Kubernetes Patterns - Chapter 4: Health Probe (扩展版)

Reusable Elements for Designing Cloud Native Applications (Second Edition)

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本PPT详细覆盖 Health Probe 模式，帮助 Kubernetes 监控和管理容器健康。扩展为20页，深入每个子节。

Chapter 4: Health Probe

章节概述

- Chapter 4: Health Probe (页41-49)
- 关键子节: Problem, Solution, Process Health Checks, Liveness Probes, Readiness Probes, Startup Probes, Discussion

> *The Health Probe pattern indicates how an application can communicate its health state to Kubernetes.*

关键点:

- 焦点: 使应用可观察，提升自动化

Chapter 4: Health Probe

Problem - 容器健康挑战 (1/2)

- 容器内进程可能遇到多种健康问题
- 传统的进程检查不足以确保应用真正健康
- Kubernetes 需要更精细的健康状态信息

> *The process health check is not sufficient to indicate the liveness of the application.*

关键点:

- 问题: 进程存在但应用无响应（无限循环、死锁等）

Problem - 容器健康挑战 (2/2)

- Kubernetes 需要外部方式检查应用是否 functioning as expected
- 无需了解内部，只验证服务能力

> *Kubernetes needs a reliable way to check the health of applications...*

关键点:

- 分布式应用失败率高

Solution - 概述

- Health probes: livenessProbe, readinessProbe, startupProbe 在 Pod spec 中配置
- 机制: HTTP, TCP, exec commands

> *Health probes are configured in the Pod specification under the .spec.containers[].livenessProbe...*

关键点:

- 自动化生命周期和流量路由

Solution - 探针类型介绍

- Process Health Checks: 基础进程监控
- Liveness: 检查是否 alive，重启失败
- Readiness: 检查是否 ready，移除端点
- Startup: 处理慢启动

> *Kubernetes provides health probes to monitor container health...*

关键点:

- 每个探针特定目的

Process Health Checks (1/2)

- kubelet 监控进程，意外终止时重启
- 确保进程运行，但不验证应用逻辑

> *Process health checks involve monitoring the container's process to ensure it is running.*

关键点:

- 基础层级检查

Process Health Checks (2/2)

- 局限: 无法检测应用级问题，如冻结
- 需结合高级探针

> *Kubernetes regularly checks the container process status and restarts it if issues are detected.*

关键点:

- 默认 Kubernetes 行为

Liveness Probes - 概念

- 确定容器是否 alive，继续运行
- 失败: Kubernetes 重启容器

> *If a liveness probe fails, Kubernetes restarts the container.*

关键点:

- 防止永久不健康状态

Liveness Probes - 配置示例 (1/2)

YAML 示例:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: liveness-probe
spec:
  containers:
  - name: liveness
    image: k8spatterns/liveness:1.0
    livenessProbe:
      httpGet:
        path: /health
        port: 8080
      initialDelaySeconds: 3
      periodSeconds: 3
```

关键点:

- HTTP GET /health，每3秒检查

Liveness Probes - 配置示例 (2/2)

- 参数: initialDelaySeconds (延迟), periodSeconds (间隔)
- 成功: HTTP 200-399

> *This example uses an HTTP GET request to check the /health endpoint every 3 seconds...*

关键点:

- 自定义阈值避免过度重启

Readiness Probes - 概念

- 确定是否 ready 服务流量
- 失败: 移除从服务端点，无重启

> *If a readiness probe fails, the container is removed from service endpoints...*

关键点:

- 提升可用性，避免发送到不健康实例

Readiness Probes - 配置示例

YAML 示例:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: readiness-probe
spec:
  containers:
  - name: readiness
    image: k8spatterns/readiness:1.0
    readinessProbe:
      httpGet:
        path: /ready
        port: 8080
      initialDelaySeconds: 5
      periodSeconds: 5
```

关键点:

- 检查 /ready 端点

Startup Probes - 概念

- 用于长初始化容器 (e.g., DB 迁移、加载 datasets)
- 确保启动完成后激活其他探针

> *Startup probes are used for containers with long initialization times...*

关键点:

- 防止早重启

Startup Probes - 配置示例

YAML 示例:

```
apiVersion: v1
kind: Pod
metadata:
  name: startup-probe
spec:
  containers:
  - name: startup
    image: k8spatterns/startup:1.0
    startupProbe:
      httpGet:
        path: /startup
        port: 8080
      failureThreshold: 30
      periodSeconds: 10
```

关键点:

- 允许30次失败，每10秒检查

Discussion - 可靠性影响 (1/2)

- Liveness: 自动恢复失败
- Readiness: 智能流量路由

> *Liveness probes ensure failed containers are restarted, while readiness probes prevent traffic...*

关键点:

- 改善服务可用性

Discussion - 可靠性影响 (2/2)

- Startup: 处理慢启动，避免 premature checks
- 参数平衡: responsiveness vs. 资源

> *Proper configuration of probe parameters... is crucial to balance between responsiveness and resource usage.*

关键点:

- 正确配置关键

Discussion - 最佳实践

- 选择合适机制 (HTTP/TCP/exec)
- 监控探针失败日志

> *Health probes are essential for maintaining application reliability in Kubernetes.*

关键点:

- 与题目相关: 强调 failureThreshold 等

More Information

- 参考: Kubernetes 文档 (Probes)
- 示例镜像: k8spatterns/liveness:1.0 等

> *No additional information sources are provided... [但基于书]*

关键点:

- 进一步: k8spatterns.io

总结 & Q&A

- Health Probe: 核心于云原生 observability
- 关键 takeaway: 配置探针自动化管理
- 与题目整合: 覆盖概念、示例、行为

关键点:

- 应用到实际部署