

Runtime Detection and Self-Healing of Integration Flows Using Intermediate Graph Models

Overview

Modern enterprises rely on integration platforms to connect cloud applications, APIs, databases, and business systems. When integration flows experience failures, performance degradation, or resource bottlenecks, existing monitoring tools typically generate alerts but still require manual diagnosis and recovery.

This invention introduces an **autonomous self-healing framework** that continuously monitors integration flows, intelligently identifies operational problems, determines their root causes, and automatically applies corrective actions. The invention uses an **Intermediate Graph Model (IGM)** to understand the structure and execution behavior of integration flows, enabling context-aware diagnosis and closed-loop recovery.

Problem

Current monitoring and observability solutions suffer from several limitations:

- Monitor infrastructure rather than actual integration flows.
- Generate numerous isolated alerts without identifying the real operational problem.
- Depend heavily on manual troubleshooting by experts.
- Cannot automatically determine the most suitable corrective action.
- Do not validate whether corrective actions successfully resolve the issue.

These limitations increase downtime, operational costs, and business risk.

Proposed Solution

The invention transforms passive monitoring into an **intelligent, graph-based self-healing system**.

The system:

- Continuously collects runtime telemetry.
- Represents deployed integration flows as **Intermediate Graph Models (IGMs)**.
- Associates telemetry with graph nodes and edges.
- Detects runtime anomalies and correlates them into higher-level operational situations.
- Identifies multiple corrective actions.
- Selects the best corrective action using policies, risk, cost, effectiveness, and historical outcomes.
- Automatically deploys corrective actions.
- Continuously validates results and refines or reverts actions if necessary.

This creates a **closed-loop autonomous runtime management system**.

Key Innovations

- Graph-based runtime intelligence using Intermediate Graph Models.
 - Flow-aware observability instead of infrastructure-only monitoring.
 - Situation-based diagnosis by correlating multiple runtime events.
 - Intelligent selection of corrective actions.
 - Closed-loop self-healing with continuous validation.
 - Granular remediation at node, edge, subgraph, or system level.
 - Policy-driven automation with optional human approval.
 - Historical learning to improve future corrective decisions.
 - Multi-flow coordinated self-healing across shared runtime environments.
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Business Benefits

- Significantly reduces application downtime.
 - Improves availability and reliability of enterprise integrations.
 - Reduces manual troubleshooting effort.
 - Enables faster incident resolution.
 - Optimizes runtime performance and resource utilization.
 - Lowers operational and maintenance costs.
 - Supports autonomous operation of mission-critical integration platforms.
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Potential Applications

- Enterprise Integration Platforms (iPaaS)
 - Cloud Integration Services
 - API Management Platforms
 - Banking & Financial Systems
 - Healthcare Integration
 - Manufacturing & Supply Chain
 - Telecommunications
 - Government Digital Services
 - Retail & E-Commerce
 - Large Enterprise Middleware Environments
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Competitive Advantage

Unlike traditional monitoring tools that only report alerts, this invention **understands the structure of integration flows, diagnoses operational situations, automatically applies corrective actions, and validates their effectiveness through continuous feedback.** It transforms enterprise integration from **reactive monitoring** to **autonomous self-healing**, delivering higher reliability, lower operational costs, and improved business continuity.