

Pod Placement

Kubernetes Node Placement Strategies

Node Selector

Node Affinity

Taints & Tolerations



Why Node Selection Matters

- Ensure Pods run on the right nodes
- Optimize for performance, cost, or isolation
- Enforce scheduling rules and access control

Node Selector

Simple, label-based filtering

```
spec:  
  nodeSelector:  
    disktype: ssd
```

- **Matches only exact key-value pairs**
- Fast and easy
- Cannot express advanced logic

Node Affinity

Advanced, expressive rules for node selection

```
affinity:  
  nodeAffinity:  
    requiredDuringSchedulingIgnoredDuringExecution:  
      nodeSelectorTerms:  
        - matchExpressions:  
          - key: disktype  
            operator: In  
            values: ["ssd"]
```

- Supports complex match expressions
- Hard (required) and soft (preferred) rules
- Good for flexible scheduling policies



Node Affinity Types

Type	Behavior
<code>requiredDuringScheduling...</code>	Pod must match rules to be placed
<code>preferredDuringScheduling...</code>	Pod prefers nodes that match

Taints and Tolerations

Nodes repel Pods unless tolerated

```
kubectl taint nodes node1 dedicated=group1:NoSchedule
```

```
tolerations:  
- key: "dedicated"  
  operator: "Equal"  
  value: "group1"  
  effect: "NoSchedule"
```

- Adds *node-side* restrictions
- Pods need matching tolerations to be scheduled

Taint Effects

Effect	Description
NoSchedule	Pod won't be scheduled unless it tolerates
PreferNoSchedule	Scheduler avoids but does not block
NoExecute	Pod is evicted if it doesn't tolerate



When to Use What?

- **Node Selector:** Simple, exact needs
- **Node Affinity:** Custom rules and preferences
- **Taints/Tolerations:** Enforce isolation or dedicated node access



Key Takeaways

- Combine these tools for precise control
- Understand node labeling, tainting, and affinity strategy
- Use **Affinity + Toleration** for real-world production policies

Summary Table

Feature	Node Selector	Node Affinity	Taints & Tolerations
Direction	Pod → Node	Pod → Node	Node → Pod
Matching	Exact match	Expressions + weights	Requires toleration
Complex Rules	✗	✓	✓
Use Case	Simple placement	Flexible scheduling logic	Node-level protection