



SDW Communication and Context-Sensitive Services

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→ Ad hoc networks and Bluetooth

■ Current activities

- Spontaneous Information Systems
- Context-sensitive services

Definition

■ Principle

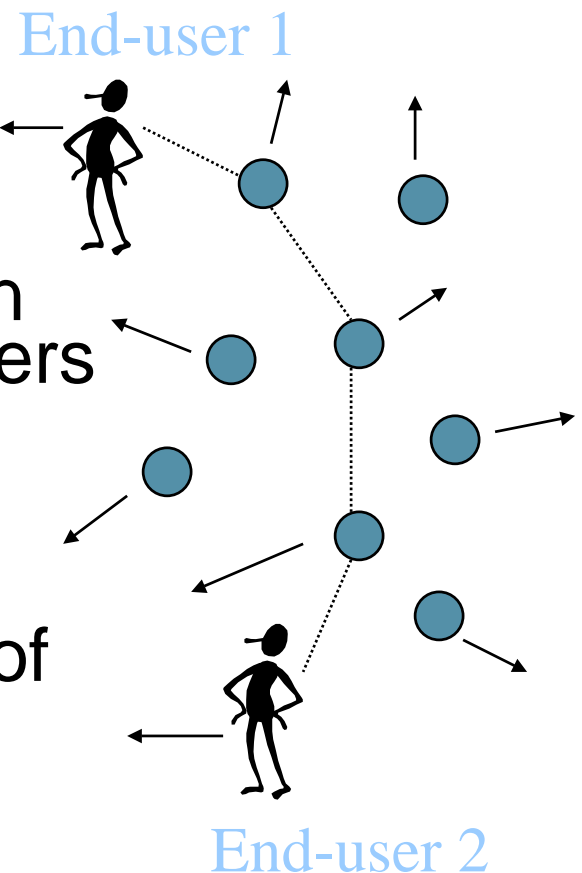
- a set of mobile nodes equipped with a wireless communication interface

■ Goal

- to provide communication facilities between end-users without any centralised infrastructure

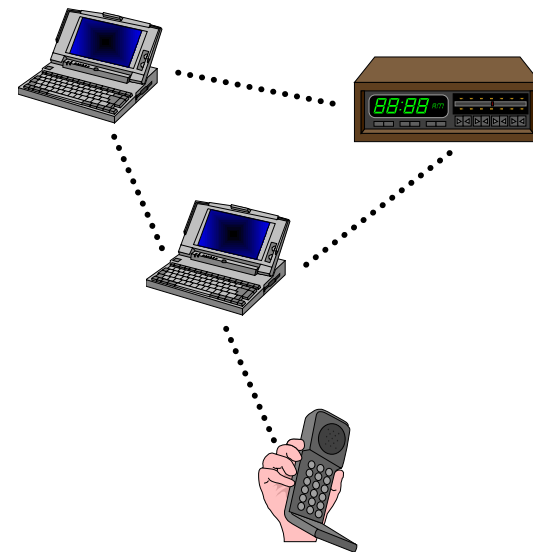
■ Assumption

- to have a strong density of nodes



Ad hoc network concept

- Spontaneous
- Autonomous
- Dynamic
- Mobile



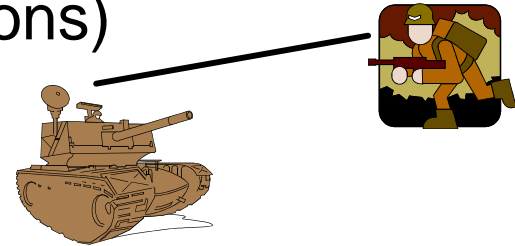
wireless interface + dynamic routing protocol

Embedded in an autonomous mobile unit

Applications

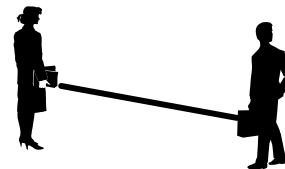
- Network deployment where no infrastructure exists

- battle field (military applications)



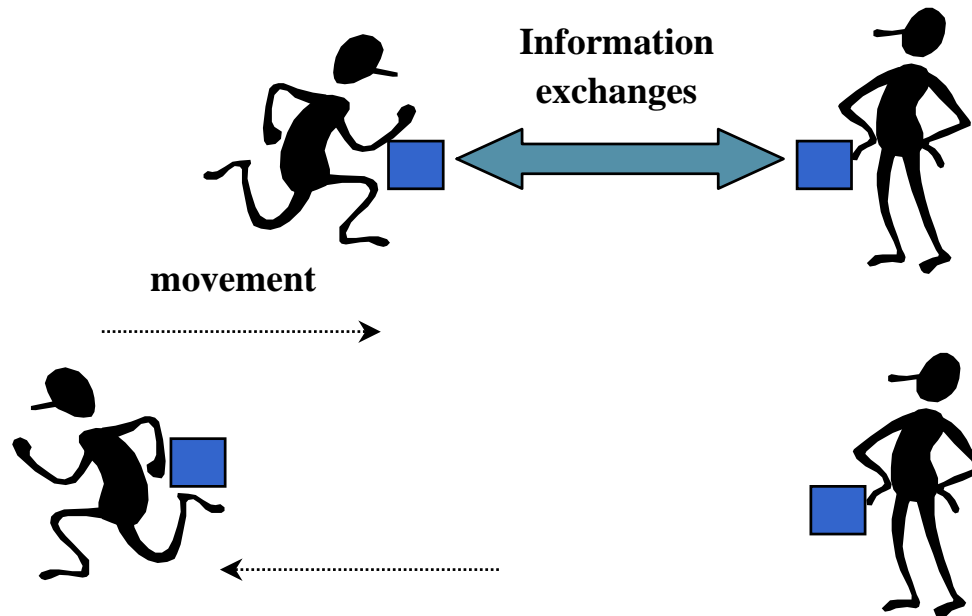
- field work (archaeology)

- mobile GroupWare



New applications

- Spontaneous information system
 - particular case of ad hoc networking (one hop)
 - user mobility belongs to the semantic of the application





New applications

■ *Contextual* network

- a network associated with a particular “geographical” context (limited in time and or space)
 - manifestation
 - train
 - shopping center



Wireless interface

- Short distance (no infrastructure or operator)
- Low power (low battery usage)
- Candidates :
 - Hiperlan II
 - 802.11b
 - Bluetooth
 - ...



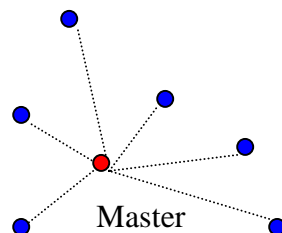
Why Bluetooth ?

- Low cost (\$5 US)
- Energy efficient
- Adopted by a large consortium

Potential for a wide availability
(ubiquitous deployment)

Bluetooth keypoints

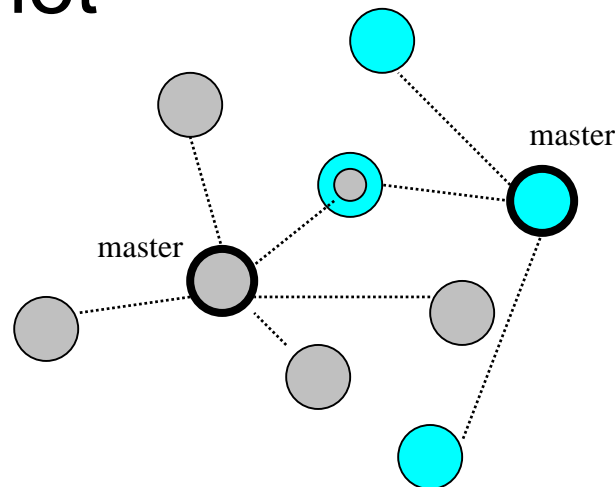
- SDW interface operating in the unlicensed band of the 2.4 Ghz
- Frequency hopping scheme
- 720 kb/s data rate
- Master/slave structure (7 devices piconet)



- A piconet is synchronised on the **master's clock**
- A slave can only communicate with the master
- The master communicates with all the slaves

Scatternet topologies

- A node can only be the master of one piconet
- But a node can be the slave of several piconet



A scatternet formed of the blue and grey piconets

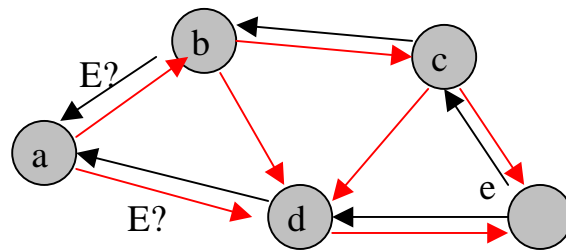


Ad hoc networking over BT

- Dynamic routing between the nodes of an ad hoc network
 - any node should be able to communicate with any other node
- The piconet structure raises many difficulties
 - only the master have a global vision of the piconet
 - a master can hardly participate into another piconet

Overcoming BT difficulties

- [Bhagwat & Segall 99] RVM
 - master = routing inside the piconet
 - slave relay for routing between piconets (scatternets)
 - on-demand routing scheme :
 - routes are discovered by a search request broadcasted by the source



Problems with bluetooth

- Neighbour nodes may be long to discover
 - inquiry/inquiry scan procedure may takes several seconds to complete
- Once a node is involved in a piconet, it may have few (or no) free time to scan for new nodes entering range
- RVM solution
 - 90-95% of the bandwidth used by the routing protocol (only 5-10% for apps)



One approach

- Dividing bluetooth nodes into two classes of mobility
 - router nodes, low mobility
 - mobile nodes, high mobility
- Pro
 - the router nodes provides a « quite stable » infrastructure
- Cons
 - broken routes longer when moving router node



Ad hoc, pro/cons (1)

■ Ad hoc networking: *pro*

- nice concept for researchers
 - design of new protocols,
 - performances, modelisation, ...
- traditional infrastructures disappeared
 - nodes are mobiles and autonomous,...
- promising applications
 - Spontaneous Information Systems (one hop),
 - ubiquitous computing (contextual), ...



Ad hoc, pro/cons (2)

■ Ad-hoc networking: *cons*

– drawbacks

- applications

- an ad hoc network is often considered as a network (its specificity is not considered at the application level)

- architecture

- energy,

- » are you agree to give a part of your battery for routing information of somebody else?

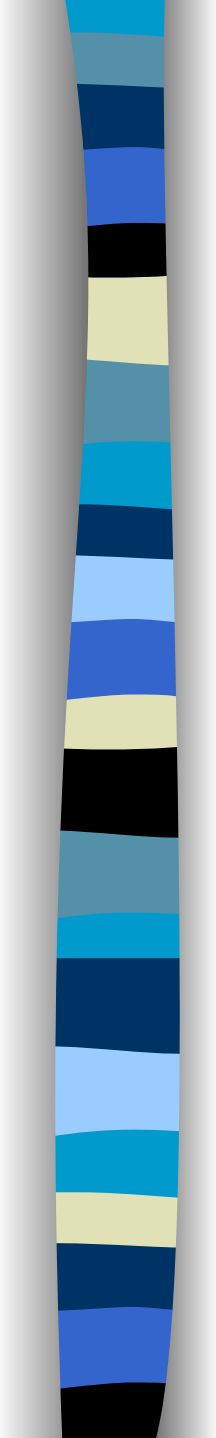
- Bandwidth for applications

- » ad hoc networking based on bluetooth (one solution based on “two levels” ad-hoc network)



Current activities

- Strongly involved in
 - Spontaneous Information Systems (*with Alcatel*)
 - Context-Sensitive Services definition using Ad Hoc Networking (SDW technology - bluetooth)

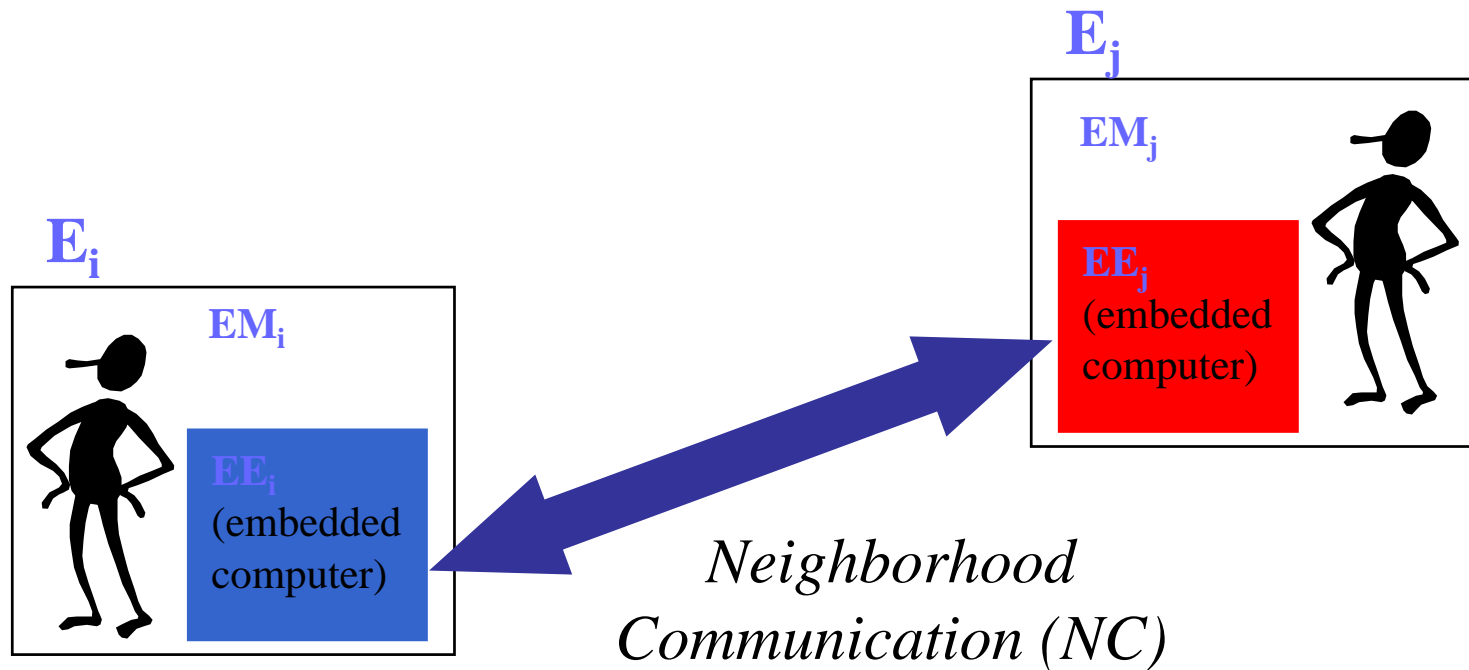
- 
- Ad hoc networks and Bluetooth
 - Current activities
 - Spontaneous Information Systems
 - Context-sensitive services



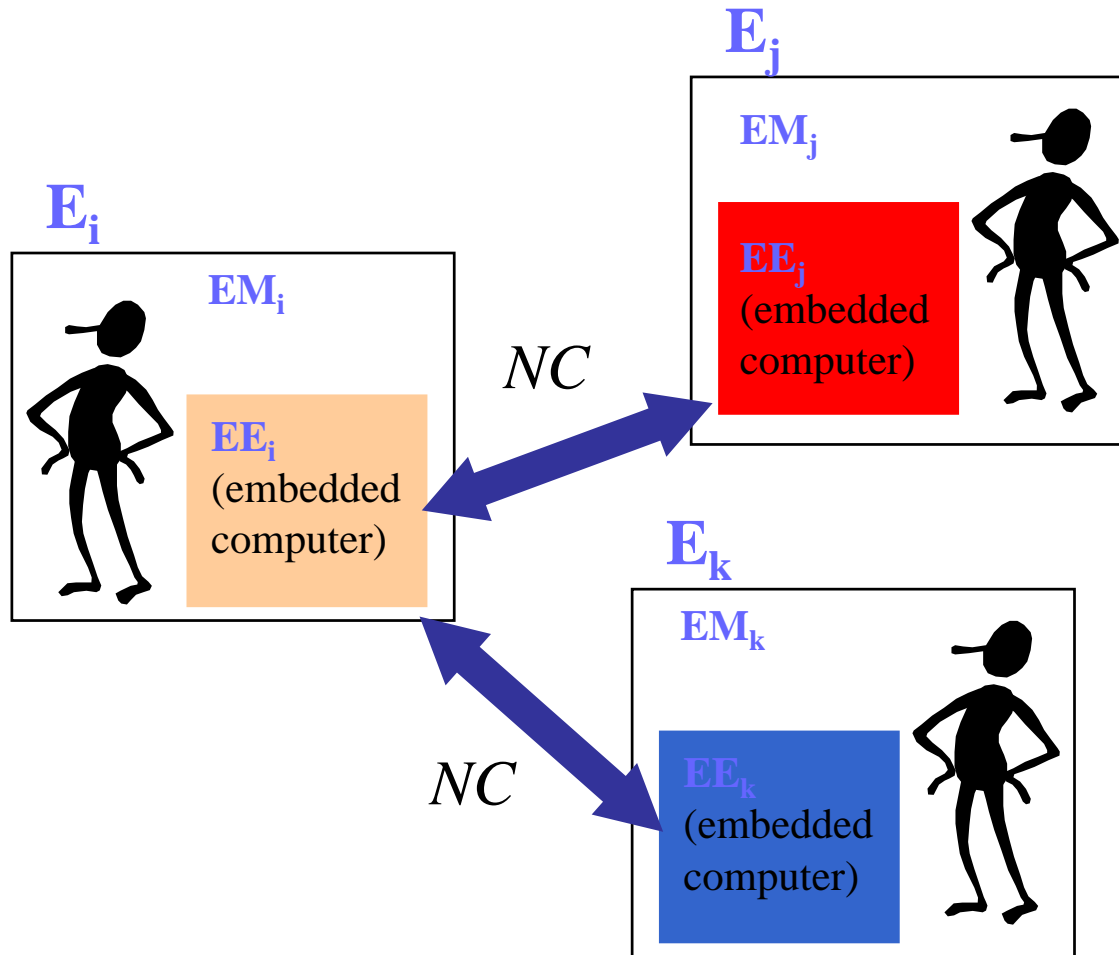
SIS context

- **Mobile and embedded entities**
 - embedded computer : PDAs, appliances ...
 - active badge, smartcards ...
- **Information exchanges performed only when entities are physically close together**
 - **direct** communication between mobile entities
- **Entities are autonomous**
 - they are able to take their decision using only local information

Communication between neighbor nodes



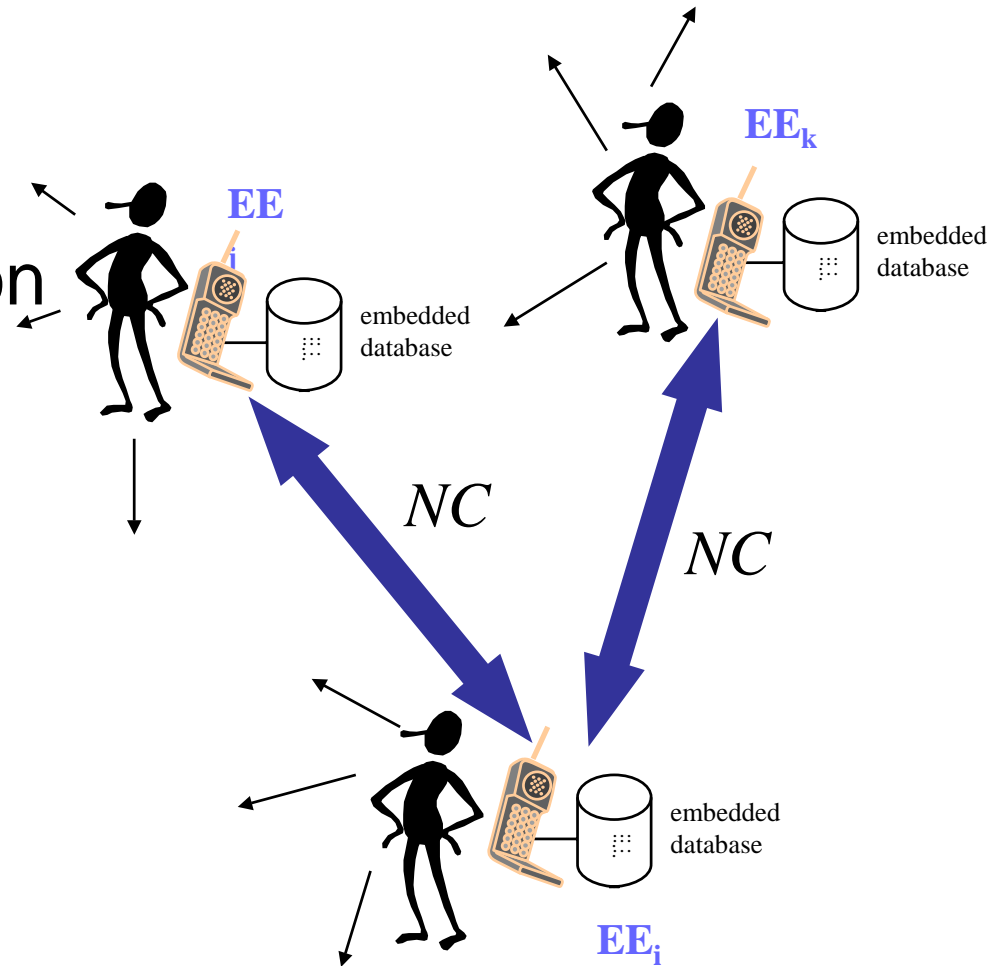
Definition of $SIS(EE_i, t_i, P_i)$



Communication systems between people

■ Examples of applications

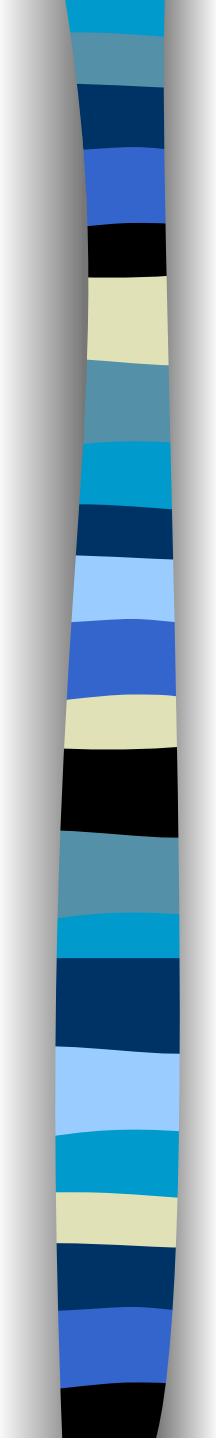
- Synchronization of agendas
- Visit cards exchanges
- Automatic registration
- Queries on “spontaneous databases”
- ...





Open problems

- To perform an efficient information process in spite of users mobility
 - disconnection are normal events
 - mobility not hidden to the embedded system
- How remote services and objects can be discovered and used to build an application ?

- 
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Localization service

■ Goal

- Providing the (absolute or relative) geographic position of a subscriber

■ Applications

- meeting
- emergencies
- ...



Beyond basic localization

■ Localization service

– “low level” service, low added-value because

- few direct applications

⇒ What are highly profitable are the services that may get benefit from location awareness, not location itself



Geographical context

■ Principle

- a geographical zone with customized services
- the *physical space* arrangement is used as a *service selection* and subscriber *profiling* tool
 - being in a certain zone means being interested by some topic associated with the physical situation (shopping center)

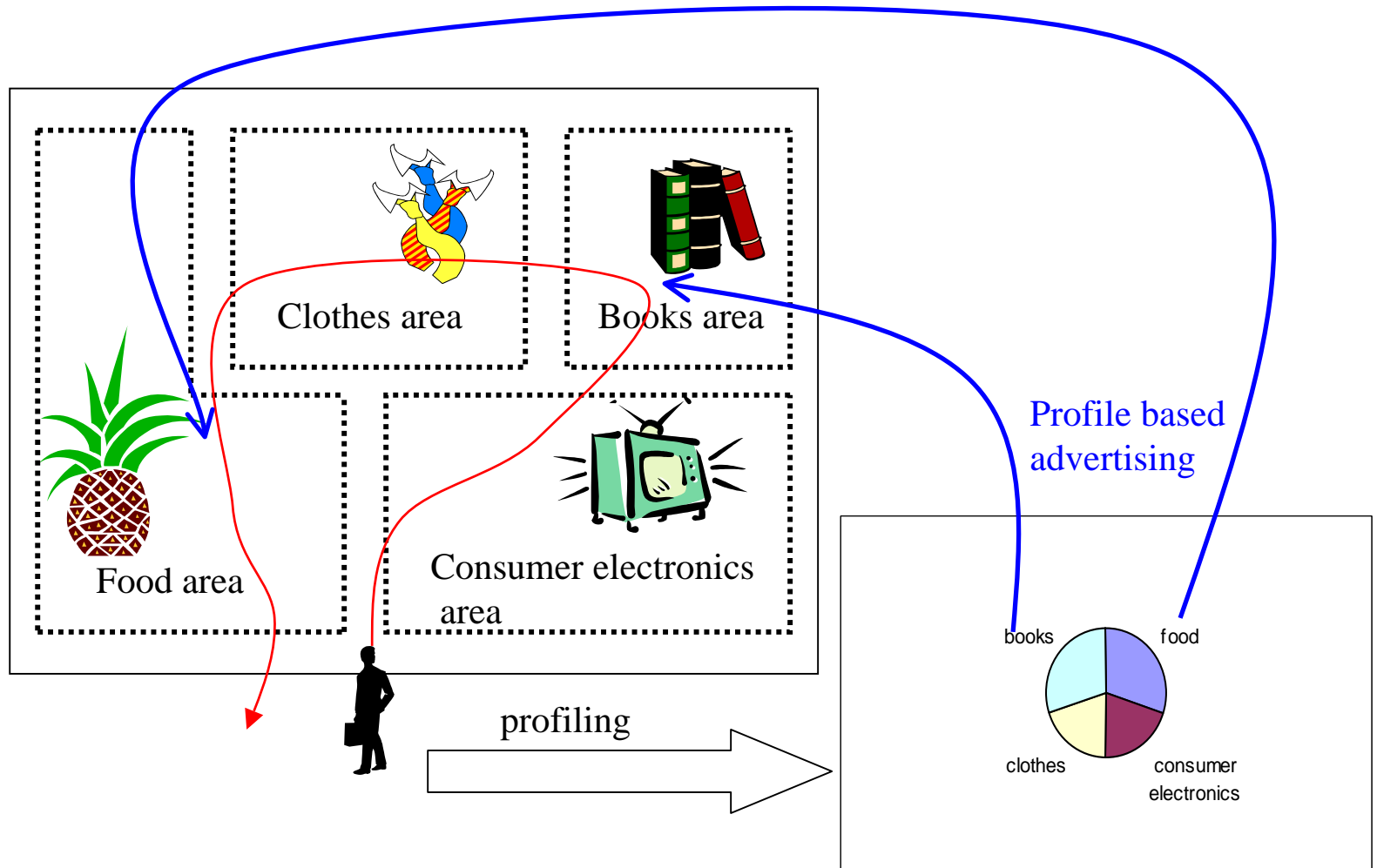


Example (1)

■ Profiling

- shopping habits in malls and shopping centers
- transportation habits (train, airports...)
- context-sensitive advertising

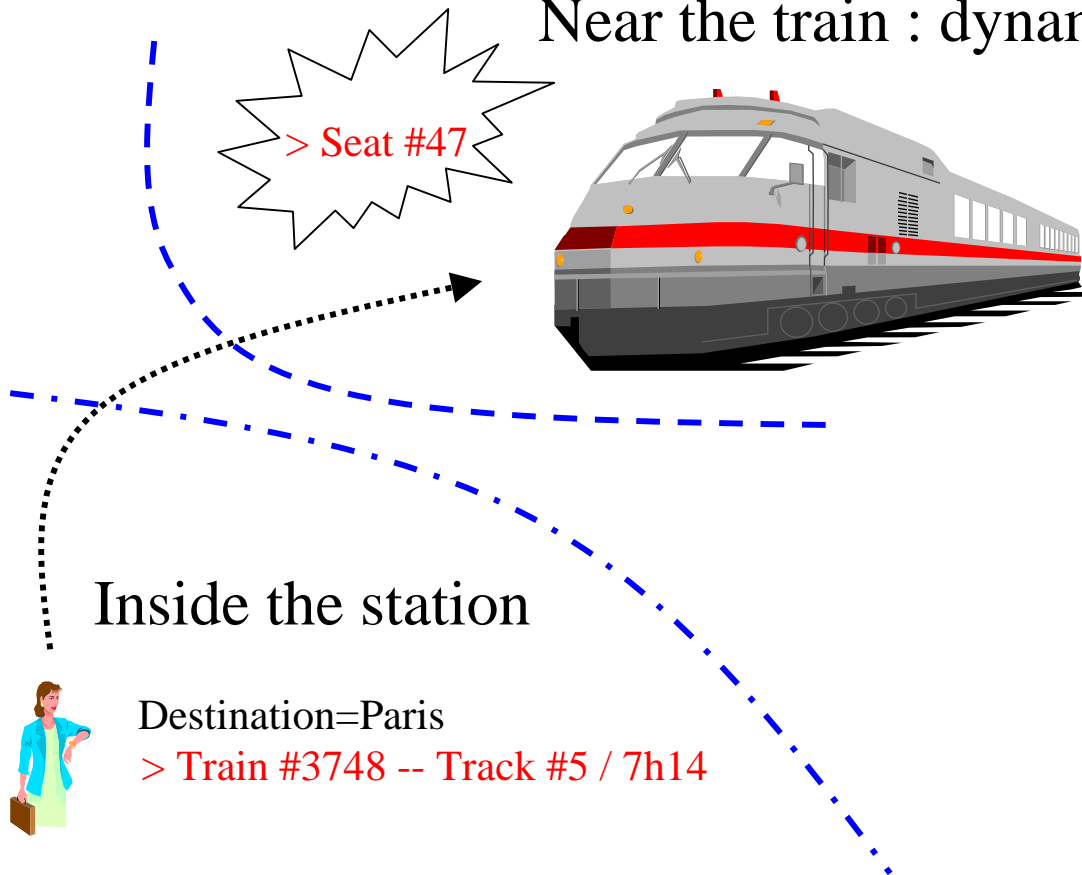
Example (2)



Example (3)

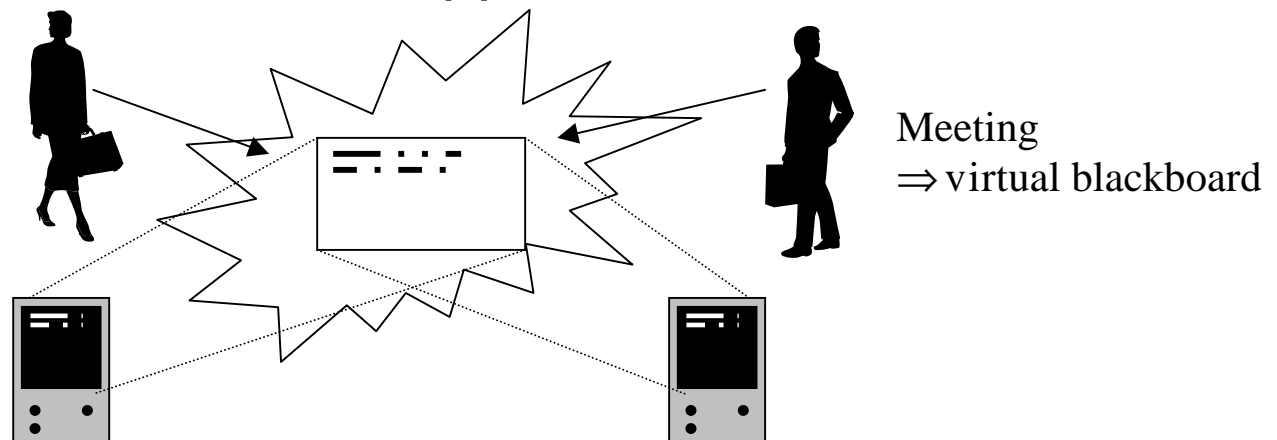
■ Transport

Near the train : dynamic reservation



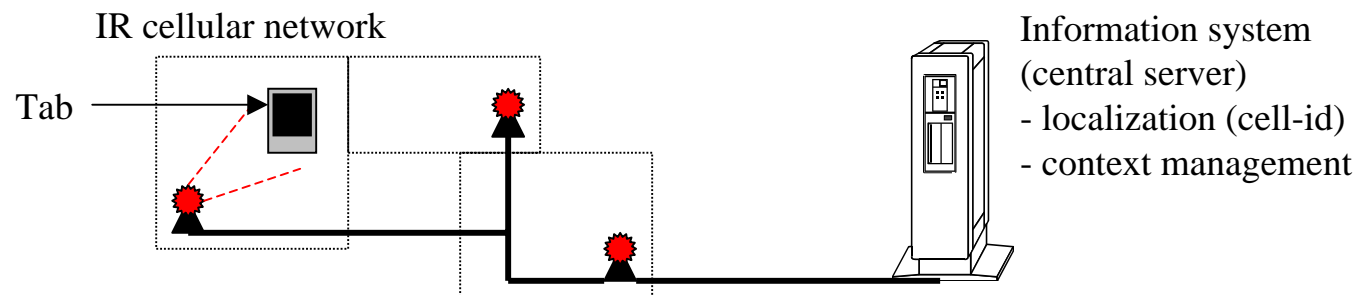
Scientific background

- *Ubiquitous computing* concepts, introduced by par M. Weiser (1991)
 - The physical environment is extended by embedded computers and communications facilities in order to assist the user with context-aware services and applications



Ubiquitous computing : example

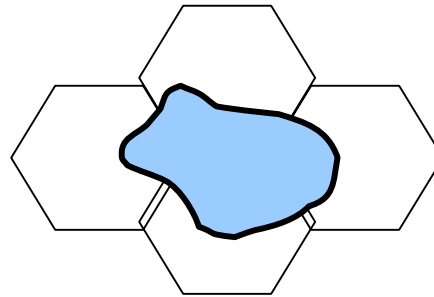
■ Xerox Parctab (1993)



- *proximate selection*
- *context-sensitive* informations (warnings, operating manuals etc.)
- *context-triggered* actions

Implementation

- The problem : how to map a geographical area (defined logically) onto a physical network ?



- Original solution based on SDW technologies
 - the “blue area” is defined using an Ad hoc network topology



Comparison with GIS approaches

■ Pros

- very fine area definition
- very easy re-definition of an area, this operation can be performed without the help of an operator
- many new services

■ Cons

- not well suited to global positioning in large areas



Conclusion

■ SIS

- robots are users, they “discover” suitable information when they are “walking”

■ Context-sensitive services

- concept of typed geographical area
- an area defines a logical profile, with customized services
- based on SDW technologies