Personalisation and Learning in Pervasive Environments

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• New applications that can interact with a wide range of devices in the environment and provide the basis for intelligent context awareness and extended personalisation
• Personalised context-aware access to feature rich services and applications
• Generic architectures for pervasive systems and application-level services
• Generic learning and inference engines capable of maintaining and processing user-defined rules and policies to infer additional information from context with associated user interfaces and user-centred configuration and control
Two EU Projects

• EU FP6 IP Daidalos
  Designing Advanced network Interfaces for the Delivery and Administration of Location independent, Optimised personal Services

  Two phases – Daidalos I and Daidalos II (~ 40 partners in each phase)

• EU FP7 STREP Persist
  Personal Self Improving Smart spaces

  Due to start in April 2008 (10 partners)
Daidalos Coverage

• Mobility Beyond 3G (WP2)
  – Heterogeneity: multi-access, multi-operator
  – Mobility: terminal, person, session
  – Separation: transport, service infrastructure
  – Integration: handover, routing, A4C, security, QoS

• Media Convergence (WP3)
  – All-IPv6 network infrastructure
  – Broadcast services
  – Device and sensor services

• Pervasive Systems and Services (WP4)
  – Service discovery and composition
  – Personalisation and learning
  – Context management
  – Security and privacy
Daidalos Overview

- Design, prototype and validate infrastructure and components for end-to-end services
- Integrate complementary, heterogeneous network technologies to provide pervasive and user-centred access to these services
- Develop optimised signalling for communication and management support in these networks
- Demonstrate results via user-centred and scenario-based development of technology
Daidalos I Scenario
Mobile University

Vision

Students studying abroad, having access to their personal set of services and dynamically discovering local services and devices
Daidalos I Scenario
Mobile University

**Key building blocks**

- Organising daily life at the university: friends, appointments and reservations, classes, projects, exams, entertainment
- Locating people and devices, checking availability, discovering local services
- Relying on best/cheapest available infrastructure
- Moving sessions and content between devices.
- Working and playing while on and off campus
- Personal broadcasting, e.g. classes and speeches
Daidalos I Scenario
Automobile Mobility

Vision
Mobility supporting services in and around the vehicle with aspects of personal multimedia, ad-hoc mobile networking and session mobility
Daidalos I Scenario
Automobile Mobility

Key building blocks

• Access to personal information and services inside and outside the vehicle
• Locating and detecting presence and reacting to it
• Service and content adaptation based on QoS across network and operator boundaries
• Session mobility between terminals (including vehicles) and across organisational and operational domains
• Broadcast services for entertainment, inter-vehicle safety and regional traffic information services
Daidalos II
Combined Scenario

Vision

Physician delivers a class at university following which she drives off in her car and, whilst driving, she is contacted by the police who need emergency medical assistance in her vicinity
Key building blocks

- Access to personal information and services inside and outside the lecture theatre and in the car
- Locating and detecting presence on the road
- Service and content adaptation based on device availability
- Session mobility across organisational and operational domains
- Broadcast services for education and inter-vehicle communication
Daidalos
Personalisation and Learning

http://www.ist-daidalos.org/
The Pervasive Service Platform

- Personalisation
- Context Management
- Privacy and Security
- Session Management
- Service Management

3rd Party Services

- API
  - User Experience Management
- API
  - Service and Identity Management

Network and access technology
Web services technology and standards
Daidalos Personalisation

Explicit
- User Manually Enters Information
- Apply User Information

Implicit
- Gather User Information
- Maintain User Information
Preferences

• Context Independent

volume = “9”

• Context Dependent

IF LOCATION = home AND TIME < 17.00
THEN
volume = “9”
ELSE
volume = “3”
Personalisation Tasks

• Service Selection
  – Filtering
  – Ranking

• Service Customization
  – Personalisable Parameters

• Network Selection
  – Network type
  – Provider
Daidalos Learning

- Multiple learning approaches
  - Batch learning (tree building)
  - Incremental dynamic network learning
  - Bayesian network learning
Personalisation System

User Actions

Personalization System

Action Handler

Learning Manager

Preference Condition Monitor

Preference Manager

Retrieve / Store User History

Retrieve / Store Preferences

Context

Context Events / New outcomes

Request / Send Outcome
Action Handler

User Action

Action Handler

User Action

PCM

Learning Manager

Context Management

Context

User History
Preference Manager

Preference Manager

Preference Handler
- Retriever
- Updater

Preference Evaluator
- Evaluator
- Resolver

Context Management
- Context
- User Preferences
Preference Condition Monitor (PCM)
Learning Manager

User Actions

IF

Context Management

User History

Learning Manager

Controller

Learning 1

Learning 2

Learning n

Output Handler

Preferences
Beyond Daidalos

• Islands of Pervasiveness
  – Current trends in the design of pervasive systems have concentrated on the provision of isolated smart spaces via a static, albeit often distributed, infrastructure
  – There is a danger that this approach will lead to the evolution of islands of pervasiveness separated by voids in which there is no support for pervasiveness whatsoever

• Personal Smart Space
  – A user-centric smart space that provides a minimum set of functionalities which can be extended and enhanced as the user encounters other smart spaces
  – A Personal Smart Space will be based on a personal area network constructed from a variety of networked components which might range from mobile or wearable devices to specks, motes or smart dust
  – Personal Smart Spaces will be able to provide limited pervasiveness and context awareness anywhere and anytime
Aims of Persist

• To develop Personal Smart Spaces (PSSs) that provide a minimum set of functionalities which can be extended and enhanced as users encounter other smart spaces during their everyday activities

• PSSs will be capable of learning and reasoning about users, their intentions, preferences and context

• PSSs will be endowed with pro-active behaviours, which will enable them to
  – Share context information with neighbouring PSSs and resolve conflicts between the preferences of multiple users
  – Make recommendations and act upon them
  – Prioritise, share and balance limited resources between users, services and devices
  – Reason about trustworthiness to protect privacy and be sufficiently fault-tolerant to guarantee their own robustness and dependability
Persist Coverage

• Core Personal Smart Spaces
  – Integrated Networking and Mobility
  – Dependability and Privacy
  – Service Discovery and Composition
  – Context and Preferences
  – Federation

• Self Improving Smart Spaces
  – Grouping and Sharing
  – User Intent
  – Recommender Systems
  – Learning and Reasoning
  – Pro-active Behaviour
Persist Overview

- Design, prototype and validate core personal smart space concept
- Integrate technologies for self improvement and pro-activity
- Integrate mechanisms for learning and reasoning about trust relationships
- Develop federation concepts for ad hoc supplier-client relationships and charging
- Demonstrate results via user-centred and scenario-based development of technology
Vision

Andy and Betty are waiting at a bus stop and Betty is able to furnish Andy with an internet connection for which she charges him.
Vision

Two people share a physical space in a rental car where they each need to configure their own seats, etc. but also need to co-operate to jointly select the temperature, etc.
Persist Scenario
Shared Infrastructure

Vision

A patient visits a doctor and the data his PSS has been collecting on him is uploaded to the surgery’s smart space infrastructure and made available to the doctor via her PSS.
The Future

• We wish to forge links with more of the (many!) other people working in related areas

• We know of Napier staff involved in
  – PANORAMA
  – SPECKNET

• Any others we should be aware of?