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Sidecar Containers are Built-in to Kubernetes: What, How, and Why Now?

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Sidecars in Kubernetes

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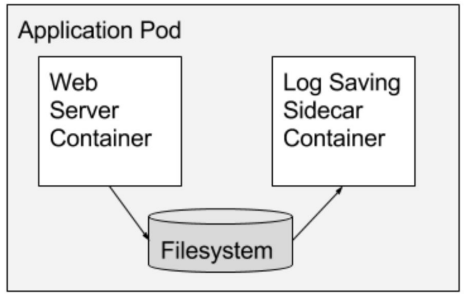
What are sidecars?

Sidecar containers extend and enhance the "main" container, they take existing containers and make them better.

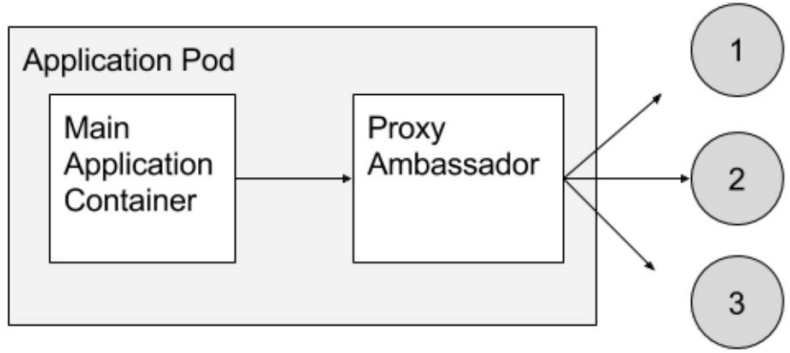
- *kubernetes.io Blog Post (June 2015)*

Examples:

- Telemetry
- Networking
- Security (certificate refresh)
- Data access



Telemetry

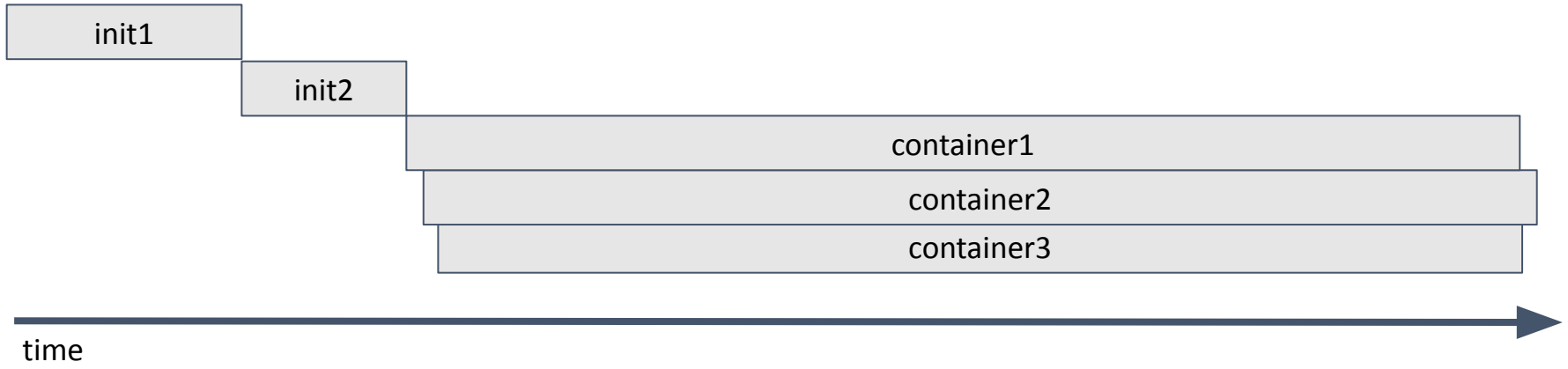


Networking

What we have today?

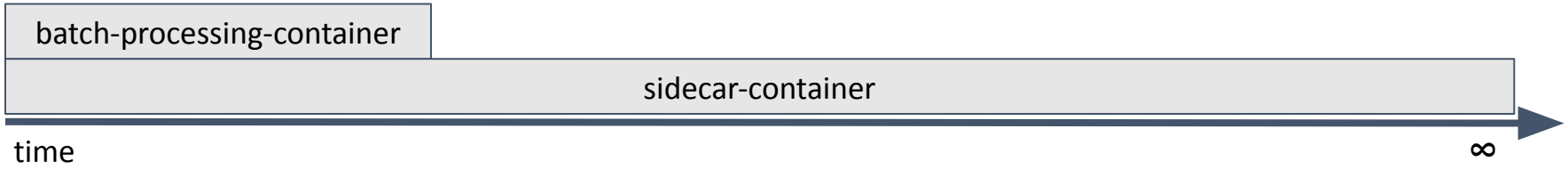
- Init Containers
  - Ordered Startup & Termination
  - Run to completion prior to subsequent init containers and any main container

- Main Containers
  - Unordered Startup & Termination
  - Share the lifetime of the pod



What about Jobs?

- Job pods typically have a finite lifetime and finish when the main containers successfully terminate
- If your “sidecar” is a main container, your job pod doesn’t terminate
- If the “sidecar” crashed, it is not being restarted again



Why now?

- Kubernetes is used widely
- SIG Node state:
  - Graduated a lot of beta features, went thru major dockershim deprecation
  - A lot of experimentation!
    - 40 feature gates
      - 5 GA
      - 16 beta (3 in supported versions)
      - 19 alpha, many draft keps

SIG Node directions:

- Support new workloads
- Better understand the hardware

Why now?

Sidecar feature is improving the support of new workloads

- Batch/jobs support
- AI/ML is in high demand
- Telemetry and mesh sidecars need more guarantees

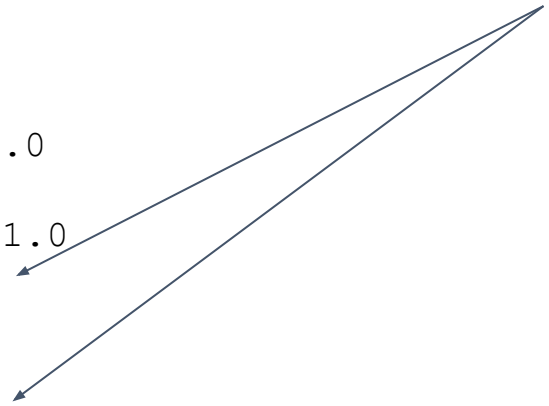
What does the sidecar feature bring?

- Ordered startup & termination
- Run for the lifetime of the pod, including restarting if they crash
- Won’t block pod completion

How are the implemented?

How?


```yaml
apiVersion: v1
kind: Pod
spec:
 initContainers:
 - name: secret-fetch
   image: secret-fetch:1.0
 - name: network-proxy
   image: network-proxy:1.0
   restartPolicy: Always
 - name: log-sender
   image: log-sender:1.0
   restartPolicy: Always
 containers:
 - name: main-app1
   image: main-app1:1.0
 - name: main-app2
   image: main-app2:1.0
 ...
```



"Sidecars" are an init container with a `restartPolicy` of `Always`.

How?


```yaml
apiVersion: v1
kind: Pod
spec:
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 - name: secret-fetch
   image: secret-fetch:1.0
 - name: network-proxy
   image: network-proxy:1.0
   restartPolicy: Always
 - name: log-sender
   image: log-sender:1.0
   restartPolicy: Always
 containers:
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 - name: main-app2
   image: main-app2:1.0
 ...
```
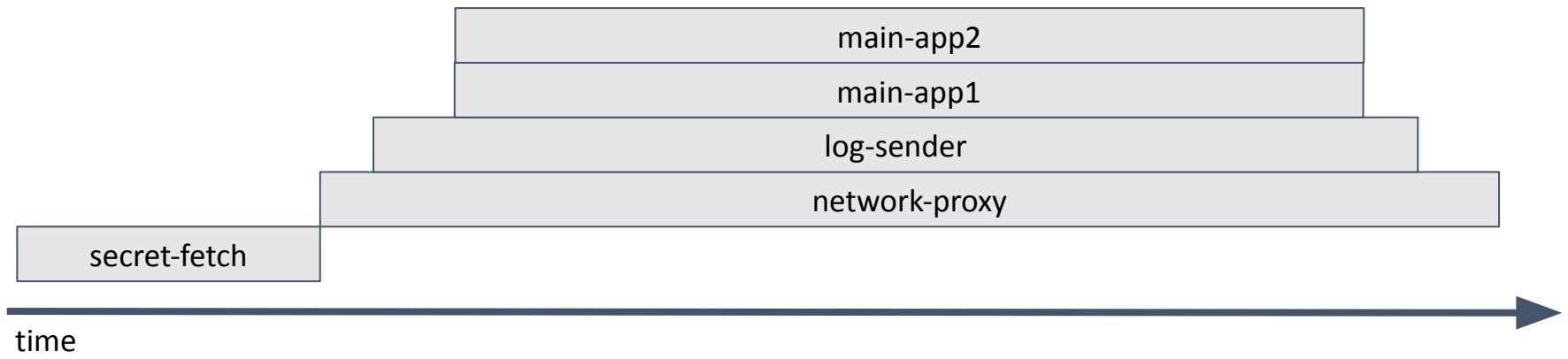
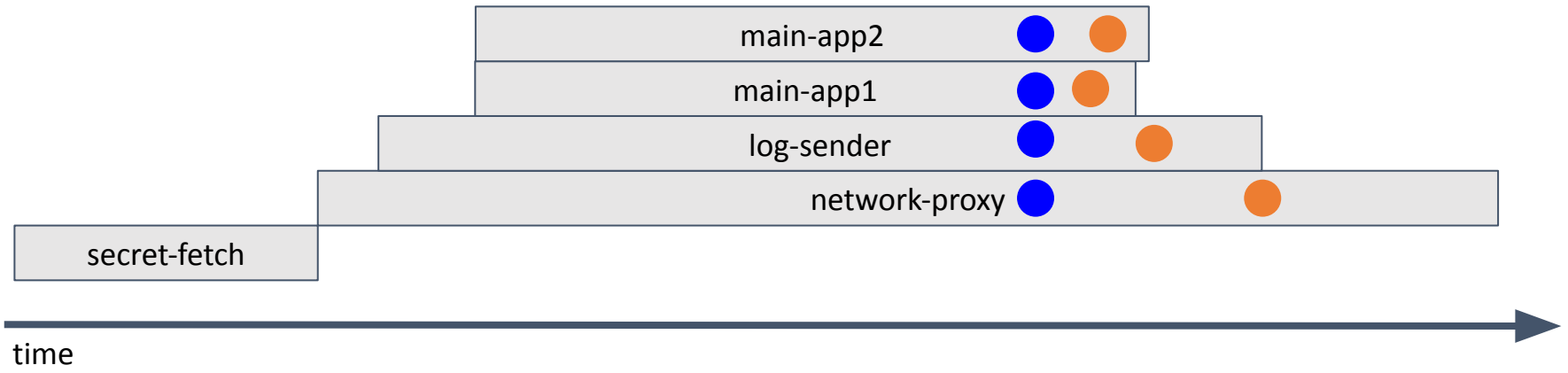



Termination Ordering for Sidecars

- PreStop -> Signals pod termination has started
- SIGTERM -> Signals that preceding sidecars/main containers have exited

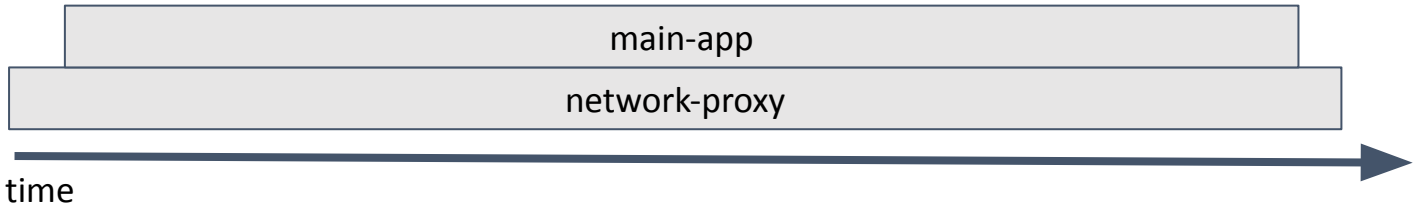


Sidecar Best/Worst Practices

Best: Define or recommend requests and limits for the sidecar & account for the increase in your planning.

Worst: Who needs requests/limits?

```yaml
apiVersion: v1
kind: Pod
spec:
 initContainers:
 - name: network-proxy
   image: network-proxy:1.0
   restartPolicy: Always
   resources:
     requests:
       cpu: 1
 containers:
 - name: main-app1
   image: main-app1:1.0
   resources:
     requests:
       cpu: 1
```

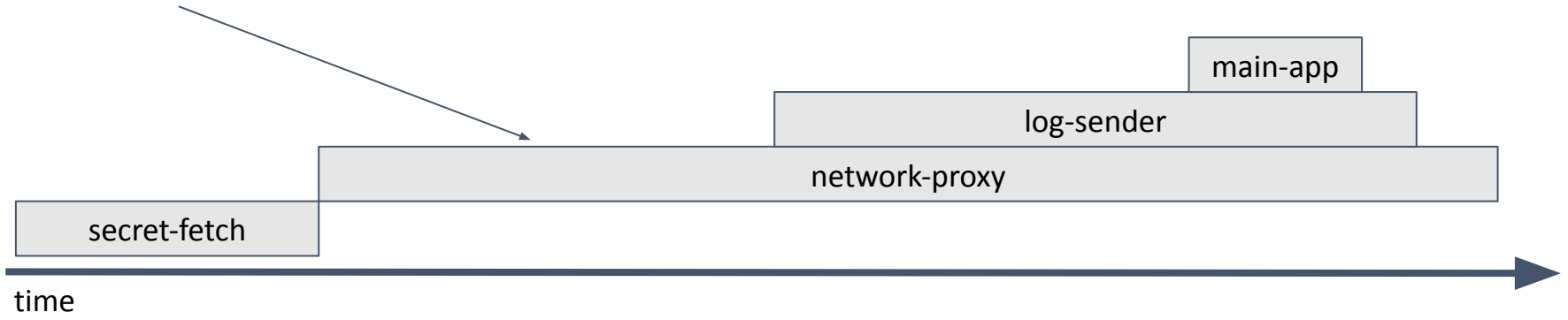


Sidecar Best/Worst Practices

Best: Minimize the time spent in startupProbe or postStart hook

Worst: Take as long as you want, the main containers will start eventually….

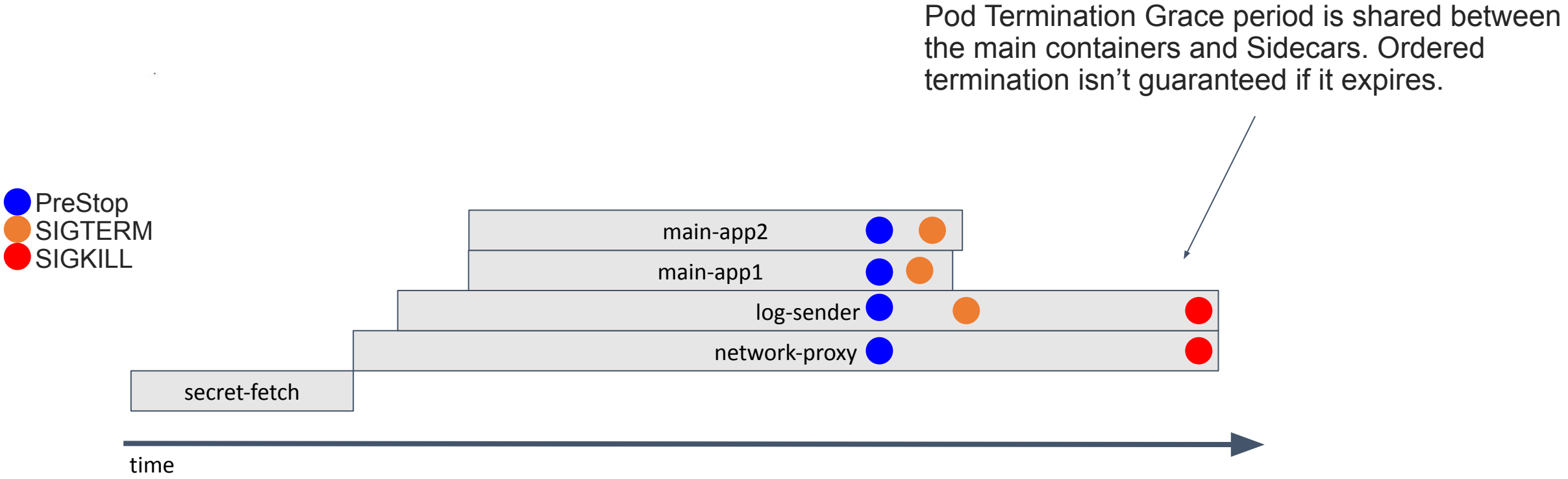
Sidecars start serially, so minimize this time for faster overall Pod startup.



Sidecar Best/Worst Practices

Best: Exit preStop hook ASAP, and shutdown fully on SIGTERM.

Worst: Take as long as you want, who needs termination ordering?



Don’t Forget!

- Any code that sums Pod resource requests is wrong if it doesn’t consider Sidecars
  - e.g. That reporting tool you wrote three years ago…

- You may need to recompile mutating admission webhooks that will silently drop the new restartPolicy field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What’s next?

State of Sidecars

- 1.28
  - Alpha Status
  - Ordered sidecar startup
  - Sidecars restart if they crash
  - No ordered sidecar termination
- 1.29
  - Beta Status
  - Adds ordered sidecar termination
  - Better integration with resource managers
- Adoption:
  - Istio: https://istio.io/latest/blog/2023/native-sidecars/
  - GCS fuse (talk: https://sched.co/1Rj4I):
- Upcoming:
  - Restart sidecars during pod termination if they crash

More goodness

- Security boundaries between the sidecar and main containers
- Different resource usage patterns - e.g. dedicated CPUs for the main containers and shared pool for the sidecars
- Crashloop backoff configuration for sidecar containers
- OOMkill and other liveness cross-dependencies between containers and sidecars
- More lifecycle control patterns

Where we will NOT go…

… anytime soon:

- Pod is a single scheduleable unit. We do not plan to make Containers even more flexible - i.e. conditional enablement of a container inside the Pod
- Full-blown systemd clone inside the Pod. We evaluated the need for things like PartOf or BindTo and decided it is too much
- Split Pod into multiple units and/or provide “Sidecar Pods”
- Define resource usage as a percentage of other containers resource usage

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