

Allianz Project Log

Kafka Connect Operations - Solution Draft

Project: Allianz EBS @ Confluent Cloud

Focus: Establish Self-Service Operations for Kafka Connect Connectors in the context of access restrictions.

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Date: 2025-12-16

Version: 1.0

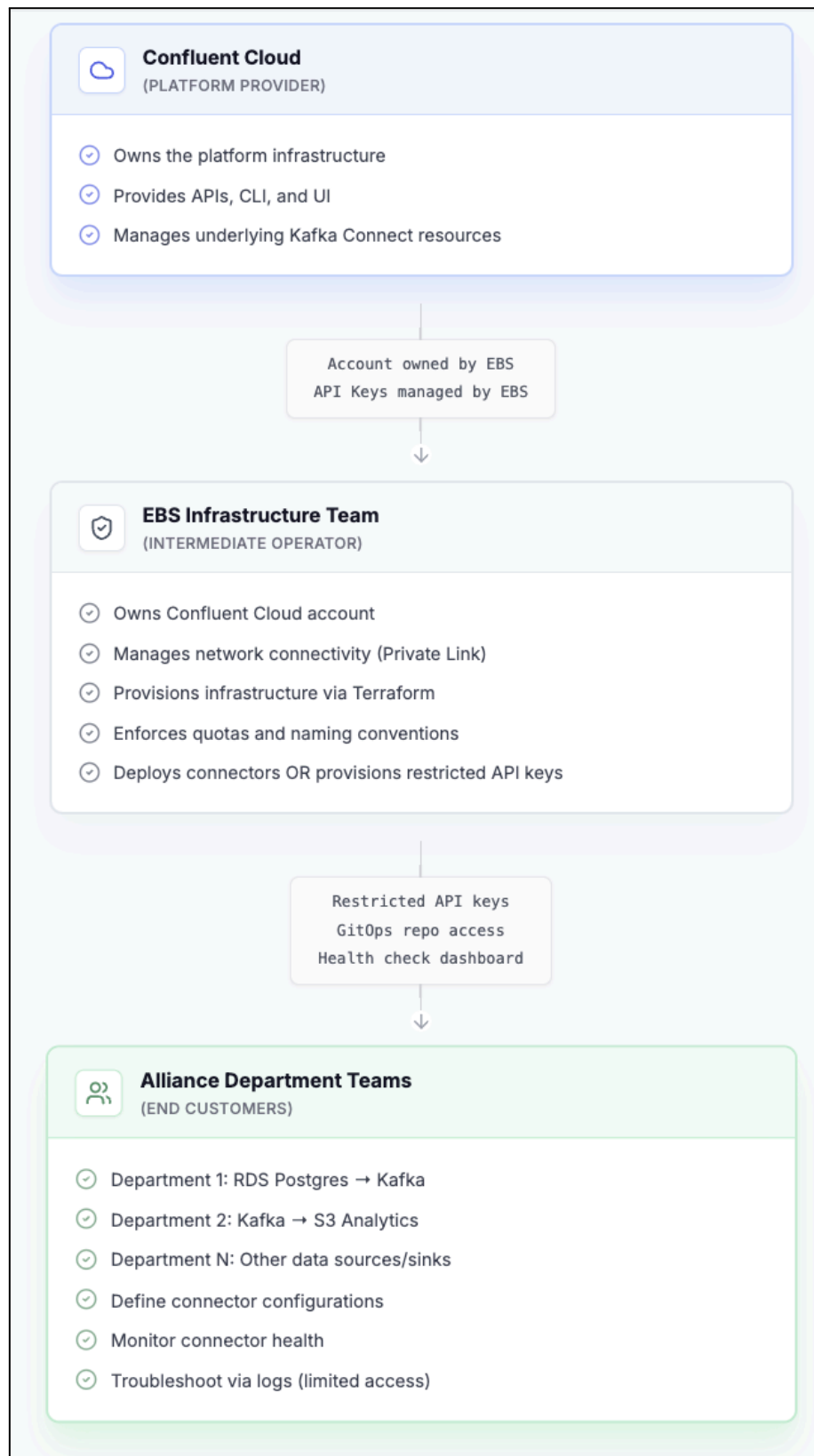
Status: Draft

Document Version History:

Version	Date	Author	Changes
1.0	2025-12-16	Confluent PS Mirko Kämpf	Initial draft

1. Organizational Context

1.1 Three-Party Model



1.2 Key Constraints

1. Shared Infrastructure

- Kafka clusters are shared across multiple departments
- Kafka Connect resources are attached to Kafka clusters (shared)
- Need isolation mechanisms to prevent cross-team interference

2. Access Restrictions

- Department teams **CANNOT** access Confluent Cloud UI
- Department teams **MAY** use Confluent CLI with restricted API keys
- Full administrative access remains with EBS team

3. Security Requirements

- Multi-tenancy requires quota enforcement
- Naming conventions prevent conflicts
- Network connectivity established per department
- Secrets managed centrally (not exposed to departments)

4. Operational Philosophy

- "Leverage Confluent as much as possible" (architectural principle)
- Avoid building custom tooling where Confluent provides solutions
- Enable self-service with guardrails

2. Role Definitions

2.1 EBS Infrastructure Team

Responsibilities:

- **Network Connectivity:** Establish a Private Link between department VPCs and Confluent Cloud
- **Account Management:** Own Confluent Cloud account, manage billing, provision environments
- **Infrastructure Provisioning:** Deploy Kafka clusters, Connect clusters, and network resources via Terraform
- **Access Control:** Create and distribute API keys with appropriate RBAC permissions
- **Quota Enforcement:** Implement and enforce quotas for connectors, topics, and throughput
- **Naming Convention Enforcement:** Validate connector names to prevent conflicts
- **Configuration Validation:** Review and validate connector configurations before deployment
- **Monitoring & Alerting:** Integrate Confluent metrics with Dynatrace
- **Troubleshooting:** Access full logs for debugging production issues
- **Deployment (Option A):** Deploy connectors on behalf of departments via GitOps
- **Enablement (Option B):** Provide restricted CLI access for department self-service

Tools:

- Terraform (infrastructure as code)
- Confluent Cloud UI (administrative access)
- Confluent CLI (administrative operations)
- Custom validation scripts (quotas, naming)
- Dynatrace (monitoring)
- Git repository (infrastructure configs)

Skills Required:

- Confluent Cloud platform expertise
- AWS networking (Private Link, VPC Endpoints)
- Terraform
- Kafka Connect operations
- Monitoring and observability

2.2 Department Connector Operator

Responsibilities:

- **Connector Design:** Define data flow requirements (source → topic → sink)
- **Configuration Creation:** Write connector JSON configurations
- **Testing:** Test connectors in development environment
- **Deployment Request:** Submit connector configs via Git (Option A) or deploy via CLI (Option B)
- **Health Monitoring:** Check connector status via health dashboard
- **Troubleshooting (Limited):** Diagnose issues using available logs/metrics
- **Lifecycle Management:** Request connector updates, pause/resume, deletion
- **Compliance:** Follow naming conventions and stay within quotas

Tools:

- Confluent CLI (with restricted API key) - Option B
- Git repository (submit connector configs)
- Health check dashboard (web-based)
- Connector configuration templates
- Documentation and runbooks

Skills Required:

- Understanding of Kafka Connect concepts
- JSON configuration
- Data pipeline design
- Basic troubleshooting

Constraints:

- **NO** Confluent Cloud UI access
- **NO** access to underlying infrastructure
- **LIMITED** log visibility (via CLI or health dashboard)
- **MUST** operate within assigned quotas
- **MUST** follow naming conventions

2.3 Department Developer/Data Engineer

Responsibilities:

- **Requirements Definition:** Specify what data needs to be ingested/exported
- **Schema Design:** Define Avro/JSON schemas if using Schema Registry
- **Solution Design:** Design end-to-end data pipeline
- **Testing Support:** Provide test data and validation criteria
- **Consumer Application Development:** Build applications consuming from Kafka topics

Tools:

- Kafka CLI tools (console producer/consumer)
- Schema Registry CLI
- Application development frameworks
- Testing tools

Skills Required:

- Data modeling
- Kafka basics (topics, partitions, consumer groups)
- Application development

2.4 Confluent Platform Engineer (Conceptual)

Note: This role doesn't exist in the customer organization but represents Confluent Cloud operations

Responsibilities:

- Operate the underlying Kafka Connect cluster infrastructure
- Provide APIs, CLI, and UI
- Handle platform-level incidents
- Scale resources as needed
- Maintain connector plugins

3. Operational Model

3.1 Deployment Options

Two deployment models were discussed:

Option A: GitOps with EBS-Managed Deployment

Process:

1. Department creates a connector configuration JSON
2. Department commits config to Git repository
3. Pull request triggers automated validation by the EBS-provided tool:
 - JSON syntax check
 - Quota enforcement check
 - Naming convention validation
 - Required fields verification
4. EBS team reviews and approves PR
5. Merge triggers automated deployment via CI/CD
6. Connector deployed using EBS administrative API keys
7. Department receives health check dashboard link

Pros:

- Full control for the EBS team
- Audit trail in Git
- Automated validation
- No need to distribute API keys

Cons:

- The EBS team is in the critical path
- Slower deployment cycle
- Ticket-based scalability concerns

Option B: Self-Service via Confluent CLI

Process:

1. EBS team provisions restricted API key for department
2. Department operator installs Confluent CLI
3. Department operator authenticates with API key
4. Department operator deploys connector directly:

```
confluent connect create --config-file postgres-source.json
```

5. Automated validation enforced by RBAC and quotas
6. Department operator monitors via CLI:

```
confluent connect describe <connector-name>
```

```
confluent connect status <connector-name>
```

Pros:

- True self-service (scalable)
- Faster deployment cycle
- Uses Confluent native tools
- Department has direct visibility

Cons:

- Requires distributing API keys
- Less control over deployment timing
- Requires quota enforcement in Confluent (if available)
- Naming convention enforcement harder

3.2 Hybrid Model (Recommended)

Development/Testing: Option B (Self-Service CLI)

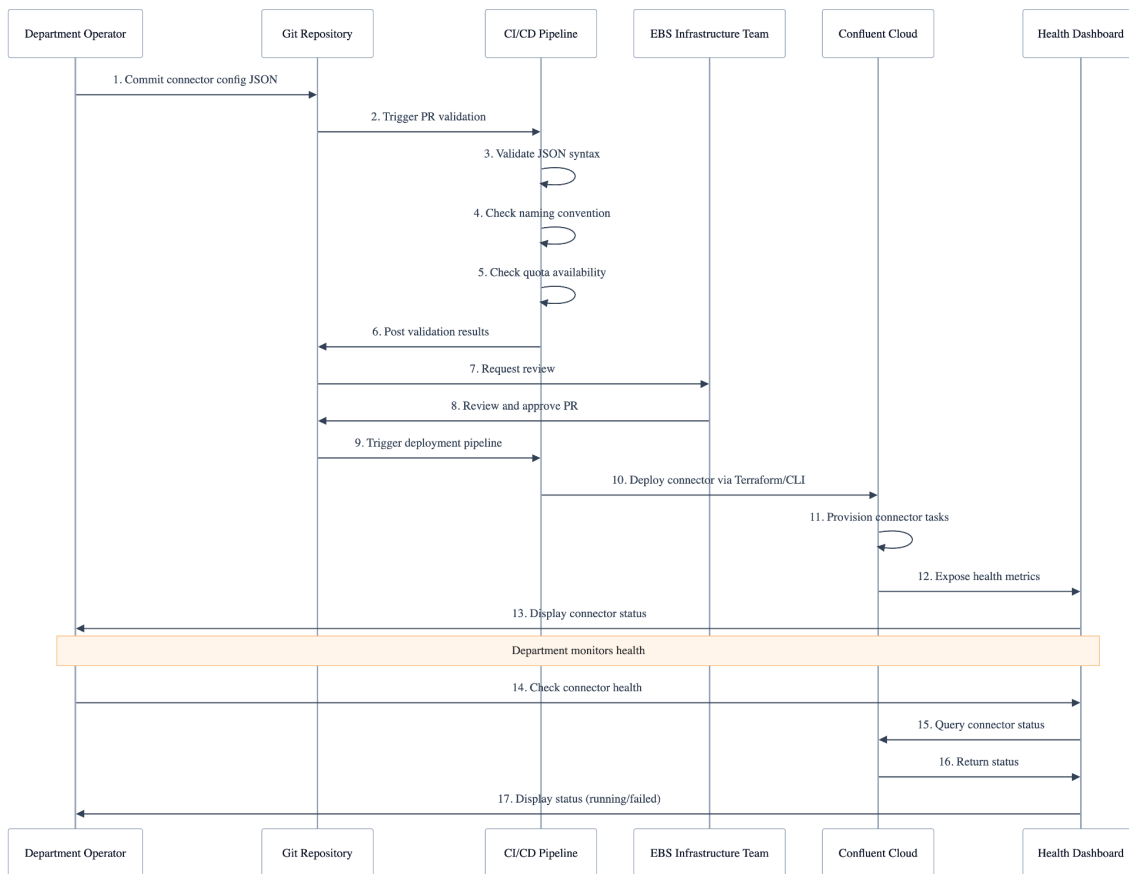
- Departments test in the dev environment with CLI
- Fast iteration and learning
- No EBS intervention needed

Production Deployment: Option A (GitOps)

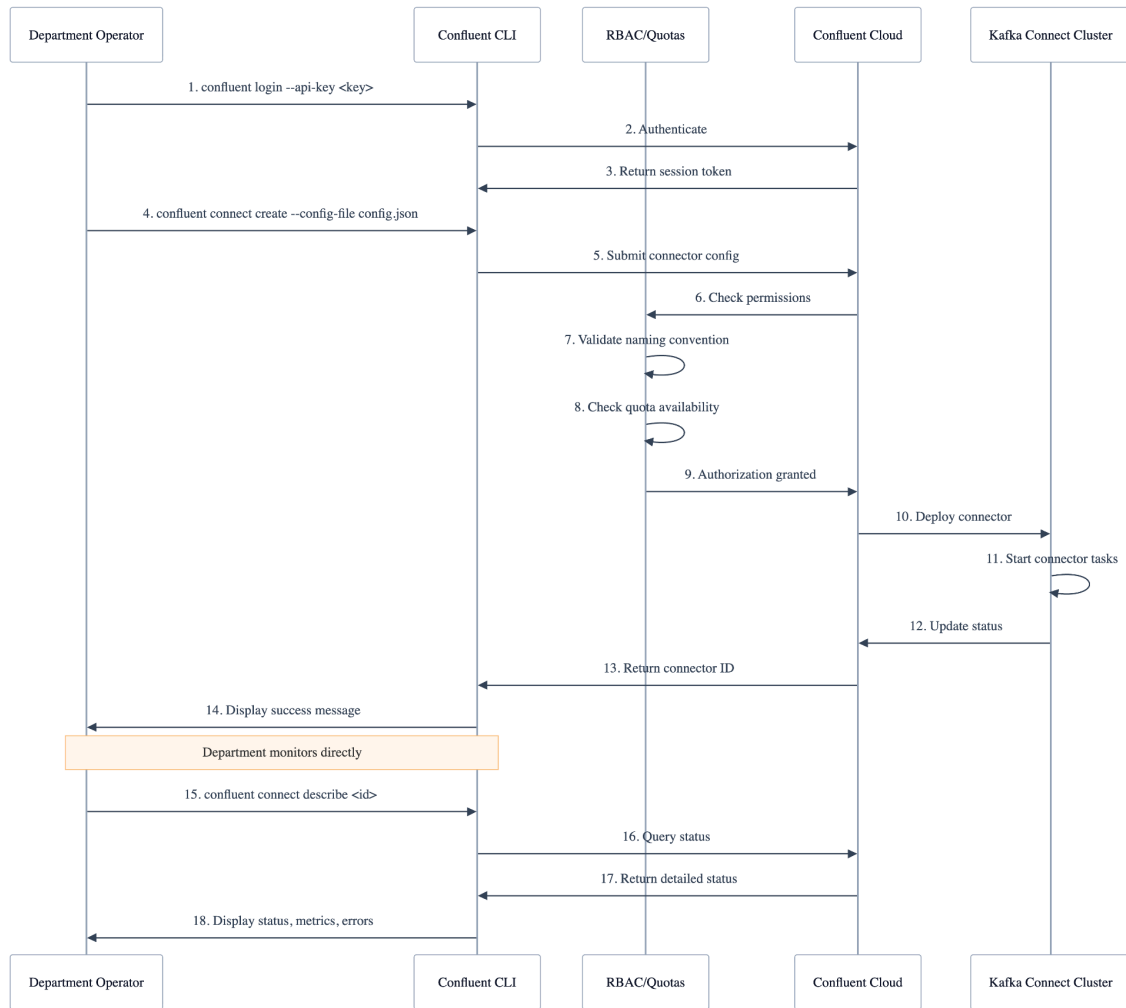
- Production requires review and approval
 - Full audit trail
 - EBS validates before deployment
 - Controlled rollout
-

4. Operational Workflows

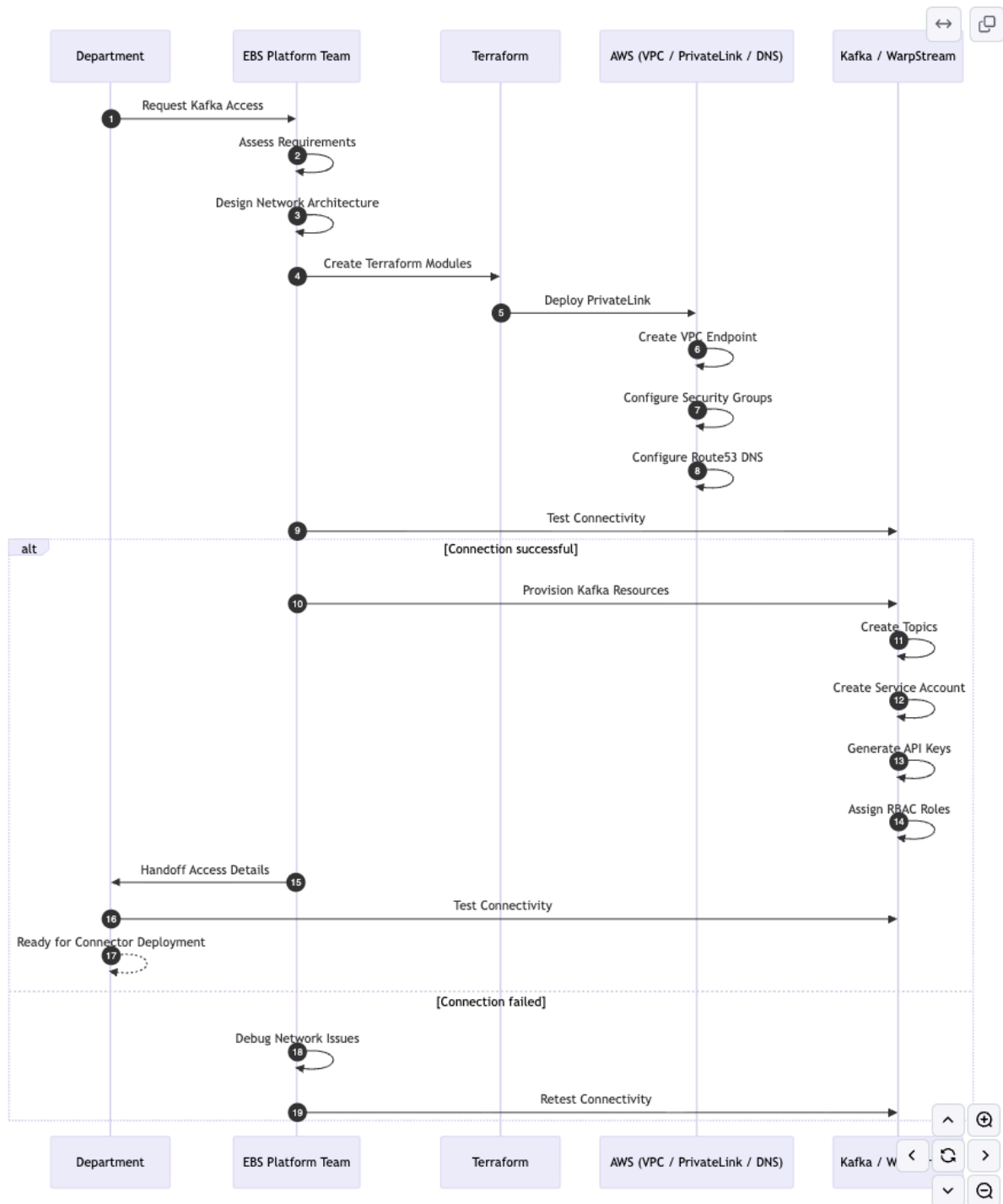
4.1 Connector Deployment Flow (GitOps Model)



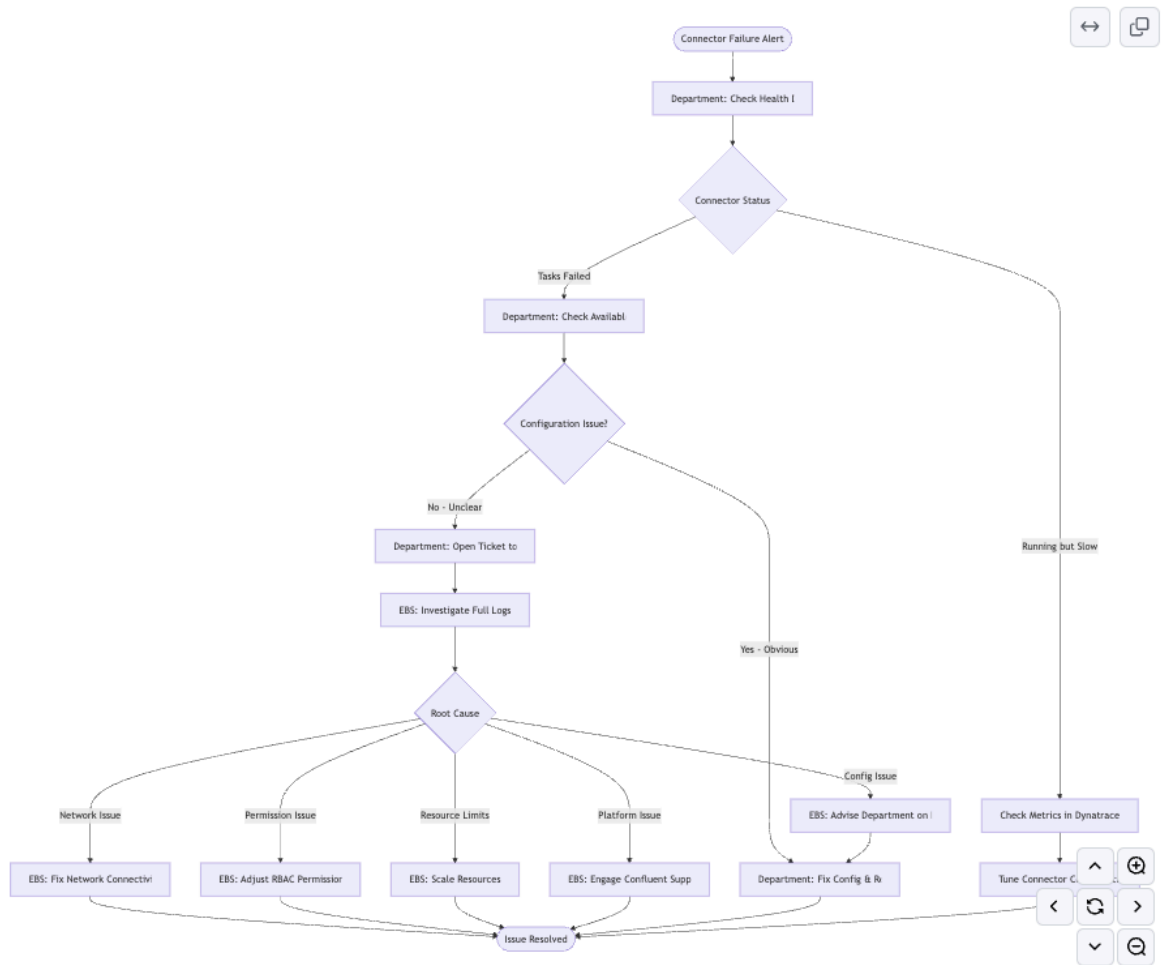
4.2 Connector Deployment Flow (Self-Service CLI Model)



4.3 Network Connectivity Establishment (One-Time Per Department)



4.4 Troubleshooting Workflow



5. Technical Requirements

5.1 Quota Management

Requirement: Enforce quotas per department to prevent resource exhaustion

Challenges Identified:

- Kafka Connect may not have built-in per-tenant quotas
- Shared Connect cluster resources (memory, CPU) are finite
- Need to prevent one department from consuming all resources

Solutions:

Option 1: Confluent Cloud Native Quotas (If Available)

Check if quotas can be set via CLI/API

```
confluent connect cluster quota set \  
  
  --service-account sa-dept-1 \  
  
  --max-connectors 5 \  
  
  --max-tasks-per-connector 3
```

Option 2: Custom Validation Script (GitOps)

Part of CI/CD validation

```
def check_quota(department, connector_count):  
  
    quotas = {  
  
        "dept-1": {"max_connectors": 5},  
  
        "dept-2": {"max_connectors": 3},  
  
    }  
  
    current = get_current_connector_count(department)  
  
    if current + connector_count > quotas[department]["max_connectors"]:  
  
        raise QuotaExceededException(f"{department} exceeds quota")
```

Option 3: RBAC-Based Isolation

- Create separate Connect clusters per department
- Use dedicated Kafka clusters for high-isolation needs
- Trade-off: Higher cost vs. better isolation

Recommendation: Start with custom validation in GitOps, migrate to native quotas if/when available

5.2 Naming Convention Enforcement

Requirement: Prevent connector name conflicts across departments

Naming Pattern:

<department-code>-<data-source>-<connector-type>-<environment>-<suffix>

Examples:

- dept1-postgres-source-prod-001
- dept2-s3-sink-dev-analytics
- finance-salesdb-source-prod-cdc

Validation Rules:

```
import re

NAMING_PATTERN = r'^[a-z0-9]+(-[a-z0-9]+)*$'

RESERVED_PREFIXES = ['connect', 'confluent', 'system', 'admin']

MAX_LENGTH = 64

def validate_connector_name(name, department):

    # Must start with department prefix

    if not name.startswith(f"{department}-"):

        raise ValueError(f"Name must start with '{department}-'")

    # Check pattern

    if not re.match(NAMING_PATTERN, name):

        raise ValueError("Invalid characters in name")

    # Check length

    if len(name) > MAX_LENGTH:

        raise ValueError(f"Name exceeds {MAX_LENGTH} characters")

    # Check reserved prefixes

    for prefix in RESERVED_PREFIXES:

        if name.startswith(prefix):

            raise ValueError(f"Cannot use reserved prefix '{prefix}'")

    return True
```

Enforcement:

- **GitOps:** Automated check in CI/CD pipeline
- **CLI:** RBAC restricts service account to create only names with department prefix
- **Terraform:** Validation in variable constraints

5.3 Logging and Monitoring Strategy

Problem Statement

- Departments don't have UI access
- Fully managed Connect logs not exported by default
- Need visibility for troubleshooting
- EBS team needs full logs for support
- Balance between self-service and operational control

Three-Tier Logging Strategy:

Tier 1: Department Self-Service (Limited Logs)

Via Confluent CLI

```
confluent connect describe <connector-id>
```

Shows: status, configuration, basic error messages

```
confluent connect status <connector-id>
```

Shows: task status, last error timestamp

Tier 2: Health Check Dashboard (Web UI)

Dashboard displays:

- Connector name, status (running/failed/paused)
- Tasks: count, failed count
- Last successful message timestamp
- Error count in last hour
- Restart button (if permissions allow)

Tier 3: Full Logs via Dynatrace (EBS Only)

Architecture:

[Confluent Connect]

→ [Kafka Topic: `_connect-logs`]

→ [Kubernetes Pod: Log Forwarder]

→ [Dynatrace API]

→ [Dynatrace Dashboard]

Department tickets EBS → EBS searches Dynatrace → provides diagnosis

Feature Request to Confluent:

Request: Export Kafka Connect logs from fully managed clusters

Options:

1. Stream logs to customer-owned Kafka topic
 2. Push logs to CloudWatch Logs
 3. Expose logs via API endpoint
 4. Enable log forwarding to external systems
-

5.4 Metrics Integration with Dynatrace

Metrics to Expose:

Connector-Level Metrics:

- `connector-status` (running, failed, paused)
- `connector-failed-task-count`
- `connector-total-task-count`
- `connector-uptime`

Task-Level Metrics:

- `task-status`
- `task-batch-size-avg`
- `task-offset-commit-avg-time-ms`
- `task-error-rate`

Source Connector Metrics:

- `source-record-poll-rate`
- `source-record-write-rate`
- `source-record-active-count`

Sink Connector Metrics:

- `sink-record-read-rate`
- `sink-record-send-rate`
- `sink-record-lag`

Integration Architecture:

[Confluent Cloud Metrics API]

→ [Prometheus Exporter (if needed)]

→ [Existing Dynatrace Agent in K8s]

→ [Dynatrace Backend]

→ [Dashboards & Alerts]

Alert Examples:

alerts:

- name: "Connector Task Failed"

condition: "connector-failed-task-count > 0"

duration: "5 minutes"

action: "Notify EBS team & Department"
 - name: "Connector High Error Rate"

condition: "task-error-rate > 0.01"

duration: "10 minutes"

action: "Notify Department operator"
 - name: "Connector Stopped"

condition: "connector-status == 'stopped'"

duration: "1 minute"

action: "Notify EBS team"
-

5.5 Isolation in Shared Clusters

Challenge: How to isolate department workloads on shared infrastructure

Isolation Levels:

Level 1: Logical Isolation (Lowest Cost)

One Kafka cluster, one Connect cluster, RBAC-based separation

Pros:

- Cost-effective
- Simple management
- Confluent manages scaling

Cons:

- Noisy neighbor potential
- One department can impact others
- Limited quota enforcement

Level 2: Connect Cluster Isolation (Medium Cost)

One Kafka cluster, multiple Connect clusters (one per department)

Pros:

- Connect resource isolation
- Department A connectors don't affect Department B
- Better quota control

Cons:

- Higher cost (multiple Connect clusters)
- More complex management
- Still shares Kafka cluster

Level 3: Full Isolation (Highest Cost)

Dedicated Kafka cluster + Connect cluster per department

Pros:

- Complete isolation
- Dedicated resources
- Independent scaling
- Clear cost attribution

Cons:

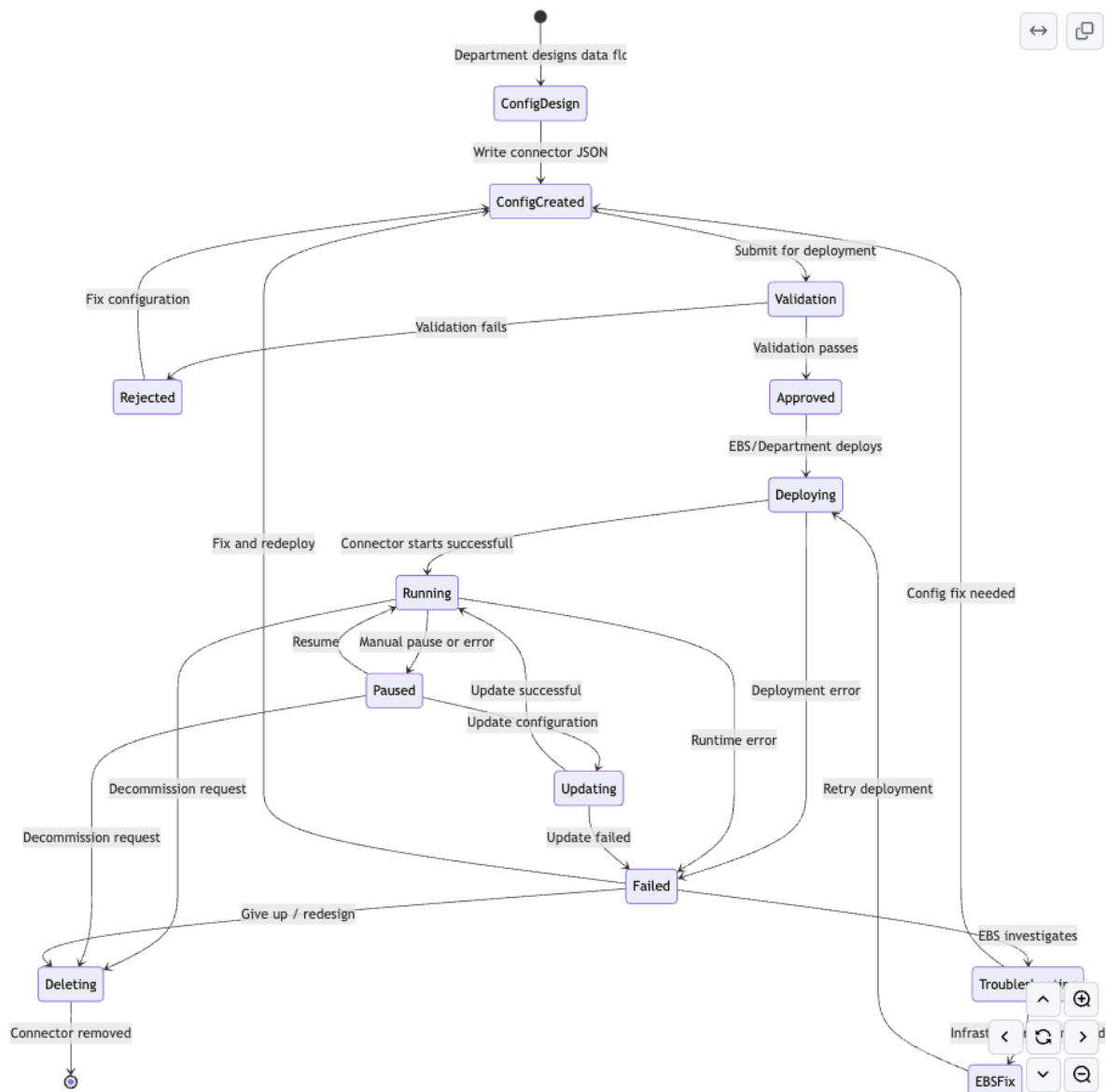
- Highest cost
- Complex management
- May not be economical for small departments

Recommendation:

- Start with **Level 1** (shared with RBAC)
 - Use quotas and monitoring to detect noisy neighbors
 - Upgrade specific departments to Level 2/3 if needed
 - Decision criteria:
 - High-throughput workloads → Level 2
 - Compliance/security requirements → Level 3
 - Standard workloads → Level 1
-

6. Connector Lifecycle Management

6.1 Lifecycle States



6.2 Lifecycle Operations

Operation	Department Operator	EBS Infrastructure Team	CLI Command	GitOps
Create	Defines config	Deploys (Option A) or approves API key (Option B)	<code>confluent connect create</code>	Merge PR to <code>connectors/prod/</code>
Read/Describe	✅ Can view own connectors	✅ Can view all	<code>confluent connect describe <id></code>	Read repo
Update	✅ Can update config	Approves changes	<code>confluent connect update <id></code>	Merge PR with changes
Pause	✅ Can pause (troubleshooting)	✅ Can pause	<code>confluent connect pause <id></code>	Commit pause command
Resume	✅ Can resume	✅ Can resume	<code>confluent connect resume <id></code>	Commit resume command
Delete	✅ Can delete (may require approval)	✅ Can delete	<code>confluent connect delete <id></code>	Delete file from repo
View Logs	🔹 Limited via CLI	✅ Full access via Dynatrace	<code>confluent connect logs <id></code>	N/A
View Metrics	✅ Via health dashboard	✅ Via Dynatrace	Via CLI or dashboard	N/A
Restart Tasks	🔹 If permitted by RBAC	✅ Always	<code>confluent connect task restart <id> <task-id></code>	API call

Legend:

- ✅ = Full capability
 - 🔹 = Limited capability
 - ❌ = Not allowed
-

7. Infrastructure Provisioning (EBS Responsibility)

7.1 Terraform Modules Needed

Based on our discussion, Terraform is **only for EBS infrastructure team**, not for departments.

Module Structure:

```
terraform/
├── modules/
│   ├── network-connectivity/
│   │   ├── private-link.tf          # AWS Private Link setup
│   │   ├── vpc-endpoint.tf         # VPC endpoint
│   │   ├── security-groups.tf      # Security groups
│   │   ├── route53.tf             # DNS configuration
│   │   └── variables.tf
│   ├── kafka-environment/
│   │   ├── confluent-env.tf        # Confluent environment
│   │   ├── kafka-cluster.tf        # Kafka cluster (shared)
│   │   ├── schema-registry.tf      # Schema Registry
│   │   └── variables.tf
│   ├── department-onboarding/
│   │   ├── service-account.tf      # Per-department SA
│   │   ├── api-keys.tf            # Restricted API keys
│   │   ├── rbac.tf                # RBAC role bindings
│   │   ├── topics.tf              # Department topics
│   │   └── variables.tf
│   └── kafka-connect-cluster/
│       ├── connect-cluster.tf      # Connect cluster (if dedicated)
│       ├── connector-configs.tf    # Connector Terraform resources
│       ├── dlq-topics.tf           # Dead letter queue topics
│       └── variables.tf
├── environments/
│   ├── dev/
│   │   ├── main.tf
│   │   ├── departments.tfvars      # Department quotas, names
│   │   └── terraform.tfvars
│   ├── staging/
│   └── prod/
├── connectors/                      # GitOps connector configs
│   ├── dev/
│   │   ├── dept1-postgres-source.json
│   │   └── dept2-s3-sink.json
│   ├── staging/
│   └── prod/
```

7.2 Department Onboarding Process

EBS Terraform Workflow:

1. Network Setup (One-time per department)

```
cd terraform/environments/prod
```

```
terraform apply -var="new_department=dept3" -var="vpc_id=vpc-xxx"
```

2. Service Account & API Key Creation

```
resource "confluent_service_account" "dept3" {  
  
  display_name = "dept3-connector-operator"  
  
  description = "Service account for Department 3 connectors"  
  
}  
  
resource "confluent_api_key" "dept3_connect" {  
  
  display_name = "dept3-connect-api-key"  
  
  owner {  
  
    id = confluent_service_account.dept3.id  
  
    # ...  
  
  }  
  
  managed_resource {  
  
    id = confluent_kafka_cluster.shared.id  
  
    # ...  
  
  }  
  
}
```

3. RBAC Configuration

```
# Allow creating connectors with dept3- prefix only
```

```
resource "confluent_role_binding" "dept3_connect_admin" {
```

```

principal = "User:${confluent_service_account.dept3.id}"

role_name = "ResourceOwner"

crn_pattern =
"${confluent_kafka_cluster.shared.rbac_crn}/connect-cluster=*/connector=dept3-*"
}

# Grant topic read/write for dept3 topics

resource "confluent_role_binding" "dept3_topic_access" {

  principal = "User:${confluent_service_account.dept3.id}"

  role_name = "DeveloperWrite"

  crn_pattern =
"${confluent_kafka_cluster.shared.rbac_crn}/kafka=${confluent_kafka_cluster.shared.
id}/topic=dept3.*"
}

```

4. **Quota Configuration** (if supported)

```

resource "confluent_quota" "dept3_connectors" {

  service_account = confluent_service_account.dept3.id

  quotas = {

    max_connectors = 5

    max_tasks      = 15

  }

}

```

5. **Handoff to Department**

- Provide API key (securely)
- Provide connector templates
- Grant access to Git repo (if GitOps)
- Provide health dashboard URL
- Schedule onboarding session

8. Key Questions (Answered)

Q1: "Who operates Kafka Connect?"

Answer: Three-tier operation model:

1. **Confluent Cloud** operates the underlying platform
 2. **EBS Infrastructure Team** operates the account, network, and infrastructure
 3. **Department Connector Operators** operate their specific connectors (with EBS support)
-

Q2: "Who is responsible for the Connect flow?"

Answer:

- **EBS** is responsible for Connect **infrastructure** (cluster, network, quotas)
 - **Departments** are responsible for Connect **flows** (individual connectors, data pipelines)
-

Q3: "Why can't departments run connectors themselves?"

Answer: Security restrictions:

- Departments don't have Confluent Cloud UI access
 - Departments don't have full API permissions
 - **Solution:** Provide restricted CLI access with RBAC, or GitOps deployment
-

Q4: "What if we have 20 people wanting connectors - is it scalable?"

Answer:

- **Ticket-based approach:** Not scalable (Option A only)
 - **Self-service CLI approach:** Scalable (Option B)
 - **Hybrid approach:** Scale with self-service, use tickets for production approvals
 - **Current reality:** "We don't have 20 people waiting, so solve the problem as it appears"
-

Q5: "How do departments see logs?"

Answer: Three options:

1. **Confluent CLI:** `confluent connect describe <id>` (shows basic errors)
 2. **Health Dashboard:** Web UI showing status and recent errors
 3. **Dynatrace:** Full logs, but **only accessible by EBS team**
 4. **Feature Request:** Ask Confluent to export logs from fully managed Connect
-

Q6: "How do we enforce quotas?"

Answer:

1. Check if Confluent Cloud supports native quotas (preferred)
 2. If not, implement custom validation in GitOps pipeline
 3. Monitor resource usage in Dynatrace
 4. Upgrade to dedicated clusters if isolation needed
-

Q7: "Is shared infrastructure viable?"

Answer: Yes, with caveats:

- Shared Kafka cluster → Connect resources are shared
 - Use RBAC for logical isolation
 - Monitor for "noisy neighbor" problems
 - Upgrade specific departments to dedicated if needed
 - Quotas are essential for fairness
-

9. Implementation Roadmap

Phase 1: Foundation (Weeks 1-2)

- ☐ Complete Terraform for network connectivity (Private Link)
- ☐ Provision shared Kafka cluster
- ☐ Set up first department service account with restricted API key
- ☐ Test Confluent CLI access from department VPC
- ☐ Create connector configuration templates

Phase 2: Tooling & Validation (Weeks 3-4)

- ☐ Build quota validation script
- ☐ Build naming convention validation script
- ☐ Create Git repository structure for connector configs
- ☐ Set up CI/CD pipeline for validation
- ☐ Test GitOps deployment workflow

Phase 3: Monitoring & Visibility (Weeks 5-6)

- ☐ Integrate Confluent metrics with Dynatrace
- ☐ Build health check dashboard (web UI)
- ☐ Set up alerting rules
- ☐ Test log forwarding (if possible)
- ☐ Create Dynatrace dashboards for EBS team

Phase 4: Documentation & Training (Weeks 7-8)

- ☐ Write operations manual (episode-based)
- ☐ Create video tutorials
- ☐ Document troubleshooting procedures
- ☐ Train first department team
- ☐ Conduct pilot deployment

Phase 5: Scale & Optimize (Ongoing)

- ☐ Onboard additional departments
 - ☐ Refine quota sizing based on usage
 - ☐ Optimize connector configurations
 - ☐ Collect feedback and iterate
 - ☐ Evaluate dedicated cluster needs
-

10. Open Questions & Action Items

Open Questions

1. Confluent Cloud Quotas:

- Does Confluent Cloud support per-service-account connector quotas?
- If yes, how to configure via Terraform?
- If no, timeline for this feature?

2. Log Export:

- Can fully managed Connect export logs to customer-owned Kafka topic?
- Can logs be forwarded to CloudWatch/Dynatrace?
- What is Confluent's roadmap for log observability?

3. RBAC Capabilities:

- Can RBAC enforce connector naming patterns (e.g., `dept3-*` only)?
- Can RBAC restrict connector plugin usage?
- What is the granularity of Connect permissions?

4. Resource Limits:

- What are the default resource limits for shared Connect clusters?
- How many connectors/tasks per cluster?
- How to monitor resource utilization?

5. Isolation:

- When should we recommend dedicated vs. shared clusters?
- Cost implications of different isolation levels?
- Can we mix shared and dedicated in one environment?

Action Items

For Confluent Engagement:

- ☐ Test Confluent CLI from department VPC
- ☐ Verify RBAC can restrict connector name prefixes
- ☐ Research Confluent quota capabilities
- ☐ Open Confluent support case for log export feature
- ☐ Define quota sizes per department tier (small/medium/large)
- ☐ Feature request: Export fully managed Connect logs
- ☐ Feature request: Per-service-account connector quotas
- ☐ Consultation: Best practices for multi-tenant Connect

For EBS team:

- ☐ Document API key distribution process (secure)
 - ☐ Write runbook: Connector deployment via CLI
 - ☐ Write runbook: Connector deployment via GitOps
 - ☐ Write runbook: Troubleshooting failed connectors
 - ☐ Create architecture diagrams
-

11. Success Criteria

1. Self-Service Capability:

- Departments can deploy connectors without EBS involvement (dev environment)
- Production deployment requires approval but is fast (<1 hour)

2. Visibility:

- Departments have real-time health status for their connectors
- EBS team has full logs and metrics for troubleshooting
- Alerts notify both department and EBS on failures

3. Isolation & Fairness:

- No department can exceed quotas
- No "noisy neighbor" issues reported
- Clear cost attribution per department

4. Operational Efficiency:

- EBS team spends <2 hours/week on connector operations
- 80% of connector deployments succeed first time
- Mean time to resolution for failures: <30 minutes

5. Scalability:

- Platform supports 20+ departments
 - Each department can operate 5-10 connectors independently
 - Onboarding new department takes <1 day
-

12. Conclusion

The operational model for Kafka Connect in this environment requires balancing:

- **Self-service** (department autonomy) vs. **Control** (EBS governance)
- **Shared infrastructure** (cost) vs. **Isolation** (performance/security)
- **Confluent native tools** (leverage platform) vs. **Custom tooling** (specific needs)

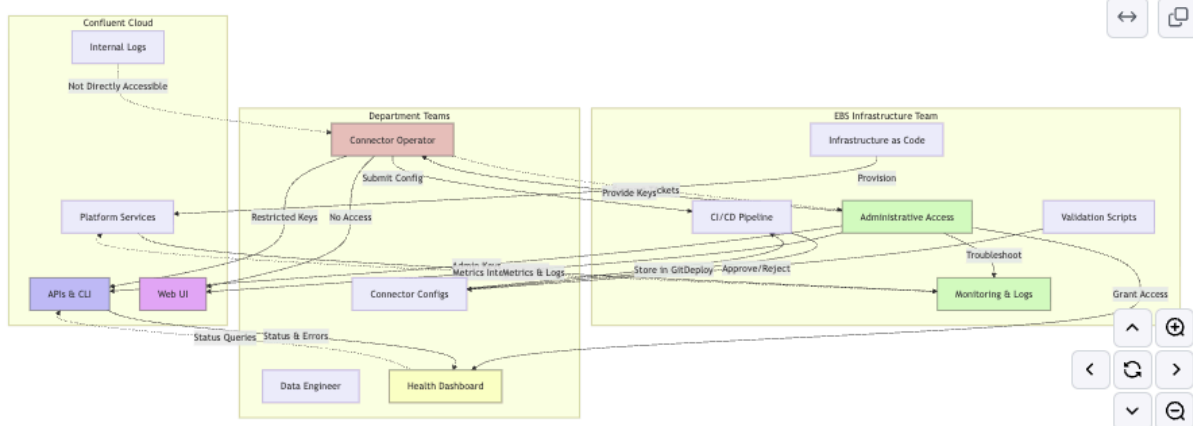
Key Principles:

1. "Leverage Confluent as much as possible" - use CLI, APIs, and native features
2. Departments operate via Confluent CLI with restricted API keys (preferred)
3. GitOps for production deployments with validation gates
4. Health checks for departments, full logs for EBS
5. Quotas and naming conventions enforced programmatically
6. Start simple (shared clusters), scale selectively (dedicated when needed)

Next Steps:

1. Validate technical capabilities with Confluent support
 2. Complete Terraform infrastructure modules
 3. Test end-to-end workflow with pilot department
 4. Document and train
 5. Roll out incrementally
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Appendix A: Role Interaction Matrix



Appendix B: Decision Matrix - Deployment Models

Factor	GitOps (Option A)	Self-Service CLI (Option B)	Hybrid (Recommended)
Deployment Speed	⚠️ Slow (PR review)	✅ Fast (immediate)	✅ Fast (dev), ⚠️ Controlled (prod)
EBS Team Load	❌ High (always involved)	✅ Low (only issues)	⚠️ Medium (prod approvals)
Audit Trail	✅ Full (Git history)	⚠️ Limited (API logs)	✅ Full (Git for prod)
Access Control	✅ Strong (PR approval)	⚠️ RBAC-dependent	✅ Strong (prod), ⚠️ Flexible (dev)
Scalability	❌ Limited by EBS capacity	✅ Self-service scales	✅ Scales with automation
Learning Curve	⚠️ Medium (Git workflows)	✅ Low (CLI commands)	⚠️ Medium (both models)
Department Autonomy	❌ Low (wait for approval)	✅ High (self-deploy)	✅ High (dev), ⚠️ Controlled (prod)
Error Prevention	✅ High (validation gates)	⚠️ Depends on RBAC	✅ High (prod), ⚠️ Learning (dev)
Troubleshooting	⚠️ EBS has full context	✅ Dept sees errors directly	✅ Best of both
Cost	⚠️ EBS time = cost	✅ Low operational cost	✅ Optimized

Legend:

- ✅ = Strong advantage
- ⚠️ = Moderate/depends
- ❌ = Disadvantage

Recommendation: Hybrid Model

- Development: Self-service CLI for fast iteration
- Production: GitOps for governance and audit