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Context

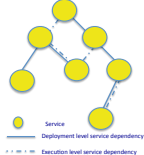
- **Internet of Things:** Physically close to the user but suffers from weak run-time execution environments.
 - **Cloud Computing:** Virtualizes and provide powerful data storage and computing power but can not be easily accessed and integrate the end-user context-awareness.
- Smartphone: Belongs to these two worlds simultaneously and accurately represents the user.



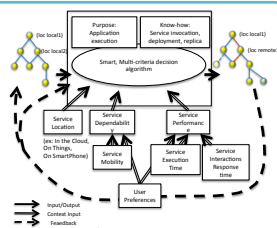
Proposition

We propose the smartphone as an artifact representing user as belonging to these two worlds (IoT and Cloud) and can provide a smart and autonomic service gateway.

Application model

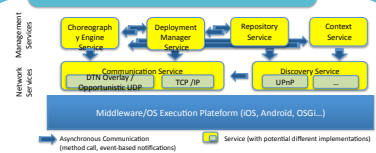


We consider service-oriented applications to be deployed as a set of interconnected services and to be modeled as a dependency graph where nodes are services and vertices are service dependencies. Dependencies can be either static at deployment or dynamic run-time invocations.



Making decision to deploy this service graph is autonomic (without the user intervention) and contextual (integrating external elements: preferences, platforms, etc.)

Architecture



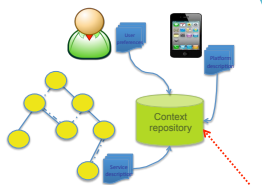
Our architecture consists of three functional levels:
 • Execution level with a middleware platform like iOS, Android, Java / OSGI.
 • Communication level with communication services (DTN / UDP, TCP / IP) and discovery services (UPnP, etc.).
 • Service Management Level with core repository and context services, decision making, deployment and execution of service choreography

Challenges

Context modeling

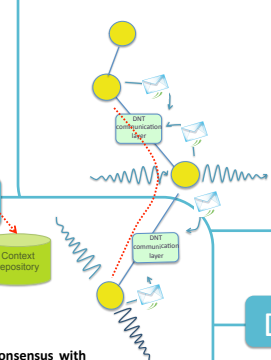
What we consider as a context is important for its modeling. With a comprehensive model, the smartphone will have a fine vision of what surrounds it and can make accurate decisions ... but conversely, the smartphone constraints in terms of memory / CPU / battery will highly limit usability of these models and smartphone life time.

A balance in the context modeling must be chosen at:
 • The expressiveness of the model: using a simple array (key / values) is not very expressive and consuming / ontology can express more relationships but consumes much more.
 • The completeness of context: a limitation when the elements found must be included for making decision uncertainly



Communication

Communication is inherently wireless and in a mobile environment, services can appear / disappear and suffer connections / disconnections. That's why we use these protocol stacks:
 • Delay-tolerant Network protocol permit to store / transmit packets in a non-blocking manner for services
 • Opportunists to exploit the mobility of smartphones to carry the packets in the communication blocks.



Collaboration

The gateway can perform its functions in collaboration with other smartphones in vicinity. It can use context repository of geographically close neighbors.

The decision making may also done in consensus with other smartphones, especially to have permission for remote execution of services.



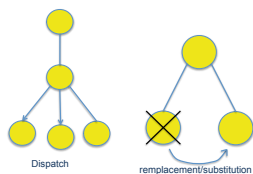
Decision making

The smartphone should exploit the possibilities of the IoT and Cloud while respecting resource constraints, user preferences, all without user intervention and disturbance.

Our system determines deployment, execution and service orchestration with the overall principle:
 • Using 'light' services on the IoT device
 • Deployment and execution of 'heavy' services in the clouds
 • Deployment / implementation of 'middle' services' on the smart phone with planning / monitoring of all services orchestration.
 • These notions of 'light / middle / heavy' services are context dependent (platform / user / etc.)

This optimization problem is highly dynamic and NP-complete, several heuristic, bio-inspired algorithms are being studied.

Execution



Platforms do not have the same technical characteristics, several features must be offered / managed by the execution middleware:
 • Deployment / implementation permissions open to other smartphones
 • Service substitution/ dispatching mechanisms
 • Dependability mechanisms

Such mechanisms must be coupled with a collaborative and incentive model encouraging users to 'open' its smartphone in rational and controlled manner.

