

OPMIG-05: Dynamic Routing & Bucket Management

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> **Series:** OPMIG | **Notebook:** 5 of 9 | **Created:** December 2025
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> ****OpenPipeline Migration Series**** | Notebook 5 of 9

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> **Level:** Intermediate
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> **Estimated Time:** 60 minutes
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Learning Objectives

By completing this notebook, you will:

1. Master dynamic routing strategies for different migration scenarios
2. Design multi-tier bucket architectures for cost optimization
3. ★ ****NEW:**** Calculate ROI and TCO for bucket optimization strategies
4. ★ ****NEW:**** Implement 3-tier and 5-tier bucket governance models
5. ★ ****NEW:**** Apply compliance-driven retention strategies
6. Configure multi-pipeline processing patterns
7. Analyze bucket usage and identify optimization opportunities

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Understanding Dynamic Routing

Dynamic routing is the mechanism that directs incoming data to specific pipelines based on matching conditions.

How Routing Works

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! [Dynamic Routing Flow]
```

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(data:image/svg+xml;base64,PHN2YzB4bWxuc20iaHR0cDovL3d3dy53My5vcmcvMjAwMC9zdmciIHZpZXQCb3g9IjAgMCA4MDAgMzQwIj4KICA8ZGVmcz4KICAgIDxsaW5lYXJHcmFkaWVudCBpZD0iZGF0YUdyYWQiIHgxPSIwJSIgeTE9IjAlIiB4Mj0iMTAwJSIgeTI9IjEwMCUuPgogICAgICA8c3RvcCBvZmZzZXQ9IjAlIiBzdHlsZT0ic3RvcC1jb2xvcjojM2I4MmYyO203N0b3Atb3BhY2l0eToxIiAvPgogICAgICA8c3RvcCBvZmZzZXQ9IjEwMCUuIHNoewXlPSJzdG9wLWVnbG9y0iMyNTYzZWl7c3RvcC1vcGFjaXR50jEiIC8+CiAgICA8L2xpbmVhckdyYWRpZW50PgogICAgPGxpbmVhckdyYWRpZW50IGlkPSJyb3V0ZUFHcmFkIiB4MT0iMCUuIHkxPSIwJSIgeDI9IjEwMCUuIHkyPSIxMDAlIj4KICAgICAgPHN0b3Agb2Zmc2V0PSIwJSIgc3R5bGU9InN0b3AtY29sb3I6IzIyYzU1ZTtdG9wLW9wYWNpdHk6MSIglZ4KICAgICAgPHN0b3Agb2Zmc2V0PSIxMDAlIiBzdHlsZT0ic3RvcC1jb2xvcjojMTZhMzRhO2N0b3Atb3BhY2l0eToxIiAvPgogICAgPC9saW5lYXJHcmFkaWVudD4KICAgIDxsaW5lYXJHcmFkaWVudCBpZD0icm91dGVGR3JhZCIgeDE9IjAlIiB5MT0iMCUuIHgyPSIxMDAlIiB5Mj0iMTAwJSI+CiAgICAgIDxzdG9wIG9mZnNldD0iMCUuIHNoewXlPSJzdG9wLWVnbG9y0iNmNTllMGi7c3RvcC1vcGFja
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Strategy 2: Environment-Based Routing

Route based on environment or namespace:

Condition	Target Pipeline	Bucket
`k8s.namespace.name == "production"`	prod-logs	default_logs (35d)
`k8s.namespace.name == "staging"`	staging-logs	dev_logs (7d)
`k8s.namespace.name == "development"`	dev-logs	dev_logs (7d)

Strategy 3: Content-Based Routing

Route based on log content patterns:

Condition	Target Pipeline	Purpose
`contains(content, "payment")`	payment-logs	Financial logs
`contains(content, "security")`	security-logs	Security events
`contains(content, "audit")`	audit-logs	Compliance logs

Strategy 4: Severity-Based Routing

Route based on log level for tiered retention:

Condition	Target Pipeline	Bucket
`loglevel == "ERROR"`	error-logs	error_logs (90d)
`loglevel == "WARN"`	warning-logs	default_logs (35d)
`loglevel == "DEBUG"`	debug-logs	short_retention (3d)

Strategy 5: Hybrid Routing

Combine multiple criteria for precise routing:

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k8s.namespace.name == "production" AND log.source == "payment-service"
```
```

Grail Buckets Explained

Grail buckets are storage containers with configurable retention and access policies.

Default Buckets

Bucket	Data Type	Default Retention
`default_logs`	Log records	35 days
`default_spans`	Span/trace data	35 days
`default_bizevents`	Business events	35 days
`default_events`	Platform events	35 days

Custom Bucket Use Cases

Use Case	Bucket Strategy	Retention
Compliance/Audit	`audit_logs`	365+ days
Financial Data	`financial_logs`	90 days
Security Events	`security_logs`	180 days
Development Logs	`dev_logs`	7 days
Debug/Trace	`debug_logs`	3 days
High-Volume Noise	`ephemeral_logs`	1 day

Bucket Benefits

- Cost Optimization**: Shorter retention = lower storage costs
- Compliance**: Longer retention for audit requirements
- Performance**: Smaller buckets = faster queries
- Access Control**: Bucket-level permissions
- Data Isolation**: Separate buckets for different teams/purposes

Bucket Routing Configuration


Configuring Bucket Routing in Pipeline

Each pipeline can route data to a specific bucket:

- Open your pipeline in OpenPipeline settings
- Go to **Storage** tab
- Select target bucket from dropdown
- Save pipeline

Bucket Routing Rules

Rule	Behavior
Pipeline bucket	Records go to pipeline's configured bucket
No bucket set	Records go to default bucket for data type
Multi-pipeline	Record stored once in first pipeline's bucket

>  **Important**: A record is stored only ONCE, even if processed by

[illegible]

wgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMSIgzM9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9IndoaXRlLiB0ZXh0LWFuY2hvcj0ibWlkZGxLIj5UaWVyIDI6IGRlZmF1bHRfbG9ncyAoMzUgZGF5cyk8L3RLeHQ+CiaAgPHRleHQgeD0imZYWIIB5PSIXNjgiIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMCigZmlsbD0icmdiYSgyNTUsMjU1LDI1NSwwLjkpIiB0ZXh0LWFuY2hvcj0ibWlkZGxLIj5TdGFuZGFyZCBPcGVyYXRpb25zPC90ZXh0PgoKICA8IS0tIFRpZXIgmzogRGV2IC0tPgogIDxyZWNOIHg9IjIxmCIgeT0IMTKwiIB3awR0aD0imZAwiBoZWlnaHQ9IjUwIiByeD0iOICIgZmlsbD0idXJsKCN0awVM0dyYWQPIiBmaWx0ZXI9InVybcGjYnRTaGFkb3cpIi8+CiaAgPHRleHQgeD0imZYWIIB5PSIYMtiIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMSIgzM9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9IndoaXRlLiB0ZXh0LWFuY2hvcj0ibWlkZGxLIj5UaWVyIDM6IGRldl9sb2dzICg3IGRheXMPcC90ZXh0PgogIDx0ZXh0IHg9Ijm2MCIgeT0imjiI4IiBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTAiIGZpbGw9InJnYmEomjU1LDI1NSwyNTUsMC45KSIGdGV4dC1hbmNob3I9Im1pZGRsZSI+RGV2ZWxvcG1lbnQgKyBTdGFnaW5nPC90ZXh0PgoKICA8IS0tIFRpZXIgmDogRHJvcCAAtLT4KICA8cmVjdCB4PSIymTAiIHk9IjI1MCIgd2lkdGg9IjMwMCIgaGVpZ2h0PSI1MCIgcng9IjgiIGZpbGw9InVybcGjZHJvcEdyYWQPIiBmaWx0ZXI9InVybcGjYnRTaGFkb3cpIi8+CiaAgPHRleHQgeD0imZYWIIB5PSIYNziIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMSIgzM9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9IndoaXRlLiB0ZXh0LWFuY2hvcj0ibWlkZGxLIj5EUk9QICgwIGRheXMPcC90ZXh0PgogIDx0ZXh0IHg9Ijm2MCIgeT0imjg4IiBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTAiIGZpbGw9InJnYmEomjU1LDI1NSwyNTUsMC45KSIGdGV4dC1hbmNob3I9Im1pZGRsZSI+REVCVUcsIFRSQUNFLCBIZWFsdGggQ2hlYT2tPC90ZXh0PgoKICA8IS0tIENvc3QgSW1wYWN0IC0tPgogIDxyZWNOIHg9IjU0MCIgeT0inZAIHdpZHRoPSIymZaiIGHlaWdodD0imjMwiIByeD0iOICIgZmlsbD0iI2ZmZiIgc3Ryb2tlPSIjZTJlOGYWIiBzdHJva2Utd2lkdGg9IjIiLz4KICA8dGV4dCB4PSI2NTUiIHk9Ijk1IiBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTIiIGZvbnQtcl6ZT0iPSIib2xkiBmaWxsPSIjMzMziB0ZXh0LWFuY2hvcj0ibWlkZGxLIj5Db3N0IEltcGFjdDwdGV4dD4KCiaAgPHJLY3QgeD0iNTU1IIB5PSIXMTAiIHdpZHRoPSIymDAiIGHlaWdodD0iNDaiIHJ4PSIOiBmaWxsPSIjZmVjYWwhIi8+CiaAgPHRleHQgeD0injU1IIB5PSIXMZaiIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMCigZm9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9IinkYZI2mjYiIHRleHQTYW5jaG9yPSJtaWRkbGUipjUlIHZvbHVtZSDDlyA5MCBkYXlzPC90ZXh0PgogIDx0ZXh0IHg9IjY1NSIgeT0iMTQziBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTAiIGZpbGw9IinkYZI2mjYiIHRleHQTYW5jaG9yPSJtaWRkbGUipkhPZ2hlciBjb3N0IGJ1dCBjcmllawNhbcBkYXRhPC90ZXh0PgoKICA8cmVjdCB4PSI1NTUiIHk9Ije1NSIGd2lkdGg9IjIwMCIgaGVpZ2h0PSI0MCIgcng9IjQiIGZpbGw9IinmZWYzYzciLz4KICA8dGV4dCB4PSI2NTUiIHk9Ije3NSIGZm9udC1mYW1pbHk9IkFYaWFLCBzyW5zLXNLcmllbiBmb250LXNpemU9IjEwIiBmb250LXdlaWdodD0iymsZCIgZmlsbD0iiZkyNDawZSIgdGV4dC1hbmNob3I9Im1pZGRsZSI+NjAlIHZvbHVtZSDDlyAzNSBkYXlzPC90ZXh0PgogIDx0ZXh0IHg9IjY1NSIgeT0iMTg4IiBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTAiIGZpbGw9Iim5MjQwMGUiIHRleHQTYW5jaG9yPSJtaWRkbGUipLn0Y5kYXJKIHJldGVudGlvbGwvdGV4dD4KCiaAgPHJLY3QgeD0iNTU1IIB5PSIymDAiIHdpZHRoPSIymDAiIGHlaWdodD0iNDaiIHJ4PSIOiBmaWxsPSIjZDFmYWU1Ii8+CiaAgPHRleHQgeD0injU1IIB5PSIymJAiIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMCigZm9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9IimwNDc4NTciIHRleHQTYW5jaG9yPSJtaWRkbGUipjM1JSB2b2xlbWUgW5cgMCBkYXlzPC90ZXh0PgogIDx0ZXh0IHg9IjY1NSIgeT0imjMziBmb250LWZhbwLseT0iQXJpYWwsIHnhbnMtc2VyaWYiIGZvbnQtcl6ZT0iMTAiIGZpbGw9IimwNDc4NTciIHRleHQTYW5jaG9yPSJtaWRkbGUipLpFuk8gc3RvcFnZSBjb3N0ITwvdGV4dD4KCiaAgPCetLSBSZXN1bhQgL50+CiaAgPHJLY3QgeD0iNTU1IIB5PSIymTAiIHdpZHRoPSIymDAiIGHlaWdodD0imzgiIHJ4PSIOiBmaWxsPSIjZWRL0WZLIi8+CiaAgPHRleHQgeD0injU1IIB5PSIYNziAiiIGZvbnQtZmFtaWx5PSJBcmllhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIXMCigZm9udC13ZWlnaHQ9ImJvbGQiIGZpbGw9Iim2ZDI4ZDKiIHRleHQTYW5jaG9yPSJtaWRkbGUipLrVdGFsIFNHdmLuZ3M6IH4zNS00MCU8L3RleHQ+CiaAgPHRleHQgeD0injU1IIB5PSIymDAiIGZvbnQtZmFtaW

x5PSJBcmlhbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIGZmlsbD0iIzZkMjhkOSIgdGV4dC1hbmNob3I9Im1pZGRsZSI+dnMuIGFsbC1pbjBkZWZhdWx0IGJ1Y2tldDwvdGV4dD4KPC9zdmc+Cg==
)

Pattern 2: Environment-Based Retention

Environment	Bucket	Retention	Cost Impact
Production	`prod_logs`	35 days	Standard
Staging	`staging_logs`	14 days	-60%
Development	`dev_logs`	7 days	-80%
Ephemeral/Test	`temp_logs`	3 days	-90%

Pattern 3: Drop + Sample

For extremely high-volume, low-value logs:

- 1. Drop 90% of health checks
- 2. Sample 10% to a short-retention bucket
- 3. Keep statistical visibility without full storage cost

Pattern 4: Metric Extraction + Drop

For logs needed only for metrics:

- 1. Extract metrics (with dimensions) from logs
- 2. Drop the raw logs after extraction
- 3. Metrics persist for 10 years, logs dropped immediately

Cost Optimization ROI Calculator ★ NEW

Understanding the financial impact of bucket strategies is critical for migration planning. This section provides detailed ROI calculations for common optimization patterns.

DDU (Davis Data Units) Pricing Model

OpenPipeline storage is measured in **Davis Data Units (DDUs)**:

Component	DDU Calculation
Log Ingestion	0.001 DDU per MB ingested
Storage (per day)	0.0001 DDU per MB per day retained
DQL Query	0.001 DDU per MB scanned

****Typical DDU Pricing:**** ~\$0.08 per DDU (varies by contract)

Cost Formula

...

Total Cost = (Ingestion Cost) + (Storage Cost) + (Query Cost)

Where:

Ingestion Cost = Volume (MB/day) × 0.001 DDU/MB × Price/DDU

Storage Cost = Volume (MB/day) × Retention (days) × 0.0001 DDU/MB/day × Price/DDU

Query Cost = Query Volume (MB) × 0.001 DDU/MB × Price/DDU

...

Scenario 1: E-Commerce Platform – Tiered Retention

****Current State (No Optimization):****

...

Volume: 100 GB/day (100,000 MB/day)

Breakdown:

- ERROR: 5% (5,000 MB/day)
- WARN: 10% (10,000 MB/day)
- INFO: 50% (50,000 MB/day)
- DEBUG: 35% (35,000 MB/day)

Retention: 35 days (default_logs)

DDU Price: \$0.08 per DDU

...

****Current Monthly Cost:****

...

Ingestion: 100,000 MB/day × 30 days × 0.001 DDU/MB × \$0.08 = \$240/month

Storage: 100,000 MB/day × 35 days × 0.0001 DDU/MB/day × \$0.08 = \$2,800/month

Query: Estimate ~20% of stored data queried/month
(100,000 × 30 × 0.2) × 0.001 × \$0.08 = \$48/month

TOTAL: \$3,088/month

...

****Optimized State (3-Tier + Drop):****

...

Tier 1 (ERROR): 5,000 MB/day → error_logs (90 days)

Tier 2 (WARN/INFO): 60,000 MB/day → default_logs (35 days)

Tier 3 (DEBUG): 35,000 MB/day → DROPPED (0 days)

...

****Optimized Monthly Cost:****

...

Ingestion (only non-dropped):

$65,000 \text{ MB/day} \times 30 \text{ days} \times 0.001 \times \$0.08 = \$156/\text{month}$

Storage:

Tier 1: $5,000 \times 90 \times 0.0001 \times \$0.08 = \$360/\text{month}$

Tier 2: $60,000 \times 35 \times 0.0001 \times \$0.08 = \$1,680/\text{month}$

Total storage = \$2,040/month

Query (20% of stored):

$(5,000 \times 30 \times 0.2 + 60,000 \times 30 \times 0.2) \times 0.001 \times \$0.08 = \$31.20/\text{month}$

TOTAL: \$2,227.20/month

...

****ROI Analysis:****

...

Monthly Savings: $\$3,088 - \$2,227 = \$861/\text{month}$

Annual Savings: $\$861 \times 12 = \$10,332/\text{year}$

Savings Percentage: 27.9%

Implementation Time: 4-8 hours

Payback Period: Immediate (operational change only)

...

Scenario 2: SaaS Platform – Multi-Environment

****Current State:****

...

Production: $50 \text{ GB/day} \times 35 \text{ days} = \$1,540/\text{month}$

Staging: $30 \text{ GB/day} \times 35 \text{ days} = \$924/\text{month}$

Development: $20 \text{ GB/day} \times 35 \text{ days} = \$616/\text{month}$

TOTAL: \$3,080/month

...

****Optimized State:****

...

Production: $50 \text{ GB/day} \times 35 \text{ days} = \$1,540/\text{month}$ (no change)

Staging: $30 \text{ GB/day} \times 14 \text{ days} = \$369.60/\text{month}$ (60% reduction)

Development: $20 \text{ GB/day} \times 7 \text{ days} = \$154.40/\text{month}$ (75% reduction)

TOTAL: \$2,064/month

...

****ROI Analysis:****

...

Monthly Savings: \$1,016/month

Annual Savings: \$12,192/year

Savings Percentage: 33%

...

Scenario 3: Global Retailer – Compliance + Cost

Requirements:

- Payment logs: PCI-DSS requires 90 days
- Audit logs: SOC 2 requires 365 days
- Application logs: 35 days standard
- Debug logs: Drop immediately

Volume Breakdown:

...

Payment logs: 10 GB/day (10% of total)
Audit logs: 5 GB/day (5% of total)
App logs: 60 GB/day (60% of total)
Debug logs: 25 GB/day (25% of total)
TOTAL: 100 GB/day

...

Cost Calculation:

...

Payment (90d): $10,000 \times 90 \times 0.0001 \times \$0.08 = \$720/\text{month}$
Audit (365d): $5,000 \times 365 \times 0.0001 \times \$0.08 = \$1,460/\text{month}$
App (35d): $60,000 \times 35 \times 0.0001 \times \$0.08 = \$1,680/\text{month}$
Debug (drop): $\$0/\text{month}$
Ingestion: $75,000 \times 30 \times 0.001 \times \$0.08 = \$180/\text{month}$

TOTAL: \$4,040/month

...

vs. No Optimization (all 35 days):

...

$100 \text{ GB/day} \times 35 \text{ days} = \$3,080/\text{month}$ (but non-compliant!)

...

****Key Insight:**** Sometimes optimization increases cost but ensures compliance. The cost of non-compliance (fines, audits) far exceeds storage costs.

Analyzing Your Bucket Usage

Use these queries to understand your current bucket utilization and plan optimization.

```python



```

// Current bucket distribution for logs
// Shows where your logs are being stored
fetch logs, from: now() - 7d
| summarize {record_count = count()}, by: {dt.system.bucket}
| fieldsAdd daily_avg = round(record_count / 7, decimals: 0)
| sort record_count desc
```

```python
// Bucket usage by log source
// Identify which sources are consuming bucket capacity
fetch logs, from: now() - 7d
| summarize {record_count = count()}, by: {dt.system.bucket, log.source}
| sort record_count desc
| limit 30
```

```python
// Bucket usage by pipeline
// Shows which pipelines are routing to which buckets
fetch logs, from: now() - 7d
| filter isNotNull(dt.openpipeline.pipelines)
| summarize {record_count = count()}, by: {dt.openpipeline.pipelines, dt.system.bucket}
| sort record_count desc
```

```python
// Bucket usage trend over time
fetch logs, from: now() - 7d
| makeTimeseries {record_count = count()}, by: {dt.system.bucket}, interval: 1d
```

```python
// Identify logs that could move to shorter retention buckets
// Debug and trace logs are prime candidates
fetch logs, from: now() - 7d
| filter dt.system.bucket == "default_logs"
| summarize {
 total = count(),
 debug = countIf(loglevel == "DEBUG" OR status == "DEBUG"),
 trace = countIf(loglevel == "TRACE" OR status == "TRACE"),
 info = countIf(loglevel == "INFO" OR status == "INFO")
}
| fieldsAdd debug_pct = round((toDouble(debug) / toDouble(total)) * 100, decimals: 2)
| fieldsAdd trace_pct = round((toDouble(trace) / toDouble(total)) * 100,

```

```

decimals: 2)
| fieldsAdd optimization_potential = round((toDouble(debug + trace) /
toDouble(total)) * 100, decimals: 2)
...

```python
// Check span bucket distribution
// Spans also use buckets
fetch spans, from: now() - 7d
| summarize {span_count = count()}, by: {dt.system.bucket}
| sort span_count desc
...

```python
// Estimate storage reduction from tiered retention
// Shows potential savings from routing to different buckets
fetch logs, from: now() - 7d
| summarize {
 total = count(),
 error_warn = countIf(loglevel == "ERROR" OR loglevel == "WARN"),
 info = countIf(loglevel == "INFO"),
 debug_trace = countIf(loglevel == "DEBUG" OR loglevel == "TRACE")
}
| fieldsAdd tier1_90day = error_warn
| fieldsAdd tier2_35day = info
| fieldsAdd tier3_drop = debug_trace
| fieldsAdd current_cost_units = total * 35
| fieldsAdd optimized_cost_units = (tier1_90day * 90) + (tier2_35day * 35) +
(tier3_drop * 0)
| fieldsAdd savings_pct = round((1.0 - (toDouble(optimized_cost_units) /
toDouble(current_cost_units))) * 100, decimals: 1)
...

Multi-Tier Bucket Strategies ★ NEW

Different organizations need different bucket architectures based on their
scale, compliance requirements, and cost targets.

3-Tier Strategy (Small to Medium Organizations)

Recommended for: 10-500 GB/day, single or few environments

| Tier | Bucket Name | Retention | Use Case | Volume % |
|-----|-----|-----|-----|-----|
| **Critical** | `critical_logs` | 90 days | Errors, security, audit | 10-15%
|

```

```
| **Standard** | `default_logs` | 35 days | WARN, INFO, app logs | 60-70% |
| **Ephemeral** | `ephemeral_logs` | 7 days | DEBUG, health checks | 20-30% |
```

#### **\*\*Routing Configuration:\*\***

```
...
```

##### Route 1 (Critical):

```
Condition: loglevel == "ERROR" OR
 contains(log.source, "security") OR
 contains(log.source, "audit") OR
 contains(content, "payment")
Pipeline: critical-logs
Bucket: critical_logs (90 days)
```

##### Route 2 (Ephemeral):

```
Condition: loglevel == "DEBUG" OR
 loglevel == "TRACE" OR
 contains(content, "/health")
Pipeline: ephemeral-logs
Bucket: ephemeral_logs (7 days)
```

##### Default Route:

```
Pipeline: standard-logs
Bucket: default_logs (35 days)
```

```
...
```

**\*\*Expected Savings:\*\*** 25-35% vs. single-bucket approach

#### **### 5-Tier Strategy (Enterprise Organizations)**

**\*\*Recommended for:\*\*** 500+ GB/day, multiple environments, strict compliance

Tier	Bucket Name	Retention	Use Case	Volume %
Compliance	`compliance_logs`	365 days	SOC 2, GDPR, HIPAA audit trails	3-5%
Security	`security_logs`	180 days	Security events, attacks, vulns	2-5%
Production	`prod_logs`	90 days	Production errors, warnings	10-15%
Standard	`default_logs`	35 days	INFO logs, standard operations	40-50%
Development	`dev_logs`	7 days	Dev/staging, DEBUG, testing	30-40%

**\*\*Expected Savings:\*\*** 40-60% vs. single-bucket approach

#### **### Hybrid Strategy (Compliance + Cost)**

**\*\*Best for:\*\* Organizations with compliance requirements AND cost constraints**

## ! [Hybrid Bucket Strategy]

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[illegible]



**\*\*Key Principle:\*\*** Compliance routes must be FIRST to ensure regulatory data isn't accidentally dropped or under-retained.

— — —

A single record can be processed by multiple pipelines (up to 5). This enables powerful patterns:

```
! [Multi-Pipeline Processing]
```

```
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```

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tc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImZ2ZDI4ZDkiPuKAoiBQYXJzZSByZXNwb25zZV90aw1lPC90ZXh0PgogICAgPHRleHQgeD0iMTAiIHk9IjM1IiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImZ2ZDI4ZDkiPuKAoiBFeHRYYWNoIG1ldHJpYzogZHVyYXRpb248L3RleHQ+CiAgPC9nPgoKICA8IS0tIFBpcGVsaW5lIDEgb3V0cHV0IGFycm93IC0tPgogIDxsaw5lIHGxPSIzNzUiIHkxPSIxMjcIiHgyPSIz0TUiIHkyPSIxMjcIiHN0cm9rZT0iIzY0NzQ4YiIgc3Ryb2tllXdpZHRoPSIyIiBtYXJrZXItZW5kPSJ1cmwoI21wQXJyb3cpIi8+CgogIDwhLS0gTWV0cmIjIE91dHB1dCAtLT4KICA8cmVjdCB4PSI0MDUiIHk9IjEwNSIgd2lkdGg9IjEwMCIGA6VpZ2h0PSI0NSIgcng9IjYiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSI0NTUiIHk9IjEyMyIgZm9udC1mYW1pbHk9IkFyaWFsLCBzYW5zLXNlcmIiBmb250LXNpemU9IjEwIiBmaWxsPSJ3aG0ZSIgdGV4dC1hbmNob3I9Im1pZGRsZSIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9InJnYmEoMjU1LDI1NSwyNTUsMC45KSIgdGV4dC1hbmNob3I9Im1pZGRsZSI+cmVxdWVzdF9kdXJhdGlvbJwvdGV4dD4KCiAgPCEtLSBQaXBlbGluZSAy0iBMB2cgU3RvcmluZSAAtLT4KICA8cmVjdCB4PSIyMDUiIHk9IjE3MCIgd2lkdGg9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHRleHQtYW5jaG9yPSJtaWRkbGUiIGZvbnQtZm9udC1zaXplPSIyMCIgZm9udC13ZWlnaHQ9ImJvbGQIPvCfk4ogTUVUUKdPC90ZXh0PgogIDx0ZXh0IHg9IjQ1NSIgeT0iMTQwIiBmb250LWZhbWlseT0iQXJpYWwsIHhbnMtc2VyaWYiIGZvbnQtC2l6ZT0iMTAiIGZpbGw9ImxMGI50DEiIGZpbHRlcj0idXJsKCnctFNoYWRvdykiLz4KICA8dGV4dCB4PSIyMDUiIHk9IjE3MCIgaGVpZ2h0PSI1MCIgcng9IjYiIGZpbGw9InVybgcgjXBQaXBIMkdyYWQpIiBmaWx0ZXI9InVybgcgjXBTAeGfkb3cpIi8+CiAgPHRleHQgeD0iMjkwIiB5PSIx0TIiIGZvbnQtZmFtaWx5PSJBcmllbCwgc2Fucy1zZXJpZiIgZm9udC1zaXplPSIxMCIgZmlsbD0id2hpdGUiIHR

### ### Use Case: Security + Operational Logs

...

#### Pipeline 1: security-analysis

- Extract security events
- Generate security alerts

#### Pipeline 2: operational-logs

- Standard parsing
- Normal storage

...

### ### Configuring Multi-Pipeline Routes

Create overlapping route conditions:


...

Route 1: log.source == "auth-service" → security-logs

Route 2: log.source == "auth-service" → app-logs

Both pipelines process the same record

...

>  **\*\*Limit:\*\*** A record can be processed by maximum 5 pipelines. Beyond this, extraction stops.

```
```python
// Identify records processed by multiple pipelines
fetch logs, from: now() - 1h
| filter isNotNull(dt.openpipeline.pipelines)
| filter arraySize(dt.openpipeline.pipelines) > 1
| summarize {multi_pipeline_count = count()}, by: {dt.openpipeline.pipelines}
| sort multi_pipeline_count desc
| limit 20
```
```

```
```python
// Count of logs by number of pipelines processing them
fetch logs, from: now() - 1h
| filter isNotNull(dt.openpipeline.pipelines)
| fieldsAdd pipeline_count = arraySize(dt.openpipeline.pipelines)
| summarize {record_count = count()}, by: {pipeline_count}
| sort pipeline_count asc
```
```

---

## Bucket Governance & Access Control ★ NEW

Proper bucket governance ensures compliance, security, and operational efficiency.

### Access Control Patterns

#### Pattern 1: Role-Based Bucket Access

| Role              | Bucket            | Access                | Permissions |
|-------------------|-------------------|-----------------------|-------------|
| **Developers**    | `dev_logs`        | Read/Write            |             |
|                   | `staging_logs`    | Read/Write            |             |
|                   | `prod_logs`       | Read-only             |             |
| **SRE/Platform**  | All buckets       | Read/Write            |             |
| **Security Team** | `security_logs`   | Read/Write            |             |
|                   | `audit_logs`      | Read-only (immutable) |             |
|                   | `compliance_logs` | Read-only (immutable) |             |
| **Auditors**      | `audit_logs`      | Read-only             |             |
|                   | `compliance_logs` | Read-only             |             |
| **Finance**       | `payment_logs`    | Read-only             |             |

#### Pattern 2: Least Privilege by Environment

...

Development Team:

- FULL access to dev\_logs
- READ access to staging\_logs
- NO access to prod\_logs

QA Team:

- FULL access to staging\_logs
- READ access to dev\_logs
- READ access to prod\_logs (for troubleshooting only)

Production SRE:

- FULL access to prod\_logs, error\_logs, security\_logs
- READ access to all other buckets

...

### Retention Policy Enforcement

| Bucket         | Min Retention | Max Retention | Enforcement           |
|----------------|---------------|---------------|-----------------------|
| `dev_logs`     | 1 day         | 14 days       | Auto-delete after max |
| `staging_logs` | 7 days        | 30 days       | Auto-delete after max |
| `default_logs` | 35 days       | 35 days       | Standard retention    |
| `prod_logs`    | 90 days       | 90 days       | Protected             |



```
`audit_logs`	365 days	2555 days	Immutable after 30d
`payment_logs`	90 days	2555 days	PCI-DSS compliant
`phi_logs`	2555 days	2555 days	HIPAA 7-year rule
```

#### **\*\*Enforcement Methods:\*\***

1. **\*\*Automated\*\***: Grail automatically purges data after retention period
2. **\*\*Immutability\*\***: Compliance buckets can be configured as write-once (after grace period)
3. **\*\*Audit Trail\*\***: All retention changes logged in audit\_logs

### **### Compliance Audit Trail Requirements**

#### **#### SOC 2 Compliance**

##### **\*\*Required Logs (365 days minimum):\*\***

- Authentication events (login, logout, MFA)
- Authorization changes (role assignments, permission changes)
- Data access (who accessed what, when)
- Configuration changes (pipeline edits, bucket changes)
- Security events (failed auth, suspicious activity)

##### **\*\*Bucket Configuration:\*\***

...

Bucket: soc2\_audit\_logs

Retention: 365 days (minimum)

Immutability: Write-once after 30-day grace period

Access: Security team + auditors only

Encryption: At-rest encryption enforced

...

#### **#### PCI-DSS Compliance**

##### **\*\*Required Logs (90 days minimum, 12 months recommended):\*\***

- Payment transaction logs (amounts MASKED, card numbers REDACTED)
- Access to cardholder data environments
- Authentication to payment systems
- Database queries touching payment data

##### **\*\*Bucket Configuration:\*\***

...

Bucket: pci\_payment\_logs

Retention: 365 days (exceeds 90-day minimum)

Processing: MASK credit card numbers, CVV codes

Access: Payment team + security + auditors

Encryption: TLS 1.2+ in transit, AES-256 at rest

Monitoring: Alert on access attempts

...

#### #### HIPAA Compliance

**\*\*Required Logs (6 years minimum, 7 years recommended):\*\***

- PHI access logs (who viewed which patient records)
- Authentication to healthcare systems
- Prescription and medical record changes
- Breach detection events

**\*\*Bucket Configuration:\*\***

```

Bucket: hipaa_phi_logs

Retention: 2555 days (7 years)

Processing: MASK patient IDs, SSNs, dates of birth
 HASH medical record numbers

Access: Healthcare IT + compliance officers only

Encryption: FIPS 140-2 compliant

Audit: All bucket access logged to separate audit bucket

```

#### #### GDPR Compliance

**\*\*Special Considerations:\*\***

- **\*\*Right to Erasure:\*\*** Logs with EU citizen PII must be deletable on request
- **\*\*Data Minimization:\*\*** Only collect necessary personal data
- **\*\*Retention Limits:\*\*** Cannot retain personal data longer than necessary

**\*\*Bucket Strategy:\*\***

```

Bucket: eu_customer_logs

Retention: 90 days (balancing security and data minimization)

Processing: MASK email addresses, IP addresses
 ADD customer_id_hash (for erasure lookup)

Deletion API: Integrate with GDPR erasure requests

Data Residency: EU-only bucket (if required)

```

#### ### Bucket Naming Conventions

**\*\*Recommended Pattern:\*\*** `\_\_logs`

Examples:

```

prod_app_logs

prod_error_logs

prod_security_logs

staging_app_logs

dev_debug_logs

compliance_audit_logs

```
compliance_soc2_logs
compliance_pci_logs
compliance_hipaa_logs
ephemeral_healthcheck_logs
````
```

#### **\*\*Benefits:\*\***

- Clear ownership and purpose
- Easy to identify in DQL queries
- Simplifies access control rules
- Supports automated governance checks

### ### Bucket Lifecycle Management

#### **\*\*Quarterly Review Checklist:\*\***

- [ ] Review bucket usage and growth trends
- [ ] Validate retention periods still match requirements
- [ ] Check for unused or abandoned buckets
- [ ] Audit access control list changes
- [ ] Verify compliance bucket configurations
- [ ] Analyze query patterns for optimization opportunities
- [ ] Review storage costs vs. budget

#### **\*\*Annual Compliance Audit:\*\***

- [ ] Verify all compliance buckets meet regulatory retention
- [ ] Confirm masking/redaction rules are working
- [ ] Test data erasure procedures (GDPR)
- [ ] Review audit trail completeness
- [ ] Validate encryption standards
- [ ] Document bucket governance changes

---

---

## ## Best Practices

### ### Routing Best Practices

| Practice                   | Description                                   |
|----------------------------|-----------------------------------------------|
| <b>**Specific first**</b>  | Place specific routes before general ones     |
| <b>**Test conditions**</b> | Validate matching conditions with sample data |
| <b>**Avoid overlap**</b>   | Unless intentional multi-pipeline is needed   |
| <b>**Document routes**</b> | Keep a map of route → pipeline → bucket       |
| <b>**Monitor default**</b> | High default pipeline volume = missing routes |

### ### Bucket Best Practices

| Practice                       | Description                            |
|--------------------------------|----------------------------------------|
| ***Meaningful names***         | Use descriptive bucket names           |
| ***Match retention to value*** | Critical data = longer retention       |
| ***Consider query patterns***  | Frequently queried data in main bucket |
| ***Plan for compliance***      | Audit logs may need 365+ days          |
| ***Review regularly***         | Re-evaluate bucket strategy quarterly  |

### ### Cost Optimization Best Practices

| Practice                   | Impact                          |
|----------------------------|---------------------------------|
| Drop DEBUG/TRACE           | 30-50% volume reduction         |
| Drop health checks         | 5-20% volume reduction          |
| Short retention for dev    | 70-80% cost reduction           |
| Extract metrics, drop logs | Metrics persist, logs don't     |
| Sample high-volume noise   | Keep visibility, reduce storage |

---

## ## Routing Configuration Examples

### ### Example 1: Environment-Based Routing

#### \*\*\*Route 1: Production Logs\*\*\*

...

Condition: k8s.namespace.name == "production" OR k8s.namespace.name == "prod"

Pipeline: production-logs

Bucket: production\_logs (35 days)

...

#### \*\*\*Route 2: Development Logs\*\*\*

...

Condition: k8s.namespace.name == "development" OR k8s.namespace.name == "dev"

Pipeline: development-logs

Bucket: dev\_logs (7 days)

...

### ### Example 2: Severity-Based Routing

#### \*\*\*Route 1: Error Logs (high value)\*\*\*

...

Condition: loglevel == "ERROR"

Pipeline: error-logs

Bucket: error\_logs (90 days)

Processing: Parse stack traces, enrich with service info

```

****Route 2: Debug Logs (low value)****

```

Condition: loglevel == "DEBUG" OR loglevel == "TRACE"

Pipeline: debug-logs

Processing: DROP all (or route to 3-day bucket)

```

Example 3: Compliance Routing

****Route 1: Audit Logs****

```

Condition: contains(log.source, "audit") OR contains(content, "authentication")

Pipeline: audit-logs

Bucket: audit\_logs (365 days)

Processing: Mask PII, add compliance tags

```

Next Steps

Now that you understand routing and buckets, continue with:

Notebook Focus Area
----- -----
OPMIG-06 Processing, Parsing & Transformation
OPMIG-07 Metric & Event Extraction
OPMIG-08 Security, Masking & Compliance
OPMIG-09 Troubleshooting & Validation

References

- [OpenPipeline Data Flow](<https://docs.dynatrace.com/docs/discover-dynatrace/platform/openpipeline/concepts/data-flow>)
- [Grail Buckets](<https://docs.dynatrace.com/docs/platform/grail/data-model/buckets>)
- [OpenPipeline Limits](<https://docs.dynatrace.com/docs/discover-dynatrace/platform/openpipeline/reference/limits>)

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