Personalisation and Learning in Pervasive Environments

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Pervasive Systems Research at HWU

- 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)
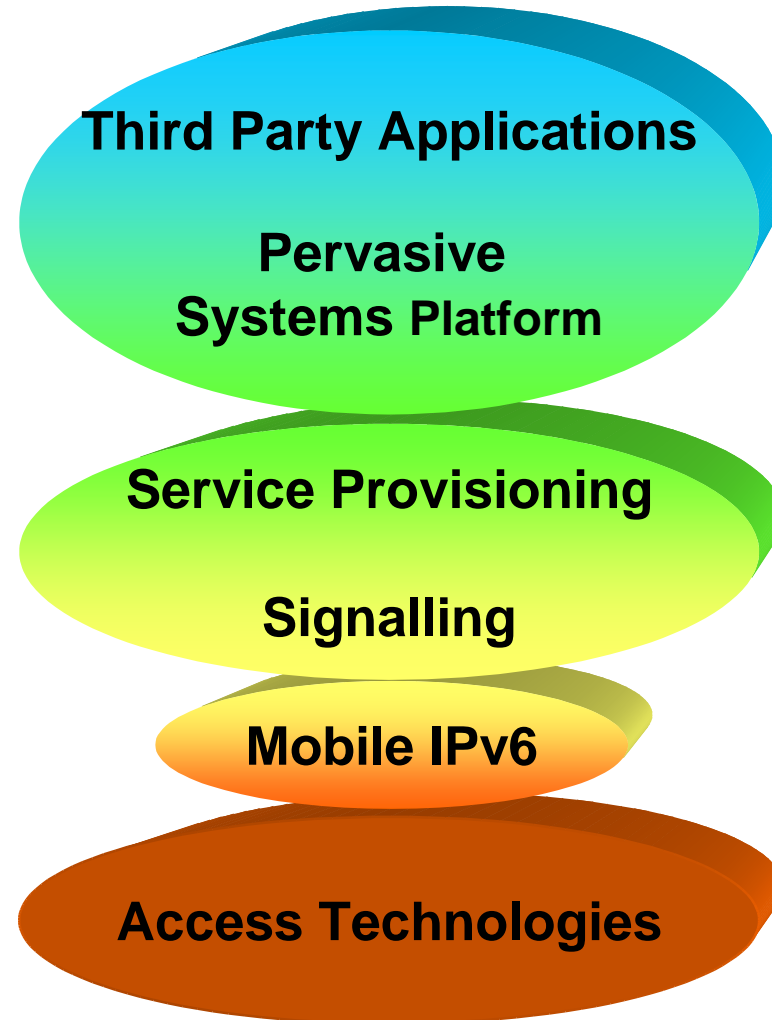
Daidalos Coverage

- 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

Third Party Applications

Pervasive Systems Platform

Service Provisioning

Signalling

Mobile IPv6

Access Technologies

Daidalos I Scenario Mobile University

Vision

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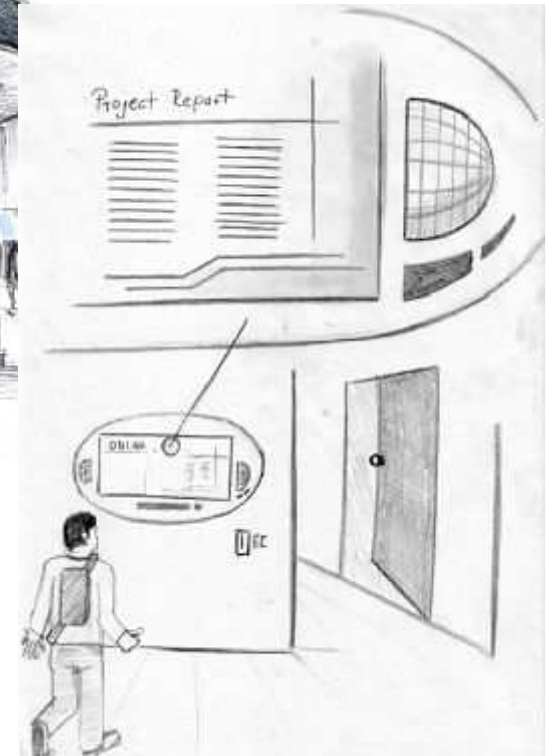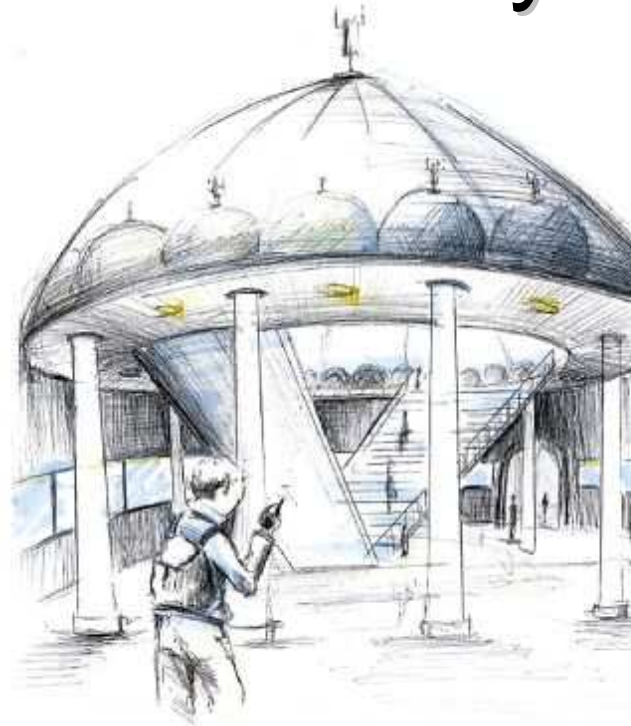
Daidalos I Scenario Mobile University

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
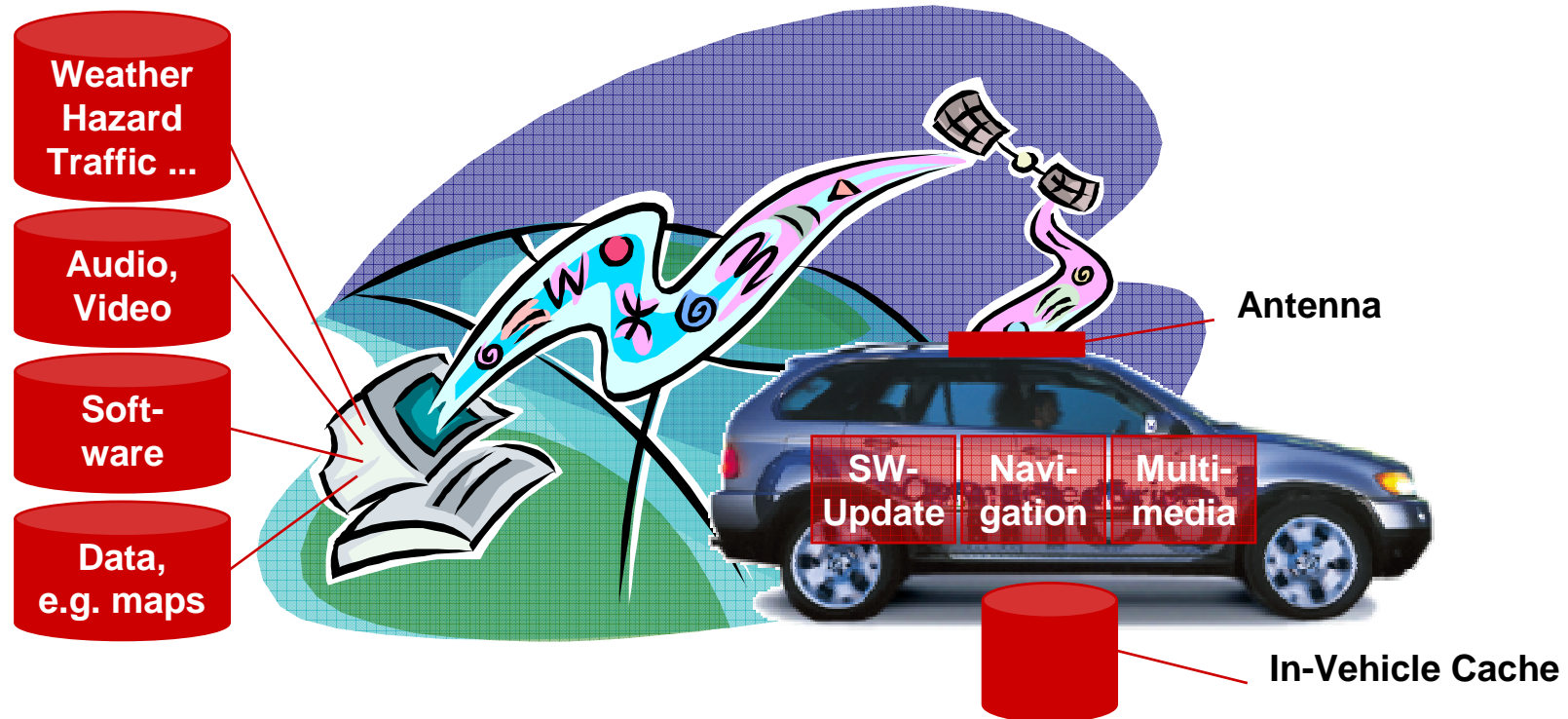- Personal broadcasting, e.g. classes and speeches

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
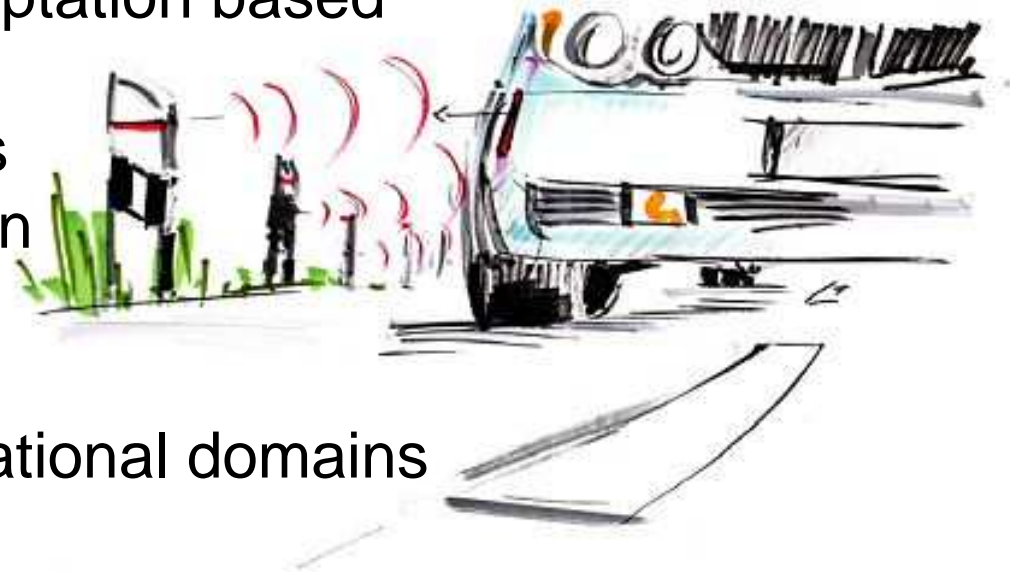
Daidalos I Scenario Automobile Mobility

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
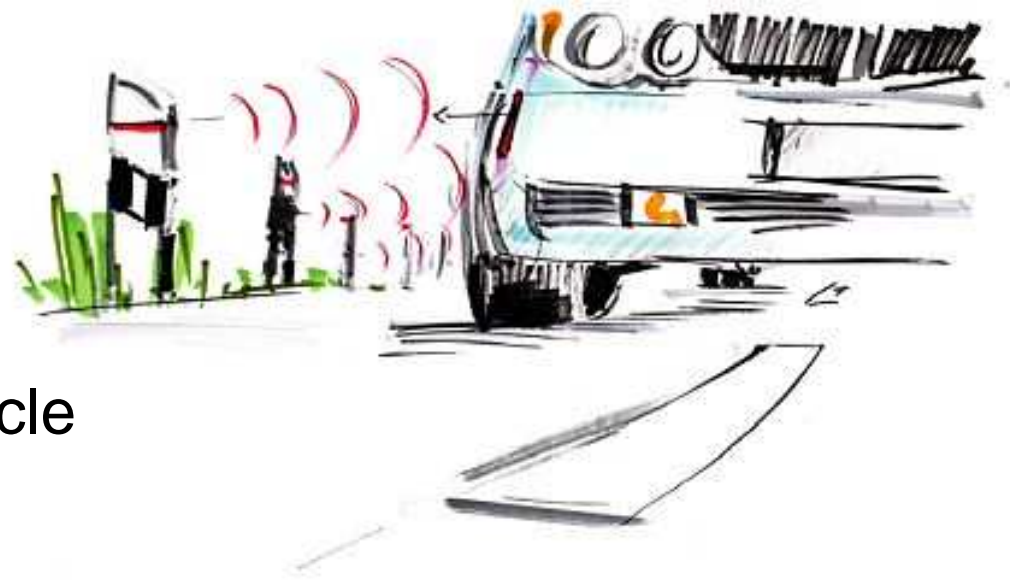
Daidalos II
Combined Scenario

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
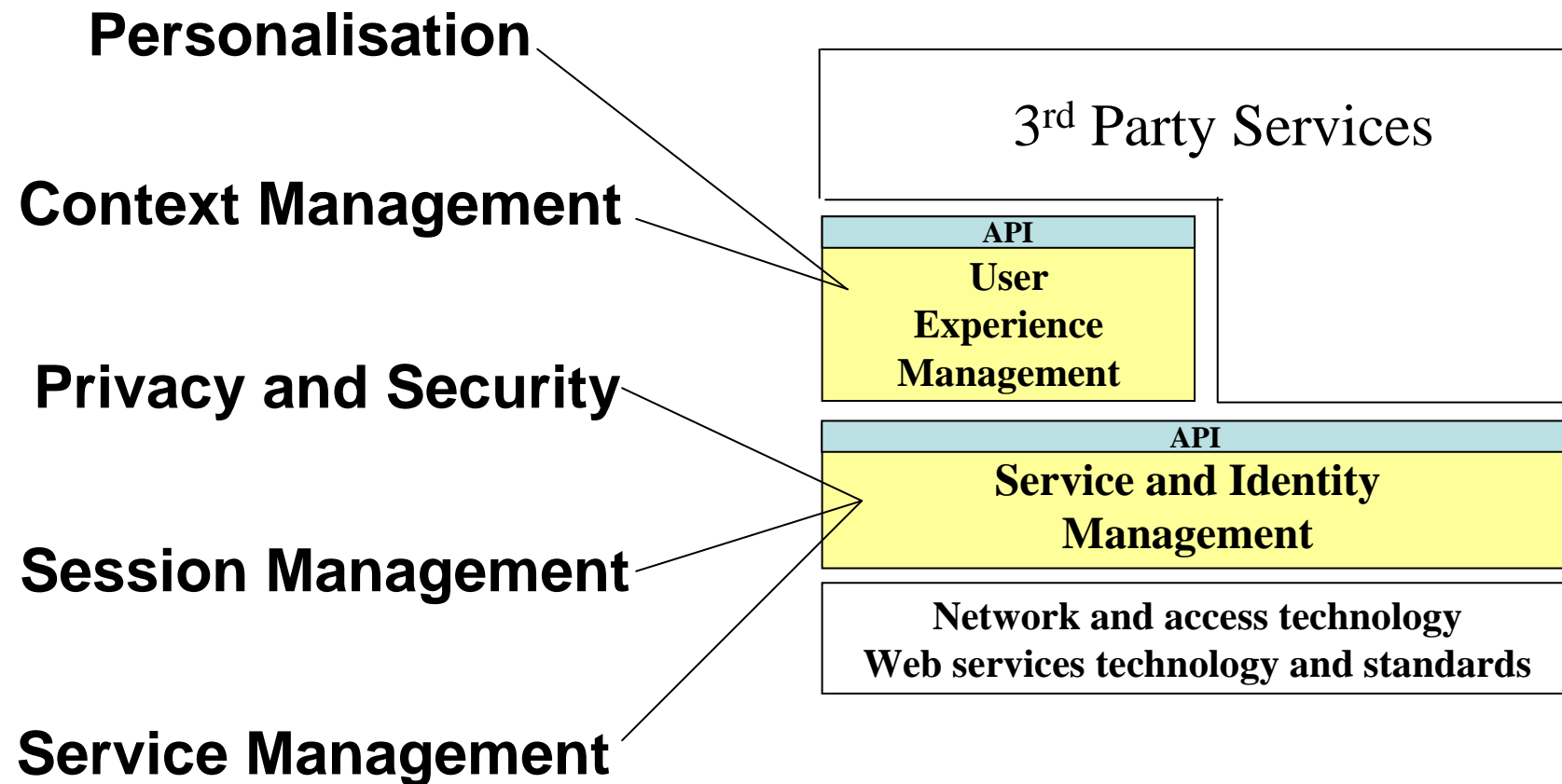
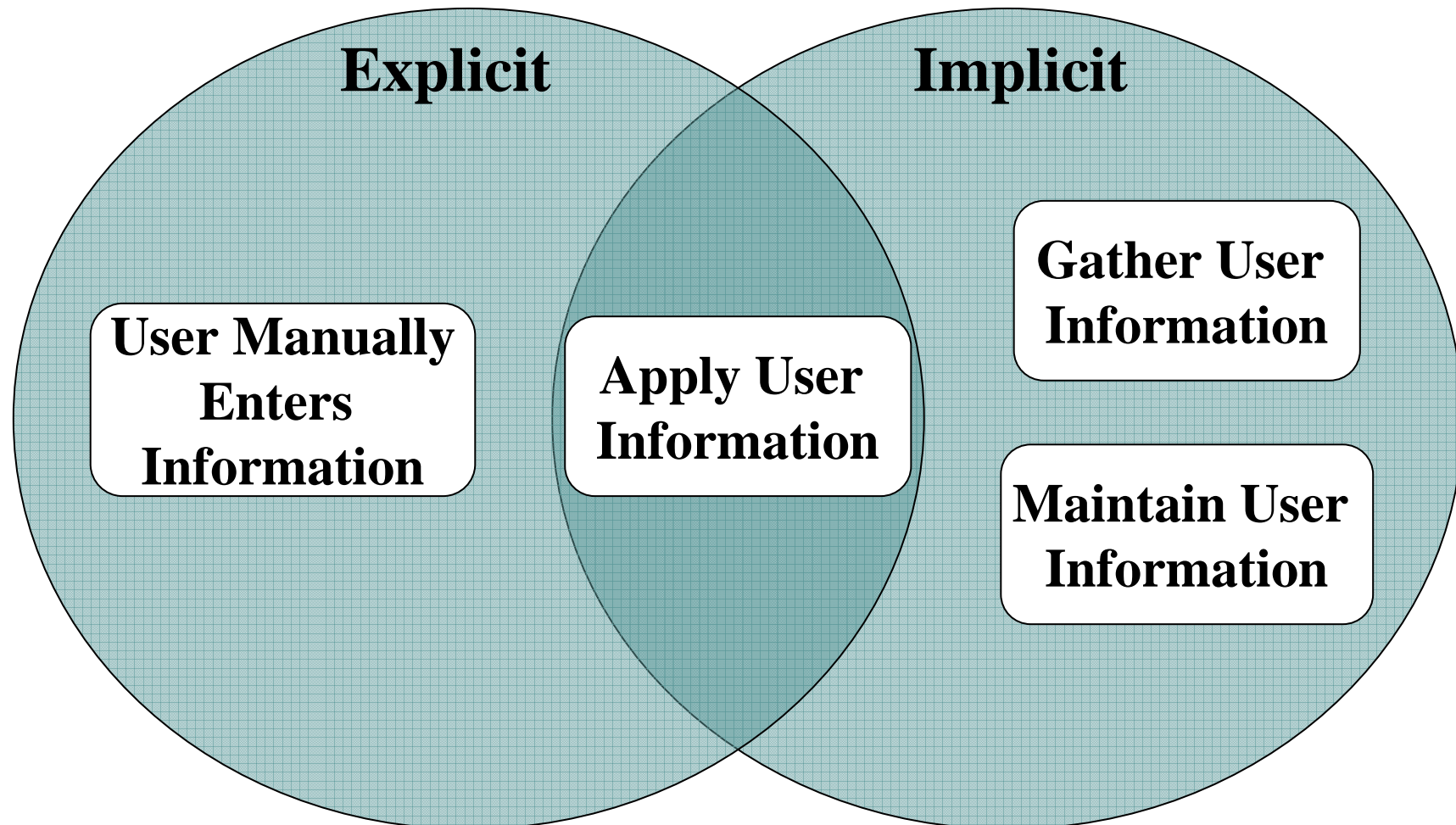# Daidalos
Personalisation and Learning

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

Implicit

User Manually Enters Information

Apply User Information

Gather User Information

Maintain User Information

Preferences

- ## Context Independent

volume = "9"

Outcome

- ## Context Dependent

IF LOCATION = home AND TIME < 17.00
THEN
volume = "9"
ELSE
volume = "3"

Conditions

Outcomes

Personalisation Tasks

- Service Selection
  - Filtering
  - Ranking
- Service Customization
  - Personalisable Parameters
- Network Selection
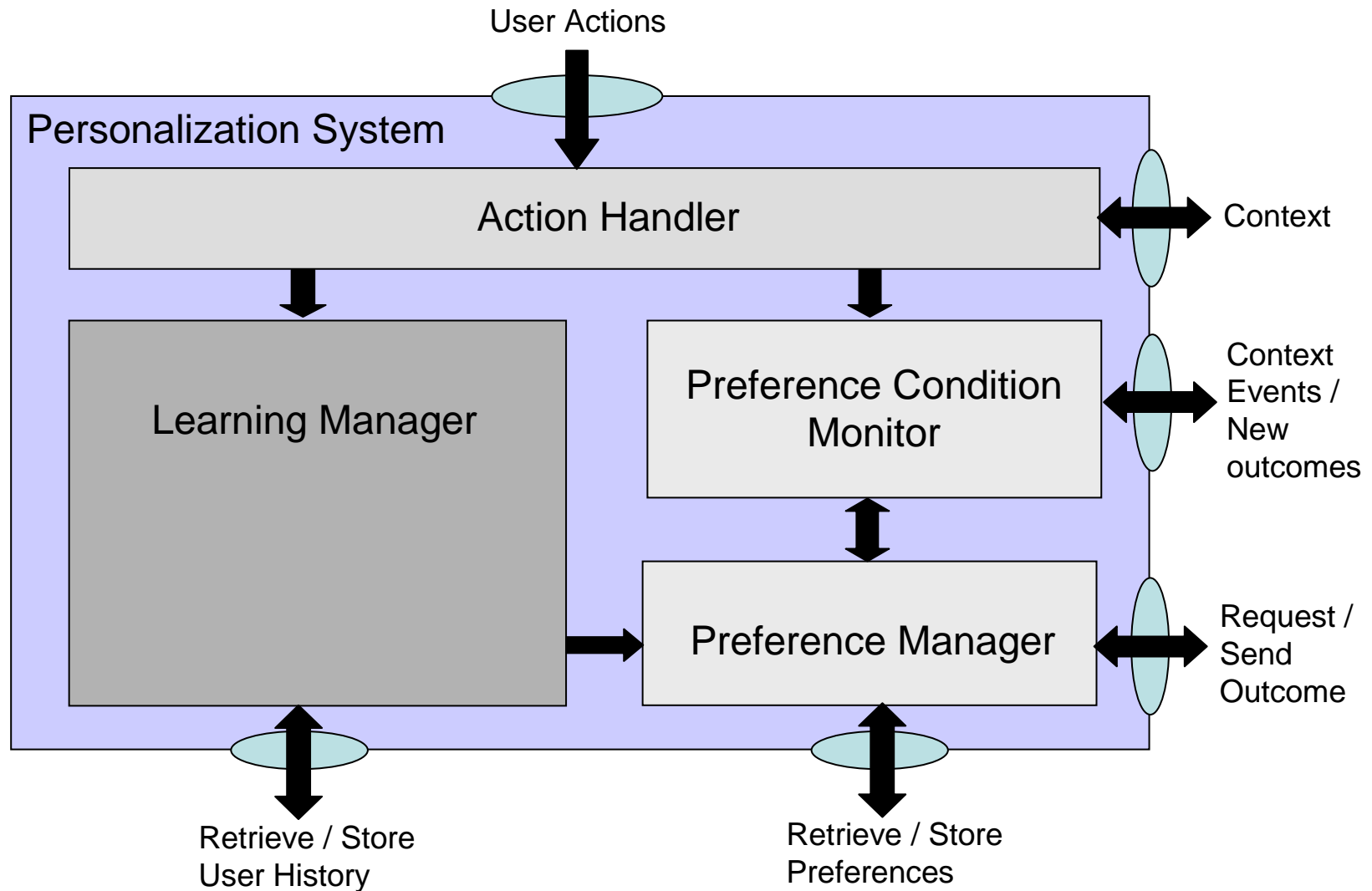 - Network type
  - Provider

Daidalos Learning

- Multiple learning approaches

  - Batch learning (tree building)

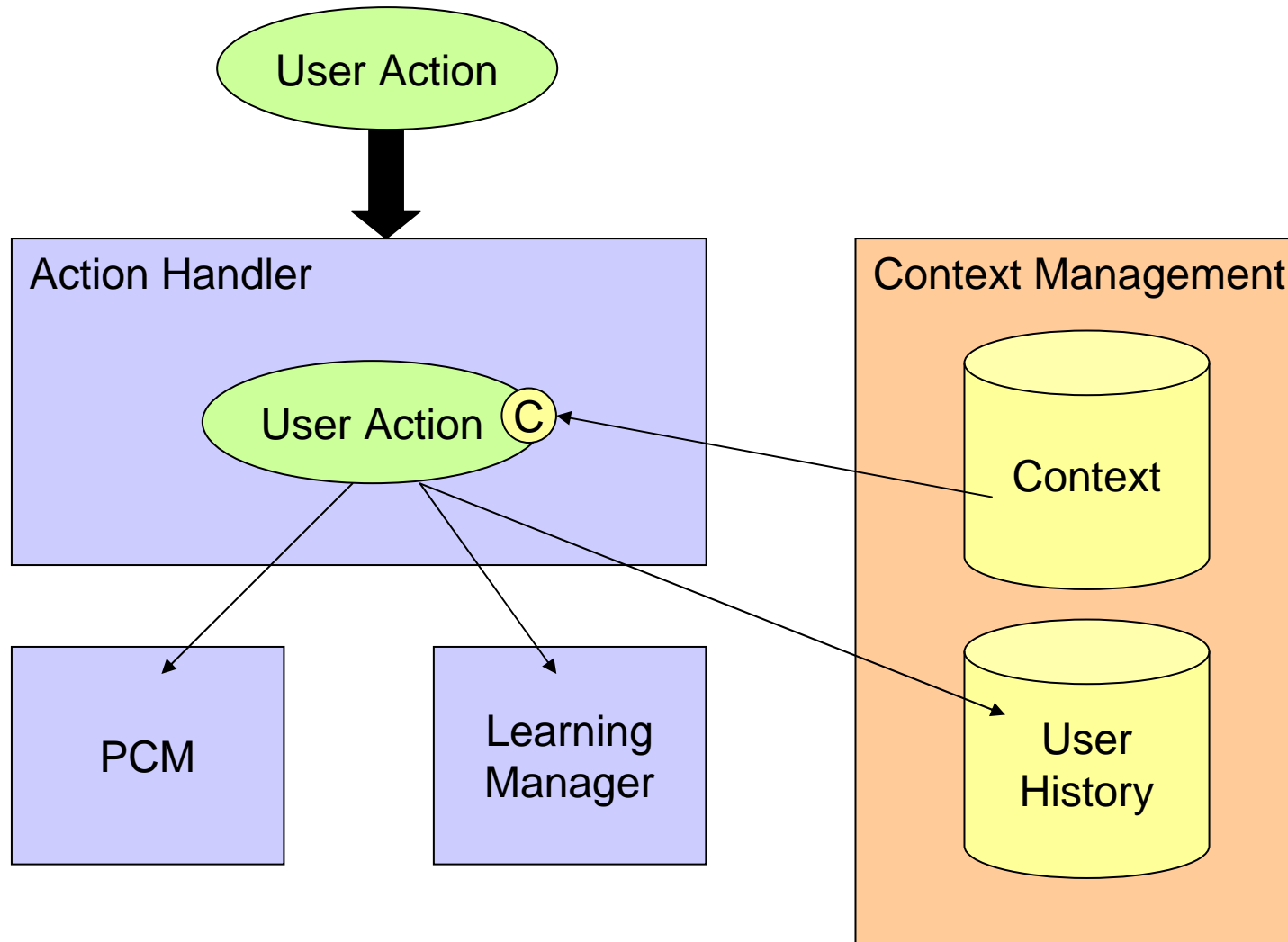 - Incremental dynamic network learning

  - Bayesian network learning
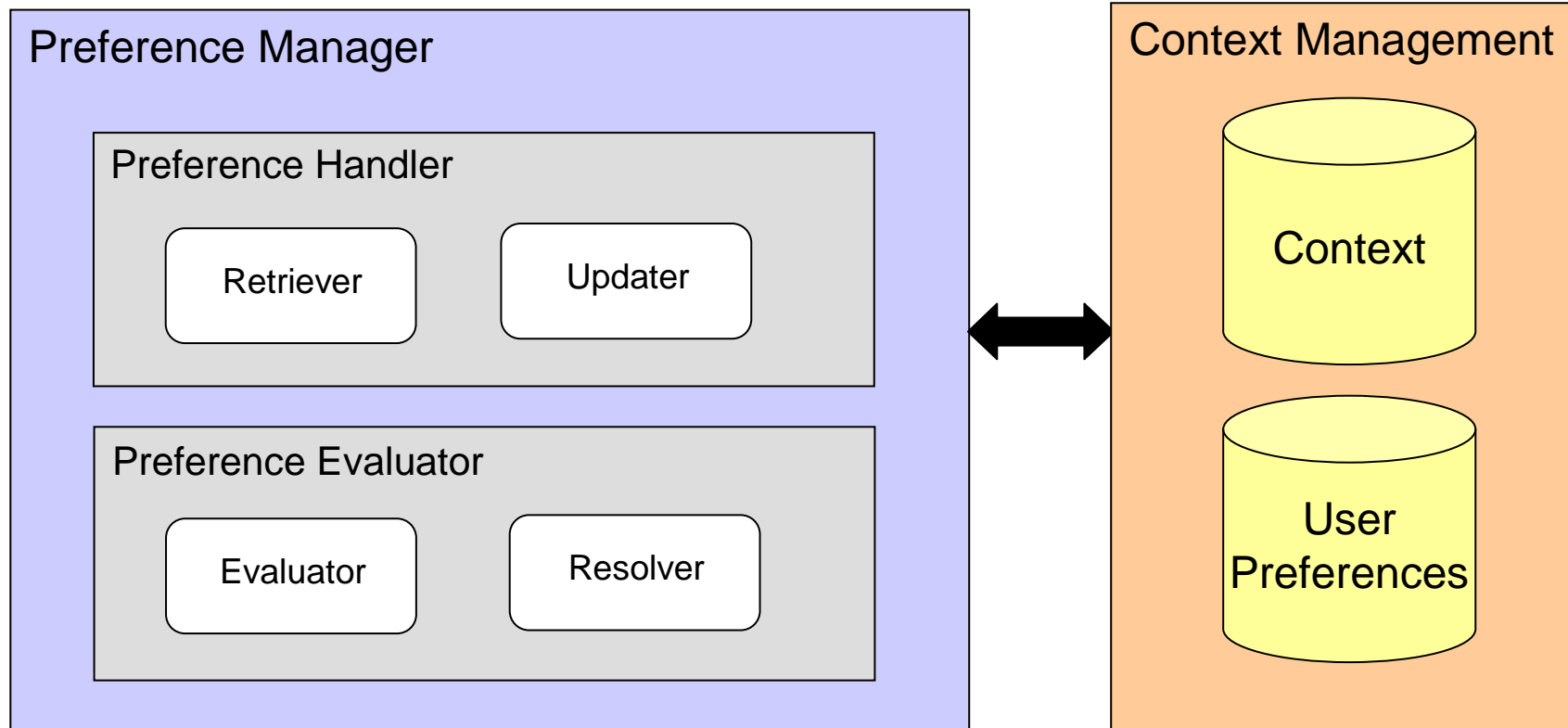
Personalisation System

User Actions

Personalization System

Action Handler

Context

Learning Manager

Preference Condition Monitor

Context Events / New outcomes

Preference Manager

Request / Send Outcome

Retrieve / Store User History
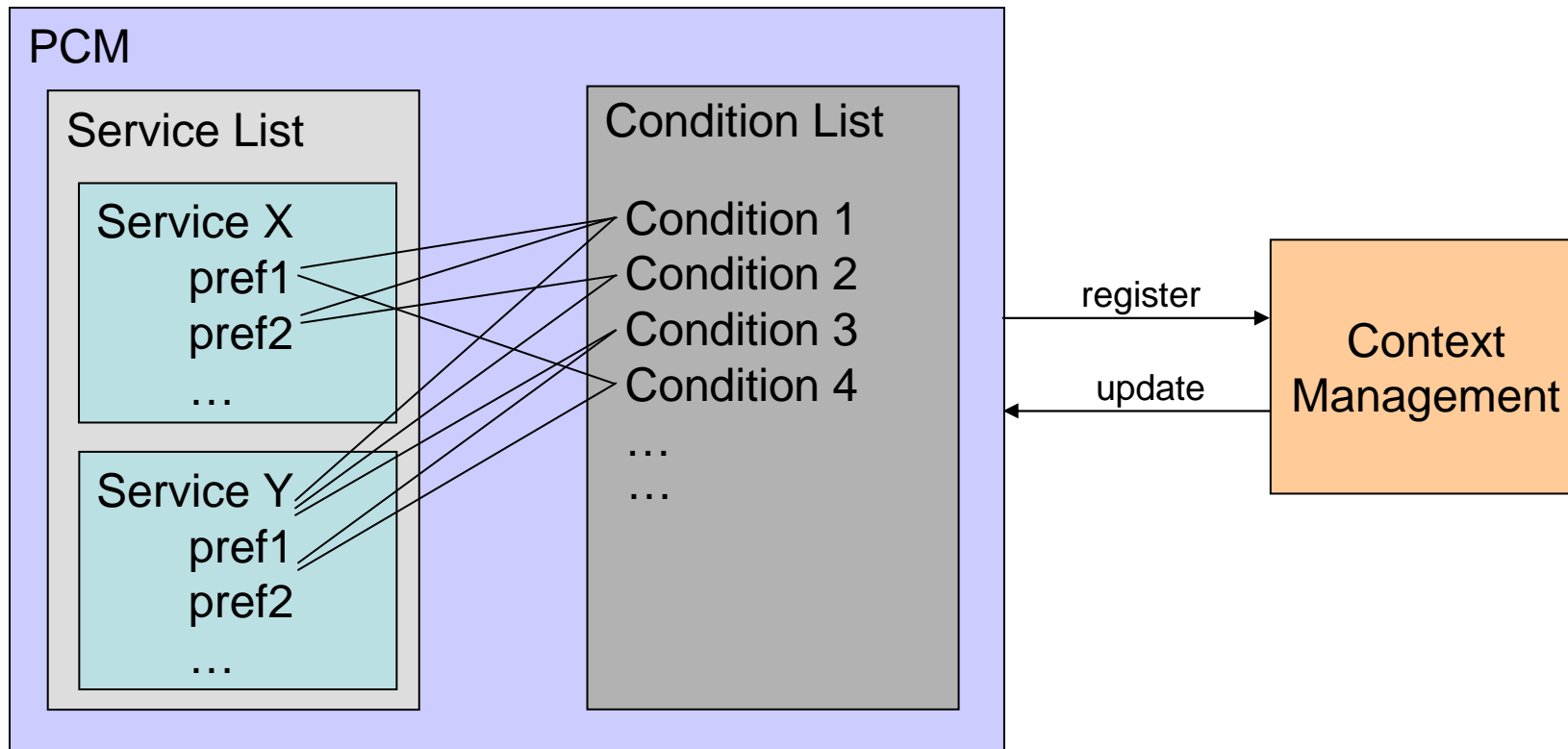
Retrieve / Store Preferences
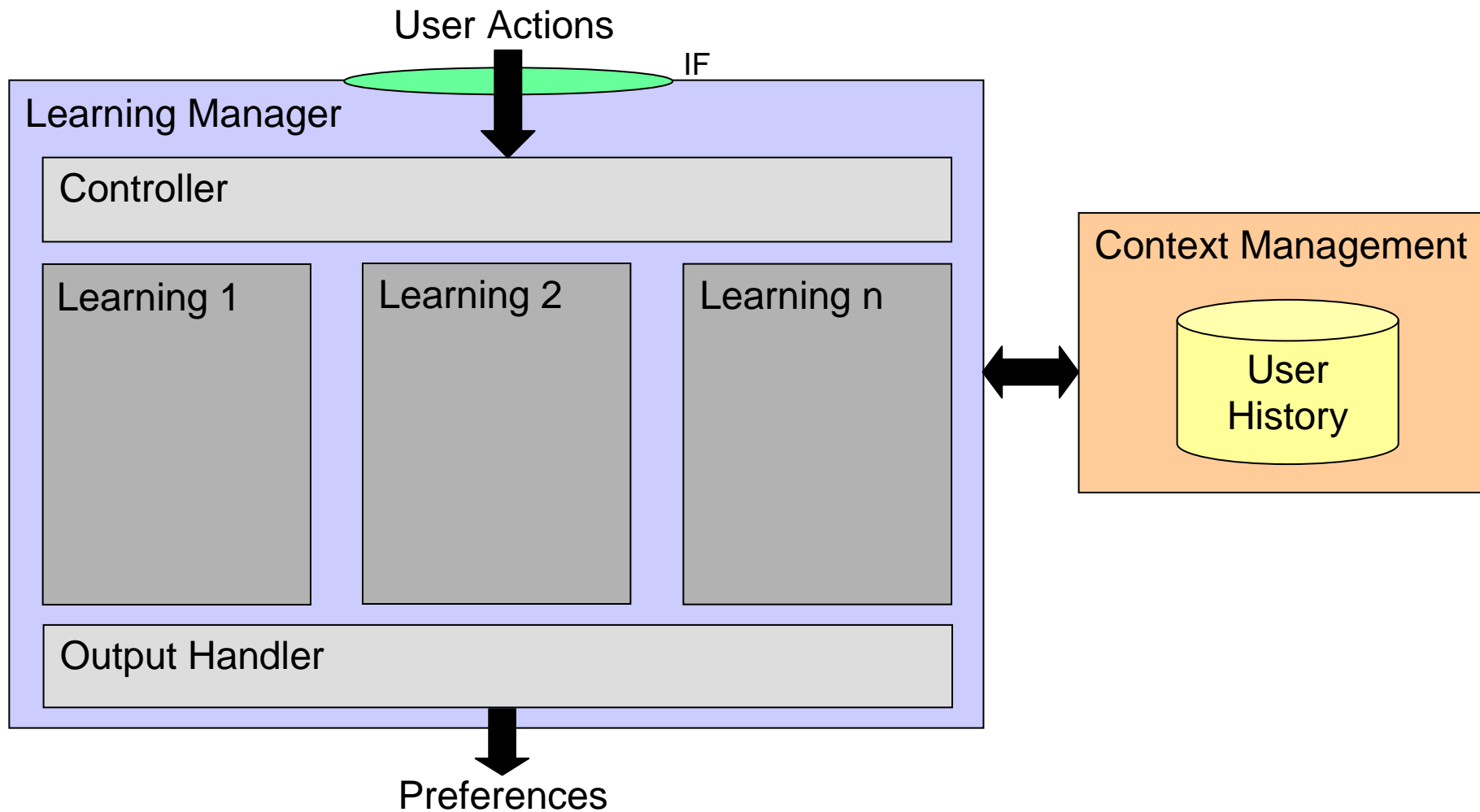
Action Handler

Preference Manager

Preference Condition Monitor (PCM)

Learning Manager

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

Personal Self Improving Smart Space

Core Personal Smart Space

Network and Access Technologies

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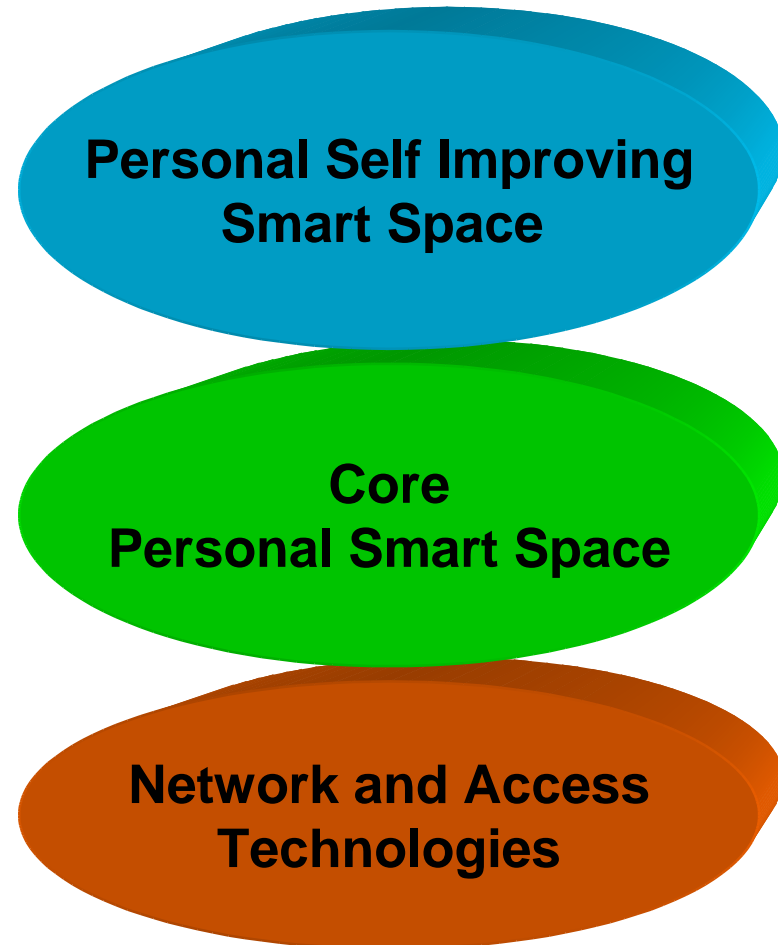
Persist Scenario
Ad hoc Connectivity

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
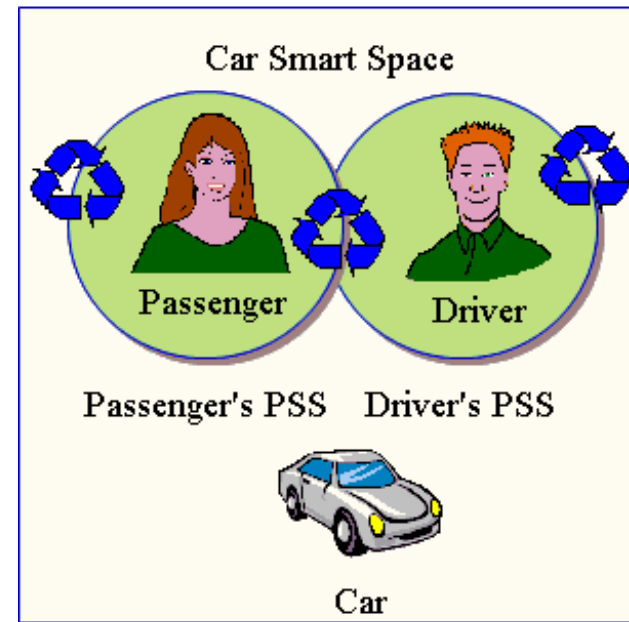

Andy's PSS seeking internet connection

Betty's PSS acting as micro-operator
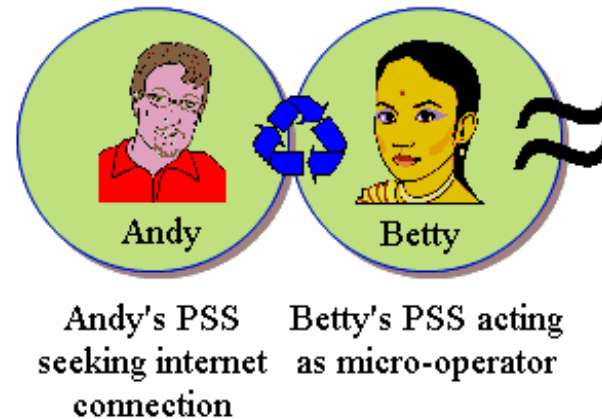
Persist Scenario
Shared Physical Space

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.
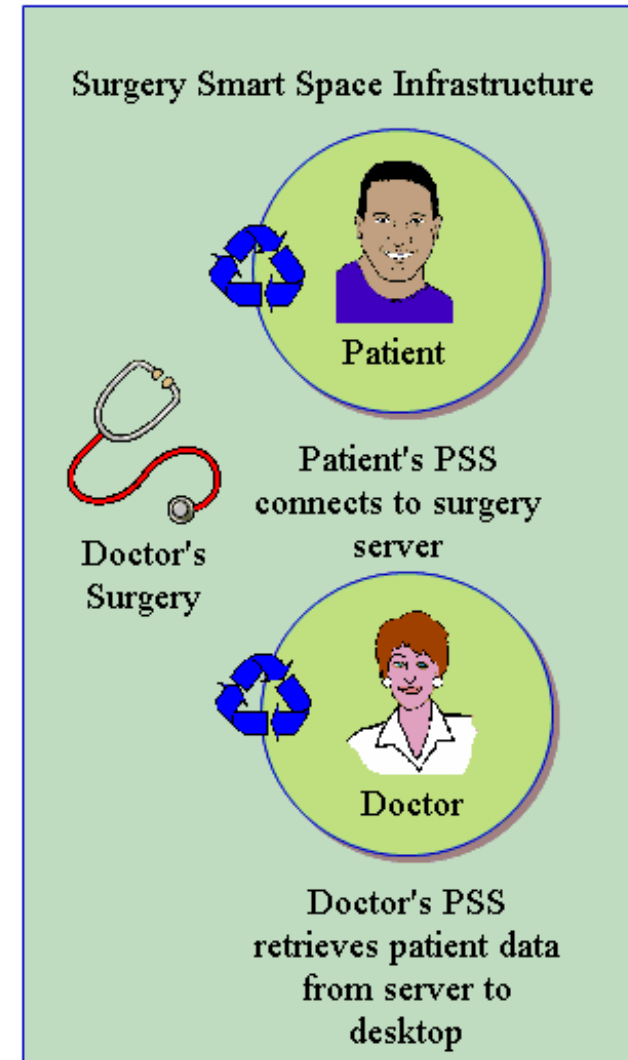

Car Smart Space

Passenger

Driver

Passenger's PSS   Driver's PSS

Car

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

Surgery Smart Space Infrastructure

Patient

Patient's PSS connects to surgery server

Doctor's Surgery

Doctor

Doctor's PSS retrieves patient data from server to desktop

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?