The Integration of the Capabilities of Wireless Sensor Networks in 3GPP IMS: Case Study and Potential Issues for Standardization

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Wireless Sensors and End-User Services
Wireless Sensors and End-User Services

Wireless sensors can capture a rich set of contextual information
- Space (e.g. refined location, velocity)
- Physiology (e.g. pulse, blood pressure)
- Environment (e.g. noise level, temperature)

This information can be used in conjunction with IMS capabilities to build a wide range of end-user services
- Enhanced version of existing services
- Brand new services

Several potential application areas
- Healthcare
- Gaming
- Life style assistance
- and many more ...
The problem at hand

How to integrate in a standardized way the islands of wireless sensor networks and IMS for end-user services
The Case Study
(A shot at the problem)

To probe further:


Outline

- Motivating scenarios
- A presence based approach
- Prototypes
Scenario I: Pervasive Game

Sample Game Scenario

(1) A fruit is available for pick up

(2) The fruit is picked up & the inventory is updated

(3) Player buys bombs to destroy other plantations
Scenario II: Enhanced Emergency Service

Fire incident occurring at night, in a place with a defective fire detector. The victim (an elderly person, mainly speaking a foreign language, wearing physiological sensors) is trapped in the burning apartment building, and calls 911 using her 3G terminal.

WSNs are used to detect and convey the user’s contextual information (i.e. spatial, physiological, and environmental data) to the network.

Location (address + room ID): to determine PSAP servicing the concerned geographic area & dispatch responders to exact room where user is located (for improved response time)  
This location information is a refinement of the location information used today in mobile emergency services (mainly consisting of a cell ID).

Environmental data (e.g. temperature, humidity, noise level) is conveyed to the fire fighters to enable a better assessment of the situation and tracking of fire progress.

Physiological data: The user’s vital signs are monitored and communicated to ambulance

Others: Info about the user’s surrounding people/devices is used by the PSAP operator to guide the user towards the nearest first aid kit, fire extinguisher, oxygen mask in the building, or even a person with medical training who can provide temporary assistance until the ambulance arrives.
A Presence Based Approach

WSN

WSN Gateway (PEA)

Extended PS

Presentity presence proxy

Watcher presence proxy

Watchers

IMS AS (e.g. GS)

IMS user applications

IMS core network entity (e.g. CSCF)
A Presence Based Approach

**Functional entities:**
- The WSN gateway:
  - Assigned the role of PEA:
    - Publishes the info provided by WSNs to the extended PS, via a trusted node (presence proxy), over the Pex\(a\) interface
    - The direct interaction between the GW and the PS is motivated by the fact that several support functions (e.g. identification and charging, authentication/authorization, and security associations establishment) which are already supported by the presentity proxy, could be leveraged by including the proxy as intermediary node
  - Directly interacts with the PS over the Pex\(b\) interface, for the mgmt of subscription policies
- The extended PS:
  - Manages and processes WSNs related info
- The info consumers: end-user applications, IMS Ass, and IMS core network entities (e.g. CSCFs)
  - Act as watchers to info published in PS, and use this info to provide value-added services to end users.

**Interfaces:**
- Inbound interfaces:
  - Pex\(a\): Used for secure info exchange, registration, identification/charging, authentication/authorization
  - Pex\(b\): Used for the mgmt of subscription policies
- Outbound interfaces:
  - Pw: an enhancement of the existing interface which enables end-user applications and IMS Ass to access info managed by the PS, via presence proxies
  - Pw\(_n\): Enables network entities acting as watchers to get direct access to information from the PS
Prototypes

Fruit Quest Pervasive Game

Components used:
- JAIN SIP server:
  * XML schema extended
  * Registrar and proxy functionalities are enhanced to emulate very simple CSCF and HSS components, with are co-located with the PS
- Existing web service based WSN gateway: remodeled to act as PEA
- A game server: acting as client

Test scenario:
- Game server is used to register as IMS corporate user
- Cricket beacons are used to detect the location of players and this info is conveyed to the GW which publishes it to the PS
- The published info is accessed by the game server
Prototypes

Enhanced Emergency Service

Components used:
- Existing IMS simulated environment (Ericsson's SDS) was extended: LRF enhanced & the CIB’s information model extended
- Existing web service based WSN gateway: remodeled to act as PEA

Test scenario:
- Clients were used to register as IMS users.
- Cricket beacons/listeners were used to detect the location of the caller’s laptop and of a first aid toolkit. An MTS300/Mica2 sensor attached to the user’s laptop was used to detect environmental conditions.
- All this information was conveyed to the WSN gateway, which publishes it (after proper formatting) in the extended presence server.
- The published information was then accessed by the CRF and used for context-aware routing to the PSAP and the conveying of the needed info to the clients.
Standardization
Potential issues

- Functional entities for integrating sensing and actuation capabilities in 3GPP IMS
  - Enhanced versions of current 3GPP functional entities (e.g. presence server)
    - And/or
  - New functional entities

- Inbound interfaces (i.e. Interfaces from the sensing/actuation world to IMS)
  - Common functions (e.g. charging, security, publication/discovery)
  - Exchange of actual data

- Outbound interfaces (i.e. Interfaces from IMS sensing/actuation functional entities to IMS and non IMS application servers)
Potential starting point

- Technical Report (TR) on the feasibility of integrating sensing and actuation capabilities in the IP Multimedia Subsystem
  - Purpose and benefits of the integration including motivating scenarios
  - Integration Use Cases relying on different business models (e.g. sensing and actuation infrastructure owned by IMS service providers vs. sensing and actuation infrastructure owned by a third party)
  - Description of integration process
  - High level requirements