



DOMAIN-SPECIFIC USE CASES FOR ROOF (REALTIME ONSITE OPERATIONS FACILITATION) COMPUTING FRAMEWORK

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DOMAIN-SPECIFIC USE CASES FOR ROOF (REALTIME ONSITE OPERATIONS FACILITATION) COMPUTING FRAMEWORK

ABSTRACT

Real-Time Operations Facilitations or ROOF is a class of computational framework for Edge Computing with Internet of Things (IoT). The ROOF framework provides support for building scalable, secure, and robust Internet of Things applications with limited tools in resource constrained situations. The ROOF helps in developing federated architecture for large scale IoT operations. At the same time, it can provide micro-models for rapid prototyping and quick decision making. It also provides autonomic architectural support for spatio-temporal events handling. The ROOF framework has been designed to provide innovation, reuse, better user experience, security by design, for harmonizing horizontal as well as vertical integration for the Internet of Things ecosystem.

KEYWORDS

context building, domain-specific cognition, Edge Computing, Industry 4.0, Industry 5.0, IoT, Next-hop connectivity, service-chain

1. EXECUTIVE SUMMARY

The Internet has changed the way the world collaborates and shares information. It is because of the Internet that the world has become a participatory eco-system providing connectivity between humans to other living and non-living entities creating a new world, the Internet of Things (IoT). The immensely massive IoT items require intriguingly large, always evolving, billions of internet connections causing a paradigm shift in human being-and-doing. This phenomenon has made people have to think and rethink about their role in society, and how they can use these tools to advance civilization towards the brighter side of the unseen future.

Building any large-scale IoT application requires scalable and robust framework with built-in security. ROOF Computing for the Internet of Things is designed to be a framework for building large-scale, secure, and robust IoT applications. The ROOF framework is based on design patterns adapted from human evolution and the federated architecture, homes, villages/communities/cities, states, countries, and worldwide participating organizations. Each of these operates semi-autonomously and cooperates and collaborates with the next level in the federation for creating more value. ROOF Computing is a class of Edge Computing for IoT applications and provides the spatio-temporal computing needs for building context, taking actions, providing security and privacy, and providing efficient and flexible connectivity to the Cloud/Service providers. The ROOF can be implemented in IoT gateways, home routers, mobile phones, personal computing platforms, and other embedded platforms that proxy the IoT items for connectivity to the network and the Cloud.

The following are the goals in developing the ROOF Framework:

- True IoT Edge: To provide a scalable, secure, and usable framework for building IoT Edge that is always available and provides computing for real-time actions and security of IoT devices, and the data being generated and transmitted.
- Horizontalization: A framework that can be realized using the industry standards without lock-in for vendor-specific solutions thereby reducing the bar for new entrants into the IoT business and focus on their strengths to build a product or solution as part of an end-to-end IoT solution.
- Usability: To bring coherent end-user experience across the devices, technologies, vendors, service providers, and stakeholders.
- Flexible Verticalization: To provide a totally flexible framework for modifiable controls on quality of service with accelerated or truncated device use with information flows affecting desired outputs, all with decreasing risks and costs in IoT operations.

It is not the goal of the working group to produce an interoperable standard at this time. It means there can be several ways that ROOF can be implemented and achieve the previous two goals. The ROOF implementation will have to adhere to the ROOF framework specification.

The first ROOF white paper [1] provides an overview of the ROOF architecture. This white paper focuses on real-world applications for the ROOF and how it delivers value for the citizens, government, and businesses. We build on the ROOF white paper [1] to provide use cases enabled by ROOF, which can be applied to real life in various domains.

2. INTRODUCTION AND PURPOSE OF THIS DOCUMENT

This document covers various use cases facilitated by ROOF. These use cases illustrate how ROOF can impart better security, usability, interoperability between the interacting systems and sub-systems, and scalability.

Each use case discusses the normal and exceptional flows to give an overall view and application of the use case. Each use case also lists additional areas where the use case can be applied as is or with minimal changes.

In some of the use case diagrams, use cases beyond the scope of ROOF are depicted. They may be implemented in the ROOF framework and by the implementing/adopting vendors. They are shown for better clarity.

This document focuses on the following aspects:

- Service-related data access, monitoring, and behavioral patterns.
- Equipment usage and their condition monitoring—sensing, computing, and communication-related data and their patterns.
- User requirements, usage patterns, and security aspects—data collection and monitoring and their pattern.

The use cases also cover the Exception flow, which is where ROOF brings the novel value to the Edge. While edge devices from the same vendors work well, interoperability between the devices from multiple vendors is one of the areas ROOF bridges. In use cases involving heterogeneous devices, ROOF can create workflows that span across multiple devices and existing workflows, take care of exception paths, and take care of rollbacks.

3. DOMAIN-SPECIFIC USE CASES OF ROOF

3.1. USE CASE I—USER EXPERIENCE—MOVING FROM ONE SECURITY PROVIDER TO ANOTHER USING ROOF-ENABLED EDGE

Use Case Name:	Change smart home security provider company using ROOF-enabled Edge
End Objective:	A customer can move from one security provider company to another with all the data and settings intact for their smart home
User/Actor:	Customer
Trigger:	This use case is triggered when the actor requests to move from one service provider company to another using an interface provided by either the service provider or a third-party vendor
Value from ROOF:	Interoperability and security while working with heterogeneous devices using an open service model

Description and Use Case Diagram
The actor has subscribed to one smart home security provider company (or multiple companies) for security services. The actor initiates the move to another security provider company for various reasons (better response time, better service, better security, etc.) through ROOF running in the Edge node of the smart home. ROOF orchestrates the move to the new security service provider company. This use case is applicable when any user wants to change to a smart home security provider company. The actor who is subscribed to one smart home security provider company for security services can initiate the move to another company for various reasons through ROOF running in the Edge node of the smart home. ROOF orchestrates the move to the new security service provider company. Services like Performing Backup, Normalizing Data, Connecting to Service Providers, and Company Rollback Requests in case of error must be performed smoothly and in a standard manner. Notes: ▪ In a more practical scenario, both the number of services and the number of companies with whom the change needs to be made can be more. ▪ Any action that involves physical movement/shift is out of the scope of this use case. This use case can be enhanced to create service chains where the system waits for manual confirmation after such moves/actions are taken care of.