Open Horizon as an Open Source Framework for Resilient Smart Farming – Concept of HofBox as a Solution of Resilient Edge Computing

ORGANIZATION

The Agricultural Service Center Rhineland-Palatinate (Germany) is a public service center of the federal government for agriculture and rural areas. The main areas are agricultural consulting, rural development, the technical center and the vocational and technical school for agriculture and viticulture. As part of the technical center, Daniel Eberz-Eder Head of Innovation and digital agriculture works with his team with **Open Horizon** in LF Edge.

CHALLENGE

The process of agricultural production is undergoing progressive **digitalization worldwide**, which is referred to as **digital farming** or smart farming, i.e., the share of software-based tools and purely software-based processes such as planning tasks is demonstrably increasing steadily. Agriculture is an essential part of Critical Infrastructure as it is essential for global food production. This becomes especially important in times of diverse crisis events such as: War, Pandemics and Climate Change. Centralized and internet-dependent software-based infrastructures and applications are then **particularly vulnerable**.

We have developed a concept called **Resilient Smart Farming** (RSF). The core of this concept is a digital hybrid cloud architecture for agriculture.

The central question here is: (How) Can decentralized data management with hybrid IT infrastructure be implemented and at the same time support the economic and ecological benefits of smart farming applications and increase resilience? Can the concept of Resilient Smart Farming provide a conceptual and technological way to strengthen resilience of digital infrastructures in agriculture?

SOLUTION

The concept and technological possibilities as well as the current developments of Resilient Smart Farming (RSF) show how data management can be designed according to the **offline-first principle**. A central building block here is Resilient Edge Computing (REC) and the developed HofBox: an industrial grade mini-server that takes over data management on the farm and implements it with innovative, open source-based container technology Open Horizon.

For the practical implementation of Resilient Smart Farming in the form of Resilient Edge Computing, a so-called HofBox was used as a mini server with the hardware of a Raspberry Pi 4 with an attached LoRa board in the first step. This simple and commercially available hardware could be manually integrated into the Open Horizon infrastructure. The LoRa board is used as a gateway for an autonomous sensor network on the farm. In the second prototype, a HofBox 2.0 with an x86 CPU and Secure Device Onboarding (SDO) was used for automated deployment of software containers.

At the infrastructure level, Resilient Edge Computing is deployed via the open source framework Open Horizon at the professional level as Software-as-a-Service (IBM Edge Application Manager). The software deployed as containers in the project is open source software in the first step, such as Libre Office, Chirpstack or the GeoBox application. You can see the different variants of the HofBoxes in (Table 1).

Table 1. Two different HofBox hardware were used

HofBox 1.2	Description	HofBox 2.0	Description
	Our first usable prototype of HofBox 1.2 was based on a Raspberry Pi 4 with 4 GB RAM and an extension of a LoRa-Board		The second usable prototype of HofBox 2.0 is a x86 with a secure device onboarding (SDO)

The HofBoxes are initialized, installed and updated without user interaction (zero touch) via the open source edge computing platform "Open Horizon". The application layer applications shall be containerizable" to run in the data center, cloud-based or locally on the HofBox (see Figure 1: IT-Architecture for Resilient Smart Farming).

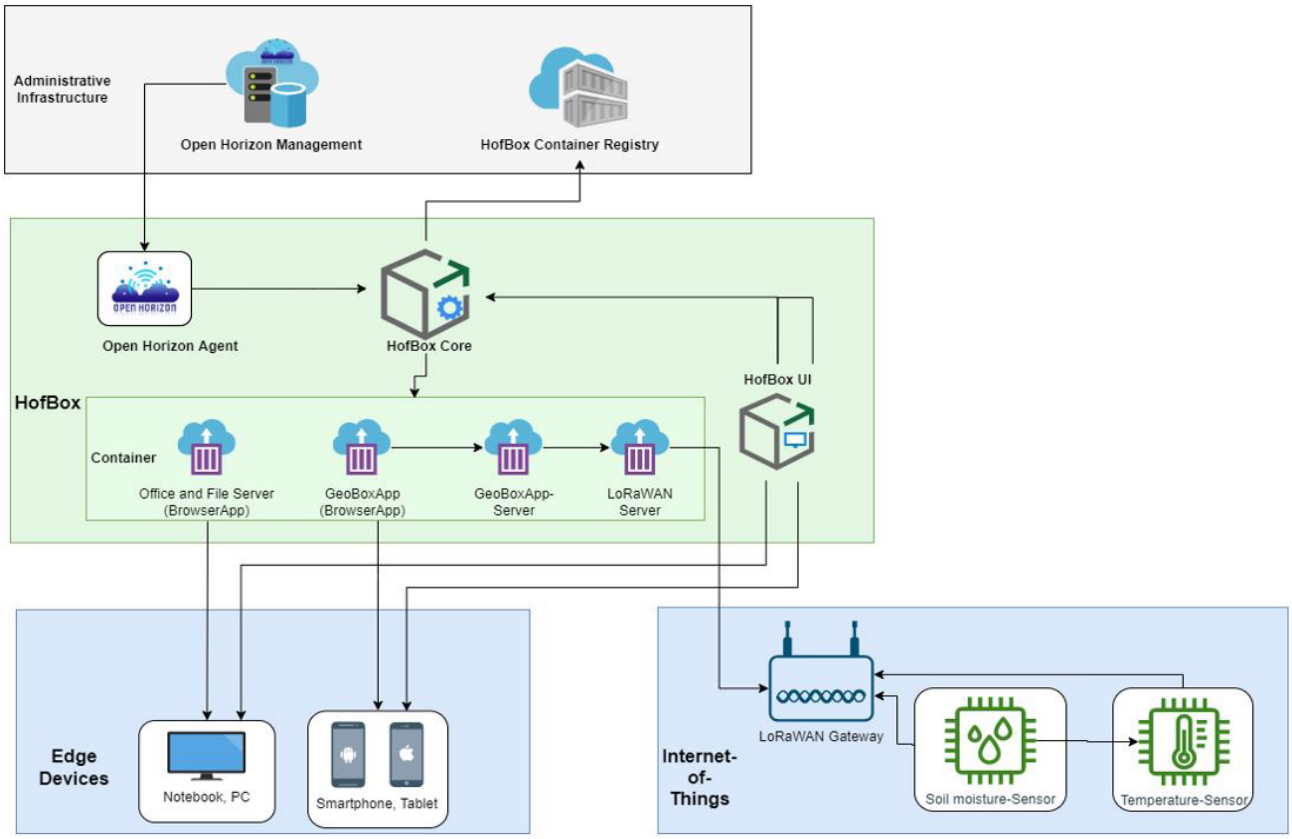

Figure 1: **IT-Architecture for Resilient Smart Farming**

The applications should be usable by means of a standard Internet browser, i.e. without additional software, accessible via a special start page on the HofBox and basically functioning without connection to the Internet. Furthermore, additional applications can be installed via the integration of an app store if desired by the user. To support the daily work, an (extendable) basic software (GeoBox app) is supplied as standard (see Figure 2: GeoBox-App running as a docker container on Open Horizon). The HofBox is a dedicated, self-contained, ruggedized compute server delivered to the farm, managed remotely, and providing localized workload and data processing services to the farmer. In order to realize Resilient Smart Farming into practice, farmers data will be on the hofbox edge device. Only by agreeing, the data can be sent and stored elsewhere. The solution is fully resilient, because of a hybrid-cloud architecture which means that the solution is cloud agnostic.

SOLUTION *(continued)*

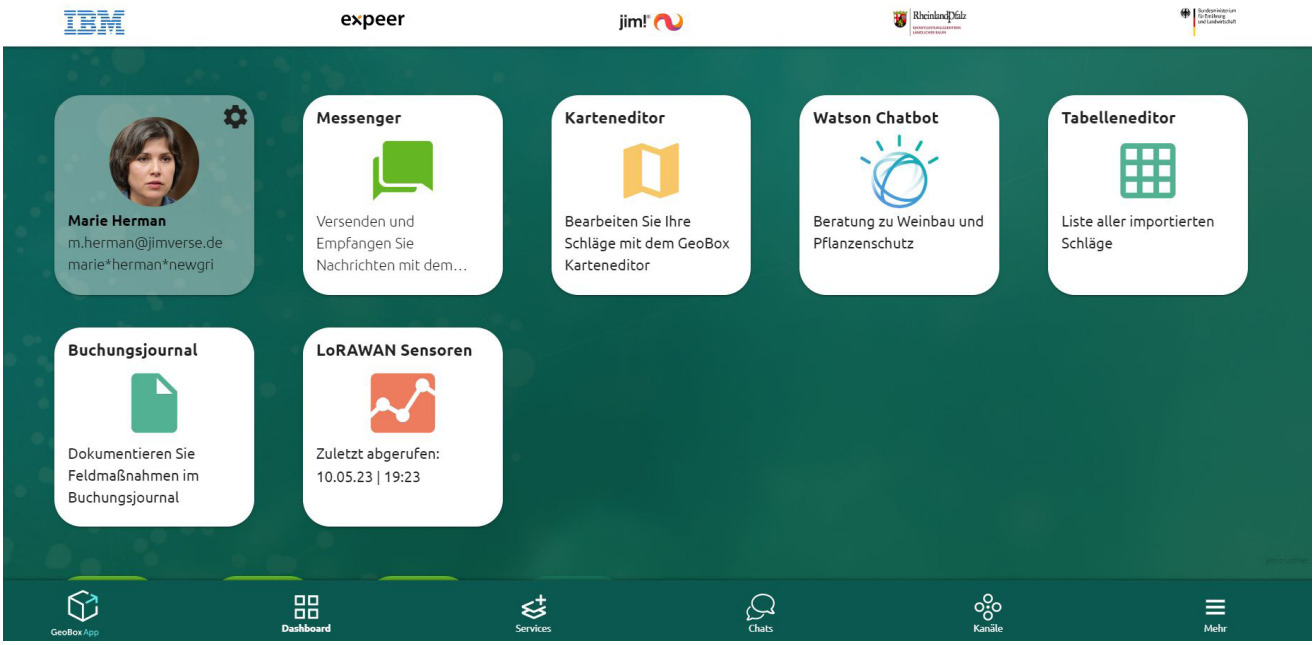

Figure 2: GeoBox-App running as a docker container on Open Horizon

Resilient smart farming thru resilient edge computing is a role model for critical infrastructure and in our opinion, it can be used as a blueprint for other critical infrastructures.

WHAT'S NEXT?

The next steps are tests in agricultural practice with existing applications as well as tests from the point of view of fail-safety. We have already conducted the first positive feasibility tests for loading and running container software on smartphones, also managed by Open Horizon or IEAM. The mobile edge will be a game changer in the future. In addition, we are currently integrating LoRaWAN network hardware that enable HofBoxes to establish a self-sufficient LoRa network with the HofBox that is independent of Internet availability. This enables the integration of agriculturally important climate sensors during normal operation and emergency communication in the event of a crisis.