

# Programming Microsoft Azure Service Fabric

Second Edition







# Programming Microsoft Azure Service Fabric Second Edition

Haishi Bai

## **Programming Microsoft Azure Service Fabric**

## **Table of Contents**

1	$\sim$	_	٠,	_	v
ı		( )	v	$\boldsymbol{-}$	r

Title Page

Copyright Page

Contents at a Glance

Contents

About the Author

**Foreword** 

Introduction

## PART I: FUNDAMENTALS

## Chapter 1 Hello, Service Fabric!

#### Microservices

Containerization

Scheduling

State Reconciliation

**Data Replication** 

Service Partitioning

#### Service Fabric Concepts

Architecture

Nodes and Clusters

Applications and Services

Partitions and Replicas

**Programming Modes** 

Stateless vs. Stateful

**Guest Applications and Containers** 



## Getting Started

Setting Up a Development Environment in Windows Provisioning a Service Fabric Cluster on Azure

Hello, World!

## Managing Your Local Cluster

Visual Studio Cloud Explorer

Service Fabric Explorer

Windows PowerShell

Service Fabric CLI

Additional Information

## Chapter 2 Stateless Services

Implementing ASP.NET Core Applications

Scalability and Availability of a Stateless Service

Availability

Scalability

## Implementing Communication Stacks

**Default Communication Stack** 

WCF Communication Stack

**Custom Communication Stack** 

Additional Information

## Chapter 3 Stateful Services

#### Architecture of Service Fabric Stateful Services

Reliable Collections

Reliable State Manager

Transactional Replicator

Logger

Consistency

#### The Simple Store Application

The Shopping-Cart Service

The Simple Store Website

Service Partition



#### Partitions and Replicas

Replica Roles

Resource Load Balancing

Additional Information

## Chapter 4 Actor Pattern

#### Service Fabric Reliable Actors

Actors

Actor Lifetime

**Actor States** 

**Actor Communications** 

Concurrency

#### An Actor-Based Tic-Tac-Toe Game

Actor Models

Creating the Application

Defining the Actor Interface

Implementing the Game Actor

Implementing the Player Actor

Implementing the Test Client

Testing the Game

Additional Thoughts

#### Timers, Reminders, and Events

**Actor Timers** 

Actor Reminders

Actor Events

## Service Diagnostics and Performance-Monitoring Basics

**Event Tracing For Windows** 

Performance Counters

Actors and Reliable Services

**Actor State Providers** 

Additional Information

## Chapter 5 Service Deployments and Upgrades



#### The Service Fabric Application-Deployment Process

Package

Upload

Register/Provision

Create/Replace/Upgrade

#### The Service Fabric Health Model

**Health States** 

Health Policy

Health Reporting and Aggregation

## Rolling Upgrades

**Upgrade Process** 

Upgrade Modes and Upgrade Parameters

#### Multiple Environments

Application Parameters and Parameter Files

**Application Publish Profiles** 

## Using Implicit Hosts

**Defining Implicit Hosts** 

RunAs Policies

Hosting a Node.js Application

Resource Governance

## Chapter 6 Availability and Reliability

**Broken Services** 

Improving Availability

Improving Reliability

Service Fabric Services Availability

Replicas

Service Placements

Service Failovers

Routing and Load-Balancing

Advanced Rolling Upgrades

Service Fabric Services Reliability



**Event Tracing for Windows** 

**Azure Diagnostics** 

Chaos Testing

Service State Backup and Restore

## Chapter 7 Scalability and Performance

#### Scalability Concepts

Vertical Scaling vs. Horizontal Scaling

Stateless Services vs. Stateful Services

Homogeneous Instances vs. Heterogeneous Instances

Single Tenancy vs. Multi-Tenancy

Manual Scaling vs. Autoscaling

## Scaling a Service Fabric Cluster Azure Resource Manager and Azure Virtual Machine

Scale Sets

Manually Scaling a Service Fabric Cluster

Autoscaling a Service Fabric Cluster

Scaling with Content Delivery Network

## Resolving Bottlenecks

State Bottlenecks

Communication Bottlenecks

Orchestration Bottlenecks

## PART II: SERVICE LIFE CYCLE MANAGEMENT

## Chapter 8 Service Fabric Scripting

Azure Cloud Shell

## Creating a Secured Service Fabric Cluster Using PowerShell

Using a Certificate to Protect Your Cluster

Using a Certificate for Client Authentication

Using Azure Active Directory for Client Authentication

Publishing Applications to a Secured Cluster from Visual Studio

#### Cluster Management Commands

Query Commands



**Node Operations** 

## Application-Management Commands

Deploying an Application

Upgrading an Application

Rolling Back an Application

Decommissioning an Application

Azure CLI

sfctl

## Chapter 9 Cluster Management

## Anatomy of a Service Fabric Cluster

Virtual Machine Scale Sets

Virtual Machines and Virtual Network Cards

Virtual Networks

Load Balancers

Storage Accounts

## Advanced Service Fabric Cluster Configuration

Role-Based Access Control

**Network Security Groups** 

Internal Load Balancer

**Updating Cluster Settings** 

## Chapter 10 Diagnostics and Monitoring

#### Diagnostics

Diagnostics Data Pipeline

Configure Azure Diagnostics

Microsoft Diagnostics EventFlow

Using Elasticsearch, Kibana, and EventFlow

Azure Operations Management Suite

Troubleshooting on Service Fabric Nodes

#### Monitoring

Service Fabric Explorer

**Application Insights** 

## Chapter 11 Continuous Delivery



#### CI, CD, and DevOps

Continuous Integration

Continuous Delivery

DevOps

## Setting Up Continuous Integration

Preparing the Visual Studio Team Services Project

Creating a Build Definition

#### Setting Up Continuous Delivery

Creating a Release Definition

Requesting Deployment Approvals

#### Software Testability

Controllability

Observability

Isolability

Clarity

#### Setting Up Automated Tests

Implementing Unit Tests

Setting Up Gated Check-Ins

Running Load Tests with VSTS

## PART III: LINUX AND CONTAINERS

## Chapter 12 Service Fabric on Linux

Service Fabric Hello, World! on Linux

Setting Up Your Linux Development Environment

Hello, World! Again

Using Communication Listeners

## Other Service Types and Frameworks

Stateful Services

**Actor Services** 

**Guest Binary Services** 

Using Yeoman

Chapter 13 Containers



#### **Docker Primer**

Containerization on Linux

Windows Containers

#### Getting Started

Running Docker on Linux

Running Docker on Windows

Running Docker on Azure

#### Service Fabric and Docker

Hosting an ASP.NET Core Container on Windows

Hosting a Minecraft Server Container on Linux

Continuous Deployment with Jenkins

## **Chapter 14 Container Orchestration**

#### Microservices Application and Orchestration Engines

A Generic Microservice Application Model

Orchestration Engines

#### Container Orchestration with Service Fabric

**DNS Service** 

Watchdogs

## Docker Compose with Service Fabric

Defining the Master Image

Defining the Slave Image

Composing the Services with Docker Compose

Deploying and Testing the Application

#### Service Meshes

Envoy and Service Meshes

Deploying Envoy on Service Fabric

## PART IV: WORKLOADS AND DESIGN PATTERNS

## Chapter 15 Scalable Web

The Azure PaaS Ecosystem

App Services

Azure Container Service (AKS)



Virtual Machine Scale Sets

Service Fabric

Choosing a PaaS Platform

## Scaling with Reduction

CDN

Home Views

Caching

**Precomputed Views** 

Data Manipulation

#### Scaling with Partition

Tenant Manager

Service Meshes (Part 2)

Scaling with Bursting

## Designing an Extensible Control Plane

A Generic Control Plane Architecture

Workload Scheduling

## Chapter 16 Scalable Interactive Systems

#### Interactive System Techniques

Latency

Throughput

#### CQRS and Event Sourcing

Basic Ideas Behind CQRS

Commands and Events

**Event Sourcing** 

## Real-Time Data-Streaming Pipelines

Composable Processing Pipelines

Implementing a Processing Sequence

## **Processing Topologies with Actors**

Parallel Batching

Streaming Top N

Join by Field

Cached Lookup Grid



Exercise: Using WebSocket for Live Data Processing

**Product Actor** 

Country/Region Actor

Global Actor

Gateway

WebSocket Listener

**Test Client** 

## Chapter 17 System Integration

## Data Storage

Relational Databases

NoSQL Databases

#### Security

Azure Active Directory

Azure Key Vault

Enable SSL with Custom Domain

## Integration with Service Brokers

Open Service Broker API

Open Service Broker for Azure

Service Fabric Service Catalog Service

#### Integration Patterns with Messaging

**Dead-Letter Channel** 

Messaging Gateway

Transaction Coordinator

Message Translators

Composing Service Fabric Services

## PART V: ADVANCED TOPICS

## Chapter 18 Serverless Computing

What Is Serverless Computing?

Serverless Deployment

Serverless Platform

Serverless Architecture



#### Benefits of Serverless

#### Serverless on Azure

**Azure Container Instances** 

Azure Event Grid

Azure Functions

Azure Logic Apps

#### Reactive Messaging Patterns with Actors

Message-Driven Systems

Responsive Systems

Resilient Systems

Elastic Systems

## Sea Breeze Design Principles

Fully Managed Environment

Container-Based Environment

Community Engagement

## Chapter 19 Artificial Intelligence

## A Brief Introduction to Artificial Intelligence

What Is AI?

Machine Learning

**Neural Networks** 

Challenges and Pitfalls

#### Recommendations

Using Azure Machine Learning Studio

Calling the Service from Service Fabric

Using the Cognitive Services Recommendation API

#### Computer Vision

Building an OCR Application

**Exploring Image-Analysis Applications** 

#### Natural Language Processing

Audio Transcription

Understanding the Users Intention

Conversational UI



Using the Bot Framework and Bot Service

Embedding a Web-Based Bot UI in Your Application

ArchiBot

#### TensorFlow and Service Fabric

Deploying a TensorFlow Cluster Using Service Fabric

Running a Clustered Jupyter Notebook with TensorFlow Containers

## Chapter 20 Orchestrating an Organic Compute Plane

## Moving Data Through Static Compute

Data Generation and Feedback

Command and Control

Data Ingress

Data Transformation and Analysis

Storage

Presentation and Actions

Sample Patterns with Static Compute

An End-to-End Scenario

#### Moving Compute to Data

Service Fabric on Edge

Workload Distribution

Closing Thoughts

## PART VI: APPENDICES

Appendix A: Using Microsoft Azure PowerShell Commands

Appendix B: Pattern Index

Index

