NOKIA

Advancing CPU management in Kubernetes

ONS 2019 Europe

Levente Kálé

23-09-2019

Whoami

Product architect working on Kubernetes based edge cloud solutions within, and without Nokia (Akraino Radio Edge Cloud)

Specalizes in satisfying 5G RAN requirements (both control plane and data plane)... most of times related to compute resource management

LinkedIn: https://www.linkedin.com/in/levovar-045/

GitHub: https://github.com/Levovar

Not a Twitter guy ☺

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- Sub-node partitioning and configuration of CPU cores

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But special industries and workloads have special needs:

- Hard isolation for increased high-availability
- Sub-node partitioning and configuration of CPU cores
- CPU pinning
  - I know, I know in an ideal world… but sometimes this is still needed

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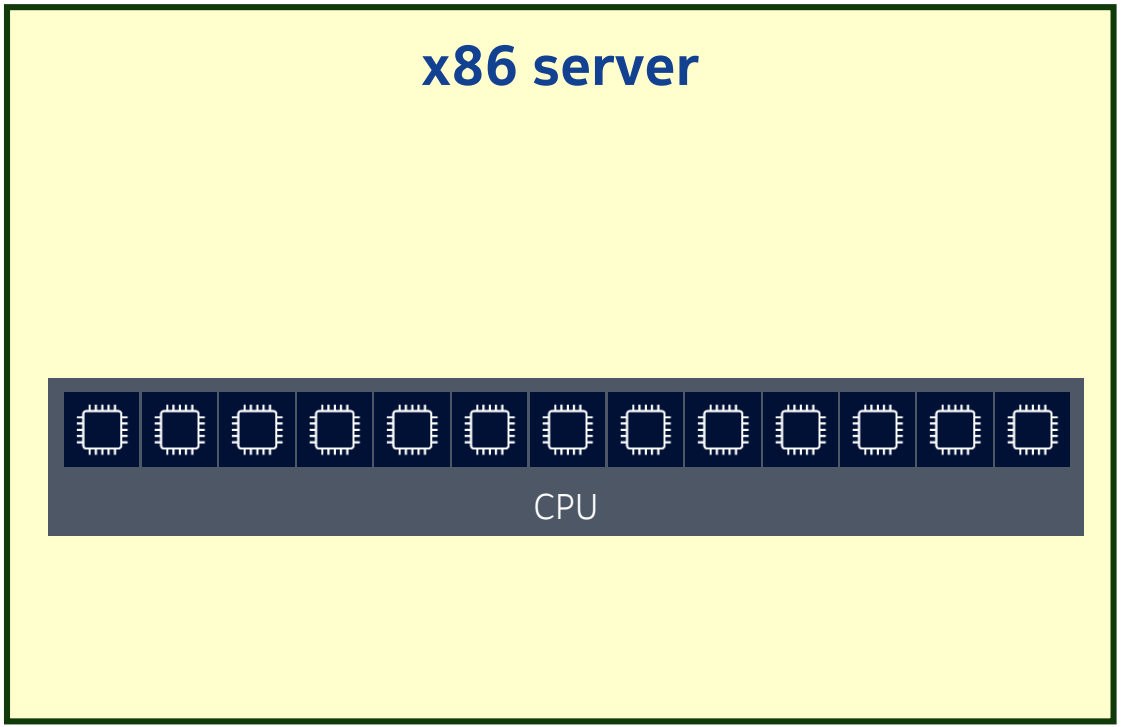
If you are also the 20%, CPU-Pooler is here to save your day!

Reservoir pools



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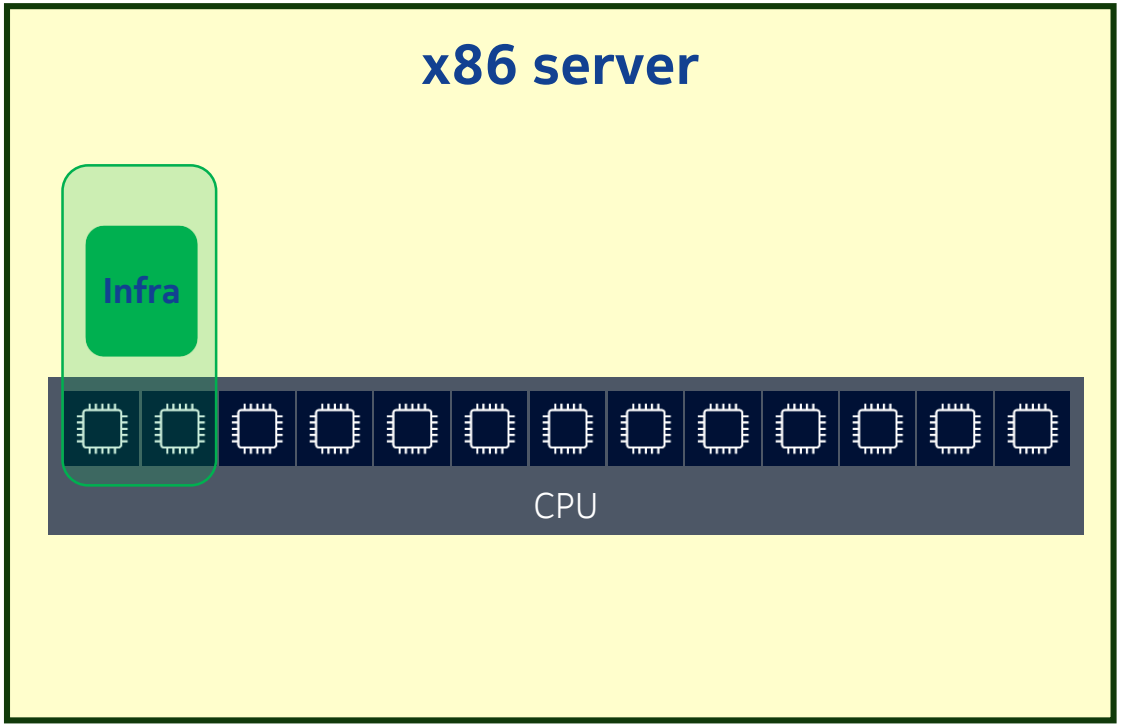
Reservoir pools



- Mr. Green, The Platfrom

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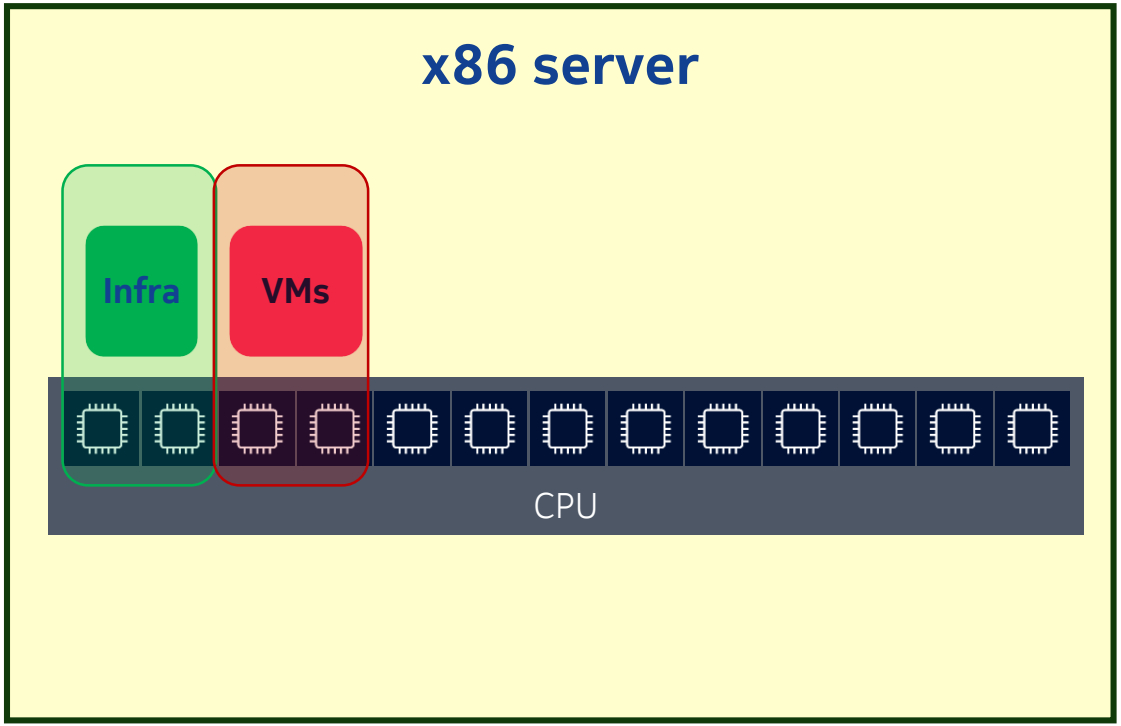
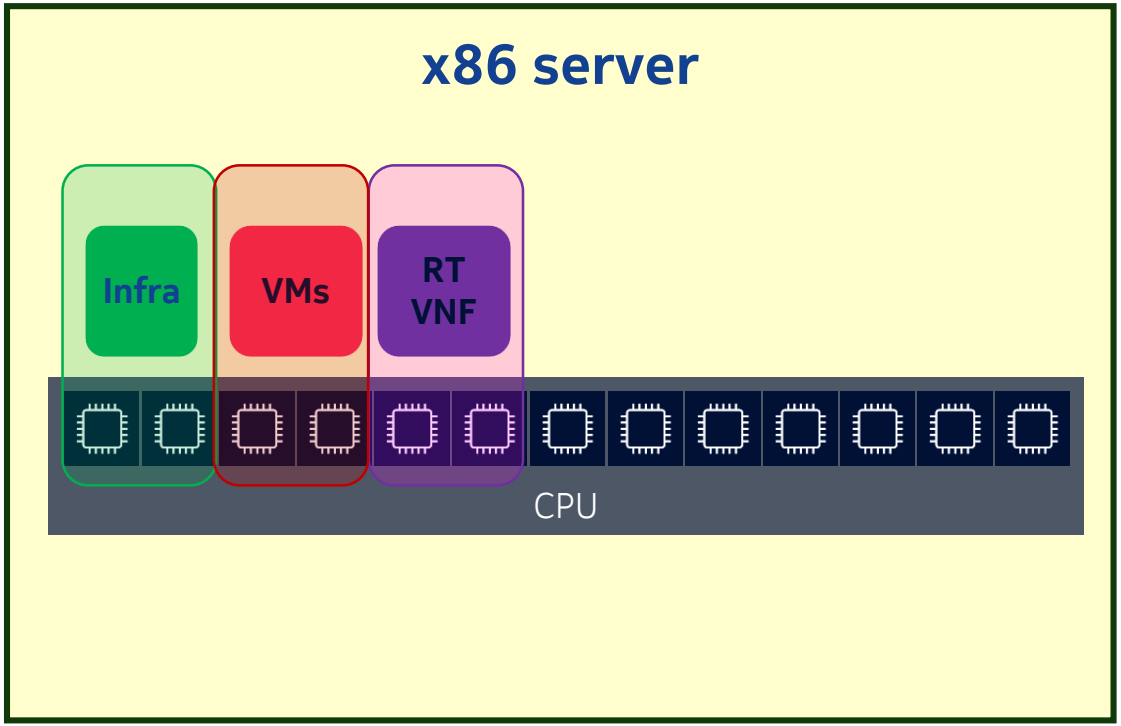


- Mr. Green, The Platfrom
- Mr. Red, The Virtual Machine

Reservoir pools



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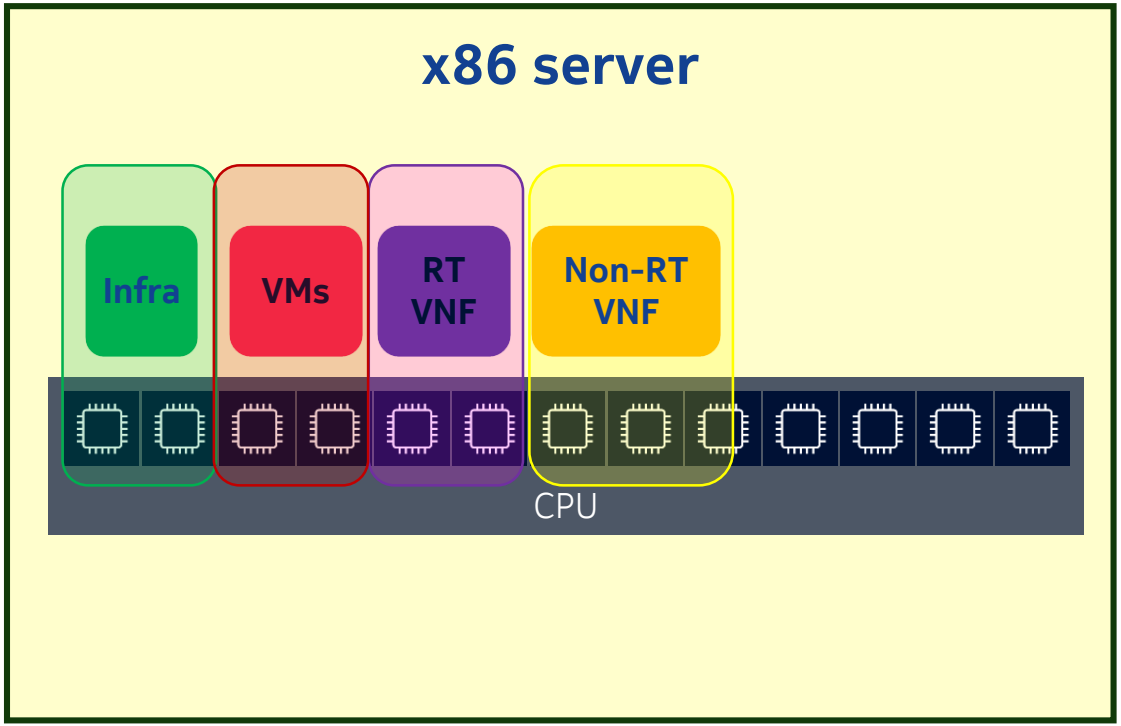
Reservoir pools



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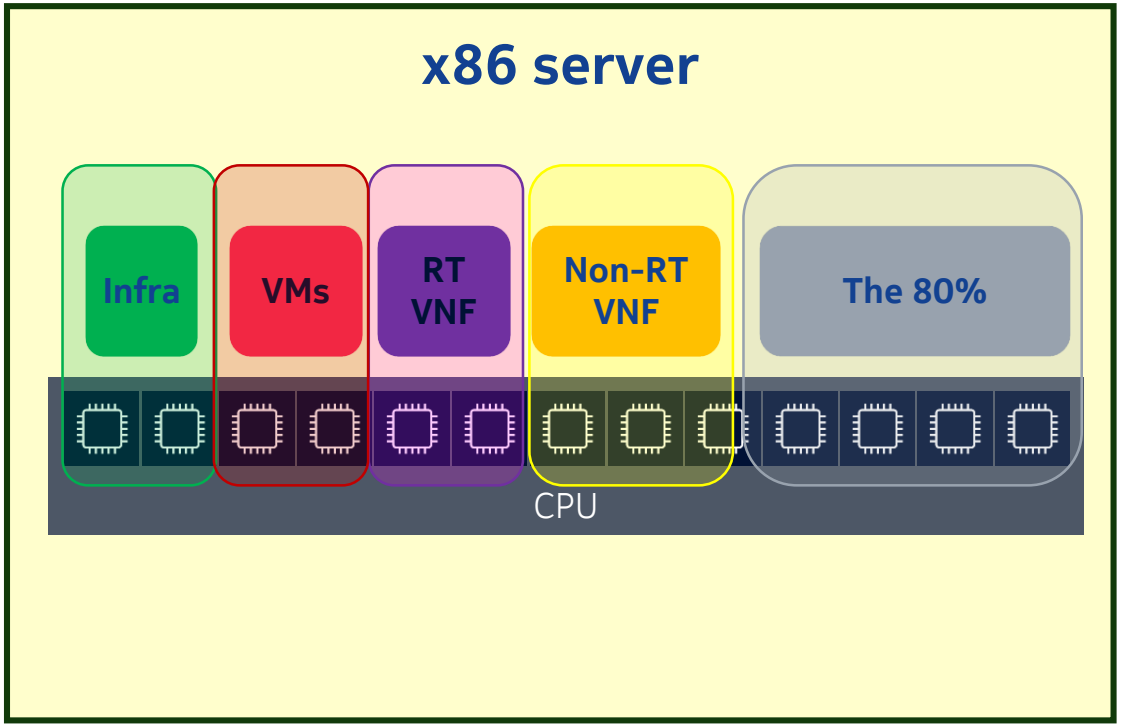
- Mr. Red, The Virtual Machine
- Mr. Purple, The Exclusive
- Mr. Orange, The Shared

Reservoir pools



- Mr. Green, The Platfrom
- Mr. Red, The Virtual Machine
- Mr. Purple, The Exclusive
- Mr. Orange, The Shared
- Mr. Grey, The Default

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Pooling done right

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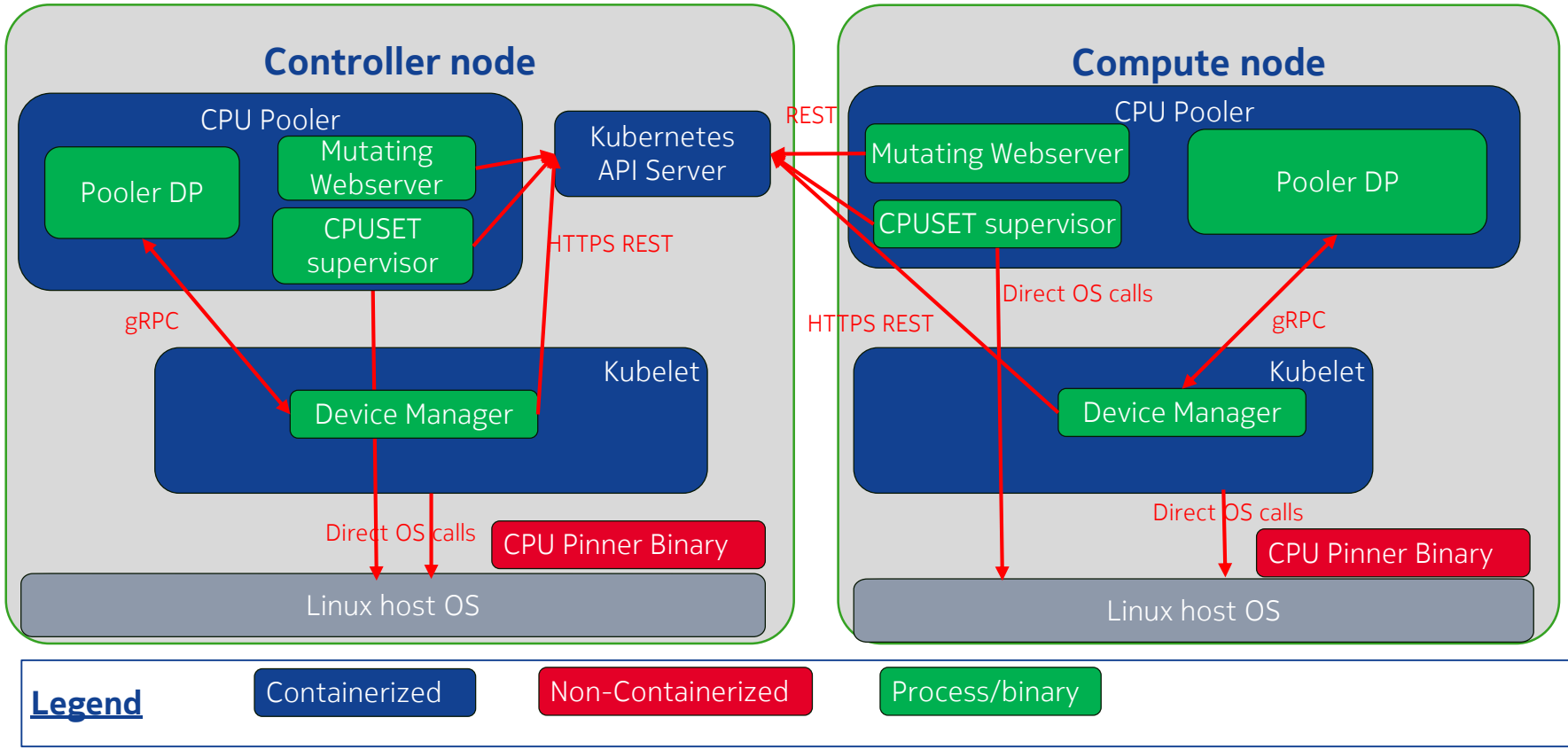
The end result?

A solutions which feels like Kubernetes, and works like Kubernetes – only with moar pools!

CPUs are *technically* devices, am I right?



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CPU-Pooler in action

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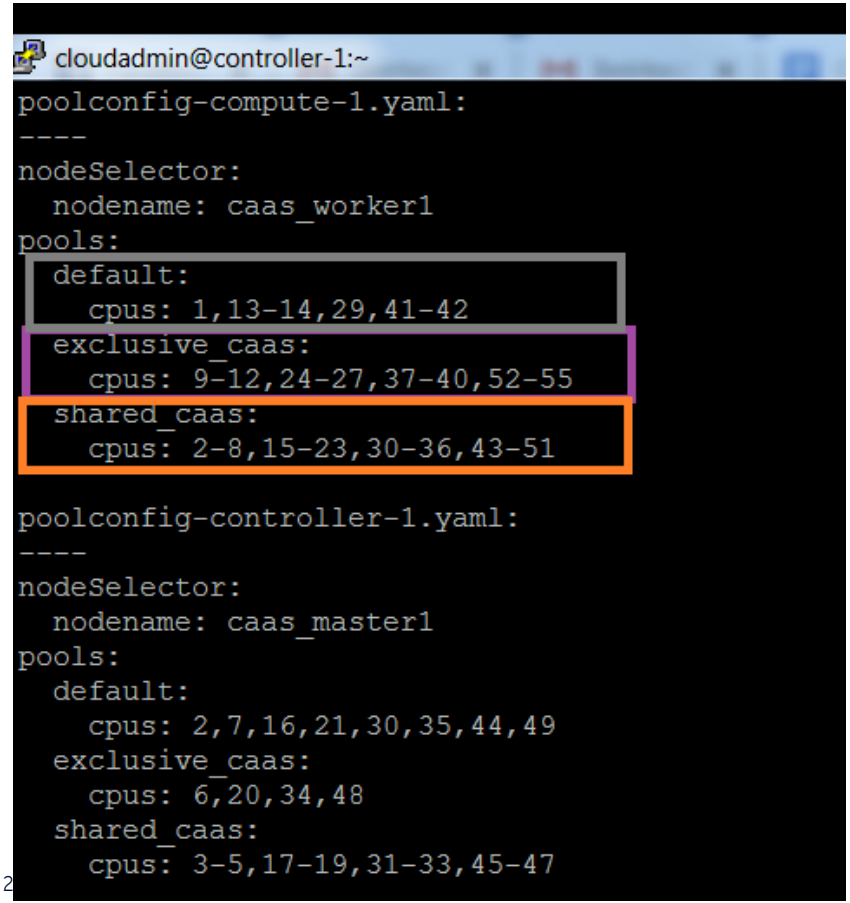

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CPU-Pooler in action

```
cloudadmin@controller-1:~
poolconfig-compute-1.yaml:
```

```
cloudadmin@controller-1:~
Capacity:
 cpu:                          56
 ephemeral-storage:            50189Mi
 hugepages-1Gi:                0
 hugepages-2Mi:                0
 memory:                       263831056Ki
 nokia.k8s.io/exclusive_caas:  16
 nokia.k8s.io/shared_caas:     32k
 pods:                         110
Allocatable:
 cpu:                          6
 ephemeral-storage:            50189Mi
 hugepages-1Gi:                0
 hugepages-2Mi:                0
 memory:                       249150992Ki
 nokia.k8s.io/exclusive_caas:  16
 nokia.k8s.io/shared_caas:     32k
 pods:                         110
System Info:
```

```
Allocated resources:
  (Total limits may be over 100 percent, i.e., overcommitted.)
  Resource                      Requests    Limits
  cpu                           100m (1%)   1 (16%)
  memory                        0 (0%)      0 (0%)
  ephemeral-storage             0 (0%)      0 (0%)
  nokia.k8s.io/exclusive_caas   0           0
  nokia.k8s.io/shared_caas      0           0
```

```
    cpus: 6,20,34,48
  shared_caas:
    cpus: 3-5,17-19,31-33,45-47
```


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CPU-Pooler in action

```
spec:
  containers:
  - name: exclusive-test
    image: registry.kube-system.svc.nokia.net:5555/caas/busybox:latest
    command: ["/bin/sh", "-c", "--"]
    args: ["while true; do sleep 1; done;"]
    resources:
      requests:
        nokia.k8s.io/exclusive_caas: 1
      limits:
        nokia.k8s.io/exclusive_caas: 1
  - name: shared-test
    image: registry.kube-system.svc.nokia.net:5555/caas/busybox:latest
    command: ["/bin/sh", "-c", "--"]
    args: ["while true; do echo \"Test\"; sleep 1; done;"]
    resources:
      requests:
        nokia.k8s.io/shared_caas: 200
      limits:
        nokia.k8s.io/shared_caas: 200
  - name: default-test
    image: registry.kube-system.svc.nokia.net:5555/caas/busybox:latest
    command: ["/bin/sh", "-c", "--"]
    args: ["while true; do echo \"Test\"; sleep 1; done;"]
    resources:
      requests:
        cpu: 1000m
      limits:
        cpu: 1000m
```

```
t, i.e., overcommitted.)
s    Limits

%)   1 (16%)
     0 (0%)
     0 (0%)
     0
     0
```

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```
Allocated resources:
  (Total limits may be over 100 percent, i.e., overcommitted.)
  Resource                        Requests    Limits
  --------                        --------    ------
  cpu                             100m (1%)   1 (16%)
  memory                          0 (0%)      0 (0%)
  ephemeral-storage               0 (0%)      0 (0%)
  nokia.k8s.io/exclusive_caas     0           0
  nokia.k8s.io/shared_caas        0           0
```

```
Allocated resources:
  (Total limits may be over 100 percent, i.e., overcommitted.)
  Resource                        Requests     Limits
  --------                        --------     ------
  cpu                             1100m (18%)  2200m (36%)
  memory                          0 (0%)       0 (0%)
  ephemeral-storage               0 (0%)       0 (0%)
  nokia.k8s.io/exclusive_caas     1            1
  nokia.k8s.io/shared_caas        200          200
```

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CPU-Pooler in action

```
poolconfig-compute-1.yaml:
---
nodeSelector:
  nodename: caas_worker1
pools:
  default:
    cpus: 1,13-14,29,41-42
  exclusive_caas:
    cpus: 9-12,24-27,37-40,52-55
  shared_caas:
    cpus: 2-8,15-23,30-36,43-51
```

```
[cloudadmin@controller-1 ~]$ kubectl exec cpu-pooling-demo-769fb5fb44-vftqx -c default-test cat /proc/1/status | grep Cpus_allowed_list
Cpus_allowed_list:      1,13-14,29,41-42
```

```
[cloudadmin@controller-1 ~]$ kubectl exec cpu-pooling-demo-769fb5fb44-vftqx -c exclusive-test cat /proc/1/status | grep Cpus_allowed_list
Cpus_allowed_list:      10
```

```
[cloudadmin@controller-1 ~]$ kubectl exec cpu-pooling-demo-769fb5fb44-vftqx -c shared-test cat /proc/1/status | grep Cpus_allowed_list
Cpus_allowed_list:      2-8,15-23,30-36,43-51
```

Closing remarks 1 - What about CPU socket alignment?

You should really attend „Topology Awareness in Kubernetes - The How and The Why” brought to you by Louise Daly & Feng Pan

(Wednesday, September 25 • 12:00 - 12:30, Marble Hall)

*****Spoiler Alert *****

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Guess which Kubernetes managed resources besides CPUs are automatically socket aligned by the Topology Manager? ☺

https://github.com/nokia/CPU-Pooler/issues/24

Closing remarks 2 - Shameless plugin

We are putting our money where our mouth is:

1. CPU-Pooler is used in production in Nokia edge cloud
2. CPU-Pooler is integrated into open source Akraino Radio Edge Cloud

https://gerrit.akraino.org/r/gitweb?p=ta%2Fcaas-cpupooler.git;a=summary

If you liked what we did with CPU management in Kubernetes, wait until you have seen what we did to networks:

https://github.com/nokia/danm