🏗 Grail Buckets & OpenPipeline

Data Architecture and Processing for Distributed Traces

This notebook covers Dynatrace Grail's bucket architecture for span storage, OpenPipeline configuration patterns, and data governance strategies.

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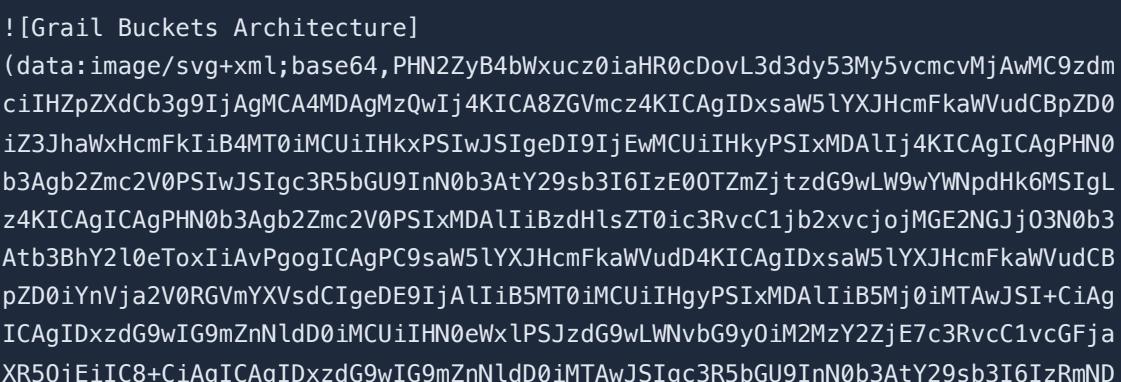8. Sampling Strategies
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Prerequisites

Before starting this notebook, ensure you have:

- ✅ Completed previous SPANS notebooks (01–06)
- ✅ Understanding of Dynatrace Grail architecture
- ✅ Admin access for bucket/pipeline configuration (optional)

1. Understanding Grail Buckets

Grail stores observability data in **buckets** – logical containers that provide data isolation, retention control, and access management.

![Grail Buckets Architecture]
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Why Use Buckets?

Purpose	Benefit
Cost Control	Different retention periods per bucket
Access Control	Restrict who can query which data
Compliance	Separate sensitive data for audit
Performance	Query specific buckets for efficiency
Team Isolation	Each team queries their own bucket

> 💡 **Tip:** The default bucket for spans is `default_spans`. Custom buckets
are configured via OpenPipeline.

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2. Querying from Specific Buckets

Use the `bucket:` parameter to query from specific buckets for improved
performance and cost efficiency.

```dql
// Query spans from the default bucket
fetch spans, bucket: {"default_spans"}
| filter span.kind == "server"
| fields start_time, dt.entity.service, span.name, duration
| sort start_time desc
| limit 50
```

```dql
// Query from multiple buckets (if you have custom buckets)
// Replace with your actual bucket names
fetch spans, bucket: {"default_spans"}
```

```
| filter span.kind == "server"
| summarize {span_count = count()}, by:{dt.entity.service}
| sort span_count desc
| limit 20
```

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3. Bucket Discovery

Discover which buckets contain your data and their characteristics.

```dql
// Find out which bucket your spans are stored in
fetch spans
| fieldsAdd bucket = dt.system.bucket
| summarize {span_count = count()}, by:{bucket}
| sort span_count desc
```

```dql
// Analyze span distribution by bucket and service
fetch spans
| fieldsAdd bucket = dt.system.bucket
| summarize {span_count = count()}, by:{bucket, dt.entity.service}
| sort bucket, span_count desc
| limit 50
```

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4. OpenPipeline Concepts

OpenPipeline processes incoming telemetry **before** storage. It enables
filtering, transformation, routing, and sampling of span data.

![OpenPipeline Flow]
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> ⚠️ **Note:** OpenPipeline configuration is done in the Dynatrace UI under **Settings > OpenPipeline**. This notebook shows how to identify candidates and verify results.

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## 5. Filtering & Dropping Unwanted Spans

![OpenPipeline Actions]
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ZW50cnkgcG9pbnRzKTwvdGV4dD4KPC9zdmc+Cg==)

### Candidates for Dropping

1. **Health checks** – `/health`, `/ready`, `/alive` endpoints
2. **Metrics endpoints** – `/metrics`, `/prometheus`
3. **Static assets** – `.js`, `.css`, `.png` requests
4. **Internal noise** – Very frequent internal operations

```dql
// Find health check spans (candidates for dropping)
fetch spans
| filter contains(span.name, "health") or
         contains(span.name, "ready") or
         contains(span.name, "alive") or
         contains(span.name, "ping")
| summarize {count = count()}, by:{dt.entity.service, span.name}
| sort count desc
```

```dql
// Find static asset requests (often low value)
fetch spans
| filter isNotNull(url.path)
| filter endsWith(url.path, ".js") or
         endsWith(url.path, ".css") or
         endsWith(url.path, ".png") or
         endsWith(url.path, ".ico")
| summarize {count = count()}, by:{dt.entity.service}
| sort count desc
```

```dql
// Find high-volume, low-value spans
// High volume but almost no errors = candidates for filtering
fetch spans
| summarize {
    count = count(),
```

```
     error_count = countIf(span.status_code == "error")
  }, by:{dt.entity.service, span.name}
| fieldsAdd error_rate = (error_count * 100.0) / count
| filter count > 1000 and error_rate < 0.1
| sort count desc
```

OpenPipeline Example: Drop Health Checks

```yaml
# Configure in Settings > OpenPipeline > Spans
pipelines:
  - name: spans_pipeline
    stages:
      - name: drop_health_checks
        rules:
          - condition: |
              contains(span.name, "health") or
              contains(span.name, "ready") or
              contains(span.name, "alive")
            action: drop
```

---

6. Transforming & Enriching Data

Pre-compute fields at ingestion time for faster queries.

OpenPipeline Example: Add Computed Fields

```yaml
stages:
  - name: add_computed_fields
    rules:
      - transform:
          fields:
            duration_ms: duration / 1000000
            is_slow: duration > 1000000000
```

OpenPipeline Example: Add Business Context

```yaml
stages:
  - name: add_business_context
    rules:
      - condition: contains(service.name, "checkout")
```

```
        transform:
          fields:
            business.domain: "commerce"
            business.criticality: "high"

      - condition: contains(service.name, "payment")
        transform:
          fields:
            business.domain: "finance"
            business.criticality: "critical"
```

```dql
// Example: Fields you might want to pre-compute
fetch spans
| fieldsAdd
    duration_ms = duration / 1000000,
    is_error = span.status_code == "error",
    latency_bucket = if(
        duration < 100ms, "fast",
        else: if(duration < 1s, "normal",
        else: "slow"))
| fields dt.entity.service, span.name, duration_ms, is_error, latency_bucket
| limit 10
```

```dql
// Identify services by domain for enrichment planning
fetch spans
| summarize {count = count()}, by:{dt.entity.service}
| sort count desc
| limit 20
```

---

7. Routing to Different Buckets

Route spans to buckets based on:
- **Retention needs** (short vs. long term)
- **Sensitivity** (PII vs. non-PII)
- **Environment** (prod vs. dev)
- **Cost** (high-value vs. low-value)

OpenPipeline Example: Route by Environment

```yaml
stages:
```

```yaml
    - name: route_by_environment
      rules:
        - condition: deployment.environment == "production"
          route:
            bucket: spans_production_90d

        - condition: deployment.environment == "staging"
          route:
            bucket: spans_staging_7d

        - condition: true  # Default
          route:
            bucket: spans_default_3d
```

OpenPipeline Example: Route by Sensitivity

```yaml
stages:
  - name: route_by_sensitivity
    rules:
      - condition: |
          contains(service.name, "payment") or
          contains(service.name, "auth")
        route:
          bucket: spans_sensitive

      - condition: true
        route:
          bucket: spans_default
```

```dql
// Check what environments/namespaces exist for routing planning
fetch spans
| summarize {count = count()}, by:{k8s.namespace.name}
| sort count desc
```

```dql
// Identify sensitive services for routing
fetch spans
| filter contains(span.name, "payment") or
         contains(span.name, "auth") or
         contains(span.name, "login")
| summarize {count = count()}, by:{dt.entity.service, span.name}
| sort count desc
```

---

8. Sampling Strategies

For very high volume services, consider sampling to reduce costs while
maintaining visibility.

OpenPipeline Example: Smart Sampling

```yaml
stages:
  - name: smart_sampling
    rules:
      # Always keep all errors (100%)
      - condition: span.status_code == "error"
        action: keep

      # Always keep slow requests (100%)
      - condition: duration > 1000000000
        action: keep

      # Sample 10% of normal requests for high-volume service
      - condition: service.name == "high-volume-service"
        sample:
          rate: 0.1

      # Sample 50% for other services
      - condition: true
        sample:
          rate: 0.5
```

```dql
// Identify high-volume services for sampling consideration
fetch spans
| summarize {
    total = count(),
    errors = countIf(span.status_code == "error"),
    slow = countIf(duration > 1s)
  }, by:{dt.entity.service}
| fieldsAdd error_rate = (errors * 100.0) / total
| fieldsAdd important = errors + slow
| fieldsAdd droppable = total - errors - slow
| filter total > 10000  // High volume services
| sort total desc
```

```dql
// Calculate potential savings from filtering
fetch spans
| summarize {
    total = count(),
    health_checks = countIf(
        contains(span.name, "health") or
        contains(span.name, "ready") or
        contains(span.name, "alive")),
    static_assets = countIf(
        endsWith(span.name, ".js") or
        endsWith(span.name, ".css") or
        endsWith(span.name, ".png")),
    errors = countIf(span.status_code == "error"),
    slow = countIf(duration > 1s)
  }
| fieldsAdd droppable = health_checks + static_assets
| fieldsAdd must_keep = errors + slow
| fieldsAdd savings_percent = (droppable * 100.0) / total
```

---

9. Access Control Patterns

Use bucket-based queries to implement access control patterns.

![Bucket Access Control]

(data:image/svg+xml;base64,PHN2ZyB4bWxucz0iaHR0cDovL3d3dy53My5vcmcvMjAwMC9zdm
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eHQ+Cjwvc3ZnPgo=)

> 💡 **Tip:** Bucket permissions are configured in the Dynatrace UI under **Account Management > Identity & Access Management**.

```dql
// Data retention analysis: Span volume by day
fetch spans
| fieldsAdd day = bin(start_time, 1d)
| summarize {span_count = count()}, by:{day}
| sort day desc
| limit 30
```

```dql
// Volume analysis by service (for cost allocation)
fetch spans
| summarize {
    span_count = count(),
    avg_duration_ms = avg(duration) / 1000000
  }, by:{dt.entity.service}
| sort span_count desc
| limit 30
```

Best Practices Summary

DO ✅

- Drop health checks and metrics endpoints
- Pre-compute commonly used fields
- Route by environment and sensitivity
- Mask PII before storage
- Sample high-volume, low-value spans

DON'T ❌

- Drop error spans (you'll need them for RCA)
- Drop slow spans (they indicate problems)
- Over-sample (lose visibility into patterns)
- Forget to test rules before deploying

Summary

In this notebook, you learned:

✅ **Grail bucket architecture** for organizing and isolating data
✅ **Querying from specific buckets** using the bucket: parameter
✅ **Bucket discovery** to understand data distribution
✅ **OpenPipeline concepts** with YAML configuration examples
✅ **Filtering & dropping** unwanted spans (health checks, static assets)
✅ **Transforming & enriching** data with computed fields
✅ **Routing to buckets** by environment and sensitivity
✅ **Sampling strategies** for high-volume services
✅ **Access control patterns** using bucket-based isolation

Next Steps

Continue to **SPANS-08: Cost-Efficient DQL Queries** to learn:
- Optimizing DQL queries for DDU efficiency
- Query cost estimation techniques
- Best practices for production queries
- Indexed fields and performance strategies