

User Presence Detection Based on Tracking Network Activity in SmartRoom

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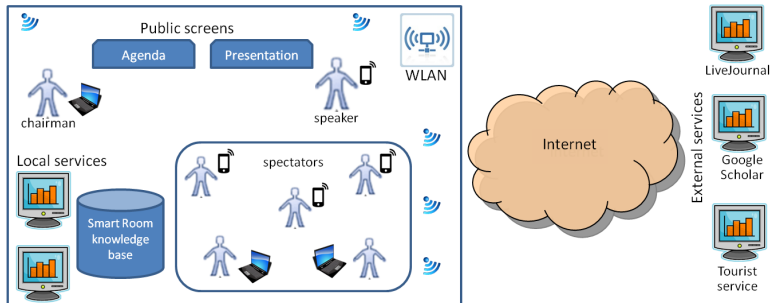


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SmartRoom: Assistance for Collaborative Work

- Many services (composition, personalization)
- Participation of many users (user can be indoor and outdoor)
- Participants come with own devices and use personal clients
- Based on the Smart-M3 platform



Presence Detection: Scenarios for SmartRoom

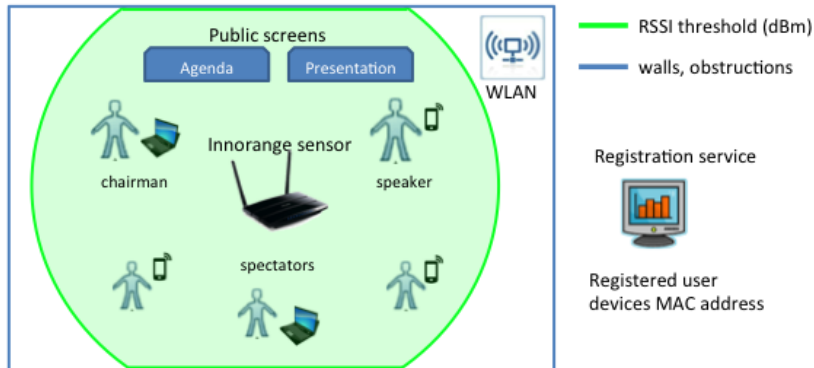
- SmartRoom services can be extended by utilization of runtime information on user presence in the room: physical and virtual
- This information is associated with network activity
- Each scenarios group supports a set of services:

Scenarios group	Description	Examples of services
S_1 (before)	user arrival to the room before starting the main activity	<ul style="list-style-type: none">– personalized welcome service– runtime initialization service
S_2 (during)	user joins and leaves during the main activity	<ul style="list-style-type: none">– runtime status for agenda service– planning speeches service
S_3 (after)	activity statistics	<ul style="list-style-type: none">– activity analysis service

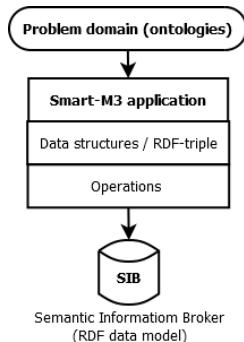
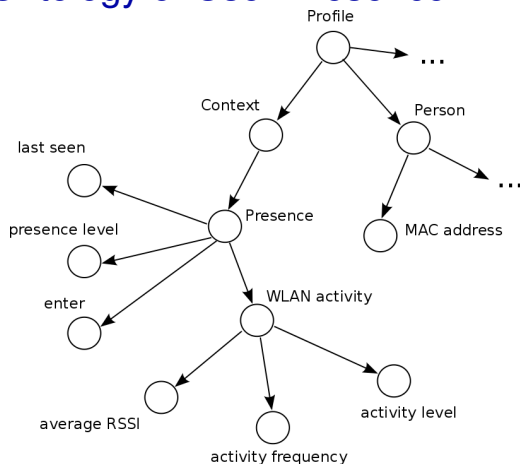
Presence Detection: Technology

- End-users have personal computers and mobile devices
- Radio Detection using Received Signal Strength Indication
- Innorange Footfall Technology
- Correspondence of users and MAC – registration service

room area

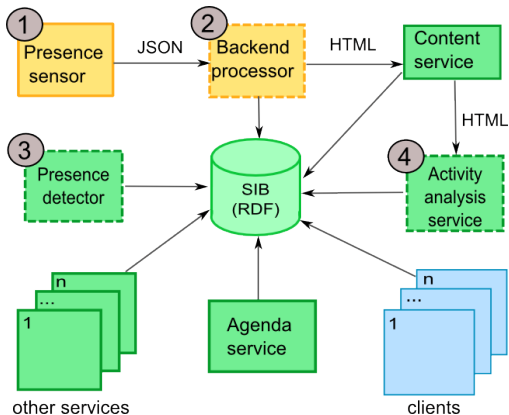


Ontology of User Presence



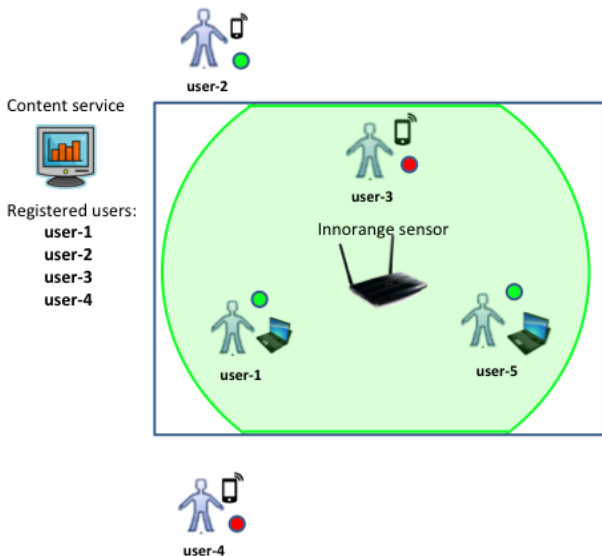
- Ontology of user presence is part of the SmartRoom ontology
- User presence is based on the context of the user profile
- All relationships here are of type “has”

Architecture of Smart-M3 based Integration



- 1** The presence sensor sends its measurements: MAC, RSSI and timestamp
- 2** Backend processor is HTTP endpoint to processing presence data from sensor
- 3** Presence detector KP detects presence information change
- 4** Activity analysis service processes of accumulated data from content service

User Presence: Device Detection + Other Context



R: the user is registered in the system by content service

D: the presence sensor is detected user's device

L: the user accessed the system using client

user-1 \leftrightarrow +R +D +L

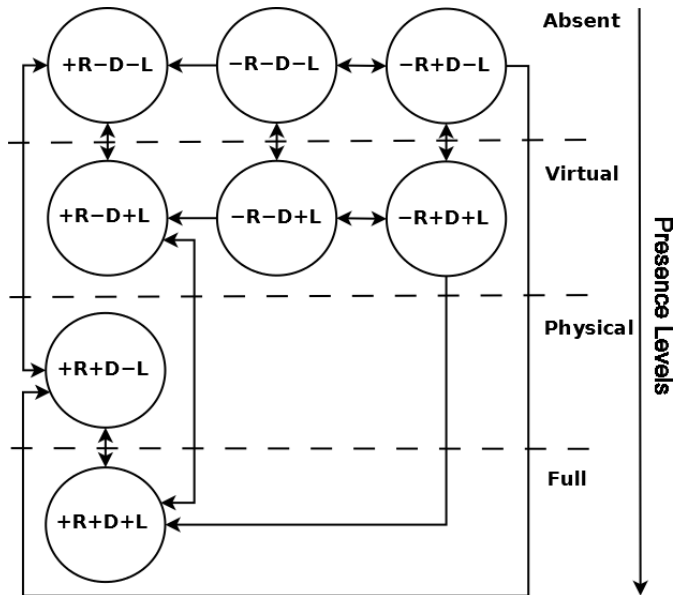
user-2 \leftrightarrow +R -D +L

user-3 \leftrightarrow +R +D -L

user-4 \leftrightarrow +R -D -L

user-5 \leftrightarrow -R +D +L

Model: User Presence State and Transitions



Visualization: Agenda-service of SmartRoom



Smart-M3 Applications

User status



11:00 - 11:10



Andrey Vdovenko

Mobile Multi-Service Smart Room Client: Initial Study for Multi-Platform Development



11:10 - 11:20



Ivan Galov

The SmartRoom Infrastructure



11:20 - 11:30



Dmitry Korzun

Proactive Personalized Mobile Multi-Blogging Service on Smart-M3



11:30 - 11:40



Pavel Kovyshin

Programming Android Client for M3 Smart Spaces



11:40 - 11:50



Aleksandr Lomov

Ontology-based KP development for Smart-M3 applications

Full

Virtual

Physical

Absent

00:00

Welcome to Ivan Galov

Evaluation: Performance of State Transitions

Use case	S_1 : User arrival to the room	S_2 : User joins and leaves during the main activity
User arrival is detected before starting main activity	$+R -D -L \rightarrow +R +D -L$	-
User is detected after the first arrival	-	$+R -D +L \leftrightarrow +R +D +L$ $+R -D -L \leftrightarrow +R +D -L$

- S_1 and S_2 are based on detecting the transitions between states
- Evaluate the time required to detect transitions of S_1 and S_2
- Scenario S_3 aggregates history of presence detection

Evaluation: Conducted Experiments

Scenario S_1 (steps):

- 1 The presence sensor determines close device and sends the device presence data
- 2 The backend processor publishes presence data in ontological form
- 3 The presence detector updates the properties and publishes the presence level property
- 4 Any service that uses information on user presence subscribes to updates of the presence level property

Steps 1–4 take **Detection time**

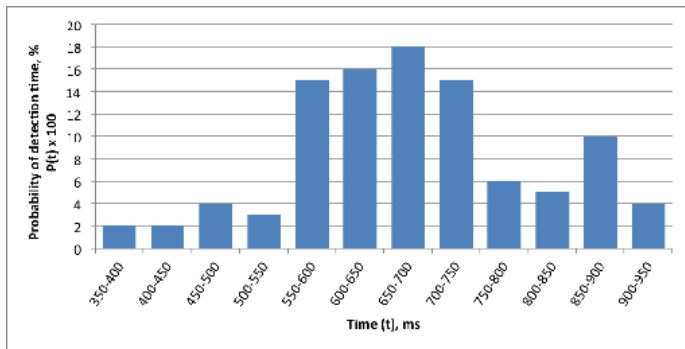
Scenario S_2 :

- 1 **Leave threshold**
- 2 Re-joining the main activity (similarly as in S_1)

Scenario S_3 :

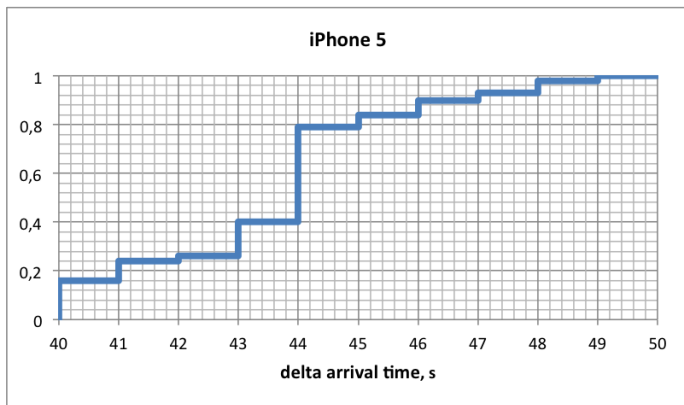
- 1 **Memory** occupied by the statistics files on the content service
- 2 **Processing time** activity analysis service of the network activity metrics

Evaluation: Detection Time in S_1



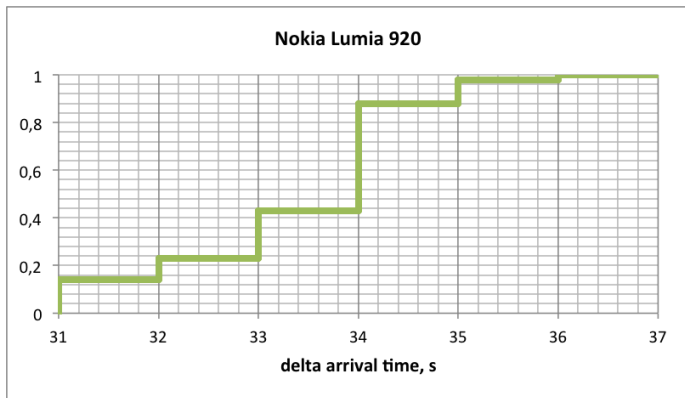
- Sample size is **100**
- Average detection time is **677 ms**
- Detection time does not depend on the number of devices

Evaluation: Leave Threshold in S_2 (1/3)



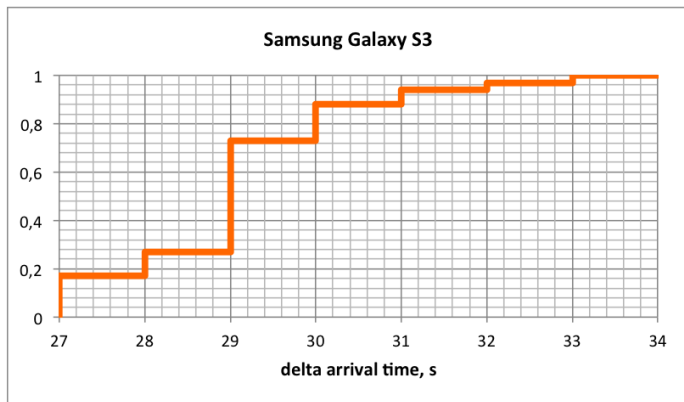
- For the **iPhone 5** device the distribution delta arrival time of probe request frames was in the range [40, 50]
- The values of high probability are **45 s**

Evaluation: Leave Threshold in S_2 (2/3)



- For the **Lumia 920** device the distribution delta arrival time of probe request frames was in the range **[31, 37]**
- The values of high probability are **35 s**

Evaluation: Leave Threshold in S_2 (3/3)



- For the **Galaxy S3** device the distribution delta arrival time of probe request frames was in the range [27, 34]
- The values of high probability are **30 s**

Evaluation: Network Activity Metrics in S_2 and S_3

- Content service is used for accumulation of statistics
- It generates on the text file for each user

Metrics:

- Level of network activity:

$$L_k = n_k$$

- Activity rate:

$$f_k = \frac{j-i}{t(s_{kj})-t(s_{ki})},$$

$$1 \leq i < j \leq n_k$$

- Average value of RSSI

	k-user.txt	
	timestamp	rsi
S _{k,1...n}	1	1411380521 -32
	2	1411380622 -23
	3	1411380723 -18
	4	1411380824 -15
	5	1411380825 -10
	6	1411381026 -28
	7	1411381127 -23
	8	1411381228 -23
	9	1411381329 -10
	10	1411381431 -32
...	1411381821 -23	
n	1411381979 -30	

Evaluation: Processing Time and Memory in S_3

- Activity includes 10 speakers
- Every speech is lasted 15 minutes
- Participants use their mobile devices
- At the end of the activity, the activity analysis service runs on a separate machine: CPU 2.30GHz, RAM 4Gb, Windows 7

Performance evaluation:

- The average data processing time is **0,72 s**
- The average size of a user statistics file is **346 KB**
- **3500 KB** of free space is needed on average to store the statistics files on the content service for 10 participants

Conclusion

- Ontological model for collecting and representing the presence information about the dynamic SmartRoom users
- The architecture for the integration the information source on user presence for use in SmartRoom
- Coarse-grained model of user presence state for determining the presence levels
- Experimental evaluation the proposed solutions
- **Open source code:** `http://sourceforge.net/projects/smartroom/services/presence-service`

Thank you for attention