CROSS LAYER TRACING IN KUBERNETES

Runzhou Han
Aditya Chechani
Reet Chowdhary

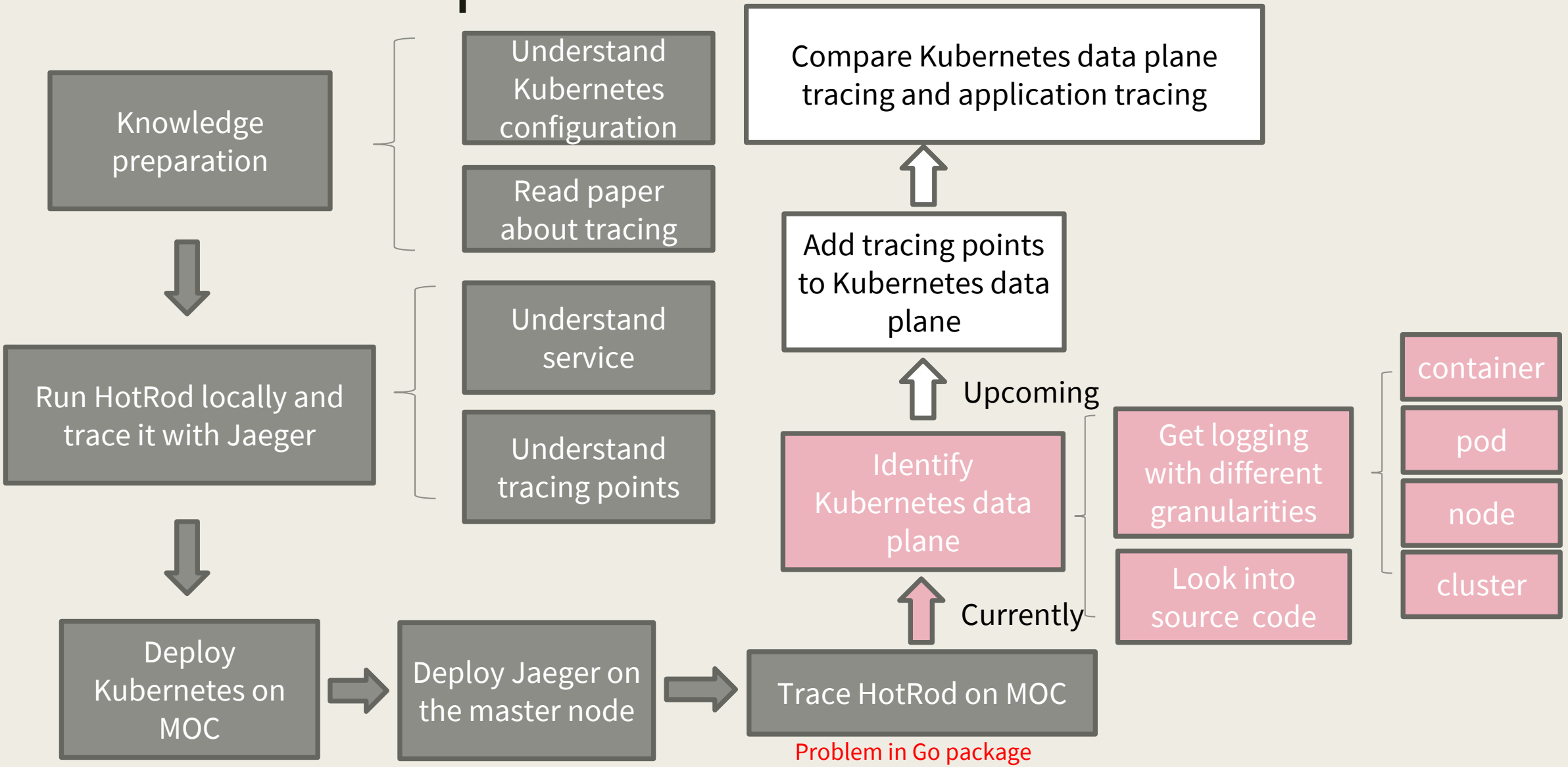
Taiga: https://tree.taiga.io/project/msdisme-2018-bucs528-template-7/

GitHub: https://github.com/BU-NU-CLOUD-SP18/Cross-Layer-Tracing-in-Kubernetes

REVIEW

- Concepts
  - *Kubernetes: The orchestration system we will add trace points to.*
    - Kubernetes data plane
  - *Jaeger: The distributed tracing system we use*
  - *Hotrod: The sample application we will trace*
- Our goal: Find out two data path by end-to-end tracing
  - *Containerized application itself*
  - *Kubernetes data plane*
    - Add trace points to Kubernetes data plane

Previous & present & future work



Demo

- Deploy Kubernetes on MOC

Instances

Instance ID = | Filter | Launch Instance | Delete Instances | More Actions

Displaying 5 items

	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
☐	CLT-4	Centos	192.168.0.12	m1.small	Adi	Active	nova	None	Running	4 days, 21 hours	Create Snapshot
☐	CLT-3	Centos	192.168.0.4	m1.small	Adi	Active	nova	None	Running	4 days, 22 hours	Create Snapshot
☐	CLT-2	Centos	192.168.0.13	m1.small	Adi	Active	nova	None	Running	4 days, 22 hours	Create Snapshot
☐	CLT-1	Centos	192.168.0.9 Floating IPs: 128.31.26.26	m1.small	Adi	Active	nova	None	Running	4 days, 22 hours	Create Snapshot
☐	CLT-5	Centos	192.168.0.10 Floating IPs: 128.31.25.255	m1.small	Adi	Active	nova	None	Running	2 weeks, 3 days	Create Snapshot

Displaying 5 items

```
[centos@192 ~]$ kubectl get nodes
NAME            STATUS     ROLES     AGE       VERSION
192.168.0.12    NotReady   node      6d        v1.9.3+coreos.0
192.168.0.13    Ready      master    6d        v1.9.3+coreos.0
192.168.0.4     NotReady   node      6d        v1.9.3+coreos.0
```

Demo

- Deploy jaeger on master node

```
[centos@192 ~]$ kubectl get pod
NAME                                READY     STATUS    RESTARTS   AGE
cassandra-0                         1/1       Unknown   0          1d
cassandra-2                         1/1       Unknown   0          1d
counter                             1/1       Unknown   0          5d
counter-76f5595c57-p4xss            0/1       Pending   0          9h
counter-76f5595c57-qzc69            0/1       Unknown   8          9h
elasticsearch-0                     0/1       Unknown   7          9h
jaeger-collector-6c8bdcfb64-j6kfb   0/1       Pending   0          9h
jaeger-collector-6c8bdcfb64-xg2g7   1/1       Unknown   6          9h
jaeger-deployment-559c8b9b8-kfjm7   1/1       Unknown   0          9h
jaeger-deployment-559c8b9b8-sdhjb   0/1       Pending   0          9h
jaeger-query-6ccd4ccb57-ghhcd       0/1       Unknown   5          9h
jaeger-query-6ccd4ccb57-sl8wz       0/1       Pending   0          9h
```

- Trace HotRod on MOC

```
[centos@192 hotrod]$ go run ./main.go all
# github.com/jaegertracing/jaeger/examples/hotrod/services/route
services/route/server.go:63: undefined: expvar.Handler
```

In problem of Go expvar package

Demo

- Logging in container scale

```
[centos@192 hotrod]$ sudo docker ps
CONTAINER ID        IMAGE                                                   COMMAND                  CREATED             STATUS              PORTS
                                    NAMES
bc080a3b74d2        gcr.io/google_containers/cluster-proportional-autoscaler-amd64   "/cluster-proportion…"   15 hours ago        Up 15 hours
                                    k8s_autoscaler_kubedns-autoscaler-5564b5585f-5r72r_kube-system_a10ce6aa-2bcf-11e8-8950-fa163e47ede6_0
b4ba4ae58650        gcr.io/google_containers/pause-amd64:3.0                "/pause"                 15 hours ago        Up 15 hours
                                    k8s_POD_kubedns-autoscaler-5564b5585f-5r72r_kube-system_a10ce6aa-2bcf-11e8-8950-fa163e47ede6_0
82e1a6487f72        jaegertracing/all-in-one:latest                         "/go/bin/standalone-…"   44 hours ago        Up 44 hours         5775/udp
6831->6831/udp, 0.0.0.0:16686->16686/tcp   cocky_tereshkova
c75e32885e9f        gcr.io/google_containers/kubernetes-dashboard-amd64             "/dashboard --insecu…"   6 days ago          Up 6 days
                                    k8s_kubernetes-dashboard_kubernetes-dashboard-69cb58d748-9jfv9_kube-system_1a633985-2701-11e8-8950-fa163e47ede6_0
```

```
[centos@192 hotrod]$ sudo docker logs 82e1a6487f72
{"level":"info","ts":1521399896.1321547,"caller":"tchannel/builder.go:89","msg":"Enabling service discovery","service":"jaeger-collector"}
{"level":"info","ts":1521399896.1322522,"caller":"peerlistmgr/peer_list_mgr.go:111","msg":"Registering active peer","peer":"127.0.0.1:14267"}
{"level":"info","ts":1521399896.1332448,"caller":"standalone/main.go:171","msg":"Starting agent"}
{"level":"info","ts":1521399896.1343007,"caller":"standalone/main.go:210","msg":"Starting jaeger-collector TChannel server","port":14267}
{"level":"info","ts":1521399896.1343572,"caller":"standalone/main.go:220","msg":"Starting jaeger-collector HTTP server","http-port":14268}
{"level":"info","ts":1521399896.2052338,"caller":"standalone/main.go:278","msg":"Registering metrics handler with jaeger-query HTTP server","route":"/metrics"}
{"level":"info","ts":1521399896.2052984,"caller":"standalone/main.go:284","msg":"Starting jaeger-query HTTP server","port":16686}
{"level":"info","ts":1521399897.1340072,"caller":"peerlistmgr/peer_list_mgr.go:157","msg":"Not enough connected peers","connected":0,"required":1}
{"level":"info","ts":1521399897.1341202,"caller":"peerlistmgr/peer_list_mgr.go:166","msg":"Trying to connect to peer","host:port":"127.0.0.1:14267"}
{"level":"info","ts":1521399897.1347342,"caller":"peerlistmgr/peer_list_mgr.go:176","msg":"Connected to peer","host:port":"[::]:14267"}
```

Demo

- Logging in pod scale

```
[centos@192 ~]$ kubectl get pod
NAME                                READY     STATUS    RESTARTS   AGE
cassandra-0                         1/1       Unknown   0          1d
cassandra-2                         1/1       Unknown   0          1d
counter                             1/1       Unknown   0          5d
counter-76f5595c57-p4xss            0/1       Pending   0          9h
counter-76f5595c57-qzc69            0/1       Unknown   8          9h
elasticsearch-0                     0/1       Unknown   7          9h
jaeger-collector-6c8bdcfb64-j6kfb   0/1       Pending   0          9h
jaeger-collector-6c8bdcfb64-xg2g7   1/1       Unknown   6          9h
jaeger-deployment-559c8b9b8-kfjm7   1/1       Unknown   0          9h
jaeger-deployment-559c8b9b8-sdhjb   0/1       Pending   0          9h
jaeger-query-6ccd4ccb57-ghhcd       0/1       Unknown   5          9h
jaeger-query-6ccd4ccb57-sl8wz       0/1       Pending   0          9h
```

```
[centos@192 hotrod]$ kubectl logs counter
Error from server: Get https://192.168.0.4:10250/containerLogs/default/counter/count: net/http: TLS handshake timeout
```

It used to be like this …

```
$ kubectl logs counter
0: Mon Jan  1 00:00:00 UTC 2001
1: Mon Jan  1 00:00:01 UTC 2001
2: Mon Jan  1 00:00:02 UTC 2001
```

Demo

- Logging in node scale

```
[centos@192 ~]$ kubectl get nodes
NAME           STATUS     ROLES     AGE       VERSION
192.168.0.12   Ready      node      6d        v1.9.3+coreos.0
192.168.0.13   Ready      master    6d        v1.9.3+coreos.0
192.168.0.4    NotReady   node      6d        v1.9.3+coreos.0
[centos@192 ~]$ journalctl
-- Logs begin at Mon 2018-03-19 21:06:38 UTC, end at Tue 2018-03-20 05:08:23 UTC. --
Mar 19 21:06:38 192.168.0.13 agent[12852]: 2018-03-19 21:06:38 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for net:[4026532234]: [Errno 2] No suc
Mar 19 21:06:38 192.168.0.13 agent[12852]: 2018-03-19 21:06:38 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/95731f96d
Mar 19 21:06:38 192.168.0.13 agent[12852]: 2018-03-19 21:06:38 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/dcb37dc9b
Mar 19 21:06:38 192.168.0.13 agent[12852]: 2018-03-19 21:06:38 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/82e1a64
Mar 19 21:06:38 192.168.0.13 agent[12852]: 2018-03-19 21:06:38 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for net:[4026532345]: [Errno 2] No suc
Mar 19 21:06:39 192.168.0.13 kubelet[22020]: I0319 21:06:39.192587   22020 kubelet_node_status.go:443] Using node IP: "192.168.0.13"
Mar 19 21:06:49 192.168.0.13 kubelet[22020]: I0319 21:06:49.204707   22020 kubelet_node_status.go:443] Using node IP: "192.168.0.13"
Mar 19 21:06:52 192.168.0.13 trace-agent[12854]: 2018-03-19 21:06:52 INFO (receiver.go:324) - no data received
Mar 19 21:06:52 192.168.0.13 trace-agent[12854]: 2018-03-19 21:06:52 INFO (service_mapper.go:59) - total number of tracked services: 0
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for net:[4026531956]: [Errno 2] No suc
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/4392223cc
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/7f109ff
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/7e82b6398
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/2a3e248
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/b83eacc9f
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/141043dbe
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/5b04708
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/1208d10c1
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/9b8bf99f8
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/8d1e0d9
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/07ba0671d
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/4f47440
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/cbe23cde3
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/12ecdd4ef
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/kubelet/pods/0630bade-270
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/7c221ca27
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/4a0b7de
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/5712f6cbc
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/kubelet/pods/1a633985-270
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/kubelet/pods/1a633985-270
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/d5e6b16b7
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/373801f
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for net:[4026532234]: [Errno 2] No suc
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/95731f96d
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/overlay2/dcb37dc9b
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for /var/lib/docker/containers/82e1a64
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | WARN | (datadog_agent.go:135 in LogMessage) | (disk.py:104) | Unable to get disk metrics for net:[4026532345]: [Errno 2] No suc
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | INFO | (serializer.go:180 in SendMetadata) | Sent host metadata payload, size: 747 bytes.
Mar 19 21:06:53 192.168.0.13 agent[12852]: 2018-03-19 21:06:53 UTC | INFO | (serializer.go:196 in SendJSONToV1Intake) | Sent processes metadata payload, size: 1348 bytes.
Mar 19 21:06:59 192.168.0.13 kubelet[22020]: I0319 21:06:59.215007   22020 kubelet_node_status.go:443] Using node IP: "192.168.0.13"
```

Demo

- Accessing a cluster service

```
[centos@192 hotrod]$ kubectl cluster-info
Kubernetes master is running at http://localhost:8080
KubeDNS is running at http://localhost:8080/api/v1/namespaces/kube-system/services/kube-dns:dns/proxy
```

```
[centos@192 client-go]$ kubectl proxy
Starting to serve on 127.0.0.1:8001
```

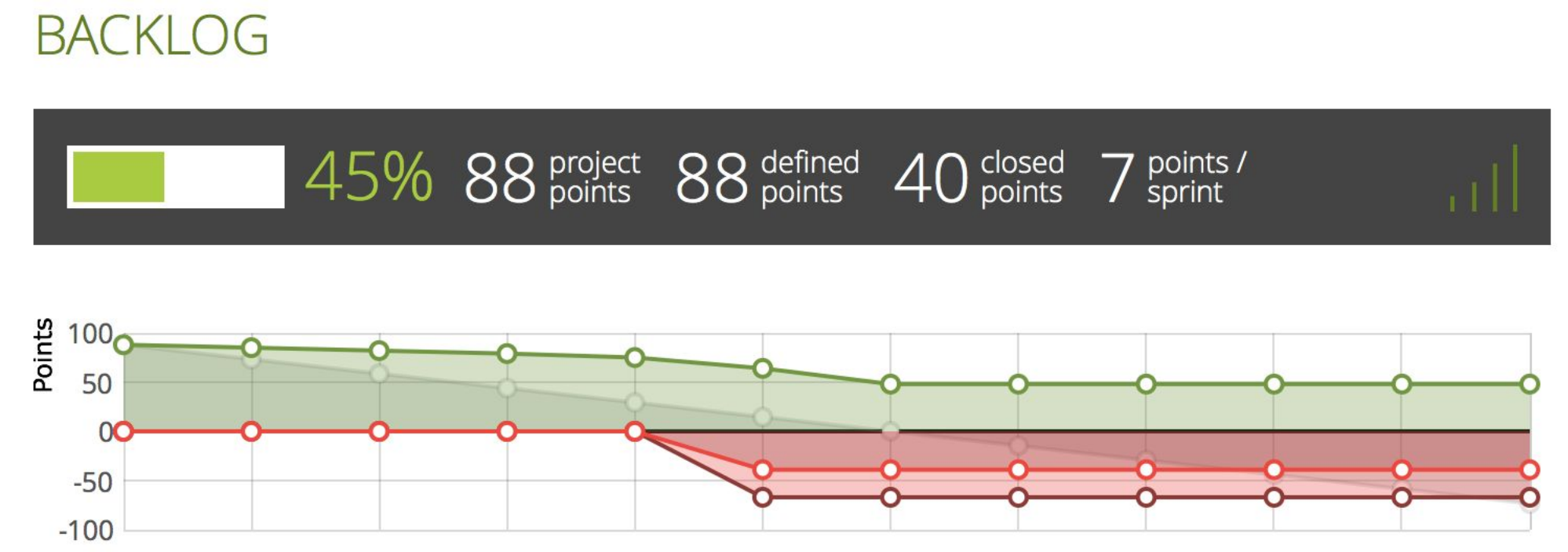
```
[centos@192 ~]$ curl http://localhost:8080/api/v1/namespaces/kube-system/service
s/kube-dns:dns/proxy
{
  "kind": "Status",
  "apiVersion": "v1",
  "metadata": {

  },
  "status": "Failure",
  "message": "no endpoints available for service \"kube-dns\"",
  "reason": "ServiceUnavailable",
  "code": 503
```

Challenge

- How do we get a comprehensive understanding from the large number of logs
- How do we identify the data path from these logs
- Where do we add tracing points in Kubernetes source code

Taiga burndown chart



Release Planning

- In sprint 4, we will:
  - Identify the data path for a service call
- In sprint 5, we will:
  - Add trace points to Kubernetes data plane
  - *Show that we can collect tracing events of Kubernetes*
- In final sprint, we will:
  - *Compare Kubernetes data plane tracing and application tracing*

Thank you!

- Questions?