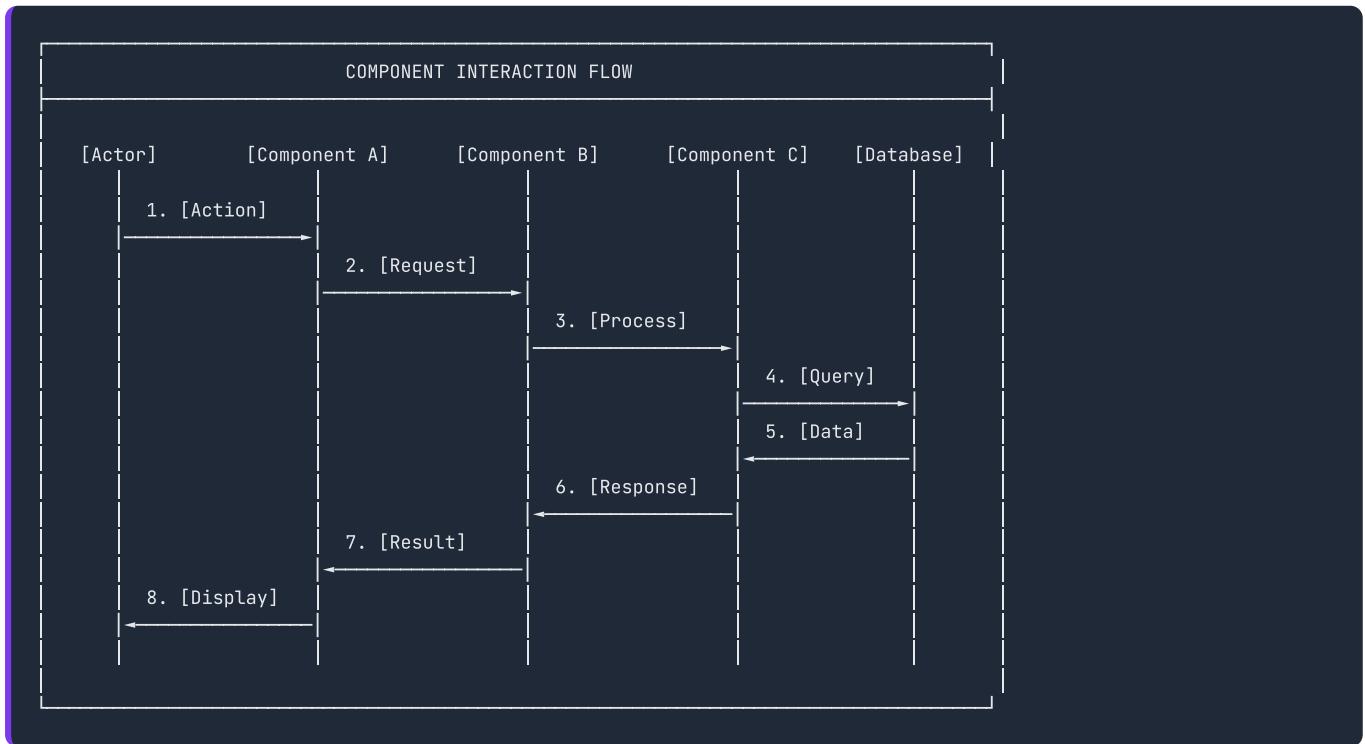
Purpose: [What this component does]

Responsibilities: - [Responsibility 1] - [Responsibility 2] - [Responsibility 3]

Dependencies: - [Dependency 1] - [Dependency 2]

```
┌─────────────────────────────────────────────────────────────┐
│              COMPONENT DIAGRAM: [NAME]                       │
├─────────────────────────────────────────────────────────────┤
│  ┌───────────────────────────────────────┐                  │
│  │          [COMPONENT NAME]              │                  │
│  ├───────────────────────────────────────┤                  │
│  │  ┌──────────┐      ┌──────────┐        │                  │
│  │  │[Module1] │─────▶│[Module2] │        │                  │
│  │  └──────────┘      └──────────┘        │                  │
│  │       │                 │              │                  │
│  │       ▼                 ▼              │                  │
│  │  ┌──────────┐      ┌──────────┐        │                  │
│  │  │[Module3] │◀─────│[Module4] │        │                  │
│  │  └──────────┘      └──────────┘        │                  │
│  └───────────────────────────────────────┘                  │
└─────────────────────────────────────────────────────────────┘
```

3.2 Component Interactions

```
┌────────────────────────────────────────────────────────────────┐
│                  COMPONENT INTERACTION FLOW                    │
├────────────────────────────────────────────────────────────────┤
│                                                                │
│  [Actor]      [Component A]    [Component B]    [Component C]    [Database] │
│    │              │                │                │              │  │
│    │ 1. [Action]  │                │                │              │  │
│    │─────────────>│                │                │              │  │
│    │              │ 2. [Request]   │                │              │  │
│    │              │───────────────>│                │              │  │
│    │              │                │ 3. [Process]   │              │  │
│    │              │                │───────────────>│              │  │
│    │              │                │                │ 4. [Query]   │  │
│    │              │                │                │─────────────>│  │
│    │              │                │                │ 5. [Data]    │  │
│    │              │                │                │<─────────────│  │
│    │              │                │ 6. [Response]  │              │  │
│    │              │                │<───────────────│              │  │
│    │              │ 7. [Result]    │                │              │  │
│    │              │<───────────────│                │              │  │
│    │ 8. [Display] │                │                │              │  │
│    │<─────────────│                │                │              │  │
│    │              │                │                │              │  │
│                                                                │
└────────────────────────────────────────────────────────────────┘
```
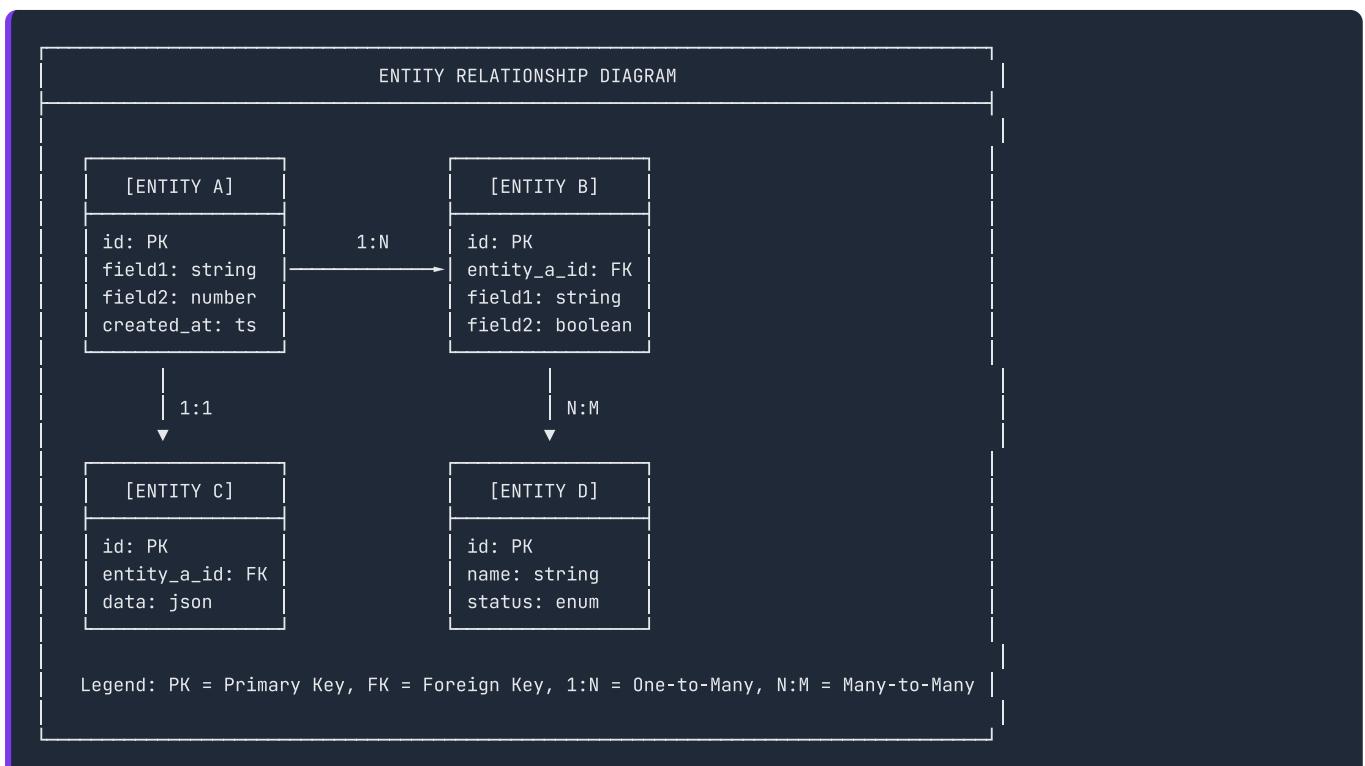
4. Data Design

4.1 Data Models

```
┌────────────────────────────────────────────────────────────────┐
│                  ENTITY RELATIONSHIP DIAGRAM                   │
├────────────────────────────────────────────────────────────────┤
│                                                                │
│  ┌──────────────┐              ┌──────────────┐                 │
│  │  [ENTITY A]  │              │  [ENTITY B]  │                 │
│  ├──────────────┤    1:N       ├──────────────┤                 │
│  │ id: PK       │─────────────>│ id: PK       │                 │
│  │ field1: string│             │ entity_a_id: FK│                │
│  │ field2: number│             │ field1: string│                │
│  │ created_at: ts│             │ field2: boolean│                │
│  └──────────────┘              └──────────────┘                 │
│         │                             │                         │
│         │ 1:1                         │ N:M                     │
│         ▼                             ▼                         │
│  ┌──────────────┐              ┌──────────────┐                 │
│  │  [ENTITY C]  │              │  [ENTITY D]  │                 │
│  ├──────────────┤              ├──────────────┤                 │
│  │ id: PK       │              │ id: PK       │                 │
│  │ entity_a_id: FK│            │ name: string │                 │
│  │ data: json   │              │ status: enum │                 │
│  └──────────────┘              └──────────────┘                 │
│                                                                │
│  Legend: PK = Primary Key, FK = Foreign Key, 1:N = One-to-Many, N:M = Many-to-Many │
│                                                                │
└────────────────────────────────────────────────────────────────┘
```

4.2 Data Flow

```
DATA FLOW: [Flow Name]

[Source] ──▶ [Transform/Process] ──▶ [Destination]

Step 1: [Description of data at this stage]
Step 2: [Description of transformation]
Step 3: [Description of final data state]
```

5. API Design

5.1 API Endpoints

Method	Endpoint	Description	Request	Response
GET	/api/v1/[resource]	[Description]	-	[Resource][]
POST	/api/v1/[resource]	[Description]	[CreateDTO]	[Resource]
PUT	/api/v1/[resource]/:id	[Description]	[UpdateDTO]	[Resource]
DELETE	/api/v1/[resource]/:id	[Description]	-	204

5.2 API Example

Request:
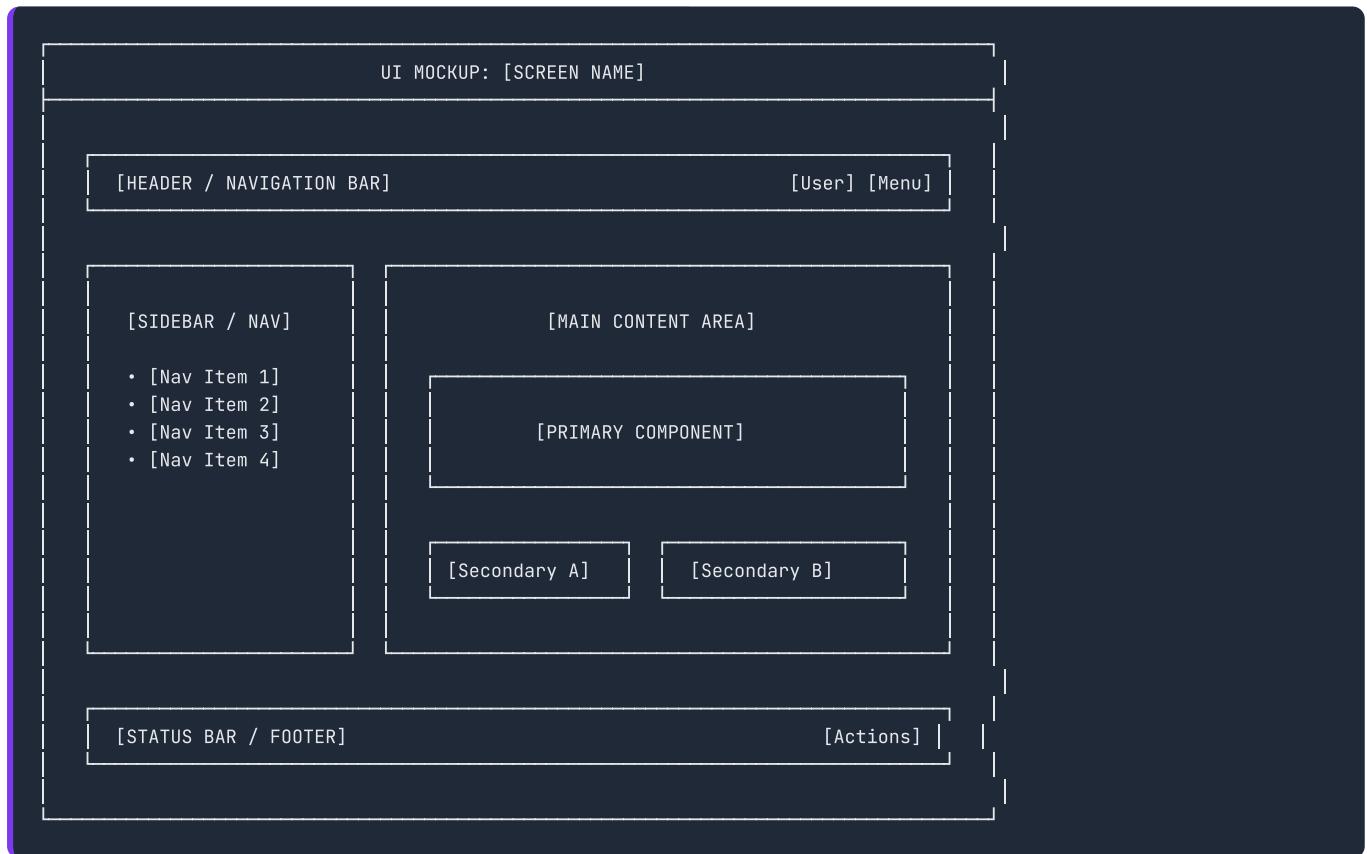
```
POST /api/v1/[resource]
Content-Type: application/json

{
  "field1": "value1",
  "field2": 123,
  "field3": true
}
```

Response:

```
HTTP/1.1 201 Created
Content-Type: application/json

{
  "id": "abc-123",
  "field1": "value1",
  "field2": 123,
  "field3": true,
  "createdAt": "2024-12-22T10:00:00Z"
}
```

6. UI/UX Design

6.1 UI Mockup: [Screen Name]

```
┌──────────────────────────────────────────────────────────┐
│                UI MOCKUP: [SCREEN NAME]                  │ │
├──────────────────────────────────────────────────────────┤ │
│                                                          │
│  ┌────────────────────────────────────────────────────┐  │
│  │ [HEADER / NAVIGATION BAR]          [User] [Menu]  │  │
│  └────────────────────────────────────────────────────┘  │
│                                                          │
│  ┌──────────────────┐  ┌──────────────────────────────┐  │
│  │ [SIDEBAR / NAV]  │  │       [MAIN CONTENT AREA]    │  │
│  │                  │  │                              │  │
│  │ • [Nav Item 1]   │  │  ┌────────────────────────┐  │  │
│  │ • [Nav Item 2]   │  │  │   [PRIMARY COMPONENT]  │  │  │
│  │ • [Nav Item 3]   │  │  │                        │  │  │
│  │ • [Nav Item 4]   │  │  └────────────────────────┘  │  │
│  │                  │  │                              │  │
│  │                  │  │  ┌──────────┐  ┌──────────┐  │  │
│  │                  │  │  │[Secondary A] │[Secondary B]│ │
│  │                  │  │  └──────────┘  └──────────┘  │  │
│  └──────────────────┘  └──────────────────────────────┘  │
│                                                          │ │
│  ┌────────────────────────────────────────────────────┐  │ │
│  │ [STATUS BAR / FOOTER]               [Actions] │  │  │
│  └────────────────────────────────────────────────────┘  │
└──────────────────────────────────────────────────────────┘
```

6.2 User Interactions

Element	Interaction	Result
[Element 1]	Click	[What happens]
[Element 2]	Hover	[What happens]
[Element 3]	Drag	[What happens]

7. Security Design

7.1 Authentication & Authorization

Aspect	Approach
Authentication	[Method: JWT, OAuth2, etc.]
Authorization	[Method: RBAC, ABAC, etc.]
Session Management	[Approach]

7.2 Security Considerations

Threat	Mitigation
[Threat 1]	[Mitigation approach]
[Threat 2]	[Mitigation approach]

8. Performance Design

8.1 Performance Requirements

Metric	Target	Measurement
Response Time	< [X]ms	[How measured]
Throughput	[X] req/sec	[How measured]
Memory Usage	< [X]MB	[How measured]

8.2 Optimization Strategies

- [Strategy 1: e.g., Caching]
- [Strategy 2: e.g., Lazy loading]
- [Strategy 3: e.g., Connection pooling]
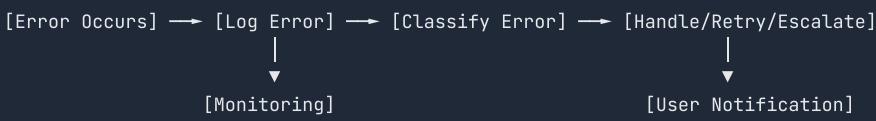
9. Reliability Design

9.1 Failure Modes

Failure Mode	Detection	Recovery
[Failure 1]	[How detected]	[Recovery action]
[Failure 2]	[How detected]	[Recovery action]

9.2 Error Handling

```
ERROR HANDLING FLOW

[Error Occurs] ──▶ [Log Error] ──▶ [Classify Error] ──▶ [Handle/Retry/Escalate]
                      |                                        |
                      ▼                                        ▼
                  [Monitoring]                          [User Notification]
```

10. Testing Strategy

10.1 Test Levels

Level	Scope	Tools
Unit	[What's tested]	[Testing tools]
Integration	[What's tested]	[Testing tools]
E2E	[What's tested]	[Testing tools]
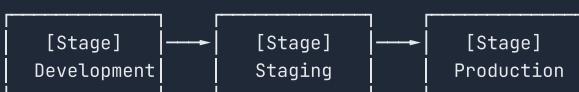
10.2 Test Cases

ID	Description	Expected Result
TC-001	[Test case]	[Expected outcome]
TC-002	[Test case]	[Expected outcome]

11. Deployment & Rollout

11.1 Deployment Architecture

```
DEPLOYMENT ARCHITECTURE

[Stage]          [Stage]          [Stage]
Development  ──▶  Staging   ──▶  Production
```

11.2 Rollout Strategy

Phase	Description	Rollback Criteria
Phase 1	[Description]	[When to rollback]
Phase 2	[Description]	[When to rollback]

12. Open Questions

ID	Question	Owner	Status
Q1	[Question]	[Owner]	Open

13. Appendix

13.1 Glossary

Term	Definition
[Term 1]	[Definition]

13.2 References

- [Reference 1]
- [Reference 2]

13.3 Change Log

Version	Date	Author	Changes
0.1.0	[Date]	[Author]	Initial draft