COMPOSE
a journey from the Internet of Things to the Internet of Services

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Project facts

- Start date: November 2012 / End date: October 2015
- Duration: 36 months
- Project cost: 7,40 M€
- Programme Acronym: FP7-ICT
- Challenge: Pervasive and Trusted Network and Service Infrastructures
- Objective: ICT-2011.1.2-b Internet of Services
- Coordinator: Benny Mandler, IBM Research, ISRAEL
Partners
OBJECTIVES

• Provide an IoT enabling ecosystem
• Easily and securely develop, deploy, share and maintain services based on Internet-connected smart objects
• Use-case driven: to implement and validate the proposed architecture and methods by means of prototypical deployments
• Cover the whole service lifecycle by integrating a number of innovative technological enablers in a coherent way
  – Service design and execution environment
• To study and identify new business models and value chains
• To promote the standardization and adoption by the industry at large of the proposed architecture and interfaces
EXPECTED RESULTS OF THE PROJECT

• Complete Ecosystem for value added services based on Service Objects
• Platform and technology adoption
• Lower barriers to develop, select, combine and use value added services
  – Open the door for SMEs to participate – leading to higher innovation
  – Integrate IoT and IoC through the IoS
  – Stimulate innovation: open source approach, standardization and open interfaces
  – Move IoT into the mass market
  – Introduce novel business models based on the Objects Market concept
Approach

Stakeholders
- Consumers
- Business
- Developers

Open Marketplace
- Application Store
- Services
- Service Objects

Objects
- RFID
- Smartphones
- Traffic Sensors
- Parking Sensors
- Weather Sensors
- Temperature Controller
- Security Cameras
- Appliance Controller
WP distribution

WP1: Architecture Design and Specification
WP2: Objects as Services
WP3.1: Service Management
WP3.2: Service Deployment
WP4: Infrastructure Development and Prototyping
WP5: Information and Service Security
WP6: Open Marketplace
WP7: Business Models and Marketplace Piloting
WP8: Dissemination, Training, and Stakeholders Engagement
WP9: Standardization and Exploitation
WP10: Project Coordination

Figure 11: WP Structure
COMPOSE Stakeholders

User
Developer
Business

Devices - smartphone, desktop, set-top-box, TV

COMPOSE Marketplace

API
Applications
Services
Service Objects

Management
Recommender
Security Analysis
Payment
Analytics
Discovery

COMPOSE Platform

Service Management
Service Deployment
Object as Services
Platform – Objects data management
Approach

Services
- Geo-Distributed In-Memory Cache (DRAM+Flash)
- Geo-Distributed K/V Store (FLASH+HDD+SAN)

SMARTS
- Real-time Stream Processing

Services Front-End
- Interface
- Geo-Distributed K/V Store (FLASH+HDD+SAN)

Open Data

Users
- Large Analytics Centers

Developers

Active Storage API (CRUD + Embedded primitives + Analytics)
- Actuate
- BRAIN
- Geo-Distributed In-Memory Cache (DRAM+Flash)
- Geo-Distributed K/V Store (FLASH+HDD+SAN)
- Active Storage API (CRUD + Embedded primitives + Analytics)
- Data Actuation
- Data Caching
- Data Processing
- Data Replication
- Performance
- Availability
- Coherence
- Security

Smart Objects

STREAMS
Simple example

Historical Maximum Average Temperature at location
Platform - Services
Objectives

- Manage COMPOSE services allowing and assisting users in defining new services out of existing objects and content-provisioning channels, discovering existing services efficiently, creating new composite services, and proactively recommending services
  - Advanced Services and Things Discovery Engine
  - Advanced Services and Things Recommender
  - Assisted Service Composition Engine
Dynamic Large-Scale Discovery

- Distributed service discovery based on the underlying communication infrastructure
  - Highly scalable, supports organic growth, takes advantage of peers internal to the platform
- Utilize publish / subscribe mechanisms
- Potentially use a DHT service
- Explore local caching aspects
Service Recommender

- Proactive advertising of services to users
- Leverage data gathered over time concerning the interaction of users with services as well as the characteristics of the different services
- Utilize available data on non-functional properties of COMPOSE entities to favour active and reliable services
Assisted Service Composition Engine

- Assist users in creating new and secure service compositions in the Marketplace
- Exploit advanced caching and indexing techniques in order to provide highly efficient composition support
- Analytical methods developed in WP5 will be used to provide feedback if users compose services in critical or insecure ways
Use Cases
Three accompanying use-cases

- **Scenario 1: “Smart space: Augmented Shopping Experience”**
  - An indoor shopping environment, focusing on personalized interactions with objects for enabling an augmented shopping experience

- **Scenario 2: “Smart City: Barcelona”**
  - Exploit the city-scale infrastructures in Barcelona, focusing on the integration of heterogeneous devices and technologies for searching cross-data opportunities, taking advantage of the wide set of existing sensors

- **Scenario 3: “Smart Territory: Trentino”**
  - Pilot on a geographically broad scale in Trentino, focusing on the integration of highly distributed objects and utilization of smartphones as service objects for enabling territory monitoring and enhanced touristic experience
Smart city: some details

Description
• The Smart City pilot creates new services and applications mashups built on the top of the COMPOSE marketplace. The resources and services available at the city of Barcelona will be gathered by the COMPOSE engine and allowed to be used to define and compose new services by its users.

Main stakeholders
• Citizens and tourists.
• Barcelona city hall.
• Sensor networks operator.

Data collected
• These are the resources that should be accessible through the COMPOSE platform:
• Barcelona's Open Data repositories (assets information, public transportation networks, traffic status and forecast, etc.).
• Real-time sensors embedded in the environment (parking, pollution, garbage, etc.).
• Social media information (assets, tracks, pictures, etc.).
Smart city: some details

Look up

- Public Transport
- Traffic
- EV Car Sharing
- Parking
- Points of charge

Planning daily activity
Smart city: some details

- Dynamic daily plan activity
- SDK
- COMPOSE PLATFORM
  - app city store
  - data access
- Wimax; Wi-Fi; UMTS; TETRA; PLC; F.O.

- SmartZone
- Service Platforms
- Open Data

- Traffic
- Parking
- Points of charge
- EV Car Sharing
- Public Transport
Smart Territory: some details

Context:
• Tourism and sport in the Trentino Region

Objective:
• Improve tourists' experience while *skiing, mountain biking, trekking* through COMPOSE platform capabilities.

[Other interesting sports that could be considered are *sailing* and *climbing*.]

Main Stakeholders:
**Smart Territory: some details**

- **Meteo sensors**: collecting weather data like temperature, humidity, wind, rain, radar images etc.
- **Meteo Forecasts**: the meteo agency can provide localized and customized weather forecasts on a periodic basis.
- **Smartphones as sensors**:
  - accelerometer, GPS, gyroscope, magnetometer, camera, microphone, temperature and humidity;
  - crowd-sensed data: direct observations of the environmental conditions coming from end users (images, text messages) etc.
Smart Territory: some details

- **Type of data:**
  - Measured Data:
    - *Phisical Sensed Data:* about 120 points of sampling of physical parameters (temperature, humidity, wind, rain, etc).
    - *Images, webcams (~10 stations)*
    - *Structured data:* meteo radar, wind profiler, ..

Forecating:
- meteo forecasts, specialized reports (wind, sliding snow,..)

- **Sampling frequency:** every 15 minutes (lower if needed...)

- **Access to meteo data via data gateway,** with restful APIs (some web services already available)

- Part of data offered as **Open Data Services**
AREAS FOR COLLABORATION WITH OTHER PROJECTS

- Objects and service virtualization and interaction
- Services semantic description and discovery; linked services
- Services deployment, underlying run-time support, including security related aspects and SLA
- Community building
Contact

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