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Open Agent Management Protocol (OpAMP): Scaling OpenTelemetry with Flexibility

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Agenda

- OpenTelemetry Overview
- Use Cases
- Challenges in managing OpenTelemetry at scale
- OpAMP Overview
- Solution
- Summary



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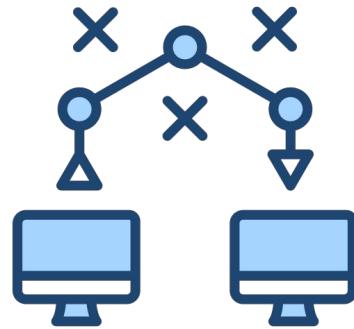
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OpenTelemetry Overview



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Traces

Traces represent the journey of end-users across multiple applications and systems



Metrics

Metrics represent data measured at various time intervals of apps or systems (CPU, memory, success rate)



Logs

Logs represents the process of generating events in apps or systems (errors, warns, other activities)

OpenTelemetry Overview



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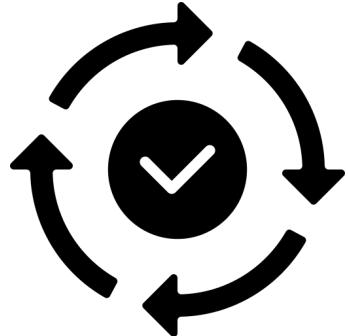
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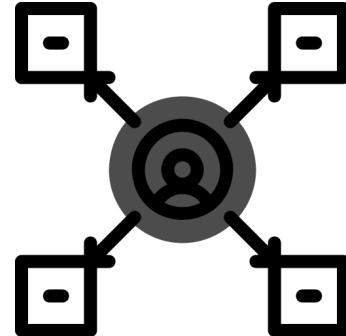
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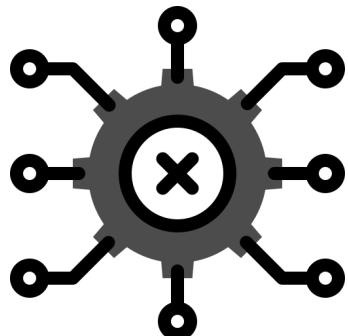
Why OpenTelemetry?



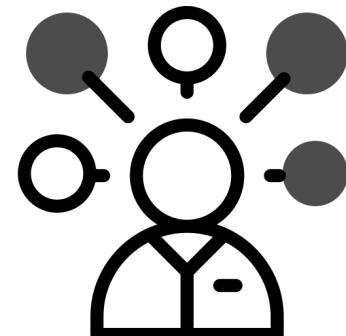
End-to-end Observability



Support Multiple Languages



Auto Instrumentation



Support Variety of Backends

OpenTelemetry Overview



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OpenTelemetry Components

- Language-specific API & SDK
 - Instrumentation (manual/automatic)
- Collector

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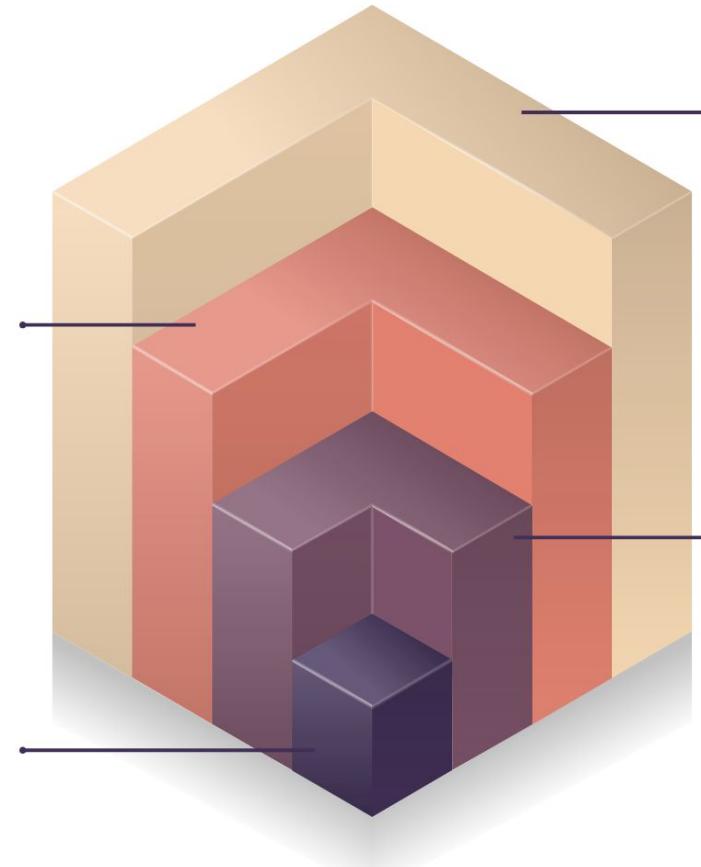
Auto-Instrumentation

Collection and Export of Telemetry Data

Automated telemetry data collection and export to backends without the need for manual intervention

Automatic Hooking into Application Frameworks and Libraries

Automatically integrate with application frameworks and libraries, streamlining the instrumentation process



Reduction of Overhead and Complexity

Auto-instrumentation diminishes the overhead and complexity associated with manual instrumentation

Instrumentation Libraries in Application Dependencies

Libraries are added to application dependencies to enable automated instrumentation

Auto-Instrumentation Supports

- Apache HTTPD / Nginx
- .NET
- GO
- Java
- Node JS
- Python

```
auto-instrumentation.yaml
```

```
1 python:
2   env:
3     - name: OTEL_TRACES_EXPORTER
4       value: otlp
5     - name: OTEL_METRICS_EXPORTER
6       value: otlp
7     - name: OTEL_LOGS_EXPORTER
8       value: otlp
9   image: ghcr.io/open-telemetry/opentelemetry-operator/autoinstru
10  resourceRequirements:
11    limits:
12      cpu: 1
13      memory: 1Gi
```

OpenTelemetry Overview

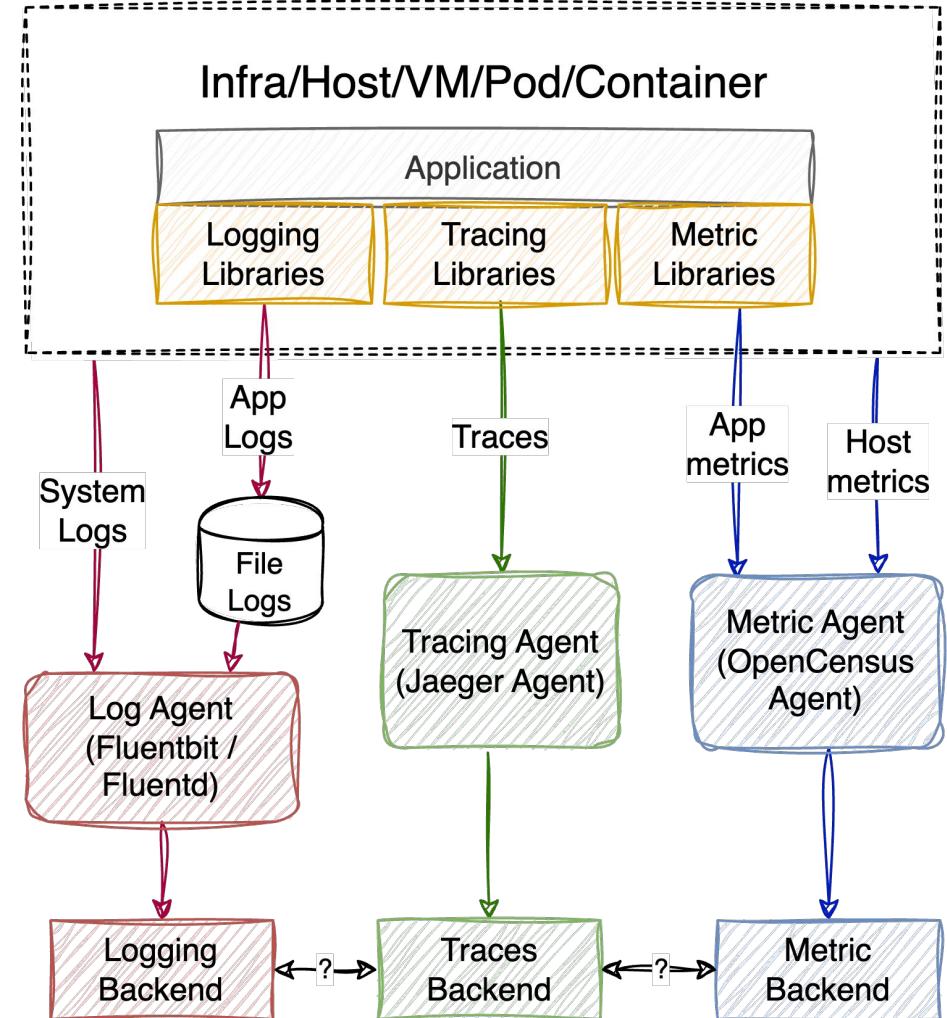


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- Difficulty in correlating logs with traces and metrics
- Lack of context information
- No transformation data

Traditional Approach



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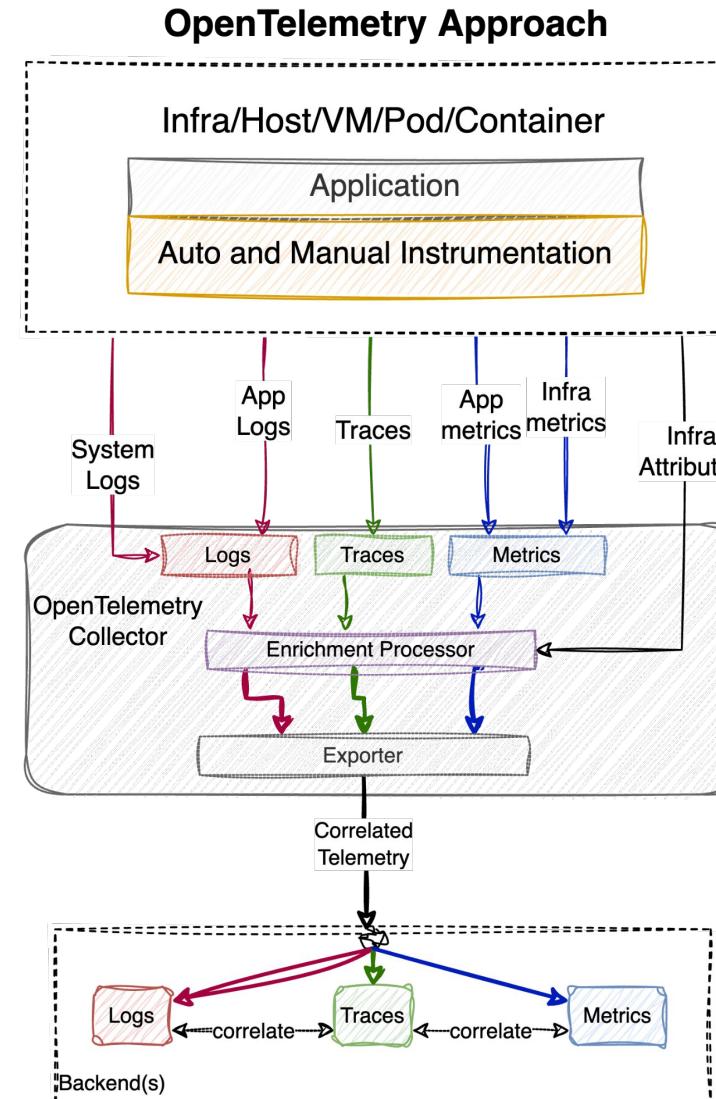
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- Improved Correlation
- Enhanced Observability
- Easily change to a new backend
- Export the data in a different format



OpenTelemetry Overview



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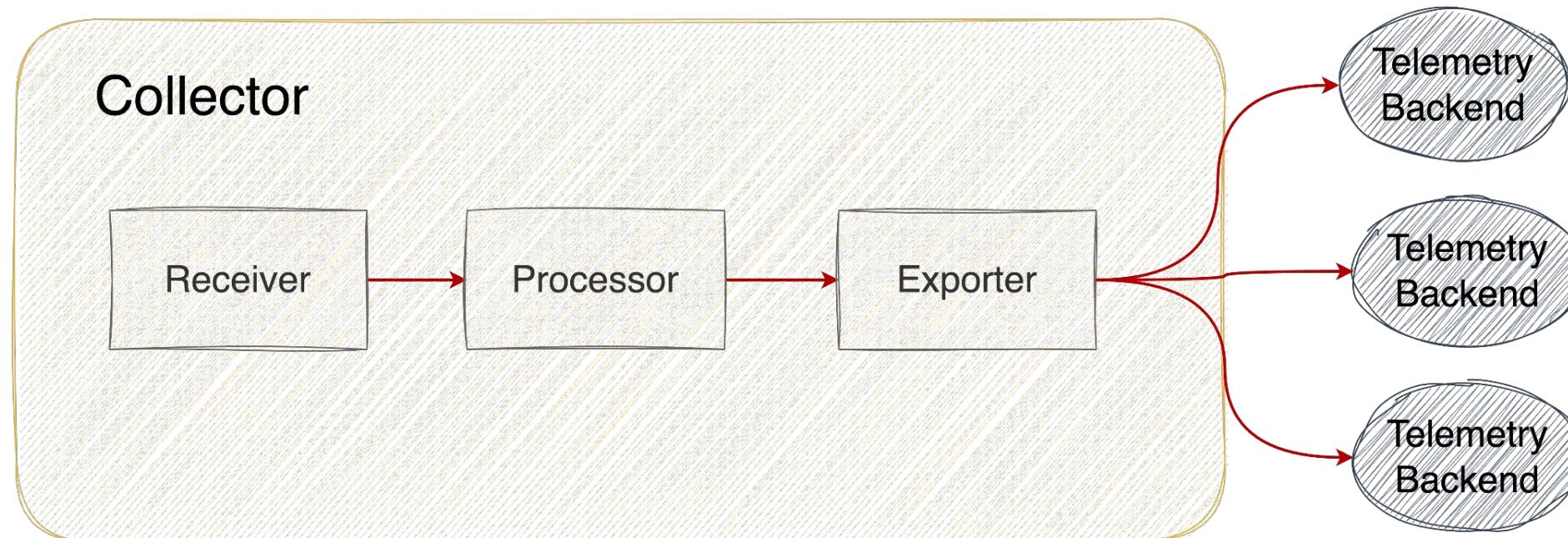
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OpenTelemetry Collector



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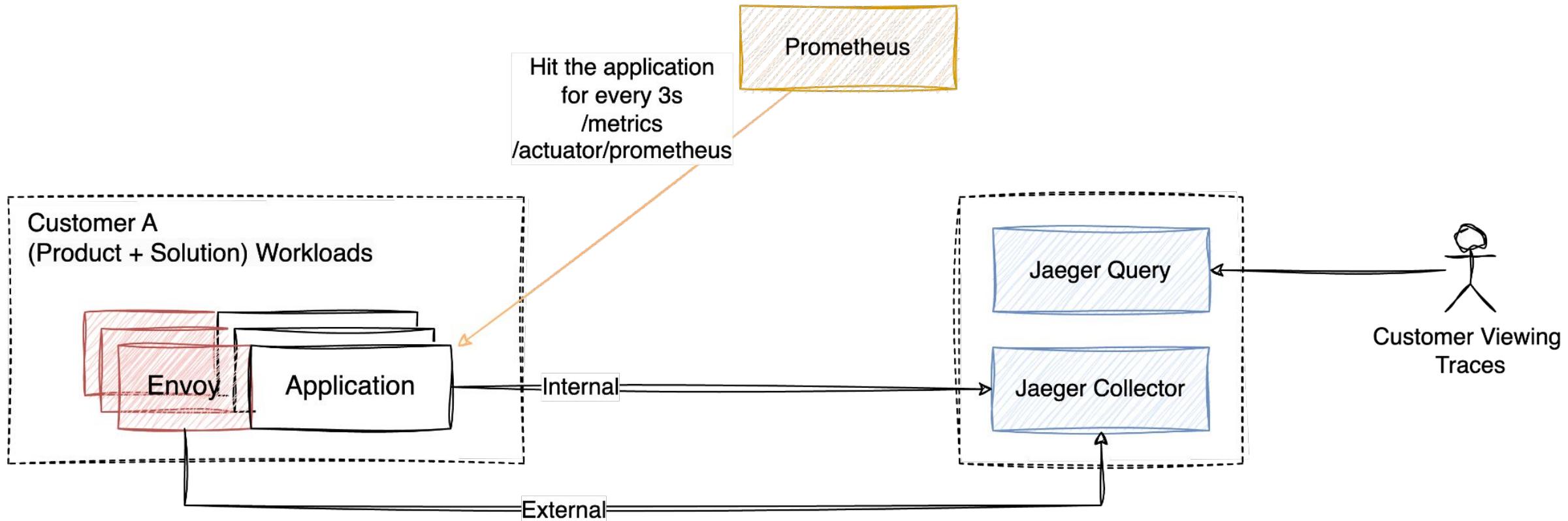
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Traditional Approach



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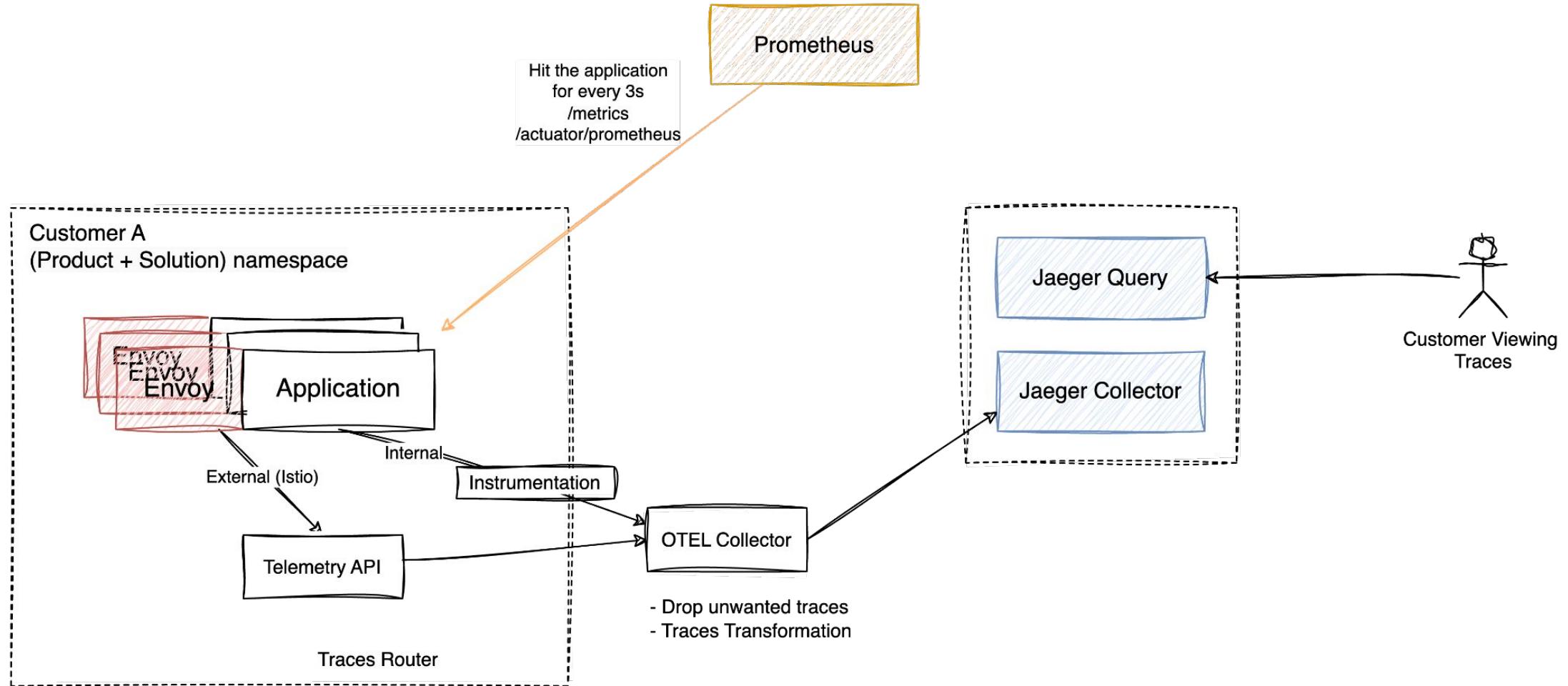
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OpenTelemetry Approach





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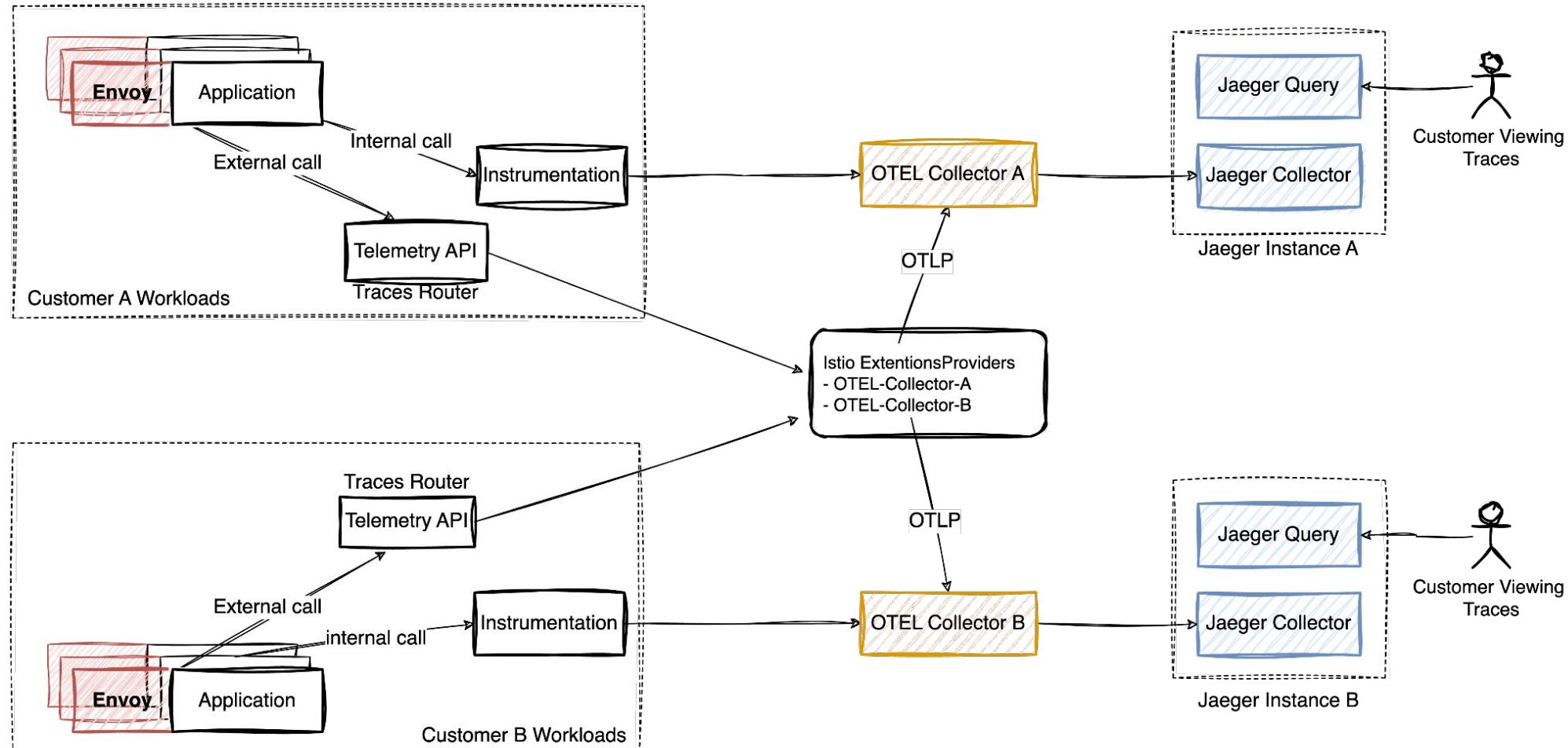
OpenTelemetry Implementations in Metrics and Traces

Implementation: OTEL in Traces



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Multi-Tenancy



Implementation: OTEL in Metrics



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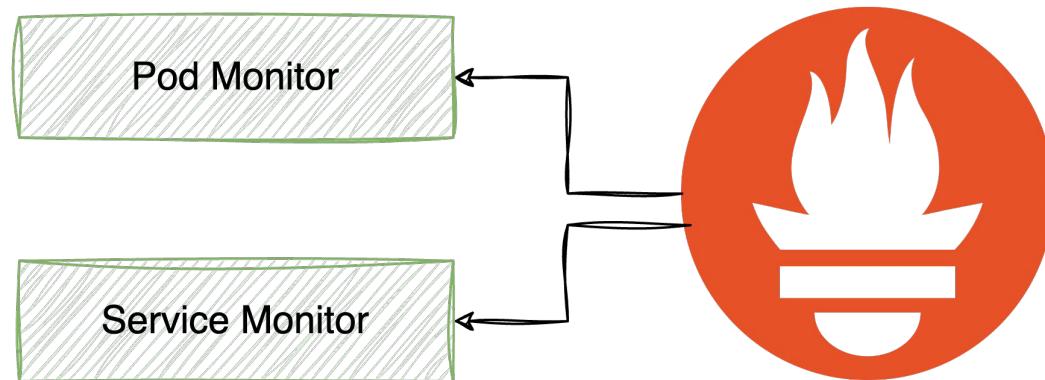
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Prometheus in OpenTelemetry Collector

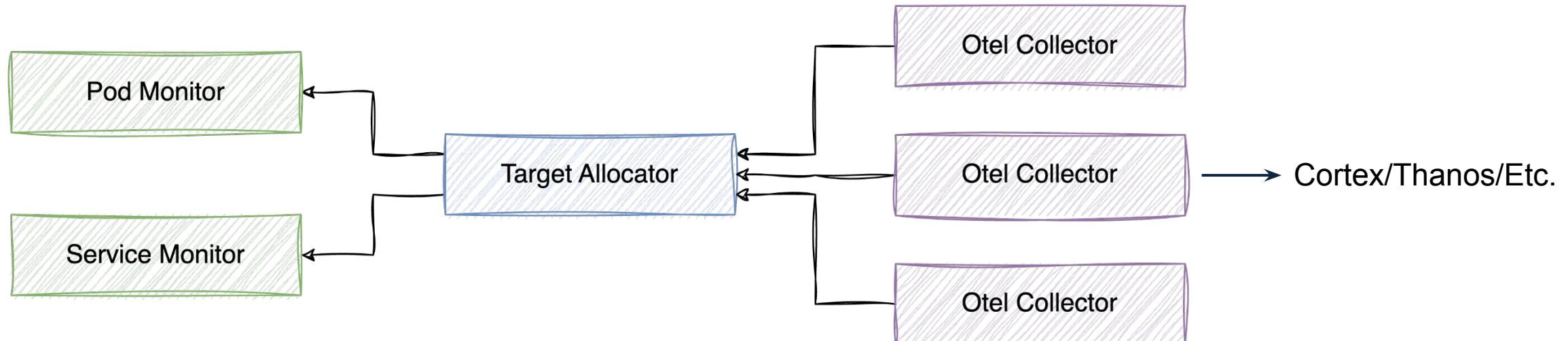


Implementation: OTEL in Metrics



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Prometheus in OpenTelemetry Collector



Challenges of Managing OTEL?



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Telemetry collection at scale will require:

- Availability
- Flexibility
- Scalability



OpAMP Overview



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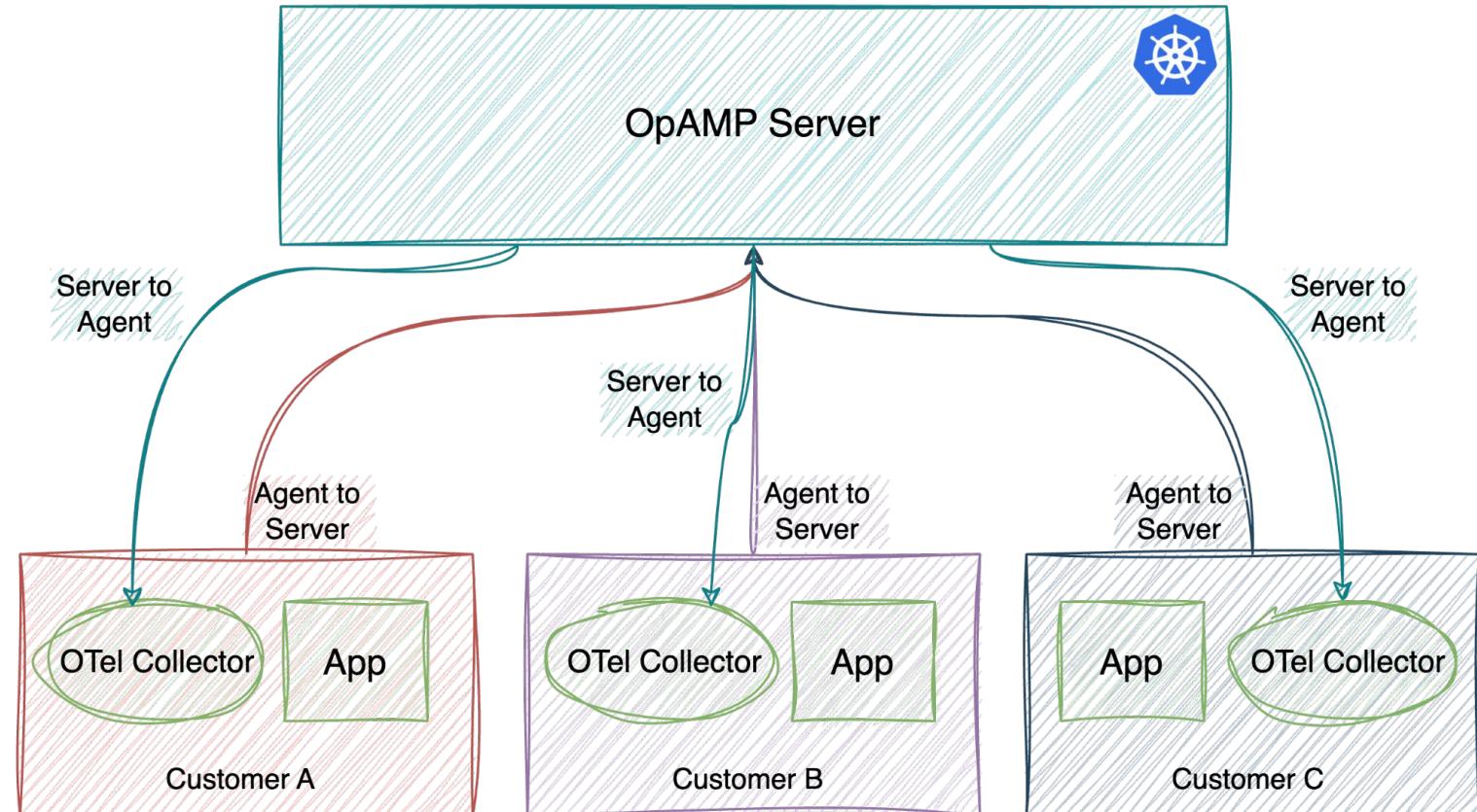


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What is OpAMP

- Remote Configuration
- Agent Information
- Agent's Telemetry
- Upgrade / Downgrade of the Agents
- Certificate Rotation



Remote Configuration

Enables centralized control and modification of configurations across multiple OpenTelemetry Collector agents remotely.

Additional Configuration:

```
receivers:  
  otlp:  
    protocols:  
      grpc:  
        endpoint: 0.0.0.0:4317  
      http:  
        endpoint: 0.0.0.0:4318  
  
processors:  
  memory_limiter:  
    check_interval: 1s  
    limit_percentage: 75  
    spike_limit_percentage: 15  
  batch:  
    send_batch_size: 10000  
    timeout: 10s  
  
exporters:  
  debug:  
    verbosity: detailed
```



Save and Send to Agent

Agent Information

Centralized view of all your
OpenTelemetry Collector agents and
monitor their current state

Agent

Instance ID:	01916196-19ef-7b86-9b35-1843795ad4e9
Up:	true
Up since:	2024-08-18 09:14:42.431335223 +0000 UTC

Attributes

service.instance.id	01916196-19ef-7b86-9b35-1843795ad4e9
service.name	otelcol-contrib-ocb
service.version	0.107.0
host.arch	amd64
host.name	paymentservice-shopping-collector-57745894b6-lpfld8
os.type	linux

Agent's Telemetry

Agent's own telemetry reporting to an OTLP-compatible backend to monitor Agent's process metrics such as CPU or RAM usage, as well as Agent-specific metrics such as rate of data processing.

```
telemetry:  
logs:  
  encoding: json  
  error_output_paths:  
    - stderr  
  initial_fields: {}  
  level: info  
  output_paths:  
    - stderr  
sampling:  
  enabled: true  
metrics:  
  address: :33735  
  level: Normal  
  readers: []  
resource:  
  host.arch: amd64  
  host.name: paymentservice-shopping  
  os.type: linux  
  service.instance.id: 01916196-  
  service.name: otelcol-contrib  
  service.version: 0.107.0
```

Upgrading and Downgrading of the Agents

Supports both upgrading and downgrading of agents, providing flexibility in managing agent versions across your deployment.

```
spec:  
  image: registry/.../otelcol-ocb-custom:0.107.0  
  config:  
    exporters:  
    debug:  
    verbosity: detailed
```

Certificate Rotation

Focus on TLS certificate revocation and rotation to ensure the security of data in transit becomes paramount on deployment scales

Client Certificate

Subject:	CN=OpAMP Example Client,O=OpenTelemetry OpAMP Workgroup,L=Agent-initiated
Not Valid Before:	2024-08-18 17:28:07 +0000 UTC
Not Valid After:	2024-09-29 09:28:07 +0000 UTC
SHA256 Fingerprint:	905543F2A845AE34D06CFF3ACD02480B6B9C3DB4EC1A7769BF3D560B1C084621

[Rotate Client Certificate](#)

OpAMP Capabilities

Capabilities:

```
AcceptsOpAMPConnectionSettings: true
AcceptsOtherConnectionSettings: true
AcceptsRemoteConfig: true
AcceptsRestartCommand: true
ReportsEffectiveConfig: true
ReportsHealth: true
ReportsOwnMetrics: true
ReportsRemoteConfig: true
ReportsStatus: true
```

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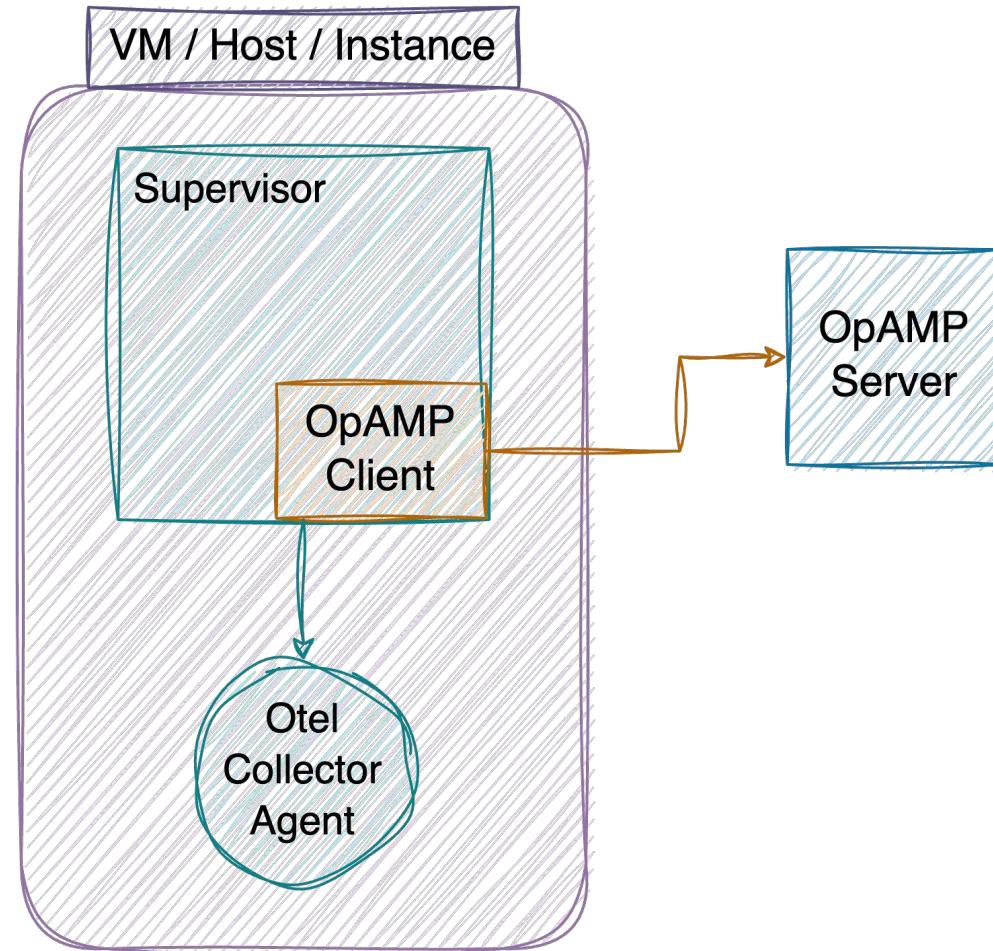
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Communication Model



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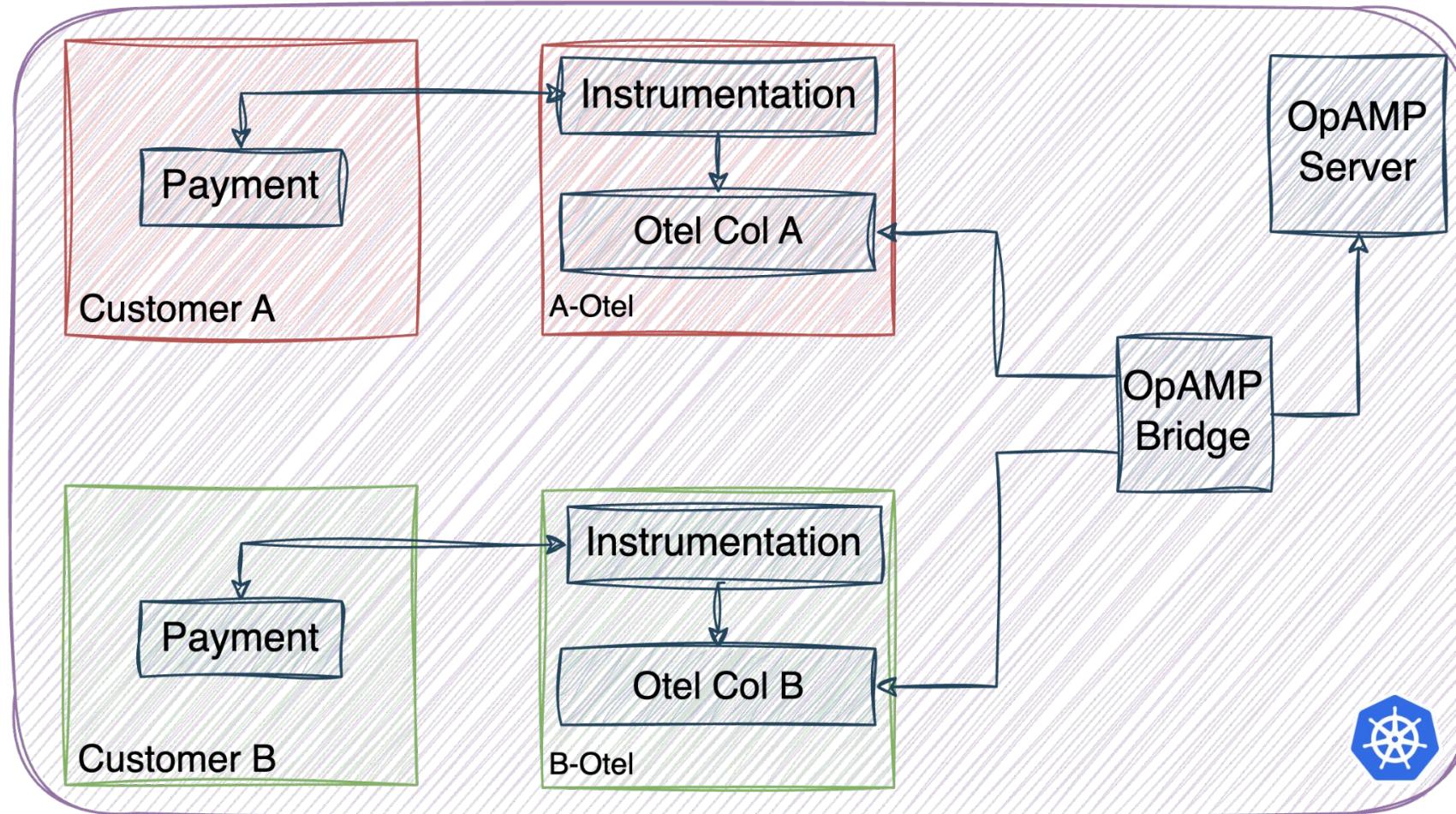
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Communication Model



OpAMP Server

Agents

Host Name	Instance ID
customer-a	019160b1-5bd0-318c-3037-3d5d642f5efd
customer-b	01916db3-5263-814b-6912-ef2ec6fac8d0
customer-c	01916a5a-c631-b220-70ca-6430e290f9ae
customer-d	01916f43-e2dc-db8d-91ae-b4846b63b4a6
customer-e	01916d9f-037a-7777-5d78-1b22287f7b05
customer-f	01916cc3-8716-69c8-c710-f1eadb2b56e7
customer-g	01916b63-e0d1-c115-99d5-81c6de6fe305
customer-h	01916b5a-b0ad-921d-6e12-e9e30bd4152a
customer-i	01916d06-b0bd-06b5-1dad-7d59f14e8b2b



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What's Next? ...

OpenTelemetry Core Distribution

- A bare-bones distribution of the Collector for OTEL
- We likely won't need every single **receiver, processor, exporter, connector, and extension**.
- How do we pick and build only the components that we need?

→ OCB (OTEL Custom Builder)

OCB (OTEL Custom Builder)



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builder-config.yaml

```
-----  
dist:  
  name: otelcol-custom  
  description: OTel Collector custom distribution  
  output_path: ./otelcol-custom  
  otelcol_version: 0.107.0  
  
exporters:  
  - gomod:  
      go.opentelemetry.io/collector/exporter/debugexporter v0.107.0  
  - gomod:  
      go.opentelemetry.io/collector/exporter/otlpexporter v0.107.0  
  
processors:  
  - gomod:  
      go.opentelemetry.io/collector/processor/batchprocessor v0.107.0  
  
receivers:  
  - gomod:  
      go.opentelemetry.io/collector/receiver/otlpreceiver v0.107.0
```

./ocb --config builder-config.yaml

OCB (OTEL Custom Builder)



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```
$ docker image ls
```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
otel-custom-builder	latest	40e90d3647a9	4 days ago	23.8MB
otel/opentelemetry-collector-contrib	0.107.0	f5b1aaeac7de	4 days ago	255MB



OCB Comparison



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Events:

Type	Reason	Age	From	Message
Normal	Scheduled	3m1s	default-scheduler	Successfully assigned shopping-otel/emailservice-shopping-collector-56b86588bc-tsljr to oooo-bg1do
Normal	Pulling	3m1s	kubelet	Pulling image ".../opentelemetry-collector-k8s:0.107.0"
Normal	Pulled	3s	kubelet	Successfully pulled image
".../opentelemetry-collector-k8s:0.107.0"				in 2m57.264s (2m57.264s including waiting)

Events:

Type	Reason	Age	From	Message
Normal	Scheduled	19s	default-scheduler	Successfully assigned shopping-otel/emailservice-shopping-collector-7cbd9c86f-zh6s6 to oooo-bg1do
Normal	Pulling	19s	kubelet	Pulling image "...otel-custom-builder:latest"
Normal	Pulled	12s	kubelet	Successfully pulled image "...otel-custom-builder:latest" in 6.659s (6.659s including waiting)

Orchestrate OTEL Deployment



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Kyverno = Kubernetes Policy Engine

→ Able to dynamically **generate** resources from an events

We use Kyverno in OTEL for:

- Automatic OTELCol creation for each tenant
- Automatic Instrumentation creation
- Automatic Network Policy for restricting cross-tenant connection

Orchestrate OTEL Deployment

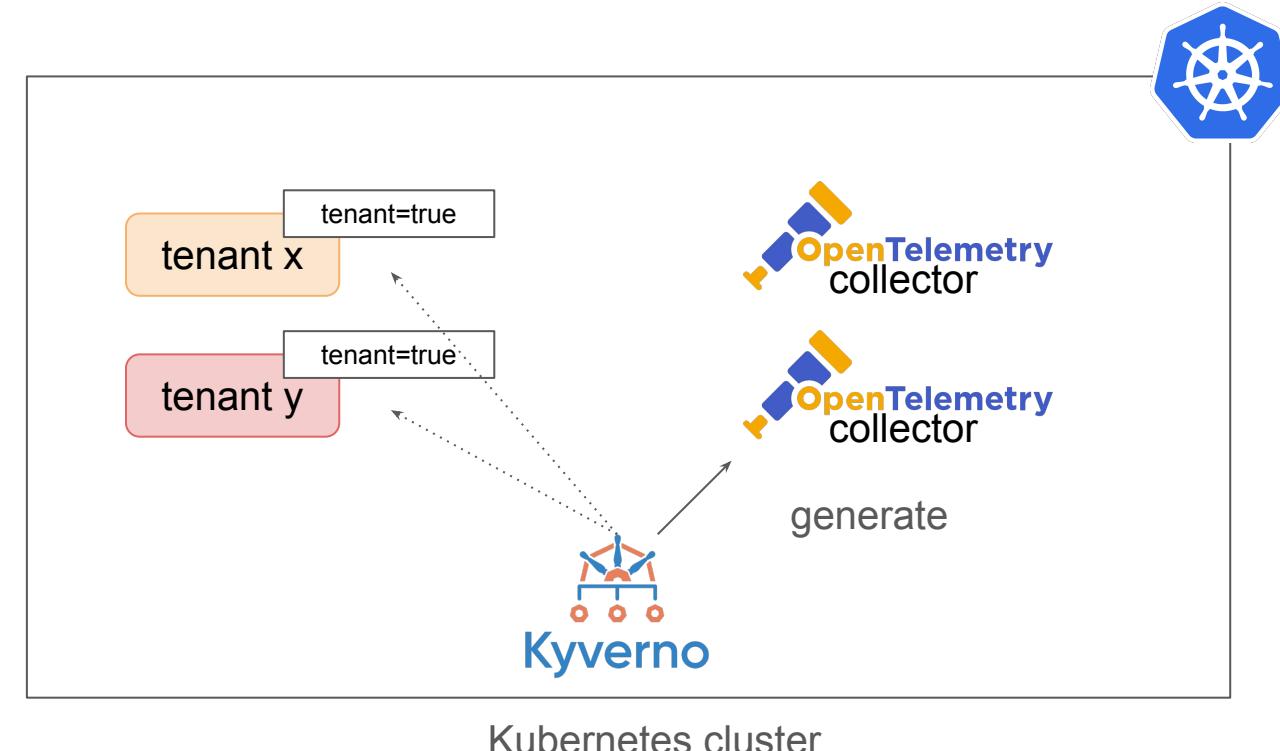


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Kyverno: Automatic OTELCol creation for each tenant onboarding

```
match:  
  any:  
    - resources:  
        kinds:  
          - Namespace  
        selector:  
          matchLabels:  
            tenant: "true"  
  
generate:  
  synchronize: true  
  apiVersion: opentelemetry.io/v1alpha1  
  kind: OpenTelemetryCollector  
  name: "{{ request.object.metadata.name }}"
```

Watch namespace with
label tenant=true, then
generate OTEL CR



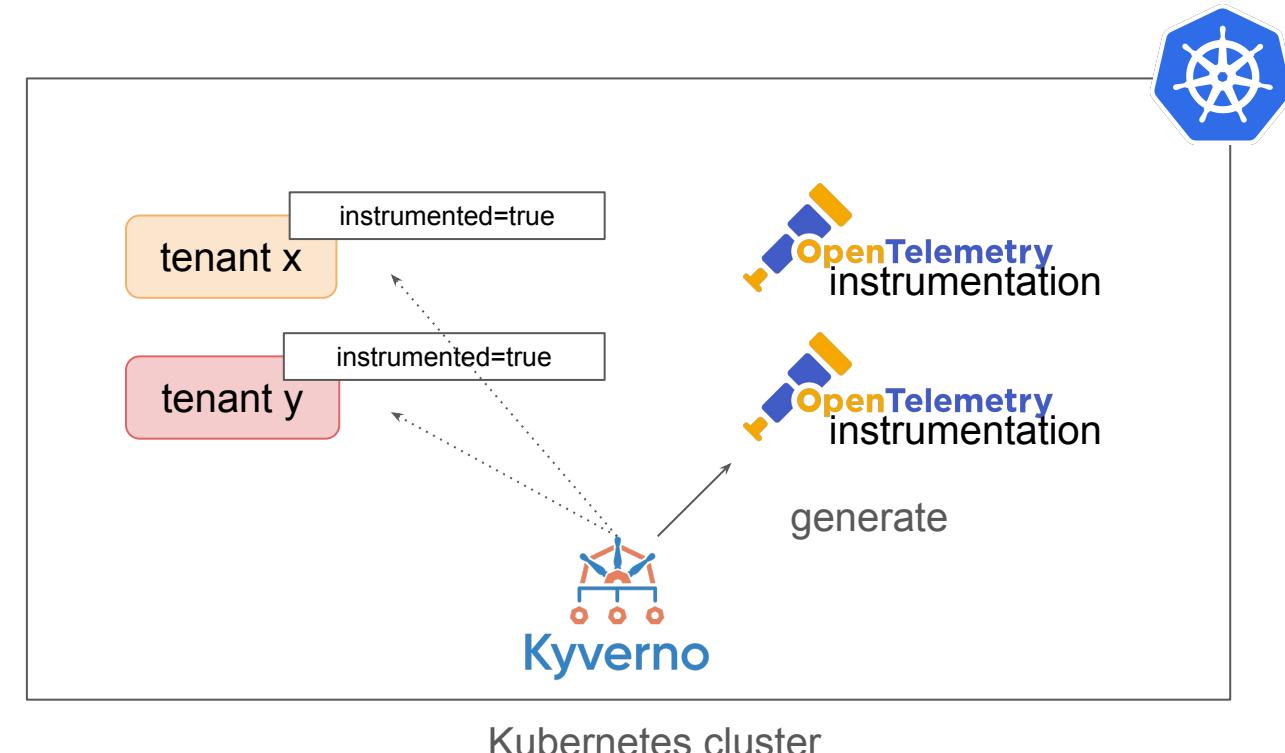
Orchestrate OTEL Deployment



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Kyverno: Automatic Microservice Instrumentation

```
match:  
  any:  
    - resources:  
        kinds:  
          - Namespace  
    selector:  
      matchLabels:  
        instrumented: "true"  
  
    generate:  
      synchronize: true  
      apiVersion: opentelemetry.io/v1alpha1  
      kind: Instrumentation  
      name: "{{ request.object.metadata.name }}"  
  
      Watch Namespace with  
      label instrumented=true,  
      then generate  
      Instrumentation object
```



Orchestrate OTEL Deployment



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Kyverno: Automatic NetworkPolicy creation

```
generate:  
    synchronize: true  
    apiVersion: networking.k8s.io/v1  
    kind: NetworkPolicy  
    name: default-deny  
    namespace: "{{request.object.metadata.name}}"  
    data:  
        spec:  
            # select all pods in the namespace  
            podSelector: {}  
            # deny all traffic  
            policyTypes:  
                - Ingress  
                - Egress
```

Summary



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- **Centralized Control**
 - Simplifies management by distributing and updating configurations centrally.
- **Automated Scaling**
 - OpAMP ease large number of agents scalability.
- **Dynamic Capabilities**
 - Enable, disable, or modify features of agents on the fly.



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Thanks!

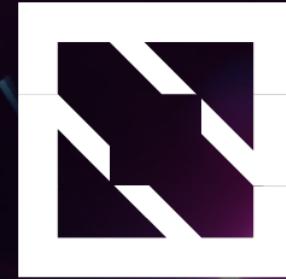


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