EVERYTHING AS A SERVICE PROVIDES FLEXIBILITY IN IOT SYSTEMS DEVELOPMENT

The different components provided within the bloTope framework provide a rich and powerful set of development tools for creating next generation IoT systems and applications. The components have been designed around Everything-as-a-Services (XaaS) approach, which supports the notion of micro services. Services can interact with or call each other and can even be transformed into new composed services. An essential set of services have already been constructed that can be selected to support a broad range of IoT systems and application deployments – and additional services can easily be added.

Each of these services can be tailored and adapted to specific application domains such as smart cities, smart buildings, smart mobility and many others. The bloTope framework provides a flexible set of components and services that will accelerate the development and deployment of innovative IoT systems.

SMART CITY PILOTS VALIDATE TECHNOLOGIES AND INNOVATIONS

Smart city pilots using bloTope technologies are already being deployed in three European cities. They include new IoT systems for:
• Increased comfort on hot city days in Lyon
• Improved safety around schools in Brussels
• New e-car charging ecosystem in Helsinki

These smart city pilots are validating each of the components and also the higher level services provided by the bloTope framework.

ADVANCED FRAMEWORK FOR RAPID DEVELOPMENT OF IoT SYSTEMS

An “Everything as a Service” approach for development of IoT Systems-of-Systems

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THE TOOLS FOR BUILDING NEXT GENERATION IOT SYSTEMS

The biTope framework provides an open set of building blocks for developing IoT software components and entire IoT systems for Connected Smart Objects – at a fraction of the costs. Based on open source components and standard interfaces, biTope provides the essential components that enable rapid deployment of secure IoT systems that exploit data from multiple sources, are context aware, and able to monetize new services and value for users.

MAKING IOT DATA ACCESSIBLE FROM EVERYWHERE

At the heart of the biTope framework are the O-MI and O-DF standards that provide the ability to create ad hoc and loosely coupled information flows between IoT objects, users, services, and business or government systems.

Accessing and exploiting IoT data is at the heart of the new innovations and services provided by IoT systems and biTope provides the tools that bring data from multiple sources and devices together. Tools that make it easy to consume data by new IoT systems are provided, but also for publication as new analysis and insights are gained from IoT system analysis and user involvement. The biTope framework provides three components that simplify IoT data handling:

1. **Publication & Consumption Component**
   - The Publication & Consumption component is used to create an O-MI Node for communicating data based on the O-MI/O-DF standard interfaces into the IoT system and knowledge discovery and reasoning about sensor data and also open linked data. The outcome of the processing is usable knowledge, which could be requested as a service via a Marketplace/Service Catalogue instance.

2. **Marketplace & Service Catalogue**
   - The Marketplace & Service Catalogue makes it easy to create complex and dynamic systems that engage the user: Building complex IoT systems is made easier with tools that accelerate the development and deployment tasks for software developers. Three building blocks make it easy to create complex and dynamic systems that engage the user.

3. **Micro-billing & Payment Component**
   - Micro-billing & Payment component optionally registers the billing and payment related information of published data/services, including the price and is called to manage the monetization transactions before giving access to the data. The billing component is based on the Lightning Network, which allows the provision of decentralized micro-payment functionalities that are essential for IoT data APIs. The component includes a layer built on blockchain that enables the use of cryptocurrencies including Bitcoin.

SECURITY AND DATA INTEGRATION FOR IOT SYSTEMS MADE EASY

 Systems and applications today face increasing challenges in protecting the data and privacy of IoT users. To maximise user satisfaction security mechanisms should be aware of the user’s situation and adapt to provide greater vigilance when IoT devices are most vulnerable. At the same time, extracting and integrating knowledge from multiple sources are essential capabilities for new IoT systems. The biTope framework provides components that streamline implementing secure IoT systems that adapt their behaviours based on local sensor data and knowledge gathered about the current situation of users:

1. **Security & Privacy Component**
   - The Security & Privacy component provides security services including secure token-based authentication and secure identity for things, as well as secure transport through the internet. It gives developers the building blocks needed to create secure applications without having to become security experts. Any application in any language and on any software stack can be connected, and different types of identity providers can be used for controlling how users log into the system. IoT identity management is provided for both things and user devices. Single sign-on, identity anchoring across environments are all part of the hassle-free token-based security component.

2. **RDF Integration & Semantics Component**
   - The RDF Integration & Semantics component extracts valuable knowledge from various instances of the Publication & Consumption component and open data that is linked to the IoT system. The component focuses on the fusion of sensor data based on the O-MI/O-DF standard interfaces into the IoT system and knowledge discovery and reasoning about sensor data and also open linked data. The outcome of the processing is usable knowledge, which could be requested as a service via a Marketplace/Service Catalogue instance.

3. **Context Provision Component**
   - The goal of the Context Provision component is to share and query context information between IoT systems and applications. Each incoming information request is forwarded to a Context Query Engine, which interprets the context request using Context Query Language (CQL) and invokes the Context Reasoning Engine as well as the Context Storage Management. The Context Reasoning Engine is able to request context information from all relevant context providers, which could come from the Publication & Consumption instances or any device.

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