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CloudNative Lives

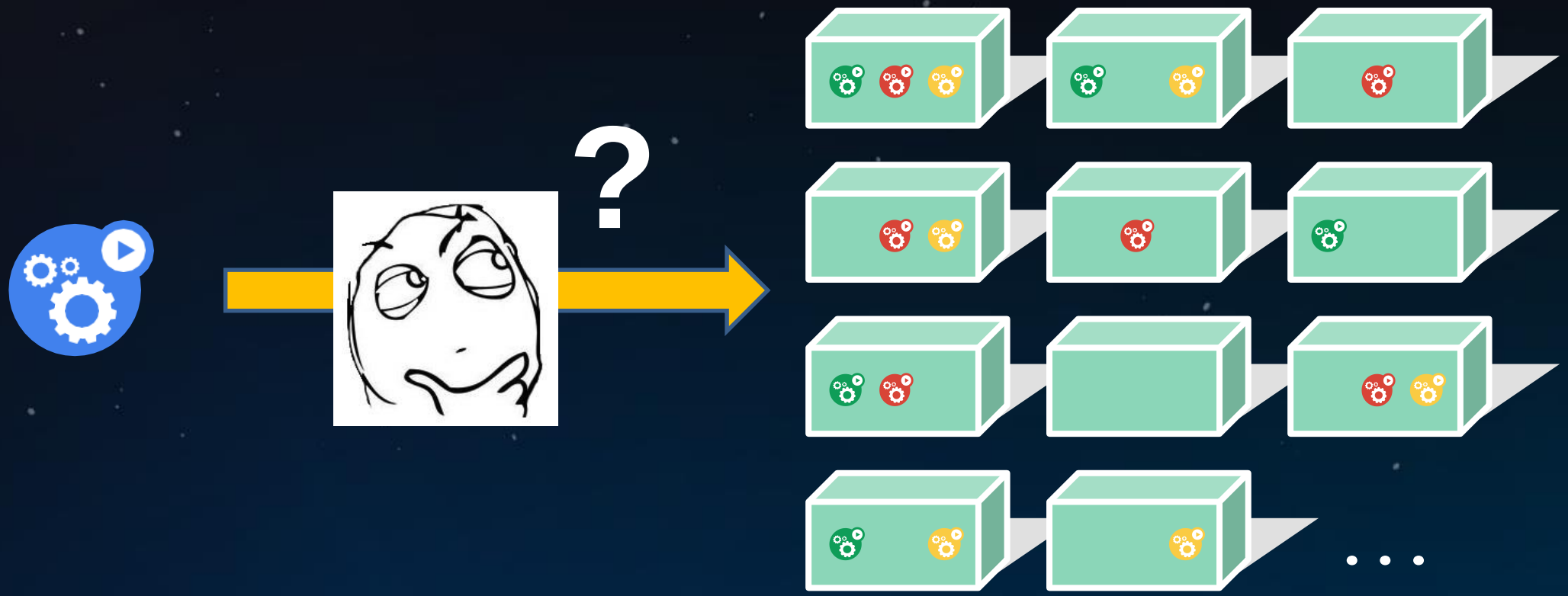
Kubernetes调度器原理剖析&实践

华为云容器团队核心架构师 & CNCF社区主要贡献者倾心打造

大 纲

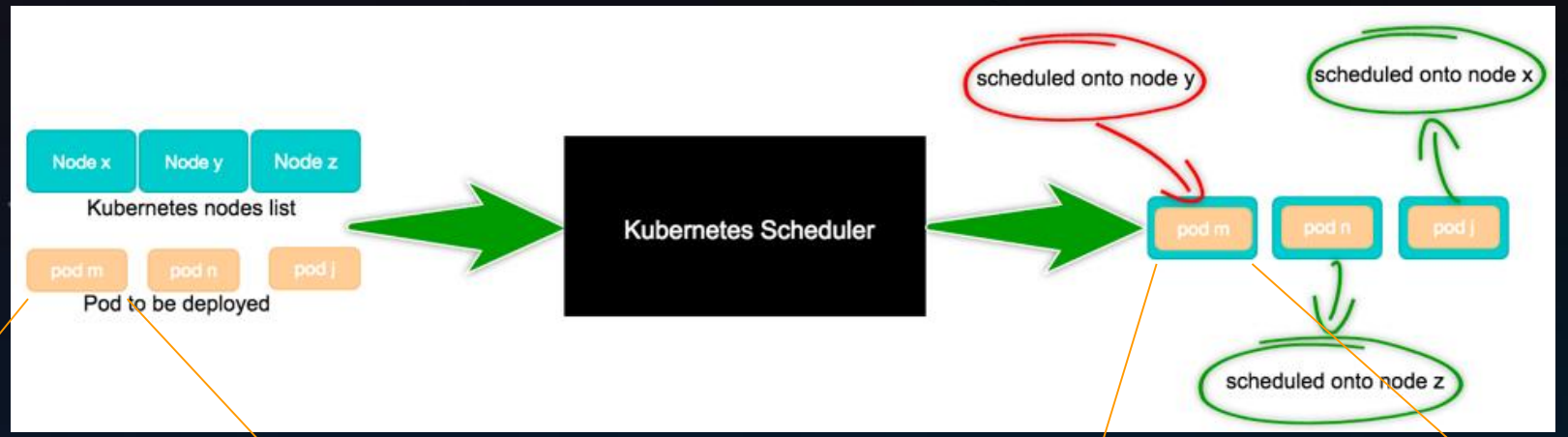
- **K8S调度机制介绍**
- K8S中的调度策略与算法
- K8S高级调度特性详解

Scheduler：为Pod找到一个合适的Node



茫茫人（Node）海，如何找到那个对的TA？

Scheduler：为Pod找到一个合适的Node




```
apiVersion: v1
kind: Pod
metadata:
  name: my-pod-76559f5d5b-l9b9p
......
spec:
  dnsPolicy: ClusterFirst
  nodeName:
  restartPolicy: Always
  containers:
......
```

```
apiVersion: v1
kind: Pod
metadata:
  name: pod-76559f5d5b-l9b9p
......
spec:
  dnsPolicy: ClusterFirst
  nodeName: node1
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```
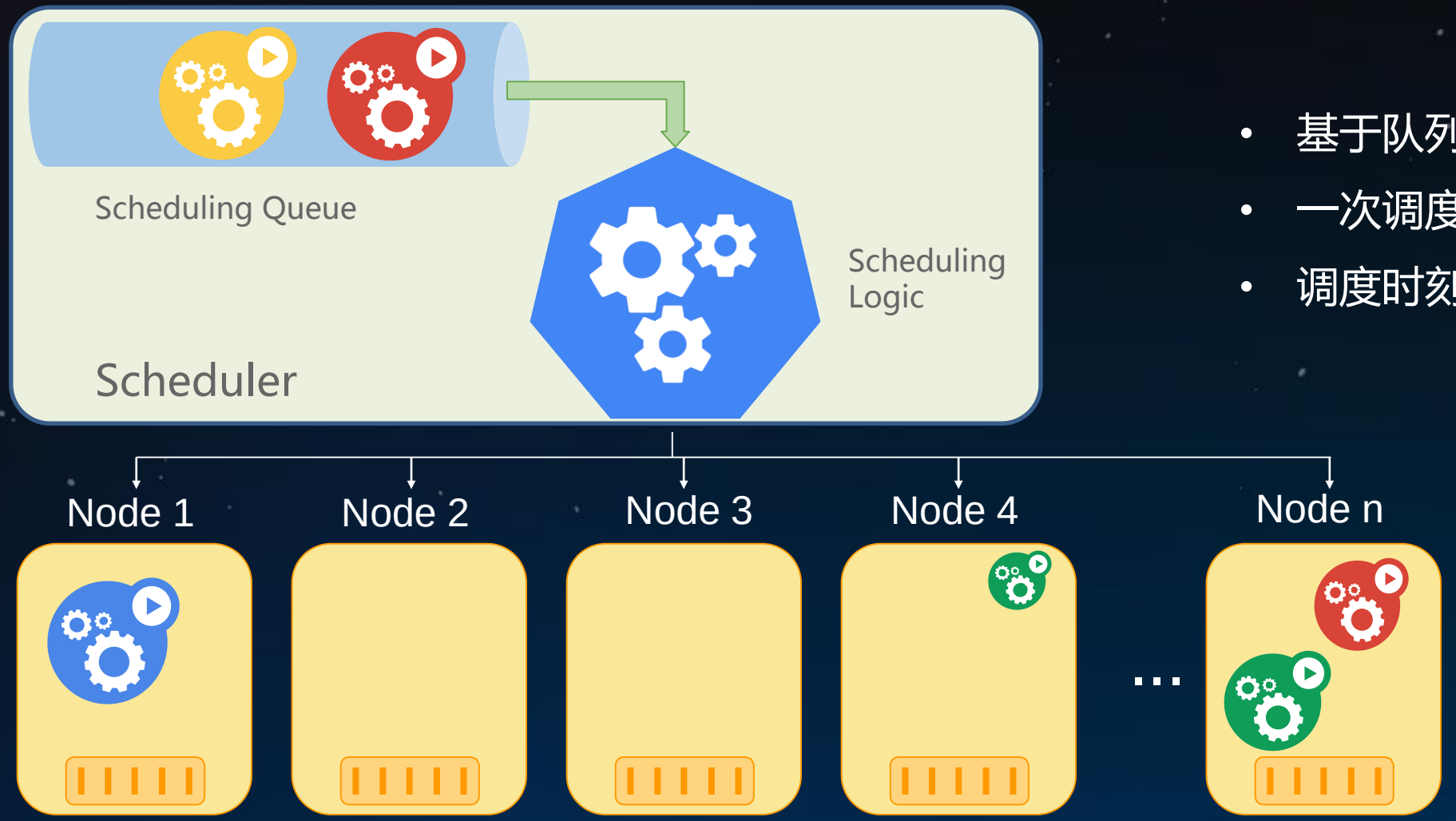

Kubernetes的Default scheduler



- 基于队列的调度器
- 一次调度一个Pod
- 调度时刻全局最优

从外部流程看调度器

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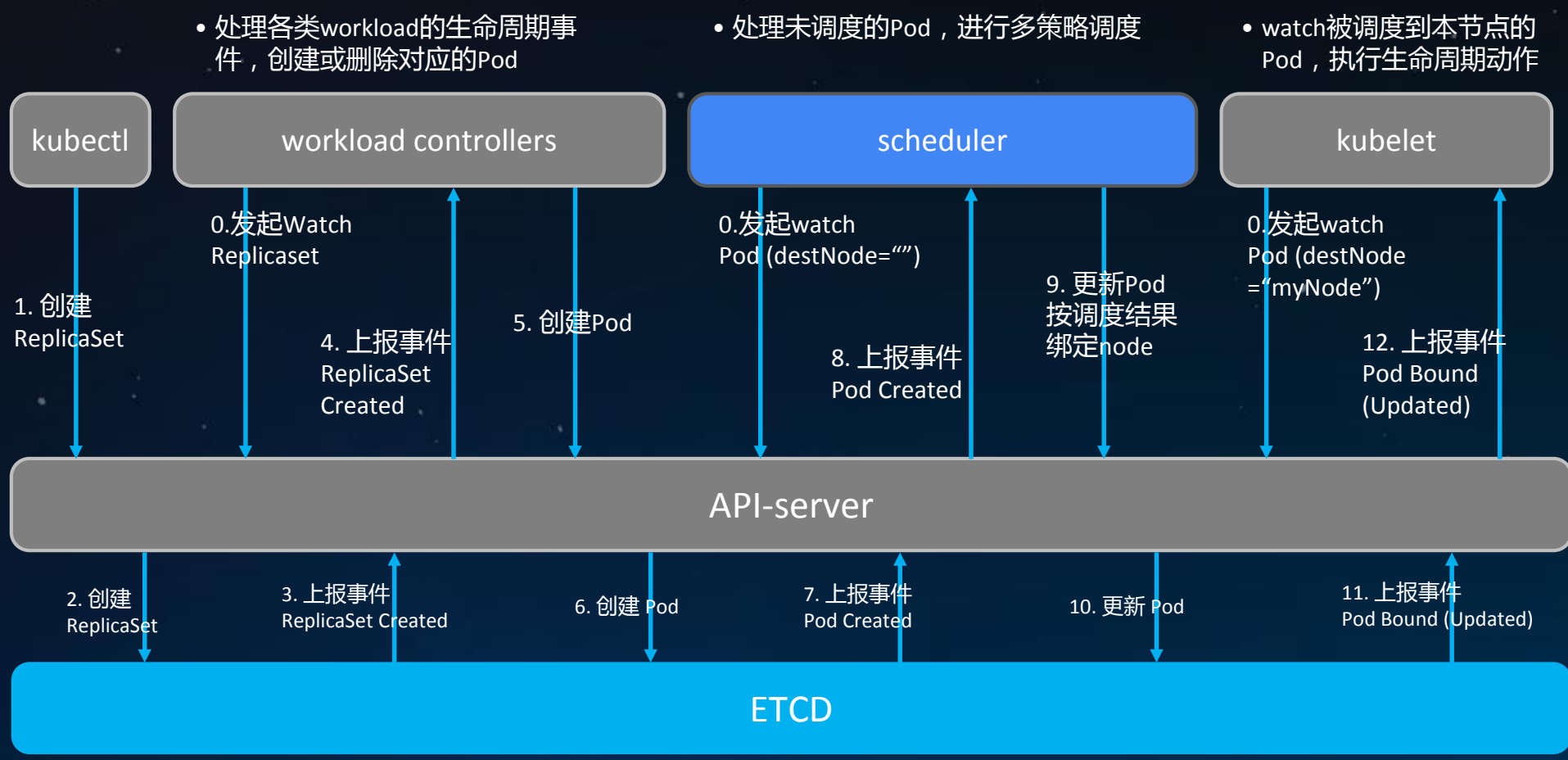
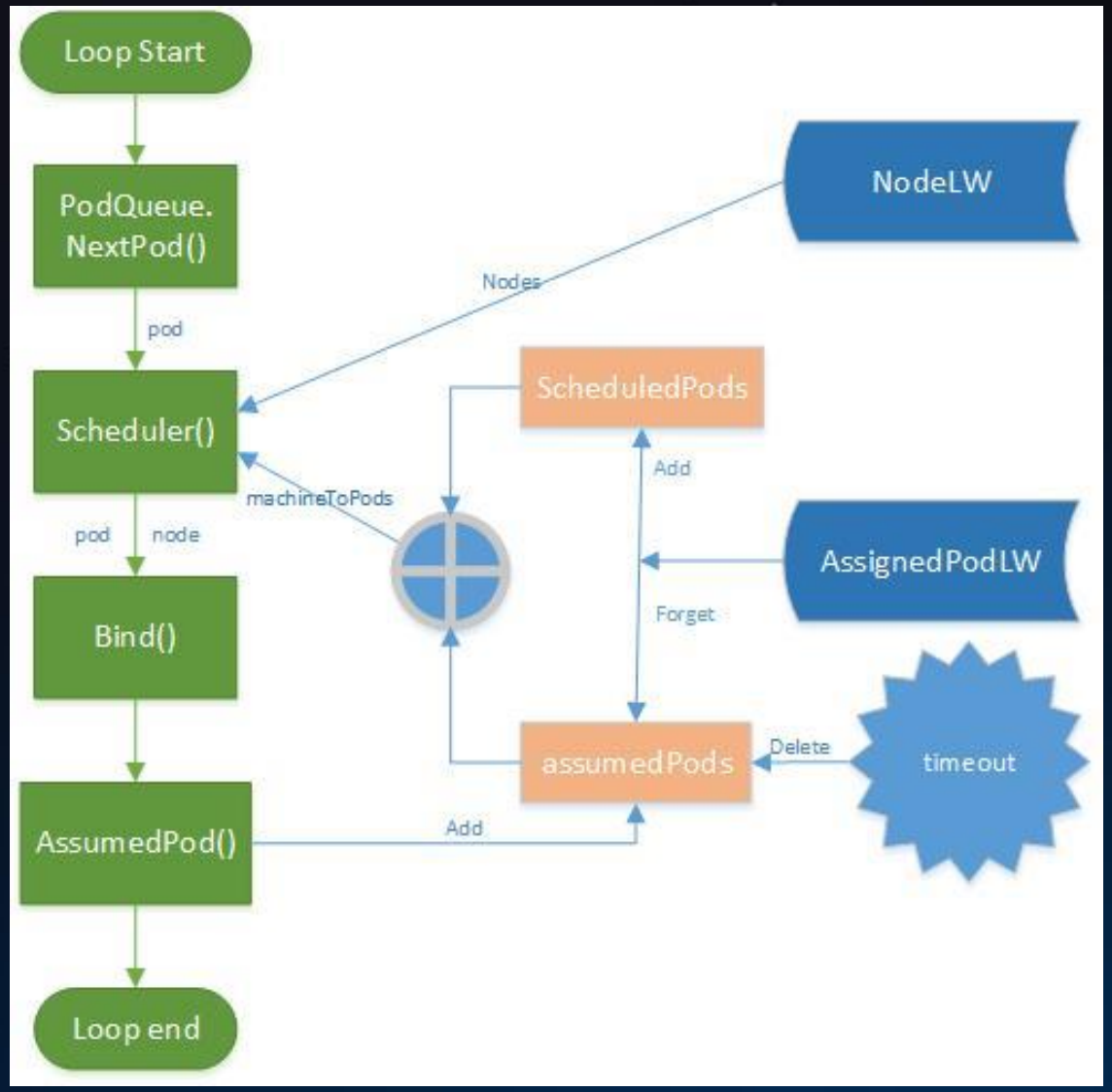
从Pod创建开始，到Pod被Bind结束



调度器的内部流程



- 通过NodeLister获取所有节点信息；
- 整合scheduled pods和assume pods，合并到pods，作为所有已调度Pod信息；
- 从pods中整理出node-pods的对应关系表nodeNameToInfo；
- 过滤掉不合适的节点；
- 给剩下的节点依次打分；
- 在分数最高的nodes中随机选择一个节点用于绑定。这是为了避免分数最高的节点被几次调度撞车。

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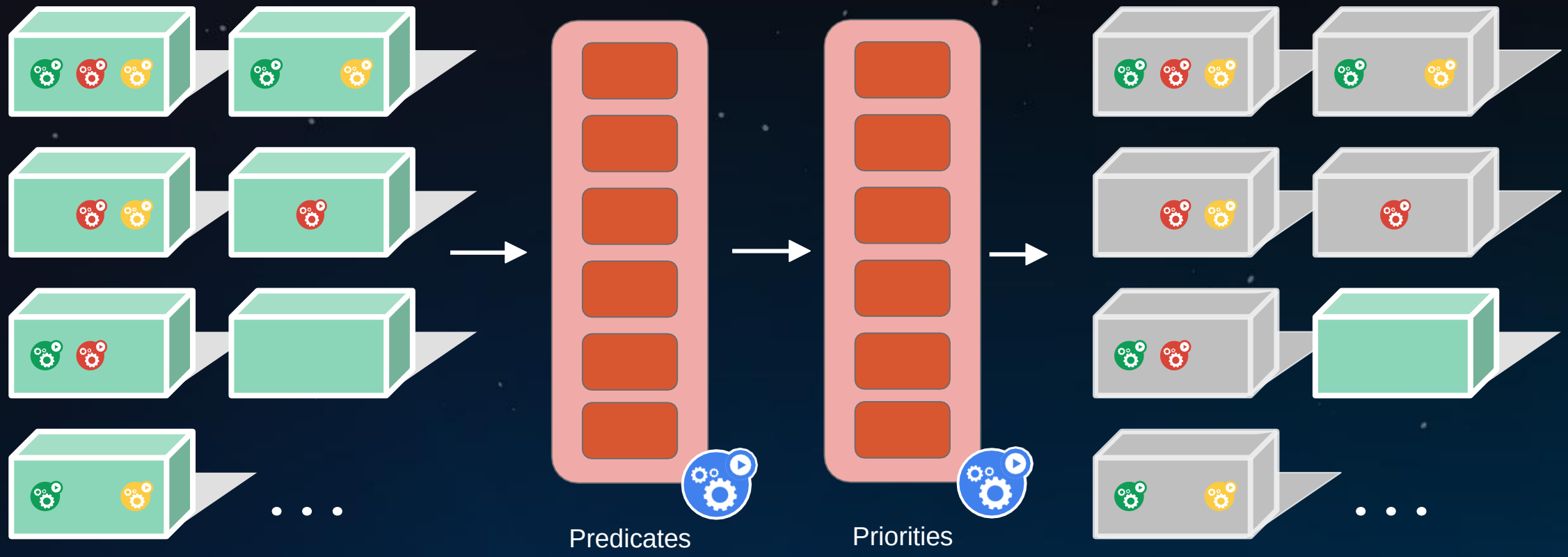
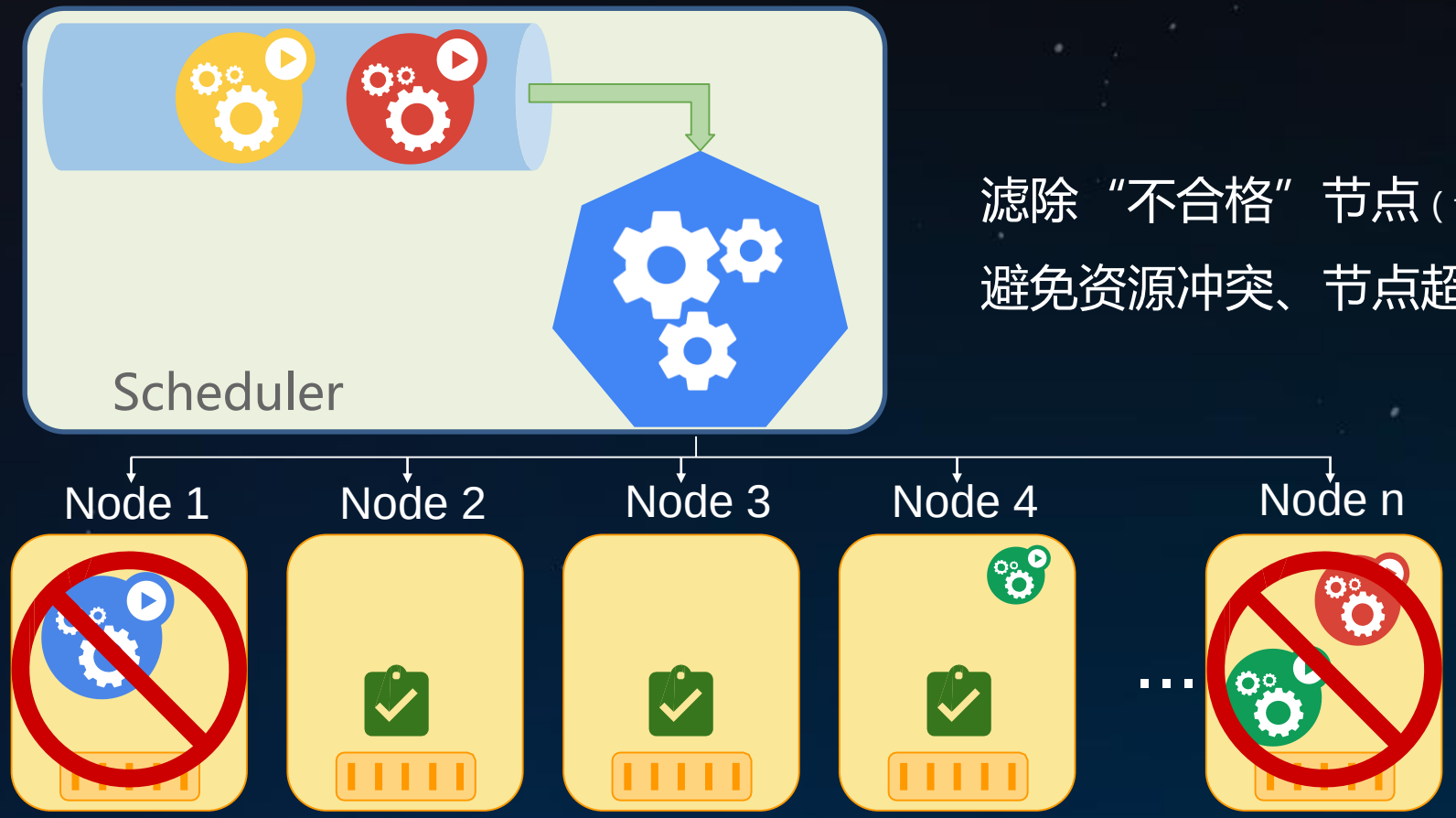
K8S中的调度策略与算法



通过Predicate策略筛选符合条件的Node



滤除“不合格”节点（调度上去也跑不起来），
避免资源冲突、节点超载等

典型Predicate算法

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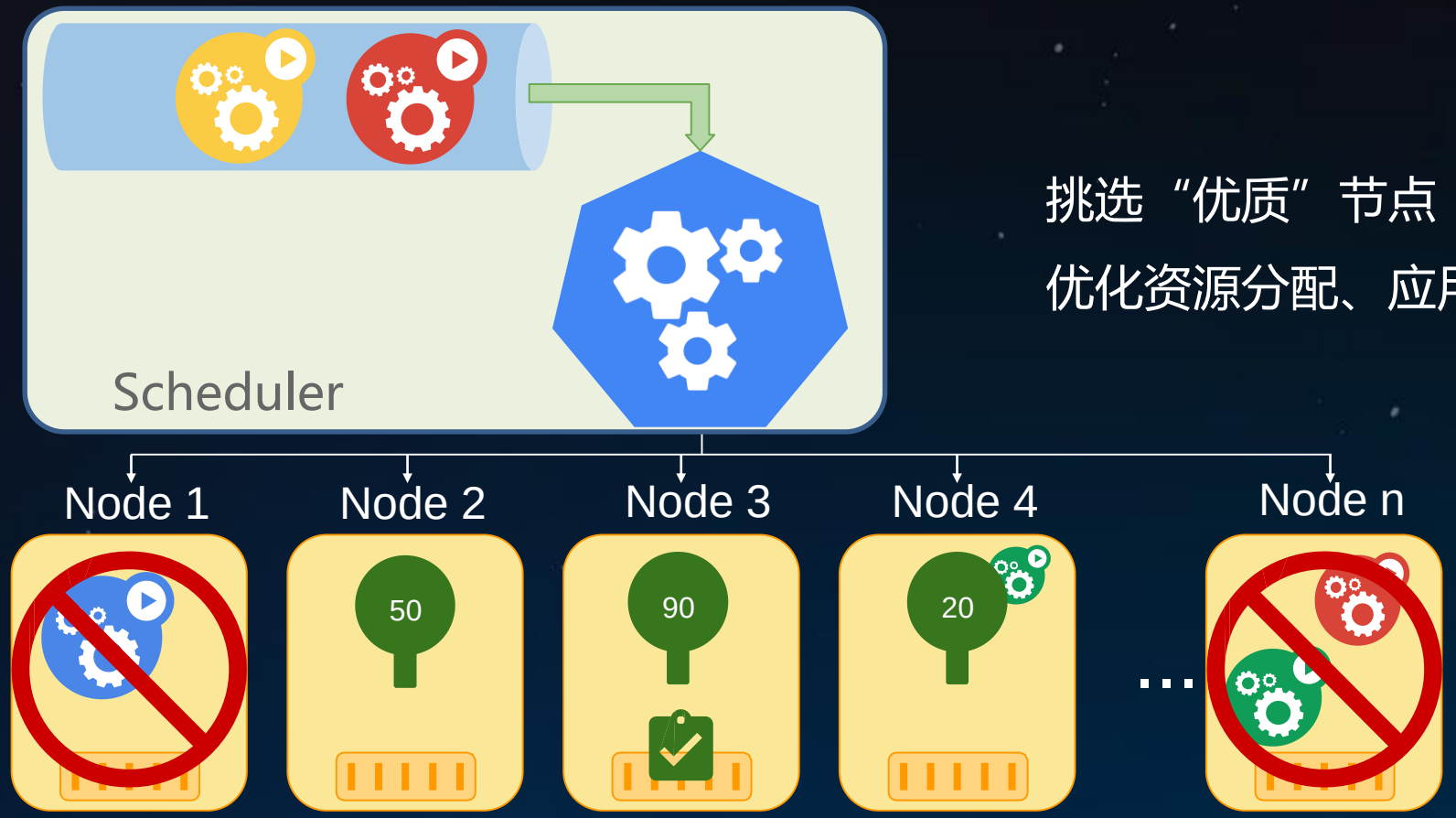
算法名称	功能
GeneralPredicates	包含3项基本检查：节点、端口和规则
NoDiskConflict	检查Node是否可以满足Pod对硬盘的需求
NoVolumeZoneConflict	单集群跨AZ部署时，检查node所在的zone是否能满足Pod对硬盘的需求
MaxEBSVolumeCount	部署在AWS时，检查node是否挂载了太多EBS卷
MaxGCEPDVolumeCount	部署在GCE时，检查node是否挂载了太多PD卷
PodToleratesNodeTaints	检查Pod是否能够容忍node上所有的taints
CheckNodeMemoryPressure	当Pod QoS为besteffort时，检查node剩余内存量，排除内存压力过大的node
MatchInterPodAffinity	检查node是否满足pod的亲和性、反亲和性需求

通过Priority策略给剩余的Node评分，挑选最优的节点



挑选“优质”节点，

优化资源分配、应用分布

典型Priority算法

算法名称	功能
LeastRequestedPriority	按node计算资源(CPU/MEM)剩余量排序，挑选最空闲的node
BalancedResourceAllocation	补充LeastRequestedPriority，在cpu和mem的剩余量取平衡
SelectorSpreadPriority	同一个Service/RC下的Pod尽可能的分散在集群中。Node上运行的同个Service/RC下的Pod数目越少，分数越高。
NodeAffinityPriority	按soft(preferred) NodeAffinity规则匹配情况排序，规则命中越多，分数越高
TaintTolerationPriority	按pod tolerations与node taints的匹配情况排序，越多的taints不匹配，分数越低
InterPodAffinityPriority	按soft(preferred) Pod Affinity/Anti-Affinity规则匹配情况排序，规则命中越多，分数越高/低

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K8S中的Label与Selector

任意的 metadata

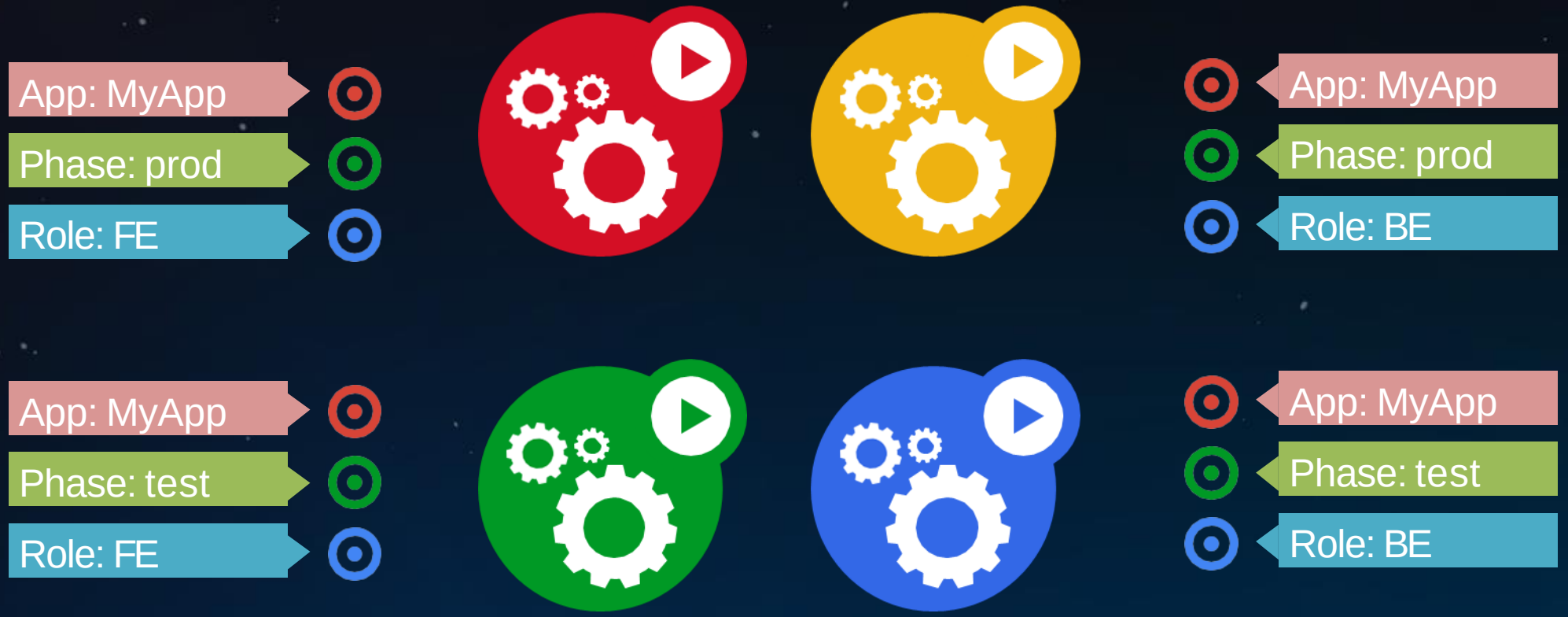
所有API对象都有Label

通常用来标记“身份”

可以查询时用**selectors**过滤

- 类似SQL ‘*select ... where ...*’

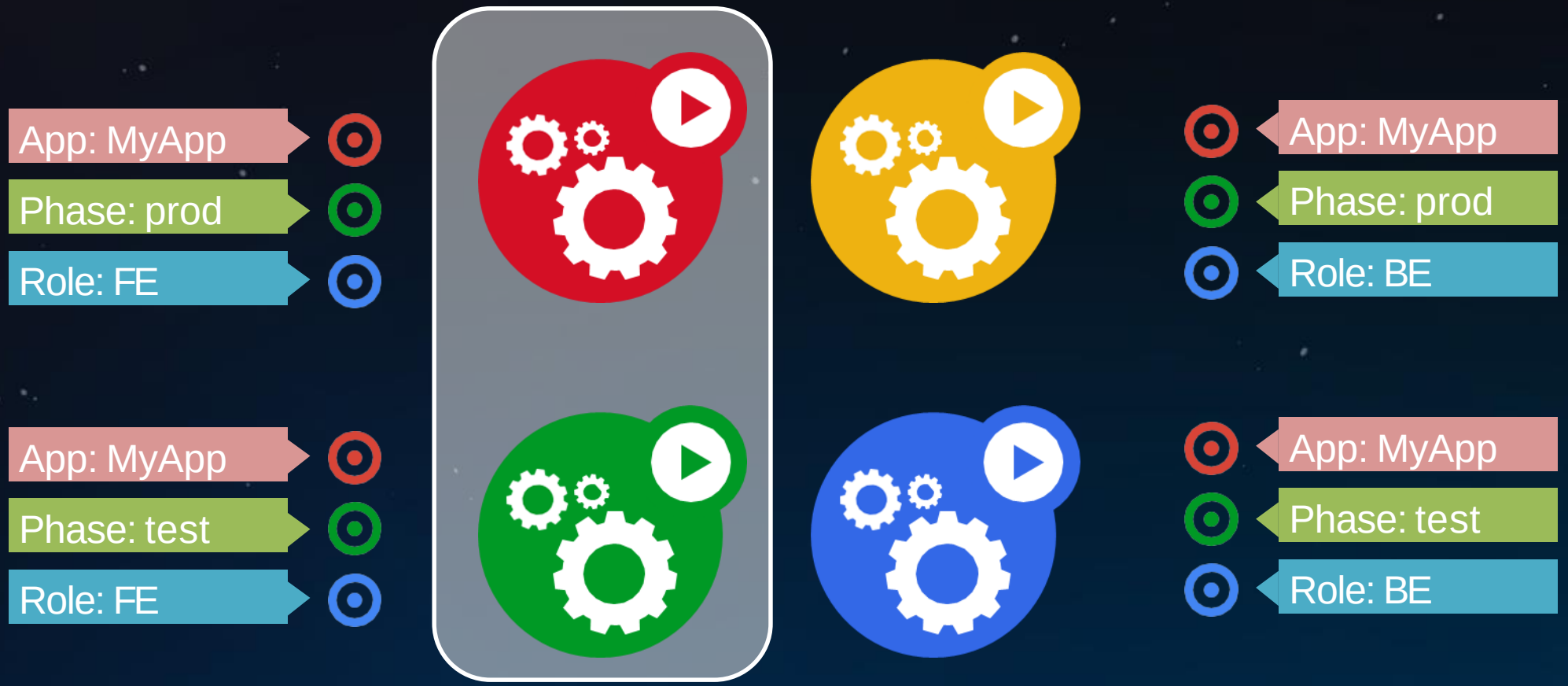
K8S中的Label与Selector



K8S中的Label与Selector

App = MyApp

K8S中的Label与Selector



App = MyApp, Role = FE

Node Affinity 让Pod在一组指定的Node上运行

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Pod Spec

```
nodeAffinity:
  labelSelector: "zone" In
{"central"}
```

nodeSelector升级版：

- 支持In和NotIn两种匹配操作
- 支持匹配相同label-key的多个取值

Node 1

Node 2

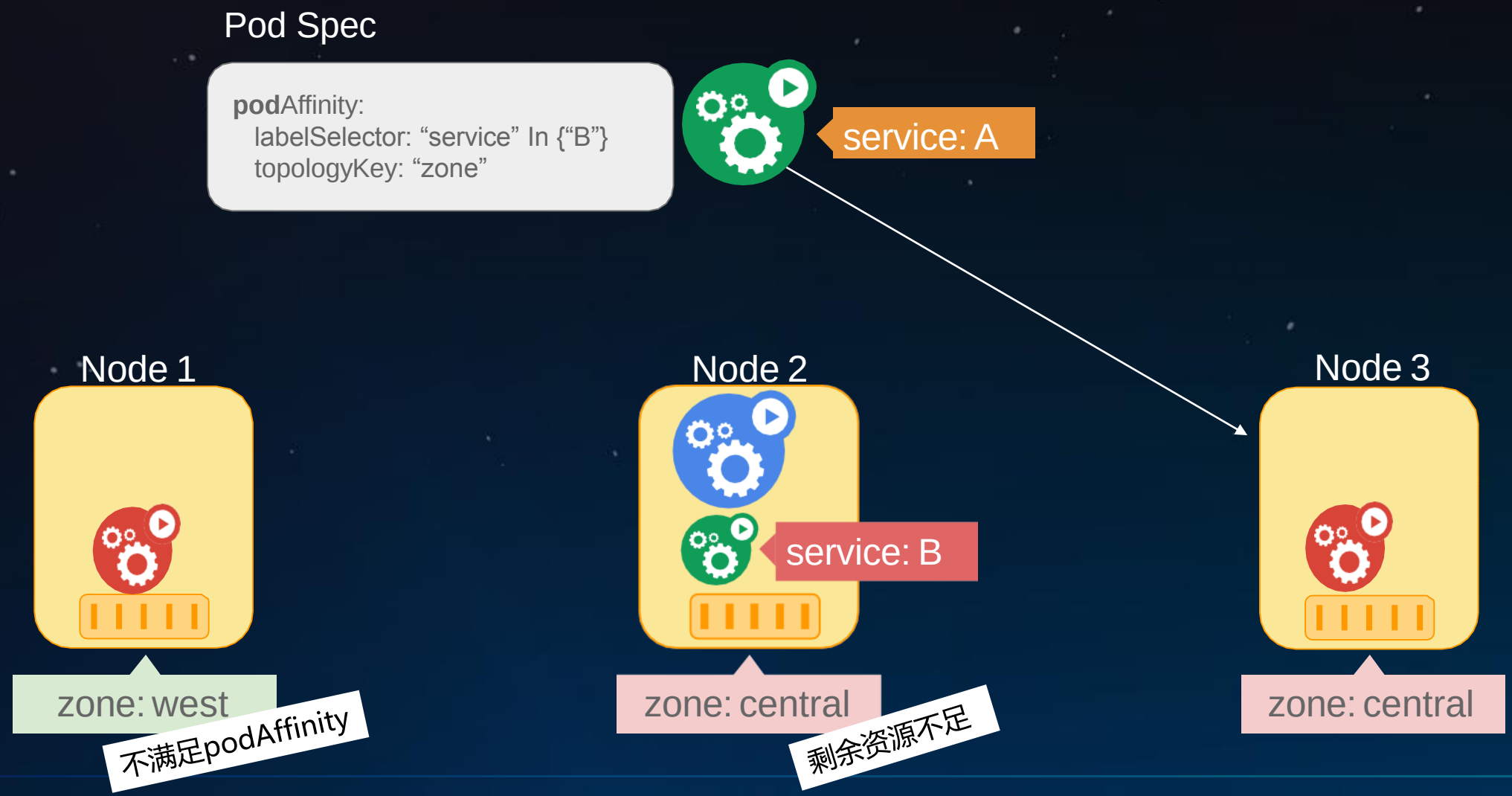
Node 3

zone: west

zone: central

zone: central

Pod Affinity 让Pod与指定Service的一组Pod在相同Node上运行



Pod Affinity 让Pod与指定Service的一组Pod在相同Node上运行

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Pod Spec

```
podAffinity:
  labelSelector: “service” In {“B”}
  topologyKey: “hostname”
```

service: A

Pod is not schedulable

Node 1

zone: west

不满足podAffinity

Node 2

service: B

zone: central

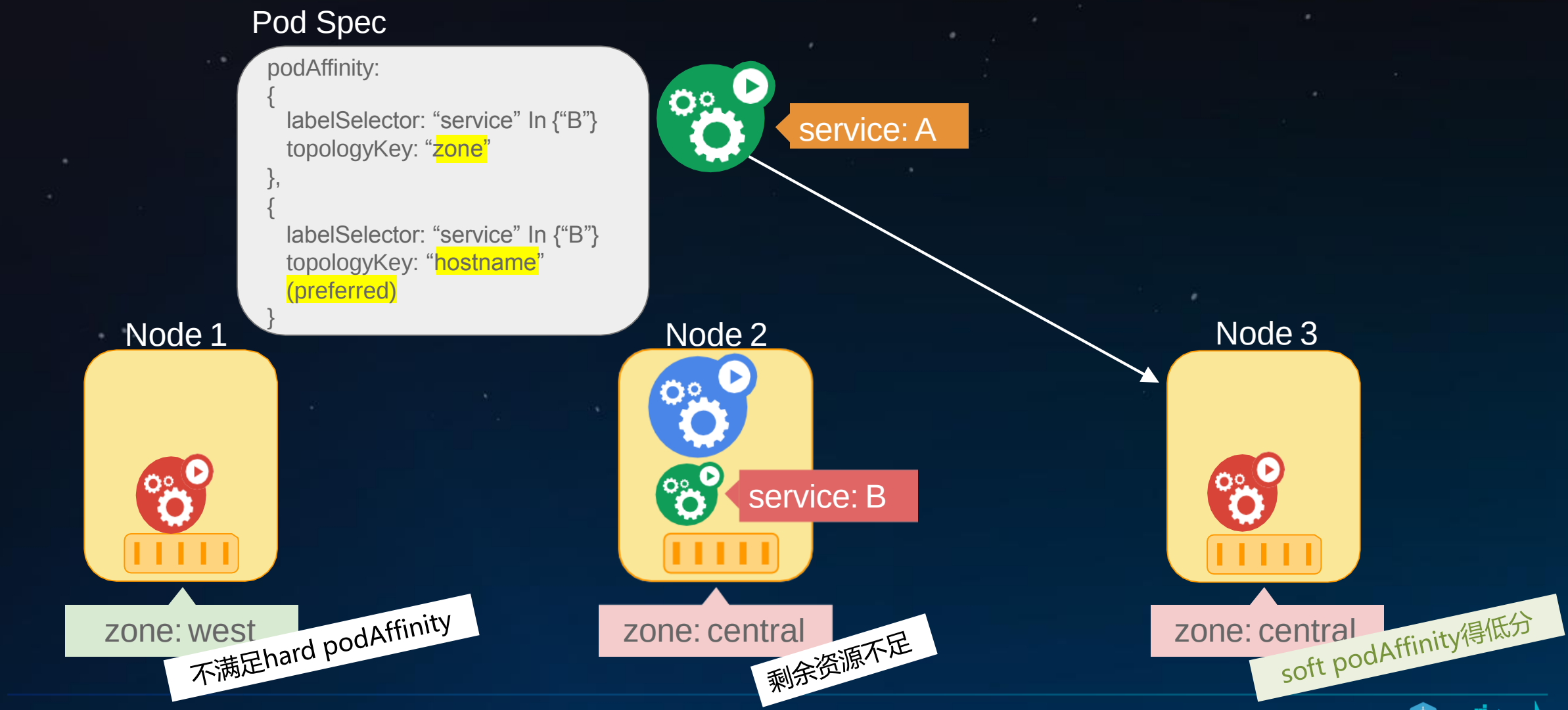
剩余资源不足

Node 3

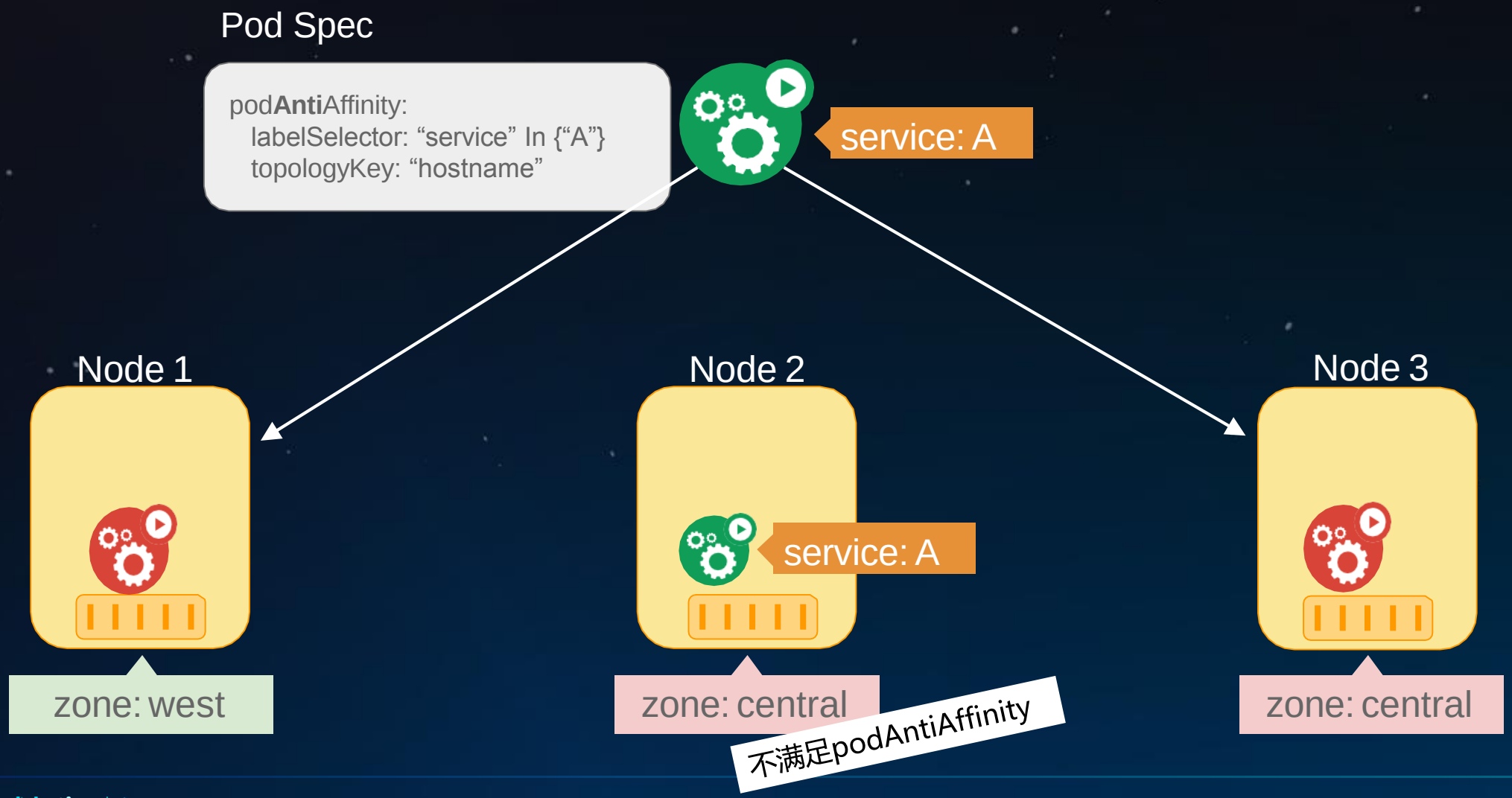
zone: central

不满足podAffinity

Pod Affinity让Pod与指定Service的一组Pod在相同Node上运行



Pod Anti-Affinity 让同一个Service的Pod分在到不同Node上运行



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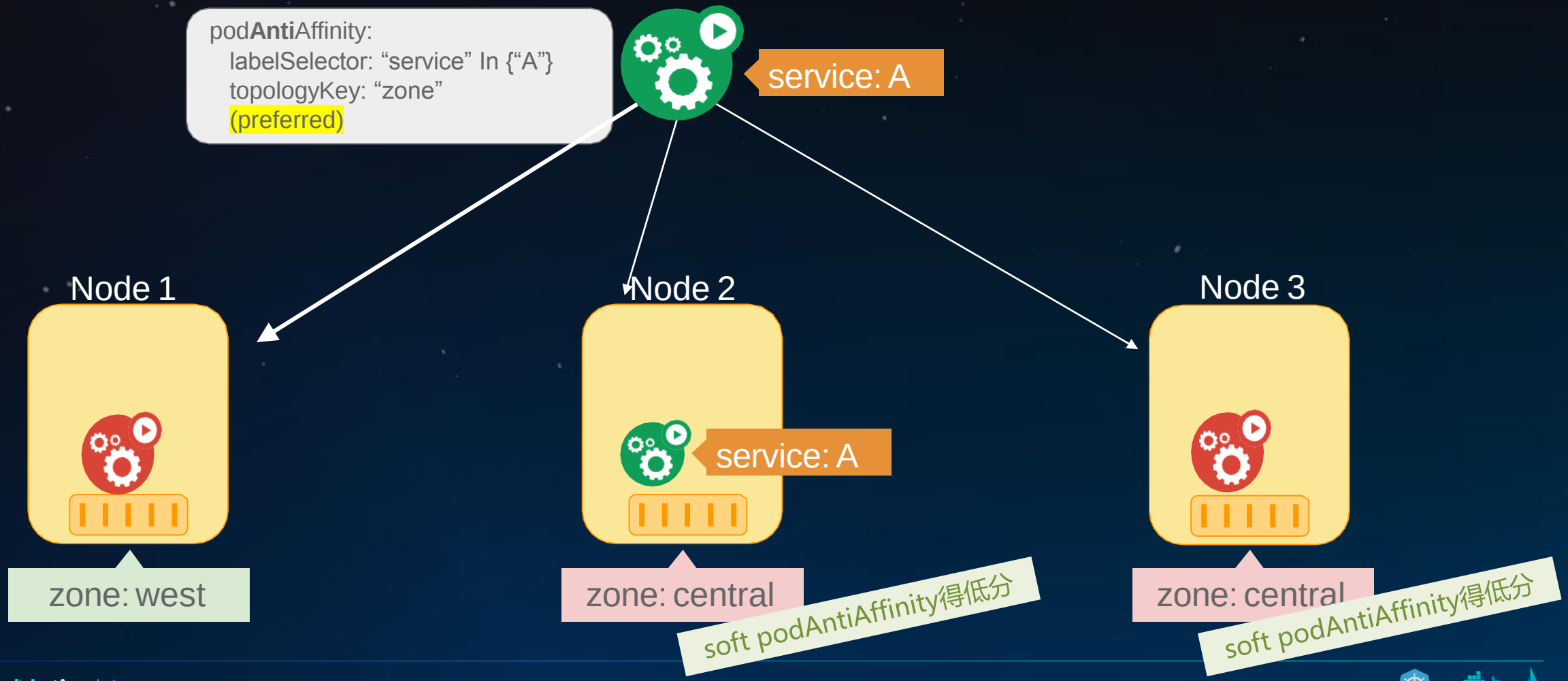
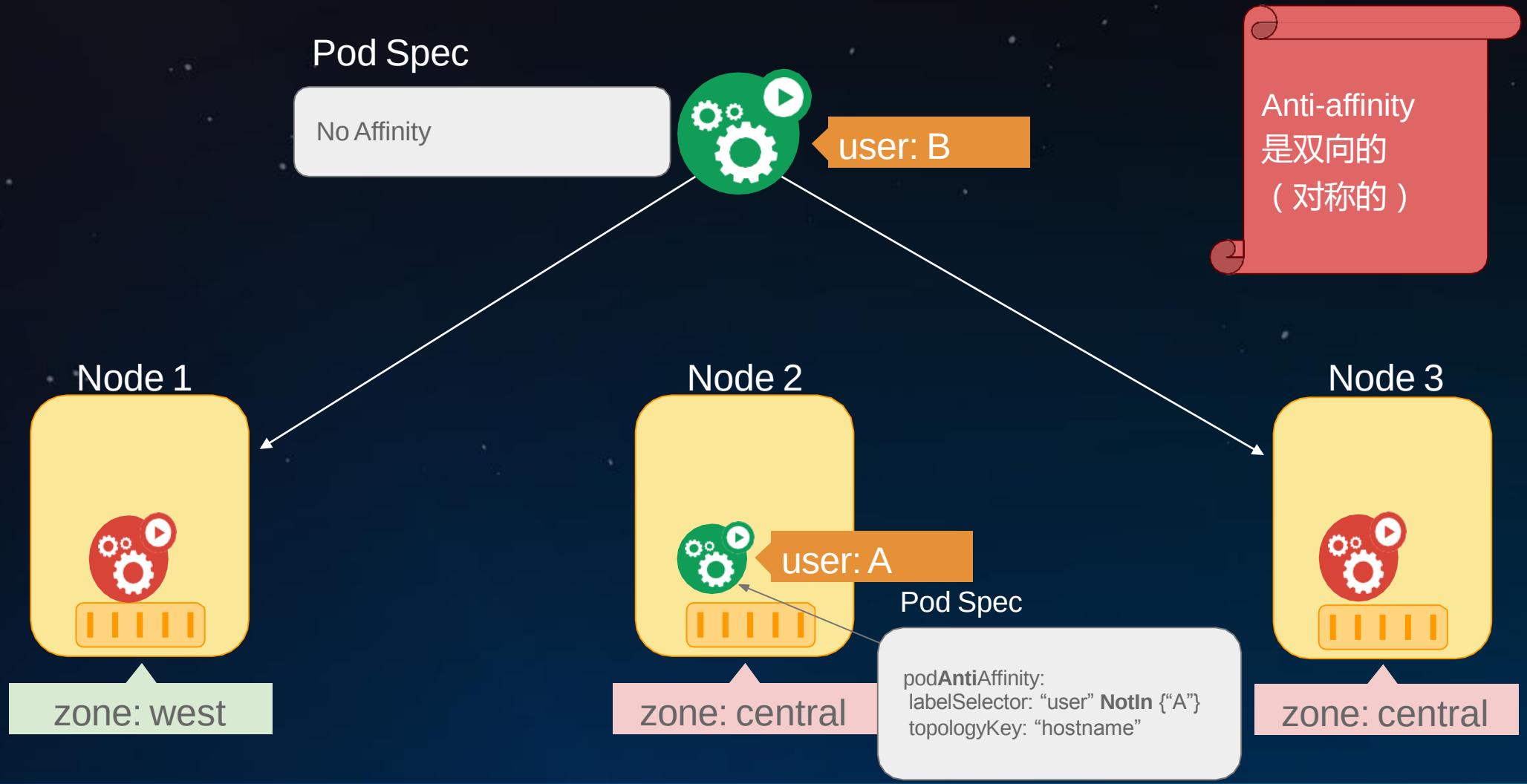
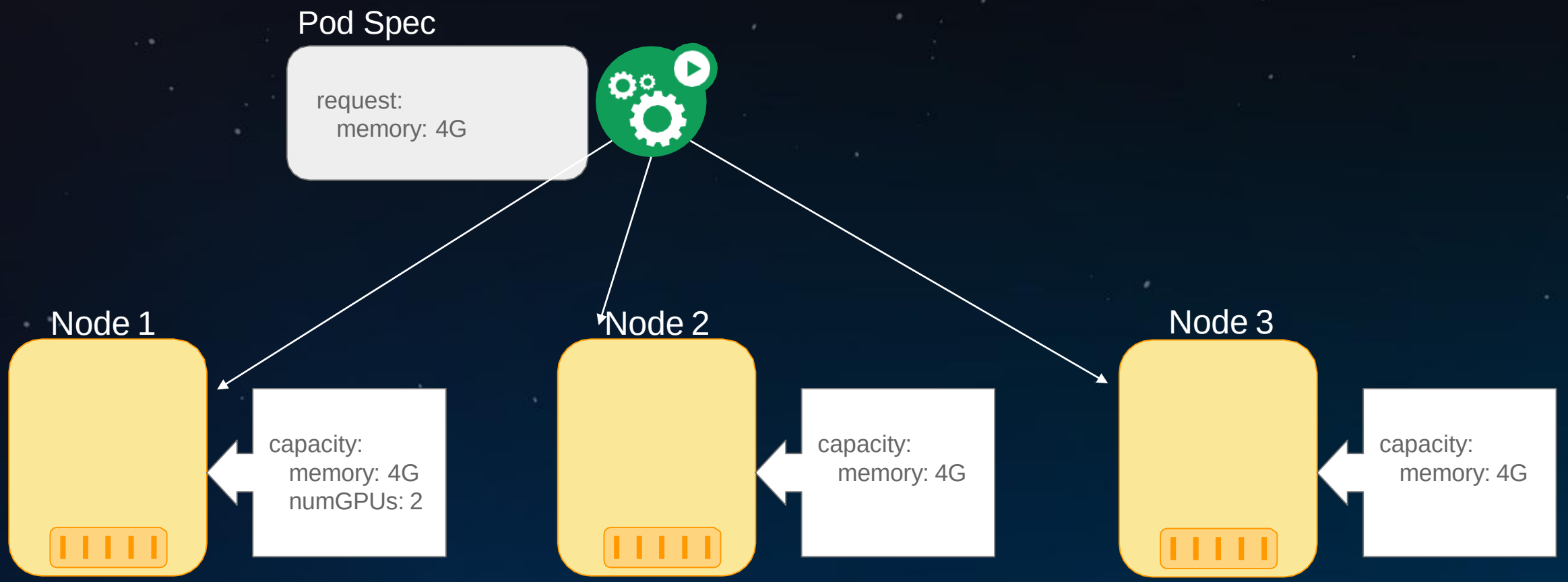


Pod Anti-Affinity具有对称性



Taints-tolerations 来自Node的反亲和配置



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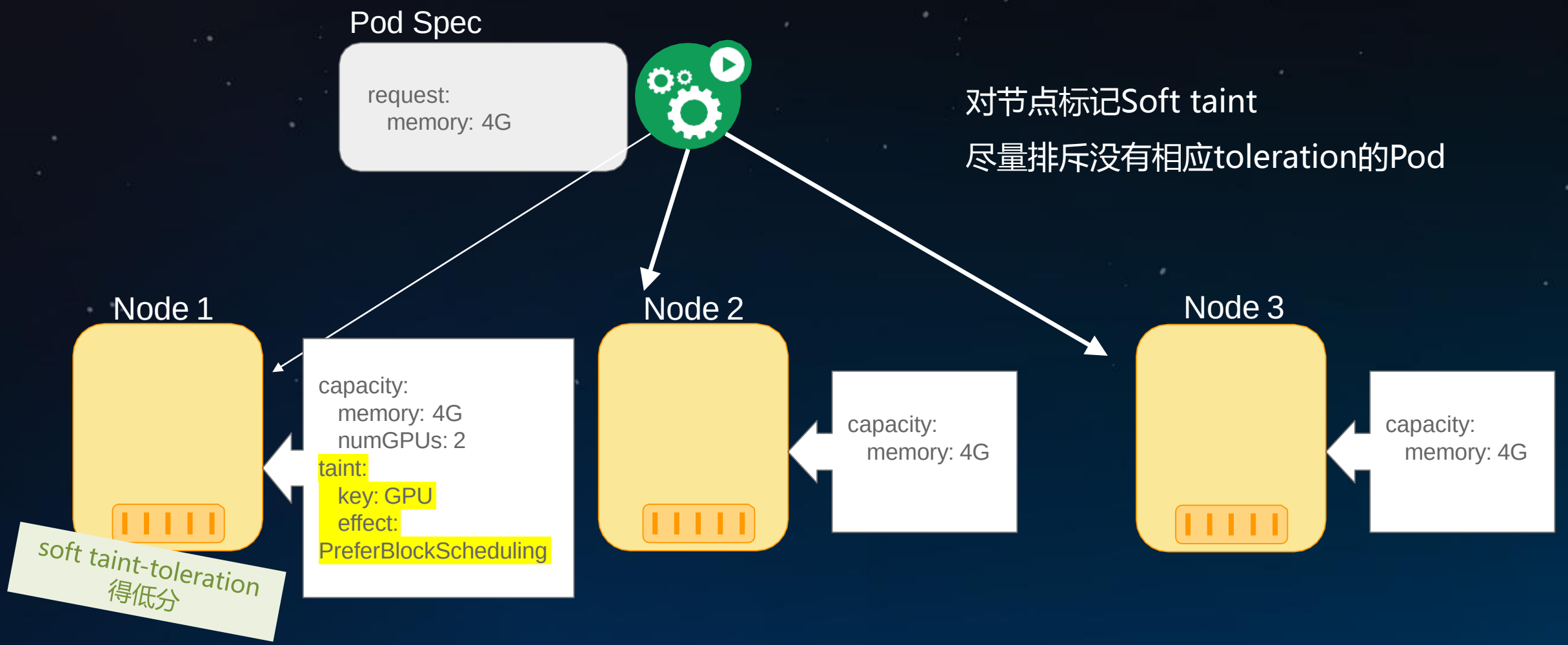

Taints-tolerations 来自Node的反亲和配置

Taints-tolerations 来自Node的反亲和配置

或者对节点标记Hard taint

强行阻止没有相应toleration的Pod

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Thank You

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