

IPDPS 2026 Tutorial Proposal

I. TUTORIAL FACTS

Title

Object-as-a-Service (OaaS): Streamlining Cloud-Native Application Development for Edge-Cloud continuum

Duration

Half-day (3 hours)

Abstract

Serverless computing, particularly Function-as-a-Service (FaaS), has revolutionized cloud application development by abstracting infrastructure management. However, FaaS remains fundamentally stateless, forcing developers to rely on external storage services. This separation of compute and state introduces significant latency and complexity, particularly for data-intensive applications with strict Quality of Service (QoS) requirements.

To bridge this gap, we introduce Object-as-a-Service (OaaS)—a novel serverless paradigm that borrows concepts from object-oriented programming to encapsulate application logic, state, and QoS policies into a single, autonomous deployment unit. By treating cloud resources as programmable objects, OaaS enables developers to build complex, stateful distributed applications with the same ease as writing monolithic code. We implemented OaaS in Oparaca, an open-source platform recently re-architected in Rust. Oparaca leverages a decentralized data plane powered by Zenoh and efficient communication protocols to support high-performance scenarios across the Edge-Cloud continuum, significantly minimizing data movement overhead.

In this tutorial, we will present the theoretical foundations of OaaS and the internal architecture of Oparaca. Participants will engage in hands-on exercises to develop, deploy, and manage stateful OaaS applications on a simulated Edge-Cloud environment using k3d. We will demonstrate how OaaS addresses critical IoT challenges—such as data locality, bandwidth constraints, and intermittent connectivity—by dynamically moving processing logic closer to data sources. Attendees will leave with practical experience in building next-generation serverless applications that are both developer-friendly and performance-optimized. This tutorial offers a comprehensive guide to the next generation of stateful serverless computing.

Goals

The main learning objectives of this tutorial are:

- Understand the evolution of serverless computing and the limitations of current FaaS models, particularly for stateful and QoS-sensitive applications.
- Learn the core concepts of the OaaS paradigm and how it encapsulates logic, data, and QoS.

- Gain hands-on experience with the Oparaca platform¹ to develop, deploy, and manage OaaS applications.
- Explore the application of OaaS in Edge-Cloud and IoT environments, addressing challenges like latency, intermittent network connection and resource constraints.

Structure

The tutorial will be delivered as a mix of lectures and hands-on exercises.

- **Lectures (50%):** We will cover the theoretical foundations of OaaS, the architecture of the Oparaca platform, and relevant use cases in IoT and Edge computing.
- **Hands-on Exercises (50%):** Attendees will use their laptops to create a simulated Edge-Cloud environment using k3d (lightweight Kubernetes in Docker). We will guide them in provisioning a multi-node cluster where specific nodes represent the “Cloud” and “Edge” tiers, enabling realistic deployment scenarios for OaaS objects.

Schedule

- **00:00 - 00:20: Introduction & Motivation.**
 - We will review the evolution of Cloud Computing, moving from Virtual Machines to Containers and Serverless Functions.
 - We will discuss the limitations of FaaS, specifically the “Data Shipping” problem, reliance on external storage, and lack of QoS control.
 - We will introduce the need for a new Serverless paradigm: OaaS.
- **00:20 - 00:50: The OaaS Paradigm & Oparaca Architecture.**
 - We will explain core concepts such as defining Classes, Objects, and Functions, and how state is co-located with compute.
 - We will detail the Oparaca Platform Design, including the K8s-based Control Plane and the Rust-based Data Plane powered by Zenoh.
 - We will compare OaaS and FaaS, highlighting architectural differences and performance benchmarks.
- **00:50 - 01:00: Short Break.**
- **01:00 - 01:30: Hands-on I: Getting Started with Oparaca.**
 - Participants will bootstrap a local k3d cluster and install the Oparaca operators.
 - Attendees will define a simple OaaS class in YAML, build the function image, and deploy it (“Hello World”).

¹GitHub repository: <https://github.com/hpccclab/OaaS-IoT>

- Participants will use the CLI or REST API to invoke methods and inspect the object’s state.
- **01:30 - 02:15: Hands-on II: Advanced OaaS Development.**
 - We will guide attendees in building a ”Counter” object that persists state across invocations without external databases.
 - Participants will learn to create object graphs by chaining function calls and managing dependencies.
 - We will demonstrate how to configure QoS policies, such as defining placement policies and consistency requirements.
- **02:15 - 02:45: OaaS for Edge-Cloud & IoT Scenarios.**
 - We will address common challenges in IoT, including bandwidth costs, privacy concerns, and intermittent connectivity.
 - We will show how Oparaca automatically migrates objects between Edge and Cloud nodes based on access patterns.
 - Demo: We will deploy a hierarchy of objects: Sensor Objects (Edge) → Aggregator Object (Edge/Cloud) → Analytics Object (Cloud). We will demonstrate how Oparaca dynamically orchestrates these objects across tiers while maintaining a unified API, effectively abstracting infrastructure complexity.
- **02:45 - 03:00: Conclusion & Q&A.**
 - We will summarize the key takeaways from the tutorial.
 - We will discuss open research directions and potential future work.

Pre-requisites

- Basic understanding of Cloud Computing and Serverless concepts.
- Familiarity with at least one programming language (Python preferred) and OOP.
- A laptop with WiFi capability. Docker installed. Basic Python environment installed.

II. PRESENTER INFORMATION

Presenters

- 1) Lead Presenter: Pawissanutt Lertpongrujikhorn, University of North Texas, Pawissanutt.Lertpongrujikhorn@unt.edu
- 2) Presenter: Mohsen Amini Salehi, University of North Texas, Mohsen.AminiSalehi@unt.edu
- 3) Presenter: Tapajit Chandra Paul, University of North Texas, TapajitChandra.Paul@unt.edu

Biography (Pawissanutt Lertpongrujikhorn):

Dr. Pawissanutt Lertpongrujikhorn received his B.Eng. in Computer Engineering from Kasetsart University, Thailand, in 2019, and his Ph.D. in Computer Science and Engineering from the University of North Texas in 2025. As a member of the High-Performance Cloud Computing (HPCC) Lab, his research centers on developing novel cloud-native programming

paradigms and advancing serverless computing technologies, specifically the OaaS paradigm. He is the main contributor to the Oparaca platform and has previously delivered a tutorial on Object-as-a-Service at ICDCS 2024.

Biography (Mohsen Amini Salehi):

Dr. Mohsen Amini Salehi is an Associate Professor and the Director of the HPCC Lab at the University of North Texas. His research focuses on democratizing cloud-native application development and building smart, trustworthy systems across the Edge-Cloud continuum. He is an NSF CAREER Awardee and has so far led 11 research projects funded by various local and federal agencies.

Biography (Tapajit Chandra Paul):

Tapajit Chandra Paul is a Ph.D. student in the Computer Science and Engineering department at the University of North Texas. He works as a research assistant at the HPCC Lab. His research interests focus on cloud computing, serverless architectures, and distributed systems. He is involved in the research and development of the OaaS paradigm and the Oparaca platform.