



Project Results

# Flex4Apps

An open, data-backed approach to digital services

## EXECUTIVE SUMMARY

Software providers increasingly need to focus on the optimisation of their services, including the ability to react to customer preferences. Through its flexible framework and algorithms, the ITEA project Flex4Apps creates a full loop that allows companies to offer more complex services while advancing the digital transition.

## PROJECT ORIGINS

In today's cloud, telecommunication and Internet of Things (IoT) domains, many applications run on heterogeneous, distributed and shared infrastructures that are growing in complexity while constantly changing. Their dynamic nature makes it difficult for both system providers and application developers to detect incidents that affect performance. The solution lies in the flexible monitoring and optimisation of large Cyber-Physical Systems (CPS), managing high data volumes without significantly disturbing the target system. Globally, this could save billions of euros in development and maintenance while enabling new business sectors such as smart homes.

Flex4Apps (Platform for Application and Infrastructure Flexibility in Cyber-Physical Systems) has enabled this optimisation and monitoring through a flexibility framework that interfaces with infrastructures and applications. The first major innovation is a scalable toolbox that embeds cloud technology and provides open APIs. This has been deployed in two use-cases: data-driven product and growth management for Software as a Service (SaaS) and data analytics as a catalyst of optimised and automated processes in large, distributed CPS. Secondly, disruptive methods and tools for data analysis, offline weak point assessment, adaptive performance optimisation and visualisation have been developed. Flex4Apps has thus created a full digital loop in which users can acquire usage data, transmit it to the platform, analyse the results and enhance their products accordingly.



*Flex4Apps provides a cloud-based flexibility framework that interfaces with infrastructures and applications*

## TECHNOLOGY APPLIED

The Flex4Apps framework consists of two main components: CPS architecture, ranging from sensors to network communication devices, and the cloud system, a software solution that receives, processes, stores and displays data from CPS. The former consists of devices, aggregators and communicators. Devices collect data and receive/execute commands, using the framework to communicate directly with the cloud. Aggregators are administering instances for several devices, assuming the conditional control logic for connected devices and providing a standardised interface for controlling them (REST).

The communicator then serves as the interface between the CPS and the cloud system.

To ensure interoperability, there are no restrictions on file formats or communication protocols when data is transferred to the cloud system. The standards defined in levels 4 to 7 of the Open Systems Interconnection model are used for staging, after which the data is transferred to a database model according to standardised calculations. Clean-up activities are carried out according to regional standards and a supplementary rule set is used to transform data into useful information for the end-user. In setting

up this architecture, Flex4Apps looked at various cloud paradigms, including microservices and serverless, that allow SMEs to make use of the technology even with limited IT resources.

In terms of security, the communicator acts as a plug-and-trust communication bridge between the CPS and cloud system. When implementing the framework, various security levels can be selected, ranging from an unsecured transmission level if the data has already been encrypted at the application level to full SE-based security for encrypted, hardware-operated data.

## MAKING THE DIFFERENCE

To cover the entire market chain, the consortium included technology, infrastructure and application providers, integrators and end-users. Their results fall into three categories: internal optimisation, new and improved services and benefits for the wider business community. Nokia is an excellent example of the former, having brought down the monthly costs of fixing bugs detected in both early and late development from over EUR 16 thousand to 1,900 – a yearly saving of EUR 180 thousand. The SaaS tool Survey/Anyplace, meanwhile, has increased their conversion rate by 33% and their activation by 54% (versus KPIs of 20% and 30% respectively).

In terms of improved services, DataStories is now using Flex4Apps' automated algorithms in 25-30%

of their projects. This has allowed them to move into data-driven product management and take on more complex assignments, enabling them to grow from six to 18 employees. Evermind, which has connected Flex4Apps to the home automation platform Eigenheim Manager, has increased sales by EUR 50-100 thousand per white-label customer. Likewise, Genode's home automation use-case has reduced their trusted computing base by a factor of 20 and grown their customer base on ARM by 70%. They predict a 200% growth in license revenue within two years, with the smart home market expected to be worth EUR 19 billion in Germany alone by 2025.

Flex4Apps aimed to instantiate 30 apps in total and achieved 40, plus three cloud setups and 14 services that are all available on Github. Additionally, Sirris' Peter Verhasselt and Nick Boucart have published '*Hyperscale and Microcare*', a book that outlines the project's methodology. This has sold over 650 copies to more than 50 companies. This open approach, combined with the innovative nature of the framework, will play a crucial role in the digital transition. In the future, a company's most valuable intellectual property will be its deep customer understanding, backed by data, rather than its technology. Companies that take up Flex4Apps stand to gain the most from this insight.

## MAJOR PROJECT OUTCOMES

### Dissemination

- 10 publications and interviews, including one released book '*Hyperscale and Microcare*' and one award winning article.
- Multiple conferences and workshops on data driven product management including the Eureka Innovation Days 2018, Helsinki; Lange Nacht der Wissenschaften 2017, Nuremberg; Data Analytics 2018, Nuremberg; Data Analytics 2018, Garching.

### Exploitation (so far)

New systems:

- Containerisation on MCUs (docker on Debian / Ubuntu for i.MX).
- Toolbox for Home Automation Systems.
- Network communicator leveraging the combination of Java with microkernel technology.

### Standardisation

- Input to the standardisation teams of the involved project partners.

ITEA is a transnational and industry-driven R&D&I programme in the domain of software innovation. ITEA is a EUREKA Cluster programme, enabling a global and knowledgeable community of large industry, SMEs, start-ups, academia and customer organisations, to collaborate in funded projects that turn innovative ideas into new businesses, jobs, economic growth and benefits for society.

## Flex4Apps 15025

### Partners

#### Belgium

Evolved Analytics Europe BVBA  
Inventive Designers  
SIRRIS  
Survey Anyplace

#### Germany

evermind GmbH  
Fraunhofer  
Genode Labs GmbH  
HiConnect  
Nokia Solutions and Networks GmbH  
NXP Semiconductors Germany GmbH

### Project start

November 2016

### Project end

October 2019

### Project leader

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