Alternative RFID based architectures for mobile HCI with physical objects

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What is WLAB?

- WLAB (Wireless Lab) is a company providing applied research and prototyping activities mostly on:
  - cutting-edge wireless technologies
  - mobile systems and software platforms
  - ubiquitous computing

- WLAB is promoted and supported by Computer Science and Engineering departments of:
  - University of Roma1 (“La Sapienza”)
  - University of Roma2 (“Tor Vergata”)

Outline

- Motivation
- A classification of alternative RFID based architectures
- Mapping real systems onto RFID based architectures
- RFID based architectures: relevant factors affecting the choice; impact on mobile usability heuristics
- Conclusions and further work

RFID today

- Widespread adoption of High Frequency passive RFID to interact with real world physical objects
- Two alternative approaches in existing solutions:
  - Static Reader (SR) approach with “mobile” tags (on movable objects and people) and static readers (integrated into back-end information systems)
  - Mobile Reader (MR) approach with static tags (on fixed objects) and mobile readers (e.g. on Nokia 3220)
- No clear and shared criteria apparently followed to devise RFID based solutions

Motivation

- Assessment of the effect SR and MR approaches have on the definition of RFID based system architectures
- Analysis of factors influencing the choice of alternative RFID based architectures fitting well with a given domain or scenario
- Investigation of the impact RFID based architectures have on a recently proposed set of heuristics for mobile HCI (Bertini et al., 2006)

RFID based systems functional blocks

- Reading of tags:

  retrieval of information from RFID tags including possible communication feature with remote systems

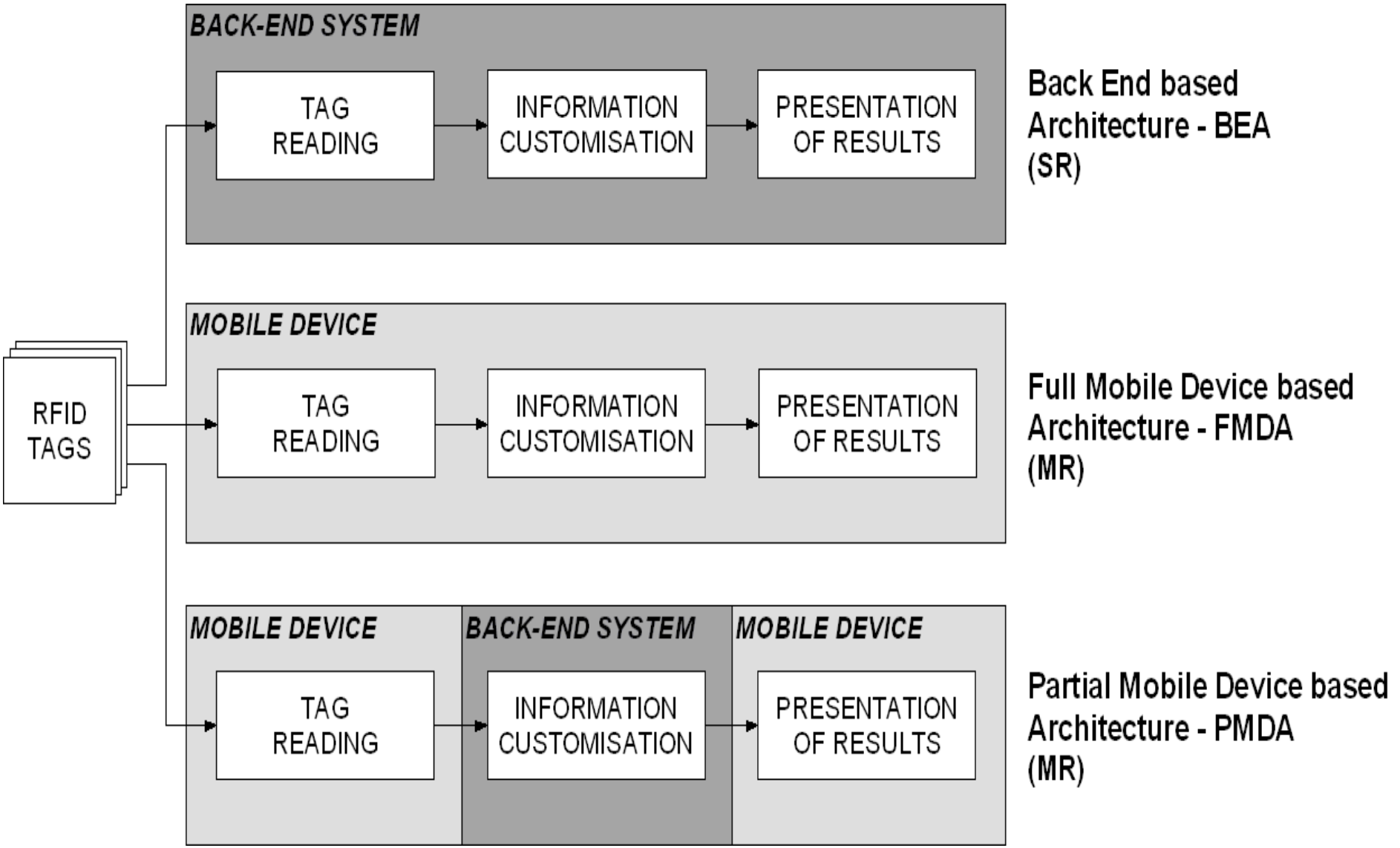
- Information customisation:

  preparation of final results on the basis of read input and profiling/data management features (e.g. access to local file systems, remote databases or legacy system)

- Presentation of results:

  how customised final information is presented, possibly on a variety of alternative channels (e.g. visual, audio, both)

An initial classification of architectures

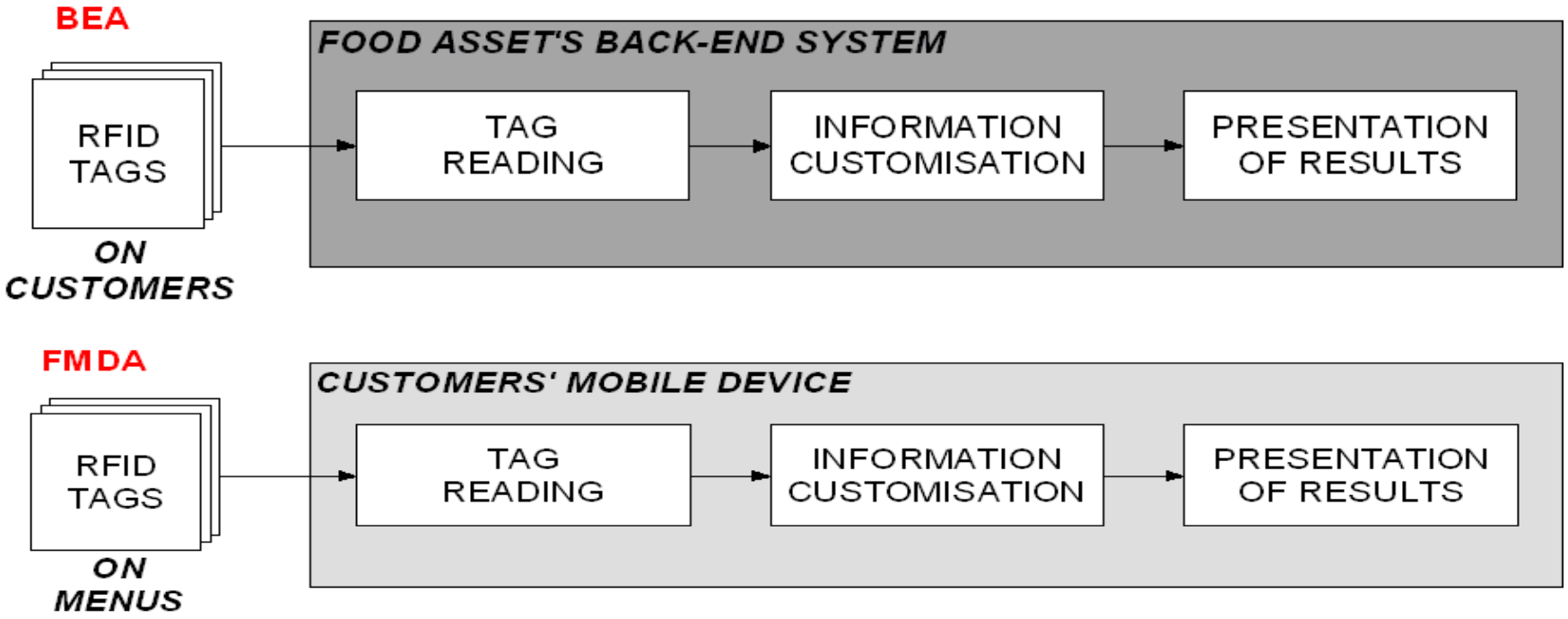


Real systems and RFID architectures (1/2)

- Real world RFID based systems mapped onto SR and MR approaches
- Most examples fitting well with only one of the proposed architectures
- In some situations both approaches seem feasible and more than one architecture can be chosen

Real systems and RFID architectures (2/2)

- An example supporting alternative architectures: an RFID based automatic personal assistant to food choice during out-of-home eating
  - Menus in food assets customised according to sensitive customers' personal nutritional profiles (e.g. allergies, diets, calories intake) and budget information
  - Customers stay in one place and usually take their time to read menus on physical objects (paper made menus or boards)
  - Food establishments can have back-end systems handling info on menus and courses



Questions

- Given a scenario, is there any “driver” towards the choice of an approach and related RFID based architectures ?

- If so, is it possible to be more “deterministic” while devising RFID based solutions to interact with real world objects ?

Some relevant factors

	SR	MR	
	BEA	FMDA	PMDA
Runtime configuration of applications	-	+	+
Back-end integrated context of use	+	-	-
Mobile and nomadic context of use	-	+	+
Size of information on tags	-	+	-
Indirect information on tags	+	-	+
Information management and customisation	+	-	+
Information presentation	+	-	+
Information privacy, security and trust	-	+	+

Usability heuristics for mobile HCI

Bertini et al. (AVI '06):

- H1 – Visibility of system status and losability/findability of the mobile device
- H2 – Match between system and the real world
- H3 – Consistency with context and mapping of actions with real tasks
- H4 – Good ergonomics and minimalist design
- H5 – Ease of input, screen readability
- H6 – Flexibility, efficiency of use and personalisation
- H7 – Aesthetic, privacy and social conventions
- H8 – Realistic error management

RFID and mobile usability heuristics (1/2)

- Example 1: Match between system and the real world

"Enable the mobile user to interpret correctly the information provided, by making it appear in a natural and logical order;...the system should have the capability to sense the environment and adapt the presentation of information accordingly."

• RFID tags enhance the user interaction with the real world and its typical environment in all architectures

• BEA: transparent match of services with real world objects can require minimal changes to user behaviour

• FMDA and PMDA: need of becoming familiar with the RFID reader available on the mobile device

  • Scanning of real world objects must be swiftly integrated with traditional presentation mechanisms

RFID and mobile usability heuristics (2/2)

- Example 2: Aesthetic, privacy and social conventions

"Take aesthetic and emotional aspects of the mobile device and system use into account. Make sure that user's data are kept private and safe. Mobile interaction with the system should be comfortable and respectful of social conventions."

- BEA: more tolerant to social conventions and traditional interaction patterns (habits not affected)

- BEA and PMDA: potential privacy issues (sensitive information sent to a back-end)

- FMDA: sensitive information and user profiles kept safe on mobile device, but possible need of novel interaction patterns

Conclusions and further work

- Initial description and discussion of relevant issues for designers and developers of RFID based systems and applications
- So far:
  - a simple classification of RFID based architectures depending on two possible interaction approaches (SR and MR)
  - on the basis of real examples, a generalisation of some relevant factors affecting the choice of an RFID based architecture fitting well with a domain
  - a complementary analysis of the impact that RFID based architectures have on a proposed and validated set of heuristics for mobile computing
- In the future:
  - further investigation to define a more systematic approach (methodology?) to devise RFID based solutions, possibly leading to automatic tools (e.g. CASE, DSS)

Thank you!

Any question?