

Chapter 5

Modelling and Simulation of Dynamic Service Composition and Adaptation in IoT Ecosystems

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ABSTRACT

The proliferation of the Internet of Things (IoT) has fundamentally transformed the landscape of distributed computing, necessitating robust architectural frameworks capable of dynamic service orchestration. IoT environments are inherently heterogeneous, encompassing diverse devices, communication protocols, and service paradigms that must interoperate seamlessly to deliver real-time, context-aware functionalities. Dynamic service orchestration refers to the automated composition, coordination, and adaptation of distributed services in response to evolving system states, user demands, and environmental conditions. Modern architectural frameworks leverage a combination of layered, modular, and microservice-based designs to achieve scalability, flexibility, and resilience in complex IoT ecosystems. At the core of these frameworks are service registries, semantic service descriptions, and orchestration engines that employ rule-based, event-driven, or AI-assisted mechanisms to manage service workflows.

1. INTRODUCTION

The proliferation of the Internet of Things (IoT) has fundamentally transformed the landscape of distributed computing, necessitating robust architectural frameworks capable of dynamic service orchestration. IoT environments are inherently heterogeneous, encompassing diverse devices, communication protocols, and service paradigms that must interoperate seamlessly to deliver real-time, context-aware functionalities. Dynamic service orchestration refers to the automated composition, coordination, and adaptation of distributed services in response to evolving system states, user demands, and environmental conditions. Modern architectural frameworks leverage a combination of layered, modular, and microservice-based designs to achieve scalability, flexibility, and resilience in complex IoT ecosystems. At the core of these frameworks are service registries, semantic service descriptions, and orchestration engines that employ rule-based, event-driven, or AI-assisted mechanisms to manage service workflows. Middleware solutions often provide abstraction layers that

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