Kubernetes Node and Pod Management Concepts

1. Node Selector

- **Purpose**: Assigns pods to specific nodes based on labels.
- **Explanation**:
  - Using nodeSelector, you can specify a particular node to schedule your pods by matching the node's labels.
  - This method is simple but lacks flexibility compared to Node Affinity.

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2. Node Affinity

- **Purpose**: Provides a more flexible and preferred way to schedule pods on specific nodes.
- **Explanation**:
  - Allows you to define rules for preferred or required node placement.
  - If the preferred node is unavailable, the scheduler will choose another node that satisfies the defined criteria.

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3. Taints and Tolerations

- **Purpose**: Control which pods can run on specific nodes and prevent undesired pod placements.
- **Explanation**:
  - **Taints**: Applied to nodes to repel pods that don’t have corresponding tolerations.
  - **Tolerations**: Allow pods to accept taints on nodes, enabling their placement on those nodes if necessary.
  - Use this mechanism to reserve nodes for high-priority workloads or isolate certain types of workloads.

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4. Liveness and Readiness Probes

- **Purpose**: Monitor and maintain the health and availability of running containers.

Liveness Probe

- Periodically checks if a container is functioning correctly, such as responding to pings or staying alive.
- If a container fails the liveness check, Kubernetes restarts it according to the restart policy.

Readiness Probe

- Checks if a container is ready to serve traffic or handle requests.
- If the readiness probe fails, the pod is removed from the Service's endpoints and will not receive traffic until it passes the check.

Key Use Cases and Summary

Feature	Purpose	Use Case
Node Selector	Schedule pods on specific nodes.	Assign a workload to nodes with a specific label.
Node Affinity	Flexible node placement preferences.	Prefer running pods on nodes with specific attributes, e.g., SSD storage.
Taints and Tolerations	Reserve nodes for specific workloads or prevent undesired pods.	Ensure high-priority pods run on designated nodes only.
Liveness Probe	Ensure containers are healthy and restart if necessary.	Restart a container if it becomes unresponsive.
Readiness Probe	Ensure containers are ready to handle traffic.	Temporarily remove a pod from Service endpoints during unavailability.

By leveraging these features, you can effectively manage pod scheduling, ensure workload isolation, and maintain application availability in a Kubernetes cluster.