

**CONTEXT AWARE SERVICE ENGINEERING IN SUPPORT  
OF FUTURE BUSINESS NETWORKS**

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Context aware service engineering can be seen as both the future trend in service engineering and an important aspect of pervasive computing.

*Existing research results in the area of context-awareness provide insight to the following critical dimensions for creating future context aware business services and environments:*

- definitions of context and context aware services, consisting a considerable part of the problem domain
- specific “sensors”, which provide context information, their integration in context provision systems and their management.
- particular prototype context aware services applications, lacking a clear and strong business and industry orientation



**The offer of COCONET context aware blueprints and prototype systems initially raises a number of particular and important open issues such as:**

- Selection and implementation of context definition and representation models for networked and knowledge-based business applications.
- Context storage capacity requirements and responsibility, in various network infrastructures.
- Context processing and decision making algorithms, in conjunction with enterprise information systems.
- Information collection techniques for context awareness.
- Security and privacy of the context related data.
- The human intent representation model, its accuracy and detail.
- The ability of the collaborative business system to infer a user's intentions by analysing available information.
- A cost benefit analysis of the system's ability to offer pro-activity.
- Appropriateness of anthropomorphic (human mimicking) services, i.e. context acquisition mechanisms should strive to collect and use context data in much the same way a human would.



CONTEXT aware Service Engineering: required *methodologies* as well as currently available *state of the art technologies*, including business scenarios analysis and state of the art service engineering frameworks, in particular UML, XML, Java, .NET, Web Services or OSA/Parlay and mobile agents platforms.





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<http://context.upc.es>

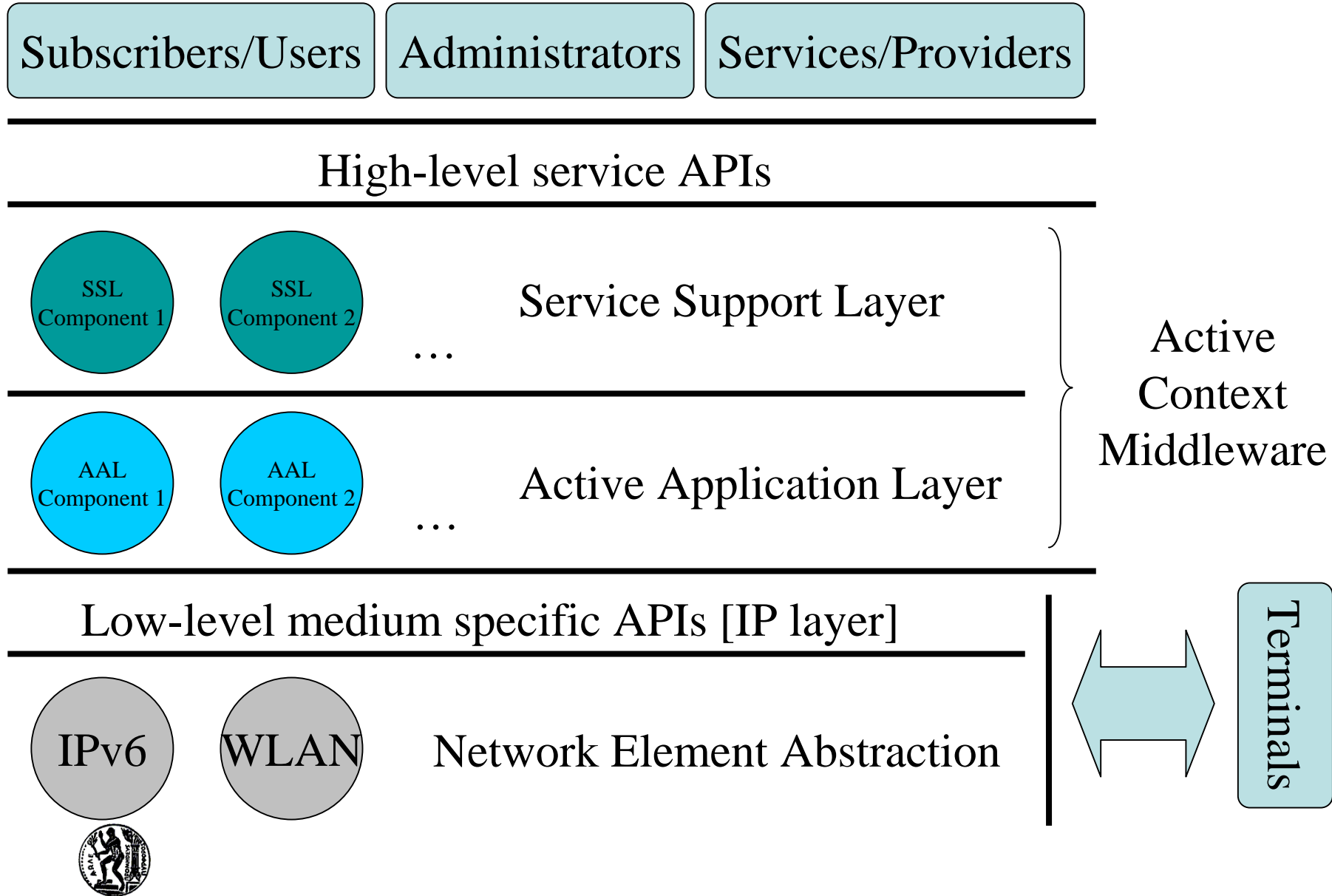


The main project objective is the specification and design of models and solutions for an efficient provisioning of context-based services making use of active networks on top of fixed and mobile infrastructure.

- **(VTT) Technical Research Centre of Finland**
- **Telefónica I+D**
- **Vodafone-Panafon Greece**
- **Algonet S.A.**
- **University College London**
- **Technion Israel Institute of Technology**
- **Universitat Politècnica de Catalunya**
- **Institute of Communications and Computer Systems**



# Context Architecture



# Context Layers

Value Added Service Providers

Distributed CONTEXT Servers

Internet + Active Nodes



## **The CONTEXT business model contains four groups of business roles**

based on TINA-C and e-business models background

- Customer/Consumer (C)
- Service Provider (SP): including Context-aware Service Provider (CASP)
- Service Component Provider (SCP): including Context-aware Service Component Provider
- Broker (B)
- Context Provider (CP)
- Network Provider (NP): including Fixed IP Network Provider (FIPNP) and Wireless Network Provider (WNP)
- Hardware Manufacturer





# CONTEXT Service Platform

## Goals:

- develop a services platform that will create, deploy and manage context -aware services
- accessibility from anywhere by a wide range of devices and networks
- personalized and highly adaptive delivery of services
- employ a context management subsystem that is able to handle (i.e. gather, process, store, and deploy) the whole variety of user context information in a generic /general way.
- support of context-aware features (including location-awareness)

## Key Issues:

- Requirements for the Service Platform
- Design of the context aware component of the service platform facilitate
- Enhancements of an Active Nets platform to facilitate dynamic and rapid deployment of context-aware service components
- Service Management Model and Requirements
- Deployment / Development scenarios
- Context Aware Services examples



# Context Definitions

- Def.1- “any information” that can be used to characterize the situation of an entity, where an entity can be a person, place, physical or computational object”. From this point of view, almost all information that occurs in the context of a specific system usage can be subsumed under the term “context” (e.g. the current time and date, the usage history, the user profile, the temperature at the user location, the position of the user, etc).
- Def 2 - “A context may either refer to aspects of the physical world or to conditions and activities in the virtual world. Further, context information can be either transient or persistent. Transient context reflects the environment at a single point of time and persistent context is a history of transient context”
- Def 3 - “A context element is an autonomous component that also can be used by a number of application services, but that exists independently of the application service”



# User's Context Information for Services

- Calendar information (e.g. activity type, time, actors, location, etc.)
- User location information (e.g. outdoors/indoors, building, room, etc.)
- Weather information (e.g. outside temperature, whether it is sunny, raining, snowing, etc.)
- Social context (e.g. role –student/staff/faculty; wife; friend; classmates, boss; colleague, director, etc.)
- Personal preferences (e.g. food preferences, favourite sports, etc.)
- Permission profiles (e.g. what services can contact the user and when, what contextual information can be made available to different types of services and under which circumstances) (e.g. “when in class, I don’t want to be disrupted by promotional messages”; “when I car, I accept only favourite sports information)
- User’s behaviour ( e.g. task, habits)
- Device & network characteristics ( e.g. available interfaces, bandwidth)
- 2 types of user’s context: manually & automatically acquired context



# Context types (1/2)

	Context type	Manually entered	Automatically acquired	Permanent	Temporary	Static	Dynamic	Service Example
<i>User "Fingerprints"</i>	Contact information / User identity	•		•		•		Directory service
	Professional context	•		•		•		Emergency service
	Social context	•		•		•		Chat service
	Health / medical context	•		•		•		Medicine Discoverer
	Physical features	•		•		•		Dating service
	Psychological features	•		•		•		Partner selector
	Background / skills / capabilities	•		•		•		Employment Agency
	Personal preferences / interests	•	•	•		•		Travel Agency
	User History context	•	•		•		•	Tourist Guide
<i>User Preferences</i>	Interface preferences	•			•	•		Any service
	Service preferences	•			•	•		Any service
<i>User Agenda</i>	Agenda / Calendar information	•	•		•		•	Meeting Scheduler



# Context types (2/2)

	Context type	Manually entered	Automatically acquired	Permanent	Temporary	Static	Dynamic	Service Example
<i>Location</i>	Location information	•	•		•		•	Transportation Route Discovery service
	“Civilisation” information		•		•		•	Theft Recovery service
	Physical environment information		•		•		•	Excursion Planner
	User surroundings information	•	•		•		•	Professional Presentation Consultant
<i>Time</i>	Date & time information		•		•		•	Dinner Planner
<i>User current state</i>	User biological state	•	•		•		•	Health Monitoring
	User emotional state	•	•		•		•	Telephone Call Filtering
<i>Application</i>	application specific information	•	•	•	•	•	•	Any service
	server specific information	•	•	•	•	•	•	Any service
<i>Terminal</i>	Terminal parameters and variables	•	•		•	•	•	Any service
<i>Network</i>	Network parameters and variables	•	•		•	•	•	Any service



# Context Usage in Applications /Services

- presenting the context information itself as content to the user (e.g. a maps having the current position)
- adapting of presentation of information and services to a user (e.g. a GUI suitable for the mobile phone the user is using currently)
- triggering actions on the occurrence of a context "constellation"
- tagging context to information for later retrieval (e.g. weather information when taking a picture in order to let the photo lab adjust the development process)

While the term context denotes the set of all information characterizing the situation of a focus entity. The single context unit can be called context element, i.e. all context elements relating to a focus entity form the context of that entity. Context elements have a context type which characterizes the context element. Context elements occur in a certain context format, which denotes the structure of the context data at the surface. The component of a service platform that deals with context is called the context service or context system.



# Interaction between Context Services- Context Sources

- In a *push mechanism*, context sources periodically push updated context information to the context service. The context service maintains the information in a context store and services client inquiries from its local store.
- In a *pull mechanism*, the context service must explicitly request context information. It can either make this request on a periodic basis (polling) or when an application demand arises.

Each mechanism has advantages and disadvantages:

- A *push system* collects data ahead of need and thus may offer better performance. However, it may consume substantial resources transferring and storing information that is never required. In addition, it must trade off information freshness with the costs of frequent updates.
- A *pull system* may use fewer resources by obtaining only the data that is required. However, this exposes the context service to inevitable network delays and unavailability. In some circumstances, it may be possible for prefetching and/or caching to alleviate these problems, but this may increase resource utilization.

In both cases, the ability to derive context information from past history is limited by the frequency with which context information is acquired or by the support offered by source.



# Goals/Research Tasks in Context Aware Service

- **Current status:** some context aware applications and research(e.g. mobile maps, fleet management)
- Viability of context Sensitive Services from business point of view ( user acceptance & business /enterprise models)
- Develop mechanisms for acquisition of contextual information
- Develop mechanisms for exchanging contextual, profiles and secure privacy information.
- Evaluate contextual information (how should services behave in order to optimise the user experience)
- Personalised services that automatically reflect user
- Services adapting dynamically to new situations ( location, time, user profiles, network and end-device capabilities)





# Current Status: Context Aware Applications

## Current status:

- some context aware applications (e.g. mobile maps, fleet management)
- UMTS standards body 3GPP is in the advanced stages of standardizing location management protocols and architectures based on a small set of position determination modes.
- The Location Interoperability Forum (LIF) is defining standards for application access to location and a number of other protocol approaches are competing for adoption, including OSA, SOAP and IETF SloP
- IST projects on Location based 2G



# Initial solutions

- Context represented and managed as Policies ( I.e. rules)
- XML as a representation language for Context
- Service creation & management based on a Policy based model ( compatible with the IETF PBNM)



# Project scope

